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Is the Affordable Care Act Medicaid Expansion Associated with Receipt of Heart Failure Guideline-Directed Medical Therapy By Race and Ethnicity?

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Abstract

Background: Uninsurance is a known contributor to racial/ethnic health inequities. Insurance is often needed for prescriptions and follow-up appointments. Therefore, we determined whether the Affordable Care Act(ACA) Medicaid Expansion was associated with increased receipt of

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guideline-directed medical treatment(GDMT) at discharge among patients hospitalized with heart failure(HF) by race/ethnicity.

Methods: Using Get With The Guidelines-HF registry, logistic regression was used to assess odds of receiving GDMT(HF medications; education; follow-up appointment) in early versus non-adopter states before(2012-2013) and after ACA Medicaid Expansion(2014-2019) within each race/ethnicity, accounting for patient-level covariates and within-hospital clustering. We tested for an interaction(p-int) between GDMT and pre/post Medicaid Expansion time periods.

Results: Among 271,606 patients(57.5% early adopter, 42.5% non-adopter), 65.5% were White, 22.8% African American, 8.9% Hispanic, and 2.9% Asian race/ethnicity. Independent of ACA timing, Hispanic patients were more likely to receive all GDMT for residing in early adopter states compared to non-adopter states (p<0.0001). In fully-adjusted analyses, ACA Medicaid Expansion was associated with higher odds of receipt of ACEI/ARB/ARNI in Hispanic patients [before ACA:OR 0.40(95%CI:0.13,1.23); after ACA:OR 2.46(1.10,5.51); p-int=0.0002], but this occurred in the setting of an immediate decline in prescribing patterns, particularly among non-adopter states, followed by an increase that remained lowest in non-adopter states. The ACA was not associated with receipt of GDMT for other racial/ethnic groups.

Conclusions: Among GWTG-HF hospitals, Hispanic patients were more likely to receive all GDMT if they resided in early adopter states rather than non-adopter states, independent of ACA Medicaid Expansion timing. ACA implementation was only associated with higher odds of receipt of ACEI/ARB/ARNI in Hispanic patients. Additional steps are needed for improved GDMT delivery for all.

Keywords

health policy; heart failure; evidence-based medicine; hospitalization

INTRODUCTION

Heart failure (HF) disproportionately affects racial and ethnic groups of color.[1] African American and Hispanic patients have higher prevalence of HF than White patients.[1] African American patients have the highest mortality from HF compared to all racial and ethnic groups.[1] In addition, African American and Hispanic patients are less likely to receive guideline-directed medical therapy (GDMT) [2,3] and appropriate subspecialist care[4–6] than White patients. It is of prime importance to consider how to improve access to life-saving GDMT to racial and ethnic groups of color.

Uninsurance is a known contributor to racial and ethnic health inequities.[7] Insurance is needed for visits with healthcare professionals and for many prescription medications. Although some HF GDMT medications are available at low-cost, the total cost of all GDMT medication is too expensive for many uninsured patients.[8] In addition, physicians believe that uninsurance contributes to inequities in healthcare delivery among racial and ethnic groups of color.[9] Since physician prescribing is influenced by patient insurance status,[9] improved patient access to healthcare insurance may lessen racial and ethnic disparities in prescribing of HF GDMT.

Implementation of the 2014 Affordable Care Act (ACA) Medicaid Expansion has been associated with significant increases in access to care, particularly among African American and Hispanic patients.[7,10] More than 20 million Americans became insured within the first two years of the ACA implementation.[11] The ACA has been positively associated with improvements among patients with HF. A 30% increase in heart transplant listings was observed in African American patients in association with the ACA Medicaid Expansion.[10] HF hospitalizations among uninsured populations also declined.[12] In the first couple years following the ACA Medicaid Expansion, hospitals that adopted the ACA Medicaid Expansion saved approximately $6.2 billion from the reduction in uncompensated care.[13] Therefore, inpatient education for patients hospitalized with HF may be more accessible in hospitals that receive additional funding through the ACA, which subsequently may lead to better delivery of HF GDMT. Among patients hospitalized with HF, it is unknown whether the ACA Medicaid Expansion was associated with increased receipt of guideline-based care on discharge from hospitalization for HF within racial and ethnic groups.

Using a national registry of hospitals committed to improving care quality, the Get With The Guidelines (GWTG)-HF Registry, we examined the association between the ACA Medicaid Expansion and receipt of GDMT on discharge from hospitalization for HF within African American, Hispanic, Asian, and White patients. Specifically, we evaluated for initiation of evidence-based medication, 60 minutes of HF education, and a scheduled post discharge appointment among racial and ethnic groups according to whether the patient was hospitalized in a state that approved the ACA Medicaid Expansion (adopter state group status) and January 2014 timing of ACA Medicaid Expansion implementation.

METHODS

Data Source

GWTG-HF is an established registry of over 600 voluntary hospitals across the U.S. that are dedicated to improving quality of patient care and performance of hospitals. Participating hospitals receive support to improve healthcare delivery through education, access to the latest clinical data, and ongoing performance feedback.[14] The database includes all inpatient hospitalizations for HF among adults aged 18 years and older.[15] Demographics including race and ethnicity as well as clinical information are uploaded into the registry by respective hospital sites. Race and ethnicity were categorized by self-report on case forms. Race options included: American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Pacific Islander, White, and unable to determine. Ethnicity options included Hispanic ethnicity. As a quality improvement program, participating hospitals had waivers for informed consent under the common rule and were required to obtain institutional review board approval.[16] Analytic method are available upon request from the study team. Data is not publicly available, and requests for data should go to American Heart Association GWTG-HF. This study was directly funded by Dr. Breathett's American Heart Association (AHA) Get With the Guidelines Young Investigator Database Seed Grant Award; and National Heart, Lung, and Blood Institute (NHLBI) K01HL142848, R56HL159216, R25HL126146 subaward 11692sc, and L30HL148881. The authors are

solely responsible for the design and conduct of this study, all study analyses, the drafting and editing of the paper and its final contents.

Study Cohort

Adults 18 years of age and older with an inpatient hospitalization with primary discharge diagnosis of HF at a participating U.S. GWTG-HF center from January 2012 to September 2019 were included (Supplemental Table 1). Hospitals were included if they enrolled at least 50 patients with HF in the year prior to 2012 (n= 274 hospitals) in order to reduce random variation. Hospitals were stratified into early adopter (implemented ACA Medicaid Expansion by January 2014, n=23 states and Washington D.C., n=112 hospitals Figure 1) and non-adopter state groups (did not adopt ACA Medicaid Expansion through September 2019, n=13 states, n=89 hospitals). Hospitals were excluded for adoption of ACA Medicaid Expansion after initial January 2014 implementation or for reducing basic coverage in 2014 (n=14 states, n=73 hospitals).[17,18] Patients were excluded for reasons that would limit ability to examine eligibility for discharge GDMT [n= 66,074 patients; missing ejection fraction, missing/unable to determine race/ethnicity or race/ethnicity too small to study (American Indian or Alaska Native, Native Hawaiian or Pacific Islander), comfort measures/terminal illness, discharge to hospice, transfer out of participating hospital, in-hospital death, left against medical advice, or missing discharge disposition; Supplemental Table 1]. Other missing values for vitals, laboratory measures, and hospital characteristics were imputed (Supplemental Table 2). The final study cohort included 201 hospitals with 271,606 patients.

Outcomes of Interest

GDMT was assessed as six individual outcomes which are representative of pertinent American Heart Association HF discharge achievement, quality, and reporting metrics.[19,20] Achievement metrics included receipt of (1) angiotensin converting enzyme inhibitor (ACEI)/ angiotensin receptor blocker (ARB)/angiotensin receptor-neprilysin inhibitors (ARNI), (2) evidence-based beta blocker (carvedilol, metoprolol succinate, or bisoprolol), and (3) post discharge appointment with specialist or primary care. Quality metrics included receipt of (4) aldosterone receptor antagonist and (5) hydralazine/nitrate. Reporting metric included (6) receipt of 60 minutes of HF education.

Patient eligibility for all medications required a diagnosis of HF with reduced ejection fraction (HFrEF) and no documented contraindications or intolerance to therapy (i.e. aldosterone receptor antagonists: potassium > 5mEq/L, creatinine >2.5 mg/dL in men or > 2mg/dL in women or glomerular filtration rate >30 mL/min/1.73m^2). Specifically, ACEI/ARB/ARNI, beta blockers, and hydralazine/nitrate included left ventricular ejection fraction (LVEF) <40% or narrative description of moderate to severe left ventricular systolic dysfunction. Patient eligibility for hydralazine/nitrate also included African American patient race. Patient eligibility for aldosterone receptor antagonist included LVEF ≤35%. Patient eligibility for remaining measures, education and post discharge appointment, had no LVEF requirements.

Statistical Analyses

Baseline characteristics were evaluated between early adopter and non-adopter state groups for the overall population and among the subgroup of patients with only HFrEF. Receipt of each of the six types of GDMT were evaluated and described for all eligible patients and within racial and ethnic groups (Non-Hispanic White, Non-Hispanic African American, Hispanic, and non-Hispanic Asian). Results were stratified by early adopter and non-adopter state groups. Differences in GDMT between patients receiving care in early adopter and non-adopter states were compared using Chi-square tests.

Logistic regression models were used to examine the associations of adopter state status and ACA Medicaid Expansion within each race and ethnic group. Models were adjusted a-priori for patient-level variables [age, sex, clinical history (Supplement), vital signs at admission (systolic blood pressure, heart rate), labs at admission [serum creatinine, serum sodium], and hospital variables [hospital size {number of beds), teaching status, rural location, and geographic region]. Generalized estimating equations were used to account for within-hospital clustering. The odds ratio of receiving each GDMT in early adopter versus non-adopter states were reported for the periods before ACA Medicaid Expansion and after ACA Medicaid Expansion. P-values are 2-sided tests and were considered statistically significant at $p<0.008$ in order to account for multiple comparison for 6 GDMT outcomes using Bonferroni correction. Interactions were tested between GDMT and pre/post ACA Medicaid Expansion implementation time periods. In order to demonstrate trends, piecewise linear models were fit to the estimated eligible percentage of patients receiving each form of GDMT with cutoff of January 2014 (time of ACA Medicaid Expansion) for each racial and ethnic group and adopter state group.

As a sensitivity analysis, we examined whether the associations between GDMT, adopter state group, and timing of hospitalization admission (before versus after ACA implementation) differed by race/ethnicity. We tested the three-way interaction term of race/ethnicity by adopter state group by timing of hospitalization admission. The unadjusted models include the first order, second order, and the three-way interaction term of the three variables. The adjusted models include all variables in the unadjusted models and adjustment variables described in the prior paragraph. Interactions were not tested for receipt of hydralazine/nitrate since this is only GDMT for patients of Black race, not other racial and ethnic groups. Thus, using Bonferroni correction for 5 GDMT outcomes, a three-way interaction p-value <0.01 was considered statistically significant for difference of associations across race/ethnicity. All analyses were executed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Baseline Characteristics

Among 271,606 patients, 57.5% were from early adopter states and 42.5% from non-adopter states (Table 1). The majority of patients were White race in both early adopter (65.7%) and non-adopter (65.1%) states. A lower proportion of Africans-American patients were in early adopter (19.2%) than non-adopter (27.6%) states. In contrast, a higher proportion

of Hispanic and Asian patients were in early adopter (10.5% Hispanic, 4.6% Asian) than non-adopter (6.6% Hispanic, 0.6% Asian) states. Across both adopter and non-adopter states, patients' median age was 73 years, 46.7% were women, and median ejection fraction was 43%. The majority of patients from both state groups had public payors with higher proportion of Medicaid payors among early adopter (18.3%) than non-adopter (14.0%) state groups. Compared to patients from non-adopter states, patients from early adopter states had modestly lower proportion of most medical comorbidities. A higher proportion of hospitals in early adopter states had teaching status, heart transplant availability, and were not located in a rural setting compared to hospitals in non-adopter states. The majority of hospitals in early adopter states were in the Northeast and West regions, and the majority of hospitals in non-adopter states were in the South region of the U.S.

Among 130,274 patients with HFrEF, 56% were from early adopter states, and 44% were from non-adopter states (Supplemental Table 3). The median ejection fraction was 25%. Median age was 69 years. Patients with HFrEF had patterns similar to the entire cohort for other variables including racial and ethnic proportions, Medicaid payors, patient comorbidities, and hospital characteristics.

Outcomes

Receipt of GDMT by State Group—Compared to patients from non-adopter states, patients from early adopter states had modestly higher receipt of ACEI/ARB/ARNI, beta blockers, and post discharge appointment without accounting for ACA Medicaid Expansion timing (Table 2). Receipt of mineralocorticoid receptor antagonists and hydralazine/nitrate were similar for both state groups. Receipt of 60 minutes of HF education was modestly lower among early adopter states than non-adopter states. Receipt of GDMT reached 90% or higher only with ACEI/ARB/ARNI and beta blockers metrics in both state groups. All other forms of GDMT in this study had receipt ranging from 29% (hydralazine/nitrates) to 76.9% (post discharge appointment) for eligible patients.

When stratified by race and ethnicity, there was state group variability in receipt of GDMT with the exception of Hispanic patients (Table 2). Hispanic patients from early adopter states had significantly higher receipt of each of the six GDMT compared to non-adopter states ($p<0.0001$), with proportions 5.1% to 18.2% higher among early adopter residents. In other races and ethnicities, ACEI/ARB/ARNI was modestly higher among White and Asian patients from early adopter states compared to non-adopter states. Post discharge appointments were higher among White, African American, and Asian patients from early adopter than non-adopter states. Mineralocorticoid receptor antagonist prescribing was lower among African American patients from early adopter than non-adopter states. HF education of 60 minutes was lower among White, African American, and Asian patients from early adopter states than non-adopter states. No significant differences were observed in other GDMT among racial and ethnic groups.

Receipt of GDMT in Relation to ACA Medicaid Expansion Timing—In analyses fully adjusted for patient-level covariates and within-hospital clustering, the association between receipt of ACEI/ARB/ARNI among Hispanic patients within early versus

non-adopter states differed pre/post ACA. The odds of Hispanic patients receiving ACEI/ARB/ANI were lower before ACA: OR 0.40 (95% CI: 0.13, 1.23) and increased after ACA: OR 2.46 (95% CI 1.10, 5.51); p-interaction (p-int) = 0.0002; Table 3. However, the change reflects an immediate decline in the proportion of Hispanic patients from both early adopter and non-adopter states who were prescribed ACEI/ARB/ARNI after 2014 (Figure 2a). The decline was greatest within non-adopter states. Prescribing patterns increased in both groups over the six years following the ACA but remained the lowest among patients in non-adopter states. Changes were not significant for prescribing of ACEI/ARB/ARNI among other racial/ethnic groups (Table 3, Figure 2b). The odds of receiving an mineralocorticoid receptor antagonist was significantly lower for African American patients from early adopter versus non-adopter states independent of timing of the ACA Medicaid Expansion [before ACA: OR 0.33 (95% CI: 0.17, 0.62); after ACA: OR 0.37 (95% CI: 0.21, 0.64); p-int = 0.6406; Supplemental Figure 1]. No significant differences were observed in receipt of other GDMT by race and ethnicity (Supplemental Figures 2–5).

Interactions of Patient Race/Ethnicity with Receipt of GDMT by State Group and Timing—Among GDMT that were assessed across all racial and ethnic groups, receipt of ACEI/ARB/ARNI was associated with significant differences by patient race/ethnicity, state group, and timing of admission hospitalization (before versus after ACA Medicaid Expansion) with $p < 0.0074$ in fully adjusted models (Supplemental Table 4). None of the other GDMT differed across combined interactions of race/ethnicity, state group, and timing.

DISCUSSION

Among hospitals voluntarily participating in quality initiatives through GWTG-HF, the ACA Medicaid Expansion was associated with receipt of one form of GDMT at HF hospitalization discharge within only Hispanic patients. There was an immediate decrease in prescribing of ACEI/ARB/ARNI in both early adopter and non-adopter state groups, but the decline was greatest among non-adopter states and subsequent increases in prescribing were lowest among non-adopter states. Thus, timing of the ACA Medicaid Expansion was associated with Hispanic patients from early adopter states having 2.46-fold greater odds of receiving ACEI/ARB/ARNI than Hispanic patients from non-adopter states. Interactions across race/ethnicity, state group, and timing revealed that only changes in ACEI/ARB/ARNI were statistically significant.

Under 90% of eligible patients received GDMT for HF with the exception of ACEI/ARB/ARNI and beta blockers. Independent of timing of the ACA Medicaid Expansion, Hispanic patients from early adopter states were more likely to receive all forms of GDMT than Hispanic patients from non-adopter states, and receipt of GDMT varied by state group for other races and ethnicities. This suggests that the ACA Medicaid Expansion had an inconsistent association with delivery of HF GDMT to patients of different racial and ethnic backgrounds within GWTG-HF hospitals, and additional changes are urgently needed.

In multiple studies, the ACA Medicaid Expansion has been associated with significant improvements in the delivery of healthcare, particularly among racial and ethnic patients of color. African American and Hispanic patients have had the greatest reductions in

uninsurance[7,21,22] due to their high proportion of uninsured. In cardiovascular care delivery, African American patients residing in early adopter states have had significant increases in receipt of heart transplants[10] and ventricular assist devices,[23] but only the former has been significantly associated with the ACA Medicaid Expansion. However, the association between the ACA Medicaid expansion and cardiovascular outcomes expands beyond race and ethnicity. The overall U.S. population of patients residing in early adopter states have experienced greater reductions in uninsured cardiovascular hospitalizations,[24] and higher cardiovascular survival than patients residing in non-adopter states.[25] Thus, this study hypothesized that GDMT for HF, of which insurance generally increases affordability, would be given at higher rates to patients residing in early adopter states than non-adopter states at the timing of ACA Medicaid Expansion.

The results of this study differ from the many studies that have observed robust improvements in cardiovascular care delivery in association with the ACA Medicaid Expansion. Multiple reasons likely contribute to this study's findings. First, this study was performed in GWTG-HF registry. GWTG-HF was designed to improve healthcare delivery through feedback, evidence based support, and commendation for improving metrics.[14] Hospitals that participate in GWTG-HF registry have been successful in reducing variability in GDMT prescribing patterns, and reducing racial and ethnic disparities in cardiovascular outcomes as illustrated among overall prescription rates in this study.[26,27] The margin for improvement may be lower in GWTG-HF hospitals than other hospitals since these hospitals are already using multiple modalities to increase access to GDMT. This supports findings from another GWTG-HF registry study. Among low income adults under age 65 years, a significant increase in follow-up visits and receipt of beta blockers was observed in early adopter patients compared to non-adopters in the first few years following the ACA Medicaid Expansion;[12] however, no other significant changes were observed in delivery of GDMT. In addition, outcomes from the ACA may be secondary to the instability of ACA infrastructure in 2017, resulting in patients not seeking appropriate medical care since it was not clear whether the ACA benefits would endure.[28]

Second, additional patient factors may contribute to low receipt of HF GDMT. Patients may be unable to afford GDMT even if they are insured. In 2014, the ACA expanded access to Medicaid, prohibited insurance companies from limiting coverage due to pre-existing conditions, eliminated annual limits on healthcare coverage, provided tax benefits for having insurance (including private insurance), and made other forms of public insurance and employer-sponsored insurance more accessible through Health Insurance Marketplace.[29] The ACA did not mandate equitable access to prescriptions, specialist care, and shared decision-making process. Most HF GDMT are available at low cost as generic medications, but the cost of the sum of medications needed for appropriate GDMT may be too high for some patients.[30] In addition, Medicaid prescription coverage and pricing varies by state,[31] which is particularly concerning for under-prescribed newer classes (i.e. ARNI) and older classes (i.e. hydralazine/isosorbide) which lack an affordable generic combination pill.[32] This may be particularly complicating for prescribing of ARNI, which was FDA approved in 2015 for HFrEF and has had slow uptake.[33,34] Barriers are compounded by specialists that do not universally accept Medicaid payors for outpatient clinical care,[35] which impact discharge follow-up and has been related to delays in care.[36] It is also unclear

what role patient refusal, preferences, or misunderstanding of the importance of GDMT contributed to low receipt of GDMT upon discharge from a HF hospitalization.[37] The shared decision-making process is not collected in GWTG-HF, with the exception of implantable cardioverter defibrillators in eligible patients.

Third, other hospital system factors may contribute to low patient receipt of GDMT. Independent of the timing of the ACA Medicaid Expansion, there were clear differences in prescribing patterns for GDMT by early adopter and non-adopter state group, particularly for Hispanic patients. GWTG-HF hospitals may have encountered system barriers that are present among other national hospital cohorts. Some of these racially disparate barriers have included inadequate receipt of care by cardiologist,[4] inadequate resources to systematically provide care (i.e. lack of funding to support specialty nurses, ideal nurse-to-census ratio),[9,38] and under-representation of health care professionals with shared backgrounds as patients.[39,40] Systemic racial and ethnic bias may have also influenced delivery of GDMT as demonstrated in other studies.[41–43] Patient choice is a also a factor. Hospitals residing in non-adopter states are projected to lose $167.8 billion in hospital reimbursement from 2013-2022.[44] This may in part explain the drop in ACEI/ARB/ARNI prescriptions among Hispanic patients in non-adopter states given reduction in resources to ensure HF quality and performance measures are met upon discharge.[20] It is unclear why this was only observed among one form of HF GDMT in non-adopter state groups and to a lesser extent in early adopter state groups.

This study highlights the urgency to disseminate successful methods for increasing HF GDMT delivery across all racial and ethnic groups. There is strong evidence that GWTG-HF participation increases delivery of HF GDMT[45] and results in lower racial and ethnic disparities as observed here, but additional steps are needed. Current U.S. healthcare policies are insufficient. Changes in healthcare policy are warranted. Racial and ethnic disparities may be reduced by broadening ACA coverage: to eliminate gaps in prescription coverage,[31] increase acceptance of Medicaid beneficiaries by providing equitable payments for service across beneficiaries,[35] and reemphasis on quality of care and shared decision-making.[37] There is a history of under prescribing ACEI/ARB and other HF therapies to Hispanic and African American patients across the U.S.[2,3,46,47] A culture shift will be needed to remove hospital system barriers rooted in structural racism,[9,48,49] increase diversity of healthcare professionals,[39,40] and eliminate bias in medicine.[41–43] Rapid assessment of methodologies for implementation can be performed with Consolidated Framework for Implementation Research, which includes evaluation of: (1) GDMT's inherent characteristics that may impact implementation, (2) outer setting of patient barriers and hospital policies, (3) inner setting of hospital culture and engagement, (4) individuals beliefs that impact GDMT delivery, and (5) process of implementation.[50]

Limitations

The results cannot be generalized to all U.S. hospitals since this study was performed within hospitals known for providing high quality care through their involvement with the GWTG-HF registry.[26] The association of the ACA Medicaid Expansion with delivery of GDMT may be underestimated for other hospitals. However, this study provides

representation throughout the U.S. and has been observed to have similar patient and hospital characteristics to patients hospitalized with HF across the U.S.[51] In addition, this study demonstrates key areas for improvement in delivering GDMT that impact the U.S. hospital care. Additional unmeasured patient and system factors may contribute to results as described earlier in the discussion. This study did not report data on post-discharge medication use, health status, or other clinical outcomes, and further studies are needed to assess the association of ACA Medicaid Expansion on these parameters. Finally, the ACA Medicaid Expansion policy has been in flux with multiple waiver changes of several adopter states throughout the study period, which were not excluded from the study. This may also underestimate the association of the ACA Medicaid Expansion with receipt of GDMT.

CONCLUSIONS

Among hospitals participating in the GWTG-HF registry, the ACA Medicaid Expansion was associated with increased receipt of only ACEI/ARB/ARNI among Hispanic patients from early adopter states compared to Hispanic patients from non-adopter states; however, this occurred with initial decline in prescribing of ACEI/ARB/ARNI among both state groups, particularly non-adopter states. The ACA Medicaid Expansion was not associated with receipt of HF GDMT for other racial or ethnic groups. Independent of the ACA Medicaid Expansion, Hispanic patients from early adopter states were significantly more likely to receive all forms of GDMT than Hispanic patients from non-adopter states. Overall, the ACA Medicaid Expansion had an inconsistent association with HF GDMT delivery within GWTG-HF hospitals. Investigation of additional implementation approaches are indicated for racial and ethnic equity in receipt of HF GDMT.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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REFERENCES

1. Virani Salim S., Alonso Alvaro, Benjamin Emelia J., Bittencourt Marcio S., Callaway Clifton W., Carson April P., Chamberlain Alanna M., Chang Alexander R., Cheng Susan, Delling Francesca N., Djousse Luc, Elkind Mitchell S.V., Ferguson Jane F., Fornage Myriam, Khan Sadiya S., Kissela Brett M., Knutson Kristen L., Kwan Tak W., Lackland Daniel T., Lewis Tené T., Lichtman Judith H., Longenecker Chris T., Loop Matthew Shane, Lutsey Pamela L., Martin Seth S., Matsushita Kunihiro, Moran Andrew E., Mussolino Michael E., Perak Amanda Marma, Rosamond Wayne D., Roth Gregory A., Sampson Uchechukwu K.A., Satou Gary M., Schroeder Emily B., Shah Svati H., Shay Christina M., Spartano Nicole L., Stokes Andrew, Tirschwell David L., VanWagner Lisa B., Tsao Connie W., null null. Heart Disease and Stroke Statistics—2020 Update. Circulation. 0:CIR.0000000000000757.
2. Chan PS, Oetgen WJ, Buchanan D, Mitchell K, Fiocchi FF, Tang F, Jones PG, Breeding T, Thrutchley D, Rumsfeld JS, Spertus JA. Cardiac performance measure compliance in outpatients: the American College of Cardiology and National Cardiovascular Data Registry's PINNACLE (Practice Innovation And Clinical Excellence) program. J Am Coll Cardiol. 2010;56:8–14. [PubMed: 20620710]
3. Vivo RP, Krim SR, Cevik C, Witteles RM. Heart Failure in Hispanics. J Am Coll Cardiol. 2009;53:1167–1175. [PubMed: 19341856]
4. Breathett K, Liu WG, Allen LA, Daugherty SL, Blair IV, Jones J, Grunwald GK, Moss M, Kiser TH, Burnham E, Vandivier RW, Clark BJ, Lewis EF, Mazimba S, Battaglia C, Ho PM, Peterson PN. African Americans Are Less Likely to Receive Care by a Cardiologist During an Intensive Care Unit Admission for Heart Failure. JACC Heart Fail. 2018;6:413–420. [PubMed: 29724363]
5. Cook NL, Ayanian JZ, Orav EJ, Hicks LS. Differences in specialist consultations for cardiovascular disease by race, ethnicity, gender, insurance status, and site of primary care. Circulation. 2009;119:2463–2470. [PubMed: 19398667]
6. Eberly LA, Richterman A, Beckett AG, Wispelwey B, Marsh RH, Cleveland Manchanda EC, Chang CY, Glynn RJ, Brooks KC, Boxer R, Kakoza R, Goldsmith J, Loscalzo J, Morse M, Lewis EF, Abel S, Adams A, Anaya J, Andrews EH, Atkinson B, Avutu V, Bachorik A, Badri O, Bailey M, Baird K, Bakshi S, Balaban D, Barshop K, Baumrin E, Bayomy O, Beamesderfer J, Becker N, Berg DD, Berman AN, Blum SM, Boardman AP, Boden K, Bonacci RA, Brown S, Campbell K, Case S, Cetrone E, Charrow A, Chiang D, Clark D, Cohen AJ, Cooper A, Cordova T, Cuneo CN, de Feria AA, Deffenbacher K, DeFilippis EM, DeGregorio G, Deutsch AJ, Diephuis B, Divakaran S, Dorschner P, Downing N, Drescher C, D'Silva KM, Dunbar P, Duong D, Earp S, Eckhardt C, Elman SA, England R, Everett K, Fedotova N, Feingold-Link T, Ferreira M, Fisher H, Foo P, Foote M, Franco I, Gilliland T, Greb J, Greco K, Grewal S, Grin B, Growdon ME, Guercio B, Hahn CK, Hasselfeld B, Haydu EJ, Hermes Z, Hildick-Smith G, Holcomb Z, Holroyd K, Horton L, Huang

G, Jablonski S, Jacobs D, Jain N, Japa S, Joseph R, Kalashnikova M, Kalwani N, Kang D, et al. Identification of Racial Inequities in Access to Specialized Inpatient Heart Failure Care at an Academic Medical Center. Circ Heart Fail. 2019;12:e006214. [PubMed: 31658831]

7. McMorrow S, Long SK, Kenney GM, Anderson N. Uninsurance Disparities Have Narrowed For Black And Hispanic Adults Under The Affordable Care Act. Health Aff (Millwood). 2015;34:1774–1778. [PubMed: 26378026]
8. Hauptman PJ, Goff ZD, Vidic A, Chibnall JT, Bleske BE. Variability in Retail Pricing of Generic Drugs for Heart Failure. JAMA Intern Med. 2017;177:126. [PubMed: 27846638]
9. Breathett K, Jones J, Lum HD, Koonkongsatian D, Jones CD, Sanghvi U, Hoffecker L, McEwen M, Daugherty SL, Blair IV, Calhoun E, de Groot E, Sweitzer NK, Peterson PN. Factors Related to Physician Clinical Decision-Making for African-American and Hispanic Patients: a Qualitative Meta-Synthesis. J Racial Ethn Health Disparities. 2018;5:1215–1229. [PubMed: 29508374]
10. Breathett K, Allen LA, Helmkamp L, Colborn K, Daugherty SL, Khazanie P, Lindrooth R, Peterson PN. The Affordable Care Act Medicaid Expansion Correlated With Increased Heart Transplant Listings in African-Americans But Not Hispanics or Caucasians. JACC Heart Fail. 2017;5:136–147. [PubMed: 28109783]
11. Garfield R, Orgera K, Damico A. The Uninsured and the ACA: A Primer - Key Facts about Health Insurance and the Uninsured amidst Changes to the Affordable Care Act [Internet]. Kaiser Family Foundation; 2019 [cited 2020 Oct 19]. Available from: https://www.kff.org/report-section/the-uninsured-and-the-aca-a-primer-key-facts-about-health-insurance-and-the-uninsured-amidst-changes-to-the-affordable-care-act-how-many-people-are-uninsured/#:~:text=Under%20the%20ACA%2C%20the%20uninsured,a%20historic%20low%20by%202016.&text=When%20the%20major%20ACA%20coverage,to%2026.7%20million%20(10.0%25).
12. Wadhera Rishi K, Joynt Maddox Karen E., Fonarow Gregg C., Zhao Xin, Heidenreich Paul A., DeVore Adam D., Matsouaka Roland A., Hernandez Adrian F., Yancy Clyde W., Bhatt Deepak L. Association of the Affordable Care Act's Medicaid Expansion With Care Quality and Outcomes for Low-Income Patients Hospitalized With Heart Failure. Circulation: Cardiovascular Quality and Outcomes. 2018;11:e004729. [PubMed: 29946015]
13. Dranove D, Gartwaite C, Ody C. The Impact of the ACA's Medicaid Expansion on Hospitals' Uncompensated Care Burden and the Potential Effects of Repeal. Issue Brief (Commonw Fund). 2017;12:1–9. [PubMed: 28574233]
14. Allen LA, Fonarow GC, Liang L, Schulte PJ, Masoudi FA, Rumsfeld JS, Ho PM, Eapen ZJ, Hernandez AF, Heidenreich PA, Bhatt DL, Peterson ED, Krumholz HM, American Heart Association's Get With The Guidelines Heart Failure (GWTG-HF) Investigators*. Medication Initiation Burden Required to Comply With Heart Failure Guideline Recommendations and Hospital Quality Measures. Circulation. 2015;132:1347–1353. [PubMed: 26316616]
15. Get With The Guidelines-Heart Failure Registry - Full Text View - ClinicalTrials.gov [Internet]. [cited 2020 Feb 5];Available from: https://clinicaltrials.gov/ct2/show/NCT02693509
16. Senthil Selvaraj, Fonarow Gregg C., Shubin Sheng, Matsouaka Roland A., DeVore Adam D., Heidenreich Paul A., Hernandez Adrian F., Yancy Clyde W., Bhatt Deepak L. Association of Electronic Health Record Use With Quality of Care and Outcomes in Heart Failure: An Analysis of Get With The Guidelines—Heart Failure. Journal of the American Heart Association. 7:e008158. [PubMed: 29602768]
17. Status of State Action on the Medicaid Expansion Decision [Internet]. The Henry J. Kaiser Family Foundation. 2020 [cited 2020 Feb 17];Available from: https://www.kff.org/health-reform/state-indicator/state-activity-around-expanding-medicaid-under-the-affordable-care-act/
18. Alex, Gates ra, 2014. Wisconsin's BadgerCare Program and the ACA [Internet]. The Henry J. Kaiser Family Foundation. 2014 [cited 2020 Feb 17];Available from: https://www.kff.org/medicaid/fact-sheet/wisconsins-badgercare-program-and-the-aca/
19. American Heart Association Get with The Guidelines Heart Failure. Target: HF [Internet], Available from: https://www.heart.org/-/media/files/professional/quality-improvement/get-with-the-guidelines/get-with-the-guidelines-hf/educational-materials/hf-fact-sheet_updated-011119_v2.pdf?1a=en&hash=1E39EB095FD5A513D1C3D19B22B48CEE3C6AF4B9

20. Heidenreich PA, Fonarow GC, Breathett K, Jurgens CY, Pisani BA, Pozehl BJ, Spertus JA, Taylor KG, Thibodeau JT, Yancy CW, Ziaeian B. 2020 ACC/AHA Clinical Performance and Quality Measures for Adults With Heart Failure: A Report of the American College of Cardiology/American Heart Association Task Force on Performance Measures. Circ Cardiovasc Qual Outcomes. 2020;13:e000099. [PubMed: 33136435]
21. Buchmueller TC, Levy HG. The ACA's Impact On Racial And Ethnic Disparities In Health Insurance Coverage And Access To Care. Health Affairs. 2020;39:395–402. [PubMed: 32119625]
22. How ACA Narrowed Racial Ethnic Disparities Access to Health Care | Commonwealth Fund [Internet]. [cited 2020 Jan 21];Available from: https://www.commonwealthfund.org/publications/2020/jan/how-ACA-narrowed-racial-ethnic-disparities-access
23. Breathett Khadijah K., Knapp Shannon M., Patrick Wightman, Archita Desai, Sula Mazimba, Elizabeth Calhoun, Sweitzer Nancy K. Is the Affordable Care Act Medicaid Expansion Linked to Change in Rate of Ventricular Assist Device Implantation for Blacks and Whites? Circulation: Heart Failure. 2020;13:e006544. [PubMed: 32233662]
24. Akhabue E, Pool LR, Yancy CW, Greenland P, Lloyd-Jones D. Association of State Medicaid Expansion With Rate of Uninsured Hospitalizations for Major Cardiovascular Events, 2009–2014. JAMA Netw Open. 2018;1:e181296. [PubMed: 30646120]
25. Khatana SAM, Bhatla A, Nathan AS, Giri J, Shen C, Kazi DS, Yeh RW, Groeneveld PW. Association of Medicaid Expansion With Cardiovascular Mortality. JAMA Cardiol. 2019;4:671–679. [PubMed: 31166575]
26. Smith SC, Fonarow GC, Zhao D. Measuring and Improving the Quality of Heart Failure Care Globally. JAMA Netw Open. 2020;3:e1918642–e1918642. [PubMed: 31913486]
27. Gray Ellrodt A., Fonarow Gregg C., Schwamm Lee H., Nancy Albert, Bhatt Deepak L., Cannon Christopher P., Hernandez Adrian F., Hlatky Mark A., Luepker Russell V., Peterson Pamela N., Mathew Reeves, Edward Smith Eric. Synthesizing Lessons Learned From Get With The Guidelines. Circulation. 2013;128:2447–2460. [PubMed: 24166574]
28. Griffith KN, Jones DK, Bor JH, Sommers BD. Changes In Health Insurance Coverage, Access To Care, And Income-Based Disparities Among US Adults, 2011–17. Health Affairs. 2020;39:319–326. [PubMed: 32011953]
29. ASPA. Key Features of the Affordable Care Act By Year [Internet]. 2013 [cited 2015 Aug 19];Available from: http://www.hhs.gov/healthcare/facts/timeline/timeline-text.html
30. Piette JD, Heisler M, Wagner TH. Cost-Related Medication Underuse: Do Patients With Chronic Illnesses Tell Their Doctors? Arch Intern Med. 2004;164:1749–1755. [PubMed: 15364667]
31. Medicaid Pharmaceutical State Laws and Policies [Internet]. [cited 2020 Mar 5];Available from: https://www.ncsl.org/research/health/medicaid-pharmaceutical-laws-and-policies.aspx
32. Smith GH, Shore S, Allen LA, Markham DW, Mitchell AR, Moore M, Morris AA, Speight CD, Dickert NW. Discussing Out-of-Pocket Costs With Patients: Shared Decision Making for Sacubitril-Valsartan in Heart Failure. J Am Heart Assoc. 2019;8:e010635. [PubMed: 30592239]
33. Entresto® (sacubitril/valsartan) for Chronic Heart Failure and Preserved Ejection Fraction [Internet]. 2020 [cited 2021 Sep 15]. Available from: https://www.fda.gov/media/144379/download
34. Ozaki AF, Krumholz HM, Mody FV, Jackevicius CA. National Trends in the Use of Sacubitril/Valsartan. Journal of Cardiac Failure. 2021;27:839–847. [PubMed: 34364661]
35. Timbie JW, Kranz AM, Mahmud A, Damberg CL. Specialty care access for Medicaid enrollees in expansion states. Am J Manag Care. 2019;25:e83–e87. [PubMed: 30875176]
36. Thomas A, Javier Valero-Elizondo, Khera R, Warraich HJ, Reinhardt SW, Ali H-J, Nasir K, Desai NR. Forgone Medical Care Associated With Increased Health Care Costs Among the U.S. Heart Failure Population. JACC: Heart Failure [Internet]. [cited 2021 Sep 15];0. Available from: 10.1016/j.jchf.2021.05.010
37. Allen LA, Stevenson LW, Grady KL, Goldstein NE, Matlock DD, Arnold RM, Cook NR, Felker GM, Francis GS, Hauptman PJ, Havranek EP, Krumholz HM, Mancini D, Riegel B, Spertus JA, American Heart Association, Council on Quality of Care and Outcomes Research, Council on Cardiovascular Nursing, Council on Clinical Cardiology, Council on Cardiovascular Radiology and Intervention, Council on Cardiovascular Surgery and Anesthesia. Decision making

in advanced heart failure: a scientific statement from the American Heart Association. Circulation. 2012; 125:1928–1952. [PubMed: 22392529]

38. Joynt KE, Orav EJ, Jha AK. Patient race, site of care, and 30-day readmission rates among elderly Americans. JAMA. 2011;305:675–681. [PubMed: 21325183]
39. Alsan M, Garrick O, Graziani GC. Does Diversity Matter for Health? Experimental Evidence from Oakland [Internet]. National Bureau of Economic Research; 2018 [cited 2020 Mar 5]. Available from: http://www.nber.org/papers/w24787
40. Mehta LS, Fisher K, Rzeszut AK, Lipner R, Mitchell S, Dill M, Acosta D, Oetgen WJ, Douglas PS. Current Demographic Status of Cardiologists in the United States. JAMA Cardiol. 2019;
41. Breathett K, Yee E, Pool N, Hebdon M, Crist JD, Knapp S, Larsen A, Solola S, Luy L, Herrera-Theut K, Zabala L, Stone J, McEwen MM, Calhoun E, Sweitzer NK. Does Race Influence Decision Making for Advanced Heart Failure Therapies? JAHA [Internet]. 2019 [cited 2020 Oct 6];8. Available from: 10.1161/JAHA.119.013592
42. Chapman EN, Kaatz A, Carnes M. Physicians and Implicit Bias: How Doctors May Unwittingly Perpetuate Health Care Disparities. J GEN INTERN MED. 2013;28:1504–1510. [PubMed: 23576243]
43. Breathett K, Yee E, Pool N, Hebdon M, Crist JD, Yee R, Knapp SM, Solola S, Luy L, Herrera-Theut K, Zabala L, Stone J, McEwen MM, Calhoun E, Sweitzer NK. Association of Gender and Race with Allocation of Advanced Heart Failure Therapies. JAMA Netw Open. 2020;3:e2011044. [PubMed: 32692370]
44. Dorn S, McGrath M, Holahan J. What is the Result of States Not Expanding Medicaid? :9.
45. Kociol RD, Peterson ED, Hammill BG, Flynn KE, Heidenreich PA, Piña IL, Lytle BL, Albert NM, Curtis LH, Fonarow GC, Hernandez AF. National survey of hospital strategies to reduce heart failure readmissions: findings from the Get With the Guidelines-Heart Failure registry. Circ Heart Fail. 2012;5:680–687. [PubMed: 22933525]
46. Breathett K, Knapp SM, Carnes M, Calhoun E, Sweitzer NK. Imbalance in Heart Transplant to Heart Failure Mortality Ratio Among African American, Hispanic, and White Patients. Circulation. 2021;143:2412–2414. [PubMed: 34125563]
47. Aditi Nayak, Hicks Albert J., Morris Alanna A. Understanding the Complexity of Heart Failure Risk and Treatment in Black Patients. Circulation: Heart Failure. 2020;13:e007264. [PubMed: 32787445]
48. Wyatt SB, Williams DR, Calvin R, Henderson FC, Walker ER, Winters K. Racism and cardiovascular disease in African Americans. Am J Med Sci. 2003;325:315–331. [PubMed: 12811228]
49. Keith Churchwell, Elkind Mitchell S.V., Benjamin Regina M., Carson April P., Chang Edward K., Willie Lawrence, Andrew Mills, Odom Tanya M., Rodriguez Carlos J., Fatima Rodriguez, Eduardo Sanchez, Sharrief Anjail Z., Mario Sims, Olajide Williams, null null. Call to Action: Structural Racism as a Fundamental Driver of Health Disparities: A Presidential Advisory From the American Heart Association. Circulation. 2020;142:e454–e468. [PubMed: 33170755]
50. Safaeinili N, Brown-Johnson C, Shaw JG, Mahoney M, Winget M. CFIR simplified: Pragmatic application of and adaptations to the Consolidated Framework for Implementation Research (CFIR) for evaluation of a patient-centered care transformation within a learning health system. Learning Health Systems. 2020;4:e10201. [PubMed: 31989028]
51. Curtis LH, Greiner MA, Hammill BG, DiMartino LD, Shea AM, Hernandez AF, Fonarow GC. Representativeness of a national heart failure quality-of-care registry: comparison of OPTIMIZE-HF and non-OPTIMIZE-HF Medicare patients. Circ Cardiovasc Qual Outcomes. 2009;2:377–384. [PubMed: 20031864]

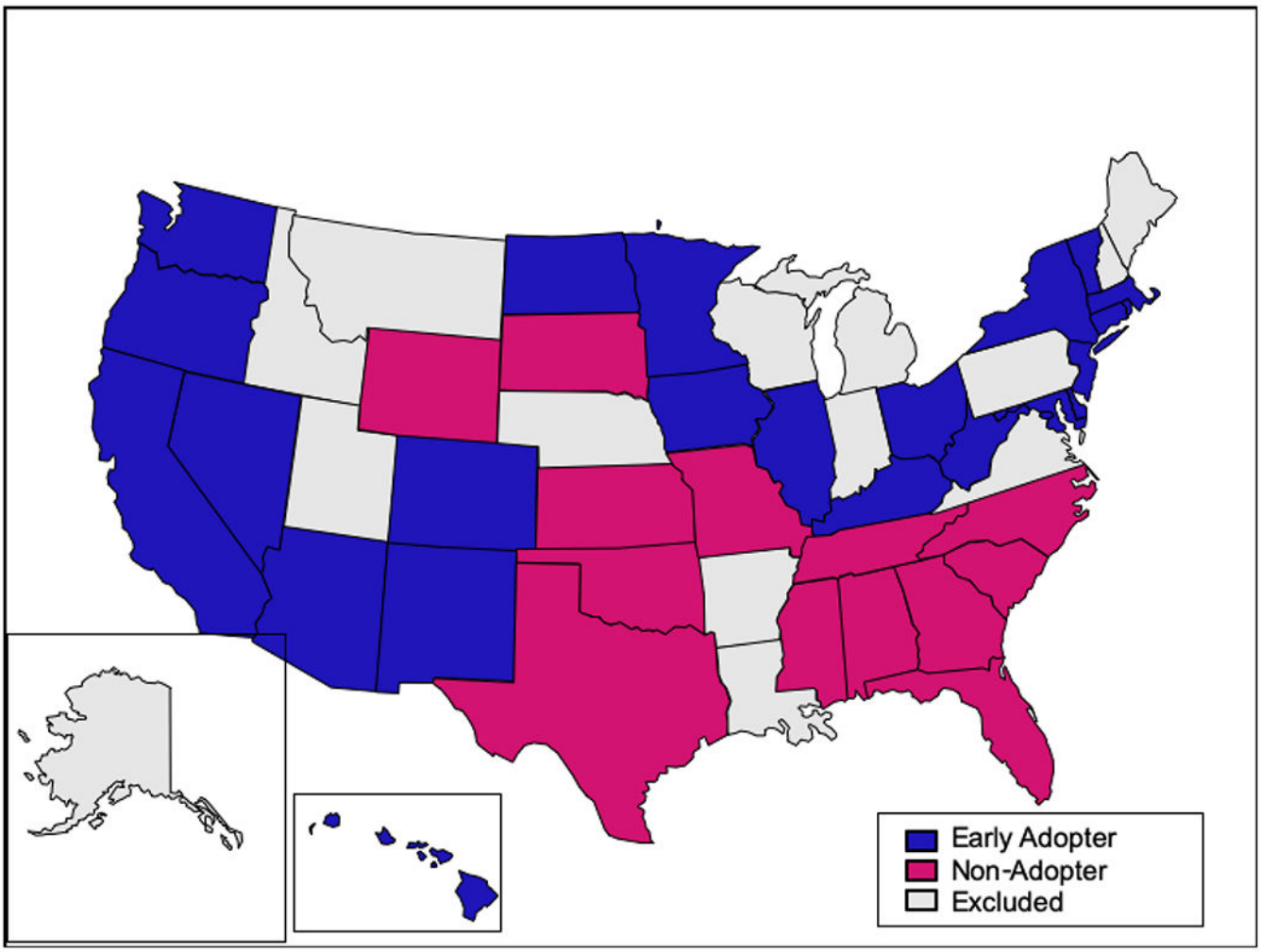
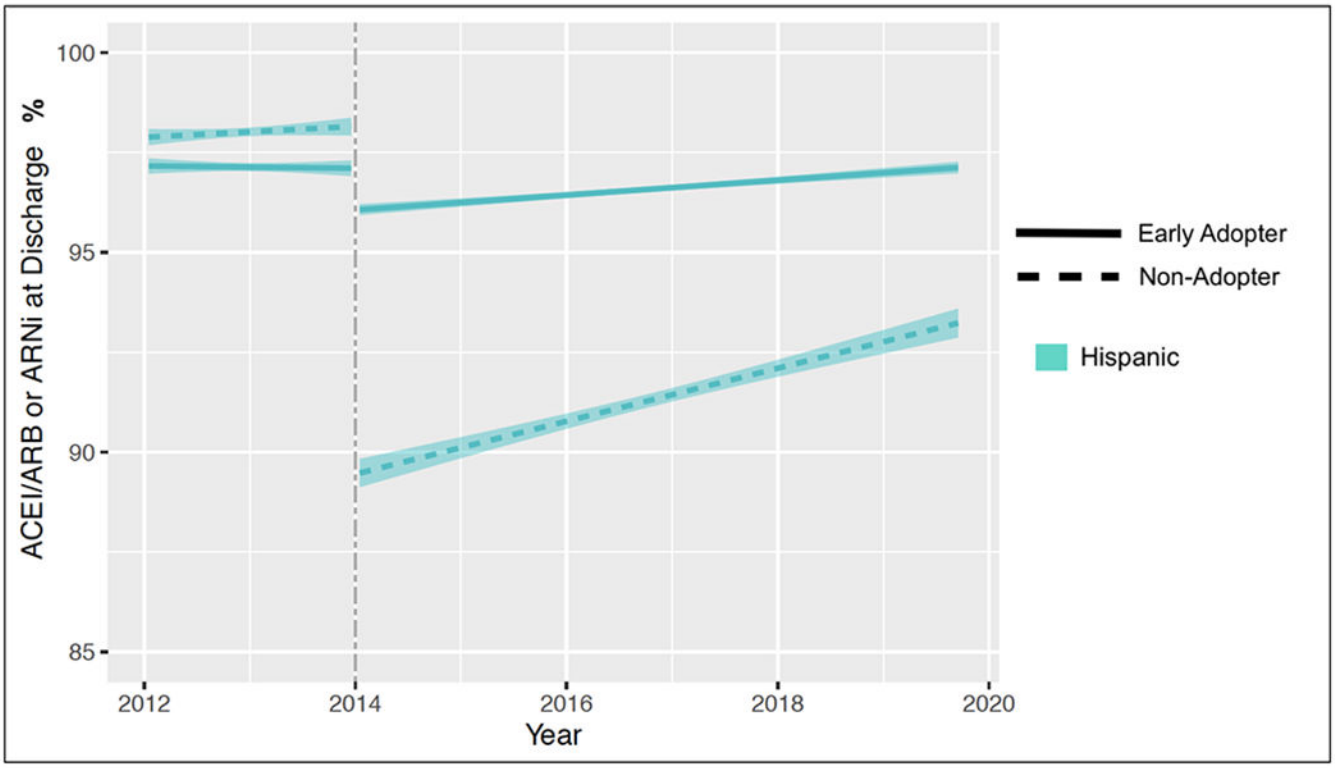


Figure 1. State Groups.

Blue indicates early adopters of the ACA Medicaid Expansion (adoption by January 2014); red, non-adopters of the ACA Medicaid Expansion through September 2019; grey, exclusion for adoption of ACA Medicaid Expansion after 2014 or reduction in coverage. This figure was created with presentation magazine.

a.



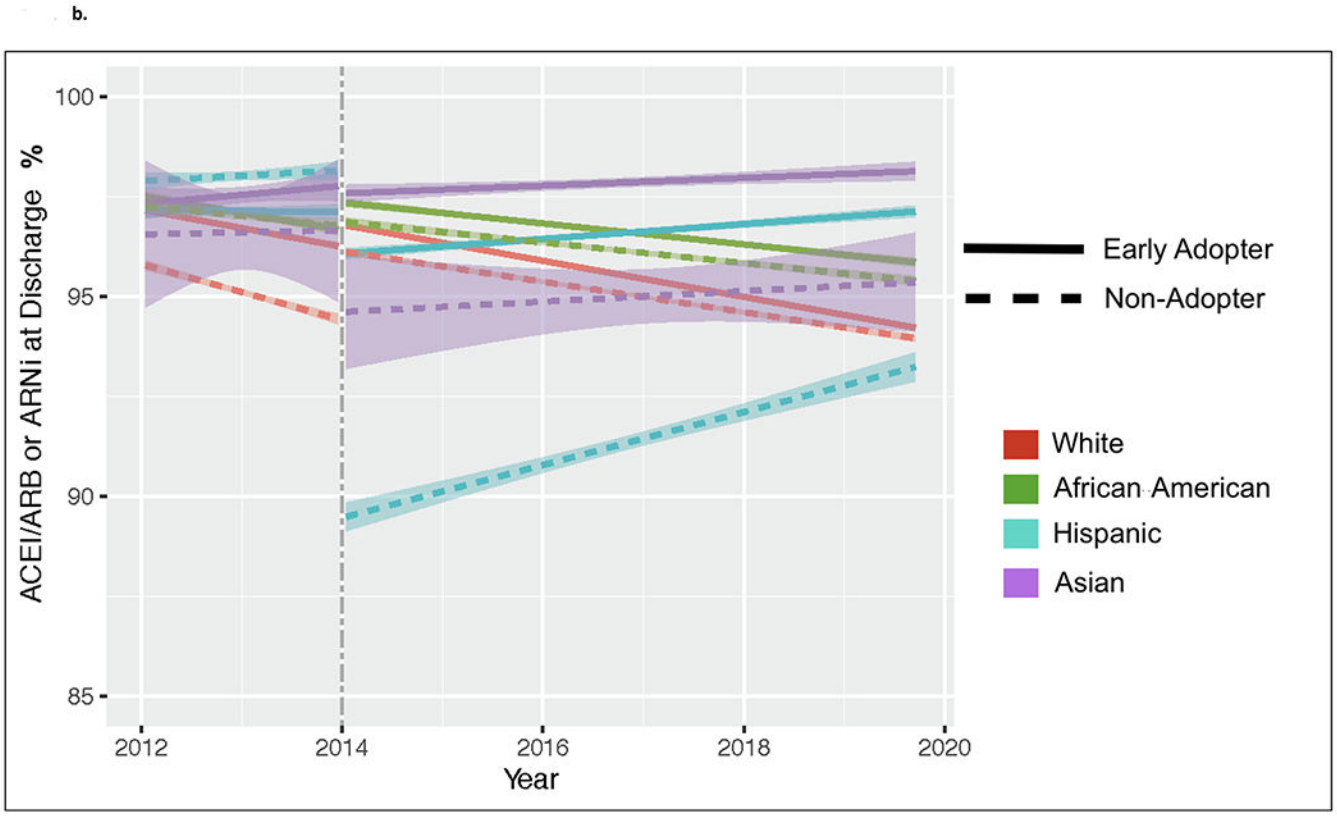


Figure 2. Percentage of Eligible Racial and Ethnic Groups Receiving ACEI/ARB/ARNI by State Group and Time.

2a represents Hispanic patients, and 2b represents all racial and ethnic groups. Lines represent piecewise linear regression models of eligible percentage of patients receiving ACEI/ARB/ARNI over time. The vertical gray line indicates timing of ACA Medicaid Expansion; Solid lines, early adopter state group; dashed line, non-adopter state group; shaded color, 95% CI band; red, White patients; green, African American patients; aqua, Hispanic patients; purple, Asian patients.

Table 1.

Baseline Characteristics of Early Adopter and Non-Adopter States

Variable	Overall N=271,606	Early Adopter States N=156,167	Non-Adopter States N=115,439
Demographics			
Age[#]	73 (61 - 83)	73 (61 - 83)	72 (60 - 82)
Women	126,896 (46.7)	72,081 (46.2)	54,815 (47.5)
Race/Ethnicity			
White	177,815 (65.5)	102,618 (65.7)	75,197 (65.1)
African American	61,856 (22.8)	29,960 (19.2)	31,896 (27.6)
Hispanic (any race)	24,055 (8.9)	16,420 (10.5)	7,635 (6.6)
Asian	7,880 (2.9)	7,169 (4.6)	711 (0.6)
EF, %[#]	43 (26 - 57)	43 (27 - 58)	43 (25 - 55)
EF groups[#]			
HFrEF, EF ≤40	130,274 (48.0)	73,433 (47.0)	56,841 (49.2)
HFmEF, EF 41-49	25,983 (9.6)	15,209 (9.7)	10,774 (9.3)
HFpEF, EF ≥50	115,349 (42.5)	67,525 (43.2)	47,824 (41.4)
Insurance Status			
Medicaid	38,822 (16.4)	24,176 (18.3)	14,646 (14.0)
Medicare	114,429 (48.3)	60,010 (45.4)	54,419 (52.1)
Private/Other	73,697 (31.1)	44,386 (33.5)	29,311 (28.1)
No Insurance/Unknown	9,842 (4.2)	3,733 (2.8)	6,109 (5.8)
Medical History			
Atrial Flutter/Fibrillation	104,494 (38.9)	61,276 (39.9)	43,218 (37.7)
COPD or Asthma	91,285 (34.0)	49,868 (32.5)	41,417 (36.1)
Diabetes	123,338 (46.0)	67,759 (44.1)	55,579 (48.5)
Heart failure (chart diagnosis)	195,222 (72.8)	111,028 (72.3)	84,194 (73.4)
Hyperlipidemia	147,783 (55.1)	81,917 (53.3)	65,866 (57.4)
Hypertension	222,121 (82.8)	124,937 (81.3)	97,184 (84.8)
PVD	31,026 (11.6)	15,502 (10.1)	15,524 (13.5)
CAD	129,092 (48.1)	71,027 (46.2)	58,065 (50.6)
Prior MI	54,923 (20.5)	31,227 (20.3)	23,696 (20.7)
CVA/TIA	43,029 (16.0)	23,422 (15.2)	19,607 (17.1)
ICD only	26,847 (10.0)	14,730 (9.6)	12,117 (10.6)
Anemia	56,175 (20.9)	31,551 (20.5)	24,624 (21.5)
Pacemaker	35,126 (13.1)	19,566 (12.7)	15,560 (13.6)
Dialysis, chronic	10,894 (4.1)	6,105 (4.0)	4,789 (4.2)
Renal insufficiency, chronic	65,378 (24.4)	34,239 (22.3)	31,139 (27.2)
Depression	37,680 (14.0)	20,592 (13.4)	17,088 (14.9)
Valvular Heart Disease	48,405 (18.0)	27,427 (17.8)	20,978 (18.3)
CRT-P	2,449 (0.9)	1,083 (0.7)	1,366 (1.2)
CRT-D	17,579 (6.6)	9,094 (5.9)	8,485 (7.4)

Variable	Overall N=271,606	Early Adopter States N=156,167	Non-Adopter States N=115,439
Ischemic Etiology	141,412 (52.7)	78,149 (50.9)	63,263 (55.2)
Med History Panel Missing	3,288 (1.2)	2,511 (1.6)	777 (0.7)
Smoking	47,244 (17.4)	25,270 (16.2)	21,974 (19.1)
Vitals on Admission			
Heart Rate, bpm[#]	84 (72 - 98)	84 (71 - 98)	84 (72 - 99)
SBP, mmHg[#]	140 (121 - 160)	138 (120 - 159)	141 (122 - 163)
DBP, mmHg[#]	77 (66 - 90)	76 (65 - 89)	78 (67 - 92)
Body mass index[#]	28.6 (24.0 - 35.0)	28.3 (23.8 - 34.6)	29.0 (24.2 - 35.6)
Lipids			
Total Cholesterol, mg/dL[#]	135 (110 - 165)	133 (108 - 163)	136 (112 - 167)
HDL, mg/dL[#]	39 (30 - 49)	38 (30 - 48)	39 (31 - 50)
LDL, mg/dL[#]	74 (56 - 98)	74 (55 - 97)	75 (57 - 99)
Triglycerides, mg/dL[#]	91 (68 - 127)	91 (68 - 127)	91 (68 - 127)
Other Lab Measures			
Serum sodium, mEq/L[#]	138 (136 - 141)	139 (136 - 141)	138 (136 - 141)
Hemoglobin, g/dL[#]	11.8 (10.2 - 13.4)	11.9 (10.3 - 13.5)	11.7 (10.2 - 13.2)
Albumin, g/dL[#]	3.5 (3.1 - 3.8)	3.4 (3.1 - 3.8)	3.5 (3.1 - 3.8)
BNP, pg/mL[#]	824 (395 - 1,657)	782 (383 - 1,523)	871 (408 - 1,812)
nBNP, pg/mL[#]	5,063 (2,240 - 11,293)	5,040 (2,208 - 11,001)	5,103 (2,281 - 11,603)
Serum creatinine, mg/dL[#]	1.3 (1.0 - 1.8)	1.3 (1.0 - 1.8)	1.3 (1.0 - 1.9)
BUN, mg/dL[#]	24 (17 - 37)	25 (17 - 38)	24 (17 - 36)
Troponin, ng/dL[#]	0.04 (0.02 - 0.10)	0.04 (0.02 - 0.10)	0.04 (0.02 - 0.10)
Potassium, mEq/L[#]	4.2 (3.8 - 4.6)	4.2 (3.8 - 4.6)	4.1 (3.8 - 4.5)
HbA1C, %[#]	6.6 (5.9 - 7.8)	6.6 (5.9 - 7.8)	6.6 (5.9 - 7.8)
Blood Glucose, mg/dL[#]	114 (96 - 149)	115 (97 - 152)	112 (95 - 146)
EKG QRS Duration, ms[#]	106 (90 - 138)	106 (90 - 138)	106 (90 - 138)
Year of index admission			
2012	38,235 (14.1)	23,057 (14.8)	15,178 (13.1)
2013	35,962 (13.2)	21,356 (13.7)	14,606 (12.7)
2014	33,691 (12.4)	19,371 (12.4)	14,320 (12.4)
2015	34,508 (12.7)	19,931 (12.8)	14,577 (12.6)
2016	35,974 (13.2)	20,091 (12.9)	15,883 (13.8)
2017	36,519 (13.4)	21,230 (13.6)	15,289 (13.2)
2018	35,023 (12.9)	19,334 (12.4)	15,689 (13.6)
2019	21,694 (8.0)	11,797 (7.6)	9,897 (8.6)

Variable	Overall N=271,606	Early Adopter States N=156,167	Non-Adopter States N=115,439
Hospital Characteristics			
Number of Beds[#]	395 (261 - 581)	415 (264 - 581)	394 (238 - 508)
Geographic Region			
Northeast	54,557 (20.1)	54,557 (34.9)	0 (0.0)
Midwest	59,964 (22.1)	36,210 (23.2)	23,754 (20.6)
South	103,447 (38.1)	12,921 (8.3)	90,526 (78.4)
West	53,638 (19.7)	52,479 (33.6)	1,159 (1.0)
Rural Location	9,886 (3.7)	4,244 (2.8)	5,642 (4.9)
Teaching Status	207,153 (76.6)	121,046 (78.0)	86,107 (74.9)
Heart Transplant Hospital	13,763 (6.8)	9,942 (8.4)	3,821 (4.5)

[#]indicates continuous variables with interquartile range in parentheses; ischemic etiology includes medical history of coronary artery disease (CAD), myocardial infarction (MI), prior percutaneous coronary intervention (PCI), prior coronary artery bypass grafting (CABG), or prior PCI/CABG; EF, ejection fraction; HFrEF, heart failure with reduced ejection fraction; HFmEF, heart failure with midrange ejection fraction; HFpEF, heart failure with preserved ejection fraction; COPD, chronic obstructive pulmonary disease; ICD, implantable cardioverter defibrillator; CRT-P, cardiac resynchronization therapy- pacemaker; CRT-D, CRT defibrillator; SBP, systolic blood pressure; DBP, diastolic BP; HDL, high-density lipoprotein; LDL, low-density lipoprotein; BNP, brain natriuretic peptide; nBNP, N-terminal pro BNP; BUN, blood urea nitrogen; HbA1c, hemoglobin A1c.

Table 2.

Achievement of Heart Failure Metrics in Early Adopter Versus Non-Adopter States

Variable	Overall N=261,190	Early Adopter States N=149,292	Non-Adopter States N=111,898	P Value
Achievement Measures				
ACEI/ARB/ARNI	78,680 (95.7)	44,981 (96.2)	33,699 (95.1)	<.0001 *
Evidence-Based Specific Beta Blockers	99,310 (93.0)	56,469 (93.2)	42,841 (92.6)	0.0003 *
Post Discharge Appointment for HF Patients	162,195 (76.0)	93,298 (76.9)	68,897 (74.7)	<.0001 *
Quality Measures				
Mineralocorticoid receptor antagonist	38,240 (51.2)	21,507 (51.2)	16,733 (51.1)	0.7289
Hydralazine/Nitrate	3,171 (30.4)	2,143 (31.2)	1,028 (29.0)	0.0246
Reporting Measures				
60 Minutes of HF Education	112,433 (41.4)	62,125 (39.8)	50,308 (43.6)	<.0001 *
White				
ACEI/ARB/ARNI	45,673 (95.5)	26,074 (95.9)	19,599 (94.9)	<.0001 *
Evidence-Based Specific Beta Blockers	57,887 (92.0)	32,962 (92.1)	24,925 (91.8)	0.1804
Post Discharge Appointment for HF Patients	100,695 (74.8)	57,681 (75.2)	43,014 (74.3)	0.0004 *
Mineralocorticoid receptor antagonist	22,053 (48.5)	12,485 (48.8)	9,568 (48.2)	0.2335
60 Minutes of HF Education	69,028 (38.8)	39,325 (38.3)	29,703 (39.5)	<.0001 *
African American				
ACEI/ARB/ARNI	23,134 (96.5)	11,484 (96.7)	11,650 (96.3)	0.1066
Evidence-Based Specific Beta Blockers	29,152 (94.8)	14,120 (95.0)	15,032 (94.6)	0.1487
Post Discharge Appointment for HF Patients	41,366 (79.3)	20,179 (81.6)	21,187 (77.3)	<.0001 *
Mineralocorticoid receptor antagonist	11,818 (56.2)	5,584 (53.9)	6,234 (58.4)	<.0001 *
Hydralazine/Nitrate	3,144 (30.4)	2,122 (31.2)	1,022 (29.0)	0.0245
60 Minutes of HF Education	29,737 (48.1)	12,575 (42.0)	17,162 (53.8)	<.0001 *
Hispanic				
ACEI/ARB/ARNI	7,851 (94.9)	5,599 (96.6)	2,252 (90.8)	<.0001 *
Evidence-Based Specific Beta Blockers	9,519 (92.9)	6,899 (94.3)	2,620 (89.2)	<.0001 *
Post Discharge Appointment for HF Patients	14,893 (73.8)	10,634 (77.0)	4,259 (66.9)	<.0001 *
Mineralocorticoid receptor antagonist	3,570 (54.5)	2,722 (60.1)	848 (41.9)	<.0001 *
60 Minutes of HF Education	11,156 (46.4)	8,045 (49.0)	3,111 (40.7)	<.0001 *
Asian				
ACEI/ARB/ARNI	2,022 (97.2)	1,824 (97.6)	198 (93.8)	0.0017 *
Evidence-Based Specific Beta Blockers	2,752 (94.5)	2,488 (94.6)	264 (93.3)	0.3579
Post Discharge Appointment for HF Patients	5,241 (78.6)	4,804 (79.2)	437 (73.0)	0.0004 *
Mineralocorticoid receptor antagonist	799 (48.3)	716 (48.4)	83 (47.4)	0.7994
60 Minutes of HF Education	2,512 (31.9)	2,180 (30.4)	332 (46.7)	<.0001 *

ACEI indicates angiotensin converting enzyme inhibitor; ARB, angiotensin receptor blocker; ARNI, angiotensin receptor-neprilysin inhibitor.

* indicates, p<0.008.

Table 3.

Odds of Receiving GDMT in Early Adopter States Compared to Non-Adopters States Before and After the ACA Medicaid Expansion

		Unadjusted Analysis		Adjusted Analysis	
		OR (95% CI)	***P-int***	**OR (95% CI)**	***P-int***
ACEI/ARB/ARNI					
White			*0.1637*		*0.2270*
	Before Expansion	1.59 (1.00, 2.51)		1.31 (0.66, 2.61)	
	After Expansion	1.14 (0.83, 1.58)		0.97 (0.59, 1.60)	
African American			*0.6054*		*0.5725*
	Before Expansion	1.01 (0.53, 1.92)		0.47 (0.21, 1.04)	
	After Expansion	1.17 (0.73, 1.87)		0.56 (0.31, 1.02)	
Hispanic			*0.0007* *		*0.0002* *
	Before Expansion	0.67 (0.28, 1.64)		0.40 (0.13, 1.23)	
	After Expansion	3.61 (1.92, 6.78) *		2.46 (1.10, 5.51)	
Asian			*0.3270*		*0.3886*
	Before Expansion	1.33 (0.30, 5.90)		1.95 (0.19, 19.86)	
	After Expansion	2.95 (1.29, 6.73)		4.06 (0.77, 21.43)	
Evidence-Based Specific Beta Blockers					
White			*0.5148*		*0.6529*
	Before Expansion	1.11 (0.89, 1.38)		0.90 (0.68, 1.19)	
	After Expansion	1.02 (0.80, 1.30)		0.85 (0.63, 1.16)	
African American			*0.7037*		*0.9608*
	Before Expansion	1.14 (0.82, 1.59)		0.79 (0.45, 1.38)	
	After Expansion	1.07 (0.77, 1.49)		0.78 (0.47, 1.30)	
Hispanic			*0.2757*		*0.1388*
	Before Expansion	1.20 (0.48, 2.99)		0.44 (0.16, 1.22)	
	After Expansion	2.61 (1.10, 6.19)		1.09 (0.52, 2.29)	
Asian			*0.6676*		*0.7704*
	Before Expansion	1.56 (0.71, 3.42)		1.07 (0.37, 3.08)	
	After Expansion	1.23 (0.58, 2.62)		0.91 (0.33, 2.47)	
Post Discharge Appointment for Heart Failure Patients					
White			*0.2833*		*0.1468*
	Before Expansion	0.93 (0.61, 1.40)		0.86 (0.58, 1.28)	
	After Expansion	1.16 (0.79, 1.69)		1.16 (0.79, 1.71)	
African American			*0.9694*		*0.4709*
	Before Expansion	1.45 (0.89, 2.36)		0.68 (0.39, 1.19)	
	After Expansion	1.44 (0.91, 2.28)		0.78 (0.44, 1.39)	
Hispanic			*0.1642*		*0.1154*
	Before Expansion	0.90 (0.30, 2.63)		0.48 (0.16, 1.46)	
	After Expansion	2.27 (1.06, 4.86)		1.33 (0.69, 2.56)	
Asian			*0.0735*		*0.0307*

		Unadjusted Analysis		Adjusted Analysis	
		OR (95% CI)	***P-int***	**OR (95% CI)**	***P-int***
	Before Expansion	0.99 (0.46, 2.12)		0.64 (0.20, 2.06)	
	After Expansion	1.85 (0.94, 3.65)		1.44 (0.50, 4.15)	
Mineralocorticoid receptor antagonist					
White			*0.9994*		*0.9273*
	Before Expansion	1.05 (0.81, 1.37)		0.74 (0.50, 1.10)	
	After Expansion	1.05 (0.73, 1.51)		0.75 (0.46, 1.23)	
African American			*0.7397*		*0.6406*
	Before Expansion	0.80 (0.50, 1.28)		0.33 (0.17, 0.62) *	
	After Expansion	0.87 (0.59, 1.29)		0.37 (0.21, 0.64) *	
Hispanic			*0.0830*		*0.1236*
	Before Expansion	1.54 (0.96, 2.49)		0.50 (0.19, 1.30)	
	After Expansion	2.53 (1.55, 4.15) *		0.76 (0.29, 2.04)	
Asian			*0.7685*		*0.5982*
	Before Expansion	0.99 (0.44, 2.26)		0.48 (0.14, 1.68)	
	After Expansion	1.14 (0.61, 2.13)		0.62 (0.24, 1.62)	
Hydralazine/Nitrate					
African American			*0.5564*		*0.9352*
	Before Expansion	1.13 (0.75, 1.72)		1.18 (0.69, 2.00)	
	After Expansion	0.97 (0.64, 1.46)		1.20 (0.83, 1.75)	
60 Minutes of Heart Failure Education					
White			*0.4304*		*0.5057*
	Before Expansion	0.85 (0.48, 1.50)		0.95 (0.42, 2.19)	
	After Expansion	1.05 (0.57, 1.91)		1.15 (0.49, 2.72)	
African American			*0.2662*		*0.2053*
	Before Expansion	0.52 (0.25, 1.09)		0.43 (0.12, 1.61)	
	After Expansion	0.71 (0.33, 1.52)		0.63 (0.16, 2.40)	
Hispanic			*0.0412*		*0.0934*
	Before Expansion	3.47 (1.26, 9.55)		2.59 (0.61, 10.95)	
	After Expansion	1.22 (0.55, 2.70)		1.09 (0.31, 3.90)	
Asian			*0.3725*		*0.4376*
	Before Expansion	0.37 (0.13, 1.05)		0.75 (0.15, 3.65)	
	After Expansion	0.57 (0.22, 1.46)		1.09 (0.24, 4.87)	

P-int indicates interaction between adopter state status and time before or after ACA Medicaid Expansion;

*, $p<0.008$.

Models were adjusted for patient-level variables (age, gender, medical history, vital signs at admission, labs at admission), and hospital variables (region, number of beds, teaching status, rural location).