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Association of the Affordable Care Act's Medicaid Expansion With Care Quality and Outcomes for Low-Income Patients Hospitalized With Heart Failure

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Abstract

BACKGROUND: Heart failure (HF) is the leading cause of morbidity and mortality in the United States. Despite advancement in the management of HF, outcomes remain suboptimal, particularly among the uninsured. In 2014, the Affordable Care Act expanded Medicaid eligibility, and millions of low-income adults gained insurance. Little is known about Medicaid expansion's effect on inpatient HF care.

METHODS AND RESULTS: We used the American Heart Association's Get With The Guidelines–Heart Failure registry to assess changes in inpatient care quality and outcomes among low-income patients (<65 years old) hospitalized for HF after Medicaid expansion, in expansion, and nonexpansion states. Patients were classified as low-income if covered by Medicaid, uninsured, or missing insurance. Expansion states were those that implemented expansion in 2014. Piecewise logistic multivariable regression models were constructed to track quarterly trends of quality and outcome measures in the pre (January 1, 2010–December 31, 2013) and postexpansion (January 1, 2014–June 30, 2017) periods. These measures were compared between expansion versus nonexpansion states during the postexpansion period. The cohort included 58804 patients hospitalized across 391 sites. In states that expanded Medicaid, uninsured HF hospitalizations declined from 7.9% to 4.4%, and Medicaid HF hospitalizations increased from 18.3% to 34.6%. Defect-free HF care was increasing during the preexpansion period (adjusted odds ratio/quarter, 1.06; 95% confidence interval, 1.03–1.08) but did not change after expansion (adjusted odds ratio, 0.99; 95% confidence interval, 0.97–1.02). Patterns were similar for other quality measures. There were no quality measures for which the rate of improvement sped up after expansion. In-hospital mortality rates remained similar during the preexpansion (adjusted odds ratio, 0.99; 95% confidence interval, 0.96–1.02) and postexpansion periods (adjusted odds ratio, 1.00; 95% confidence interval, 0.97–1.03). Among nonexpansion states, uninsured HF hospitalizations increased (11.6% to 16.7%) as did Medicaid HF hospitalizations (17.9% to 26.6%), and no quarterly improvement was observed for most quality measures in the post compared with preexpansion period. During the postexpansion period, defect-free care and mortality did not differ between expansion and nonexpansion states.

CONCLUSIONS: Medicaid expansion was associated with a significant decline in uninsured HF hospitalizations but not improvements in quality of care or in-hospital mortality among sites participating in a national quality improvement initiative. Efforts beyond insurance expansion are needed to improve in-hospital outcomes for low-income patients with HF.

Keywords

heart failure; hospitalizations; insurance; Medicaid; mortality; Patient Protection and Affordable Care Act; quality of health care

Heart failure (HF) is the leading cause of morbidity and mortality in the United States.[1] Despite considerable advancement in the management of HF, outcomes remain suboptimal,[2–4] particularly among the uninsured. Patients with reduced ejection fraction HF who lack insurance, for example, have higher mortality rates compared with the insured, potentially because they are less likely to receive evidence-based care.[5] Given the anticipated rise in

clinical and financial burden of HF, there is an urgent need to improve care quality and outcomes in this vulnerable population.[1]

In 2014, the Affordable Care Act (ACA) expanded Medicaid eligibility to nonelderly adults earning up to 138% of the federal poverty level. As a result, millions of low-income adults gained insurance coverage in 32 states.[6] Medicaid expansion has been associated with improved access to outpatient care and increased adherence to prescription drugs, both important to the longitudinal care of HF patients.[7–11] However, little is known about the impact of expansion on inpatient HF care. This is of particular interest because before the ACA, uninsured HF patients received lower quality care and experienced worse outcomes during hospitalization.[5] There are a few ways having insurance could potentially improve these disparities in care. Insurance may lead to closer outpatient care and monitoring, greater ambulatory use of guideline-directed medications, and reduced delays in seeking inpatient care, collectively diminishing the acuity of illness at time of HF hospitalization. In addition, being insured may impact decisions regarding inpatient management, such as implantation of cardiac devices, length of hospitalization, and use of postacute services, to the extent that these decisions are influenced by reimbursement.

Given the ongoing debate regarding whether to expand Medicaid among nonexpansion states, understanding the impact of expansion on quality of care and outcomes among low-income patients hospitalized for HF is important. In this study, we aimed to answer 3 questions. First, how did Medicaid expansion affect the composition of HF hospitalizations for the uninsured and Medicaid patients? Second, was expansion associated with improved care quality among low-income, nonelderly patients hospitalized for HF relative to non-expansion states? Third, were in-hospital outcomes for these patients better in states that expanded Medicaid compared with states that did not?

METHODS

Data Source

We used the American Heart Association's Get With The Guidelines–Heart Failure registry, an ongoing, national, voluntary hospital-based quality improvement program initiated in 2005. Details regarding the design and objectives of the Get With The Guidelines–Heart Failure registry and quality and achievement measures have been described previously.[12–16] The registry includes patients admitted with a primary diagnosis of HF or who developed significant HF symptoms during hospitalization. The registry is representative of hospitals from all regions and includes community and large tertiary-care hospitals. Trained personnel at the participating hospital sites use an internet-based patient management tool to collect patient-level information on consecutive HF admissions. Data collected include both patient-level characteristics (patient demographics, medical history, medications, laboratory data, in-hospital treatment, in-hospital outcomes, discharge medications, discharge status, and postdischarge follow-up) and hospital-level characteristics. All participating institutions were required to comply with local regulatory and privacy guidelines and, if required, to secure institutional review board approval. Because data were used primarily at the local site for quality improvement, sites were granted a waiver of informed consent under the common rule. Quintiles serves as the data collection (through their Patient Management Tool) and

coordination center for Get With The Guidelines. The Duke Clinical Research Institute serves as the data analysis center and has an agreement to analyze the aggregate deidentified data for research purposes. The data are not publicly available, but analytic methods and study materials can be made available to other researchers for purposes of reproducing the results or replicating the procedure.

State Medicaid Expansion Status

We considered expansion states to be those that implemented ACA Medicaid expansion from January 1, 2014 to January 1, 2015 (Table I in the Data Supplement). We initially excluded 5 states (DC, DE, MA, NY, and VT) from our analysis that already provided Medicaid coverage to low-income adults from 2010 to 2013 that was comparable to the ACA's Medicaid expansion. We also excluded 4 states that were late expanders of Medicaid (IN, AL, MT, LA). The remaining states were considered nonexpansion states and served as a control group for comparison.

Our preintervention period included the 4 years before expansion (January 1, 2010–December 31, 2013), and our intervention period included the years after expansion (January 1, 2014–June 30, 2017). The postexpansion period was defined based on the implementation date in each state.

Patient Population

There were 503896 patients hospitalized for HF across 608 sites from January 1, 2010 to June 30, 2017. We first excluded patients ≥65 years of age, whom were eligible for Medicare insurance (n=359 444). Next, we excluded early expansion states (DC, DE, MA, NY, and VT) and patients residing in states that were late expanders of Medicaid (AL, IN, MT, LA). We then used this cohort to characterize rates of Medicaid and uninsured HF hospitalizations among all HF hospitalizations, before and after Medicaid expansion, in states that expanded Medicaid compared with those that did not. For our main analysis, we identified a low-income cohort by only, including patients that were covered by Medicaid or were uninsured or had no insurance information at the time of hospitalization (Figure I in the Data Supplement).

Achievement, Quality, and Outcome Measures

All achievement, quality, and outcome measures were characterized before and after Medicaid expansion, stratified by state expansion status, and then compared between expansion and nonexpansion states during the postexpansion period.[13] We first assessed rates of defect-free care for eligible patients, defined as 100% compliance with all required achievement measures. Four major achievement measures evaluated in the study were (1) discharge instructions regarding activity, diet, medications, follow-up, weight monitoring, and what to do if symptoms worsen; (2) HF patients with documentation of left ventricular ejection fraction (LVEF); (3) HF patients with left ventricular systolic dysfunction (LVSD) discharged on a β-blocker; and (4) HF patients with LVSD discharged on angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARB).

We also evaluated additional quality measures for eligible patients, including: (1) evidence-based β-blocker use; (2) patients with LVSD discharged on an aldosterone antagonist; (3) patients with LVSD discharged on hydralazine and isosorbide dinitrate combination; (4) patients discharged with counseling or prescription or implantation of an implantable cardioverter defibrillator with LVEF ≤35%; (5) patients discharged with prescription or implantation of cardiac resynchronization therapy (if EF ≤35%); (6) anticoagulation for atrial fibrillation; (7) deep vein thrombosis prophylaxis; (8) Influenza vaccination during flu season; (9) pneumococcal vaccination; and (10) follow-up visit within ≤7 days. Our main outcomes of interests were in-hospital mortality, hospital length of stay, and rates of home discharge.

Statistical Analysis

In our overall cohort, trends in absolute counts and rates of HF hospitalizations were described by insurance status (Medicaid, uninsured) during the pre- and postexpansion periods, stratified by state expansion status. Cochran-Armitage trend testing was used to evaluate trends. Next, for our main analytic (low-income) cohort, baseline characteristics, including patient demographic information, medical history, and hospital characteristics were summarized for the periods before and after Medicaid expansion. Other clinical data, including vital signs on admission, laboratory values on admission, LVEF, and outcomes were similarly described. Categorical variables were compared using Pearson χ^2 tests and continuous variables using the Wilcoxon test.

Piecewise (or segmented) logistic multivariable regression models were then performed to track the trends over time of achievement and quality measures and other outcomes in pre- and post-Medicaid expansion periods, by state expansion status. The generalized estimating equation method with exchangeable working correlation matrix was applied to provide valid inference after accounting for the within-site correlation. Models were adjusted to account for differing patient and hospital characteristics over time and included (1) patient demographics (age, sex, race); (2) medical history: ischemic history, cerebrovascular event/transient ischemic attack, diabetes mellitus (insulin and noninsulin treated), hyperlipidemia, hypertension, peripheral vascular disease, renal insufficiency, smoking, chronic obstructive pulmonary disease or asthma, anemia, and LVEF ≤40%; and (3) hospital characteristics: region, rural location, hospital type (teaching versus non-teaching), and number of beds. For each outcome, we calculated an odds ratio (OR; with 95% confidence interval [CI]) per 3 calendar months as the rate of improvement during the period before Medicaid expansion, and OR (with 95% CI and *P* value) per 3 months after Medicaid expansion, and then compared these values to evaluate if the rate of improvement significantly changed after implementation of expansion. Next, we compared achievement, quality, and outcome measures in expansion versus nonexpansion states during the postexpansion period using multivariable logistic regression models with generalized estimating equation method to account for the clustering of data within hospitals. Outcome measures were also adjusted to account for different patient and hospital characteristics as described above.

As an additional analysis, we included the 5 states (NY, DE, MA, DC, VT) that already provided Medicaid coverage to low-income adults from 2010 to 2013 that was comparable

to the ACA's Medicaid expansion and compared performance on all quality and outcome measures between expansion and nonexpansion states in the postexpansion period. We also repeated this analysis after excluding patients with missing insurance information. Missing rates of most patient-level covariates were low (<2%). Missing race was imputed as white and missing medical history was imputed as no. Missing hospital characteristics were excluded. All statistical tests were 2-sided with a significance level of 0.05. Analyses were performed using SAS software (version 9.2; SAS Institute, Cary, NC).

RESULTS

Medicaid and Uninsured Hospitalization Trends

Among all HF hospitalizations, the proportion of patients insured by Medicaid increased from 18.3% to 34.6% in expansion states and 17.9% to 26.6% in nonexpansion states, from the preexpansion to postexpansion periods (P<0.001; Figure [A]). The proportion of uninsured HF hospitalizations declined significantly in expansion states (7.9%–4.4%) and increased in nonexpansion states (11.6%–16.7%), from the pre to postexpansion periods (P<0.001; Figure [B]).

Study Population

Our low-income cohort included 58 804 patients hospitalized at 391 sites across 40 states. Of these patients, 53% were insured by Medicaid, 21% were uninsured, and 26% had missing insurance information (Table II in the Data Supplement). Overall, 24 745 patients were hospitalized during the preexpansion period and 34 059 during the postexpansion period. Baseline demographics were similar among patients hospitalized during the pre- and postexpansion periods (Table II in the Data Supplement). Vital signs and laboratory values on admission, as well as hospital characteristics, are also shown in Table II in the Data Supplement.

Relationship Between Medicaid Expansion and Care Quality and Outcomes

In expansion states, defect-free HF care was increasing during the preexpansion period (adjusted OR [aOR], 1.06/quarter; 95% CI, 1.03–1.08; P<0.001; Table 1) but did not improve further after expansion (aOR, 0.99/quarter; 95% CI, 0.97–1.02; P=0.58). The rate of increase in defect-free HF care in the postexpansion relative to preexpansion period was lower (aOR, 0.94; 95% CI, 0.90–0.98; P=0.004). Among the individual measures, patterns were similar: β-blocker use at discharge was increasing before expansion (aOR, 1.07; 95% CI, 1.02–1.13; P=0.01) but did not change further after expansion (aOR, 0.97; 95% CI, 0.92–1.02; P=0.20). ACE inhibitors or ARB use also was increasing during the preexpansion period (aOR, 1.07; 95% CI, 1.03–1.11; P<0.001) but slowed after expansion (aOR, 0.92; 95% CI, 0.89–0.95; P<0.001). The rate of increase of both β-blocker and ACE inhibitors/ARB use was lower in the post compared with preexpansion periods (β-blocker: aOR, 0.90; 95% CI, 0.82–0.99; P=0.04; ACE inhibitors/ARB aOR, 0.86; 95% CI, 0.81–0.92; P<0.001). In comparison, among nonexpansion states, there were no significant quarterly changes in performance either pre or postexpansion for any of the achievement measures, with the exception of β-blocker use which was increasing before expansion (aOR, 1.05; 95% CI, 1.00–1.00; P=0.04).

Several quality measures also changed in expansion states after the implementation of Medicaid expansion (Table 2). For example, cardiac resynchronization therapy defibrillator or cardiac resynchronization therapy pacemaker use was increasing during the preexpansion period (aOR, 1.06; 95% CI, 1.01–1.11; *P*=0.01) but slowed after expansion (aOR, 0.97; 95% CI, 0.95–1.00; *P*=0.04; post-compared with pre-aOR, 0.92; 95% CI, 0.86–0.98; *P*=0.01). During the preexpansion period, implantable cardioverter defibrillator placement for an LVEF ≤35% was increasing (aOR, 1.12; 95% CI, 1.06–1.18; *P*<0.001) but after expansion did not change further (aOR, 0.99; 95% CI, 0.97–1.02; *P*=0.50); this difference was significant (aOR, 0.88; 95% CI, 0.82–0.95; *P*<0.001). Trends in the use of other evidence-based medications, such as aldosterone antagonists for LVSD, hydralazine and isosorbide dinitrate for LVSD, evidence-based β-blockers, as well as follow-up within 7 days of discharge, were all increasing significantly before expansion and did not change significantly after expansion; there were no quality measures for which the rate of improvement sped up after expansion (Table 2). Among nonexpansion states, no change in the odds of quarterly improvement was observed for any quality measures in the postexpansion period compared with the preexpansion period, with the exception of pneumococcal vaccination.

In expansion states, odds of in-hospital mortality were not changing neither before Medicaid expansion (aOR, 0.99; 95% CI, 0.96–1.02; *P*=0.37; Table 3) nor after expansion (aOR, 1.00; 95% CI, 0.97–1.03; *P*=0.90, aOR for post compared with pre, 1.02; 95% CI, 0.96–1.07; *P*=0.56). Similarly, lengths of stay remained similar before and after expansion. Odds of discharge home did not change in the preexpansion period (aOR, 1.02; 95% CI, 0.96–1.07; *P*=0.56) but declined in the postexpansion period (aOR, 0.99; 95% CI, 0.98–1.00; *P*=0.03). Among nonexpansion states, patterns of inhospital mortality, lengths of stay, and discharge home were similar in the pre- and postexpansion periods.

State Expansion Status, Care Quality, and Outcomes in the Postexpansion Period

In the postexpansion period, observed rates of all achievement measures were high (>95%) and similar in expansion and nonexpansion states (Table 4). There were no significant differences between expansion and nonexpansion states in performance on any of the quality measures during the postexpansion period, with the exception of a slightly higher rate of use of evidence-based β-blockers in expansion states.

Length of stay (5.3 versus 5.6 days; aOR, 0.94; 95% CI, 0.86–1.03; *P*=0.175) and in-hospital mortality (1.24% versus 1.09%; aOR, 0.90; 95% CI, 0.55–1.46; *P*=0.66) were similar between states during the post-expansion period. Rates of discharge home were lower in expansion states (88.5% versus 92.4%, aOR, 0.81; 95% CI, 0.67–0.98; *P*=0.03).

Additional Analyses

In additional analyses, including 5 states that were initially excluded from our cohort because they already offered generous Medicaid coverage before the ACA Medicaid expansion, our findings were similar (Table III in the Data Supplement). In addition, exclusion of patients with missing insurance information did not alter our main findings in a significant manner (Table IV in the Data Supplement)

DISCUSSION

Though Medicaid expansion has been associated with meaningful changes in access to and utilization of out-patient health services, in this study of patients hospi talized for HF at institutions participating in a national quality improvement initiative, expansion was not associated with improvements in inpatient care quality and outcomes. Prior studies have evaluated the impact of insurance expansion on mortality and revealed conflicting findings.[17–19] Our study is the first to examine the effect of Medicaid expansion on outcomes during an acute hospitalization for HF, a condition that is both common and rising in prevalence and from which low-income patients are at particular risk for poor outcomes.[20] Although we found that patients hospitalized for HF were more likely to be insured by Medicaid, and less likely to be uninsured, after the implementation of Medicaid expansion, these shifts did not affect quality of care or outcomes during hospitalization in a consequential manner. Understanding this relationship between insurance expansion and inpatient HF care is particularly important because HF mortality rates after an acute hospitalization have increased in recent years.[21] Insurance may mitigate financial risk associated with acute hospitalization, but our findings suggest that efforts beyond insurance expansion are needed to improve HF outcomes, particularly among low-income populations.[22]

To date, only 32 states have elected to expand Medicaid under the ACA, but evidence has grown regarding the positive effects of expansion. Insurance plays an important role in managing financial risk, and Medicaid expansion has been associated with reduced catastrophic out-of-pocket expenditures and improved financial well being.[19,23] Such financial protection is particularly important for low-income patients with HF, who are heightened risk for hospital admission, subsequent readmission, and adverse events.[24,25] Beyond financial security, coverage expansions have resulted in greater access to outpatient care and increased outpatient visits.[7,26,27] Continuity of outpatient care is a central to the longitudinal management of patients with HF, and early outpatient follow-up after a hospitalization for HF is associated with better outcomes.[28,29] In addition, adherence to guideline-directed medical therapy for HF is low and nonadherence is associated with worse quality of life and increased risk of morbidity and mortality; Medicaid expansion has been associated with increased prescription drug utilization and medication adherence.[7,11,23,30] Collectively, the evidence to date clearly demonstrates that expansion has led to significant gains in outpatient care which have likely benefited low-income patients with HF.

However, in our study, although the delivery of evidence-based care (ie, β-blocker, ACE inhibitors or ARB for LVSD, aldosterone antagonist for LVSD), defect-free HF care, and implantation of indicated cardiac devices (ie, implantable cardioverter defibrillator, cardiac resyn chronization therapy) were increasing significantly before expansion among states that elected to expand Medicaid, no further increases were observed after the implementation of expansion. Though being insured mediates access to healthcare services, and also clearly influences reimbursement for inpatient care, these findings suggest that such factors may not necessarily drive clinician decision-making about inpatient management once a patient is hospitalized. We also found that Medicaid expansion was not associated with signifi-cant reductions in in-hospital mortality and that mortality was similar among expansion and nonexpansion states in the postexpansion period. This may, in part, be because of the fact

that inpatient care quality did not improve significantly in states that implemented expansion. It is also conceivable that the positive effects of being insured, such as greater access and use of out-patient care, medications, and treatment of chronic illness, have little effect on mortality during an acute HF hospitalization.[10,27] Given that HF mortality rates on a national level have risen over the last several years, our findings suggest that dedicated initiatives, rather than the provision of insurance alone, are needed to improve outcomes in this vulnerable population.[21]

Beyond care quality and mortality, other outcomes that might be more sensitive to insurance reimbursement, such as length of hospitalization, did not change after the implementation of expansion. This supports the notion that clinician decision-making regarding timing of discharge is influenced most by whether a patient is medically optimized, rather than patients' ability to pay for a hospitalization. Furthermore, at time of discharge, decisions regarding the use of postacute care services, such as skilled nursing facilities, are likely influenced by insurance status. It is not surprising then that the likelihood of being discharged home declined after implementation of expansion and was significantly lower in expansion compared with nonexpansion states, implying that patients in expansion states were more likely to be discharged to a post-acute facility during the vulnerable postdischarge period.

There are other potential explanations for the observed lack of improvement in care patterns after Medicaid expansion. First, because hospitals participating in the Get With The Guidelines–Heart Failure registry have an interest in quality improvement, performance on quality measures for inpatient HF care were already high for many measures (ie, provision of defect-free HF care was >90% before expansion), limiting room for significant improvement after expansion. Expansion could potentially have had a greater impact on HF care for low-income patients in hospitals not participating in formal quality improvement initiatives. Second, quality of care at states that elected to expand Medicaid may have differed at baseline compared with nonexpansion states, making them less sensitive to expansion. Finally, the modest increase in Medicaid hospitalizations observed in non-expansion states, potentially because of the woodwork effect (the uptake of Medicaid by individuals who were already eligible for Medicaid before expansion) may have diminished insurance-based differences in care between expansion and nonexpansion states after expansion.[31]

Our study has several limitations. First, the Get With The Guidelines–Heart Failure registry enrolls patients hospitalized for HF at hospitals that have a strong interest in quality improvement and may not necessarily be representative of all hospitals across the United States. Second, these registry data only include HF patients admitted to a hospital, therefore, patients who died before reaching the hospital or were discharged home from the Emergency Department were not included. Furthermore, postdischarge care quality and outcomes that might be influenced by insurance status were not characterized. Third, our analysis was observational in nature, and it is possible that external factors or coding changed over time and confounded our temporal comparison of expansion and nonexpansion states.

In summary, we found that low-income, nonelderly adults hospitalized for HF were significantly more likely to be insured by Medicaid and significantly less likely to be uninsured, in states that implemented Medicaid expansion, compared with states that did not expand. However, Medicaid expansion was not associated with meaningful improvements in inpatient care quality or in-hospital mortality, suggesting that clinician decision-making and management of HF patients, once hospitalized, may not be affected by factors related to insurance status. Efforts beyond insurance expansion are needed to improve in-hospital outcomes in this population. Future investigation should evaluate the potential impact of Medicaid expansion on long-term outcomes in the post-discharge period after an HF hospitalization, a phase of care where being insured might be especially beneficial.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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WHAT IS KNOWN

- In 2014, the Affordable Care Act expanded Medicaid eligibility to nonelderly adults earning up to 138% of the federal poverty level. As a result, millions of low-income adults gained insurance coverage in states that elected to expand.
- Medicaid expansion has been associated with improved access to outpatient care and increased adherence to prescription drugs, both important to the longitudinal care of patients with heart failure.

WHAT THE STUDY ADDS

- States that implemented Medicaid expansion experienced a significant decline in uninsured heart failure hospitalizations relative to nonexpansion states.
- Medicaid expansion was not associated with meaningful improvements in inpatient care quality or in-hospital mortality.

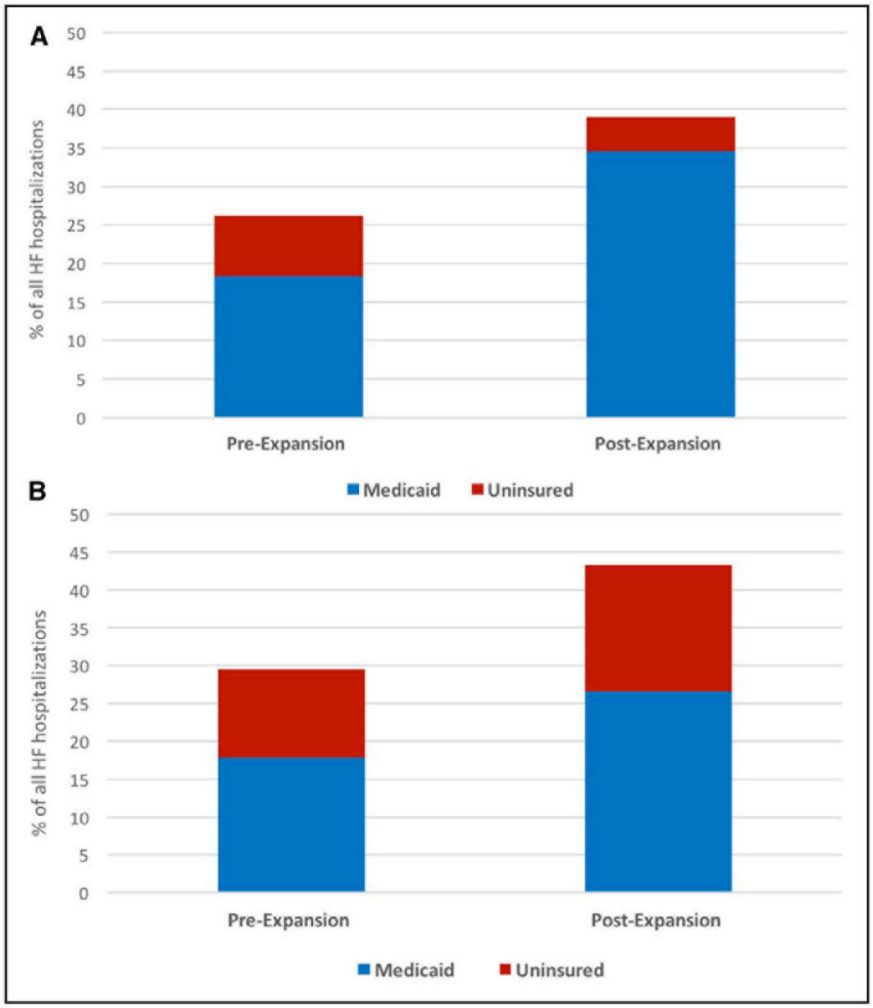

Figure. Rates of Medicaid and uninsured heart failure (HF) hospitalizations during the pre- and postexpansion periods, by state expansion status.

A, Medicaid expansion states. **B**, Nonexpansion states. **P* value <0.001 for Medicaid and uninsured hospitalizations in the pre vs postexpansion period.

Table 1.

Trends in Achievement Measures by State Expansion Status in the Pre- vs Postexpansion Periods

	Expansion States (aOR; 95% CI; *P* Value)*			Nonexpansion States (aOR; 95% CI; *P* Value)*		
	Preexpansion	**Postexpansion**	**Post vs Preexpansion**	**Preexpansion**	**Postexpansion**	**Post vs Preexpansion**
ACE inhibitor/ARB for LVSD at discharge	1.07 (1.03–1.11); <0.001	0.92 (0.89–0.95); <0.001	0.86 (0.81–0.92); <0.001	1.00 (0.96–1.05); 0.84	0.98 (0.95–1.01); 0.19	0.97 (0.91–1.04); 0.46
β-blocker at discharge	1.07 (1.02–1.13); 0.01	0.97 (0.92–1.02); 0.20	0.90 (0.82–0.99); 0.04	1.05 (1.00–1.10); 0.04	1.00 (0.96–1.05); 0.89	0.96 (0.89–1.03); 0.25
Discharge instructions	1.06 (1.02–1.09); <0.001	0.98 (0.95–1.01); 0.25	0.93 (0.88–0.98); 0.01	1.03 (0.99–1.08); 0.13	1.02 (0.98–1.07); 0.36	0.99 (0.92–1.07); 0.81
HF defect-free measure	1.06 (1.03–1.08); <0.001	0.99 (0.97–1.02); 0.58	0.94 (0.90–0.98); 0.004	1.02 (0.99–1.06); 0.18	1.03 (1.00–1.05); 0.08	1.00 (0.95–1.05); 0.98

Measurement of LV function had very few cases of no, so multivariate model could not be run for this achievement measure. ACE indicates angiotensin-converting enzyme; aOR, adjusted odds ratio; ARB, angiotensin II receptor blockers; CI, confidence interval; HF, heart failure; LV, left ventricular; and LVSD, LV systolic dysfunction.

*aOR and associated 95% CI for quarterly (every 3 mo) trends in achievement measures.

Table 2.

Trends in Quality Measures by State Expansion Status in the Pre vs Postexpansion Periods

	Expansion States (aOR; 95% CI; *P* Value)*			Nonexpansion States (aOR; 95% CI; *P* Value)*		
	Preexpansion Period	**Postexpansion Period**	**Post vs Preexpansion**	**Preexpansion Period**	**Postexpansion Period**	**Post vs Preexpansion**
Aldosterone antagonist for LVSD at discharge	1.07 (1.03–1.12); 0.002	1.01 (0.98–1.05); 0.44	0.95 (0.89–1.01); 0.08	1.04 (1.00–1.07); 0.03	1.03 (1.01–1.05); 0.006	0.99 (0.95–1.03); 0.73
Evidence-based specific β-blockers	1.07 (1.03–1.10); <0.001	1.02 (1.00–1.04); 0.06	0.96 (0.91–1.00); 0.05	1.06 (1.02–1.09); <0.001	1.03 (1.01–1.05); 0.02	0.98 (0.93–1.02); 0.31
Hydralazine and isosorbide dinitrate for LVSD at discharge	1.06 (1.03–1.10); <0.001	1.01 (0.95–1.08); 0.78	0.95 (0.87–1.04); 0.26	0.99 (0.96–1.03); 0.60	1.02 (0.96–1.08); 0.62	1.02 (0.96–1.10); 0.49
ICD for LVEF ≤35%	1.12 (1.06–1.18); <0.001	0.99 (0.97–1.02); 0.50	0.88 (0.82–0.95); <0.001	1.05 (1.01–1.09); 0.02	1.02 (0.99–1.05); 0.17	0.98 (0.92–1.03); 0.35
CRT-D or CRT-P placed at discharge	1.06 (1.01–1.11); 0.01	0.97 (0.95–1.00); 0.04	0.92 (0.86–0.98); 0.01	1.03 (0.97–1.09); 0.36	1.00 (0.96–1.05); 0.91	0.98 (0.89–1.07); 0.61
Anticoagulation for atrial fibrillation	1.03 (1.00–1.07); 0.06	1.02 (0.996–1.040); 0.12	0.98 (0.94–1.03); 0.52	1.03 (0.99–1.08); 0.1 5	1.02 (0.99–1.04); 0.18	0.99 (0.93–1.05); 0.62
DVT prophylaxis	1.13 (1.08–1.18); <0.001	1.00 (0.97–1.03); 0.97	0.89 (0.84–0.94); <0.001	1.09 (1.04–1.14); <0.001	1.05 (1.00–1.10); 0.07	0.96 (0.88–1.05); 0.40
Influenza vaccination during flu season	1.14 (1.08–1.21); <0.001	0.96 (0.92–1.01); 0.13	0.84 (0.78–0.91); <0.001	1.07 (1.02–1.13); 0.007	1.03 (0.97–1.09); 0.32	0.96 (0.87–1.06); 0.41
Pneumococcal vaccination	1.13 (1.08–1.18); <0.001	0.90 (0.86–0.94); <0.001	0.80 (0.75–0.86); <0.001	1.07 (1.03–1.13); 0.003	0.93 (0.89–0.97); S0.001	0.86 (0.80–0.93); <0.001
Follow-up visit within ≤7d	1.04 (1.01–1.06); 0.008	1.02 (1.00–1.04); 0.08	0.98 (0.95–1.02); 0.32	1.05 (1.02–1.08); 0.001	1.01 (0.99–1.03); 0.36	0.96 (0.92–1.01); 0.08

aOR indicates adjusted odds ratio; CI, confidence interval; CRT-D, cardiac resynchronization therapy defibrillator; CRT-P, cardiac resynchronization therapy pacemaker; DVT, deep vein thrombosis; ICD, implantable cardioverter defibrillator; LVEF, left ventricular ejection fraction; and LVSD, left ventricular systolic dysfunction.

*aOR and associated 95% CI for quarterly (every 3 mo) trends in quality measures.

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Table 3.

Trends in Outcomes by State Expansion Status in the Pre- vs Postexpansion Periods

	Expansion States (aOR; 95% CI; *P* Value)*			Nonexpansion States (aOR; 95% CI; *P* Value)*		
	Preexpansion	**Postexpansion**	**Post vs Preexpansion**	**Preexpansion**	**Postexpansion**	**Post vs Preexpansion**
Mortality	0.99 (0.96–1.02); 0.37	1.00 (0.97–1.03); 0.90	1.02 (0.96–1.07); 0.56	0.98 (0.96–1.01); 0.22	0.99 (0.96–1.02); 0.44	1.00 (0.96–1.06); 0.83
Length of stay	1.00 (0.99–1.01); 0.71	1.00 (1.00–1.01); 0.45	1.00 (1.00–1.01); 0.50	1.00 (1.00–1.01); 0.49	1.00 (1.00–1.01); 0.99	1.00 (0.99–1.01); 0.64
Discharge home	1.02 (0.96–1.07); 0.56	0.99 (0.98–1.00); 0.03	1.00 (0.98–1.03); 0.91	1.00 (0.99–1.01); 0.97	1.00 (0.99–1.01); 0.99	1.00 (0.98–1.02); 0.98

aOR indicates adjusted odds ratio; and CI, confidence interval.

* aOR and associated 95% CI for quarterly (every 3 mo) trends in outcome measures.

Table 4.

Performance on Achievement, Quality, and Outcome Measures in Expansion vs Nonexpansion States During the Postexpansion Period

	Expansion States (n=16253)	Nonexpansion States (n=17806)	OR (Expansion vs Nonexpansion)	95% CI	*P* Value
Achievement measures					
ACE/ARB for LVSD at discharge	6132 (96.0)	7229 (95.7)	0.96	0.67–1.37	0.81
β-blocker at discharge	7362 (98.4)	8738 (98.6)	0.89	0.57–1.39	0.60
Discharge instructions	11 505 (95.6)	14035 (96.7)	0.76	0.50–1.17	0.22
HF defect-free care: 100% compliance	13911 (93.8)	15315 (93.5)	0.95	0.71–1.28	0.75
Quality measures					
Aldosterone antagonist for LVSD at discharge	3688 (57.9)	3608 (48.0)	1.13	0.92–1.39	0.25
Evidence-based specific β-blockers	7001 (95.2)	8287 (94.9)	1.34	1.04–1.75	0.03
Hydralazine and isosorbide dinitrate combination for LVSD at discharge	184 (34.9)	94 (27.6)	0.97	0.51–1.85	0.92
ICD counseling or ICD placed or prescribed at discharge	2361 (66.9)	2689 (69.8)	0.88	0.65–1.20	0.41
CRT-D or CRT-P placed or prescribed at discharge	544 (50.5)	466 (49.2)	1.23	0.84–1.80	0.29
Anticoagulation for atrial fibrillation	2475 (82.7)	2296 (82.6)	1.11	0.87–1.43	0.39
DVT prophylaxis	3706 (89.4)	4678 (87.8)	1.08	0.72–1.61	0.72
Influenza vaccination during flu season	4583 (81.7)	4891 (87.2)	1.09	0.76–1.57	0.64
Pneumococcal vaccination	7685 (65.9)	8853 (72.5)	1.03	0.77–1.37	0.85
Follow-up visit within 7 d	9892 (78.2)	10313 (68.9)	1.37	1.11–1.69	0.003
Outcomes[*]					
Mortality, %	1.24	1.09	0.90	0.55–1.46	0.66
Discharge home, %	88.5	92.4	0.81	0.67–0.98	0.03
LOS, d[†]	5.3	5.6	0.94	0.86–1.03	0.18

ACE indicates angiotensin-converting enzyme; ARB, angiotensin II receptor blockers; CI, confidence interval; CRT-D, cardiac resynchronization therapy defibrillator; CRT-P, cardiac resynchronization therapy pacemaker; DVT, deep vein thrombosis; HF, heart failure; ICD, implantable cardioverter defibrillator; LOS, length of stay; LVSD, left ventricular systolic dysfunction; and OR, odds ratio.

[*] ORs for outcomes (mortality, discharge home, LOS) are adjusted for patient and hospital characteristics.

[†] LOS treated as continuous variable. Because of skewed distribution, Poisson regression model with log link was used. Risk ratio reported.

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