Trends in Hospitalizations and Outcomes for Acute Cardiovascular Disease and Stroke: 1999-2011

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Abstract

***Background*—**The past decade focused intensely on improving the quality of care for people with, or at risk for, cardiovascular disease and stroke. We sought to quantify the changes in hospitalization rates and outcomes during this period.

***Methods and Results*—**We used national Medicare data to identify all Fee-For-Service patients aged ≥65 years hospitalized with unstable angina, myocardial infarction, heart failure, ischemic stroke, and all other conditions from 1999 through 2011 (2010 for 1-year mortality). For each condition, we examined trends in adjusted rates of hospitalization per patient-year and, for each hospitalization, rates of 30-day mortality, 30-day readmission, and 1-year mortality overall and by demographic subgroups and regions. Rates of adjusted hospitalization declined for cardiovascular conditions (38.0% for 2011 compared with 1999 [95% CI] [37.2% to 38.8%] for myocardial infarction; 83.8% [83.3% to 84.4%] for unstable angina; 30.5% [29.3% to 31.6%] for heart failure; and 33.6% [32.9% to 34.4%] for ischemic stroke compared with 10.2% [10.1% to 10.2%] for all other conditions). Adjusted 30-day mortality rates declined 29.4% [28.1% to 30.6%] for myocardial infarction; 13.1% [1.1% to 23.7%] for unstable angina; 16.4% [15.1% to 17.7%] for heart failure; and 4.7% for ischemic stroke [3.0% to 6.4%]. There were also reductions in rates of 1-year mortality and 30-day readmission and consistency in declines among the demographic subgroups.

***Conclusions*—**Hospitalizations for acute cardiovascular disease and stroke from 1999 through 2011 declined more rapidly than for other conditions. For these conditions, mortality and readmission outcomes improved.

Key words: heart disease, stroke, outcome, trends, rehospitalization

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Introduction

During the past decade, a time of few major therapeutic advances in cardiovascular disease and stroke that apply to large numbers of patients, health care professionals and organizations focused their efforts on improving the quality of care for these conditions and ensuring the appropriate application of proven interventions. Professional organizations including the American College of Cardiology, American Heart Association, and American Stroke Association supported efforts to measure performance and monitor care through registries and national quality improvement campaigns.[1-13] The Centers for Medicare & Medicaid Services (CMS) sustained national efforts to improve care and publicly reported risk-standardized 30-day mortality and readmission rates for myocardial infarction and heart failure.[14-17]

Although several reports have indicated that hospitalization rates and outcomes for cardiovascular disease and stroke improved in the recent past, many focused on specific communities, populations, or conditions and did not assess the conditions together or assess demographic or geographic differences.[18-26] In addition, some focused on more distant time periods.[19, 27] Thus, we lack a contemporary, comprehensive national perspective on the trends for the most common cardiovascular and stroke conditions and how they compare with other conditions.

Accordingly, we studied a national cohort of all Medicare Fee-For-Service beneficiaries from 1999-2011 to evaluate trends in rates of hospitalization, mortality, and readmission; payments; length of stay; and discharge disposition for unstable angina, myocardial infarction, heart failure, and ischemic stroke. We assessed rates of hospitalization for all other conditions for comparison. We also examined variation in rates among demographic and geographic subgroups to determine if any differences between the groups changed over time. By examining myocardial

infarction and unstable angina concomitantly, we sought to determine whether coding shifts between the conditions were responsible for the reported changes during this period and to understand the relationship among the 4 conditions and the relationship of cardiovascular conditions and stroke with all other conditions.

Methods

Study Sample

We used the Medicare beneficiary denominator file from CMS to identify beneficiaries aged 65 years or older who were enrolled in the Fee-For-Service plan for at least 1 month from January 1, 1999 to December 31, 2011. We calculated person-years for each beneficiary to account for new enrollment, disenrollment, or death for each year of the study. We then linked the person-years beneficiary data to the Medicare inpatient claims data to identify patients who were discharged from acute care hospitals with a principal discharge diagnosis code for myocardial infarction, unstable angina, heart failure, or ischemic stroke, according to the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes (**Table S1**). For comparison with other conditions, we created a cohort of all Fee-For-Service Medicare beneficiaries aged 65 years or older who were discharged without these diagnoses from acute care hospitals. We conducted a secondary analysis for ischemic stroke by removing code 436.xx (acute, but ill-defined, cerebrovascular disease), a new definition for ischemic stroke proposed by the American Heart Association and American Stroke Association.[28]

Patient Characteristics and Comorbidities

Patient demographic information included age, sex, and race (white, black, other). We identified clinical comorbidities, including 7 cardiovascular history variables and 14 other variables that

represent additional coexisting illnesses, using the method employed by CMS to profile hospital 30-day mortality measures for cardiovascular conditions.[16, 17] We determined comorbidities for the index hospitalization from secondary diagnosis codes as well as the principal and secondary diagnosis codes from all hospitalizations for 12 months before the index hospitalization.

Outcomes

For each condition and year, we calculated rates of condition-specific hospitalization by dividing the total number of condition-specific hospitalizations in each year, state, and age-gender-race group by the corresponding person-years of Fee-For-Service beneficiaries for that year, state, and age-gender-race group. For individuals with multiple hospitalizations, all hospitalizations were included in the calculation.

We also determined rates of mortality and readmission. We defined rates of 30-day and 1-year mortality as the percentages of condition-specific hospitalizations resulting in death, regardless of cause, within 30 days and 365 days from the date of admission by year and condition. We defined all-cause 30-day readmission as any re-hospitalization to an acute care hospital within 30 days from the date of discharge for patients who were discharged alive and were not transferred to another acute care hospital. In the mortality and readmission calculations, if a patient had more than 1 hospitalization during a year, we randomly selected 1 hospitalization as the index admission. This was based on a rationale to minimize sample selection biases. If we select the first hospitalization, the mortality rate would be low and readmission rate would be high; if we select the last hospitalization, the mortality rate would be high and readmission rate would be low. Patients could belong to >1 condition-specific cohort.

Other outcomes included major discharge dispositions, Medicare expenditures associated

with the index hospitalization, and length of stay. Major discharge dispositions included discharge to home, homecare, intermediate care or skilled nursing facility, or hospice; transfer to another acute care hospital; or in-hospital death. We measured Medicare expenditures as the mean Medicare payment per hospitalization, adjusting for the annual Consumer Price Index inflation rate and using 2011 as the index year (http://www.bls.gov/data/inflation_calculator.htm). We excluded patients with lengths of stay >100 days.

Statistical Analysis

We examined patient demographic and clinical characteristics across years. Rates of condition-specific hospitalization were expressed as per 100,000 person-years. Rates of mortality and readmission, and discharge disposition, were expressed as percentages, and Medicare expenditures and length of stay as means (standard deviation [SD]). We used the Cochran-Armitage trend test to determine the statistical significance of changes over time in the binary outcomes and the Cuzick nonparametric test in the continuous outcomes.[29]

We fitted a generalized linear mixed effects model with a Poisson link function, adjusting for age, sex, and race, to evaluate temporal change in the rates of hospitalization and computed incidence rate ratios to summarize changes. The condition-specific number of hospitalizations was the outcome and the person-years information was used as an offset in the model. We fitted the mixed model with a logit link function, adjusting for patient demographics and comorbidities, to estimate the temporal changes in rates of mortality. For rates of 30-day all-cause readmission, we conducted a survival analysis to calculate the proportion of patients who were readmitted to an acute care hospital within 30 days of a condition-specific discharge, censoring those who died before readmission. We constructed a Cox proportional hazards model

to assess the change in rates of readmission. We estimated models with hospital- (state for the hospitalization model) specific random intercepts to account for within-hospital (within-state for the hospitalization model) and between-hospital (between-state for the hospitalization model) variations. All models included an ordinal time variable, corresponding to each year of the study period, after the visual inspection of crude rates revealed a linear pattern. To permit complete follow-up, we restricted the 1-year mortality model to 2010 discharges and the 30-day readmission model to November 30, 2011 discharges. We fitted separate models for each condition and repeated the models for age and gender-race groups. Using these models, we also assessed the changes in outcomes for all other conditions. To assess the changes between the ending (2011 [2010 for 1-year mortality]) and starting (1999) points, we fitted the models with an indicator for the ending point.

To quantify variation between states, we estimated the odds of a condition-specific hospitalization for a Fee-For-Service beneficiary who resided in a state that was 1 standard deviation above the national average rate of hospitalization relative to beneficiaries residing in a state that was 1 standard deviation below the national average for 2011.[30] We computed these odds for each condition and used a similar method to compare the between-hospital variations for rates of 30-day and 1-year mortality, and 30-day readmission for 2011 (2010 for 1-year mortality). All statistical testing was 2-sided at a significance level of 0.05. We conducted the analyses with SAS version 9.3 64-bit (SAS Institute Inc., Cary, North Carolina). To facilitate data presentation and increase the sample in age-gender-race subgroups, we report patient characteristics and outcomes by bi-annual intervals: 1999-2010, 2005-2006, and 2010-2011. These represent the baseline, midpoint, and end-of-study periods. We obtained Institutional Review Board approval through the Yale University Human Investigation Committee; informed

consent was not required.

Results

Study Sample

We identified 409,591,889 observations, representing 33,952,331 individual Medicare beneficiaries aged 65 years or older who contributed a total of 363,261,068 person-years. There were 3,267,884 hospitalizations for myocardial infarction; 314,875 for unstable angina; 5,895,686 for heart failure; 3,726,488 for ischemic stroke; and 68,178,855 for all other conditions. In 1999, the top 5 conditions other than myocardial infarction, unstable angina, heart failure, and stroke were other forms of chronic ischemic heart disease (6.5%); pneumonia (6.2%); cardiac dysrhythmias (4.2%); chronic bronchitis (3.8%); and disorders of fluid electrolyte and acid-base balance (2.9%). These conditions changed substantially over the study period. In 2011, the top 5 conditions other than myocardial infarction, unstable angina, heart failure, and stroke were pneumonia (4.4%); unspecified septicemia (3.9%); acute cystitis (2.9%); obstructive chronic bronchitis with acute exacerbation (2.9%); and unspecified acute kidney failure (2.7%). The percent of patients with comorbidities increased over time across the 4 conditions (**Table S2**). The secondary analysis that excluded code 436.xx identified 3,361,411 ischemic stroke hospitalizations. The proportion of 436.xx in the combined 433.xx, 434.xx, and 436.xx sample declined significantly over the study period, from 22% in 1999 to 1% in 2005 to 0.1% in 2010.

Rates of Hospitalization

The observed rates of hospitalization declined significantly for all targeted conditions across all age and gender-race groups. **Table 1** shows bi-annual rates by study period and condition.

Between 1999 and 2011, the overall declines (per 100,000 person-years) were 1283 to 801 for myocardial infarction; 202 to 30 for unstable angina; 2475 to 1730 for heart failure; and 1390 to 925 for ischemic stroke (p values <0.001 for trend [**Figure S1A**]). The adjusted annual declines represented by the incidence risk ratio (IRR) of the time variable were 4.6% (95% CI [4.5 to 4.7]) for myocardial infarction; 15.3% (15.2 to 15.4) for unstable angina; 3.1% (3.0 to 3.2) for heart failure; and 3.8% (3.7 to 3.9) for ischemic stroke. This pattern did not change substantially after accounting for patient characteristics and geographical differences (**Figure S1B**). Rates of hospitalization for all other conditions also declined, from 19,352 in 1999 to 17,372 in 2011 (per 100,000, p<0.001 for trend). Adjusted rates of hospitalization declined (38.0% for 2011 compared with 1999 [95% CI] [37.2% to 38.8%] for myocardial infarction; 83.8% [83.3% to 84.4%] for unstable angina; 30.5% [29.3% to 31.6%,] for heart failure; 33.6% [32.9% to 34.4%] for ischemic stroke [**Figure 1**]; and 10.2% [10.1% to 10.2%,] for other conditions). Although geographic variation was observed at the county level, the declines were remarkable for all 4 conditions nationwide (**Figures 2A and 2B**). Regardless of the improvements from 1999 to 2011, the need for further improvement remains substantial (**Figure 3**).

The secondary analysis that excluded 436.xx for ischemic stroke shows that the stroke hospitalization rate (per 100,000 person-years) declined 15.2%, from 1089 in 1999 to 924 in 2011 (p value <0.001 for trend). The age-sex-race adjusted annual decline rate was 1.2% (1.08%, 1.21%).

Patient Outcomes, Discharge Disposition, and Hospital Expenditures

Table 2 summarizes the observed outcomes bi-annually. Between 1999 and 2011, adjusted rates of 30-day mortality declined 29.4% [28.1% to 30.6%,] for myocardial infarction; 13.1% [1.1% to 23.7%] for unstable angina; 16.4% [15.1% to 17.7%,] for heart failure; and 4.7% for ischemic

stroke [3.0% to 6.4%]. Adjusted rates of 1-year mortality declined 23.4% [22.3% to 24.5%] for myocardial infarction; 21.1% [14.4% to 27.3%] for unstable angina; 13.0% [12.1% to 13.9%] for heart failure; and 13.1% [11.9% to 14.3%] for ischemic stroke. Adjusted rates of 30-day readmission declined 18.6% [17.1% to 20.0%] for myocardial infarction; 32.3% [26.6% to 37.6%] for unstable angina; 9.7% [8.5% to 10.8%] for heart failure; and 5.9% [4.2% to 7.6%] for ischemic stroke (**Figure 1**). The declines varied substantially by conditions and subgroups (**Figure S2**). Between 1999 and 2011, the annual inflation-adjusted Medicare payments for the index hospitalization increased $486 ($14,018 to $14,504), $65 ($4350 to $4415), $1531 ($7048 to $8579), and $825 ($7626 to $8451) for myocardial infarction, unstable angina, heart failure, and ischemic stroke, respectively. Between 1999 and 2011, discharge to home was not consistent across the diagnoses, with an increase of 4.1% [3.9% to 4.3%] for myocardial infarction; decrease of 4.2% [3.9% to 5.1%] for unstable angina; decrease of 24.7% [23.9% to 24.8%] for heart failure; and decrease of 11.2% [10.9% to 12.4%] for ischemic stroke. The mean length of stay decreased 1.2 (6.5 to 5.3), 0.6 (3.1 to 2.5), 0.6 (5.8 to 5.2), and 1.1 (5.5 to 4.4) days for myocardial infarction, unstable angina, heart failure, and ischemic stroke, respectively. The changes were consistent across subgroups (**Tables S3 and S4**).

Although rates of hospitalization, mortality, and readmission declined over time, variation was observed across states and hospitals (**Figure S3**). Between-hospital variation was not estimated for unstable angina due to the insufficient sample size for each hospital for that condition.

Discussion

This study reveals an era in the history of cardiovascular disease that was characterized by

improvements in the rates of hospitalization and outcomes of 4 major cardiovascular conditions, with particular gains for myocardial infarction and unstable angina. This improvement in rates of hospitalization is far greater than that achieved for other causes of hospitalization. Importantly, the declines and improvements in cardiovascular conditions and stroke were not associated with increases in hospitalizations for other conditions, and the improvements occurred across demographic groups.

There are many potential reasons for these findings, including concurrent improvements in the identification and treatment of hypertension, a rapid rise in the use of statins, and marked declines in smoking.[31-33] There were also improvements in the use of evidence-based medications and the timeliness of treatment for patients with ST-segment elevation myocardial infarction.[34, 35] The period was also replete with quality improvement initiatives directed toward these conditions and the use of registries and other data to track performance and support improvement efforts.[11, 36, 37] There were also publicly reported measures for myocardial infarction and heart failure.[14-17]

Additional explanations for our findings include the possibility of changes in coding over time. Such secular trends might have accounted for an observed reduction in mortality for myocardial infarction if patients with unstable angina were increasingly classified as having had a myocardial infarction. The Will Rogers phenomenon, with the migration of high-risk unstable angina patients to the myocardial infarction group, could have led to reductions in mortality in both groups.[38] However, not only did mortality decline in both groups, but rates of hospitalization dropped dramatically, which suggests that we are not observing a change in coding. However, this is based on indirect evidence and we cannot exclude a change in coding practices over time; though it seems implausible that coding shifts could have accounted for the

dramatic overall changes we observed, they may have played some role in overall reductions or in state-to-state variability. Interestingly, the decline in rates of hospitalization occurred despite a shift in the official definition of myocardial infarction toward greater sensitivity with a reliance on troponin levels.[39, 40] For the cardiovascular diagnoses, we have no evidence that the cohorts were healthier in the more recent years of the study period. On the contrary, patients in that time period were slightly older with more comorbidity, consistent with findings from studies with more detailed clinical data.[22, 41] In addition, we focused on hospitalizations, but many patients who experience these events either do not seek medical attention or die before being admitted to a hospital. These differences, however, are too large to be attributed to events outside the hospital.

This study expands upon our previous work in which we reported a decline in rates of hospitalization for myocardial infarction from 2002-2007, rates of mortality from myocardial infarction from 1995-2006, rates of hospitalization for heart failure from 1998-2008, and rates of mortality from heart failure and rates of readmission from 1993-2006. The current study presents these conditions together, with time periods extended and aligned, unstable angina and stroke added, and outcomes expanded to include short- and long-term mortality, readmission, and payments. This comprehensive perspective on the results achieved with cardiovascular conditions and stroke over the past decade also places the results in perspective of the trends that occurred for all other conditions. Our findings broaden the results of a 2010 study from Kaiser Permanente, which extended only to 2008 and focused exclusively on myocardial infarction and short-term outcomes.[23]

In our study of all patients in Medicare Fee-For-Service, which has the additional benefit of a comparison of trends in cardiovascular conditions and stroke with all other conditions, we

also found declines in the rates for all other conditions, suggesting that the hospitalizations averted for cardiovascular conditions and stroke were not displaced into other conditions. Moreover, our findings largely demonstrate consistency in the trends across demographic groups and regions. We do, nevertheless, note that some states have not improved and the differences we observe may represent opportunities for improvement.

We were limited to studying Medicare Fee-For-Service, the only national database that can provide information about rates of hospitalization and long-term outcomes. During the study period, Medicare Advantage enrollment was increasing. Based on previous studies, we would have expected that this movement would have left a higher risk group in Medicare Fee-For-Service, which in the absence of any secular changes should have been associated with an increase in rates of hospitalization. Thus, the bias should have been against finding reductions in rates of hospitalization or better outcomes. Moreover, our findings for myocardial infarction are consistent with the report from 4 communities in the Atherosclerosis Risk in Communities (ARIC) study, which used clinical data to evaluate events.[22] In addition, this study only examined hospitalizations and did not include observation stays. However, observation stays account for a very small percentage of all acute care and are unlikely to have substantively affected our results.[42] Finally, the use of administrative data precludes the consideration of some clinically relevant prognostic factors as well as the evaluation of the quality of care. Nevertheless, previous studies by our group have shown that the performance of administrative data-based models for heart failure and myocardial infarction is comparable to that of the medical chart abstract-based models. [16,17]

Our efforts in medicine should be measured against what is actually accomplished for patients. This study documents the deaths that were averted, the hospitalizations and events that

were avoided, and costs that were saved as a result of the improvements. The challenge ahead is to understand the key determinants of this result, continue the positive trends, and remove cardiovascular disease and stroke from among the top causes of disease and disability.

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Table 1. Rates of hospitalization* overall and by age-race-gender.

	Myocardial Infarction			Unstable Angina			Heart Failure			Ischemic Stroke		
	1999-2000	2005-2006	2010-2011	1999-2000	2005-2006	2010-2011	1999-2000	2005-2006	2010-2011	1999-2000	2005-2006	2010-2011
Overall												
Hospitalization	1295 (1292-1298)	1003 (1001-1006)	816 (813-818)	192 (191-194)	64 (63-64)	32 (32-33)	2474 (2470-2478)	2165 (2162-2169)	1782 (1778-1785)	1375 (1372-1378)	1061 (1058-1064)	931 (929-934)
Unique patient	1061 (1058-1064)	861 (859-863)	729 (726-731)	180 (179-181)	62 (61-62)	32 (32-33)	1853 (1850-1857)	1623 (1619-1626)	1360 (1357-1363)	1251 (1248-1254)	968 (966-971)	862 (859-864)
Age (yrs)												
65-74												
Hospitalization	969 (965-973)	706 (703-709)	574 (571-576)	167 (166-169)	57 (56-57)	27 (27-28)	1480 (1476-1485)	1211 (1207-1215)	916 (912-919)	936 (932-939)	708 (705-711)	604 (601-607)
Unique patient	771 (768-774)	599 (597-602)	511 (508-513)	157 (155-158)	55 (54-56)	27 (26-28)	1076 (1072-1080)	880 (876-883)	677 (674-680)	836 (833-840)	636 (633-639)	550 (547-553)
75-84												
Hospitalization	1535 (1529-1540)	1170 (1165-1175)	957 (952-961)	217 (214-219)	71 (70-72)	38 (37-39)	3032 (3024-3039)	2647 (2640-2654)	2200 (2193-2207)	1718 (1712-1724)	1318 (1313-1323)	1170 (1165-1175)
Unique patient	1255 (1250-1261)	997 (992-1001)	849 (845-854)	203 (201-205)	68 (67-70)	37 (37-38)	2268 (2261-2275)	1979 (1973-1985)	1675 (1669-1681)	1563 (1558-1569)	1202 (1198-1207)	1080 (1076-1085)
≥85												
Hospitalization	2015 (2005-2026)	1774 (1764-1783)	1446 (1438-1455)	232 (229-236)	74 (72-76)	41 (40-43)	5176 (5159-5193)	4798 (4782-4813)	4239 (4225-4254)	2293 (2282-2305)	1813 (1804-1823)	1677 (1668-1686)
Unique patient	1758 (1748-1768)	1571 (1562-1580)	1312 (1304-1320)	217 (213-221)	72 (70-74)	41 (39-42)	4027 (4012-4042)	3719 (3706-3733)	3327 (3314-3340)	2148 (2137-2159)	1699 (1689-1708)	1589 (1580-1598)
Race-gender												
Black female												
Hospitalization	1045 (1032-1057)	909 (898-921)	794 (784-805)	221 (216-227)	90 (87-94)	44 (41-47)	4013 (3989-4037)	3573 (3551-3594)	2912 (2892-2932)	1717 (1701-1733)	1352 (1338-1365)	1175 (1162-1188)
Unique patient	883 (871-894)	786 (776-796)	698 (688-708)	208 (203-214)	87 (84-91)	44 (41-46)	2811 (2791-2831)	2470 (2452-2489)	2047 (2030-2064)	1563 (1548-1578)	1235 (1222-1248)	1082 (1069-1094)
Black male												
Hospitalization	1163 (1146-1180)	1012 (998-1027)	860 (847-874)	181 (174-187)	73 (69-77)	37 (34-40)	3629 (3600-3659)	3518 (3491-3546)	2885 (2861-2910)	1624 (1605-1644)	1337 (1320-1354)	1182 (1166-1198)
Unique patient	977 (962-993)	870 (857-884)	761 (749-774)	170 (163-176)	70 (67-74)	37 (34-40)	2544 (2519-2569)	2384 (2361-2406)	1986 (1966-2007)	1477 (1458-1496)	1216 (1200-1233)	1083 (1068-1099)
White female												
Hospitalization	1115 (1111-1119)	869 (866-872)	702 (699-705)	184 (183-186)	62 (61-63)	32 (31-32)	2335 (2330-2341)	1982 (1977-1987)	1644 (1639-1649)	1294 (1290-1298)	990 (986-994)	892 (888-895)
Unique patient	921 (917-924)	749 (746-753)	631 (628-634)	173 (171-175)	60 (59-60)	31 (31-32)	1772 (1768-1777)	1517 (1513-1522)	1283 (1279-1287)	1187 (1183-1191)	912 (908-915)	832 (828-835)

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White male												
Hospitalization	1654 (1648-1659)	1232 (1228-1237)	998 (994-1002)	188 (186-190)	59 (58-60)	31 (30-32)	2430 (2423-2437)	2182 (2176-2188)	1802 (1797-1808)	1480 (1474-1485)	1140 (1135-1144)	980 (976-984)
Unique patient	1338 (1333-1343)	1053 (1048-1057)	891 (887-895)	177 (175-179)	57 (56-58)	31 (30-32)	1839 (1833-1846)	1646 (1641-1652)	1384 (1379-1389)	1331 (1326-1336)	1028 (1024-1033)	899 (895-903)
Other female												
Hospitalization	779 (766-793)	664 (653-676)	512 (502-522)	295 (286-303)	89 (85-94)	38 (36-41)	2057 (2036-2079)	1700 (1682-1719)	1307 (1292-1323)	944 (930-959)	717 (705-730)	600 (589-610)
Unique patient	652 (639-664)	567 (556-578)	453 (444-462)	264 (256-272)	85 (81-90)	37 (34.8-40.2)	1467 (1448-1485)	1242 (1226-1258)	978 (965-992)	867 (853-882)	664 (652-676)	560 (549-570)
Other male												
Hospitalization	1128 (1108-1147)	918 (903-934)	711 (698-724)	275 (266-285)	81 (76-86)	32 (29-35)	2051 (2025-2077)	1749 (1727-1771)	1318 (1300-1335)	1082 (1063-1101)	842 (827-857)	703 (690-716)
Unique patient	933 (915-951)	778 (764-793)	628 (616-640)	251 (242-260)	78 (74-83)	31 (29-34)	1447 (1425-1469)	1261 (1243-1280)	969 (954-985)	987 (969-1006)	767 (753-782)	647 (635-660)

*Rates are presented as per 100,000 person-years (95% CI)

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Table 2. Observed outcomes, 1999 to 2011.

	Myocardial Infarction			Unstable Angina			Heart Failure			Ischemic Stroke		
	1999-2000	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**
Total patients	564,879	496,010	405,531	95,999	35,479	17,859	986,670	934,733	756,715	666,085	557,822	479,465
Mortality % (95% CI)												
In-hospital	13.9 (13.8-14.0)	10.4 (10.3-10.5)	8.3 (8.18-8.35)	0.7 (0.60-0.71)	0.7 (0.60-0.78)	0.8 (0.66-0.93)	6.1 (6.07-6.17)	4.5 (4.51-4.59)	4.0 (3.94-4.03)	6.4 (6.31-6.43)	5.0 (4.95-5.06)	4.5 (4.40-4.52)
30-day	18.9 (18.8-19.0)	16.0 (15.9-16.1)	13.7 (13.6-13.8)	2.3 (2.22-2.41)	2.3 (2.15-2.46)	2.4 (2.19-2.65)	11.7 (11.6-11.7)	10.8 (10.7-10.8)	11.1 (11.0-11.2)	12.1 (12.0-12.2)	11.5 (11.4-11.6)	11.6 (11.5-11.7)
1-year	31.1 (31.0-31.2)	28.7 (28.6-28.9)	27.22 (27.1-27.3)	9.2 (9.06-9.43)	8.1 (7.86-8.43)	8.9 (8.5-9.1)	31.7 (31.6-31.8)	30.8 (30.7-30.9)	33.2 (33.0-33.5)	23.9 (23.8-24.0)	22.7 (22.6-22.8)	23.1 (22.9-23.4)
All-cause 30-day readmission % (95% CI)	21.5 (21.4-21.6)	20.8 (20.6-20.9)	18.7 (18.6-18.8)	17.8 (17.6-18.1)	15.9 (15.5-16.4)	13.7 (13.2-14.3)	20.2 (20.1-20.3)	20.7 (20.7-20.8)	20.0 (19.9-20.1)	12.5 (12.4-12.6)	13.1 (13.0-13.2)	12.3 (12.2-12.4)
Discharge disposition % (95% CI)												
Home	46.6 (46.5-46.8)	45.7 (45.6-45.9)	48.1 (48.0-48.3)	64.3 (64.0-64.6)	58.0 (57.5-58.5)	60.7 (60.0-61.4)	56.5 (56.4-56.6)	49.0 (48.9-49.1)	42.9 (42.8-43.1)	44.0 (43.9-44.2)	42.1 (42.0-42.2)	39.2 (39.1-39.3)
Home care	9.8 (9.72-9.88)	12.9 (12.8-13.0)	13.6 (13.5-13.7)	4.4 (4.30-4.56)	4.9 (4.65-5.10)	6.8 (6.47-7.21)	13.6 (13.5-13.6)	18.5 (18.4-18.6)	21.6 (21.5-21.7)	8.4 (8.32-8.45)	10.6 (10.5-10.7)	11.3 (11.2-11.4)
SNF/ICF	13.6 (13.5-13.7)	16.4 (16.3-16.5)	16.5 (16.4-16.6)	4.5 (4.35-4.61)	4.9 (4.73-5.18)	6.1 (5.75-6.46)	17.5 (17.4-17.5)	19.7 (19.7-19.8)	21.9 (21.8-22.0)	25.1 (25.0-25.2)	21.4 (21.3-21.5)	21.6 (21.5-21.8)
Hospice	0.1 (0.13-0.15)	2.0 (2.01-2.09)	3.0 (2.98-3.08)	0.0 (0.01-0.03)	0.2 (0.18-0.28)	0.4 (0.33-0.52)	0.2 (0.15-0.17)	2.2 (2.15-2.21)	3.9 (3.88-3.96)	0.2 (0.22-0.24)	2.7 (2.61-2.70)	4.5 (4.48-4.60)
Transferred*	12.1 (12.0-12.2)	8.0 (7.96-8.11)	6.0 (5.90-6.04)	24.1 (23.8-24.4)	28.6 (28.2-29.1)	22.1 (21.5-22.8)	3.1 (3.10-3.16)	2.5 (2.44-2.50)	1.9 (1.88-1.94)	2.2 (2.14-2.21)	1.3 (1.23-1.29)	1.2 (1.13-1.19)
Mean length of stay, days (SD)	6.5 (6.7)	6.1 (6.2)	5.4 (5.4)	3.1 (3.1)	2.6 (2.5)	2.5 (2.4)	5.8 (5.8)	5.5 (5.2)	5.2 (4.9)	5.5 (6.0)	4.8 (4.9)	4.4 (4.5)
Annual inflation-adjusted spending per hospitalization with Medicare Mean cost $(SD)	$13,950 ($16,190)	$15,935 ($16,103)	$14,732 ($15,564)	$4278 ($6020)	$4221 ($4870)	$4409 ($5668)	$7132 ($8989)	$8868 ($10,983)	$8766 ($11,376)	$7527 ($7834)	$8000 ($7101)	$8489 ($8078)

SNF/ICF: Skilled nursing facility/intermediate care facility
*To another acute-care hospital

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Figure Legends:

Figure 1. Adjusted changes in outcomes between 2011 and 1999 (2010 for 1-year mortality).

Figure 2. A. Maps of trends in observed rates (per 100,000 person-years) of hospitalization for myocardial infarction (top panel) and unstable angina (bottom panel) conditions (1999 to 2011) at the county level. In 1999, the myocardial infarction hospitalization rate varied from lowest counties (green, 0-534) to highest counties (red, 1607-1793) and the unstable angina hospitalization rate varied from lowest counties (green, 0-12) to highest counties (red, 795-1843). For Puerto Rico, the mean (SD) hospitalization rates for myocardial infarction declined from 9 (7.7) in 1999 to 5 (5.3) in 2011 and from 24 (1.4) in 1999 to 16 (8.0) in 2011 for unstable angina. **B.** Maps of trends in observed rates (per 100,000 person-years) of hospitalization for heart failure (top panel) and ischemic stroke (bottom panel) conditions (1999 to 2011) at the county level. In 1999, the heart failure hospitalization rate varied from lowest counties (green, 0-860) to highest counties (red, 2884-3259) and the unstable angina hospitalization rate varied from lowest counties (green, 0-682) to highest counties (red, 1830-2059). For Puerto Rico, the mean (SD) hospitalization rates declined for heart failure from 11 (6.2) in 1999 to 2 (1.2) in 2011 and from 11 (6.5) in 1999 to 2 (2.8) in 2011 for ischemic stroke.

Figure 3. Maps of current observed rates (per 100,000 person-years) of hospitalization for myocardial infarction, unstable angina, heart failure, and ischemic stroke (2011) at the county level.

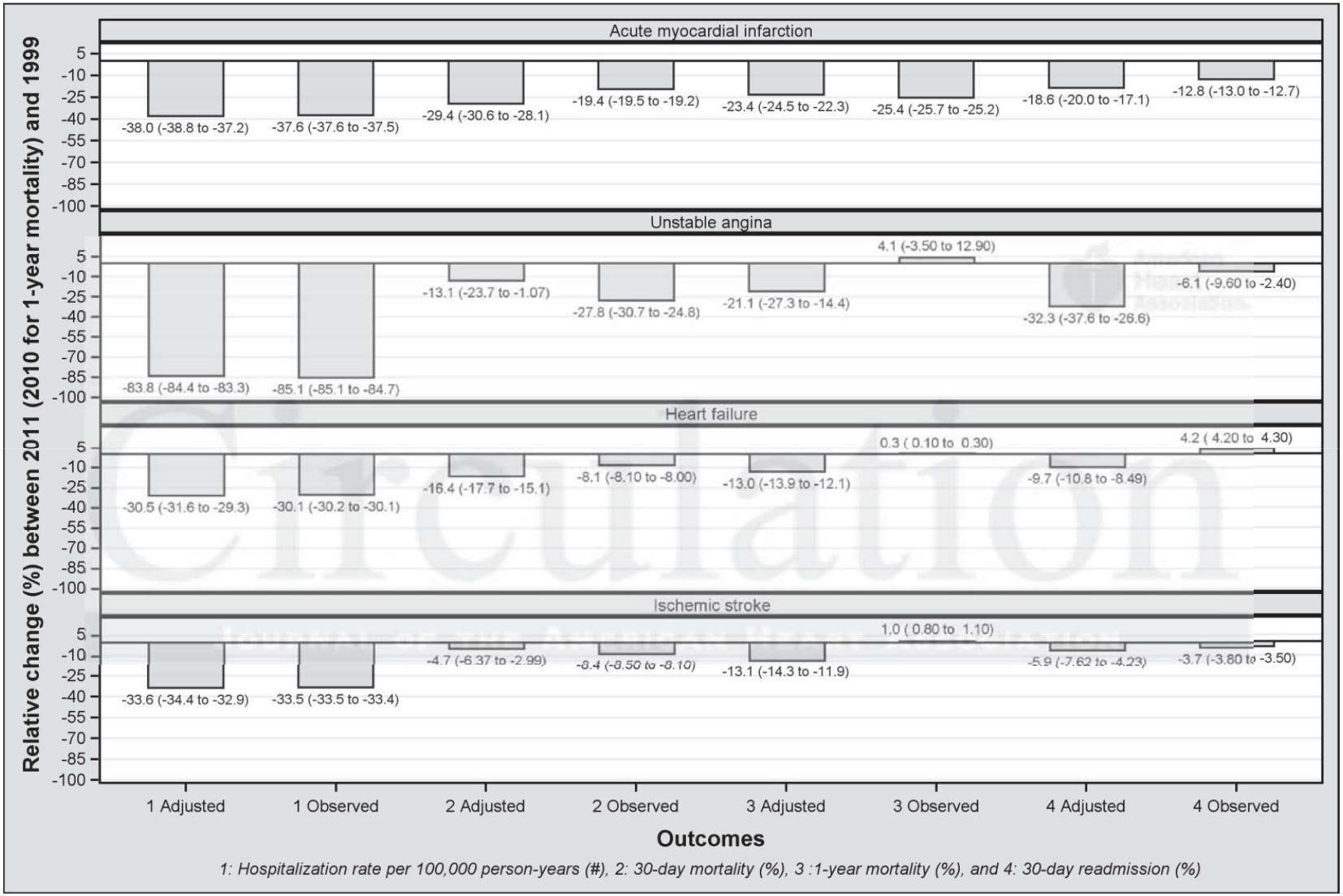


Figure 1

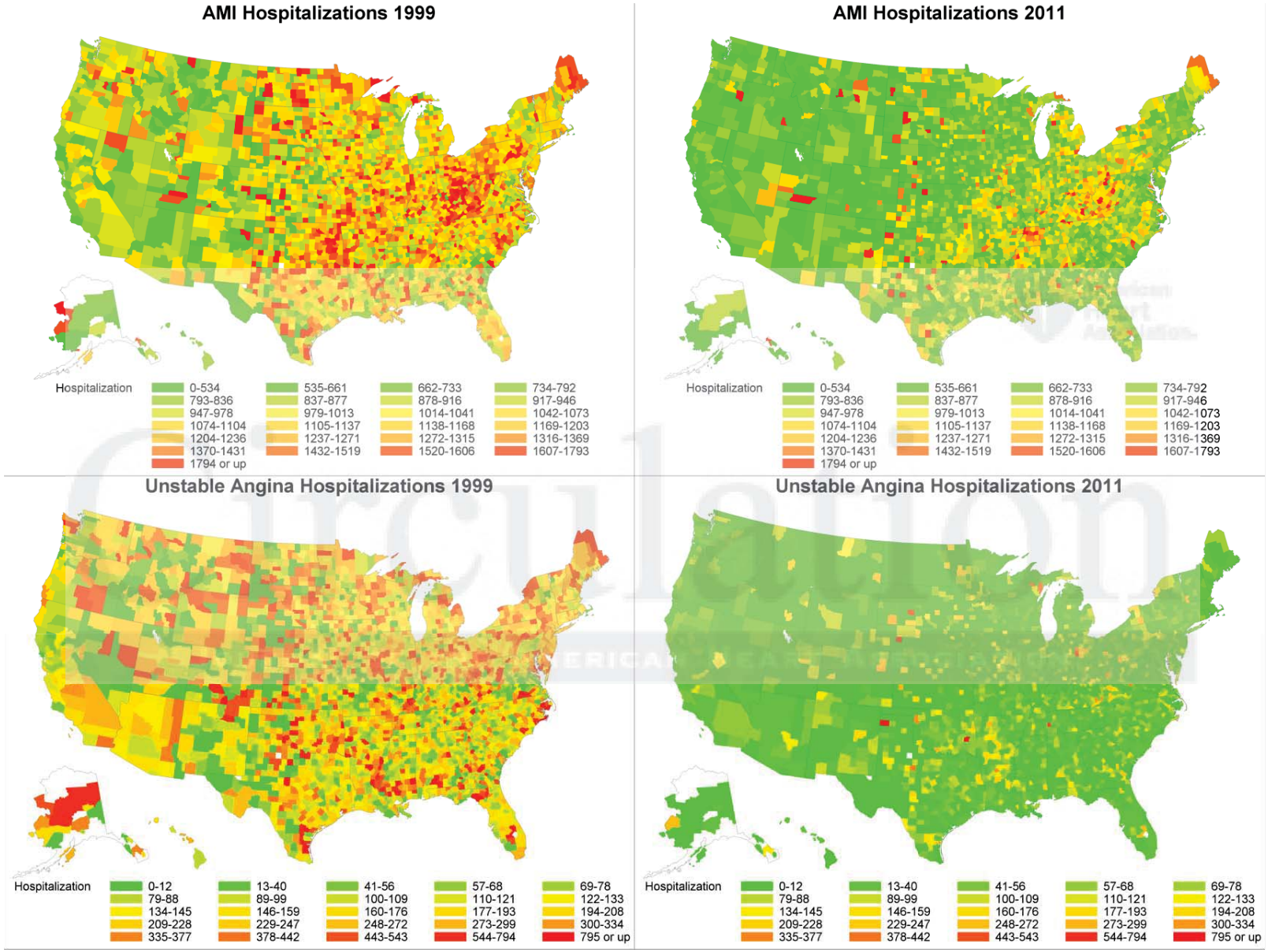


Figure 2A

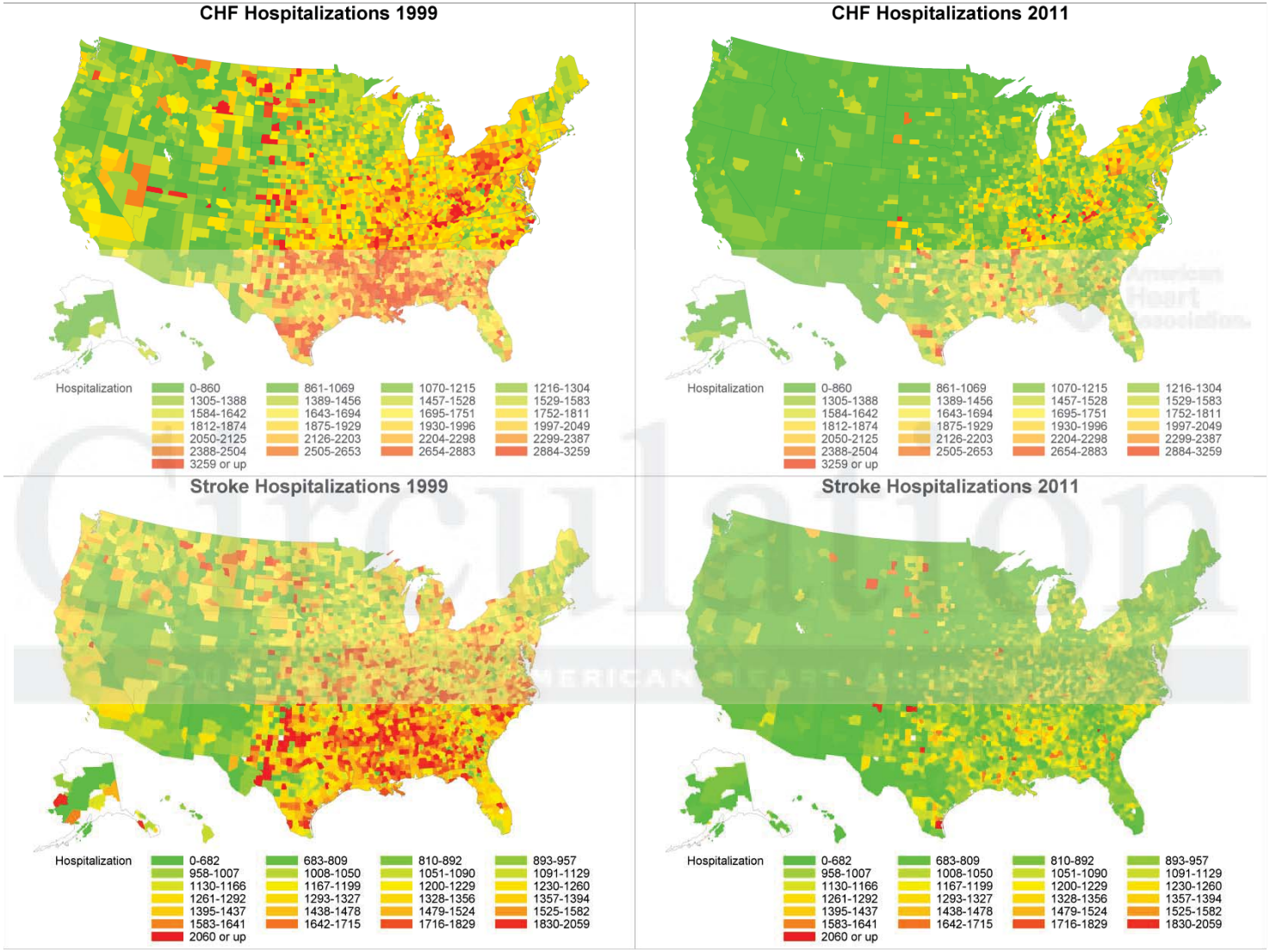


Figure 2B

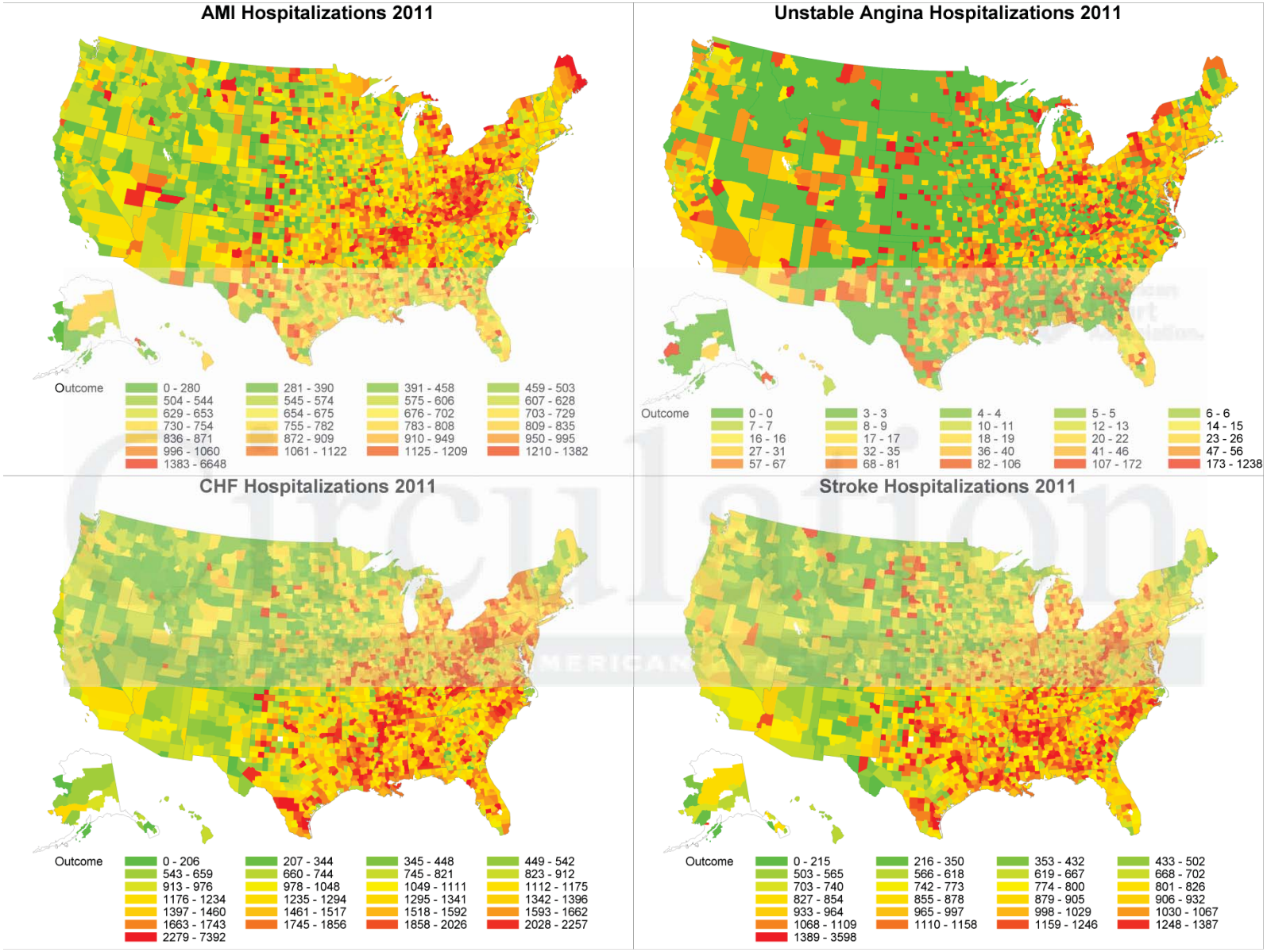


Figure 3

SUPPLEMENTAL MATERIAL

Table S1. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes.

Table S2. Patient characteristics.

Table S3. Observed trends in outcomes by subgroup: age-race-gender.

Table S4. Trends in discharge status and Medicare payment ($) by subgroup: age-race-gender.

Table S5. Adjusted annual change in outcomes by condition: overall and subgroups.

Figure S1A. Observed trends in rates of hospitalization by conditions, 1999 to 2011. The numbers around each trend line represent the observed hospitalization rates for each year.

Figure S1B. Adjusted annual changes in rates of hospitalization by conditions and subgroups, 1999 to 2011.

Figure S2. Adjusted annual changes in rates of mortality and readmission by condition (1-year mortality restricted to 2010).

Figure S3. Estimated between-state (for rates of hospitalization) and between-hospital (for rates of mortality and readmission) variation.

Table S1. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes.

Condition	Principal discharge code
Acute myocardial infarction	410.xx, except 410.x2
Unstable angina	411.xx
Heart failure	402.01, 402.11, 402.91, 404.01, 404.11, 404.91, 428, 404.03, 404.13, 404.93, and 428.xx
Ischemic stroke	433.xx, 434.xx, and 436.xx
All others	Any ICD-9-CM codes except codes listed above

Table S2. Patient characteristics.

	Myocardial infarction			Unstable angina			Heart failure			Ischemic stroke		
	1999-2000	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**
Total patients	564,879	496,010	405,531	95,999	35,479	17,859	986,670	934,733	756,715	666,085	557,822	479,465
Characteristics												
Age (yrs), mean (SD)	78.5 (7.7)	78.8 (8.2)	78.7 (8.6)	77.1 (7.3)	76.8 (7.6)	77.2 (8.0)	80.0 (7.9)	80.2 (8.3)	80.8 (8.7)	78.9 (7.5)	79.0 (7.8)	79.3 (8.2)
Female, # (%)	285,740 (50.6)	247,131 (49.8)	196,416 (48.4)	57,077 (59.5)	21,070 (59.4)	10,295 (57.6)	582,339 (59.0)	526,729 (56.4)	417,474 (55.2)	379,860 (57.0)	308,071 (55.2)	262,517 (54.8)
White, # (%)	504,646 (89.3)	435,518 (87.8)	353,227 (87.1)	80,691 (84.1)	28,966 (81.6)	14,749 (82.6)	832,655 (84.4)	780,349 (83.5)	629,930 (83.2)	576,227 (86.5)	476,806 (85.5)	408,528 (85.2)
Black, # (%)	37,949 (6.7)	37,247 (7.5)	32,170 (7.9)	8031 (8.4)	3670 (10.3)	1816 (10.2)	111,968 (11.3)	110,965 (11.9)	89,916 (11.9)	63,251 (9.5)	55,893 (10.0)	48,101 (10.0)
Other, # (%)	22,284 (3.9)	23,245 (4.7)	20,134 (5.0)	7277 (7.6)	2843 (8.0)	1294 (7.2)	42,047 (4.3)	43,419 (4.6)	36,869 (4.9)	26,607 (4.0)	25,123 (4.5)	22,836 (4.8)
History of heart failure, # (%)	93,942 (16.6)	84,747 (17.1)	66,907 (16.5)	15,747 (16.4)	5127 (14.5)	2631 (14.7)	432,459 (43.8)	438,880 (47.0)	362,319 (47.9)	78,616 (11.8)	69,882 (12.5)	56,026 (11.7)
History of MI, # (%)	41,660 (7.4)	34,833 (7.0)	29,874 (7.4)	6669 (6.9)	2059 (5.8)	1124 (6.3)	82,083 (8.3)	78,791 (8.4)	64,363 (8.5)	16,907 (2.5)	14,110 (2.5)	12,145 (2.5)

Unstable angina, # (%)	35,828 (6.3)	20,599 (4.2)	13,582 (3.3)	12,727 (13.3)	2951 (8.3)	1193 (6.7)	76,046 (7.7)	47,671 (5.1)	28,310 (3.7)	21,637 (3.2)	12,183 (2.2)	6918 (1.4)
Chronic atherosclerosis, # (%)	376,578 (66.7)	352,332 (71.0)	297,496 (73.4)	47,473 (49.5)	15,617 (44.0)	8865 (49.6)	578,794 (58.7)	568,759 (60.8)	432,881 (57.2)	229,834 (34.5)	205,661 (36.9)	166,746 (34.8)
Cardiopulmonary respiratory disease, # (%)	16,006 (2.8)	17,618 (3.6)	23,034 (5.7)	2250 (2.3)	914 (2.6)	755 (4.2)	67,482 (6.8)	81,705 (8.7)	111,978 (14.8)	11,711 (1.8)	12,993 (2.3)	17,890 (3.7)
Hypertension, # (%)	299,337 (53.0)	291,812 (58.8)	273,798 (67.5)	58,790 (61.2)	25,606 (72.2)	13,927 (78.0)	534,601 (54.2)	565,206 (60.5)	533,514 (70.5)	435,740 (65.4)	408,468 (73.2)	373,236 (77.8)
Cerebrovascular disease, # (%)	31,595 (5.6)	22,851 (4.6)	17,601 (4.3)	5380 (5.6)	1545 (4.4)	785 (4.4)	70,598 (7.2)	53,642 (5.7)	41,250 (5.5)	89,931 (13.5)	72,583 (13.0)	59,851 (12.5)
Renal failure, # (%)	26,484 (4.7)	45,577 (9.2)	60,416 (14.9)	3444 (3.6)	2195 (6.2)	2198 (12.3)	109,196 (11.1)	200,666 (21.5)	256,462 (33.9)	21,209 (3.2)	36,564 (6.6)	52,684 (11.0)
COPD, # (%)	127,537 (22.6)	125,429 (25.3)	85,314 (21.0)	17,891 (18.6)	7090 (20.0)	3618 (20.3)	344,698 (34.9)	370,158 (39.6)	271,517 (35.9)	109,730 (16.5)	105,114 (18.8)	76,970 (16.1)
Pneumonia, # (%)	70,880 (12.5)	74,509 (15.0)	64,827 (16.0)	6257 (6.5)	2404 (6.8)	1413 (7.9)	184,236 (18.7)	219,761 (23.5)	226,293 (29.9)	51,602 (7.7)	45,403 (8.1)	40,639 (8.5)
Protein calorie malnutrition, # (%)	13,207 (2.3)	15,408 (3.1)	21,091 (5.2)	859 (0.9)	430 (1.2)	431 (2.4)	37,382 (3.8)	43,153 (4.6)	63,151 (8.3)	18,629 (2.8)	17,030 (3.1)	23,569 (4.9)
Dementia, # (%)	48,419 (8.6)	51,754 (10.4)	45,218 (11.2)	4427 (4.6)	2296 (6.5)	1442 (8.1)	103,076 (10.4)	114,136 (12.2)	101,187 (13.4)	87,351 (13.1)	83,123 (14.9)	76,494 (16.0)
Functional disability, #	15,215	11,740	10,998	2014	649	388	36,932	29,306	28,834	33,173	24,222	23,675

(%)	(2.7)	(2.4)	(2.7)	(2.1)	(1.8)	(2.2)	(3.7)	(3.1)	(3.8)	(5.0)	(4.3)	(4.9)
Peripheral vascular	36,873	36,284	28,839	5784	2203	1125	105,349	112,318	87,695	42,801	40,415	31,435
disease, # (%)	(6.5)	(7.3)	(7.1)	(6.0)	(6.2)	(6.3)	(10.7)	(12.0)	(11.6)	(6.4)	(7.2)	(6.6)
Metastatic cancer, # (%)	34,341	32,865	26,683	4989	1839	1027	84,287	78,770	63,945	42,835	37,084	31,571
	(6.1)	(6.6)	(6.6)	(5.2)	(5.2)	(5.8)	(8.5)	(8.4)	(8.5)	(6.4)	(6.6)	(6.6)
Trauma, past year, # (%)	28,098	31,284	24,292	3280	1523	791	70,573	82,899	68,258	42,821	39,694	32,197
	(5.0)	(6.3)	(6.0)	(3.4)	(4.3)	(4.4)	(7.2)	(8.9)	(9.0)	(6.4)	(7.1)	(6.7)
Major psychiatric disorder,	10,165	8543	8721	1623	653	453	25,470	21,518	21,817	15,034	12,223	12,100
# (%)	(1.8)	(1.7)	(2.2)	(1.7)	(1.8)	(2.5)	(2.6)	(2.3)	(2.9)	(2.3)	(2.2)	(2.5)
Chronic liver disease, #	2968	3368	3044	404	249	113	12,193	13,613	12,662	3351	3176	2979
(%)	(0.5)	(0.7)	(0.8)	(0.4)	(0.7)	(0.6)	(1.2)	(1.5)	(1.7)	(0.5)	(0.6)	(0.6)
Depression, # (%)	23,616	26,670	23,294	5177	2522	1477	69,270	76,848	57,612	37,181	40,254	35,425
	(4.2)	(5.4)	(5.7)	(5.4)	(7.1)	(8.3)	(7.0)	(8.2)	(7.6)	(5.6)	(7.2)	(7.4)
Diabetes, # (%)	172,118	156,973	134,804	27,377	11,480	6419	373,170	380,355	307,576	191,185	170,297	153,015
	(30.5)	(31.6)	(33.2)	(28.5)	(32.4)	(35.9)	(37.8)	(40.7)	(40.6)	(28.7)	(30.5)	(31.9)
One or more comorbidity,	526,353	472,161	390,961	84,424	32,407	16,856	931,642	898,801	733,242	599,477	521,006	451,656
# (%)	(93.2)	(95.2)	(96.4)	(87.9)	(91.3)	(94.4)	(94.4)	(96.2)	(96.9)	(90.2)	(93.4)	(94.2)

COPD, chronic obstructive pulmonary disease; MI, myocardial infarction; SD, standard deviation

Table S3. Observed trends in outcome by subgroup: age-race-gender.

	Myocardial infarction			Unstable angina			Heart failure			Ischemic stroke		
	1999-2000	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**
Age (yrs)												
65-74												
30-day	12.3	9.4	8.0	1.5	1.4	1.2	8.0	6.7	6.8	6.7	5.8	5.4
mortality	(12.1-12.4)	(9.28-9.56)	(7.89-8.17)	(1.38-1.62)	(1.18-1.56)	(1.00-1.51)	(7.88-8.09)	(6.64-6.84)	(6.66-6.88)	(6.59-6.80)	(5.68-5.90)	(5.32-5.54)
1-year	20.2	17.5	16.6	5.8	5.2	5.8	23.9	22.4	23.7	13.9	12.8	12.5
mortality	(20.0-20.4)	(17.3-17.7)	(16.3-16.9)	(5.56-6.03)	(4.85-5.56)	(5.13-6.60)	(23.7-24.0)	(22.2-22.6)	(23.4-23.9)	(13.7-14.0)	(12.7-13.0)	(12.3-12.8)
30-day	20.0	19.3	17.1	17.4	14.9	13.3	20.8	21.7	21.5	11.7	12.2	11.5
readmission	(19.8-20.2)	(19.1-19.6)	(16.9-17.3)	(16.9-17.8)	(14.2-15.6)	(12.4-14.2)	(20.7-21.0)	(21.6-21.9)	(21.3-21.7)	(11.5-11.8)	(12.0-12.3)	(11.3-11.6)
In-hospital	9.4	6.7	5.5	0.4	0.4	0.5	4.4	3.0	2.7	4.2	3.1	2.8
mortality	(9.26-9.52)	(6.55-6.79)	(5.33-5.57)	(0.38-0.52)	(0.31-0.52)	(0.33-0.66)	(4.32-4.47)	(2.97-3.10)	(2.61-2.76)	(4.16-4.33)	(3.01-3.18)	(2.67-2.84)
75-84												
30-day	18.4	15.1	12.6	2.4	2.3	2.3	10.7	9.6	9.8	10.5	9.6	9.3
mortality	(18.2-18.6)	(15.0-15.3)	(12.5-12.8)	(2.23-2.53)	(2.07-2.58)	(1.98-2.72)	(10.6-10.8)	(9.47-9.66)	(9.66-9.88)	(10.4-10.7)	(9.46-9.70)	(9.17-9.44)
1-year	30.6	27.3	25.1	9.4	8.1	7.7	29.8	27.9	29.9	21.6	19.8	19.5
mortality	(30.4-30.8)	(27.1-27.5)	(24.8-25.4)	(9.09-9.66)	(7.62-8.53)	(6.81-8.59)	(29.7-30.0)	(27.7-28.0)	(29.7-30.2)	(21.4-21.7)	(19.6-19.9)	(19.3-19.8)
30-day	22.3	21.4	19.2	18.0	16.5	13.2	20.5	20.8	20.3	12.6	13.1	12.4
readmission	(22.1-22.5)	(21.2-21.6)	(19.0-19.4)	(17.5-18.4)	(15.8-17.3)	(12.2-14.1)	(20.4-20.6)	(20.7-21.0)	(20.1-20.4)	(12.5-12.7)	(13.0-13.3)	(12.3-12.6)
In-hospital	13.7	10.3	8.1	0.7	0.6	0.7	5.7	4.2	3.7	5.8	4.5	4.0
mortality	(13.6-13.9)	(10.2-10.4)	(7.95-8.23)	(0.60-0.76)	(0.47-0.73)	(0.51-0.92)	(5.65-5.79)	(4.16-4.29)	(3.66-3.80)	(5.73-5.90)	(4.45-4.62)	(3.93-4.11)
≥85												
30-day	29.6	25.7	22.5	4.1	4.6	5.0	16.3	15.6	15.4	21.8	21.4	21.3

mortality	(29.4-29.9)	(25.5-26.0)	(22.2-22.7)	(3.82-4.42)	(4.06-5.11)	(4.34-5.80)	(16.2-16.5)	(15.5-15.7)	(15.3-15.6)	(21.6-22.0)	(21.2-21.7)	(21.1-21.5)
1-year	48.0	45.3	43.4	17.0	15.5	18.3	41.4	41.1	43.1	40.8	39.3	39.7
mortality	(47.7-48.3)	(45.0-45.6)	(43.0-43.8)	(16.5-17.6)	(14.6-16.4)	(16.6-20.1)	(41.2-41.5)	(40.9-41.3)	(42.8-43.4)	(40.5-41.0)	(39.1-39.6)	(39.3-40.1)
30-day	22.2	21.7	20.2	18.5	16.7	15.5	19.1	19.8	18.8	13.4	14.1	13.2
readmission	(21.9-22.4)	(21.5-22.0)	(20.0-20.5)	(17.8-19.1)	(15.7-17.8)	(14.2-16.8)	(19.0-19.3)	(19.6-19.9)	(18.6-18.9)	(13.2-13.6)	(13.9-14.3)	(13.0-13.4)
In-hospital	20.7	15.2	12.1	1.1	1.6	1.6	8.2	6.2	5.1	10.1	8.1	6.9
mortality	(20.5-21.0)	(15.0-15.4)	(11.9-12.3)	(0.93-1.24)	(1.29-1.93)	(1.24-2.10)	(8.14-8.33)	(6.11-6.28)	(5.06-5.23)	(9.94-10.2)	(7.93-8.21)	(6.78-7.05)
Race-gender												
Black female												
30-day	20.0	16.2	13.6	1.3	1.3	1.4	8.0	7.4	7.0	11.3	10.7	10.1
mortality	(19.5-20.6)	(15.7-16.7)	(13.1-14.1)	(1.05-1.68)	(0.87-1.81)	(0.79-2.23)	(7.77-8.16)	(7.19-7.58)	(6.79-7.22)	(11.0-11.7)	(10.4-11.0)	(9.77-10.5)
1-year	35.1	32.3	30.2	7.6	6.2	6.7	25.8	25.1	26.9	26.5	25.8	25.0
mortality	(34.5-35.7)	(31.7-32.9)	(29.3-31.2)	(6.92-8.35)	(5.26-7.21)	(4.87-8.89)	(25.5-26.1)	(24.8-25.5)	(26.4-27.5)	(26.0-26.9)	(25.4-26.3)	(24.3-25.7)
30-day	24.4	25.0	23.6	15.4	15.6	12.9	20.5	22.1	22.1	16.4	17.7	16.4
readmission	(23.7-25.0)	(24.4-25.7)	(22.9-24.2)	(14.4-16.4)	(14.0-17.2)	(10.9-15.2)	(20.2-20.8)	(21.8-22.4)	(21.7-22.5)	(16.0-16.8)	(17.3-18.1)	(16.0-16.9)
In-hospital	15.3	10.9	8.4	0.5	0.5	0.5	4.5	3.5	2.7	7.0	5.5	4.4
mortality	(14.8-15.8)	(10.5-11.3)	(8.01-8.82)	(0.35-0.75)	(0.23-0.81)	(0.19-1.12)	(4.33-4.63)	(3.33-3.60)	(2.59-2.87)	(6.76-7.26)	(5.31-5.80)	(4.20-4.68)
Black male												
30-day	17.3	15.0	12.1	2.4	2.4	2.4	8.5	7.5	7.2	11.7	9.5	8.6
mortality	(16.7-17.9)	(14.5-15.6)	(11.5-12.6)	(1.84-3.04)	(1.63-3.43)	(1.40-3.94)	(8.18-8.73)	(7.30-7.80)	(6.98-7.52)	(11.3-12.1)	(9.08-9.87)	(8.19-8.98)
1-year	31.8	29.8	27.6	10.1	9.9	12.1	27.9	26.4	27.2	27.1	23.3	22.4
mortality	(31.1-32.6)	(29.1-30.5)	(26.5-28.7)	(8.94-11.3)	(8.29-11.7)	(8.93-16.0)	(27.5-28.4)	(26.0-26.8)	(26.6-27.9)	(26.5-27.7)	(22.7-23.9)	(21.6-23.3)
30-day	22.2	23.0	21.4	18.0	17.6	17.2	20.7	22.4	21.7	17.1	17.1	16.1
readmission	(21.5-23.0)	(22.3-23.8)	(20.6-22.1)	(16.4-19.7)	(15.2-20.1)	(14.1-20.7)	(20.3-21.1)	(22.0-22.8)	(21.3-22.2)	(16.6-17.7)	(16.6-17.7)	(15.6-16.7)
In-hospital	12.9	10.1	7.5	0.6	0.8	1.2	4.6	3.5	2.8	7.1	4.9	4.1

mortality	(12.4-13.5)	(9.60-10.6)	(7.08-7.98)	(0.35-0.98)	(0.39-1.47)	(0.53-2.39)	(4.43-4.84)	(3.29-3.64)	(2.59-2.93)	(6.78-7.45)	(4.65-5.23)	(3.80-4.37)
White female												
30-day	20.3	17.3	14.9	2.2	2.3	2.4	11.6	11.1	11.5	13.6	13.5	13.9
mortality	(20.1-20.5)	(17.2-17.5)	(14.8-15.1)	(2.07-2.33)	(2.09-2.54)	(2.06-2.72)	(11.5-11.7)	(11.1-11.2)	(11.4-11.6)	(13.5-13.7)	(13.4-13.7)	(13.8-14.1)
1-year	32.8	30.5	28.9	8.9	7.7	8.9	31.2	31.1	33.3	25.5	25.0	25.9
mortality	(32.7-33.0)	(30.3-30.7)	(28.6-29.2)	(8.62-9.13)	(7.31-8.12)	(8.08-9.79)	(31.1-31.3)	(31.0-31.3)	(33.1-33.5)	(25.4-25.7)	(24.9-25.2)	(25.7-26.2)
30-day	22.1	21.3	19.3	16.9	14.5	12.4	19.7	20.4	19.5	11.8	12.4	11.8
readmission	(21.9-22.3)	(21.1-21.5)	(19.1-19.5)	(16.5-17.3)	(13.9-15.1)	(11.6-13.2)	(19.6-19.9)	(20.3-20.5)	(19.3-19.6)	(11.7-11.9)	(12.3-12.6)	(11.7-12.0)
In-hospital	14.8	10.9	8.7	0.6	0.6	0.8	6.1	4.6	4.0	6.7	5.5	4.9
mortality	(14.6-14.9)	(10.8-11.1)	(8.54-8.81)	(0.54-0.69)	(0.53-0.78)	(0.64-1.04)	(6.00-6.13)	(4.52-4.65)	(3.92-4.05)	(6.64-6.81)	(5.42-5.59)	(4.86-5.04)
White male												
30-day	17.6	14.9	12.8	2.7	2.6	2.8	13.1	11.6	12.3	10.4	9.5	9.4
mortality	(17.4-17.7)	(14.8-15.1)	(12.7-13.0)	(2.56-2.91)	(2.29-2.86)	(2.36-3.18)	(13.0-13.2)	(11.5-11.8)	(12.1-12.4)	(10.3-10.6)	(9.37-9.62)	(9.30-9.56)
1-year	29.0	26.8	25.4	10.3	9.0	9.4	34.5	32.4	35.5	21.1	19.5	19.7
mortality	(28.8-29.2)	(26.6-27.0)	(25.1-25.7)	(9.96-10.6)	(8.48-9.52)	(8.46-10.5)	(34.4-34.7)	(32.2-32.5)	(35.3-35.8)	(21.0-21.3)	(19.3-19.7)	(19.5-20.0)
30-day	20.4	19.6	17.3	20.2	18.1	15.3	20.5	20.5	19.9	12.2	12.5	11.7
readmission	(20.2-20.6)	(19.4-19.8)	(17.1-17.5)	(19.7-20.7)	(17.2-18.9)	(14.3-16.4)	(20.3-20.6)	(20.4-20.7)	(19.8-20.1)	(12.0-12.3)	(12.3-12.6)	(11.5-11.8)
In-hospital	12.9	9.7	7.9	0.7	0.8	0.8	6.8	4.9	4.4	5.7	4.3	3.9
mortality	(12.7-13.0)	(9.60-9.85)	(7.73-7.98)	(0.65-0.83)	(0.65-0.98)	(0.58-1.03)	(6.71-6.88)	(4.82-4.97)	(4.37-4.52)	(5.62-5.80)	(4.20-4.37)	(3.79-3.96)
Other female												
30-day	19.4	15.3	14.0	1.6	1.8	1.8	8.8	8.6	8.3	11.9	11.0	12.5
mortality	(18.7-20.2)	(14.7-16.0)	(13.3-14.7)	(1.29-2.06)	(1.20-2.52)	(0.98-2.99)	(8.45-9.16)	(8.30-9.00)	(7.96-8.71)	(11.3-12.4)	(10.5-11.6)	(11.9-13.1)
1-year	31.8	29.0	28.4	7.2	6.7	7.9	26.6	26.9	27.9	23.8	22.8	24.9
mortality	(30.9-32.7)	(28.2-29.8)	(27.2-29.8)	(6.50-8.05)	(5.60-8.05)	(5.51-10.9)	(26.1-27.2)	(26.3-27.4)	(27.0-28.8)	(23.1-24.5)	(22.1-23.5)	(23.8-26.1)

30-day	23.1	22.8	22.0	15.2	13.8	13.9	21.5	21.9	21.1	14.2	15.0	14.3
readmission	(22.2-24.1)	(22.0-23.7)	(21.1-23.0)	(14.1-16.4)	(12.0-15.7)	(11.4-16.8)	(21.0-22.1)	(21.3-22.4)	(20.5-21.7)	(13.6-14.8)	(14.4-15.6)	(13.7-15.0)
In-hospital	15.5	11.0	9.2	0.5	0.5	0.4	5.1	4.2	3.2	6.8	5.5	5.6
mortality	(14.8-16.1)	(10.4-11.6)	(8.59-9.75)	(0.30-0.73)	(0.20-0.93)	(0.08-1.12)	(4.87-5.42)	(3.93-4.44)	(3.01-3.50)	(6.37-7.18)	(5.14-5.92)	(5.22-6.05)
Other male												
30-day	17.5	14.9	12.7	2.2	2.3	2.1	10.2	8.8	9.0	10.4	8.7	8.3
mortality	(16.8-18.2)	(14.3-15.6)	(12.1-13.3)	(1.74-2.86)	(1.55-3.39)	(1.08-3.81)	(9.78-10.7)	(8.44-9.26)	(8.52-9.40)	(9.81-10.9)	(8.24-9.28)	(7.75-8.79)
1-year	29.4	26.3	26.1	8.6	9.9	8.1	29.8	28.0	29.8	21.8	19.2	19.4
mortality	(28.6-30.3)	(25.5-27.1)	(24.9-27.3)	(7.62-9.70)	(8.23-11.8)	(5.12-12.0)	(29.1-30.5)	(27.4-28.7)	(28.8-30.8)	(21.0-22.5)	(18.5-20.0)	(18.4-20.5)
30-day	22.0	20.6	19.2	17.4	18.2	14.1	21.8	21.8	21.7	14.4	14.7	13.9
readmission	(21.1-22.9)	(19.8-21.4)	(18.4-20.1)	(16.0-19.0)	(15.7-20.8)	(10.8-17.9)	(21.1-22.5)	(21.2-22.5)	(21.0-22.3)	(13.8-15.1)	(14.0-15.4)	(13.2-14.5)
In-hospital	13.8	10.7	9.0	0.9	0.8	1.0	5.9	4.3	3.8	6.5	5.0	4.1
mortality	(13.2-14.5)	(10.1-11.2)	(8.41-9.51)	(0.56-1.27)	(0.36-1.48)	(0.32-2.26)	(5.55-6.27)	(3.98-4.57)	(3.56-4.16)	(6.05-6.95)	(4.60-5.40)	(3.74-4.50)

Rates of outcomes are presented as % (95% CI)

Table S4. Trends in discharge status and Medicare payment ($) by subgroup: age-race-gender.

	Myocardial infarction			Unstable angina			Heart failure			Ischemic stroke		
	1999-2000	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**	**1999-2000**	**2005-2006**	**2010-2011**
Age (yrs)												
65-74												
Total	194,048	167,353	146,340	39,479	15,206	7595	268,840	250,857	199,332	206,860	173,743	152,746
Home	57.8 (57.6-58.0)	60.6 (60.4-60.9)	63.0 (62.8-63.2)	63.9 (63.4-64.4)	58.7 (57.9-59.5)	63.8 (62.7-64.9)	68.9 (68.8-69.1)	63.6 (63.4-63.8)	57.3 (57.1-57.6)	59.3 (59.0-59.5)	57.6 (57.4-57.8)	54.7 (54.5-55.0)
Home care	7.7 (7.62-7.86)	10.8 (10.6-10.9)	11.3 (11.1-11.5)	2.3 (2.16-2.46)	3.1 (2.81-3.36)	4.2 (3.76-4.68)	11.0 (10.9-11.1)	15.2 (15.1-15.4)	19.0 (18.8-19.2)	7.1 (7.00-7.22)	9.2 (9.08-9.35)	10.0 (9.89-10.2)
ICF/SNF	5.8 (5.71-5.92)	7.2 (7.04-7.29)	7.8 (7.67-7.95)	1.7 (1.62-1.88)	2.1 (1.88-2.34)	3.0 (2.59-3.37)	8.4 (8.33-8.54)	10.4 (10.3-10.5)	12.7 (12.6-12.9)	13.5 (13.4-13.7)	11.3 (11.2-11.5)	11.9 (11.7-12.1)
Hospice	0.1 (0.05-0.07)	0.8 (0.78-0.87)	1.1 (1.05-1.16)	0.0 (0.00-0.02)	0.1 (0.06-0.17)	0.1 (0.05-0.22)	0.1 (0.10-0.12)	1.1 (1.08-1.16)	1.8 (1.74-1.86)	0.1 (0.09-0.12)	1.0 (0.97-1.07)	1.6 (1.51-1.64)
Transferred	16.1 (15.9-16.3)	9.9 (9.78-10.1)	7.1 (6.99-7.25)	29.6 (29.2-30.1)	33.0 (32.3-33.8)	25.3 (24.3-26.3)	4.5 (4.41-4.57)	3.4 (3.34-3.48)	2.8 (2.69-2.84)	2.4 (2.35-2.48)	1.5 (1.44-1.56)	1.4 (1.37-1.49)
LOS	6.3 (6.9)	5.9 (6.6)	5.3 (5.9)	2.8 (2.8)	2.4 (2.3)	2.3 (2.3)	5.8 (6.4)	5.4 (5.9)	5.4 (5.7)	5.0 (6.0)	4.3 (5.1)	4.1 (4.7)
Medicare payment ($)	15,786 (18,371)	18,352 (18,027)	16,746 (17,681)	4585 (6303)	4449 (5350)	4783 (6435)	7682 (10,754)	10,434 (14,186)	10,472 (16,485)	7924 (8750)	8201 (8068)	8681 (9200)
75-84												
Total	238,276	197,445	145,448	39,715	14,029	6649	419,251	377,145	273,057	296,510	239,598	186,956
Home	45.7	45.1	48.0	64.5	57.6	60.2	58.2	51.2	45.8	44.5	43.6	41.4

	(45.5-45.9)	(44.9-45.3)	(47.8-48.3)	(64.0-65.0)	(56.8-58.4)	(59.0-61.4)	(58.1-58.4)	(51.1-51.4)	(45.6-46.0)	(44.3-44.7)	(43.4-43.8)	(41.2-41.7)
Home care	10.4	13.4	14.1	4.5	4.9	6.7	14.1	18.9	22.1	8.9	11.1	11.8
	(10.3-10.6)	(13.3-13.6)	(13.9-14.3)	(4.31-4.72)	(4.57-5.29)	(6.10-7.32)	(14.0-14.2)	(18.8-19.1)	(22.0-22.3)	(8.78-8.99)	(11.0-11.2)	(11.7-11.9)
ICF/SNF	12.9	15.5	15.4	4.1	4.7	5.2	15.4	17.3	19.1	24.0	19.6	19.6
	(12.8-13.1)	(15.4-15.7)	(15.3-15.6)	(3.90-4.29)	(4.37-5.08)	(4.68-5.77)	(15.3-15.5)	(17.2-17.4)	(19.0-19.2)	(23.8-24.1)	(19.5-19.8)	(19.4-19.8)
Hospice	0.1	1.7	2.5	0.0	0.2	0.3	0.1	1.9	3.3	0.2	2.1	3.3
	(0.11-0.14)	(1.66-1.77)	(2.40-2.56)	(0.01-0.04)	(0.12-0.27)	(0.18-0.46)	(0.14-0.16)	(1.84-1.92)	(3.21-3.34)	(0.18-0.21)	(2.02-2.13)	(3.26-3.42)
Transferred	12.9	9.0	6.8	24.3	29.4	24.0	3.4	2.8	2.2	2.2	1.3	1.2
	(12.8-13.1)	(8.89-9.14)	(6.64-6.90)	(23.9-24.8)	(28.6-30.2)	(23.0-25.1)	(3.34-3.45)	(2.76-2.87)	(2.15-2.26)	(2.17-2.28)	(1.26-1.35)	(1.17-1.27)
LOS	6.7	6.3	5.6	3.1	2.7	2.5	5.9	5.5	5.3	5.5	4.7	4.3
	(7.0)	(6.6)	(5.6)	(3.3)	(2.6)	(2.2)	(5.7)	(5.2)	(5.1)	(5.8)	(4.8)	(4.6)
Medicare payment	14,280	16,643	15,358	4330	4289	4383	7215	9244	8935	7568	8050	8433
($)	(16,755)	(17,015)	(16,257)	(6340)	(4768)	(5516)	(8985)	(11,316)	(10,944)	(7859)	(7115)	(8157)
≥85												
Total	132,555	131,211	113,743	16,805	6244	3615	298,579	306,731	284,326	162,715	144,481	139,763
Home	32.0	27.7	29.1	64.9	57.1	55.4	42.7	34.4	30.1	23.8	20.8	19.2
	(31.7-32.2)	(27.4-27.9)	(28.8-29.4)	(64.2-65.6)	(55.9-58.4)	(53.7-57.0)	(42.6-42.9)	(34.2-34.5)	(30.0-30.3)	(23.6-24.0)	(20.6-21.0)	(19.0-19.4)
Home care	11.7	14.8	16.0	9.2	9.1	12.6	15.2	20.6	23.0	9.1	11.4	11.9
	(11.5-11.8)	(14.6-15.0)	(15.8-16.2)	(8.80-9.68)	(8.44-9.89)	(11.6-13.7)	(15.0-15.3)	(20.5-20.8)	(22.9-23.2)	(8.95-9.23)	(11.3-11.6)	(11.7-12.0)
ICF/SNF	26.3	29.5	28.9	11.8	12.4	14.3	28.5	30.4	31.1	41.9	36.4	35.0
	(26.1-26.5)	(29.3-29.8)	(28.7-29.2)	(11.3-12.3)	(11.6-13.3)	(13.2-15.5)	(28.3-28.7)	(30.3-30.6)	(30.9-31.3)	(41.7-42.1)	(36.2-36.7)	(34.7-35.2)
Hospice	0.3	4.1	6.2	0.1	0.6	1.2	0.2	3.4	6.0	0.4	5.6	9.4
	(0.25-0.31)	(4.00-4.22)	(6.07-6.35)	(0.03-0.11)	(0.44-0.85)	(0.91-1.66)	(0.21-0.24)	(3.34-3.47)	(5.93-6.11)	(0.40-0.47)	(5.47-5.71)	(9.23-9.54)
Transferred	4.9	4.2	3.5	10.6	16.3	12.1	1.5	1.3	1.0	1.8	0.9	0.8
	(4.79-5.02)	(4.07-4.28)	(3.37-3.59)	(10.2-11.1)	(15.4-17.2)	(11.1-13.2)	(1.49-1.57)	(1.24-1.31)	(1.00-1.07)	(1.71-1.84)	(0.84-0.94)	(0.73-0.82)

LOS	6.4 (5.7)	5.9 (5.1)	5.2 (4.4)	3.4 (3.1)	3.0 (2.5)	2.8 (2.6)	5.8 (5.4)	5.4 (4.4)	5.1 (4.0)	6.1 (6.1)	5.4 (4.6)	4.8 (4.1)
Medicare payment	10,744	11,910	11,478	3443	3529	3702	6530	7158	7446	6959	7684	8363
($)	(10,293)	(10,464)	(10,596)	(4236)	(3707)	(3970)	(7026)	(6484)	(6169)	(6418)	(5731)	(6574)
Race-gender												
Black female												
Total	22,770	21,879	18,541	5388	2427	1161	72,467	68,824	54,349	40,306	34,416	28,708
Home	44.8 (44.2-45.5)	39.7 (39.0-40.3)	41.1 (40.4-41.8)	73.7 (72.5-74.9)	65.9 (64.0-67.8)	63.0 (60.2-65.8)	60.7 (60.4-61.1)	49.6 (49.3-50.0)	43.9 (43.5-44.3)	31.7 (31.2-32.1)	25.7 (25.3-26.2)	24.5 (24.1-25.1)
Home care	11.6 (11.2-12.1)	16.1 (15.6-16.6)	18.0 (17.4-18.5)	6.1 (5.48-6.78)	8.7 (7.64-9.93)	9.8 (8.17-11.7)	15.1 (14.9-15.4)	21.8 (21.5-22.1)	25.7 (25.3-26.0)	12.0 (11.7-12.3)	15.6 (15.3-16.0)	15.8 (15.4-16.2)
ICF/SNF	14.9 (14.5-15.4)	19.2 (18.6-19.7)	18.6 (18.0-19.2)	4.5 (3.94-5.06)	5.6 (4.76-6.64)	7.6 (6.12-9.26)	14.1 (13.9-14.4)	17.9 (17.6-18.2)	20.1 (19.7-20.4)	28.3 (27.9-28.8)	27.6 (27.1-28.0)	27.7 (27.2-28.2)
Hospice	0.1 (0.10-0.20)	2.0 (1.84-2.22)	2.9 (2.66-3.15)	0.0 (.-0.07)	0.1 (0.03-0.36)	0.9 (0.41-1.58)	0.1 (0.06-0.11)	1.4 (1.33-1.51)	2.3 (2.18-2.43)	0.1 (0.10-0.18)	2.2 (2.02-2.33)	3.6 (3.39-3.83)
Transferred	8.7 (8.35-9.09)	7.0 (6.66-7.34)	5.6 (5.23-5.89)	12.9 (12.0-13.8)	16.2 (14.7-17.7)	14.2 (12.3-16.4)	2.2 (2.14-2.35)	2.0 (1.87-2.08)	1.5 (1.42-1.63)	2.7 (2.52-2.84)	1.5 (1.34-1.60)	1.4 (1.23-1.51)
LOS (days)	7.5 (7.7)	7.0 (7.8)	6.0 (6.1)	3.7 (3.1)	3.2 (2.7)	2.9 (2.4)	6.3 (6.3)	5.9 (5.7)	5.6 (5.3)	7.3 (8.3)	6.4 (6.3)	5.8 (6.6)
Medicare payment	14,303	15,546	14,704	4683	4902	4666	7952	8924	9096	8780	9207	9880
($)	(17,586)	(17,462)	(15,836)	(5915)	(5161)	(5223)	(10,028)	(10,828)	(10,623)	(11,832)	(10,222)	(10,632)
Black male												
Total	15,179	15,368	13,629	2643	1243	655	39,501	42,141	35,567	22,945	21,477	19,393
Home	51.6	47.6	50.0	71.7	62.1	59.8	66.4	58.3	52.5	35.8	31.8	30.9

	(50.8-52.4)	(46.8-48.4)	(49.2-50.8)	(69.9-73.4)	(59.3-64.8)	(56.0-63.6)	(65.9-66.9)	(57.8-58.7)	(51.9-53.0)	(35.1-36.4)	(31.1-32.4)	(30.3-31.6)
Home care	9.0	12.4	13.5	3.1	5.6	7.8	12.1	16.6	20.2	9.7	12.1	12.8
	(8.58-9.50)	(11.9-12.9)	(13.0-14.1)	(2.51-3.88)	(4.42-7.06)	(5.85-10.1)	(11.8-12.5)	(16.3-17.0)	(19.8-20.6)	(9.29-10.1)	(11.7-12.6)	(12.3-13.3)
ICF/SNF	11.1	15.0	14.9	4.8	6.4	8.1	11.0	14.1	16.1	25.2	23.7	24.1
	(10.6-11.6)	(14.4-15.6)	(14.3-15.5)	(3.99-5.65)	(5.06-7.86)	(6.12-10.5)	(10.7-11.4)	(13.8-14.5)	(15.8-16.5)	(24.6-25.7)	(23.1-24.3)	(23.5-24.7)
Hospice	0.1	1.5	2.2	0.1	0.2	0.2	0.1	1.4	2.2	0.2	1.3	2.2
	(0.06-0.16)	(1.30-1.69)	(1.93-2.42)	(0.01-0.27)	(0.02-0.58)	(0.00-0.85)	(0.06-0.12)	(1.28-1.51)	(2.07-2.38)	(0.11-0.22)	(1.13-1.43)	(1.96-2.37)
Transferred	10.8	7.9	6.1	16.7	20.4	17.1	2.6	2.3	2.0	3.0	1.6	1.7
	(10.3-11.3)	(7.49-8.35)	(5.70-6.51)	(15.3-18.2)	(18.2-22.7)	(14.3-20.2)	(2.46-2.77)	(2.20-2.49)	(1.83-2.13)	(2.74-3.19)	(1.43-1.77)	(1.53-1.90)
LOS (days)	7.2	6.8	6.0	3.6	3.1	2.6	6.2	5.8	5.5	7.3	6.4	5.7
	(7.3)	(6.9)	(6.1)	(3.8)	(3.0)	(2.0)	(6.4)	(5.7)	(5.5)	(8.0)	(6.7)	(6.0)
Medicare payment	14,728	16,877	16,212	4787	4631	4556	8064	10,181	10,112	9042	9563	10,086
($)	(17,088)	(16,973)	(16,914)	(5462)	(4619)	(4639)	(10,076)	(12,798)	(14,173)	(13,045)	(12,252)	(11,485)
White female												
Total	251,701	213,762	168,285	47,301	16,953	8352	484,679	433,095	342,438	324,522	260,110	221,882
Home	41.3	39.5	41.7	62.6	57.0	59.5	51.1	42.5	36.7	38.8	36.5	33.6
	(41.1-41.5)	(39.3-39.7)	(41.5-41.9)	(62.1-63.0)	(56.2-57.7)	(58.5-60.6)	(51.0-51.3)	(42.3-42.6)	(36.6-36.9)	(38.7-39.0)	(36.3-36.7)	(33.4-33.8)
Home care	10.8	13.6	14.6	5.3	5.4	7.3	14.5	19.7	22.5	8.7	10.9	11.5
	(10.7-10.9)	(13.5-13.8)	(14.4-14.8)	(5.14-5.54)	(5.08-5.77)	(6.75-7.88)	(14.4-14.6)	(19.6-19.8)	(22.4-22.7)	(8.64-8.83)	(10.8-11.0)	(11.4-11.7)
ICF/SNF	18.0	21.3	21.3	5.9	6.1	7.3	22.0	24.9	27.1	29.8	25.6	25.5
	(17.8-18.1)	(21.2-21.5)	(21.1-21.5)	(5.67-6.10)	(5.71-6.44)	(6.79-7.92)	(21.9-22.1)	(24.8-25.0)	(26.9-27.2)	(29.6-29.9)	(25.4-25.7)	(25.3-25.7)
Hospice	0.2	2.5	3.7	0.0	0.3	0.4	0.2	2.4	4.4	0.3	3.5	6.1
	(0.15-0.18)	(2.43-2.56)	(3.65-3.83)	(0.01-0.04)	(0.18-0.34)	(0.29-0.58)	(0.16-0.19)	(2.34-2.43)	(4.30-4.44)	(0.28-0.32)	(3.46-3.60)	(6.00-6.20)
Transferred	11.1	7.6	5.7	23.7	28.7	22.2	3.0	2.3	1.7	2.0	1.1	1.0
	(10.9-11.2)	(7.47-7.69)	(5.59-5.81)	(23.4-24.1)	(28.1-29.4)	(21.4-23.2)	(2.91-3.01)	(2.21-2.30)	(1.70-1.79)	(1.96-2.06)	(1.08-1.16)	(0.97-1.05)

LOS (days)	6.5	6.0	5.2	3.0	2.6	2.4	5.8	5.5	5.2	5.4	4.7	4.3
	(6.4)	(5.8)	(4.9)	(3.0)	(2.3)	(2.2)	(5.6)	(4.9)	(4.6)	(5.4)	(4.4)	(3.9)
Medicare payment	12,952	14,434	13,207	3975	3932	4050	6783	7735	7870	7114	7659	8134
($)	(14,794)	(14,151)	(13,343)	(5422)	(3945)	(4364)	(7984)	(8502)	(8500)	(6212)	(5754)	(6793)
White male												
Total	252,945	221,755	184,942	33,390	12,013	6397	347,976	347,254	287,492	251,705	216,696	186,646
Home	51.4	51.9	54.4	61.3	54.4	60.4	60.7	55.0	48.0	53.4	52.7	49.4
	(51.2-51.6)	(51.7-52.1)	(54.2-54.7)	(60.8-61.8)	(53.6-55.3)	(59.2-61.6)	(60.6-60.9)	(54.8-55.2)	(47.8-48.2)	(53.2-53.6)	(52.5-52.9)	(49.2-49.6)
Home care	8.8	11.8	12.2	3.3	3.5	5.5	12.3	16.5	19.9	7.1	9.0	9.8
	(8.70-8.92)	(11.6-11.9)	(12.0-12.3)	(3.12-3.51)	(3.17-3.84)	(4.99-6.12)	(12.2-12.5)	(16.4-16.7)	(19.8-20.1)	(7.03-7.23)	(8.88-9.12)	(9.67-9.94)
ICF/SNF	9.7	12.0	12.3	3.1	3.5	4.4	13.4	15.1	17.7	18.9	15.4	16.0
	(9.57-9.80)	(11.9-12.1)	(12.2-12.5)	(2.87-3.24)	(3.16-3.82)	(3.90-4.92)	(13.2-13.5)	(15.0-15.3)	(17.5-17.8)	(18.7-19.0)	(15.2-15.5)	(15.8-16.2)
Hospice	0.1	1.7	2.5	0.0	0.2	0.4	0.2	2.2	4.1	0.2	1.9	3.2
	(0.10-0.13)	(1.66-1.77)	(2.46-2.61)	(0.01-0.05)	(0.14-0.32)	(0.24-0.56)	(0.16-0.19)	(2.19-2.29)	(3.98-4.13)	(0.15-0.18)	(1.88-1.99)	(3.11-3.27)
Transferred	13.7	8.5	6.2	29.5	34.4	25.2	3.6	2.8	2.2	2.2	1.3	1.2
	(13.5-13.8)	(8.42-8.66)	(6.07-6.29)	(29.0-30.0)	(33.6-35.3)	(24.2-26.3)	(3.59-3.71)	(2.79-2.90)	(2.14-2.24)	(2.16-2.28)	(1.30-1.39)	(1.17-1.27)
LOS (days)	6.3	6.0	5.3	2.8	2.4	2.4	5.6	5.3	5.2	5.0	4.3	4.0
	(6.6)	(6.3)	(5.5)	(3.0)	(2.5)	(2.5)	(5.7)	(5.2)	(5.0)	(5.5)	(4.6)	(4.3)
Medicare payment	14,759	17,158	15,699	4683	4466	4835	7217	9965	9380	7613	7908	8275
($)	(16,893)	(17,023)	(16,549)	(6921)	(5340)	(7265)	(9631)	(12,978)	(13,586)	(7881)	(6783)	(7906)
Other female												
Total	11,269	11,490	9590	4388	1690	782	25,193	24,810	20,687	15,032	13,545	11,927
Home	48.5	44.8	44.5	79.8	70.8	70.3	64.1	52.8	47.6	41.3	35.2	29.9

	(47.6-49.5)	(43.9-45.8)	(43.5-45.5)	(78.6-81.0)	(68.6-73.0)	(67.0-73.5)	(63.6-64.7)	(52.2-53.5)	(46.9-48.2)	(40.5-42.1)	(34.4-36.0)	(29.1-30.8)
Home care	9.8	15.9	16.6	3.4	4.8	8.2	12.2	20.2	23.6	10.2	14.3	14.7
	(9.27-10.4)	(15.2-16.6)	(15.8-17.3)	(2.92-4.02)	(3.82-5.92)	(6.36-10.3)	(11.8-12.6)	(19.7-20.7)	(23.1-24.2)	(9.75-10.7)	(13.7-14.9)	(14.1-15.4)
ICF/SNF	11.9	13.9	15.5	2.1	3.7	4.0	13.0	15.3	17.6	24.3	22.7	24.0
	(11.3-12.5)	(13.2-14.5)	(14.8-16.3)	(1.69-2.57)	(2.88-4.74)	(2.71-5.58)	(12.6-13.4)	(14.9-15.8)	(17.1-18.2)	(23.6-25.0)	(22.0-23.4)	(23.3-24.8)
Hospice	0.1	1.8	2.9	0.0	0.2	0.4	0.1	1.7	2.8	0.2	2.0	4.8
	(0.07-0.21)	(1.53-2.02)	(2.55-3.23)	(.-0.08)	(0.06-0.60)	(0.08-1.12)	(0.08-0.17)	(1.51-1.83)	(2.56-3.01)	(0.16-0.32)	(1.79-2.27)	(4.41-5.19)
Transferred	10.4	8.1	6.5	12.1	17.0	13.4	2.6	2.3	1.5	2.1	1.2	1.3
	(9.86-11.0)	(7.57-8.57)	(6.01-7.01)	(11.2-13.1)	(15.2-18.9)	(11.1-16.0)	(2.38-2.78)	(2.08-2.45)	(1.38-1.72)	(1.89-2.36)	(0.99-1.36)	(1.08-1.49)
LOS (days)	7.2	6.7	6.0	3.9	3.1	2.7	6.2	5.9	5.5	6.4	5.8	5.4
	(8.3)	(6.9)	(6.2)	(3.6)	(2.4)	(2.2)	(7.0)	(6.1)	(5.2)	(8.6)	(5.7)	(5.4)
Medicare payment	14,635	16,742	16,337	3771	3996	4030	8034	9493	9960	8296	9238	10,557
($)	(19,645)	(19,329)	(17,184)	(5202)	(4521)	(4015)	(10,679)	(11,608)	(10,519)	(9877)	(9908)	(11,306)
Other male												
Total	11,015	11,755	10,544	2889	1153	512	16,854	18,609	16,182	11,575	11,578	10,909
Home	54.9	52.3	52.9	79.8	70.5	66.0	69.3	60.9	54.5	49.5	44.9	42.2
	(53.9-55.8)	(51.4-53.2)	(52.0-53.9)	(78.3-81.3)	(67.8-73.1)	(61.7-70.1)	(68.6-70.0)	(60.2-61.6)	(53.7-55.3)	(48.6-50.4)	(44.0-45.8)	(41.2-43.1)
Home care	7.7	12.6	13.0	2.1	2.4	5.3	10.1	16.1	19.5	8.2	11.8	12.0
	(7.20-8.20)	(12.0-13.2)	(12.4-13.7)	(1.62-2.70)	(1.62-3.49)	(3.50-7.58)	(9.66-10.6)	(15.6-16.7)	(18.9-20.2)	(7.68-8.69)	(11.2-12.4)	(11.4-12.7)
ICF/SNF	7.7	9.1	11.4	1.5	2.6	4.5	8.4	10.8	13.2	18.3	16.5	17.4
	(7.17-8.17)	(8.57-9.62)	(10.8-12.0)	(1.05-1.96)	(1.76-3.69)	(2.87-6.66)	(8.03-8.87)	(10.4-11.3)	(12.7-13.7)	(17.6-19.1)	(15.9-17.2)	(16.7-18.1)
Hospice	0.1	1.3	1.9	0.0	0.3	0.2	0.1	1.4	2.6	0.1	1.4	2.4
	(0.03-0.14)	(1.13-1.55)	(1.61-2.14)	(.-0.13)	(0.05-0.76)	(0.00-1.08)	(0.03-0.12)	(1.19-1.53)	(2.35-2.85)	(0.07-0.20)	(1.17-1.60)	(2.11-2.69)
Transferred	12.1	9.0	6.7	13.6	19.4	19.9	3.2	2.8	2.2	2.6	1.6	1.4
	(11.5-12.7)	(8.51-9.56)	(6.19-7.15)	(12.4-14.9)	(17.2-21.8)	(16.6-23.7)	(2.90-3.44)	(2.60-3.08)	(1.94-2.40)	(2.28-2.86)	(1.39-1.85)	(1.18-1.63)

LOS (days)	7.0 (8.0)	6.8 (7.8)	6.0 (6.8)	3.8 (3.2)	3.2 (3.3)	2.7 (2.7)	6.1 (6.8)	5.7 (6.2)	5.5 (5.8)	6.4 (7.9)	5.6 (7.0)	5.2 (6.5)
Medicare payment ($)	15,988 (20,433)	19,369 (21,401)	19,338 (23,154)	4148 (5713)	4401 (9691)	4810 (5914)	8442 (11,547)	11,070 (14,131)	11,477 (16,178)	8932 (11,535)	9464 (10,354)	10,637 (13,046)

ICF/SNF: Intermediate care facility/Skilled nursing facility; LOS: length of stay

Discharge dispositions are presented as %, (95 CI), length of stay and Medicare payment are presented as mean (SD)

Table S5. Adjusted annual change in outcomes by condition: overall and subgroups.

	Myocardial infarction	Unstable angina	Heart failure	Ischemic stroke
Outcome				
Overall				
1-year mortality	0.975 (0.974-0.975)	0.979 (0.974-0.983)	0.985 (0.984-0.985)	0.986 (0.985-0.986)
30-day mortality	0.968 (0.967-0.969)	0.996 (0.989-1.003)	0.979 (0.978-0.980)	0.993 (0.993-0.994)
30-day readmission	0.982 (0.981-0.983)	0.971 (0.968-0.975)	0.992 (0.991-0.993)	0.996 (0.995-0.996)
By subgroup				
Age (yrs)				
65-74				
1-year mortality	0.970 (0.968-0.971)	0.968 (0.960-0.976)	0.974 (0.973-0.975)	0.977 (0.975-0.979)
30-day mortality	0.962 (0.960-0.963)	0.974 (0.962-0.986)	0.966 (0.964-0.968)	0.977 (0.975-0.979)
30-day readmission	0.978 (0.977-0.980)	0.966 (0.961-0.972)	0.990 (0.989-0.991)	0.992 (0.991-0.994)
75-84				
1-year mortality	0.972 (0.970-0.973)	0.971 (0.964-0.977)	0.980 (0.979-0.981)	0.981 (0.979-0.982)
30-day mortality	0.966 (0.965-0.968)	0.991 (0.981-1.001)	0.976 (0.975-0.977)	0.989 (0.987-0.990)
30-day readmission	0.982 (0.980-0.983)	0.972 (0.966-0.977)	0.992 (0.991-0.993)	0.996 (0.995-0.997)

≥85				
1-year mortality	0.977 (0.975-0.978)	0.992 (0.985-0.999)	0.992 (0.991-0.993)	0.989 (0.988-0.991)
30-day mortality	0.970 (0.969-0.971)	1.016 (1.004-1.027)	0.985 (0.984-0.986)	0.999 (0.998-1.001)
30-day readmission	0.988 (0.987-0.990)	0.979 (0.972-0.986)	0.993 (0.992-0.994)	0.998 (0.996-0.999)
Race-gender				
Black female				
1-year mortality	0.967 (0.963-0.971)	0.971 (0.954-0.989)	0.980 (0.977-0.982)	0.982 (0.979-0.985)
30-day mortality	0.956 (0.952-0.960)	1.015 (0.992-1.039)	0.971 (0.968-0.975)	0.985 (0.981-0.988)
30-day readmission	0.989 (0.985-0.993)	0.984 (0.971-0.998)	0.996 (0.993-0.998)	0.996 (0.993-0.999)
Black male				
1-year mortality	0.977 (0.973-0.982)	0.976 (0.955-0.998)	0.980 (0.978-0.983)	0.977 (0.973-0.981)
30-day mortality	0.968 (0.963-0.973)	0.934 (0.909-0.960)	0.975 (0.971-0.979)	0.977 (0.972-0.981)
30-day readmission	0.992 (0.988-0.997)	0.988 (0.970-1.005)	0.992 (0.990-0.995)	0.992 (0.988-0.996)
White female				
1-year mortality	0.971 (0.969-0.972)	0.981 (0.975-0.987)	0.985 (0.984-0.986)	0.988 (0.987-0.989)
30-day mortality	0.964 (0.963-0.966)	1.001 (0.992-1.011)	0.979 (0.978-0.981)	0.997 (0.996-0.998)
30-day readmission	0.982 (0.980-0.983)	0.966 (0.961-0.970)	0.993 (0.992-0.994)	0.998 (0.996-0.999)

White male				
1-year mortality	0.979 (0.978-0.980)	0.975 (0.968-0.982)	0.983 (0.982-0.984)	0.982 (0.981-0.983)
30-day mortality	0.972 (0.971-0.974)	0.993 (0.982-1.003)	0.979 (0.978-0.981)	0.989 (0.987-0.990)
30-day readmission	0.981 (0.980-0.983)	0.971 (0.965-0.977)	0.991 (0.990-0.992)	0.993 (0.992-0.994)
Other female				
1-year mortality	0.971 (0.966-0.976)	0.970 (0.950-0.991)	0.984 (0.980-0.987)	0.987 (0.982-0.992)
30-day mortality	0.961 (0.955-0.966)	1.007 (0.975-1.039)	0.976 (0.971-0.981)	0.998 (0.992-1.004)
30-day readmission	0.988 (0.983-0.994)	0.986 (0.970-1.002)	0.989 (0.985-0.993)	0.995 (0.990-1.001)
Other male				
1-year mortality	0.976 (0.971-0.982)	0.974 (0.950-0.998)	0.980 (0.976-0.985)	0.982 (0.976-0.988)
30-day mortality	0.973 (0.967-0.979)	0.973 (0.938-1.009)	0.978 (0.973-0.984)	0.985 (0.978-0.992)
30-day readmission	0.981 (0.976-0.987)	0.979 (0.960-0.998)	0.991 (0.986-0.995)	0.995 (0.989-1.001)

Adjusted annual changes were represented by adjusted odds ratio (95% CI) of the ordinal time variable.

Figure S1A.

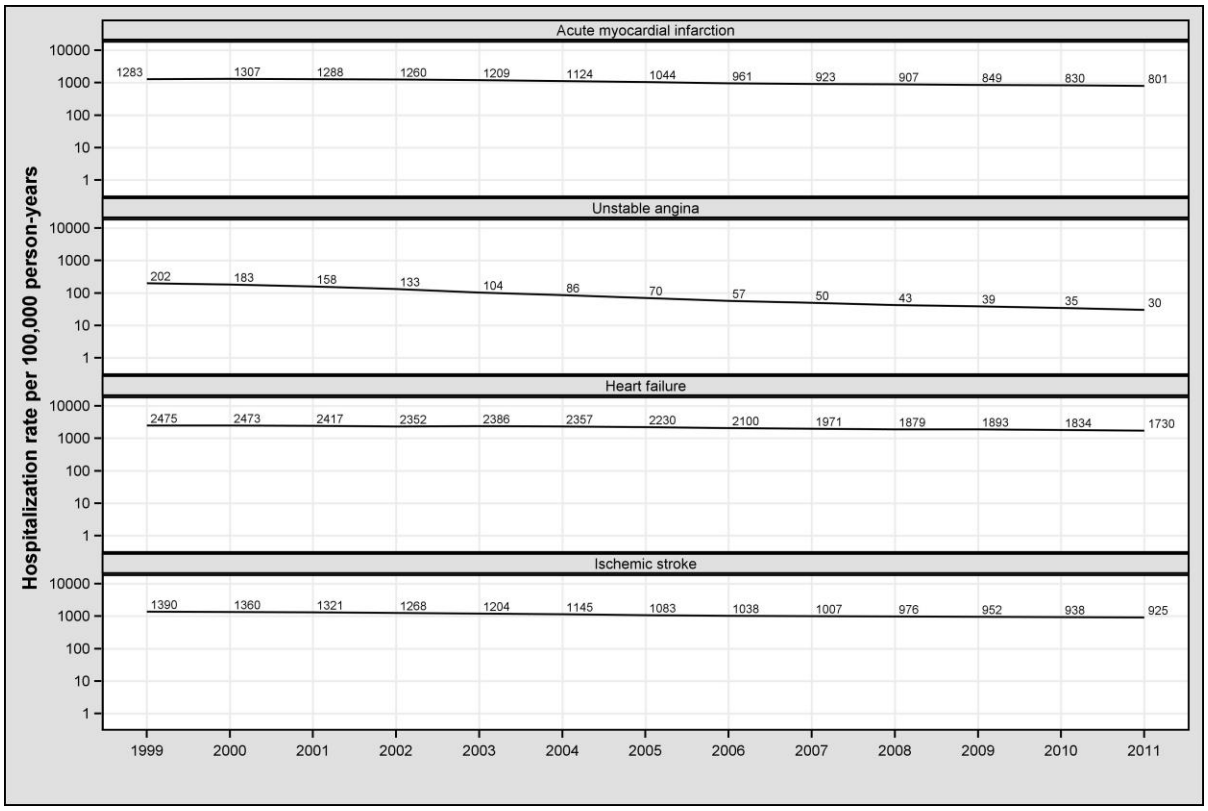

Acute myocardial infarction
1283 1307 1288 1260 1209 1124 1044 961 923 907 849 830 801
Unstable angina
202 183 158 133 104 86 70 57 50 43 39 35 30
Heart failure
2475 2473 2417 2352 2386 2357 2230 2100 1971 1879 1893 1834 1730
Ischemic stroke
1390 1360 1321 1268 1204 1145 1083 1038 1007 976 952 938 925
Hospitalization rate per 100,000 person-years
10000
1000
100
10
1
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011

Figure S1B.

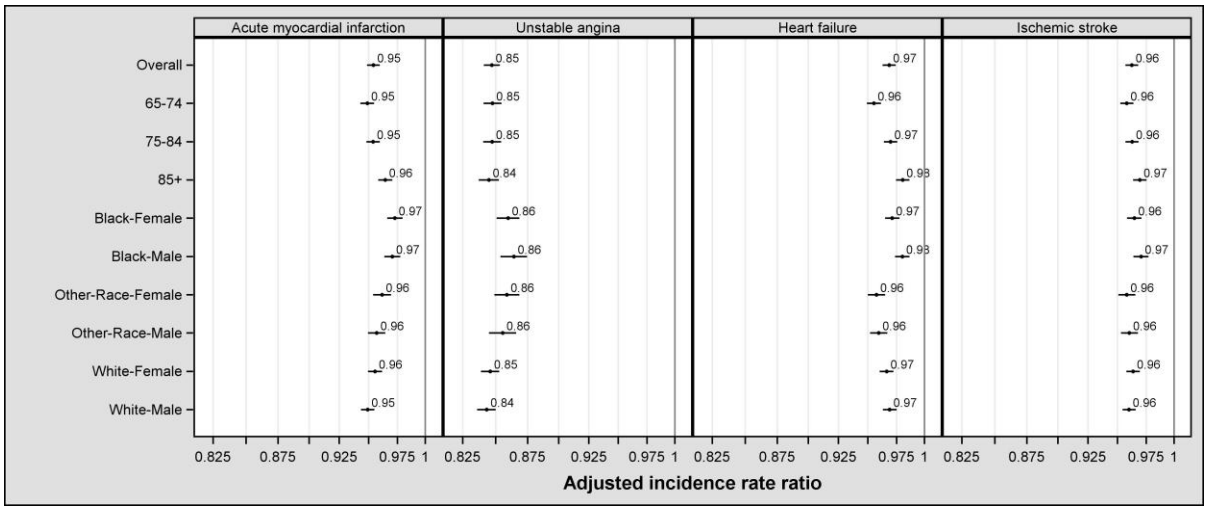

Acute myocardial infarction
Unstable angina
Heart failure
Ischemic stroke
Overall
65-74
75-84
85+
Black-Female
Black-Male
Other-Race-Female
Other-Race-Male
White-Female
White-Male
0.95
0.95
0.95
0.96
0.97
0.97
0.96
0.96
0.96
0.95
0.85
0.85
0.85
0.84
0.86
0.86
0.86
0.86
0.85
0.84
0.97
0.96
0.97
0.98
0.97
0.98
0.96
0.96
0.97
0.97
0.96
0.96
0.97
0.96
0.96
0.97
0.96
0.96
0.96
0.96
0.96
0.96
0.825
0.875
0.925
0.975
1
Adjusted incidence rate ratio

Figure S2.

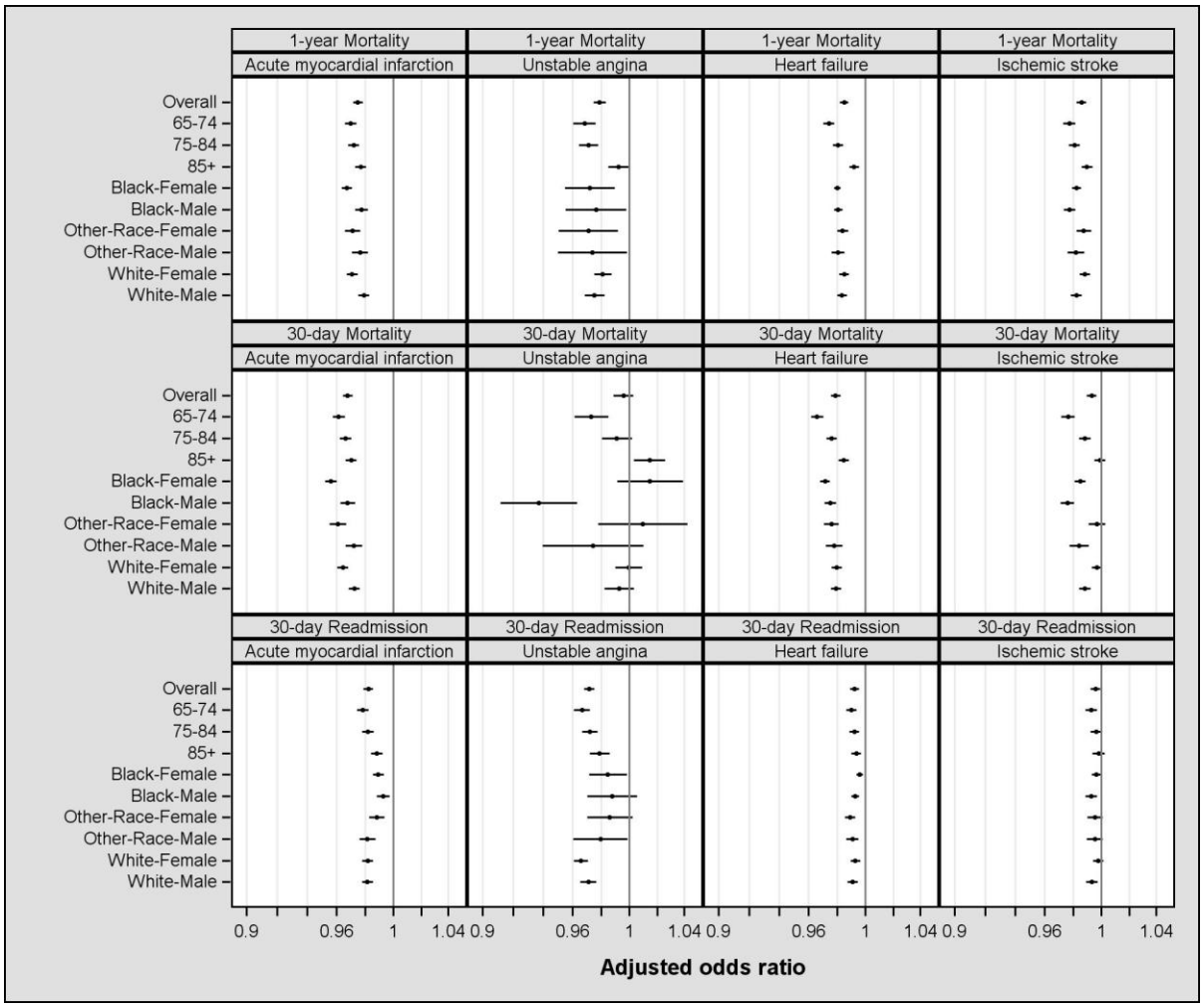
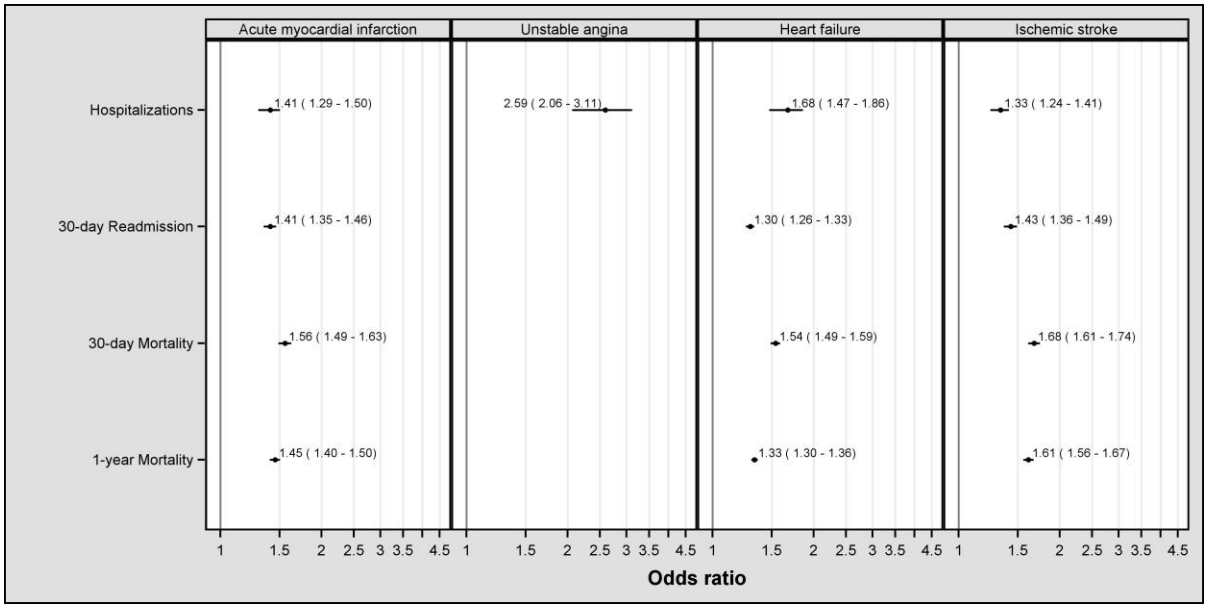

1-year Mortality
Acute myocardial infarction
1-year Mortality
Unstable angina
1-year Mortality
Heart failure
1-year Mortality
Ischemic stroke
30-day Mortality
Acute myocardial infarction
30-day Mortality
Unstable angina
30-day Mortality
Heart failure
30-day Mortality
Ischemic stroke
30-day Readmission
Acute myocardial infarction
30-day Readmission
Unstable angina
30-day Readmission
Heart failure
30-day Readmission
Ischemic stroke
Overall
65-74
75-84
85+
Black-Female
Black-Male
Other-Race-Female
Other-Race-Male
White-Female
White-Male
0.9
0.96
1
1.04
Adjusted odds ratio

Figure S3.



Estimated between-state (for rates of hospitalization) and between-hospital (for rates of mortality and readmission) variation represented by the odds in a state (hospital for rates of mortality and readmission) 1 standard deviation above vs. 1 standard deviation below the national average of rates of hospitalization, 30-day mortality, 1-year mortality, and 30-day readmission based on the 2011 (2010 for 1-year mortality) data.[1, 2] The between-hospital variation was not estimated for unstable angina due to the insufficient sample size by each hospital for that condition.

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2. Zaslavsky AM. Statistical issues in reporting quality data: small samples and casemix variation. *Int J Qual Health Care*. 2001;13:481-488.