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Socio-economic Status and Access to Care and the Incidence of a Heart Failure Diagnosis in the Inpatient and Outpatient Setting

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Abstract

Background—Despite well-documented associations of socio-economic status (SES) with incident heart failure (HF) hospitalization, little information exists on the relationship of SES with HF diagnosed in the outpatient (OP) setting.

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Methods—We used Poisson models to examine the association of area-level indicators of educational attainment, poverty, living situation, and density of primary care physicians with incident HF diagnosed in the inpatient and outpatient settings among a cohort of Medicare beneficiaries (n=109,756; 2001-2013).

Results—The age-standardized rate of HF incidence was 35.8 (95% confidence interval (CI) 35.1, 36.5) and 13.9 (95% CI 13.5, 14.4) cases per 1,000 person-years in inpatient and outpatient settings, respectively. The incidence rate differences (IRD) per 1,000 person-years in both settings suggested greater incidence of HF in high compared to low poverty areas (IP IRD=4.47 (95% CI 3.29, 5.65), OP IRD=1.41 (95% CI 0.61, 2.22)) and in low compared to high education areas (IP IRD=3.73 (95% CI 2.63, 4.82), OP IRD=1.72 (95% CI 0.97, 2.47)).

Conclusions—Our results highlight the role of area-level social determinants of health in the incidence of HF in both the inpatient and outpatient setting. These findings may have implications for HF prevention policies.

Introduction

Heart failure (HF) is a clinical syndrome characterized by breathlessness, fatigue and edema due to an inability of the heart to provide adequate cardiac output to the body at rest or with exertion, or to do so only in the setting of elevated cardiac filling pressures.[1] Patients diagnosed with HF have a poor prognosis characterized by frequent hospital admissions and readmissions, they suffer from multiple comorbidities,[2] and have a median survival of 5 years following the initial diagnosis.[1] Geographic variation in hospitalizations among patients with HF has been observed[3,4] and may be due to regional differences in access to care and socio-economic factors.

Socio-economic status (SES), often operationalized with measures of income, poverty, wealth, education, or occupational class,[5,6] is an independent predictor of poor health[7,8] and cardiovascular disease (CVD).[5] Residence in socioeconomically disadvantaged neighborhoods is linked to greater incidence of coronary heart disease,[9-11] and a greater prevalence of CVD risk factors, such as diabetes,[12] hypertension,[13] and obesity.[14] It also imparts a greater risk of HF-related hospitalizations,[15-17] re-admissions,[17,18] and mortality.[17,18] Disparities by SES may be due to lack of regular health care, poor access to care, less knowledge about managing CVD risk factors, or environmental factors that affect diet and physical activity participation.[9,19,20]

Despite well documented associations of SES with incident HF hospitalization,[5,15,16] data on the relationship of SES with HF diagnosed in the outpatient setting are rare. Results from a handful of studies, which included diagnoses of HF in the outpatient setting, suggest a lower comorbidity burden,[21,22] fewer hospitalizations,[21] and lower case fatality[21-23] for HF patients diagnosed in the outpatient as compared to the inpatient setting. However, none of these studies examined variation of incidence rates by SES or access to care. Therefore, we sought to examine the associations of area-level SES and access to care factors with incidence of HF diagnosed in the inpatient and outpatient settings among the Centers for Medicare and Medicaid Services (CMS) Medicare beneficiaries residing in four geographically distinct regions of the United States.

Methods

Study Design

We constructed an open cohort of white and African American Medicare fee-for-service (FFS) beneficiaries residing in four geographic regions in which the Atherosclerosis Risk in Communities Study (ARIC) conducts surveillance for cardiovascular disease events (Washington County, MD; Minneapolis, MN; Jackson, MS; Forsyth County, NC). We used a 100% Medicare sample from these regions. We included inpatient and outpatient Medicare claims from the longest continuous FFS enrollment period that was 2 years or longer from January 1, 2001 to December 31, 2013. The first two years of enrollment were used as a baseline period to identify prevalent HF and measure beneficiary characteristics. Follow-up to ascertain incident heart failure events started in year 3 of the enrollment period (Figure 1).

Beneficiary sample and eligibility

Inpatient and outpatient Medicare claims for all beneficiaries were obtained and linked by a unique beneficiary identifier. Records for inpatient encounters were selected from annual Medicare Provider Analysis and Review (MedPAR) files. Outpatient claims were identified from the Carrier and Outpatient files using the following Evaluation and Management Healthcare Common Procedure Coding System codes: 99201–99205, 99211–99215, 99241–99245, 99385–99387, 99395–99397. Outpatient events that occurred in federally qualified health centers were identified from annual outpatient files as claims with revenue center codes 521 and 522.

Heart Failure Ascertainment

A diagnosis of incident HF in the inpatient setting was defined as the first hospitalization in the incidence period (Figure 1) with International Classification of Disease, 9th Revision, Clinical Modification (ICD-9) codes in any position included in the Chronic Conditions Data Warehouse (CCW) HF algorithm (ICD-9 codes 398.91, 402.01, 402.11, 402.91, 404.01, 404.11, 404.94, 404.03, 404.13, 404.93, and 428.x). A diagnosis of incident HF in the outpatient setting was defined as two consecutive claims with CCW HF algorithm codes within 365 days. The date of the second claim was defined as the date of the HF diagnosis. For a beneficiary with claims identifying HF diagnoses in both the inpatient and outpatient setting, the first diagnosis that occurred was used. If both diagnoses occurred on the same day, then beneficiaries were classified as having incident HF diagnosis in the inpatient setting (N=45). A two year baseline period of the first two years of enrollment was used to identify prevalent inpatient and outpatient HF (Figure 1).[24,25]

SES and Medical Care Access Factors

Area-level SES and medical care access factors were assessed at the zip code tabulation area (ZCTA) level. Area-level SES was operationalized with the following Census 2000 variables specific to the 65 years and older population accessed from the RTI Spatial Impact Factor website: proportion in poverty, proportion with more than a high school education, and proportion that live alone.[26] The number of clinically active primary care physicians per 100,000 population for the year 2006 within study geographic areas was obtained from the

Health Resources and Service Administration website.[27] All area-level variables were categorized as tertiles. We used a cross-walk[28] of ZCTA to zip code to join the area-level data to the Medicare beneficiary cohort data. In our study population we had 85 ZCTAs.

Covariates

Age at entry into the cohort, sex, race, and geographic region were considered as confounders in multivariable analyses and were identified from the annual Master Beneficiary Summary Files. Due to a small number of beneficiaries over the age of 95, we recoded ages 96 – 106 as age 95. Age was centered at 75 years and race was categorized as white and African American. We obtained the zip codes of the four geographic regions and classified beneficiaries into community by the zip code obtained from the Master Beneficiary Summary File.

To further describe beneficiary characteristics we calculated the number of inpatient and outpatient encounters, the number of visits to primary care providers (general practice, family practice, internal medicine, nurse practitioner, and multi-specialty clinic providers), and total number of visits to cardiologists during the two year baseline period prior to beginning of study follow-up (Figure 1). We also estimated prevalence of comorbidities (Supplemental Table 1 for ICD-9 codes) identified from MedPAR records and ambulatory care claims during the two year baseline period (Figure 1).

Exclusions

Excluded from analysis were beneficiaries who had less than two years of enrollment (N=20,901), those considered to have prevalent HF within the two-year baseline period (N=8,279), those missing all covariate information (N=19), and those younger than 65 years (N=5,937). This provided an analytic sample of 109,756 beneficiaries (Supplemental Figure 1). After identifying which HF diagnosis occurred first (inpatient or outpatient) two analytic samples were created for each setting. The inpatient HF sample included beneficiaries diagnosed with inpatient HF and those who did not develop HF during the period of observation (2003-2013). Similarly the outpatient sample consisted of beneficiaries diagnosed with outpatient HF and those who did not develop HF during the period of observation.

Statistical Analysis

Crude estimates of incidence rates (per 1,000 person-years) of HF diagnosis in the inpatient and outpatient setting were age-standardized to reflect the age distribution of the national 2003 CMS Medicare population age 67 and older - the earliest age of the cohort given the two year lookback period. Person-time was calculated as time from start of follow-up (after completion of first 2 years of enrollment) to an incident HF event (inpatient or outpatient setting), death, or end of enrollment, whichever came first (Figure 1). To estimate associations between area-level SES and access to care factors with incident HF diagnosis, we used Poisson models with generalized estimating equations to estimate incidence rates (IR), incidence rate ratios (IRR), incidence rate differences (IRD) per 1,000 person-years, and 95% confidence intervals (95% CI). We used an unstructured correlation matrix to

adjust for clustering of beneficiaries within zip code. All models were adjusted for age, race, sex, and community.

This study has been approved by the Institutional Review Boards of participating ARIC study centers.

Results

Following exclusions, the study sample consisted of 109,756 beneficiaries (Supplemental Figure 1). At time of entry into the cohort, the average age of beneficiaries was 72 years (SD 7.4 years), 60% were female, and 85% were white (Table 1). The median number of primary care physicians per 100,000 population was similar by HF diagnosis setting, as were the mean proportion in poverty, proportion with more than a high school education, and proportion living alone (Table 1). From 2003-2013 over a median follow-up time of 3.9 years, 11.4% of beneficiaries were diagnosed with incident HF in the inpatient setting and 4.3% were diagnosed in the outpatient setting. The baseline prevalence of comorbidities was similar across diagnostic settings for beneficiaries diagnosed with HF and it was greater in comparison with beneficiaries free of HF (Table 1). The average age at diagnosis for beneficiaries diagnosed in the inpatient and outpatient setting was 82 (SD 7.6 years) and 80 years (SD 7.5 years).

The standardized rate of HF incidence in the inpatient setting was 35.8 (95% CI 35.1, 36.5) cases per 1,000 person years and 13.9 (95% CI 13.5, 14.4) cases per 1,000 person-years in the outpatient setting (Table 2). Across both settings, the HF incidence rate was higher for older beneficiaries than younger and for males than females (Table 2). In the inpatient setting, slightly higher HF diagnosis rates were observed for African American beneficiaries as compared to whites (40.9 vs. 35.0), with little difference by race observed for HF diagnosed in the outpatient setting.

Area-level associations with HF

Across both healthcare settings, the HF incidence rate differed by area-level indicators of proportion in poverty and proportion with more than a high school education (Figure 2). Compared to those living in low poverty areas beneficiaries in high poverty areas had 4.47 (95% CI 3.29, 5.65) more incident inpatient HF diagnoses per 1,000 person-years and 1.41 (95% CI 0.61, 2.22) more incident outpatient HF diagnoses per 1,000 person-years. Similarly, beneficiaries in geographic areas with low as compared to high educational attainment had 3.73 (95% CI 2.63, 4.82) more incident inpatient HF diagnoses per 1,000 person-years and 1.72 (95% CI 0.97, 2.47) more incident outpatient HF diagnoses per 1,000 person-years. Across both settings few differences in HF incidence were observed by number of primary care physicians per 100,000 population and by the proportion of persons living alone. Similar associations of area-level factors with incidence of HF across diagnostic setting were observed with incidence rate ratios as the measure of association (Supplemental Figure 2).

Discussion

To our knowledge, this is one of few studies in the United States to present HF incidence estimates separately by diagnostic setting[23,29] and to compare the association of area-level socioeconomic and access to care factors with the incidence of an inpatient and outpatient HF diagnosis. In this open cohort of Medicare beneficiaries, we observed the highest rates of incident inpatient and outpatient HF diagnosis among beneficiaries living in areas with low levels of educational attainment and high poverty. Overall, in this population of Medicare beneficiaries, incidence of HF was much higher in the inpatient, as compared to the outpatient setting.

Our observation of the association of high poverty with greater frequency of HF diagnosis extends findings from two extant studies that examined the association of area-level poverty measures with incident HF hospitalization[15,16] to the outpatient setting. Underlying social gradients in CVD risk factor distributions may partially explain why higher rates of HF diagnosis are observed among beneficiaries in more impoverished areas. A greater burden of diabetes,[12] hypertension,[13] obesity,[14] and coronary heart disease,[9-11] conditions that often precede a HF diagnosis, is observed among individuals living in low as compared to high SES neighborhoods. Individuals with limited socioeconomic resources tend to make fewer ambulatory care visits,[19] are less likely to have a regular medical provider,[16,20] and more likely to delay care[20] in comparison with those from less deprived areas.[30]

We observed a gradient in rates of HF diagnosis in both the inpatient and outpatient setting across levels of educational attainment in beneficiaries' areas of residence. Our findings extend to the outpatient setting previous research on the association of education with HF incidence obtained from hospitalization-only data.[5,31] Education may be associated with diagnosis of HF as it relates to health literacy, the ability to access health services, a person's cognitive capacity to modify risk factors and behaviors early to prevent HF, and availability of income and the resources to manage health.[32]

We found a lack of association between area-level proportion of individuals 65 years and older living alone and HF incidence. Our results are not consistent with previous research, which underscores the importance of social support in the lowering HF incidence through help with medication management, emotional support, and symptom recognition.[33,34] However, healthcare claims data did not allow us the direct assessment of beneficiaries' living status.

It is possible that the observed lack of an association of area-level density of primary care providers with incident inpatient or outpatient HF diagnosis is due to the relatively greater importance of continuity of care among the elderly, independent of clinician type.[35] Patients who have a large proportion of their medical care provided by one healthcare practitioner have low rates of hospitalizations, emergency department visits, and fewer complications.[36] Further, findings from the National Hospital Discharge Survey suggest an association between density of primary care physicians with HF hospitalizations among non-elderly but not among those 65 years of age and older.[4]

The focus on HF diagnosis in the outpatient setting is a strength of this study. We are one of the few studies to provide incidence rates of HF in both the inpatient and outpatient settings and to demonstrate how those rates vary by area-level SES characteristics. Since not all individuals diagnosed with HF have a HF-related hospitalization,[21,37] by including HF diagnosed in either the inpatient or outpatient setting we address patient characteristics and SES findings for those who have been overlooked in past research. Our findings also point to the greater incidence of HF diagnosed in the inpatient as opposed to the outpatient setting. Almost three-fourths of incident HF diagnoses in our cohort occurred in the inpatient setting. This finding is similar to results based on a 5% national Medicare sample[23] in which the authors observed that 65% incident HF diagnoses occurred in the inpatient compared to 35% in the outpatient setting. Further, we observed that the incidence rate for HF diagnosed in the inpatient setting was 2.5 times the rate of HF diagnosed in the outpatient setting. Additionally, some of our coauthors recently published a study conducted in a 20% national Medicare sample that suggested the rate of inpatient HF diagnosis is almost twice that of the rate of outpatient HF diagnosis.[29] These findings underscore opportunities for earlier recognition of incident HF in the outpatient setting and greater outpatient management of at risk populations in the prevention of HF hospitalizations.

Study limitations

The magnitude of our findings regarding the incidence of outpatient HF diagnosis may be subject to different diagnosis definitions. No agreed upon claims-based definition of outpatient HF exists, although we used a definition similar to that of other studies.[22,29] By using the CCW HF algorithm based on ICD-9 codes in any position for the identification of HF, we relied on a comprehensive definition to identify beneficiaries who were recognized to have any aspect of HF. For example, this approach identifies beneficiaries who may be admitted to the hospital for other acute conditions that were coded as the primary diagnosis that may have been accompanied by a secondary diagnosis of decompensated HF.[38] In a recent study, a high concordance was observed between hospitalizations with CCW HF ICD-9 codes in any position and events classified as definite or possible acute decompensated HF and chronic stable HF, determined from review of medical records of ARIC cohort participants.[39] Further, this study and others observed a higher sensitivity for an ICD-9 code for HF in any position compared to the first position.[39-41]

We employed a 2-year baseline period to limit inclusion of prevalent HF cases. Shorter baseline periods (also known as look-back, washout, or prevalence periods) potentially misclassify incident HF events and over estimate the incidence rate when compared to longer periods.[24,25] In an effort to reduce misclassification we may have selected a healthy cohort of beneficiaries who had to survive at least 2 years to be in our analysis.

Although analyses were limited to four distinct geographic regions, included were all Medicare beneficiaries residing within these regions. We thus avoided the bias which may occur when small area analyses of health disparities are conducted in randomly selected populations, such as with the 5% Medicare sample.[42] Our choice of the zip code as the geographic unit was dictated by the limited availability of geographic identifiers in Medicare data. Smaller geographic areas, such as participant-defined neighborhoods or Census block

groups, may have had higher validity for measuring the association of area-level SES with development of HF.[43] The primary care physician density data at the zip code level were only available for the year 2006, but we anticipate the number of primary care physicians to be similar across the years covered by our analysis. We acknowledge that our results may be subject to the modifiable areal unit problem such that the use of different geographic boundaries may have led to different results.[44] While we lack individual-level data on SES and access to health care, previous research suggests an independent association of area-level measures with health outcomes that is above and beyond individual-level characteristics.[45]

Conclusion

This is one of the few studies to present HF diagnosis incidence rates separately for the inpatient and outpatient setting in the United States. Associations of modest magnitude were observed between area-level socio-economic factors and incident HF diagnosis across both diagnosis settings. Our findings suggest that among Medicare beneficiaries, the majority of HF diagnoses occur in the inpatient setting. An emphasis on prevention of HF and outpatient HF management of at risk populations, may lead to earlier recognition of HF and reduction of avoidable hospitalization for acute decompensated HF.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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List of abbreviations and acronyms

ARIC	Atherosclerosis Risk in Communities Study
CVD	Cardiovascular disease
CMS	Centers for Medicare and Medicaid Services
CCW	Chronic Conditions Data Warehouse
95% CI	Confidence interval
FFS	Fee-for-service
HF	Heart failure

ICD-9	International Classification of Disease, 9th Revision, Clinical Modification
IR	Incidence rates
IRR	Incidence rate ratios
IRD	Incidence rate differences
MedPAR	Medicare Provider Analysis and Review
SES	Socio-economic status
ZCTA	Zip code tabulation area

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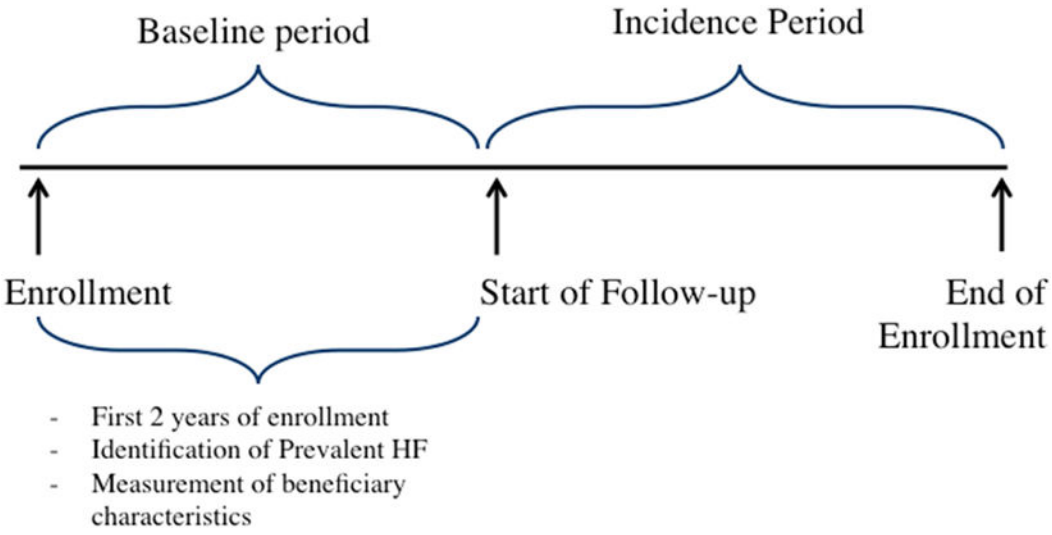

Figure 1.

Study design for estimating incidence of heart failure diagnosis in the inpatient and outpatient setting among CMS Medicare FFS beneficiaries (2001 – 2013).

Footnotes: Abbreviations- FFS (fee-for-service), HF (heart failure)

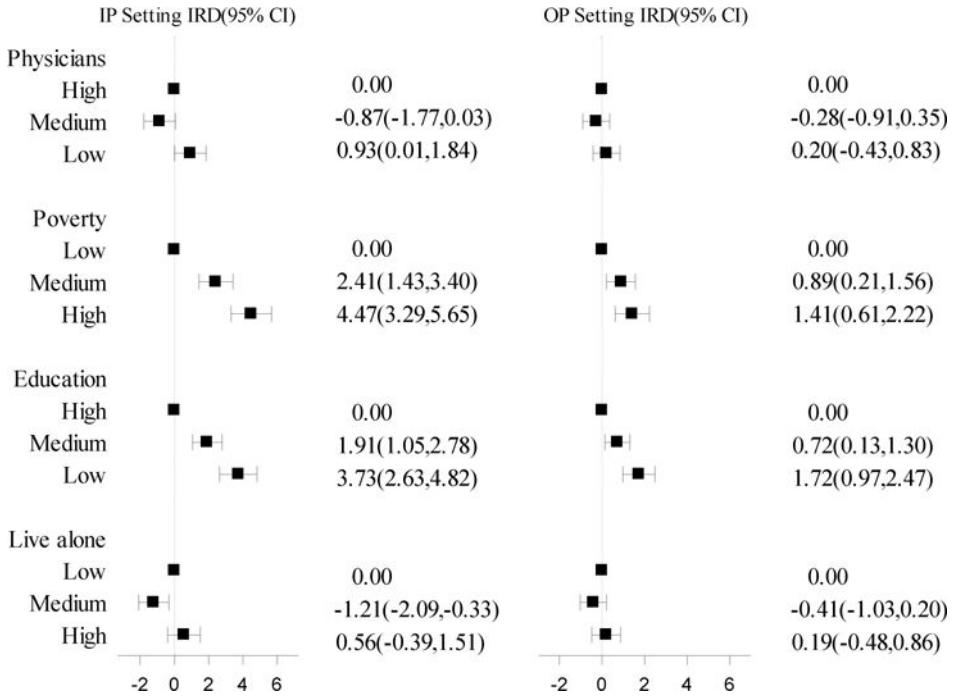

Figure 2.

Incidence rate differences (95% CI) per 1,000 person-years of diagnosis of HF in the inpatient and outpatient setting by area-level SES and access to care factors, CMS Medicare FFS Beneficiaries (2001 – 2013) (IP Setting n=105,013, OP Setting n=97,295).

Footnotes: abbreviations- CI (Confidence Interval), FFS (fee-for-service), HF(Heart Failure), IRD (Incidence Rate Difference), IP (Inpatient), OP (Outpatient), SES (Socio-Economic Status). Category boundaries: physicians (number of primary care physicians per 100,000 population), low (0-29.4), medium (29.5-78.6), high (78.7-400); poverty (proportion > 65 in poverty) low (0 - 0.054), medium (0.055–0.088), high (0.089-0.370); education (proportion > 65 with > high school education) low (0-0.25), medium (0.25-0.42), high (0.43-0.78); live alone (proportion > 65 that live alone) low (0-0.27), medium (0.28-0.31), high (0.32-0.60).

Table 1

CMS Medicare FFS beneficiary participant characteristics by setting of incident HF diagnosis (2001 – 2013) (n=109,756).

	Inpatient HF Diagnosis (N=12,461)	Outpatient HF Diagnosis (N=4,743)	No HF (N=92,552)
Age at entry to cohort, mean years (SD)	76.2 (7.6)	75.0 (7.3)	71.6 (7.2)
Age at diagnosis, mean years (SD)	81.7 (7.6)	80.3 (7.5)	NA
Male, N (%)	4,735 (38.0)	2,122 (44.7)	36,512 (39.5)
African American, N (%)	2,111 (16.9)	700 (14.8)	15,124 (16.3)
Comorbidities [*], **N (%)**			
Hypertension	7,951 (63.8)	2,963 (62.5)	51,635 (55.8)
Diabetes	3,141 (25.2)	1,172 (24.7)	16,033 (17.3)
Coronary atherosclerosis	3,265 (26.2)	1,478 (31.2)	12,227 (13.2)
Atrial fibrillation/Atrial flutter	1,420 (11.4)	654 (13.8)	4,190 (4.5)
Cardiac dysrhythmias	1,627 (13.1)	674 (14.2)	8,728 (9.4)
Heart valve disorder	1,007 (8.1)	431 (9.1)	3,918 (4.2)
Acute myocardial infarction	146 (1.2)	79 (1.7)	588 (0.6)
Conduction disorder	638 (5.1)	260 (5.5)	2,256 (2.4)
Pneumonia	871 (7.0)	277 (5.8)	3,868 (4.2)
COPD exacerbations	437 (3.5)	135 (2.9)	1,621 (1.8)
Anemia	1,322 (10.6)	409 (8.6)	6,249 (6.8)
Total number of comorbidities, mean (SD)	2 (0,3)	2 (1,3)	1 (0,1)
Healthcare encounters [*], [†], median number of visits (P25, P75)			
Inpatient setting	0 (0,1)	0 (0,1)	0 (0,0)
Outpatient setting	13 (8,21)	14 (9,22)	11 (6,18)
To primary care providers[§]	7 (3,11)	8 (4,11)	5 (2,9)
To cardiologists	0 (0,0)	0 (0,1)	0 (0,0)
Area-level characteristics, mean (SD)			
Number of primary care physicians [‖]	52.9 (24.6, 88.2)	53.1 (24.6, 88.2)	47.1 (24.6, 88.2)
Proportion in poverty[#]	0.09 (0.06)	0.09 (0.06)	0.09 (0.06)
Proportion > high school education[#]	0.35 (0.16)	0.34 (0.16)	0.36 (0.17)
Proportion live alone[#]	0.30 (0.06)	0.29 (0.06)	0.29 (0.06)

[*] Measured during the baseline period (first two years of enrollment)

[†] Number of visits over two years

[§] Includes general practice, family practice, internal medicine, nurse practitioner, and multi-specialty clinic providers

[‖] Per 100,000 population

[#] For 65 years and older population

Abbreviations: COPD (chronic obstructive pulmonary disease), FFS (fee-for-service), HF (heart failure), IP (inpatient), OP (outpatient), P25 (25th percentile), P75 (75th percentile), SD (standard deviation)

Table 2

Standardized HF incidence rates in the inpatient and outpatient setting by age, gender, and race, CMS Medicare FFS beneficiaries (2001 – 2013).

	N	Number of events	Person-years	Standardized IR*, † (95% CI)
Inpatient Heart Failure				
Overall	105,013	12,461	504,504	35.8 (35.1, 36.5)
Age group				
65 – 74	70,344	5,438	356,893	18.2 (17.7, 18.8)
75 and older	34,669	7,023	147,611	50.2 (49.0, 51.4)
Gender				
Male	41,247	4,735	193,578	37.8 (36.5, 39.1)
Female	63,766	7,726	310,926	34.7 (33.8, 35.5)
Race				
White	87,778	10,350	433,685	35.0 (34.3, 35.8)
African	17,235	2,111	70,818	40.9 (38.9, 42.8)
American				
Outpatient Heart Failure				
Overall	97,295	4,743	476,526	13.9 (13.5, 14.4)
Age group				
65 – 74	67,279	2,373	343,882	8.12 (7.70, 8.50)
75 and older	30,016	2,370	132,644	18.7 (17.9, 19.5)
Gender				
Male	38,634	2,122	183,771	17.1 (16.2, 18.0)
Female	58,661	2,621	292,755	12.3 (11.8, 12.8)
Race				
White	81,471	4,043	410,385	14.0 (13.5, 14.5)
African	15,824	700	66,141	13.7 (12.5, 14.9)
American				

*per 1,000 person-years

†Standardized to the 2003 National CMS Medicare population

Abbreviations: FFS (fee-for-service), HF (heart failure), IR (incidence rate), CI (confidence interval)