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Mortality and Readmission Rates in Patients Hospitalized for Acute Decompensated Heart Failure: A Comparison Between Cardiology and General-Medicine Service Outcomes in an Underserved Population

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ABSTRACT

Background: With recent legislation imposing penalties on hospitals for above-average 30-day all-cause readmissions for patients with acute decompensated heart failure (ADHF), there is concern these penalties will more heavily impact hospitals serving socioeconomically vulnerable and underserved populations.
Hypothesis: Patients with ADHF and low socioeconomic status have better postdischarge mortality and readmission outcomes when cardiologists are involved in their in-hospital care.
Methods: We retrospectively searched the electronic medical record for patients hospitalized for ADHF from 2001 to 2010 in 3 urban hospitals within a large university-based health system. These patients were divided into 2 groups based on whether a cardiologist was involved in their care or not. Measured outcomes were 30- and 60-day postdischarge mortality and readmission rates.
Results: Out of the 7516 ADHF patients, 1434 patients were seen by a cardiologist (19%). These patients had lower 60-day mortality (5.4% vs 7.0%; hazard ratio [HR]: 0.70, 95% confidence interval [CI]: 0.52-0.96, $P=$ 0.034) and lower 30- and 60-day readmission rates (16.7% vs 20.6%; HR: 0.76, 95% CI: 0.66-0.89, $P=0.002$, and 26.1% vs 30.2%; HR: 0.81, 95% CI: 0.72-0.92, $P=0.003$, respectively). There was no significant difference in the in-hospital mortality between the 2 groups. Compared with other races, whites with systolic HF have marginally lower HF-related readmission rates when treated by cardiologists.
Conclusions: In this cohort of ADHF patients from the Bronx, New York, involvement of a cardiologist resulted in improved short-term mortality and readmission outcomes compared with treatment by general internal medicine.

Background

Acute decompensated heart failure (ADHF) accounts for >1 million hospital admissions annually, with >25% of these patients getting readmitted within 30 days of discharge.[1,2] Under the Affordable Care Act, hospitals are now penalized for above-average 30-day all-cause readmission rates for Medicare patients with heart failure (HF),[3] with the first group of penalties levied on >2000 hospitals in October 2012.[4] There is a growing concern, however, that such metrics may unfairly impact hospitals serving the most vulnerable, namely low-income, minority, and underserved patient populations.[5,6]

In light of these developments, we investigated the impact of involving a specialist, namely a cardiologist, on important clinical endpoints including 30-day and 60-day mortality and readmission rates in patients admitted for ADHF to several hospitals serving the Bronx, New York. Previous studies have yielded conflicting results,[7–11] and none have focused on a largely minority and socioeconomically vulnerable population.

Methods

Study Population

All patients seen at 3 distinct hospitals within the Montefiore Medical Center (MMC) health system, a large university

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hospital system in the Bronx, New York, and diagnosed with HF over a 10-year period (from January 2001 to December 2010) were screened (>48 000 patients). Patients admitted to the hospital with ADHF as an admission diagnosis based on the *International Classification of Diseases, Ninth Revision* (ICD-9) codes 428.x, 402.x1, 404.x1, and 404.x3 were selected for analysis. The earliest or the only admission in the study period was taken as the index admission. A list including all cardiology attending physicians who worked in the hospitals during the study period (cardiologists) was created. The previously identified patients were divided into 2 groups based on the specialty of the treating physician. One group consisted of those who received care from the cardiologists during the index hospitalization (the cardiologists group), and all other patients treated by general internal medicine physicians without the involvement of specialized cardiology services were included in the other group (the generalists group). Involvement of the cardiology service was considered if the patient was consulted on, admitted, or discharged by one of the cardiologists.

A subgroup of patients with systolic HF was defined as those with an echocardiogram showing a left ventricular ejection fraction (LVEF) <50% within 1 year of the index admission. These patients were also divided into the 2 groups (cardiologists vs generalists), as described above.

Patients who had cardiac transplant or ventricular assist devices were excluded, as were those who received inotropes or vasopressor agents during the index hospitalization. Out of 7932 hospital admissions initially screened for this study, 416 admissions were found to be elective admissions and were excluded from the main cohort. Most of the elective admissions were in the cardiologists group and were for device placement, including automatic implantable cardioverter-defibrillator (AICD) and cardiac resynchronization therapy (CRT). The Committee on Clinical Investigations at the Albert Einstein College of Medicine and MMC approved the study.

Data Extraction

Clinical Looking Glass (CLG; Emerging Health Information Technology, Yonkers, NY), an interactive software application developed at MMC that integrates clinical and administrative datasets, was used to retrospectively interrogate the electronic medical records of 3 separate hospitals within the health system, which constitute a total capacity of 1491 beds.

Manual verification of all the electronically collected data was performed to confirm that ADHF was indeed the admission diagnosis. Further verification of this data was performed on a randomly selected sample to verify how many admissions qualify as ADHF based on Framingham criteria.[12] This sample included 547 patients (about 7% of the total study population) and represented both groups equally. Out of these patients, 241 patients belonged to the systolic HF subgroup (about 9% of patients in this subgroup). Any admission that fulfilled ≥2 major criteria or 1 major criterion and 2 minor Framingham criteria was considered a true ADHF admission.

Study Endpoints

We evaluated 30-day and 60-day all-cause mortality from the index date (date of discharge from index admission), as well as 30-day and 60-day readmission rates (both all-cause and HF-specific). Mortality data were tracked through CLG, which merges hospital death records with the Social Security Death Registry on a monthly basis. Additionally, we assessed the trends of prescribing HF-specific medication in both groups over the 10-year study period. Race, defined as white vs all others, was evaluated for a possible role in modifying the effect of specialty care on outcomes.

Statistical Analyses

Baseline patient characteristics and clinical data are summarized using descriptive statistics: mean (SD) for continuous variables and frequency (%) for discrete variables. Because outcomes of patients treated by the same provider are likely to cluster, we took into account the possibility of such clustering by employing the generalized estimating equations approach in the univariate comparison of baseline characteristics between cardiologist and generalist groups, as well as in the comparison for the in-hospital mortality.[13] Likewise, marginal Cox regression model was used for both crude and adjusted analysis of 30-day and 60-day mortality and readmission outcomes. Adjustment was made for prespecified important potential confounders such as age, ischemic heart disease, hypertension, diabetes mellitus, atrial fibrillation, blood pressure, sex, type of HF, creatinine, heart rate, and LVEF. In the entire group comparison, multiple imputations were employed to handle the missing LVEF, heart rate, and creatinine data.[14] To address the possibility that postdischarge mortality might differ strictly as a result of differences in in-hospital mortality (ie, the possibility that the sicker patients died in the hospital, thereby improving overall postdischarge survival for survivors), we compared in-hospital mortality as binary outcomes between the 2 groups. Prespecified effect modification was assessed by employing a formal test for interaction. Additionally, the Elixhauser scoring system was used to compare the patients' comorbidities between the study groups.[15] This ICD-9–based score was employed as a surrogate for disease burden and a basis for propensity-adjusted assessment of pattern of HF medications prescription over time. Results are summarized as hazard ratios (HR), or odds ratio (OR) in case of in-hospital mortality, and 95% confidence intervals (CI). A P value ≤0.05 was considered statistically significant.

Results

Baseline Characteristics of the Main Group

Baseline characteristics for all patients included in the cohort are shown in Table 1. Mean age for the 7516 patients included in the study was 71.1 years. Overall, 65% of the entire cohort was either Hispanic or African American (31.7% and 33.5%, respectively). The group of patients seen by cardiologists constituted 19% of the study population (1434 patients). This group included younger patients, more males, fewer African-Americans, and more patients with systolic HF, ischemic heart disease, and atrial fibrillation.

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Table 1. Baseline Characteristics

	Main Group			Systolic HF Subgroup		
	Cardiologists	Generalists	*P* Value[a]	Cardiologists	Generalists	*P* Value[a]
Total no. of patients	1434 (19)	6082 (81)		639 (23)	2116 (77)	
Age, y	67.7 ± 14.1	72 ± 14.7	<0.001	66.3 ± 14	70.0 ± 15.1	0.343
Female sex	667 (47)	3470 (57)	<0.001	259 (41)	977 (46)	0.009
Other races						
Hispanics	490 (34)	1896 (31)	0.067	254 (40)	710 (34)	0.011
African American	424 (30)	2099 (35)	<0.001	202 (32)	809 (38)	0.002
CAD	1016 (71)	3805 (63)	<0.001	485 (76)	1591 (75)	0.476
Hypertension	1192 (83)	5249 (86)	<0.001	547 (86)	1855 (88)	0.084
DM requiring Rx	771 (54)	3367 (55)	0.481	374 (59)	1183 (56)	0.087
MI	34 (2)	120 (2)	0.098	24 (4)	67 (3)	0.155
AF	558 (39)	2207 (36)	0.002	258 (40)	810 (38)	0.072
Systolic HF, LVEF <50%	750 (52)	2120 (35)	<0.001	639 (100)	2116 (100)	—
HF with preserved LVEF	149 (10)	2497 (41)	<0.001	0 (0)	0 (0)	—
No documented LVEF	444 (31)	1464 (24)	<0.001	0 (0)	0 (0)	—
Heart rate, bpm	80 ± 17	82 ± 16	<0.001	82 ± 18	84 ± 16	0.002
SBP, mm Hg	135 ± 26	141 ± 26	<0.001	132 ± 25	139 ± 25	<0.001
DBP, mm Hg	75 ± 16	78 ± 16	<0.001	76 ± 17	80 ± 17	<0.001
ProBNP values	10 168 ± 19 042	9005 ± 16 525	0.568	11 100 ± 22 316	12 457 ± 20 303	0.653
BUN, mg/dL	29.8 ± 18.2	29.8 ± 33.2	0.965	30.3 ± 19	29 ± 18.2	0.016
Cr, mg/dL	1.39 ± 0.64	1.37 ± 0.69	0.111	1.4 ± 0.62	1.4 ± 0.67	0.990
Serum Na, mg/dL	138.8 ± 4.1	138.7 ± 4.6	0.842	139 ± 4.0	139 ± 4.3	0.493
LVEF, %	42.2 ± 17.0	49.0 ± 16.3	0.101	32.5 ± 11.7	34.5 ± 11.9	<0.001
Length of stay, d	6.4 ± 5.3	6.4 ± 6.2	0.771	6.4 ± 5.0	6.4 ± 6.0	0.960
Verified using Framingham score, %	94	92	0.89	98	96	0.91
Elixhauser score	4.7 ± 3.1	4.8 ± 3.0	0.286	4.9 ± 3.0	4.9 ± 3.1	0.127
Echocardiography	964 (67)	4617 (76)	<0.001	639 (100)	2116 (100)	—
Use of HF medications and devices						
ACEIs/ARBs	912 (64)	3408 (56)	<0.001	421 (66)	1387 (65)	0.993
β-Blockers	1006 (70)	3668 (60)	<0.001	483 (76)	1539 (73)	0.158
Spironolactone	260 (18)	679 (11)	<0.001	145 (23)	400 (19)	0.024
Hydralazine/nitrates	87 (6)	311 (5)	0.103	62 (10)	175 (8)	0.182
AICD, %[b]	—	—	—	51	30	<0.001
CRT, %[b]	—	—	—	23	8	0.005

Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; AF, atrial fibrillation; AICD, automatic implantable cardioverter-defibrillator; ARB, angiotensin II receptor blocker; BUN, blood urea nitrogen; CAD, coronary artery disease; Cr, creatinine; CRT, cardiac resynchronization therapy; DBP, diastolic blood pressure; DM, diabetes mellitus; GEE, generalized estimating equations; HF, heart failure; LVEF, left ventricular ejection fraction; MI, myocardial infarction; Na, sodium; proBNP, pro-brain natriuretic peptide; Rx, medical treatment; SBP, systolic blood pressure; SD, standard deviation. Values are reported as mean ± SD for continuous data and frequency (%) for categorical data.

[a] *P* value from GEE model. [b] The use of AICD and CRT percentage was calculated from the eligible patients with LVEF <35%.

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Table 2. The Rate of Prescribing HF Medications in the Systolic HF Subgroup Over the 10-Year Study Period

	2001–2003	2004–2006	2007–2010	*P* Value (Unadjusted)	*P* Value (Adjusted)[a]
ACEIs/ARBs					
Cardiologists	59	69	71	0.82	0.67
Generalists	63	65	68		
β-Blockers					
Cardiologists	67	78	84	0.95	0.39
Generalists	62	73	79		
Spironolactone					
Cardiologists	14	27	29	0.99	0.67
Generalists	15	20	21		
Hydralazine/nitrates					
Cardiologists	5	6	20	0.37	0.28
Generalists	2	5	14		

Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker; HF, heart failure.
Data are presented as the % of patients prescribed the medication upon discharge out of the total number of patients included in the group in a given period.
[a]*P* value for assessing interaction between specialty and time (ie, time period) in looking at medication prescription patterns. Adjustment for disease severity was made using propensity score. Propensity score was defined as the predicted probability of being in the highest quartile of Elixhauser comorbidity score using all baseline characteristics listed in Table 1.

Heart failure–optimizing medications including β-blockers, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, and spironolactone were more frequently prescribed by the cardiologists. The mean Elixhauser comorbidity index score was identical between the 2 groups, indicating that there was no significant difference in the comorbid conditions recorded in the patients' problem list. In the random sample selected and checked for Framingham HF criteria, the diagnosis of ADHF was confirmed in 92.5% of patients in the main cohort (94% of the sample from the cardiologists group sample vs 92% from the generalists group sample).

Systolic HF Subgroup

The total number of patients in this subgroup was 2755, with mean age of 68.8 years, 71.7% of whom were either Hispanic or African American (35.0% and 36.7%, respectively). Mean LVEF was 34%, with ischemic cardiomyopathy reported in 75% of the patients.

Patients in the cardiologists group constituted 23% of the systolic HF subgroup (639 patients). These patients were significantly more likely to be male and Hispanic and less likely to be African American, with lower mean LVEF compared with their counterparts in the generalists group. Mean age and comorbidity index comparison did not differ significantly between the 2 groups, with 97% of the patients meeting Framingham HF criteria (98% in the cardiologists group vs 96% in the generalists group).

Although spironolactone was more frequently prescribed by cardiologists, the prescription rates of the remainder of the HF medications did not differ significantly between the groups (Table 2). Beyond the overall differences in HF medication use, we also assessed the trend in the prescription of HF medications over the 10-year study period (Table 2), which was divided into 3 time intervals to evaluate changes in prescription patterns over time coinciding with updates in the HF guidelines (2001, 2005, 2009), introduction of a new evidence-based HF class of medication (2001–2003: β-blocker and spironolactone data integrated; 2004–2006: African American Heart Failure Trial [A-HEFT] published), or the implementation of the American Heart Association (AHA) practice-modification initiative Get With The Guidelines (2004–2006).[16–21] Although there was an overall increase in the prescription rates of all HF medication classes in both groups during the study period, a noticeable surge in the percentage of patients receiving prescriptions for spironolactone was noted in both groups in the second time period (2004–2006) compared with the first (2001–2003), as well as an increase in the percentage of patients getting a prescription for hydralazine/nitrates in the latest time period (2007–2010) compared with earlier time periods. None of the changes, however, reached statistical significance.

Clinical Outcomes

Mortality: Of the 7516 patients in this study, 305 patients (4%) were lost to follow-up for mortality data (26 from the cardiologists group and 279 from the generalists group). All-cause mortality rate at 60 days postdischarge was lower in the cardiologists group as compared with the generalists group, in both the main study group (HR: 0.70, 95% CI: 0.52-0.96, $P = 0.034$), as well as the systolic HF subgroup (HR: 0.56, 95% CI: 0.36-0.89, $P = 0.021$) on multivariable analysis (Table 3). There was no statistically significant

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Table 3. Outcomes Analysis

	Cardiologists	Generalists	Univariate Models		Multivariable Models[a]	
			HR (95% CI)	*P* Value	HR (95% CI)	*P* Value
Main group						
In-hospital mortality[b]	23 (1.6)	186 (3.1)	—	—	—	—
30-day postdischarge						
All-cause mortality	38 (2.7)	224 (3.8)	0.70 (0.47-1.05)	0.064	0.63 (0.41-1.01)	0.054
All-cause readmission	236 (16.7)	1212 (20.6)	0.79 (0.67-0.93)	0.002	0.76 (0.66-0.89)	0.002
HF readmission	205 (14.5)	1065 (18.1)	0.78 (0.66-0.94)	0.003	0.74 (0.63-0.87)	0.001
60-day postdischarge						
All-cause mortality	76 (5.4)	410 (7.0)	0.77 (0.57-1.04)	0.057	0.70 (0.52-0.96)	0.034
All-cause readmission	368 (26.1)	1783 (30.2)	0.83 (0.72-0.96)	0.004	0.81 (0.72-0.92)	0.003
HF readmission	332 (22.8)	1568 (26.6)	0.83 (0.71-0.97)	0.008	0.81 (0.70-0.91)	0.003
Systolic HF group						
In-hospital mortality[b]	8 (1.3)	48 (2.3)	—	—	—	—
30-day postdischarge						
All-cause mortality	16 (2.5)	88 (4.3)	0.59 (0.37-0.95)	0.041	0.56 (0.32-1.00)	0.051
All-cause readmission	109 (17.3)	467 (22.6)	0.74 (0.60-0.91)	0.004	0.74 (0.60-0.91)	0.009
HF readmission	103 (16.3)	436 (21.1)	0.75 (0.59-0.95)	0.011	0.76 (0.61-0.95)	0.022
60-day postdischarge						
All-cause mortality	26 (4.1)	149 (7.2)	0.56 (0.36-0.88)	0.009	0.56 (0.36-0.89)	0.021
All-cause readmission	177 (28.1)	681 (32.9)	0.81 (0.69-0.95)	0.013	0.82 (0.70-0.96)	0.023
HF readmission	164 (26.0)	635 (30.7)	0.81 (0.67-0.98)	0.022	0.81 (0.68-0.97)	0.028

Abbreviations: AF, atrial fibrillation; BP, blood pressure; CI, confidence interval; Cr, creatinine; DM, diabetes mellitus; HR, hazard ratio; LVEF, left ventricular ejection fraction.
Data are presented as frequency of events (%) and HR (95% CI). In all analyses, the generalists group was taken as the reference group.
[a]Adjusted for age, ischemic heart disease, hypertension, DM, AF, BP, race, sex, type of HF, imputed Cr, imputed heart rate, and imputed LVEF. [b]Cox proportional hazards model was used to adjust for important potential confounders.

difference in mortality between the 2 groups at 30 days. In-hospital mortality was calculated and showed no significant differences between the 2 groups after multivariable adjustment (cardiologists vs generalists analysis showed in-hospital mortality of 1.6% vs 3.1%; OR: 0.60, 95% CI: 0.37-1.01, $P = 0.055$ in the main group, and 1.3% vs 2.3%; OR: 0.68, 95% CI: 0.29-1.62, $P = 0.4$ in the systolic HF subgroup).

Readmission: All-cause 30-day and 60-day readmission rates were lower in the cardiologists group compared with the generalists group (HR: 0.76, 95% CI: 0.66-0.89, $P = 0.002$ and HR: 0.81, 95% CI: 0.72-0.92, $P = 0.003$, respectively). Thirty-day and 60-day HF-related readmission rates were also significantly lower in the cardiologists group as compared with the generalists group. Additionally, in the systolic HF subgroup, thirty-day and 60-day readmission rates, both all-cause readmissions as well as HF-related readmissions, were also significantly lower for the cardiologist-treated group (Table 3).

Differential Effect by Race

We investigated the possibility of differential effect by race (Table 4), defined as white vs all other races, with the reported outcomes. Race did not seem to modify the effect of cardiologist intervention in the main group; however, in the systolic HF subgroup, cardiologist intervention seemed to have a more favorable effect on the 30-day and 60-day HF-related readmission rates in whites compared with all other races ($P = 0.04$ and $P = 0.05$ for the 30-day and 60-day readmission rates, respectively).

Discussion

We report the impact of the treating-physician specialty on clinical outcomes for patients admitted for ADHF at 3 hospitals within an urban university health system in the Bronx, New York, one of the poorest counties in the country, with a large minority population and significant burden of cardiovascular disease.[22,23] We found significantly decreased 30-day and 60-day all-cause and HF readmission,

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Table 4. Interaction of Race With Physician Specialty[a]

	Main Group			Systolic HF Subgroup		
	HR (95% CI)	*P* Value[b]	*P* Value[c]	HR (95% CI)	*P* Value[b]	*P* Value[c]
30-day all-cause mortality						
Cardiologists, white	0.56 (0.30-1.04)	0.078	0.48	0.39 (0.14-1.08)	0.082	0.29
Cardiologists, other	0.74 (0.43-1.27)	0.28		0.75 (0.39-1.43)	0.39	
30-day all-cause readmission						
Cardiologists, white	0.66 (0.47-0.91)	0.019	0.26	0.49 (0.29-0.83)	0.013	0.10
Cardiologists, other	0.80 (0.69-0.94)	0.009		0.82 (0.65-1.04)	0.12	
30-day HF readmission						
Cardiologists, white	0.58 (0.40-0.84)	0.008	0.12	0.46 (0.27-0.78)	0.009	0.04
Cardiologists, other	0.80 (0.68-0.94)	0.013		0.86 (0.67-1.09)	0.23	
60-day all-cause mortality						
Cardiologists, white	0.62 (0.38-1.03)	0.078	0.47	0.46 (0.19-1.12)	0.10	0.53
Cardiologists, other	0.79 (0.54-1.14)	0.21		0.64 (0.38-1.09)	0.11	
60-day all-cause readmission						
Cardiologists, white	0.71 (0.56-0.91)	0.011	0.22	0.58 (0.39-0.87)	0.014	0.09
Cardiologists, other	0.85 (0.74-0.97)	0.022		0.89 (0.73-1.08)	0.24	
60-day HF readmission						
Cardiologists, white	0.65 (0.49-0.85)	0.004	0.08	0.54 (0.35-0.82)	0.008	0.05
Cardiologists, other	0.85 (0.73-0.98)	0.036		0.89 (0.73-1.09)	0.27	

Abbreviations: AF, atrial fibrillation; BP, blood pressure; CI, confidence interval; Cr, creatinine; DM, diabetes mellitus; HF, heart failure; HR, hazard ratio; LVEF, left ventricular ejection fraction.
All comparisons are adjusted for age, ischemic heart disease, hypertension, DM, AF, BP, race, sex, type of HF, imputed Cr, imputed heart rate, and imputed LVEF.
[a]Race is categorized as white vs others. [b] For comparison within group as defined by race. [c] For interaction of race and physician specialty.

as well as 60-day postdischarge mortality, for those patients treated by cardiologists as compared with those treated by general internal medicine physicians. Additionally, there was a trend toward a reduction in 30-day postdischarge mortality, though this did not reach statistical significance.

Despite the health implications and financial impact that ADHF has on society, with >1 million ADHF admissions occurring annually—a number that has significantly increased over the last 30 years[24]—the vast majority of these patients are not under the care of cardiologists in the acute setting.[25] Recently, Kociol et al performed the largest US-based analysis evaluating the effect of using hospitalists on quality measures and clinical outcomes, namely 30-day mortality and readmission rates, in >31 000 Medicare claims for patients admitted with HF across 166 hospitals.[11] Overall, after adjustment, there was no difference in 30-day readmission rates, though there was a small but statistically significant increase in 30-day mortality (risk ratio: 1.03, 95% CI: 1.00-1.06, $P = 0.02$) associated with increasing rates of hospitalist care. There was also a minimal decrease in length of stay (0.09 days; 95% CI: 0.02 to 0.16) associated with hospitalist care. The involvement of cardiologists in the care of acute HF patients did not show a significant improvement in the short-term outcomes either, though there appeared to be a synergy in the hospitals with the greatest use of both hospitalist and cardiologist care in leading to better adherence to established HF quality measures.

Our study findings highlight differences from the Kociol et al study. First, our study did not strictly focus on hospitalist care per se, but rather on cardiologist-centered care vs general internal medicine–centered care. Second, and more important, our cohort is composed largely of a minority population from a socioeconomically depressed region, compared with Kociol et al, whose cohort included a significantly higher percentage of whites (83.2%), with only 11.1% of the cohort identified as African American. Our findings suggest that the findings of Kociol et al (as the authors themselves note) may therefore not be generalizable to minority and socioeconomically vulnerable populations. In fact, inpatient care comprises a substantial proportion of care in patients with low socioeconomic strata,[26] as such patients have more limited access to preventive care or outpatient specialist care due to the complexity of the referral process as well as other insurance-related barriers. Thus, these patients may be

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more likely to present in the decompensated state, as recently described by Bikdeli et al, showing that HF patients who live in neighborhoods with lower socioeconomic status were more likely to be readmitted at 6 months.[27] This might explain why in-hospital cardiologist intervention is more essential to improve outcomes in this population, compared with other populations with better access to health care resources. Interestingly, however, the possibility of effect modification by race was investigated and did not show a significant contribution to mortality or readmission outcomes in the overall population.

Heart Failure Medications and Devices

In the main cohort, we found that the overall rate of prescription of HF medications was significantly higher in the cardiologists group (with the exception of hydralazine/nitrates). In the systolic HF subgroup, there was no statistically significant difference between the 2 groups. On review of the change of the rate of HF medication prescription over time, although there was an increase in the rate of spironolactone prescription in the second period of the study (2004 and beyond) that may correlate with the adoption of the results of the Randomized Aldactone Evaluation Study (RALES) and the 2001 HF guidelines,[16] along with a similar increase in the prescription rates of hydralazine/nitrates following the A-HEFT trial,[19] the 2005 and 2009 HF guidelines, and the launching of the AHA Get With The Guidelines initiative,[18,20,21] none of these percentages showed a statistically significant difference between the 2 groups, whether in the overall prescription rates or when these rates were compared over time.

The use of implantable devices, including AICD and CRT in patients with LVEF <35%, was significantly higher in the cardiologists group. We performed detailed analyses to verify the role of these devices on the reported outcomes by including AICD/CRT in the multivariable analysis, which resulted in 7% to 9% reduction in the estimated effect of specialty on postdischarge mortality, whereas AICD/CRT remained statistically significant with a substantial protective effect both for 30-day and 60-day mortality. Moreover, further restricting the analysis to patients with an LVEF ≤35% resulted in a similar trend, albeit with a more pronounced effect of specialty on postdischarge mortality (13% to 19% reduction) and a pronounced protective effect associated with AICD/CRT. In all these additional analyses, no evidence of effect modification of specialty effect by AICD/CRT is observed. The difference in AICD/CRT use was the only significant variable between the 2 groups to most likely drive the differences in outcomes; other possible contributors might include factors that cannot be reliably verified using the current database but are suggested in the recent literature, including incomplete in-hospital diuresis and neurohormonal stabilization, poor coordination of services, and poor communication of discharge plans to patient and caregiver.[28]

Study Limitations

Our study has several important limitations. As this is a retrospective observational study in nature, it is limited by the usual constraints of such a study design. It was not possible to determine exactly why the cardiology service was involved in the care of a specific patient. Also, as this study includes patients from a single health system in the Bronx, New York, its findings may not be generalizable to all settings. It is important to note, however, that the data were drawn from several distinct hospitals within the health system, mitigating the single-center nature of the study. Additionally, data were obtained from an administrative database, and therefore may be incomplete or inaccurate,[29] though such data have been used previously for hospitalizations related to cardiovascular disease and other conditions.[30,31] To mitigate this, we randomly reviewed a fairly sizable patient data to verify the accuracy of the administratively derived information, and by using the Framingham criteria we were able to establish the accuracy of the diagnosis of ADHF in >90% of cases. Other limitations include our inability to assess concordance in language between the patient and the provider, as this might have partly explained our finding; inability to measure adherence to prescribed HF medications postdischarge; and the inability to track medication prescription, follow-up, and readmissions at other institutions outside the MMC health system. However, mortality data remain unaffected by this concern, as mortality was ascertained via the Social Security Death Registry.

Conclusion

Our study found significant improvements in outcomes in hospitalized ADHF patients who are treated by cardiologists as compared with those treated by general internal medicine physicians. As a glimpse into the trends at a large, urban, university health system, it sheds light on the experience of a socioeconomically vulnerable population. Given the enormous impact of ADHF, and the legislation penalizing hospitals with excessive 30-day readmissions—with specific concern that this legislation might unevenly affect hospitals serving the most underserved—this study highlights the importance of creating novel strategies to involve specialty care in the care of all patients with ADHF in an attempt to ensure improved outcomes in this patient population. Such approaches may include cardiologists or cardiology-oriented services (which may include hospitalists and advanced practitioners working alongside or in consultation with a cardiologist) or requiring a follow-up with a cardiologist after discharge for ADHF. Other alternative approaches may focus on improving patient education and discharge planning or enhancing HF-focused continuing medical education for general internal medicine physicians, all of which may ultimately lead to decreased costs and improved care.

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