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Relationship Between Anemia and Health Care Costs in Heart Failure

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Abstract

Background—Anemia is associated with higher morbidity and mortality in patients with heart failure (HF), but its implications for health care costs are not well described.

Methods and Results—We analyzed data on 1056 patients with symptomatic HF seen at Duke University between 2002 and 2006. Health care costs were obtained from the hospital cost accounting data system. Adjustments for censoring and covariate imbalance were performed using inverse probability weighted estimators and propensity scores. The prevalence of anemia was 32%. Unadjusted mortality at 3 years was 50.3% in anemic versus 26.5% in non-anemic patients. The adjusted costs per year alive were \$22,926 for patients with anemia and \$17,189 for those without ($P = .04$). For those with ejection fraction $\geq 40\%$ adjusted costs per year alive were \$32,914 for anemic versus \$18,423 for non-anemic patients ($P = .01$).

Conclusions—Anemia in HF patients was independently associated with greater total costs after accounting for differences in survival, but appeared to be confined primarily to patients with low ejection fraction. These results provide a framework for understanding the economic implications of therapies for anemia in heart failure, and suggest that targeting patients with impaired systolic function has the potential to most favorably affect costs.

Keywords

Heart failure; anemia; resource utilization; costs

In recent years, anemia has been increasingly recognized as a potentially important comorbidity in heart failure. Multiple studies have identified a high prevalence of anemia among heart failure patients, and anemia has been shown to be a powerful risk factor for adverse outcomes in a variety of heart failure populations.^{1–5} It remains unknown whether anemia is simply a marker of more severe heart failure or greater burden of comorbidity, or whether anemia directly influences clinical outcomes in heart failure.⁶ Multiple small studies have suggested a potential beneficial effect of therapies directed specifically at anemia (such as iron supplementation and erythropoietin analogues) on clinical outcomes in heart failure,^{7–9} and an international Phase III study evaluating the effects of the erythropoietin analog darbepoetin on morbidity and mortality in patients with chronic heart failure and anemia is ongoing.¹⁰

Given the observed association between anemia and heart failure outcomes, the extent to which anemia may affect resource utilization and costs in heart failure patients is central to understanding the potential impact of therapies targeted at anemia in this population. Heart failure is associated with significant health care utilization,^{11,12} with costs estimated at \$33.2 billion annually in the United States.¹³ It is expected that heart failure hospitalizations and the associated economic burden will continue to increase at a rapid pace for the near future.¹⁴ Claims data have suggested that anemic heart failure patients may have higher costs than non-anemic patients, but these studies have been limited by inability to perform comprehensive adjustment for other covariates because of lack of clinical detail.^{15,16}

Consequently, we assessed the health care service utilization and associated medical costs for heart failure patients with anemia compared with those without anemia, using a well-characterized contemporary cohort of heart failure patients.

Methods

Participants

The study cohort was selected from the Duke Databank for Cardiovascular Disease (DDCD), an ongoing database of all patients undergoing diagnostic catheterization at Duke University Medical Center since 1969.^{5,17} To select patients receiving contemporary medical therapy and to allow sufficient lag time to collect billing and follow-up data, the study cohort was restricted to subjects enrolled between July 1, 2002, and June 30, 2006. All patients with symptomatic heart failure (New York Heart Association functional Class II-IV)¹⁸ at the time of entry into the database were included, regardless of ejection fraction (EF). This resulted in a cohort of 1522 patients. Subsequently excluded from the cohort were 69 patients because of missing index hemoglobin within 30 days of enrollment, 162 patients with significant valvular disease, and 235 with congenital heart disease. The study was approved by the Duke University Institutional Review Board.

Data Collection

Baseline characteristics, comorbidities, laboratory data, and study results were obtained from the DDCD and the Duke electronic medical record.⁵ Initial service utilization and cost data were obtained from the Duke cost accounting T2 data system, which included diagnosis codes, billing codes, laboratory testing, inpatient medications, transfusions, and procedures. Subsequent health care utilization information was obtained through the Decision Support Repository (through the Duke Cost Accounting Division) for inpatient and outpatient events within Duke University Health System and through annual self-administered questionnaires, with telephone follow-up of non-responders, to include hospitalizations and procedures which occurred outside the Duke system. Vital status was determined from a search of the National Death Index as well as from hospital sources.¹⁹

The recorded hemoglobin at time of enrollment was used to define patients as anemic versus non-anemic according to the World Health Organization definition of anemia (female: hemoglobin <12 g/dL; male: hemoglobin <13 g/dL).²⁰

Data Analysis

Descriptive statistics included medians and interquartile ranges for continuous variables (due to the presence of non-normally distributed values) and percentages for categorical variables. Variables were compared across anemia status using chi-square test or Wilcoxon rank sum test, as appropriate. Statistical significance was determined at the 2-sided alpha = 0.05.

To balance the patient characteristics between the anemic and non-anemic cohorts, propensity score weights were developed using logistic regression. The variables included in the model were age, race, EF, hypertension, chronic kidney disease, history of percutaneous coronary intervention, history of myocardial infarction, non-cardiac Charlson index, glomerular filtration rate, and serum sodium. We applied model-based direct adjustment to assess the adequacy of the propensity score estimates for balancing the baseline characteristics.²¹

Non-Duke system costs were estimated using health care resource utilization data obtained from questionnaires, applying the same associated costs as those within the Duke system. Total costs in the 3 years after the index catheterization were calculated. Costs were subdivided into fixed versus variable, direct versus indirect, and cardiac (medical and surgical) versus non-cardiac as allocated by the Decision Support Repository according to preexisting cost accounting definitions. Cardiac catheterization-related costs were assigned to the cardiac medical category. We prespecified a primary subgroup analysis for impaired systolic function (EF $\leq$ 40%) versus preserved systolic function (EF >40%).²²

Health care services utilization for the non-anemic patient group was compared with the anemic patient group using a modification of the statistical method described by Bang and Tsiatis,²³ with adjustments for censoring and covariate imbalance performed using inverse probability weighted estimators.²⁴ These techniques allow for adjustment of cost differences resulting from measured patient characteristics other than anemia, with the goal of determining the independent contribution of anemia to costs. The inverse weighted estimators were based on partitioning the data into monthly intervals. The estimates were adjusted for variables in the estimated propensity score model. An annual discount rate of 3% was used based on the standard provided by the US Public Health Service. Costs were reported in 2002 USD.²⁵ Because costs per year alive give a better representation of ongoing resource use by surviving patients and thus provide some insight into value,^{26–28} the final primary outcome was adjusted total costs per year alive. Confidence intervals were determined using robust standard error estimates. Bootstrapping was used to generate 95% confidence intervals and *P* values for estimates of cost per year alive. Sensitivity analysis was performed by repeating the main analyses after truncating cost above the 99th percentile, and then separately the 95th percentile, to assess the extent to which outliers were driving the results. SAS version 8.1 or higher was used for all analyses (SAS Institute Inc, Cary, NC).

Results

Study Population

The study cohort consisted of 1056 symptomatic heart failure patients from the DDCD who met the predefined inclusion and exclusion criteria. The median hemoglobin was 13.7 mg/dL (25th, 75th: 12.3, 14.7) for men and 12.7 mg/dL (25th, 75th: 11.7, 13.7) for women. Thirty-two percent of patients (*n* = 335) met the World Health Organization definition for anemia.²⁰ Comorbidities were common. Anemic patients were more likely to be older, to have an ischemic etiology of heart failure, and to have hypertension, diabetes, and renal dysfunction (Table 1). The majority of patients (58.8%) had heart failure with preserved systolic function. After model-based direct adjustment, the baseline patient characteristics appeared to be adequately balanced (Table 2).

Clinical Outcomes

A total of 133 in the study cohort died over a median follow-up of 435 days. Unadjusted 3-year survival was significantly worse in patients with anemia (49.7% v. 73.5% for non-

anemic patients, $P = .0002$). The adjusted 3-year survival estimates were 58.2% in the anemic group vs. 71.5% in the non-anemic group ($P = .04$). Patients with anemia had a greater number of total inpatient days over the follow-up period (adjusted 3-year means per patient: 16.8 days for anemic vs. 11.3 days for non-anemic, $P = .03$). Increased hospital days for anemic patients appeared to be driven by both trends in longer length of stay and a higher number of total hospitalizations (adjusted 3-year mean rehospitalizations per patient after the index catheterization: 2.9 for anemic vs. 2.6 for non-anemic, $P = .17$). There was no significant difference in revascularization procedures during follow-up for anemic compared with non-anemic patients (adjusted 3-year averages per 100 patients: 32.8 vs. 35.6, $P = .48$).

Unadjusted Costs

The mean 3-year total unadjusted discounted costs trended 27% higher for anemic patients (\$54,525) compared with non-anemic patients (\$42,792) (95% confidence interval for the difference $-\$1773$ to $\$25,239$, $P = .09$; Table 3, Fig. 1A). Median costs outside of the Duke system represented 16% of the total median costs. Inpatient costs accounted 82% of total costs for anemic patients and 83% of total costs for non-anemic patients. Costs were largely driven by a balance of variable direct and fixed indirect costs. Estimated costs were consistently higher for anemic patients compared with their non-anemic counterparts across all of these costing subdivisions at all time intervals analyzed (Table 3). When all International Statistical Classification of Diseases-9 codes directly related to the evaluation and treatment of anemia were grouped, these anemia-specific costs accounted for only 1.5% of the total Duke costs.

Adjusted Costs

The relationships between anemia and costs were minimally changed by adjustment for other baseline differences (Table 4). Adjusted 3-year cumulative costs were \$54,731 for anemic patients compared with \$44,927 for non-anemic patients (95% confidence interval of the difference $-\$4527$ to $\$24,135$, $P = .18$). Differences in costing subdivisions also were not markedly changed by adjustment (Table 4). Although not significant during any period, this trend in total cost difference was apparent during all intervals of follow-up, such that anemic heart failure patients tended to accrue progressively more costs over time in comparison to their non-anemic counterparts (Fig. 1B).

Adjusted Costs per Year Alive

Given the substantially increased mortality associated with anemia, we examined the costs/year alive for anemic patients compared with those without anemia. On average, patients with anemia had significantly fewer years alive (2.39) than non-anemic patients (2.61) over the 3 years after the index catheterization ($P = .005$). The adjusted total cost/year alive was significantly higher for anemic heart failure patients, at \$22,926 for patients with anemia and \$17,189 for those without (difference of \$5737; 95% confidence interval \$247 to \$11,623, $P = .04$; Table 5).

Sensitivity analyses truncating patients whose costs were in the highest 1% and 5% did not significantly alter these results; differences in costs per year alive remained significantly higher for patients with anemia compared with those without, suggesting that extreme outliers were not driving the observed cost differences by anemia status.

Impaired versus Preserved Systolic Function

Among the 435 patients with impaired systolic function (EF $\leq 40\%$), those with anemia trended toward lower 3-year adjusted survival rates compared with those without anemia (55.2% vs. 69.6%, $P = .15$). Among the 621 patients with preserved systolic function (EF

>40%), those patients with anemia trended toward lower 3-year survival (60.2% vs. 73.1%, $P = .12$). For patients with impaired systolic function, adjusted costs per year alive were significantly greater for those patients with anemia (\$32,914/year alive) compared with those patients without anemia (\$18,423/year alive, $P = .01$; Table 5). Conversely, in the group with preserved systolic function, there was no significant difference in adjusted costs/year alive (\$18,069/year alive for those with anemia vs. \$17,265 for those without, $P = .37$; Table 5). The interaction between EF group and anemia status for total cost is shown in Fig. 2A, 2B.

Discussion

Our analysis demonstrates that anemia is associated with increased resource utilization and cost per year alive for patients with heart failure. Although there were significant baseline differences between anemic and non-anemic patients, the observed differences in costs per year alive remained significant after careful adjustment for covariate imbalances. The association of higher medical costs with anemia appeared to increase in magnitude over time, suggesting that anemia status may be linked to a long-term propensity for increased health care utilization. The trend in increased costs associated with anemia in heart failure patients was generally seen across all categories of costs, whether divided by location of care (inpatient vs. outpatient) or by type of care (medical vs. surgical, cardiac vs. non-cardiac). Finally, our data suggest that the increased costs per year alive associated with anemia are particularly marked in heart failure patients with impaired systolic function whereas the increase appears to be marginal in those patients with preserved systolic function.

The majority of costs in our analysis were associated with inpatient care, which is consistent with prior published data.²⁹ Several previous studies have demonstrated increased rates of hospitalization in heart failure patients with anemia, and our data showed a greater number of total hospital days during follow-up for anemic patients compared to non-anemic patients.^{30,31} These data suggest that interventions that decrease hospitalization and length of stay in anemic patients with heart failure could have a major impact on overall costs for this population. Costs directly related to the presence of anemia (such as those associated with blood transfusions, erythropoietin analogs) represented less than 2% of the overall costs for the anemia group, suggesting that the evaluation and treatment of anemia itself did not explain observed differences in costs over time.

Although most previous studies of anemia in heart failure have focused on patients with impaired systolic function, some data suggest that the adverse impact of anemia on survival is present in patients with preserved systolic function as well.⁵ Data from elderly patients in the Cardiovascular Health Study have suggested that overall costs related to heart failure are similar regardless of EF.³² Although our power to look at subgroups was limited by our overall sample size, our study identified a much greater association between anemia and costs in the patient with impaired systolic function. These findings suggest the possibility that efficacious therapy targeting anemic patients with impaired systolic function are more likely to have a significant impact on overall costs.

Our data extend and complement results from studies of administrative claims data. Solid et al compared costs for anemic versus non-anemic Medicare patients with heart failure, and found unadjusted annual costs in 2003 USD at \$21,372 for anemic versus \$13,709 non-anemic.¹⁵ This unadjusted cost ratio of 1.56 was attenuated to 1.25 when adjustment for identifiable covariate imbalance was performed (close to our adjusted cost ratio here of 1.22). Similarly, Nordyke et al showed annual costs in 2000 USD of \$14,535 for anemic versus \$9,451 for non-anemic heart failure patients.¹⁶ Our study design has several

advantages over previous work. Solid et al based their analysis purely on the Medicare 5% sample; therefore, it is focused primarily on costs in an elderly heart failure population. Both previous studies suffer from the limitations inherent in using claims data, which lack characterization of critical covariates (such as EF or creatinine) and the use of diagnostic codes rather than hemoglobin values to characterize anemia. Survival bias was present in these other studies because of censoring of patients who were diagnosed with heart failure but did not survive through the index year. By using a detailed clinical database from within a single large health system, our study was able to characterize costs in a large cohort while also providing detailed adjustment for important clinical differences.

From a societal perspective, the cost implications of our findings are important. Given the estimated prevalence of anemia in the heart failure population (20% to 50% depending on the study), our data suggest that anemia may contribute to several billion dollars of increased health care costs annually in the United States. The presence of anemia in heart failure defines a population not just with increased mortality, but also with increased resource utilization and costs. The adjusted costs per year alive data from our study will provide an essential part of the framework for estimating the potential cost-effectiveness of anemia-targeted therapy in heart failure (eg, erythropoietin analogues, intravenous iron).²⁸

Limitations

Although these data provide unique insight into the costs associated with anemia, our analyses have important limitations. The DDCD is limited to patients undergoing cardiac catheterization, and so our findings may be less applicable to other populations of heart failure patients and the estimates of cost may be biased by studying a population of patients selected for an invasive procedure. Patients in our study were generally younger and were less likely to have substantial renal impairment than other less selected heart failure cohorts, but otherwise were broadly similar.^{31,33} Costs were assessed from a hospital perspective and therefore do not include indirect costs such as lost wages, decreased productivity, and travel that are important from patient and societal perspectives. Although we were able to capture detailed data on cost within the Duke University Health System, our estimations for health care costs outside of the Duke system relied on patient reporting of medical encounters, and are therefore likely to be less precise. The non-Duke costs in our analysis made up a small proportion of overall costs, suggesting that this was unlikely to significantly distort our findings. Specific strengths of our approach include the detailed characterization of baseline differences and the careful adjustment for such differences in our statistical approach in a diverse, contemporary heart failure cohort. We believe these data provide the most comprehensive view to date of the health care costs associated with anemia in heart failure.

Conclusion

In summary, anemia is associated with increased resource utilization and medical costs per year alive in patients with heart failure, even after detailed adjustment for covariate imbalance between anemic and non-anemic heart failure patients. The effect of anemia on costs appears to be confined to patients with impaired systolic function. These results provide a framework for understanding the potential economic implications of therapies targeted at anemia in heart failure.

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Fig. 1.
Cumulative mean costs per patient: (A) unadjusted, (B) adjusted.

Fig. 2.

Adjusted cumulative mean costs per patient stratified by left ventricular systolic function: (A) low ejection fraction (EF $\leq$ 40%), (B) high ejection fraction (EF $>$ 40%).

Table 1

Baseline Characteristics Stratified by Anemia Status

Variable	Anemia Status		P Value
	Anemic n = 335	Non-Anemic n = 721	
Age, y	66 (56–74)	61 (52–70)	<.01
African-American race	33.1%	27.2%	.05
Female	43.9%	44.2%	.91
Ejection fraction, (%)	47.3 (33.6–62.6)	45.7 (29.4–60.9)	.08
Hypertension	76.1%	69.2%	.02
Diabetes	47.8%	35.2%	<.01
Chronic kidney disease	6.3%	1.9%	<.01
Significant coronary stenosis	65.5%	55.1%	<.01
History of MI	35.8%	25.1%	<.01
History of PCI	21.8%	21.2%	.83
History of CABG	28.7%	25.0%	.20
History of cerebrovascular disease	14.0%	10.1%	.06
History of PVD	15.8%	8.9%	<.01
Smoker, past or current	50.1%	49.9%	.95
COPD	10.1%	9.4%	.71
Non-cardiac Charlson index 2+	36.4%	19.7%	<.01
NYHA functional class			.15
Class II	33.7%	39.7%	
Class III	46.6%	43.7%	
Class IV	19.7%	16.6%	
BMI, kg/m ²	28.7 (25.0–34.7)	29.1 (25.4–34.8)	.40
SBP, mm Hg	143 (125–163)	138 (122–156)	.02
Glomerular filtration rate, mL/min	70.9 (48.5–99.1)	90.2 (65.3–115.3)	<.01
Sodium, mmol/L	139 (137–141)	140 (138–142)	<.01

MI, myocardial infarction; PCI, percutaneous coronary intervention; CABG, coronary artery bypass surgery; PVD, peripheral vascular disease; COPD, chronic obstructive pulmonary disease; NYHA, New York Heart Association functional class; BMI, body mass index; SBP, systolic blood pressure; HR, heart rate.

Continuous variables presented as medians; dichotomous variables as percents. *P* values were calculated using either chi-square or Wilcoxon rank sum test.

Table 2

Baseline Characteristics Stratified by Anemia Status after Direct Adjustment

Variable	Anemia Status		P Value
	Anemic n = 335	Non-Anemic n = 721	
Age, y	61.5	62.4	.49
African-American race	31.8%	30.4%	.70
Female	43.9%	46.7%	.46
Ejection fraction, (%)	45.5	45.8	.79
Hypertension	71.9%	72.7%	.84
Diabetes	37.1%	38.9%	.63
Chronic kidney disease	4.0%	4.5%	.78
Significant coronary stenosis	59.7%	56.4%	.39
History of MI	28.3%	28.6%	.92
History of PCI	22.9%	21.8%	.75
History of CABG	26.9%	24.9%	.55
History of cerebrovascular disease	11.1%	12.5%	.55
History of PVD	10.9%	11.6%	.75
Smoker, past or current	50.4%	48.4%	.61
COPD	8.4%	9.6%	.56
Non-cardiac Charlson index 2+	25.3%	26.3%	.76
NYHA functional class			
Class II	38.1%	36.6%	.71
Class III	44.6%	46.1%	.70
Class IV	17.4%	17.3%	.98
BMI, kg/m ²	30.9	30.4	.41
SBP, mm Hg	142	141	.52
Glomerular filtration rate, mL/min	89.4	88.4	.78
Sodium, mmol/L	139	139	.97

MI, myocardial infarction; PCI, percutaneous coronary intervention; CABG, coronary artery bypass surgery; PVD, peripheral vascular disease; COPD, chronic obstructive pulmonary disease; NYHA, New York Heart Association functional class; BMI, body mass index; SBP, systolic blood pressure; HR, heart rate.

Adjustment was performed using a propensity score weighting that included age, race, ejection fraction, hypertension, chronic kidney disease, history of percutaneous coronary intervention, history of myocardial infarction, non-cardiac Charlson index (a global measure of non-cardiac comorbidities), glomerular filtration rate, and serum sodium. Continuous variables are presented as means; dichotomous variables as percents.

Table 3

Unadjusted Estimates for Anemic and Non-anemic Patients

	Anemic (n = 335)	Non-anemic (n = 721)	Difference: Anemic – Non-anemic (95% CI)	P Value for the Difference
Total cost in year 1 (\$)	27,415	23,162	4253 (–2379, 10,885)	.21
Total cost in year 2 (\$)	14,416	11,245	3171 (–2561, 8903)	.28
Total cost in year 3 (\$)	12,694	8385	4309 (–2771, 11,388)	.23
Total cost at 2 years (\$)	41,831	34,406	7424 (–2532, 17,381)	.14
Total cost at 3 years (\$)	54,525	42,792	11733 (–1773, 25,239)	.09
Traditional costing divisions				
Variable direct at 3 years (\$)	26,500	22,250	4251 (–2788, 11,289)	.24
Variable indirect at 3 years (\$)	615	454	161 (–5, 326)	.06
Fixed direct at 3 years (\$)	3963	3149	814 (–114, 1741)	.09
Fixed indirect at 3 years (\$)	19,469	13,780	5689 (834, 10,542)	.01
Specialty costing divisions				
Cardiac medical at 3 years (\$)	13,650	8661	4989 (608, 9370)	.03
Cardiac surgical at 3 years (\$)	3820	4785	–965 (–3160, 1230)	.39
Non-cardiac (\$)	37,054	29,346	7708 (–3189, 18,605)	.17
Location of care				
Inpatient at 3 years (\$)	44,894	35,633	9261 (–2890, 21,412)	.14
Outpatient at 3 years (\$)	9630	7158	2472 (–452, 5396)	.10
Resource utilization				
Total inpatient days	17.3	10.7	6.6 (1.7, 11.6)	<.01
Revascularization at 3 years (%)	35.9	34.0	1.9 (–5.4, 9.2)	.61

P values were calculated using generalized least square estimation.

Table 4

Adjusted Estimates for Anemic and Non-anemic Patients

	Anemic (n = 335)	Non-anemic (n = 721)	Difference: Anemic – Non-anemic (95% CI)	P Value for the Difference
Total cost in year 1 (\$)	28,351	24,638	3712 (–4180, 11,604)	.36
Total cost in year 2 (\$)	13,517	11,397	2121 (–3130, 7372)	.43
Total cost in year 3 (\$)	12,863	8892	3971 (3706, 11,647)	.31
Total cost at 2 years (\$)	41,868	36,035	5833 (–4916, 16,582)	.29
Total cost at 3 years (\$)	54,731	44,927	9804 (–4527, 24,135)	.18
Traditional costing divisions				
Variable direct at 3 years (\$)	26,928	23,299	3629 (–3929, 11,187)	.17
Variable indirect at 3 years (\$)	601	491	109 (–64, 282)	.22
Fixed direct at 3 years (\$)	3970	3303	667 (–319, 1652)	.18
Fixed indirect at 3 years (\$)	19,078	14,745	4333 (–540, 9206)	.08
Specialty costing divisions				
Cardiac medical at 3 years (\$)	12,904	9603	3300 (–1674, 8274)	.19
Cardiac surgical at 3 years (\$)	4464	5326	–862 (–3703, 1979)	.55
Non-cardiac (\$)	37,363	29,998	7365 (–3790, 18,519)	.20
Location of care				
Inpatient at 3 years (\$)	45,203	37,635	7568 (–5314, 20,450)	.25
Outpatient at 3 years (\$)	9528	7292	2236 (–927, 5398)	.17
Resource utilization				
Total inpatient days	16.8	11.3	5.5 (0.6, 10.3)	.03
Revascularization at 3 years (%)	32.8	35.6	–2.9 (–10.8, 5.1)	.48

Adjustment was performed using a propensity weighting score as described in Table 2. Bootstrapping was used to generate 95% confidence intervals and p-values for estimates of cost per year alive.

Table 5

Summary of Costs and Survival, Stratified by Left Ventricular Systolic Function

	Anemic (n = 335)	Non-Anemic (n = 721)	Difference: Anemic v. Non-Anemic (95% CI)	P Value for Difference
Overall				
Adjusted total cost at 3 years (\$)	54,731	44,927		
Adjusted total survival at 3 years (days)	871.4	954.0		
Adjusted total cost per year alive (\$/year)	22,926	17,189	5737 (247, 11,623)	.04
LVEF 40%				
Adjusted total cost at 3 years (\$)	76,674	48,021		
Adjusted total survival at 3 years (days)	850.3	951.4		
Adjusted total cost per year alive (\$/year)	32,914	18,423	14,490 (3016, 29,590)	.01
LVEF >40%				
Adjusted total cost at 3 years (\$)	43,035	44,705		
Adjusted total survival at 3 years (days)	869.3	945.1		
Adjusted total cost per year alive (\$/year)	18,069	17,265	804 (−6715, 8337)	.37

LVEF, left ventricular ejection fraction.

Bootstrapping was used to generate 95% confidence intervals and *P* values for estimates of cost per year alive.