Improved Cost and Utilization Among Medicare Beneficiaries Dispositioned From the ED to Receive Home Health Care Compared With Inpatient Hospitalization

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ABSTRACT

OBJECTIVES: As the shift from volume to value in healthcare expands, efforts to develop alternatives to hospitalization are gaining momentum. This study explores home health care initiated directly from the emergency department (ED) using the Medicare-reimbursed home health benefit as a potential alternative to hospitalization. We address barriers to home-based care by comparing costs and utilization of care for older adults dispositioned to home health care versus hospital admission.

STUDY DESIGN: We conducted a retrospective institutional and carrier claims analysis of 5% of total Medicare fee-for-service beneficiaries from January 2012 through December 2013 using 2 cohorts: patients treated in the hospital following an ED visit (inpatient) and patients treated at home following an ED visit (home health). Patients had 1 of the following: congestive heart failure, chronic obstructive pulmonary disease, urinary tract infection, pneumonia, or cellulitis.

METHODS: Propensity score–weighted regression was used to measure the total cost of care for 90 days post index visit, hospital admissions/readmissions, and ED revisits.

RESULTS: Total 90-day costs were lower for the home health cohort than for the inpatient cohort ($13,012 vs $20,325; P <.0001). The home health cohort also had lower hospital admissions/readmissions (23.7% vs 33.0%; odds ratio, 1.535; P <.0001) compared with the inpatient cohort. Although the home health cohort had fewer ED revisits, the difference was not statistically significant.

CONCLUSIONS: The findings suggest that risk-bearing healthcare organizations could use home-based alternatives to hospital admission as a means of providing high-quality care at a lower cost.

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Healthcare spending in the United States exceeded $3.3 trillion in 2016, which translates into an average of $10,348 per capita annually.[1] Despite some slowing in growth in 2016, experts still predict an unsustainable spending trajectory.[2] Of total healthcare spending, hospital-based care accounts for the largest percentage at 32%, or $1.056 trillion. In 2016, hospital costs increased by 4.6%, which, although 1% slower than the growth in 2015,[3] is still unsustainable. Because of this unsustainable growth in healthcare costs and poor value for the amount we spend, major efforts are underway nationally to shift Medicare from a volume-based system to a value-based system. Due to the high cost of hospitalization, alternatives to hospital admission have become a focal point of that shift.

Providing hospital-level care at home as an alternative to hospitalization is showing promising results in value-based care and may become a significant asset to a chronic care model in a senior service line portfolio.[4] A growing body of evidence suggests that providing higher-intensity acute care in the home achieves the quadruple aim of improving population health, lowering costs, and improving patient and provider experience.[5-15] This particular type of hospital-level care at home has demonstrated significantly better outcomes for selected patients compared with standard inpatient hospitalization, including comparable mortality,[5,6] improved mortality,[6,7] similar readmissions,[7] decreased readmissions,[8] decreased length of stay (LOS),[7,9,10] significant cost reduction,[6-11] improved functional recovery,[12,13] overall positive provider evaluations,[12] lower levels of family member stress,[14] and increased patient satisfaction.[6,7,15] In late 2017, the Physician-Focused Payment Technical Advisory Committee recommended that the secretary of HHS implement the hospital-at-home model as an advanced payment model.[16]

Despite evidence that home-based acute care models are cost-effective and safe, the scaling and sustainability of these models has been limited by the historical lack of payment reimbursements by Medicare parts A and B.[17] The objective of this paper is to address this issue by investigating the potential for Medicare cost savings and reductions in utilization when providing home-based acute care. This study is unique in that it explores the implications of using the Medicare home health benefit to pay for the delivery of needed care after an emergency department (ED) visit, as opposed to the typical stand-alone hospital substitute model described in the literature. We compare the costs and utilization for seniors transitioned from the ED to home health care versus admission to the hospital from the ED. Data were analyzed to explore (1) whether care delivered in the home following an ED visit has lower costs than that delivered in a hospital and (2) whether ED and hospital utilization are reduced in the 90 days following an episode of care for similar patients. Answers to these 2 questions have important implications for policy makers and the medical community, as adoption of acute home-based care innovations is currently limited in the United States.

METHODS

We conducted a retrospective analysis of 5% of Medicare claims data using carrier and institutional claims from January 2012 through December 2013. Patients included in the analysis were 65 years or older and had visits originating in the ED with a principal diagnosis, identified by Clinical Classifications Software (CCS) groupings, of congestive heart failure (CHF), pneumonia, urinary tract infection (UTI), chronic obstructive pulmonary disease (COPD), or cellulitis. Patients with end-stage renal disease (ESRD) and metastatic cancer were excluded. Patients needed to be enrolled in Medicare fee-for-service (FFS) continuously as age-eligible beneficiaries for 6 months before the index ED visit and 3 months after ED or hospital discharge.

To answer our research questions, we constructed 2 cohorts: (1) patients admitted to hospitals from the ED (inpatient cohort) and (2) patients dispositioned from the ED to home health care (home health cohort). **Table 1** shows how we created these cohorts and indexed the visits. For the inpatient cohort, the index episode of care was defined as the hospital stay. For the home health cohort, the index episode of care was defined as the home health stay.

To construct an inpatient cohort comparable with the home health cohort in terms of the potential to be dispositioned to care in the home, we selected patients with diagnosis-related groups (DRGs) with and without comorbidities or complications (CCs) but without major comorbidities or complications (MCCs). The following DRG codes were included: 292, heart failure and shock with CCs; 293, heart failure and shock without CCs/MCCs; 194, simple pneumonia and pleurisy with CCs; 195, simple pneumonia and pleurisy without CCs/MCCs; 690, kidney and urinary tract infections without MCCs; 191, COPD with CCs; 192, COPD without CCs/MCCs; and 603, cellulitis without MCCs.

Patients in the inpatient cohort also needed to have a LOS of fewer than 4 days. Additionally, inpatient cohort designees could not have a procedure code that may have required an overnight stay.

To generate a list of codes representing events that normally would require an overnight hospital stay, we first tabulated all *International Classification of Diseases, Ninth Revision* (*ICD-9*) procedure codes, revenue center codes, and Healthcare Common Procedure Coding System (HCPCS) codes associated with hospitalizations for CHF, pneumonia, UTI, COPD, and cellulitis. Then, 2 healthcare practitioners, an emergency physician and a critical care nurse (J.H. and A.R.S.), each with clinical and research experience, independently examined these codes to identify procedures that conservatively would require a hospital overnight stay. Their resulting list of exclusion codes were then presented to a second emergency physician, not connected to the research team, for review. A final list was developed by these 3 clinicians based on discussion and consensus. A complete list of exclusion codes is listed in the **eAppendix** (available at **ajmc.com**).

Patients assigned to the home health cohort were those transitioned directly to home health care following an ED visit. To be included in this cohort, patients needed to have a visit by a home health provider within 2 days of an ED visit with CHF, pneumonia, UTI, COPD, or cellulitis as the principal diagnosis by CCS grouping in both the ED and the home health claims. The 2-day limit was imposed to ensure that only home health visits immediately after ED visits were included and no other claims from other providers were processed. To ensure that the 2 cohorts were comparable, we applied the same exclusion criteria to the home health cohort as we applied to the inpatient cohort, including procedure codes, revenue center codes, and HCPCS codes, and exclusion of any patient with metastatic cancer or Medicare eligibility due to ESRD.

Outcome Variables

This research compares the costs and utilization for the 2 cohorts. Cost variables include the amount of out-of-pocket (OOP) dollars the patient paid and the amount of Medicare reimbursement, including total reimbursements for the episode of care and costs in the 90 days following the index visit. The cost for the index episode of care included all facility fees, physician fees, and durable medical equipment. The 90-day follow-up costs included all costs from inpatient, outpatient, skilled nursing facility, home health, and hospice claims from both institutional and carrier claims. We used 2 common hospital measures to track utilization within 90 days of the index visit: (1) percent of inpatient hospital readmissions and (2) percent of ED revisits.[18]

Table 1. Cohort Construction Flow Diagram for Inpatient and Home Health Cohorts

Cohort Construction Variables	Inpatient Cohort	Home Health Cohort
Starting observations in 5% data set 1. Inpatient[a] 2. Home health[b]	1,078,646	650,615
Diagnosis and initial facility type Principal diagnoses: CHF, pneumonia, UTI, COPD, cellulitis[a,b] 1. Admitted to inpatient hospital facility[a] 2. Outpatient hospital facility[b]	168,472	86,382
ED visit/hospitalization profile 1. Date eligibility through ED[a,b] 2. No death during index visit[a,b] 3. Discharge from nonobservational ED outpatient to home health claim <48 hours from ED discharge[b]	85,380	517
Eligibility[a,b] 1. Age ≥65 years 2. Medicare age eligibility 3. Merge institutional and carrier claims 4. Continuous enrollment	65,666	392
DRGs without MCCs and LOS <4 days[a] DRG: 292, 293, 194, 195, 690, 191, 192, 603	27,748	N/A
No procedures requiring hospitalization[a,b]	17,855	355
Exclude metastatic cancer[a,b]	17,565	354

CHF indicates congestive heart failure; COPD, chronic obstructive pulmonary disease; DRG, diagnosis-related group; ED, emergency department; LOS, length of stay; MCC, major comorbidity and complication; N/A, not applicable; UTI, urinary tract infection.
[a]Inpatient cohort.
[b]Home health cohort.

Analytical Models

Regression models were used to compare the costs and utilization of the ED/hospital for the 2 cohorts. Ideally, the characteristics of these cohorts should be comparable. To account for differences among member profiles of the 2 cohorts, we used propensity scoring to balance the characteristics of the cohorts. The propensity score indicates the probability of a patient being in a group after all observable characteristics are controlled for. Through this technique, researchers can conveniently control for the probability of belonging in the case group (home health) or the control group (inpatient) and create a quasi-experimental design.[19,20]

Typically, a logistic model is used to generate a propensity score. In this research, a simple logistic model was problematic in generating propensity scores because the sample sizes of the patient cohorts were imbalanced. The number of observations in the inpatient cohort was about 50 times the number of observations in the home health cohort. Ideally, the probability of being in a group should be higher than 0.1 because the logistic model may underestimate rare events.[21,22] To address this issue, we first drew a 10% random sample from the inpatient cohort, then we combined this 10% random sample with the home health cohort and used a logistic model to calculate the probability of being in the home health cohort.[23] Covariates for the propensity score model included age, gender, Medicaid eligibility, geographic locations, types of disease, a history of hospitalization, and Charlson Comorbidity Index (CCI) score.

We used a propensity score–weighted regression to evaluate costs and utilization of services.[24-26] The propensity score weighting method was used for 2 reasons. First, there were relatively few observations in the home health cohort. Using propensity score matching further risked reducing the number of observations in the home health cohort. In addition, research has shown that propensity score weighting is more robust to misspecifications of regression models. It is more likely to generate an unbiased estimate of treatment effect, even when the model is not specified correctly.[25]

RESULTS

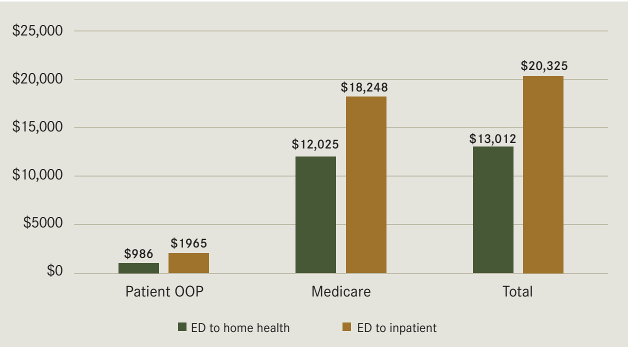
Descriptive Statistics

A summary of the descriptive statistics by cohort, weighted and unweighted (available in eAppendix), shows that before propensity score weighting, observations in the 2 cohorts were different in several ways, including demographics, comorbidities, Medicaid eligibility, and geographical locations. Upon weighting, cohorts were more evenly balanced. The differences in age groups, average age, gender, Medicaid status, principal diagnosis, CCI score, and history of hospitalization became statistically nonsignificant. The only remaining statistical differences were geographical location and having a comorbid cancer diagnosis. Most important, once these groups were weighted, they had similar propensity scores: 0.0198 for inpatient versus 0.0200 for home health ($P = .812$). This means that after weighting, patients in the inpatient cohort had near identical opportunities to be in the home health cohort.

The average actual OOP costs for the patient, average Medicare payment, and total average reimbursement for the index episode and the 90-day follow-up period are shown in **Figure 1**. The average reimbursements for the home health cohort were much lower than those for the inpatient cohort. The average Medicare reimbursements for the home health cohort were \$986 for patient OOP costs, \$12,025 for the episode, and \$13,012 for the 90-day total. For the inpatient cohort, reimbursements were \$1965, \$18,248, and \$20,325, respectively ($P < .0001$).

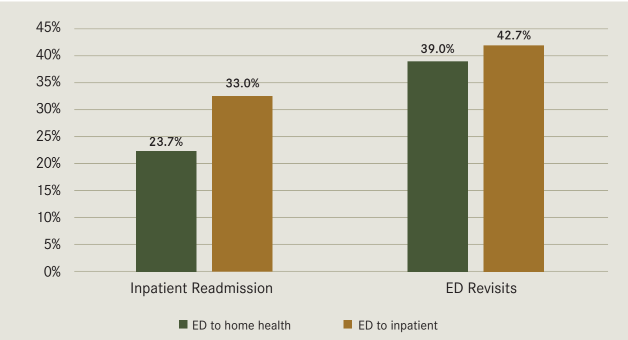
Figure 2 summarizes the 90-day inpatient hospital readmissions and ED revisits. Patients in the home health cohort had lower inpatient hospital readmissions at 23.7% (n = 84) compared with 32.8% (n = 5790) readmissions for patients in the inpatient cohort (odds ratio [OR], 3.796; $P < .0001$). There were no statistically significant differences in 90-day ED revisits between the home health cohort at 39.0% (n = 138) and the inpatient cohort at 42.7% (n = 7496) ($P = .2349$).

Figure 1. Average OOP, Medicare, and Total Reimbursement for the Index Episode and 90-Day Follow-up Period for Home Health and Inpatient Cohorts



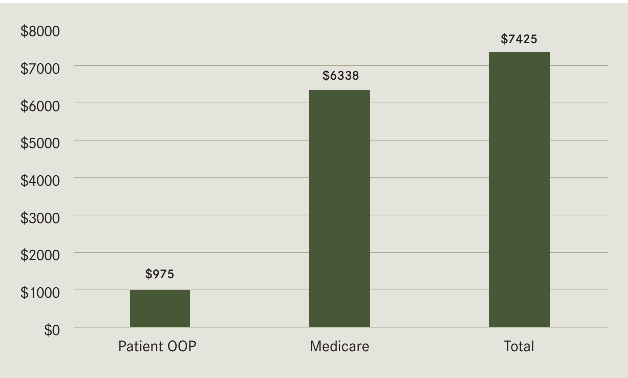
ED indicates emergency department; OOP, out of pocket.

Figure 2. 90-Day Inpatient Hospital Readmissions and ED Revisits for Home Health and Inpatient Cohorts



ED indicates emergency department.

Figure 3. Least Squares Mean Linear Regression Modeled Average Cost Differences for the Index Episode and the 90-Day Follow-up Period: OOP, Medicare Reimbursements, and Total Reimbursements Comparing Inpatient and Home Health Cohorts



ED indicates emergency department; OOP, out of pocket.

Figure 3 provides least squares mean linear regression modeled average cost differences for the index episode and the 90-day follow-up period: OOP, Medicare reimbursements, and total reimbursements comparing the inpatient and home health cohorts.

Regression Results

Propensity score–weighted regressions were used to model the impact of discharges to home health as opposed to inpatient admissions from the ED. The average OOP costs to the patient, Medicare payment, and total reimbursement difference for the index episode and 90-day follow-up were $975, $6338, and $7425, respectively, which means that the inpatient cohort costs were greater than those of the home health cohort with statistical significance (P <.0001).

The ORs for ED revisits and inpatient hospitalization within the 90-day period are reported in **Table 2**. Overall, compared with the home health cohort, patients in the inpatient cohort were more likely to be readmitted to the hospital (OR, 1.535; P <.0001). The OR for ED visits in the 90-day follow-up period was not statistically significant, at 1.806 (P = .2128).

DISCUSSION

In a comparison of patients transitioned from the ED with 1 of 5 conditions, those patients transitioned to home health care had overall cost and utilization advantages compared with those admitted to the inpatient setting. When costs were compared for the index episode plus the 90-day follow-up period, the lower costs of the home health cohort were highly statistically significant. When episode of care and follow-up period are considered, the cost delta reached $7495 per patient. This number could represent a significant cost reduction opportunity for Medicare and for patients. In this study, the inpatient cohort had 21,608 patients per 9-month period. Annually, this accounts for 576,213 patients across the nation who might have similar admission profiles. If acute home-based care options were available to all emergency physicians across the nation for just these 5 conditions, this could account for an annual savings of $3.7 billion in total costs, $3 billion in Medicare savings, and $520 million in patient OOP expenses. This suggests that programs that support more acute care at home could have a major impact on lowering healthcare costs.

Finally, our research shows that moving patients to home health care directly from the ED could result in a reduction in utilization and associated costs. Although we have considered the patient's and the payer's financial perspective in this analysis, one must also look at the hospital's point of view. In general, inpatient admissions for the DRGs in this study may not be of major value to hospitals, as the DRG weights from the Medicare fiscal year 2015 final rule are all less than 1, with the highest geometric mean LOS at 3.8 days and arithmetic mean LOS at 4.5 days.[27] Hospitals offering

Table 2. **Logistic Regression ORs Weighted by Inverse Propensity Treatment Weight for 90-Day Inpatient Hospital Readmissions and ED Revisits for Inpatient Versus Home Health Cohorts**

	Inpatient vs Home Health	95% Wald Confidence Limits		*P*
		Inpatient	Home Health	
90-day inpatient hospital readmission OR	1.535	1.330	1.772	<.0001
90-day ED revisit OR	1.086	0.954	1.238	.2125

ED indicates emergency department; OR, odds ratio.

clinicians and patients a home-based care alternative could create an increased hospital capacity for planned procedure-based admissions that could enhance revenue and reduce overcrowding in the hospital as well as in the ED. Thus, the transition to home health care from the ED, when appropriate, would support a viable financial model from the perspectives of the patient, payer, hospital, and home health agency, assuming that the home health agencies are being appropriately reimbursed for these conditions, in the right setting.[28]

Limitations

This research sought to corroborate the improvement in outcomes related to cost and utilization that were previously demonstrated in the substitutive hospital model for Medicare Advantage and Medicaid patients.[7] We used purely operational information from the Medicare FFS 5% claims so we could get a firm measurement of the cost, as carrier claims are available only in the 5% data set. Our model looks nationally at beneficiaries who were transitioned to home health care directly from the ED. We used an artificial construct, because currently, on a national scale, transitions of patients to home health care from the ED are a rare occurrence relative to inpatient admissions.

All factors within the claims data that we could abstract were used to control for acuity, comorbidity, geolocation, and other demographic factors. Our acuity and comorbidity control factors included using DRGs that did not contain MCCs, a LOS of less than 4 days in the inpatient group, CCI scores, revenue center codes, *ICD-9* procedure codes, and HCPCS codes that would not require hospitalization. In addition, we included patient age, gender, payer status, hospitalization history, principal *ICD-9* diagnosis by CCS category, age eligibility, and exclusion based on metastatic cancer and stays in the intensive care unit. Although we used propensity scores to balance these characteristics across the 2 cohorts, we recognize that physicians face more variables when they make the decision to disposition a patient to home health care or to admit a patient to the hospital. We did not attempt to control such differences in the study, as they are not present within the claims data set.

CONCLUSIONS

This analysis of Medicare claims data compared a small population of patients transitioned directly from the ED to home health care with patients transitioned from the ED to inpatient hospitalization, both with selected conditions. The home health cohort had statistically significant lower costs as well as reduced readmissions at a significant level. The favorable outcomes for this small number of patients transitioned from ED to home health care, derived from the Medicare FFS claims data set, suggest that home-based alternatives to hospitalization, using the home health benefit, are worthy of further exploration and testing in real-world scenarios. Developing processes to support an ED to home health care disposition option may benefit risk-bearing organizations such as accountable care organizations and Medicare Advantage participants. Although the scale and scope of this study is limited, the possibility of financial and utilization benefits supports continued research in this area.

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eAppendix. Weighted and Unweighted Propensity Matching of Inpatient and Home Health Cohorts

	Unweighted			Weighted		
	Inpatient cohort	**Home Health cohort**	***p* value**	**Inpatient cohort**	**Home Health cohort**	***p* value**
Number of Observation	17565	354		17565	354	
Gender						
Male	38.8%	28.0%				
Female	61.2%	72.0%	<.0001	61.44	61.74	0.5632
Age Group						
65-69	12.8%	7.3%				
70-74	16.4%	16.7%				
74-79	18.3%	19.5%				
80-84	20.6%	18.6%				
85+	31.9%	37.9%				
Mean (SD)	79.93 (8.1885)	81.2627 (8.2319)	0.0025	79.9533 (8.2674)	79.8612 (59.4043)	0.838
Dually Eligible						
Medicaid Eligible	24.1%	30.5%	0.0054	24.23	23.37	0.0565
Geographical Locations						
Northeast	25.0%	29.1%	0.0778	25.08	30.99	<.0001
Southeast	29.1%	35.3%	0.0104	29.18	25.29	<.0001
Midwest	25.7%	15.8%	<.0001	25.46	21.97	<.0001
Southwest	10.1%	9.3%	0.6353	10.07	9.14	0.0029
West	10.2%	10.5%	0.8778	10.21	12.6	<.0001

Principal Diagnoses						
CHF (108)	19.8%	22.9%	0.1503	19.86	23.37	<.0001
PNA (122)	25.4%	8.5%	<.0001	25.05	23.87	0.0097
UTI (159)	25.0%	25.4%	0.8433	24.97	25.97	0.0318
COPD (127)	17.7%	31.1%	<.0001	18.01	15.15	<.0001
Cellulitis (197)	12.1%	12.1%	0.9803	12.1	11.64	0.1784
Propensity Score						
Mean (SD)	0.195 (0.0159)	0.0329 (0.0183)	<.0001	0.0198 (0.0162)	0.0200 (0.1138)	0.8121
Charlson Comorbidity Index						
Mean (SD)	2.0347 (1.5656)	1.6554 (1.3231)	<.0001	2.0284 (1.5778)	1.9797 (11.2824)	0.57
Comorbidities (Based on Charlson Groups)						
Myocardial Infarction	7.8%	0.8%	<.0001	7.7	5.44	<.0001
Congestive Heart Failure	34.7%	39.0%	0.0912	34.75	39.26	<.0001
Peripheral Vascular Disease	8.8%	3.7%	0.0007	8.69	10.65	<.0001
Cerebrovascular Disease	5.3%	3.7%	0.1812	5.24	7.52	<.0001
Dementia	6.7%	8.2%	0.2798	6.76	6.2	0.0305
Chronic Pulmonary Disease	44.6%	45.2%	0.8195	44.6	43.72	0.0938
Connective Tissue Disease-Rheumatic Disease	3.8%	1.7%	0.041	3.77	2.75	<0.0001
Peptic Ulcer Disease	0.6%	0.0%				

Mild Liver Disease	1.5%	0.3%	0.0626	1.47	1.75	0.0379
Diabetes without Complications	29.1%	24.0%	0.0368	29	27.4	0.0008
Diabetes with Complications	3.3%	4.0%	0.526	3.33	5.17	<.0001
Paraplegia and Hemiplegia	0.3%	0.0%				
Renal Disease	21.7%	13.8%	0.0004	21.53	17.03	<.0001
Cancer	4.8%	1.7%	0.007	4.74	4.44	0.1754
Moderate or Severe Liver Disease	0.1%	0.0%				
AIDS/HIV	0.0%	0.0%				
Hospitalization History						
Having hospitalization within 1 year prior to event	51.1%	52.8%	0.5221	51.14	52.44	0.0145
Costs						
Total Episode Costs (SD)	$6,335.30 (1,690.5)	$4,206.60 (1853.7)	<.0001	$6,334.70 (1707.7)	$4,216.60 (13873.5)	<.0001
Medicare Episode Costs (SD)	$5,396 (1771.4)	$3,927.40 (1732.1)	<.0001	$5,395.80 (1789.3)	$3,922 (13162.0)	<.0001
Patient Episode Costs (SD)	$894 (499.1)	$279.20 (311.3)	<.0001	$893.80 (504.3)	$294.60 (2240.3)	<.0001
Total Episode Costs + Follow-Up Costs (SD)	$20,325 (20259.0)	$13,011.60 (15497.2)	<.0001	$20,330.20 (20454.0)	$12,905.10 (101347)	<.0001
Medicare Episode Costs + Follow-Up Costs (SD)	18,247.40 (18895.3)	$12,025.40 (14399.5)	<.0001	$18,253.10 (19078.4)	$11,915.40 (95367.5)	<.0001
Patient Episode Costs + Follow-Up Costs (SD)	$1,964.80 (2328.8)	$986.20 (1518.1)	<.0001	$1,965.10 (2353.4)	$989.70 (9790.3)	<.0001

Utilization in follow-up period						
Any ED visits during follow-up period	42.7%	39.6%	0.2387	42.71	40.77	0.0002
Any hospitalization during follow-up period	33.0%	24.6%	0.0009	32.99	25.9	<.0001