

# Rural Hospital Transitional Care Program Reduces Medicare Spending

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CMS seeks to identify ways to deliver better healthcare, improve health, and lower costs for beneficiaries of its programs, particularly those with the highest healthcare needs.<sup>1</sup> One promising approach toward achieving this goal is transitional care, which encompasses a range of services provided to patients as they transfer across settings or levels of care to improve outcomes and avoid preventable hospitalizations, readmissions, and emergency department (ED) visits.<sup>2</sup> Transitional care interventions vary in the populations they target, the services they provide, the types of providers delivering services, and the duration of support. Intervention components typically include patient or caregiver education, discharge planning, scheduling postdischarge appointments, monitoring a patient's condition and adherence to the discharge plan, medication reconciliation, and coordination among health professionals involved in the transition.<sup>3-5</sup>

Prior studies have found that care transitions programs can improve patients' outcomes.<sup>4-7</sup> However, there is limited evidence on which interventions work best in different settings,<sup>3,4</sup> and transitional care interventions at stand-alone community hospitals might not always achieve their goals.<sup>8</sup> Further, lower rates of follow-up care and greater risk of ED visits for postdischarge Medicare beneficiaries in rural settings, compared with urban beneficiaries, highlight the need for policies that increase follow-up care in rural settings.<sup>9,10</sup> Testing of transitional care programs in rural settings is needed.<sup>4</sup>

This study examined how a telephonic transitional care intervention for patients discharged from the hospital affected service use and Medicare spending in a small rural healthcare system.

## METHODS

Using an observational cohort design, we evaluated the intervention's effects on service use and spending among Medicare fee-for-service (FFS) beneficiaries using difference-in-differences (DID) design with a matched comparison group.

## ABSTRACT

**OBJECTIVES:** To evaluate impacts of a telephonic transitional care program on service use and spending for Medicare fee-for-service beneficiaries at a rural hospital.

**STUDY DESIGN:** Observational cohort study.

**METHODS:** Patients discharged from Atlantic General Hospital (AGH) with an AGH primary care provider were assigned a nurse care coordinator for 30 days. The nurse reviewed the patient's conditions, assessed needs for transition support, conducted weekly telephone calls (beginning 24-72 hours after discharge) to monitor adherence to treatment plans, and scheduled follow-up appointments. Using claims data, we evaluated impacts on service use and spending using a difference-in-differences design with a matched comparison group.

**RESULTS:** The intervention reduced Medicare spending in the 6-month period after discharge by 30.8%, or \$1333 per beneficiary per month (90% CI, -\$2078 to -\$589), which was partly driven by a 39.4% reduction in spending for inpatient claims (difference, -\$729; 90% CI, -\$1234 to -\$225). There were no statistically significant changes in the 14-day ambulatory care follow-up rate, 30-day unplanned readmission rate, number of inpatient admissions, or number of emergency department visits, although this may be due to modest statistical power to detect effects.

**CONCLUSIONS:** The estimated \$5.4 million in savings from this intervention more than offset the costs of the \$1.1 million funding for the award. Although other studies have found that care transitions programs can improve outcomes, this study was unique in the size of the impacts relative to the low-touch intervention and the location in a small rural healthcare system.

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## Setting

Atlantic General Hospital (AGH) is a private, not-for-profit, community-based healthcare delivery system with a 62-bed hospital and 7 primary care practices. AGH is located in Worcester County, Maryland, a largely rural county and a federally designated medically underserved area. Although the hospital is located in a resort area, most of AGH's primary care patients live there year-round. AGH program administrators note that many residents are older than 65 years and have low levels of literacy.

## Intervention

In July 2012, AGH received \$1.1 million in Health Care Innovation Award (HCIA) funding from CMS' Center for Medicare & Medicaid Innovation (CMMI) to implement a patient-centered medical home model that included a care transitions program.<sup>11</sup> The program aimed to reduce 30-day readmissions and healthcare costs and targeted patients discharged from AGH who had any diagnosis and an AGH primary care provider (PCP). The program employed 1 full-time nurse care coordinator with extensive clinical and case management experience who managed a caseload of 40 to 50 patients at any given time.

The nurse monitored the hospital's daily census to identify eligible patients. Using AGH's electronic health record system, the nurse reviewed patient information, including reason for the hospital stay, recent primary care visits, and discharge instructions, and notified the patient's AGH PCP of the admission. The nurse visited patients in the hospital to describe the program and identify postdischarge needs. She later called patients at home within 24 to 72 hours of discharge to enroll them in the program. (Participation was voluntary; 10% of patients opted out or could not be reached by phone after 3 tries.) During the initial call, the nurse reviewed the patient's conditions, reconciled medications and identified barriers to medication compliance, identified immediate needs for support and barriers to self-care, and scheduled follow-up appointments with the AGH PCP. Thereafter, the nurse called participants weekly to monitor their conditions and compliance with postdischarge treatment plans. Participants with unstable conditions based on the nurse's clinical judgment or who needed additional support received more frequent calls to address emerging needs in a timely manner. In rare cases, the nurse contacted the participant's PCP regarding urgent needs and coordinated additional office visits or referrals. Patients left the transitional care program within 30 days after discharge from the hospital.

## Population

The treatment group for our analysis included 638 Medicare FFS patients who had an AGH PCP and were discharged from AGH during

## TAKEAWAY POINTS

A telephonic transitional care program at a rural hospital reduced postdischarge Medicare spending and inpatient spending for Medicare fee-for-service beneficiaries.

- ▶ Healthcare decision makers seek to identify ways to deliver better healthcare at lower costs to beneficiaries with high healthcare needs, including patients recently discharged from a hospital.
- ▶ Small rural community-based hospitals have the ability to reduce posthospitalization spending and healthcare use.
- ▶ The estimated \$5.4 million in savings from this transitional care program well exceeded CMS' \$1.1 million costs for the award.
- ▶ This promising program model merits further testing.

the HCIA funding period (February 2013-May 2015). We defined the treatment group using intent-to-treat criteria and thus included some patients who did not participate in the program because they declined to participate or could not be reached by the care transitions care coordinator after 3 attempts. (Data indicate that 396 of the treatment group members, or 62%, were actually enrolled in the intervention.) **eAppendices A and B** (available at [ajmc.com](http://ajmc.com)) provide additional details on sample selection, data availability, and sample sizes. The intervention also targeted other patients, including those enrolled in Medicaid, Medicare managed care, or commercial insurance, but data limitations precluded them from being included in the study.

Each treatment beneficiary was matched to 1 to 4 comparison beneficiaries. The comparison group was selected using exact matching and propensity score matching techniques,<sup>12</sup> and it included 2232 FFS Medicare beneficiaries who were discharged during the same time frame from either Peninsula Regional Medical Center (PRMC) or AGH but did not have an AGH provider (so the beneficiaries were not contacted by the nurse care coordinator). PRMC is a larger hospital than AGH, but it was selected as a comparison because it is located just 30 miles from AGH in Salisbury, Maryland, a city of about 30,000; participated in Maryland's global payment model, like AGH; and did not implement the care transitions component.

To support the DID analyses, we also measured outcomes for 226 patients with an AGH PCP who were discharged from AGH in a 1-year period before the intervention began (July 2011-June 2012) and 1008 matched comparison beneficiaries from the same time frame. The pre- and postintervention cohorts included different patients—a potential study limitation.

## Data and Outcomes

Using Medicare FFS parts A and B claims data, we measured 5 outcomes: (1) the percentage of beneficiaries with an ambulatory care follow-up visit with a primary care or specialist physician within 14 days of the discharge that qualified the patient for the treatment or comparison group, (2) the percentage of beneficiaries with an unplanned readmission within 30 days of discharge, (3) the average number of all-cause readmissions within 6 months after

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discharge, (4) the average number of outpatient ED visits within 6 months after discharge, and (5) average Medicare parts A and B spending in the 6 months after discharge. These 5 confirmatory outcomes were prespecified based on being of the highest interest to CMMI. We later added 2 exploratory outcomes: average inpatient and noninpatient Medicare spending.

### Statistical Analyses

Impact estimates measured the differences in postdischarge outcomes between the treatment group patients during the intervention period and matched comparison beneficiaries, minus the differences in postdischarge outcomes between treatment group patients discharged in a 1-year period before the intervention began and matched comparison beneficiaries.

We used linear regression models to implement the DID framework, adjusting for patient-level covariates. The covariates included patients' demographics, chronic conditions, and service use and spending 0 to 3 months and 4 to 12 months before enrollment, as well as indicators for each matched set and treatment status. The DID estimate was the coefficient for an interaction of a beneficiary's treatment status with an indicator for being in the postintervention cohort. Weighted regression models were estimated to account for many-to-one matching, and inference was based on bootstrap standard errors. See eAppendix A for additional details.

## RESULTS

Some baseline characteristics of the 638 Medicare FFS beneficiaries in the postintervention treatment group, such as gender and age, were similar to benchmarks for the national Medicare population, but other characteristics indicate that the treatment group had more healthcare needs than the general population (eAppendix C). The Hierarchical Condition Category risk score for the treatment group was 2.47, indicating that the group could be expected to have Medicare spending more than double the national average over the next year.<sup>13</sup> The prevalence of chronic obstructive pulmonary disease, chronic kidney disease, and congestive heart failure in the treatment group was more than twice the national average. Treatment group members also had high service use and spending. The treatment group beneficiaries had, on average, 1092 hospitalizations and 406 ED visits per 1000 beneficiaries, and their Medicare spending averaged \$6603 per month in the quarter before enrollment.

In both the pre- and postintervention cohorts, the treatment and comparison beneficiaries were well matched on individual-level characteristics at baseline, including demographics, health status, chronic conditions, reason for the hospitalization leading to eligibility for enrollment in the care transitions program, and health service use and spending 1 year before discharge (eAppendix C).

As shown in the [Table](#), the follow-up ambulatory care visit rate in the 14 days following discharge was 73.5%, 5.9 percentage points

higher than the regression-adjusted rate for the comparison group. This DID estimate was not statistically significant (90% CI, -1.6 to 13.4;  $P = .194$ ).

The treatment group's 30-day unplanned readmission rate following discharge was 11.6%, 1.9 percentage points higher than the comparison group's after regression adjustment. This was a large difference (18.9%), but the large standard error means that the unfavorable impact was estimated imprecisely (90% CI, -3.6 to 7.3;  $P = .578$ ).

The treatment group averaged 229 all-cause inpatient admissions per 1000 beneficiaries per quarter over the first 2 quarters following the beneficiary's qualifying discharge, which was estimated to be 72 admissions fewer than the comparison group (90% CI, -149 to 4;  $P = .121$ ), a statistically insignificant difference of about 24%.

The treatment group rate of outpatient ED visits within 6 months after discharge was similar to the comparison group rate (after regression adjustment); however, the DID was not estimated precisely (difference, -19; 90% CI, -111 to 73;  $P = .735$ ).

Medicare parts A and B spending for the treatment group averaged \$2992 per beneficiary per month over the first 2 quarters following the beneficiary's discharge, which was estimated to be \$1333 lower than regression-adjusted spending for the comparison group. This DID estimate is statistically significant (90% CI, -\$2078 to -\$589;  $P = .003$ ) and large (31% lower than the adjusted comparison group's spending). The treatment group's spending was higher than the comparison group's during the preintervention period, but lower in the intervention period, leading to the large DID estimate.

Decreases in spending for inpatient claims accounted for 55% of the reduction in total spending. Specifically, regression-adjusted inpatient spending was \$729 lower than the comparison group's spending (90% CI, -\$1234 to -\$225;  $P = .017$ ), whereas spending for noninpatient claims was \$604 lower (90% CI, -\$968 to -\$239;  $P = .006$ ).

## CONCLUSIONS

This telephonic intervention decreased Medicare parts A and B spending substantially (by nearly one-third) during the first 6 months after beneficiaries' enrollment, driven in part by a decrease in inpatient spending. AGH expected cost reductions to occur through decreases in the readmission rate and the number of ED visits, and it set a goal to obtain a 20% reduction for these 2 measures. However, tests for these outcomes, as well as for a decrease in the number of admissions and an increase in the rate of ambulatory care follow-up within 14 days of discharge, did not yield statistically significant results. The lack of observed effects may be due to imprecision in the estimates; AGH's expected impacts fall within the 90% CIs.

Although other studies have found that care transitions programs can improve outcomes, this study was unique in both the size of the impacts relative to the low-touch (and low-cost) telephonic

**TABLE.** Estimated Effects of the Care Transitions Intervention

Outcome (units)	Cohort	Unadjusted Treatment Group Mean	Unadjusted Comparison Group Mean	Adjusted DID Estimate (Bootstrap SE) [90% CI]	Percentage Difference <sup>a</sup>	P
<b>Confirmatory (prespecified) Outcomes</b>						
Inpatient admissions followed by an ambulatory care visit with a primary care or specialist provider within 14 days of the enrollment admission (%)	Preintervention	68.1	68.2	5.9 (4.6)	8.8%	.194
	Postintervention	73.5	67.8	[-1.6 to 13.4]		
Unplanned hospital readmissions within 30 days of the enrollment admission (%)	Preintervention	10.9	11.7	1.9 (3.3)	18.9%	.578
	Postintervention	11.6	11.4	[-3.6 to 7.3]		
All-cause inpatient admissions over the first 2 quarters following the enrollment admission (n/1000 beneficiaries/quarter)	Preintervention	309	267	-72 (46)	-23.9%	.121
	Postintervention	229	260	[-149 to 4]		
Outpatient ED visits over the first 2 quarters following the enrollment admission (n/1000 beneficiaries/quarter)	Preintervention	370	312	-19 (56)	-5.5%	.735
	Postintervention	325	302	[-111 to 73]		
Medicare parts A and B FFS spending over the first 2 quarters following the enrollment admission (\$/beneficiary/month)	Preintervention	4124	3033	-1333* (453)	-30.8%	.003
	Postintervention	2992	3304	[-2078 to -589]		
<b>Exploratory Outcomes</b>						
Medicare parts A and B FFS spending for inpatient claims over the first 2 quarters following the enrollment admission (\$/beneficiary/month)	Preintervention	1665	1238	-729* (307)	-39.4%	.017
	Postintervention	1121	1447	[-1234 to -225]		
Medicare parts A and B FFS spending for noninpatient claims over the first 2 quarters following the enrollment admission (\$/beneficiary/month)	Preintervention	2459	1796	-604* (222)	-24.4%	.006
	Postintervention	1871	1858	[-968 to -239]		

DID indicates difference-in-differences; ED, emergency department; FFS, fee-for-service; SE, standard error.

\*Significantly different from 0 at the  $P < .05$  level, 2-tailed test.

<sup>a</sup>Percentage difference is calculated as the regression-adjusted DID estimate divided by the estimate of the counterfactual. The counterfactual is the outcome the treatment group would have had in the absence of the intervention. Our estimate of the counterfactual is the treatment group mean minus the regression-adjusted DID estimate.

intervention and the location in a small rural healthcare system—a setting not often represented in such studies. The estimated \$5.4 million in savings from the transitional care component well exceeded the \$1.1 million HCIA award. The effects coincided with successful implementation of the program, including process improvements throughout the program to accommodate patients' needs. Thus, this promising program model merits further testing, and hospitals looking to implement a care transitions program, particularly in a rural setting, might consider implementing AGH's program model. ■

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## eAppendix A. Methodological Details

<b>Data Collection</b>	<p>We used Medicare Enrollment Database and claims data accessed through the Virtual Research Data Center at CMS. Zip code poverty rates were merged from the American Community Survey Zip Code Characteristics.</p> <p>We collected data for Medicare FFS beneficiaries discharged from AGH or PRMC during the study period. The postintervention cohort included beneficiaries whose enrollment or pseudo-enrollment dates were from February 1, 2013, to May 31, 2015, and the preintervention cohort included beneficiaries whose enrollment or pseudo-enrollment dates were from July 1, 2011, to June 30, 2012.</p> <p>We limited patients in the study to those continuously enrolled in FFS Medicare for the 4 quarters before their discharge to ensure a complete claims history to use in matching treatment to comparison patients. Furthermore, each Medicare beneficiary had to be alive and insured by Medicare FFS Part A and B after discharge to be included in the analytic sample. Patients were included in the pre- or postintervention cohort at most once. See eAppendix B for sample sizes.</p> <p>The treatment group included 25 patients who were enrolled in the other major component of AGH’s patient-centered medical home program—care coordination for participants with chronic conditions. Results were similar when we excluded data for these beneficiaries from the impact analysis, suggesting that the care coordination component was not a major factor in our findings.</p>
<b>Allocation</b>	<p>To be allocated to the treatment group, patients had to 1) be discharged from AGH and 2) be an AGH patient. We identified AGH patients as those who had their most recent primary care visit with an AGH provider (we received the list of providers from AGH) or who had the plurality of their primary care visits in the past 2 years with an AGH provider. The remaining patients were allocated to the potential comparison group; this included patients 1) discharged from PRMC or 2) discharged from AGH but not attributed to an AGH provider. See eAppendix B for sample sizes.</p> <p>These claims-based allocation rules used to define the 2 treatment groups represent an “intent-to-treat” analysis. That is, the analysis presumes that the hospital recruited, or intended to recruit, all the patients in the postintervention treatment group. This approach has 2 advantages over an alternative definition that includes only those who actually enrolled in the care transitions component of AGH’s program. First, because AGH targeted any patients discharged from AGH with an AGH PCP, this definition corresponds to everyone the program intended to treat (that is, the definition follows an intent-to-treat design). Most notably, the claims-based definition includes Medicare patients who did not consent to participate in the program or who could not be contacted by the care transitions care coordinator. One limitation of the claims-based rules is that we include some Medicare patients AGH did not intend to treat—namely, those already being monitored by another AGH program (for example, the cancer center). Second, we can use exactly the same definition to identify a preintervention treatment group, which is needed to</p>

	<p>implement the difference-in-differences design. We did not conduct sensitivity analyses to estimate impacts among only those who enrolled because, without the ability to replicate individuals' enrollment decisions using claims data, we could not create a comparison group that would have made such sensitivity analyses meaningful.</p>
<b>Covariates</b>	<p>We used claims and enrollment data to construct covariates which describe a beneficiary's characteristics at the time of discharge. The covariates were 1) used for constructing a matched comparison group (matching) and 2) used in the regression models for estimating impacts to adjust for existing characteristics. See eAppendix C for a list of covariates. The covariates were prespecified; they were chosen because we believed these covariates were the most important predictors of treatment and/or outcomes that were available in the claims and enrollment data.</p>
<b>Matching</b>	<p>We used propensity score matching and exact matching techniques to limit the potential comparison pool to a list of matched comparison beneficiaries, separately for the pre- and postintervention cohorts. Each treatment beneficiary was matched to up to 4 beneficiaries from the potential comparison group.</p> <p>Within the family of propensity score matching methods, we implemented a technique called full matching to form matched sets that contain 1 treatment beneficiary and 1 or more comparison beneficiaries. Full matching achieves maximum bias reduction on observed matching variables and, subject to this constraint, maximizes the size of the comparison sample.<sup>1,2</sup> The variables included in the propensity score model are listed in eAppendix C.</p> <p>We used exact matching techniques to ensure matched comparison group beneficiaries had 1) a qualifying inpatient discharge within 90 days of the treatment beneficiary's enrollment date, 2) the same gender as the treatment beneficiary, and 3) the same reason for the hospitalization that caused a person to enter the treatment or comparison group.</p>
<b>Analytical Weights</b>	<p>For all analyses, the matched comparison group was weighted based on the number of matched comparisons per treatment beneficiary. For example, if 4 comparison beneficiaries were matched to 1 treatment beneficiary, each of the 4 comparison beneficiaries had a matching weight of 0.25.</p>
<b>Follow-Up</b>	<p>Using Medicare FFS claims, we constructed outcomes for the first 2 quarters after a beneficiary's the enrollment admission (that is, the inpatient discharge that led to a beneficiary being assigned to the treatment or comparison group). The quarters are 3-month periods; that is, the first intervention quarter (I1) is the first 3 months after the enrollment admission, and the second intervention quarter (I2) is months 4 to 6.</p> <p>The 5 confirmatory outcomes were prespecified and selected because they were of the highest interest to CMMI; these outcomes were used consistently across multiple CMMI HCIA evaluations.</p> <p>In each intervention quarter, the sample consisted of Medicare FFS beneficiaries who were 1) enrolled early enough to be potentially followed up for all 91 or 92 days in the quarter and 2) whose outcomes were observable for at least 1 day during the quarter. Outcomes were observable if the beneficiary</p>

	<p>was alive, enrolled in Medicare FFS (Part A and B), and had Medicare as his or her primary payer of medical bills. Outcomes were constructed through November 30, 2015.</p> <p>The sample sizes are smaller in I2 than I1 because 1) some treatment or comparison group members exited the sample due to death or becoming unobservable and 2) if any member of a matched set dropped from the sample, we dropped all remaining members of the matched set. The latter restriction allowed the treatment beneficiary's outcomes to be compared with the outcomes for all of his or her comparison beneficiaries.</p> <p>The sample sizes are smaller for the 14-day follow-up ambulatory care visit rate and 30-day readmission rate measure because the sample is limited to beneficiaries whose qualifying hospital discharges met the criteria for an index stay for each measure. For the readmissions measure, certain admissions were excluded from the universe of index admissions; among these were discharges with lengths of stay longer than 1 year; stays at cancer hospitals exempt from the PPS; stays for psychiatric conditions, rehabilitation, or cancer; and admissions that involved a transfer to another acute care facility. Planned readmissions (excluded from the measure) included cancer- or rehabilitation-related readmissions, nonacute readmissions for elective surgeries, obstetrical deliveries, and organ transplants. The same definition of an index stay as used for the 30-day unplanned readmission measure, with the exception that the beneficiary had to be enrolled in Medicare Parts A and B in the 14 days after discharge for this measure.</p> <p>See eAppendix B for sample sizes.</p>
<p><b>Regression Models</b></p>	<p>For the service use and spending outcomes, the impact estimates were estimated separately for the first and second quarters after the enrollment admission (that is, the inpatient discharge that led to a beneficiary being assigned to the treatment or comparison group), and then averaged to obtain an average impact estimate for the first 2 quarters. The quality-of-care outcomes were constructed using only data from the first intervention quarter.</p> <p>We used a regression model to implement the difference-in-differences framework. For each quarter-specific outcome, the model estimates the relationship between the outcome and predictor variables, assuming that each of the predictor variables has a linear (additive) relationship with the outcome. The predictor variables include 1) the beneficiary-level covariates (listed in eAppendix C); 2) an interaction of each beneficiary-level covariate with each intervention quarter; 3) indicators for each matched set (a treatment beneficiary plus his or her matched comparison beneficiaries) in each quarter; 4) whether the beneficiary was assigned to the treatment or comparison group; 5) an interaction of a beneficiary's treatment status with an indicator for being in the postintervention cohort (as opposed to the preintervention cohort); 6) an interaction of a beneficiary's treatment status with each intervention quarter; and 7) a 3-way interaction of a beneficiary's treatment status with each intervention quarter with an indicator for being in the postintervention cohort.</p> <p>The estimated relationship between the 3-way interaction term and an outcome in a given quarter provides the difference-in-differences estimate for</p>

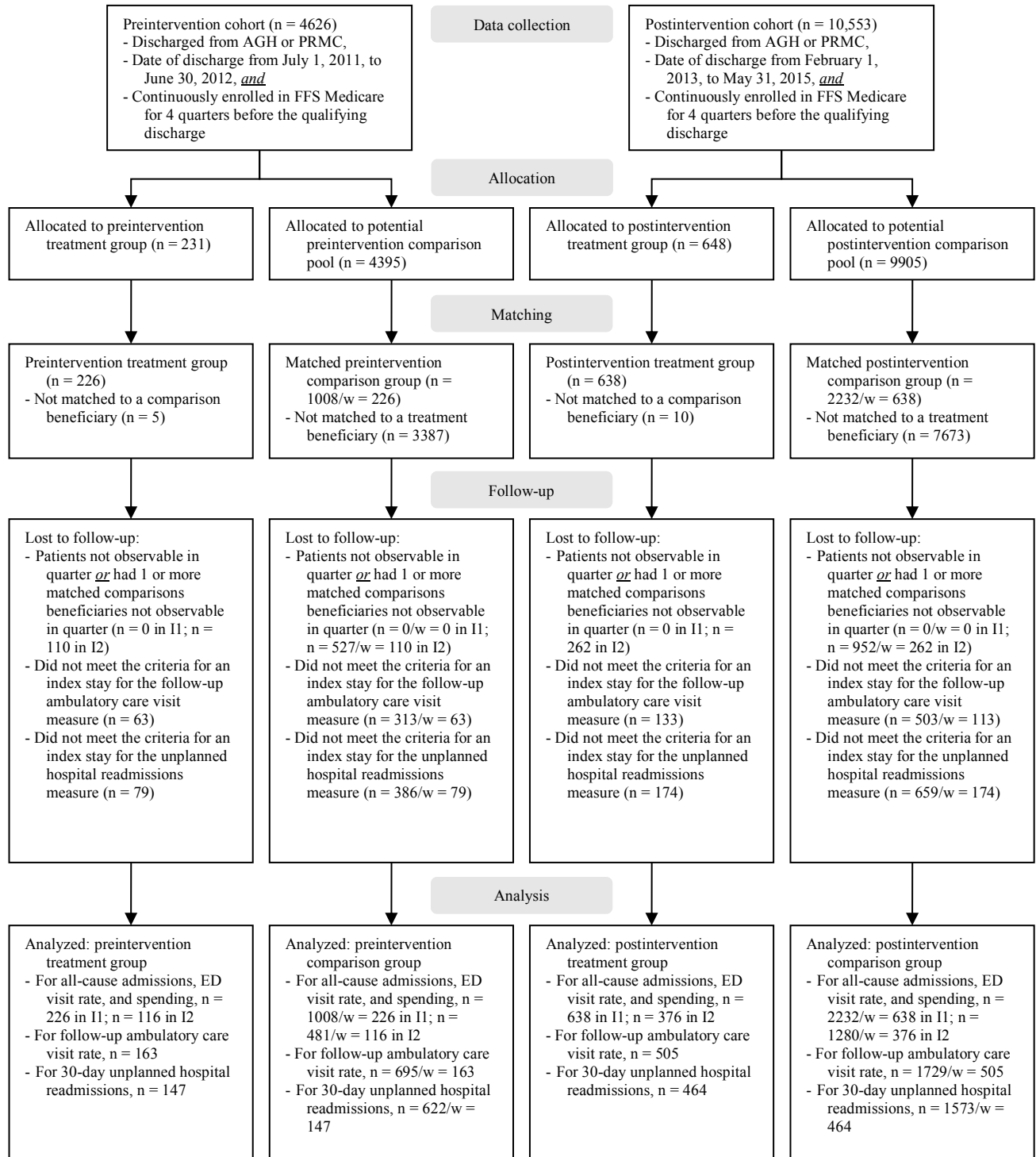


	<p>that quarter and outcome. It measures the average difference between outcomes for postintervention beneficiaries assigned to the treatment and comparison groups in a certain quarter, subtracting out any differences between the preintervention treatment and comparison groups during the same quarter. We estimated the standard errors for the parameters using bootstrap methods, as described in the Statistical Inference section. The model quantifies the uncertainty in the difference-in-differences estimates, allowing for statistical tests that determine whether observed differences are likely due to chance.</p> <p>The regression models were estimated using Stata version 14.1.</p>
<p><b>Statistical Inference</b></p>	<p>Inference was based on bootstrap-based clustered standard errors and CIs. Block bootstrapping was used to account for 1) correlation in each outcome across quarters for a given beneficiary, 2) correlation in each outcome across beneficiaries in a matched set, and 3) correlation across outcomes for a given beneficiary in each quarter. Specifically, we drew 2500 bootstrap samples, where each bootstrap sample was a random draw of matched sets with replacement (that is, each matched set could be drawn at random once, more than once, or not at all). For each matched set (cluster) drawn, we included data for all outcomes and all quarters for the treatment beneficiary and all matched comparison beneficiaries in the matched set. Sampling was stratified by cohort, so the ratio of beneficiaries in the pre- and postintervention cohorts was fixed. The regression models (1 for each outcome) were estimated with each bootstrap sample, and the regression coefficients were stored and used for calculating standard errors and 90% CIs. Normal-based, 2-sided <math>P</math> values tested the null hypothesis that the estimate is equal to 0; <math>P</math> values were not adjusted for multiple comparisons. A threshold of <math>P &lt; .10</math> for statistical significance was used in light of CMMI's goal of identifying promising programs and the size of the study.</p>

AGH, Atlantic General Hospital; ED, emergency department; FFS, fee-for-service; PCP, primary care provider; PPS, Prospective Payment System; PRMC, Peninsula Regional Medical Center.

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## eAppendix B. Sample Flow Diagram, by Cohort



AGH indicates Atlantic General Hospital; ED, emergency department; FFS, fee-for-service; I1, first intervention quarter (first 3 months after the enrollment admission); I2, second

intervention quarter (months 4 to 6 after the enrollment admission); n, number of beneficiaries;  
PCP, primary care provider; PRMC, Peninsula Regional Medical Center; w, sum of weights.

**eAppendix C.** Characteristics at Baseline of Treatment and Comparison Beneficiaries in the Pre- and Postintervention Cohorts

Characteristic	Treatment Group (n = 638)	Unmatched Comparison Pool (n = 9905)	Comparison Group (n = 2232)	Absolute Difference <sup>a</sup>	Standardized Difference <sup>b</sup>	Medicare FFS Average
<b>Panel A: Postintervention Cohort</b>						
<b>Exact Match Variables<sup>c</sup></b>						
Female (%)	55.2	55.8	55.2	0	0	54.7 <sup>1</sup>
Number of days from January 1, 2013, to enrollment	441.9	413.9	439.9	2.0	0.008	n.a.
<i>Reason for hospitalization<sup>d</sup></i>						
MDRG 114: Intracranial hemorrhage or cerebral infarction (%)	4.7	5.4	4.7	0	0	NA
MDRG 409: COPD	4.9	3.7	4.9	0	0	
MDRG 410: Simple pneumonia and pleurisy (%)	6.7	6.1	6.7	0	0	NA
MDRG 524: Heart failure and shock (%)	5.2	5.4	5.2	0	0	NA
MDRG 807: Major joint replacement (%)	5.8	8.0	5.8	0	0	NA
MDRG 1110: Renal failure (%)	4.1	3.0	4.1	0	0	NA
MDRG 1808: Septicemia (%)	6.6	6.0	6.6	0	0	NA
<b>Propensity-Matched Variables<sup>e</sup></b>						
<i>Demographic characteristics</i>						
Age (years)	76.8	74.9	76.5	0.3	0.029	71 <sup>2</sup>
Race: white (%)	92.3	82.1	90.8	1.5	0.051	81.8 <sup>1</sup>
Zip code poverty rate greater than 20% (%)	2.0	12.3	3.2	-1.1	-0.069	NA
<i>Medicare-related characteristics</i>						
Dual status at enrollment	12.9	21.4	12.9	0.0	-0.001	22 <sup>3</sup>
Original reason for entitlement (%)						
Disability	16.9	23.6	17.9	-1.0	-0.025	16.7 <sup>1</sup>
ESRD	0.2	1.4	0.3	-0.1	-0.022	0.13 <sup>1</sup>
<i>Health status and chronic conditions</i>						
HCC risk score	2.47	2.63	2.58	-0.10	-0.066	1.0
Chronic conditions <sup>f</sup> (%)						

Alzheimer's	8.0	6.5	7.3	0.7	0.027	4.9 <sup>4</sup>
Alzheimer's disease, related disorders, or senile dementia	16.8	16.3	16.0	0.7	0.020	11.1 <sup>4</sup>
Cancer	17.4	17.4	18.8	-1.4	-0.037	NA
CHF	37.3	38.6	38.6	-1.3	-0.027	15.3 <sup>4</sup>
COPD	29.9	31.5	32.0	-2.1	-0.044	11.8 <sup>4</sup>
CKD	41.8	46.4	44.0	-2.2	-0.044	16.2 <sup>4</sup>
Diabetes	42.5	43.3	42.1	0.3	0.007	28.0 <sup>4</sup>
<i>Service use and spending 3 months before enrollment or pseudo-enrollment</i>						
Number of unplanned readmissions (#/1000 beneficiaries/quarter)	44	59	30	14*	0.078	NA
Number of hospitalizations <sup>g</sup> (#/1000 beneficiaries/quarter)	1092	1114	1071	21*	0.080	74 <sup>5</sup>
Number of ED visits (#/1000 beneficiaries/quarter)	406	367	395	11	0.014	105 <sup>6</sup>
Primary care (%) <sup>h</sup>	96.4	95.9	96.1	0.3	0.016	NA
Medicare spending (\$/month)	6125	6982	6097	28	0.005	860 <sup>7</sup>
<i>Service use and spending 4 to 12 months before enrollment or pseudo-enrollment</i>						
Number of unplanned readmissions (#/1000 beneficiaries/quarter)	3	17	3	0	0	NA
Number of hospitalizations (#/1000 beneficiaries/quarter)	67	101	63	4	0.030	74 <sup>5</sup>
Number of ED visits (#/1000 beneficiaries/quarter)	241	239	229	12	0.029	105 <sup>6</sup>
Primary care (%) <sup>h</sup>	95.1	85.2	94.3	0.9	0.037	NA
Medicare spending (\$/month)	1198	1391	1153	45	0.021	860 <sup>7</sup>
<b>Panel B: Preintervention Cohort</b>						
<b>Exact Match Variables<sup>c</sup></b>						
Female (%)	56.2	57.8	56.2	0	0	54.7 <sup>1</sup>
Number of days from January 1, 2013, to enrollment	-364.1	-380.3	-366.9	2.8	0.028	n.a.
<i>Reason for hospitalization<sup>d</sup></i>						
MDRG 114: Intracranial hemorrhage or cerebral infarction (%)	4.4	5.1	4.4	0	0	NA

MDRG 409: COPD (%)	4.4	4.5	4.4	0	0	
MDRG 410: Simple pneumonia and pleurisy (%)	6.2	5.6	6.2	0	0	NA
MDRG 524: Heart failure and shock (%)	8.0	6.9	8.0	0	0	NA
MDRG 1110: Renal failure (%)	6.6	3.4	6.6	0	0	NA
MDRG 615: GI hemorrhage (%)	4.9	9.1	4.9	0	0	
MDRG 807: Major joint replacement (%)	4.4	5.1	4.4	0	0	NA
<b>Propensity-Matched Variables<sup>e</sup></b>						
<i>Demographic characteristics</i>						
Age (years)	77.9	75.7	77.5	0.4	0.040	71 <sup>2</sup>
Race: white (%)	93.8	82.7	91.2	2.6	0.093	81.8 <sup>1</sup>
Zip code poverty rate greater than 20% (%)	4.9	11.5	6.1	-1.2	-0.049	NA
<i>Medicare-related characteristics</i>						
Dual status at enrollment	9.3	20.3	11.5	-2.2	-0.070	22 <sup>3</sup>
Original reason for entitlement (%)						
Disability	12.8	22.1	15.9	-3.1	-0.088	16.7 <sup>1</sup>
ESRD	0	1.5	0.4	-0.4	-0.081	0.13 <sup>1</sup>
<i>Health status and chronic conditions</i>						
HCC risk score	2.73	2.78	2.68	0.06	0.037	1.0
Chronic conditions <sup>f</sup> (%)					-0.011	
Alzheimer's	8.4	8.5	8.7	-0.3	0.041	4.9 <sup>4</sup>
Alzheimer's disease, related disorders, or senile dementia	24.3	19.9	23.5	0.9	-0.011	11.1 <sup>4</sup>
Cancer	22.6	17.7	20.9	1.7	0.035	NA
CHF	43.4	44.7	41.6	1.7	-0.009	15.3 <sup>4</sup>
COPD	33.2	35.3	33.6	-0.4	0.033	11.8 <sup>4</sup>
CKD	52.7	50.4	51.0	1.7	-0.030	16.2 <sup>4</sup>
Diabetes	44.7	43.7	46.2	-1.5	0.021	28.0 <sup>4</sup>
<i>Service use and spending 3 months before enrollment or pseudo-enrollment</i>						
Number of unplanned readmissions (#/1000 beneficiaries/quarter)	27	67	24	3	0.017	NA
Number of hospitalizations <sup>g</sup> (#/1000 beneficiaries/quarter)	1084	1129	1078	6	0.022	74 <sup>5</sup>

Number of ED visits (#/1000 beneficiaries/quarter)	296	375	303	-7	-0.012	105 <sup>6</sup>
Primary care (%) <sup>h</sup>	96.9	95.7	95.9	1.0	0.051	NA
Medicare spending (\$/month)	6603	7203	6116	486	0.081	860 <sup>7</sup>
<i>Service use and spending 4 to 12 months before enrollment or pseudo-enrollment</i>						
Number of unplanned readmissions (#/1000 beneficiaries/quarter)	7	33	6	1	0.031	NA
Number of hospitalizations (#/1000 beneficiaries/quarter)	106	160	103	4	0.019	74 <sup>5</sup>
Number of ED visits (#/1000 beneficiaries/quarter)	252	223	204	48*	0.136	105 <sup>6</sup>
Primary care (%) <sup>h</sup>	95.6	87.0	93.5	2.0	0.083	NA
Medicare spending (\$/month)	1306	1680	1266	40	0.016	860 <sup>7</sup>

AGH indicates Atlantic General Hospital; CHF, congestive heart failure; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; ED, emergency department; ESRD, end-stage renal disease; FFS, fee-for-service; GI, gastrointestinal; HCC, Hierarchical Condition Category; MDC, major diagnostic category; MDRG, modified diagnosis-related group; NA, not available, n.a., not applicable; PRMC, Peninsula Regional Medical Center.

\*Significantly different from 0 at the  $P < .10$  level, 2-tailed test. No differences were significantly different from 0 at the .05 or .01 levels.

<sup>a</sup>The absolute difference is the difference in means between the matched treatment and comparison groups. Absolute differences might not be exact due to rounding.

<sup>b</sup>The standardized difference is the difference in means between the treatment and comparison groups divided by the standard deviation of the variable, which is pooled across the treatment and comparison groups.

<sup>c</sup>Variables on which we required treatment and comparison members to match exactly. For example, a treatment group beneficiary whose reason for hospital discharge was intracranial hemorrhage or cerebral infarction (MDRG 1114) could be matched only to a comparison beneficiary who had the same reason for discharge. The date of the qualifying inpatient discharge for matched comparison beneficiaries had to be within 90 days of the treatment

beneficiary's enrollment date. Instead of including these variates as covariates in the regression models, we included indicators for each matched set (a treatment beneficiary plus his or her matched comparison beneficiaries); this controls for interactions between the exact-matching covariates and any other characteristics constant over time within a matched set.

<sup>d</sup>The reason for the hospitalization that caused a person to enter the treatment or comparison group. We used MDRG codes to define the types of hospital stays. In addition to the 7 hospitalization types listed in the table, we exactly matched on 20 other MDRGs (for 27 MDRG codes), which captured the reason for discharge for most treatment beneficiaries. For the remaining treatment group beneficiaries, MDRG codes were too uncommon to provide sufficient matches in the comparison group; in such cases, MDC codes (instead of MDRG codes) were used for exact matching. To pay acute care inpatient FFS claims, Medicare assigns discharges to Medicare severity diagnosis-related groups (MS-DRGs), which group patients with similar clinical problems expected to require similar amounts of hospital resources; MDRGs group one or more related DRG codes into larger categories. MDC codes, in turn, group one or more MDRG codes together into even larger categories. Because the sample sizes were smaller in the preintervention period, we exactly matched on 15 MDRG codes (instead of 27).

<sup>e</sup>Variables on which we matched through a propensity score, which captures the relationship between beneficiaries' characteristics and their likelihood of being in the treatment group. In addition to the variables shown, we also matched on the number of months with Part A and B coverage 0 to 3 months and 4 to 12 months before a beneficiary's enrollment or pseudo-enrollment date.

<sup>f</sup>The chronic condition flags are calculated using 1 to 3 years of claims before the enrollment or pseudo-enrollment date (depending on the condition), using the Chronic Conditions Data Warehouse definitions.

<sup>g</sup>The program-targeting criteria explain the spike in hospitalization rates in the quarter before enrollment. The program enrolled people who were in the hospital; therefore, the population hospitalization rate had to reach or exceed 1000 (corresponding to at least 1 stay per person) in that quarter.

<sup>h</sup>Percentage of beneficiaries with any expenditures for primary care services in the 3 months before enrollment (or 4 to 12 months before enrollment).



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