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Final Report

HCIA Round 2 Evaluation: Four Seasons Compassion for Life

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FOUR SEASONS COMPASSION FOR LIFE

Four Seasons Compassion for Life, a nonprofit hospice and palliative care organization based in western North Carolina, received a cooperative agreement under Round 2 of the Health Care Innovation Awards (HCIA R2) to expand the Increasing Patient and System Value with Community-Based Palliative Care (CPC) program to other providers and nearby communities. The target population consisted of Medicare fee-for-service (FFS) beneficiaries with a life-limiting illness. The goals of the program were to (1) reduce hospitalizations by 10 percent, (2) reduce in-hospital deaths by 15 percent, and (3) save more than $25 million during the three-year cooperative agreement. The HCIA R2-funded CPC program launched in September 2014. The intervention period funded by HCIA R2 ended in November 2017, after Four Seasons received a three-month no-cost extension. Table 1 summarizes the program's key characteristics.

Important issues for understanding the evaluation

- The CPC program represented an expansion of an existing program and aimed to reduce hospitalizations and total expenditures among Medicare beneficiaries with life-limiting illness by providing palliative care.
- This analysis relied on 6,241 Medicare FFS beneficiaries who met the claims-based eligibility criteria. Of these, 2,097 were treatment-eligible beneficiaries who lived in one of Four Seasons' catchment areas (Henderson County) and 4,144 were comparison cases who lived in six comparison regions well-matched to Henderson County. Among the treatment-eligible group, 791 (38 percent) actually participated in CPC. These 791 participants comprised 14 percent of the 5,652 total program participants at all sites.
- A rigorous impact analysis of all participants was not possible because enrollment into the program relied heavily on clinical evaluation and judgment that could not be replicated for identifying a credible comparison group. The comparison of all eligible Medicare beneficiaries in the treatment and comparison areas eliminates this selection bias. However, other differences between the two areas rather than the program might have caused the differences in outcomes between hospitalized beneficiaries in their last year of life (38 percent of whom participated in the program) and similar beneficiaries in comparison areas. Also, the results cannot be generalized to the 86 percent of enrollees not included in the analysis.

The awardee hypothesized that palliative care received at least one year before the death of a patient with a life-limiting illness can improve the patient's quality of life and reduce the cost of health care. The CPC program provided patient-centered palliative care to participants with life-limiting illnesses through a collaborative, multidisciplinary care team that served participants' needs holistically. Services focused on achieving participants' goals related to symptom management, quality of life, psychosocial and spiritual support, coordination with community-based resources, and advance care planning. HCIA R2 funding also supported the program's activities to educate participants, families, and providers about palliative care.

This impact analysis compares changes in outcomes between a group of Medicare FFS beneficiaries in their last year of life who met program eligibility criteria assessable in claims (but were not necessarily enrolled in CPC) to outcomes for a matched comparison group. Enrollment into the CPC program depended on the provider's assessment of the beneficiary's health and prognosis. Therefore, it was not possible to identify a comparison group that would match the participants on these selection criteria and allow for a rigorous impact evaluation. To eliminate this selection bias, this analysis included only beneficiaries who died within one year of admission to a hospital or observation stay, and resided either in Henderson County, North Carolina, the location of Four Seasons' main site, or in one of the comparison regions. The six comparison regions were hospital referral regions (HRRs) that had similar demographic characteristics and end-of-life care as that used in Henderson County before CPC. The estimated differences in outcomes in the last year of life for beneficiaries in the treatment and comparison regions therefore could be due to other differences between the two areas that are unrelated to the intervention.

Table 1. Program characteristics at a glance

Program characteristics	Description
Purpose	Four Seasons Compassion for Life enrolled patients with life-limiting illness in the CPC program and provided them with a continuum of services that addressed participants' needs and integrated their care. Four Seasons also sought to change the behavior of participants and physicians by educating participants and their families, providers, and communities about palliative care.
Major innovation	The program aimed to implement a model of community-based palliative care in inpatient and outpatient settings in health care organizations and regions other than those where Four Seasons provided palliative care before the award.
Program components	• Integrated care to deliver symptom management, social work services, disease management education, advance care planning, support with complex medical decisions, and psychosocial support • Education and training of patients and their families, physicians, and other providers
Target population	Individuals ages 65 and older who were enrolled in FFS Medicare and who had a life-limiting illness with a prognosis of surviving three years or less
Participating providers	Four Seasons; Palliative Care and Hospice of Catawba Valley; one site in Asheville, North Carolina; and two sites in Greenville, South Carolina
Total enrollment	Four Seasons enrolled a total 5,652 participants in the CPC program (73 percent of the enrollment goal).
Level of engagement	Because nearly two-thirds (63 percent) of the 5,803 participants were enrolled in the CPC program during or after the eighth program quarter; these participants might have received less exposure to program services.
Theory of change or theory of action	If a continuum of services addresses participants' needs and integrates their care in all the settings through which participants with advanced illnesses transition, the participants should have fewer hospitalizations and emergency department visits, be less likely to have an in-hospital death, and have lower total Medicare costs. If participants, families, providers, and communities are educated in palliative care, then the behavior of participants and physicians will change such that the use of community-based palliative care will increase.

Table 1 (*continued*)

Program characteristics	Description
Award amount	$9,569,123
Effective launch date	September 2, 2014
Program settings	Any setting in which a participant received health care, including specialty care clinics, hospitals, long-term care facilities, hospices, primary care practices, and a participant's private residence
Market area	Rural, suburban, urban
Market location	Western North Carolina and Greenville, South Carolina
Target outcomes	• 10 percent reduction in hospitalizations for CPC participants • 15 percent fewer in-hospital deaths among CPC participants • $25,272,000 in total Medicare savings on the cost of care for participants who receive the CPC intervention during the three-year cooperative agreement
Payment model	New Medicare FFS payment, bundled, or episode payment
Sustainability plans	Continuing the program unchanged from the award period with funding from health insurers billed for services; developing a new capitated payment model

CPC = Community-Based Palliative Care program; FFS = fee-for-service.

The impact analysis presented in this report included 2,097 Medicare FFS beneficiaries who lived in one of Four Seasons' catchment areas (Henderson County), had a hospital stay, and died within one year of that hospital admission. This treatment-eligible group included 791 CPC participants (38 percent). The study identified a comparison group of 4,144 Medicare FFS beneficiaries who met the same criteria but resided in six HRRs that were similar to Henderson County but were not in CPC's catchment area. Table 2 summarizes the key features of the evaluation. Appendix A, Table A.1 describes the identification of the study sample.

Table 2. Key features of program evaluation

Features	Description
Evaluation design	The analysis relied on two different models, depending on the outcome: (1) a first-differences model using the difference between the outcome of interest during the follow-up period and the baseline year as the dependent variable for continuous outcomes; and (2) a post-period comparison of outcomes between eligible treatment beneficiaries and the comparison group for binary outcomes. Both models used regression analysis to control for differences in baseline characteristics that might be correlated with outcomes.
Intervention group for evaluation	The treatment group for this analysis included 2,097 Medicare FFS beneficiaries who lived in Henderson County, North Carolina, and were likely eligible to participate in the CPC program (that is, they had a hospitalization and died within one year after that admission). Among these 2,097 beneficiaries, the CPC program enrolled 791 (38 percent). The intervention group included only Henderson County residents because the participation rate among eligible beneficiaries in other counties was too low to support an evaluation.

Table 2 (*continued*)

Features	Description
Comparison group	The comparison group included 4,144 beneficiaries who met the same criteria and lived in one of six HRRs with pre-program demographic characteristics and end-of-life care similar to that of Henderson County before CPC.
Limitations	If treatment-eligible beneficiaries differed from the comparison group in ways not captured in Medicare administrative files and claims, the impact estimates might be biased. More importantly, other factors in the treatment and comparison areas unrelated to the intervention might have affected outcomes differently for patients in the two areas. The 38 percent participation rate among the treatment-eligible group means that impacts on those actually receiving the intervention are likely to be about 2.5 times larger than the estimates obtained on the treatment-eligible group. This analysis might not detect even large true effects (for example, 20 percent) on participants.

CPC = Community-Based Palliative Care program; FFS = fee-for-service; HRR = hospital referral region.

PROGRAM DESIGN AND ADAPTATION

Four Season's CPC program had two components: (1) integrated palliative care and (2) patient education and provider training.[1] The analysis could not measure the independent effect of each intervention component on changes in outcomes.

Integrated care

The CPC program did not undergo major changes to the type of health care services provided during the cooperative agreement. The awardee sought to address participants' needs holistically—for example, by providing spiritual and social support as well as clinical care. The highly collaborative, multidisciplinary CPC care teams integrated inpatient and outpatient care such that it spanned all settings through which participants with advanced illnesses transition, such as hospitals, clinics, private residences, nursing homes, and assisted living facilities. A nurse practitioner or a physician assistant oversaw the care teams; they oversaw registered nurses, social workers, and administrative support staff.

According to the program's protocols, CPC care teams were to schedule in-person home appointments within 48 hours of enrollment for high-risk participants; for low-risk participants, the care teams were to schedule a home visit within 7 to 10 days or an in-person clinic visit within two weeks of enrollment. Care teams followed up with participants in person or by phone as needed throughout the remainder of their enrollment. During the first encounter, program staff typically assessed the participant's health, developed a care plan with input from the participant and caregivers, and documented decisions for advance care planning. Other services included symptom management, social work, education in disease management, support with complex medical decisions, and psychosocial support.

[1] The Third Annual Evaluation Report provides additional details on the design and implementation of the program. It is available at https://downloads.cms.gov/files/cmmi/hcia2-yr3evalrpt.pdf.

Education and training

The awardee trained CPC providers and referring providers about how to judge whether to refer patients to the program based on the primary diagnosis, physical limitations, prognosis, and other elements listed in a paper screening tool developed by Four Seasons. The training consisted of a 40-hour immersion course on palliative care, cultural competency, and other relevant topics, along with ongoing training to implementation sites through weekly or monthly calls, summary of quality monitoring, and one-on-one communication with members of the team as needed. The awardee also offered participant and family education about palliative care.

ACHIEVEMENTS AND CHALLENGES OF PROGRAM IMPLEMENTATION

A review of qualitative and quantitative information suggests that Four Seasons successfully implemented the CPC program. According to data it submitted, the awardee hired and retained staff throughout the cooperative agreement despite challenges in the general palliative care field with workforce shortages and staff burnout. Four Seasons received positive feedback about the training it provided to program staff and clinicians. One respondent to a staff survey described the ongoing training from Four Seasons as "solid and continuous" support that helped the implementing sites to "focus on what we need to improve."

Implications of program implementation for detecting impacts

- Program participants received comprehensive services that addressed their needs holistically, including spiritual and social support and symptom management.
- There were fewer participants than the awardee had anticipated who were most likely to benefit from the CPC program because they were either seriously ill or were transitioning from one type of care to another. This led to a suboptimal patient mix and might have limited the program's ability to reduce expenditures.
- The awardee was confident, however, that the program had achieved its intended goals.

However, Four Seasons faced several challenges implementing its program. First, the awardee had to revise its program enrollment target after finding that many more patients than expected were ineligible to participate in the CPC program because they were enrolled in Medicare Advantage plans. Second, misperceptions about palliative care among participants and their families also created challenges in enrollment and service delivery. However, the efforts of Four Seasons and its implementing partners to expand its community outreach efforts by launching a patient and family education module succeeded in overcoming these misperceptions, according to interview respondents. Third, due to the nature of the CPC program, many participants were enrolled for only a short time before death. This happened most likely because providers who referred these beneficiaries to Four Seasons' program did so only shortly before the participants' death. One-quarter of treatment group

members who participated in the program died within 20 days of enrollment and 50 percent died within 70 days. Because of short enrollment periods, the intervention might have had a smaller effect than the awardee had expected.

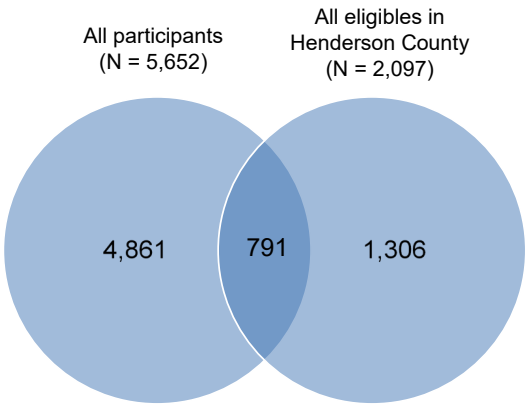
ESTIMATING PROGRAM IMPACTS

Study sample

Because Medicare claims data do not contain the type of clinical information providers used to identify beneficiaries to enroll in the program, it was not feasible to identify a comparison group that matched well to the CPC program participants. Enrollment into the CPC program relied heavily on the provider's assessment of the beneficiary's health and prognosis. Elements that providers considered when assessing health and prognosis included whether the provider would be surprised if the patient died in the next three years; physical limitations such as fall risk; presence of serious illness, such as an advanced or end-stage disease; and social determinants such as housing status, substance abuse, and lack of caregiver support. Most of these data are not available in Medicare claims.

To minimize the risk of bias due to self-selection into palliative care, the treatment group used for this analysis consisted only of beneficiaries who met certain criteria (described below) that made it likely they were eligible to enroll in the program. The analysis further restricted the treatment group to beneficiaries who lived in Henderson County, where Four Seasons has its main location, because a high proportion of those meeting these evaluation criteria actually did enroll in CPC. To be included in the analysis, treatment group members had to meet four criteria: (1) in Medicare FFS in the enrollment month and at least three months in the year before enrollment, (2) had at least one hospital admission in the year before enrollment, (3) died within one year of the last hospital admission in the year before enrollment, and (4) were not in hospice in the 90 days before enrollment. The potential comparison group included all Medicare beneficiaries who met the same four criteria and lived in one of six HRRs in which health care use by Medicare beneficiaries in the last two years of life was similar to that of beneficiaries in Henderson County before the program start. This approach ensured that the treatment and comparison groups had comparable access to palliative care before the program began.

Because members of the comparison group and non-enrolled members of the treatment group did not have an enrollment date, and participants often enrolled some time after the hospital discharge, the evaluation assigned pseudo-enrollment dates to these sample members. The pseudo-enrollment date for a given non-enrolled eligible treatment group member or comparison group member at an assigned number of days after the index hospital discharge date. The assigned number of days was randomly selected so that the distribution of days between the index hospital discharge date and the pseudo-enrollment date for these sample members matched the distribution of actual time between hospital discharge and enrollment dates for program participants. (For two-thirds of the participants, the enrollment date occurred during a hospitalization.)



Participants enrolled in the CPC program on a rolling basis from September 2014 to August 2017. Among the total of 5,652 FFS Medicare beneficiaries who participated in the program, the analysis included only the 791 (14 percent) who lived in Henderson County. Because Four Seasons is based in Henderson County and had the highest participation rate there, the evaluation restricted the analysis to this area. The treatment group included an additional 1,306 Medicare beneficiaries not enrolled in the program but who met the selection criteria described earlier. Hence, the program enrolled 38 percent of the eligible treatment group. The evaluation used propensity score matching to select the comparison group, and it consisted of 4,144 Medicare FFS beneficiaries. (Appendix A, Table A.1 describes the identification of the analytic sample).

Characteristics of treatment and comparison group beneficiaries

The treatment and comparison groups were similar in terms of demographic characteristics, expected future health care costs, and health care use and expenditures in the baseline year (Table 3). Most beneficiaries in both groups were 75 or older, and they were predominantly White. Following the sample selection criteria, all beneficiaries had a hospital admission (or observation stay; the table shows the percentage with an admission) during the year before enrollment and more than half of the sample had an emergency department (ED) visit during the year before enrollment. Their disease burden was relatively high, with an average hierarchical condition category (HCC) score of almost 4 in the treatment and comparison groups, meaning the study sample had expected annual Medicare costs four times the national average of all FFS beneficiaries. Almost 25 percent of beneficiaries had an HCC score of 5 or higher. Average spending per beneficiary per month (PBPM) was $3,044 for the treatment group and $3,034 for the comparison group, more than twice the national average. Although the treatment and comparison group areas had similar measures of end-of-life care for chronically ill Medicare beneficiaries, there might have been unmeasured differences, and those differences might have been related to study outcomes.

Due to the sample selection criteria, all beneficiaries died within one year of their last hospital admission before enrollment. As a result, the follow-up period lasted at most 12 months, and it was typically much shorter. Treatment beneficiaries died within 78 days on average after enrollment and comparison beneficiaries died within 113 days of their pseudo-enrollment date on average. The 35-day difference in survival after enrollment between the treatment and comparison beneficiaries might suggest differences in end-of-life care between Henderson County and the comparison regions. Alternatively, the timing of enrollment for program participants might relate to specific changes in their health or services received, whereas no such association exists for members of the treatment or comparison groups who did not enroll in the

program. Appendix B provides the full balance results measured during the 12 months before the enrollment date.

Table 3. Baseline characteristics of treatment and comparison group beneficiaries

Measure	Treatment (N = 2,097)	Comparison (N = 4,144)
Demographics, %		
Age group		
65 to 74	21	16
75 to 84	33	39
85 and older	46	45
Male	46	46
Race, %		
White	97	98
Black	2.4	1.2
Other	1.0	1.0
Original reason for Medicare eligibility, %		
Old age and survivor's insurance	88	88
Disability insurance benefits	11	11
End-stage renal disease	0.4	0.2
Medicare and Medicaid dual status, %		
Not dually eligible	83	83
Dually eligible	17	17
HCC score[a]		
Mean	3.9	3.8
25th percentile	2.5	2.4
Median	3.6	3.6
75th percentile	5.0	4.9
Baseline expenditures ($ PBPM)		
Total expenditures	3,030	3,023
Service use during the year before enrollment, %		
Hospital stay[b]	96	95
ED visit	54	61

Sources: Mathematica's analysis of information from awardee's finder file as of November 30, 2017, and Medicare claims and enrollment data as of August 31, 2019.

Notes: The baseline period covers the 12-month period before the enrollment (or pseudo-enrollment) date that led to sample inclusion for each beneficiary.

The statistics are weighted means, with participant weights proportional to the number of months during the 12-month baseline period that the participant was enrolled in Medicare. Observations on comparison beneficiaries were also weighted to reflect the number of different treatment group beneficiaries to which the comparison beneficiary was matched.

Appendix B presents full balance results. Exact matching variables include the index date of hospital discharge.

Table 3 (*continued*)

[a] The HCC score incorporates diagnosis history and demographics to estimate a score representing the expected costs of a Medicare beneficiary in the upcoming year. A score of one represents average expected expenditures. The analysis used the most recently available HCC algorithms to calculate HCC scores.

[b] All sample members had to have had either an inpatient or an observation stay during the year before enrollment or pseudo-enrollment. Almost all had an inpatient stay.

ED = emergency department; FFS = fee-for-service; HCC = hierarchical condition category; PBPM = per beneficiary per month.

Analytic approach

The impact analysis relied on two different models, depending on the outcome: (1) a first-differences model for continuous outcome measures, using the difference between the outcome of interest during the follow-up period and the baseline year as the dependent variable; and (2) a post-period comparison of binary outcomes between eligible treatment beneficiaries and a set of matched comparison beneficiaries. Both models controlled for differences in baseline characteristics that might be correlated with outcomes. The follow-up period was the time from the enrollment (or pseudo-enrollment) date to the date of death. The study outcomes included Medicare expenditures PBPM and measures of health care use for up to one year after enrollment, as well as expenditures and hospital use during the last 7, 14, and 30 days of participants' lives. For all beneficiaries, the study calculated measures of total expenditures and expenditure categories as the difference between the outcome during the follow-up period and the baseline year. Appendix A contains a detailed description of the study sample, the statistical models, and the outcomes used to estimate the treatment–comparison differences.

IMPACT RESULTS

The study found that expenditures were an estimated 10 percent higher among treatment group beneficiaries than among comparison group beneficiaries, not lower as expected (Table 4). The higher hospice and skilled nursing facility (SNF) expenditures for the treatment group than the comparison group drove the higher total spending for the treatment group (see Appendix C). Although the rate of hospice use did not differ significantly, the analysis estimated hospice spending among beneficiaries in the treatment group to be on average 59 percent higher than among comparison group members. Appendix C presents the full results of the impact analysis. Appendix D shows the results from the Bayesian analysis.

Table 4. Estimated impacts of the Four Seasons Compassion for Life intervention on selected outcomes during a 12-month follow-up period

	Treatment-comparison difference	Percentage change in outcomes[a]	*p*-value
Total Medicare expenditures ($ PBPM)	601*	10%	0.08
Hospice expenditures ($ PBPM)	480***	59%	< 0.01
Percentage with a hospital admission	-8.1	-10%	0.26
Percentage with in-hospital death	-1.1	-12%	0.41

Table 4 (*continued*)

Sources: Mathematica's analysis of information from awardee's finder file as of November 30, 2017, and Medicare claims and enrollment data as of August 31, 2019.

Notes: Due to the approach used to select the sample, all beneficiaries died within the first 12 months of the follow-up period. Appendix C presents full impact estimates. Appendix D shows the results from the Bayesian analysis.

[a] Percentage difference is equal to the ratio of the estimated difference divided by the treatment group mean minus the estimated difference.

*Significantly different from zero at the .10 level, two-tailed test.

**Significantly different from zero at the .05 level, two-tailed test.

***Significantly different from zero at the .01 level, two-tailed test.

PBPM = per beneficiary per month.

These findings suggest treatment group members might have received more intensive or longer hospice services, though the study cannot make that claim with confidence because there was a substantial risk of unobserved differences between the comparison and treatment groups. The higher SNF expenditures and lower home health expenditures for the treatment group (shown in Appendix C) might suggest differences between treatment and comparison geographic areas in sources of post-acute care, or to the timing of enrollment for program participants. In addition, Four Seasons' experience delivering palliative care and the fact that care teams focused on symptom management and psychosocial needs might have led to an increased recognition of care needs better addressed in inpatient hospice or SNF settings.

Main findings from impact evaluation

- Due to limitations in the research design, the findings from this analysis might not be reliable measures of program impacts.
- The treatment group had total Medicare expenditures that exceeded those of the comparison group by $601 PBPM.
- Higher hospice and SNF expenditures drove the higher total expenditure.
- Estimated effects on both hospitalization and in-hospital death rates were both favorable, but were not statistically significant.

The estimated difference between treatment and comparison groups might be associated with program participation. For example, hospice expenditures were higher among treatment group members who participated in Four Seasons' program than among treatment group members who did not participate in the program, and program participants were more likely to use hospice than nonparticipants in the treatment group. The awardee's four decades of experience providing hospice care in Henderson County might explain the more intensive use of hospice services. It is possible that Four Seasons could better identify the needs of its enrollees and provided more extensive and more expensive hospice services than hospice agencies serving non-enrolled treatment beneficiaries in the same area. The evaluation did not estimate differences between enrollees and non-enrolled treatment beneficiaries in hospice use.

The treatment group had lower hospitalization rates and in-hospital death rates, but the association of treatment status with these outcomes was not statistically significant. The likely failure to substantially reduce the percentage of beneficiaries hospitalized probably explains why

total expenditures did not decline as the awardee had hoped. The higher hospice and SNF expenditures for the treatment group were not offset by an equally large or larger reduction in inpatient expenditures. The awardee might not have engaged participants early enough to reduce hospitalizations and overall expenditures. Most enrollees participated in the program for a brief time before their death. Despite its efforts to educate patients and families about palliative care, Four Seasons might not have had enough time to help participants substitute lower-cost palliative care for hospitalizations.

CONCLUSIONS

Although the awardee successfully enrolled participants in its CPC program and delivered palliative care services to them as intended, this analysis suggests that the intervention did not reduce Medicare spending among patients near the end of life in Henderson County. Total expenditures were higher for the treatment group than for the comparison group due to higher hospice and SNF spending. The findings point to a more intensive use of hospice care among the participants of Four Seasons' program. Due to its extensive experience with delivering hospice services and the focus during implementation on educating of patients, families, and providers, it is possible that the awardee identified unmet care needs among program participants. Delivering these services might have led to an associated increase in total expenditures. At the same time, there was no compelling evidence that the CPC program led to fewer hospitalizations, which contradicts the theory of action. The findings suggest, however, that the awardee did not achieve its goal of saving $25 million during the three-year cooperative agreement. Although the estimates suggest that CPC did not save money, the estimates do suggest there might have been a modest improvement in patients' experience among patients near the end of life in Henderson County. Because patients often express a preference for dying at home instead of in an inpatient setting, the estimated reduction in in-hospital death rates likely had positive implications for their quality of life. This is in line with the program's theory of action.

Limitations of evaluation

The palliative care intervention could have caused the estimated differences in outcomes between the eligible treatment group and the matched comparison group. However, the estimated differences in outcomes could be due to other factors affecting the patterns of end-of-life health care use and expenditures in Henderson County and the HRR comparison areas. In addition, the program enrolled only 38 percent of the beneficiaries in the treatment group, which substantially dilutes estimated program effects on eligible participants. This analysis includes only 14 percent of all participants in Four Seasons' CPC program during the period covered by the cooperative agreement. It is possible that the program had different impacts on health care use and expenditures for most enrollees, whom the analysis could not include because of the low participation rate among seemingly eligible patients in those geographic areas.

PROGRAM SUSTAINABILITY

After its award ended in November 2017, Four Seasons reported that all five participating sites continued the CPC program without major changes. Four Seasons had always anticipated that it would continue the CPC program beyond the award period because it had operated the program at a single site for 12 years before the award. The awardee partnered with four additional sites to implement the program during the award period, all of which continued the program with one change: Four Seasons no longer oversaw the partners' programs, which also meant that the sites no longer reported data to Four Seasons or received program-related data feedback reports from Four Seasons.

Four Season's proposed payment model

Four Seasons proposed paying for the CPC program through a bundled payment model. The PBPM payments would cover the following standard set of palliative care and hospice services:

- Advance care planning
- Up to three goals-of-care conferences
- Home visits
- Clinic visits
- Symptom management
- Coordination of services
- Social work
- Some services provided by the hospice team

Services unrelated to palliative care were carved out of the payment model, including hospitalizations, primary care, and specialty care. The awardee partnered with the American Academy of Hospice and Palliative Medicine to develop the model.

Four Seasons and its implementing partners sustained CPC at their sites by funding the program the same way Four Seasons did before the award—billing insurers when possible and using internal funding or external grants to cover the rest of the program costs. Knowing that these funding streams could not reliably sustain CPC in the long term, Four Seasons continued to work on securing funding for its bundled payment model after the award ended. The awardee submitted an alternative payment model to the Physician-Focused Payment Model Technical Advisory Committee, which the committee approved for a demonstration according to the awardee. The awardee was also in talks with commercial payers to fund its proposed capitated payment model but had not reached any agreements as of July 2018.

Appendix A

Description of modeling strategy and analytic sample

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Sample construction

Treatment group

The treatment group for the analysis consisted of Medicare fee-for-service (FFS) beneficiaries who satisfied the following conditions: (1) lived in Henderson County, North Carolina, where Four Seasons operates its main site, during the admission month; (2) had a hospital or observation stay with an admission date from September 1, 2013, to August 31, 2017; (3) died within one year from the admission date; (4) were enrolled in Medicare FFS during the month of the discharge from the hospitalization or end of the observation stay; and (5) were at least 65 years old. These selection criteria identified 2,385 beneficiaries in claims data who met these analytic criteria for inclusion in the treatment group, of whom 820 were already enrolled in Four Seasons' Community-Based Palliative Care (CPC) program. Some beneficiaries had multiple hospitalizations that met those criteria. For beneficiaries enrolled in the CPC program, the evaluation used the most recent admission before the enrollment date as the index admission for each beneficiary. For non-enrolled beneficiaries with multiple admissions during the program period, the evaluation treated a randomly selected admission as the index admission.

Table A.1 shows the how the evaluation defined the participant portion of the analysis sample for this study. The table lists why the evaluation excluded participants and the number of participants withdrawn for each reason.

Table A.1. Number of participants excluded from impact analysis, by reason

	Number of participants removed from analytic sample	Number of participants remaining in analytic sample
Total program participants through August 31, 2017		**5,652**
Excluded beneficiaries who:		
Were not found in Medicare crosswalk file	159	5,493
Did not live in Henderson County, North Carolina	3,762	1,731
Did not have any inpatient or observation stay with an admission date from September 1, 2013 to August 31, 2017	133	1,598
Did not die within one year of admission	571	1,027
Were enrolled in FFS in the month of discharge	3	1,024
Were younger than 65 during the month of admission	1	1,023
Were not living in treatment geographic area during month of admission	37	986
Did not have any inpatient or observation stay claim during year before enrollment date on the finder file	166	820
Were in hospice at any time during the 90 days before the index hospitalization	29	791
Final analytic sample		**791**

Source: Mathematica's analysis of information from awardee's finder file as of November 30, 2017, and Medicare claims and enrollment data as of August 31, 2019.

FFS = fee-for-service.

Pseudo-enrollment date

The definition of the pseudo-enrollment date differs between enrolled and not enrolled beneficiaries in Four Seasons' CPC program. For beneficiaries enrolled in the program, the evaluation defined the pseudo-enrollment date as the program enrollment date if enrollment did not occur on the admission date of the qualifying hospitalization or observation stay. If enrollment occurred on the date of the hospital admission or start of the observation stay, the evaluation defined the index date as one day after the enrollment date. This ensures that the costs associated with the qualifying hospital or observation stay are part of the baseline period and not the intervention period, because the program typically identified beneficiaries as candidates for CPC after they arrived at the hospital.

For members of the treatment group not enrolled in the program, the evaluation assigned the pseudo-enrollment date by adding to the index hospitalization date a number drawn randomly from the distribution of days from hospital admission to the actual enrollment date for the enrolled beneficiaries. This ensured that the distribution of the number of days from hospital admission to the pseudo-enrollment date for both the comparison group and the non-enrolled treatment group members matched the distribution of days from hospital admission to actual enrollment date of the enrolled beneficiaries (for example, the program participants).

The pseudo-enrollment date defined the baseline and follow-up periods, which are both beneficiary specific. The baseline comprised the 365 days before the pseudo-enrollment date. The follow-up period started on the pseudo-enrollment date and varied in length because it lasted from the pseudo-enrollment date to each beneficiary's death. Because of the sample selection criteria, the follow-up period lasted at most 365 days.

To arrive at the final treatment group used in the study, the analysis dropped the following observations on non-enrolled treatment group members (matching the criteria used to select program participants included in the analysis): the pseudo-enrollment date occurred on the admission date of a subsequent hospitalization; the beneficiary was in hospice within 90 days before the pseudo-enrollment date; the beneficiary was not enrolled in Medicare FFS in the month of the pseudo-enrollment date or at least three months in the year before the pseudo-enrollment date; the beneficiary did not live in Henderson County in the month of the pseudo-enrollment date; or the beneficiary died on or before the assigned pseudo-enrollment date. The final treatment group consisted of 2,097 beneficiaries, of whom 791 were enrolled in the program.

Potential comparison group

The potential comparison group consisted of Medicare FFS beneficiaries who satisfied the same conditions as treatment group members, except that they lived in one of six comparison hospital referral regions (HRRs) instead of Henderson County during the month of the qualifying hospital admission or observation stay. These selection criteria identified 60,003 potential comparison group members.

Comparison geographic areas

Because local conditions influence health care use and expenditures, drawing the comparison group from areas adjacent to the awardee's service area would be ideal. However, this was not feasible, because organizations that referred patients to the awardee treated many qualifying beneficiaries. The awardee worked with many hospitals, long-term care facilities, skilled nursing facilities, clinics, and other organizations to obtain referrals for CPC. Because many of these organizations were located in counties near Henderson County, the evaluation could not select a potential comparison group that excluded all beneficiaries treated by these organizations using administrative data.

The analysis used a two-step process to select comparison geographic areas whose end-of-life care and demographic characteristics were similar to Henderson County. The analysis sample consisted of beneficiaries in the last year of life. Therefore, in Step 1, the analysis used the 2013 Dartmouth Atlas to find HRRs where end-of-life care was similar to the Asheville, North Carolina, HRR, where Henderson County is located, based on three measures of health care use by chronically ill Medicare beneficiaries at the end of life:

1. Percentage of decedents receiving hospice benefits
2. Percentage of deaths occurring in hospital
3. Hospital care intensity index, which is a standardized ratio of inpatient days to inpatient admissions

The study examined data on these three measures to identify HRRs that had values similar to the Asheville HRR. For example, 54.8 percent of chronically ill Medicare beneficiaries who died in 2013 in the Asheville HRR received hospice benefits. Therefore, the study limited potential comparison HRRs to those where the rate of hospice use ranged from 49.8 to 59.8 percent. Other HRRs in North Carolina and the southeastern states have markedly different patterns of end-of-life care than the Asheville HRR; those HRRs have lower rates of hospice use, higher rates of in-hospital death, and higher values of the hospital care intensity index than Asheville. Therefore, the potential comparison geographic areas identified in Step 1 are in other regions of the country.

In Step 2, the study examined potential comparison HRRs identified in Step 1 to determine which of them had counties with somewhat similar demographic characteristics to Henderson County based on the following county-level measures from the Area Resource File:

- Percentage urban population, 2010
- Median household income, 2013
- Percentage Black or African American or Hispanic, 2013

Based on data on health care use at the end of life and demographic characteristics, the study selected the following HRRs as comparison areas: Iowa City, Iowa; Waterloo, Iowa; Portland,

Maine; Muskegon, Michigan; Petoskey, Michigan; and Salem, Oregon. The evaluation refers to them as the comparison geographic areas.

Pseudo-enrollment date

For potential comparison group members, the evaluation defined the possible pseudo-enrollment date as 1, 2, 3, 5, 7, 10, 14, 30, or 90 days after the admission date of the qualifying hospital stay if the resulting index date was at least one day before the beneficiary's death. That is, each beneficiary who lived in one of the comparison geographic areas and met sample eligibility criteria had up to nine versions in the potential comparison group, and each version had a different pseudo-enrollment date. The analysis selected this distribution of days (1, 2, 3, and so on) based on examining the distribution of days from admission to enrollment among beneficiaries in the treatment group who enrolled in the CPC program. From these, up to nine possible observations per beneficiary, the evaluation excluded observations for the following reasons: the pseudo-enrollment date occurred on the admission date of a subsequent hospitalization; the beneficiary was in hospice or had a claim for palliative care within 90 days before the pseudo-enrollment date; the beneficiary was not enrolled in Medicare FFS in the month of the pseudo-enrollment date or at least three months in the year before the pseudo-enrollment date; the beneficiary did not live in a comparison geographic area in the month of the pseudo-enrollment date; or the beneficiary died on the pseudo-enrollment date. The potential comparison group used for propensity score matching had 333,601 observations—each with a unique combination of beneficiary identification number and pseudo-enrollment date.

Description of modeling strategy and outcome variables

The analysis estimated program impacts on total and service-specific expenditures using a first-difference approach. Specifically, it subtracted expenditures per beneficiary per month (PBPM) in the baseline period (the 12-month period before a beneficiary's index date) from expenditures PBPM in the follow-up period (the period from the index date to the beneficiary's death, which was always less than one year after the index date). The estimates show the regression-adjusted change between baseline and intervention periods for the treatment group relative to that for the comparison group. These regressions control for beneficiaries' characteristics and number of hospital stays, emergency department (ED) visits or observation stays, and primary care visits during the baseline period. The evaluation then regression-adjusted treatment–comparison differences of estimates for the binary outcomes of any hospital stay and any ED visit during the follow-up period based on regressions that controlled for a beneficiary's baseline characteristics and whether the beneficiary had any hospital stay and any ED visit, respectively, during the baseline period. The regressions for any hospital stay and any ED visit also controlled for the beneficiary's number of hospital stays, ED visits or observation stays, and primary care visits and total expenditures per month during the baseline period.

In addition to the standard outcomes described in Appendix A of Volume I of this report, awardee-specific outcomes included total expenditures in the last 7, 14, and 30 days of life and binary outcomes of any hospital stay in the last 30 days of life; any hospice stay during the

follow-up period; and in-hospital death. The analysis calculated total expenditures in the last 7, 14, and 30 days of life only for beneficiaries who survived for at least those numbers of days during the follow-up period. The analysis calculated the outcome of any hospital stay in the last 30 days of life only for beneficiaries who survived for at least 30 days during the follow-up period. The outcome equals one if a beneficiary was admitted to a hospital within 30 days of the date of death. The outcome of any hospice stay equals one if the beneficiary used any hospice services in the follow-up period.

The regressions did not control for a program maturity indicator. At the start of the Round 2 of the Health Care Innovation Award grant period, Four Seasons had provided outpatient palliative care in Henderson County for 12 years. Four Seasons did not substantially change the palliative care services it offered or its selection of patients during the award period. The only major change was that the program began collecting and monitoring patients' data through its Quality Data Collection Tool database. Its collection and use of patients' data changed throughout the three-year award period, and the analysis identified no particular time when collection and use of those data matured.

To account for different lengths of time observed, the analysis weighted regressions for the outcomes of total and service specific expenditures PBPM, any hospital stay, any ED visit, and any hospice stay by the number of days from the index date to a beneficiary's death.

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Appendix B

Results from balance assessment of treatment and comparison groups

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Table B.1 shows the variables used for matching. The table displays the weighted means of baseline characteristics for the 2,097 treatment beneficiaries and the 4,144 matched comparison beneficiaries used in the analysis. The table shows the means, difference in means, the percentage difference, and the standardized difference for each variable, calculated as the ratio of the difference in weighted means and the standard deviation of the variable (estimated on the treatment group). Standardized differences of less than 10 percent were generally considered a good fit. The matching variables include demographic characteristics (age, gender, and race); Medicare entitlement and dual eligibility status; health status (as measured by the hierarchical condition category [HCC] score and chronic condition indicators); Medicare expenditures in total and by type of service; and service use. The analysis required an exact match on whether the beneficiary was hospitalized on the index date.[1] The analysis measured variables over various specified intervals before each beneficiary's index date.

The table also shows the results of the equivalency-of-means tests. *p*-values come from a weighted two-sample t-test, which provides evidence of whether the difference in the means is statistically significant. The equivalence test *p*-values are the greater of two one-sided weighted t-test *p*-values equivalence tests, which assess whether the treatment and comparison group means differ by more than 0.25 standard deviations. Finally, the study also performed an omnibus test in which the null hypothesis is that the treatment and matched comparison groups balanced across all linear combinations of the covariates. The results assess the closeness of fit between the treatment and matched comparison groups on key characteristics likely associated with study outcomes.

Final sample

The study selected the comparison group by propensity score matching. The final estimation sample consisted of 6,241 beneficiaries—2,097 treatment group members and 4,144 comparison group members. The treatment group included 791 beneficiaries who participated in Four Seasons' Community-Based Palliative Care (CPC) program during the funding period, met the selection criteria used for this evaluation, and resided in Henderson County, North Carolina, plus 1,306 Medicare fee-for-service (FFS) nonparticipating beneficiaries who resided in Henderson County and met the same sample selection criteria. The comparison group consisted of 4,144 Medicare beneficiaries who resided in six comparison hospital referral regions, met the sample selection criteria, and were selected as matches for the treatment group members. Although the potential comparison group had multiple observations per beneficiary, the matched comparison group included only one observation for a given comparison beneficiary.

The two groups matched well on most characteristics, but a few differences caused concerns about possible bias. Proportionate differences that are large are not necessarily a concern if they are due to small absolute differences between the groups divided by a small mean (for example, the difference in hospice care during the baseline period is only 1.5 percentage points, but 41

[1] The index date is the first day of the post-period. The measure of whether a beneficiary was hospitalized on his or her index date reflects whether the beneficiary was in the hospital or discharged from the hospital on the index date.

percent of the mean). However, differences such as those observed for the proportion with dementia with complications (13 versus 8.5 percent) and the proportion with depressive disorder (12 versus 8.6 percent) exceeded 30 percent of the treatment group mean.

Table B.1. Baseline characteristics of treatment and matched comparison groups for FSCL

Characteristic	Treatment mean (SE)	Matched comparison mean (SE)	Adjusted difference (SE)	Percentage difference	Standardized difference	*p*-value	Equivalence *p*-value
Demographics							
Age, years	82 (0.19)	83 (0.12)	-0.28 (0.25)	< +/-1	-0.03	0.27	< 0.01
Male, %	46 (1.1)	46 (0.77)	-0.21 (1.6)	< +/-1	0.00	0.89	< 0.01
White, %	97 (0.40)	98 (0.23)	-1.2 (0.53)	-1.3	-0.07	0.02	< 0.01
Black, %	2.4 (0.33)	1.2 (0.17)	1.2 (0.43)	51	0.08	< 0.01	< 0.01
American Indian, Alaska Native, Asian or Pacific Island American, or other, %	0.48 (0.15)	0.81 (0.14)	-0.33 (0.25)	-70	-0.05	0.19	< 0.01
Hispanic, %	0.19 (0.10)	0.05 (0.03)	0.14 (0.10)	75	0.03	0.16	< 0.01
Unknown, %	0.33 (0.13)	0.14 (0.06)	0.19 (0.15)	57	0.03	0.21	< 0.01
Dual eligibility status, %							
Dually eligible for Medicare and Medicaid	17 (0.82)	17 (0.57)	0.19 (1.2)	1.1	0.01	0.87	< 0.01
Original reason for Medicare eligibility, %							
Old age and survivor's insurance	88 (0.70)	88 (0.49)	-0.24 (1.0)	< +/-1	-0.01	0.81	< 0.01
Disability insurance benefits	11 (0.69)	11 (0.49)	0.02 (0.98)	< +/-1	0.00	0.98	< 0.01
End-stage renal disease	0.43 (0.14)	0.21 (0.07)	0.21 (0.17)	50	0.03	0.21	< 0.01
Health status and diagnoses							
HCC score[a]	3.9 (0.04)	3.8 (0.03)	0.10 (0.06)	2.6	0.05	0.08	< 0.01
Acute renal failure, %	41 (1.1)	41 (0.76)	0.48 (1.5)	1.2	0.01	0.76	< 0.01

Table B.1 (*continued*)

Characteristic	Treatment mean (SE)	Matched comparison mean (SE)	Adjusted difference (SE)	Percentage difference	Standardized difference	*p*-value	Equivalence *p*-value
Anemia, %	41 (1.1)	42 (0.77)	-0.91 (1.5)	-2.2	-0.02	0.55	< 0.01
CHF, %	55 (1.1)	54 (0.77)	0.69 (1.5)	1.3	0.01	0.65	< 0.01
COPD, %	33 (1.0)	33 (0.73)	-0.14 (1.5)	< +/-1	0.00	0.92	< 0.01
Dementia with complications, %	13 (0.73)	8.5 (0.43)	4.2 (0.95)	33	0.13	< 0.01	< 0.01
Dementia without complications, %	29 (0.99)	26 (0.68)	2.5 (1.4)	8.6	0.05	0.08	< 0.01
Diabetes with acute complications, %	0.91 (0.21)	1.2 (0.17)	-0.33 (0.32)	-37	-0.04	0.30	< 0.01
Electrolytes, %	62 (1.1)	61 (0.76)	0.79 (1.5)	1.3	0.02	0.59	< 0.01
Major depressive disorder, %	12 (0.72)	8.6 (0.43)	3.6 (0.98)	30	0.11	< 0.01	< 0.01
Metastatic cancer and acute leukemia, %	13 (0.73)	14 (0.54)	-0.91 (1.0)	-7.0	-0.03	0.37	< 0.01
Morbid obesity, %	7.9 (0.59)	6.3 (0.37)	1.6 (0.78)	20	0.06	0.04	< 0.01
Protein-calorie malnutrition, %	38 (1.1)	36 (0.74)	1.9 (1.5)	5.1	0.04	0.20	< 0.01
Septicemia, %	32 (1.0)	26 (0.68)	6.2 (1.4)	19	0.13	< 0.01	< 0.01
Vascular disease, %	28 (0.99)	35 (0.74)	-6.5 (1.4)	-23	-0.14	< 0.01	< 0.01
Medicare expenditures							
Total expenditures[b]	2,951 (53)	2,981 (34)	-31 (73)	-1.0	-0.01	0.68	< 0.01
Total expenditures, 3 months before enrollment	6,978 (148)	7,451 (100)	-472 (208)	-6.8	-0.07	0.02	< 0.01
Acute inpatient expenditures[b]	1,318 (27)	1,429 (19)	-111 (39)	-8.4	-0.09	< 0.01	< 0.01

Table B.1 (*continued*)

Characteristic	Treatment mean (SE)	Matched comparison mean (SE)	Adjusted difference (SE)	Percentage difference	Standardized difference	*p*-value	Equivalence *p*-value
Service use							
Total hospitalizations	1,635 (25)	1,597 (16)	38 (35)	2.3	0.03	0.27	< 0.01
Total hospitalizations, 3 months before enrollment	4,654 (57)	4,626 (38)	29 (79)	< +/-1	0.01	0.71	< 0.01
Total ED or observation visits	1,106 (33)	1,141 (21)	-35 (43)	-3.2	-0.02	0.42	< 0.01
Total ED or observation visits, 3 months before enrollment	1,925 (76)	2,193 (49)	-268 (101)	-14	-0.08	< 0.01	< 0.01
Primary care visits, any setting	14,896 (251)	12,684 (140)	2,212 (323)	15	0.19	< 0.01	0.02
Primary care visits, any setting, 3 months before enrollment	26,196 (469)	23,622 (283)	2,574 (628)	9.8	0.12	< 0.01	< 0.01
Hospice use in baseline, %[c]	3.8 (0.42)	2.2 (0.23)	1.5 (0.52)	41	0.08	< 0.01	< 0.01
Reasons for sample inclusion, %							
Categorical days from most recent hospitalization to index date, Category 1	34 (1.0)	38 (0.76)	-4.6 (1.5)	-14	-0.10	< 0.01	< 0.01
Categorical days from most recent hospitalization to index date, Category 2	22 (0.90)	19 (0.60)	3.3 (1.3)	15	0.08	0.01	< 0.01
Categorical days from most recent hospitalization to index date, Category 3	44 (1.1)	43 (0.77)	1.4 (1.5)	3.1	0.03	0.38	< 0.01
Qualified due to observation stay	6.8 (0.55)	10 (0.47)	-3.6 (0.87)	-52	-0.14	< 0.01	< 0.01
No clinician visit or hospital stay on index date	27 (0.97)	27 (0.69)	-0.14 (1.3)	< +/-1	0.00	0.92	< 0.01
Clinician visit on index date	8.6 (0.61)	8.5 (0.43)	0.14 (0.83)	1.7	0.01	0.86	< 0.01
Propensity score	0.38 (0.00)	0.37 (0.00)	0.01 (0.01)	2.1	0.04	0.20	< 0.01
Number of beneficiaries	2,097	4,144					

Table B.1 (*continued*)

Characteristic	Treatment mean (SE)	Matched comparison mean (SE)	Adjusted difference (SE)	Percentage difference	Standardized difference	*p*-value	Equivalence *p*-value
Omnibus test				Chi-squared statistic 473.34	Degrees of freedom 40.00	*p*-value 0.00	

Sources: Mathematica's analysis of information from awardee's finder file as of November 30, 2017, and Medicare claims and enrollment data as of August 31, 2019.

Note: Standard errors in parentheses. Standardized difference calculated as the ratio of the difference and the treatment group standard deviation. *p*-values come from a weighted two-sample t-test; equivalence test *p*-values are the greater of the *p*-values for the two one-sided weighted t-tests of whether the true treatment–comparison difference exceeded 0.25 standard deviations of the variable. The analysis calculated the comparison group means in the table by weighting observations by the matching weight. The matching weight reflects the number of times a comparison beneficiary is matched to a treatment beneficiary. Unlike the weight used in the baseline characteristics table in the body of the report and the model results tables in the body of the report and Appendix A, the matching weight does not account for the number of months a beneficiary was enrolled in Medicare. The numbers in this table differ slightly from those in Table 3 in the report, due to the use of follow-up period weights in constructing the means presented there. Those weights were equal to the proportion of the follow-up period observed. Exact matching variables include index date during hospitalization.

[a] The HCC score incorporates diagnosis history and demographics to estimate a score representing the expected costs of a Medicare beneficiary in the upcoming year. A score of one represents average expected expenditures. The analysis used the most recently available HCC algorithms to calculate the HCC scores.

[b] Top-coded at the 98th percentile based on the distribution of the treatment beneficiaries in the baseline and follow-up periods.

[c] The hospice measure used for matching includes use of hospice on the day of enrollment. This has little bearing on the matches selected. For estimating impacts on hospice, the follow-up period outcome measure of hospice use includes admission to hospice on the day of enrollment (or pseudo-enrollment).

CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; ED = emergency department; FSCL = Four Seasons Compassion for Life; HCC = hierarchical condition category; SE = standard error.

Appendix C

Detailed results from impact analyses

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Table C.1 displays the results from the analysis for the full sample of 6,241 beneficiaries. The analysis estimated models for Medicare expenditures and probability of using any service, in total and by type of service. The estimated percentage change in outcomes is the estimated change in outcomes divided by a counterfactual value defined as the treatment group mean minus the estimated change in outcomes. One, two, and three asterisks indicate estimated changes in outcomes that differ statistically from zero at the .10, .05, and .01 levels, respectively, using a two-tailed test.

Table C.1. Estimated changes in select Medicare FFS expenditures (dollars PBPM) and use measures associated with the FSCL intervention during a 12-month follow-up period

	All beneficiaries					
	Treatment group mean	Comparison group mean	Estimated change in outcomes (SE)	Percentage change in outcomes[a]	Participation rate[b]	*p*-value
Total Medicare expenditures ($ PBPM)						
Baseline year	3,030	3,023				
12-month follow-up period	6,441	6,337	601* (344)	10%	0.38	0.08
Total Medicare expenditures ($ PBPM)[d]						
Baseline year	2,976	3,005				
12-month follow-up period	5,850	5,658	634** (258)	12%	0.38	0.01
Acute inpatient expenditures ($ PBPM)						
Baseline year	1,391	1,468				
12-month follow-up period	1,853	2,191	-34 (210)	-1.8%	0.38	0.87
Acute inpatient expenditures ($ PBPM)[d]						
Baseline year	1,329	1,437				
12-month follow-up period	1,452	1,704	-25 (138)	-1.7%	0.38	0.86
Other inpatient expenditures ($ PBPM)						
Baseline year	121	123				
12-month follow-up period	111	157	-66 (79)	-37%	0.38	0.41
Hospital outpatient expenditures ($ PBPM)						
Baseline year	469	449				
12-month follow-up period	555	639	-148 (103)	-21%	0.38	0.15
Professional Part B expenditures ($ PBPM)						
Baseline year	442	455				
12-month follow-up period	915	843	102 (65)	13%	0.38	0.12

Table C.1 (*continued*)

	All beneficiaries					
	Treatment group mean	Comparison group mean	Estimated change in outcomes (SE)	Percentage change in outcomes[a]	Participation rate[b]	*p*-value
Home health expenditures ($ PBPM)						
Baseline year	136	133				
12-month follow-up period	220	244	-59** (26)	-21%	0.38	0.03
SNF expenditures ($ PBPM)						
Baseline year	424	339				
12-month follow-up period	1,451	1,306	353*** (120)	32%	0.38	< 0.01
Durable medical equipment expenditures ($ PBPM)						
Baseline year	39	45				
12-month follow-up period	43	64	-26* (15)	-38%	0.38	0.08
Hospice expenditures ($ PBPM)						
Baseline year	7.4	7.9				
12-month follow-up period	1,293	893	480*** (83)	59%	0.38	< 0.01
Percentage of beneficiaries with any hospital admission in a time period						
Baseline year	96	95				
12-month follow-up period	74	77	-8.1 (7.2)	-9.9%	0.38	0.26
Percentage of beneficiaries with any ED or observation visits in a time period						
Baseline year	54	61				
12-month follow-up period	65	72	-4.5 (3.3)	-6.4%	0.38	0.18
Percentage of beneficiaries with hospice use in a time period						
Baseline year	0.81	0.55				
12-month follow-up period	62	59	2.5 (2.3)	4.2%	0.38	0.28
Total Medicare expenditures during the last 7 days of life ($ PBPM)[e]						
12-month follow-up period	2,727	2,057	670*** (259)	33%	0.38	< 0.01
Total Medicare expenditures during the last 14 days of life ($ PBPM)[f]						
12-month follow-up period	5,056	4,285	771** (384)	18%	0.37	0.04

Table C.1 (*continued*)

	All beneficiaries					
	Treatment group mean	Comparison group mean	Estimated change in outcomes (SE)	Percentage change in outcomes[a]	Participation rate[b]	*p*-value
Total Medicare expenditures during the last 30 days of life ($ PBPM)[g]						
12-month follow-up period	8,938	9,069	-131 (644)	-1.4%	0.37	0.84
Total Medicare expenditures during the last 7 days of life ($ PBPM)[d,e]						
12-month follow-up period	2,483	1,975	508*** (195)	26%	0.38	< 0.01
Total Medicare expenditures during the last 14 days of life ($ PBPM)[d,f]						
12-month follow-up period	4,738	4,083	656** (320)	16%	0.37	0.04
Total Medicare expenditures during the last 30 days of life ($ PBPM)[d,g]						
12-month follow-up period	8,640	8,715	-75 (540)	< 1%	0.37	0.89
Percentage with hospital stay in the last 30 days of life[g]						
12-month follow-up period	33	37	-4.7* (2.8)	-13%	0.37	0.09
Percentage with an in-hospital death						
12-month follow-up period	8.1	9.2	-1.1 (1.4)	-12%	0.38	0.41
Sample sizes						
Number of beneficiaries						
Baseline year	2,097	4,144				
12-month follow-up period	2,097	4,144				
Survived at least 7 days of the follow-up period	1,685	3,770				
Survived at least 14 days of the follow-up period	1,394	3,437				
Survived at least 30 days of the follow-up period	1,093	2,929				

Sources: Mathematica's analysis of information from awardee's finder file as of November 30, 2017, and Medicare claims and enrollment data as of August 31, 2019.

Note: Estimates effects on expenditures PBPM during the 12-month follow-up period relied on a first-difference approach and show the regression-adjusted change for the treatment group relative to that for the comparison group between the baseline and follow-up periods. The estimate for the binary outcomes of any hospital stay, ED visit, or hospice use is a regression-adjusted treatment–comparison difference based on a regression that controls for a beneficiary's characteristics and the probability of having any hospital stay or ED visit at baseline. The estimate for outcomes in the last 7, 14, or 30 days of life is a regression-adjusted treatment–comparison difference based on a regression that controls for a beneficiary's characteristics. The intervention years are beneficiary specific and defined relative to each beneficiary's date of enrollment or pseudo-enrollment.

Table C.1 (*continued*)

[a] Percentage change in outcomes is relative to a counterfactual value defined as the treatment mean minus the estimated change in outcomes.

[b] The participation rate is the number of participants among treatment group beneficiaries—that is, those who actually received the intervention—divided by the total number of treatment group beneficiaries who were eligible to receive the intervention.

[c] The adjusted change in outcomes represents the estimated effect of the intervention on only the participants—that is, those who received the intervention. It is derived by dividing the estimated change in outcomes for all eligible treatment group beneficiaries by the participation rate.

[d] 98th percentile values for top-coding were determined from the weighted distribution of treatment beneficiaries pooled over the four semiannual periods covering the baseline and follow-up years.

[e] Sample includes only beneficiaries who survived at least 7 days of the follow-up period.

[f] Sample includes only beneficiaries who survived at least 14 days of the follow-up period.

[g] Sample includes only beneficiaries who survived at least 30 days of the follow-up period.

*Significantly different from zero at the .10 level, two-tailed test.

**Significantly different from zero at the .05 level, two-tailed test.

***Significantly different from zero at the .01 level, two-tailed test.

ED = emergency department; FFS = fee-for-service; FSCL = Four Seasons Compassion for Life; PBPM = per beneficiary per month, SE = standard error, SNF = skilled nursing facility.

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Appendix D

Results from Bayesian analysis

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In addition to the traditional frequentist analysis presented in the body of this report, the evaluation also estimated the program impacts for Four Seasons Compassion for Life (FSCL) using a Bayesian approach. The Bayesian approach supplements the main analysis by framing conclusions in probabilistic terms, which facilitates decision making by summarizing both the size and the certainty of an impact in a single value. Drawing probabilistic conclusions requires external or prior evidence. In this analysis, the findings from the evaluation of 87 awardees included in Round 1of the Health Care Innovation Awards (HCIA R1) provided the prior evidence, with more weight on results from awardees with background characteristics similar to FSCL. The evaluation calculated probabilities using the results of a Bayesian regression that models FSCL's impacts on total Medicare expenditures jointly with impacts from HCIA, thereby improving the precision of the impact estimates. For more detail on the Bayesian methodology, see Appendix D in Volume I of this report.

Table D.1 compares the Bayesian impact estimate for total Medicare expenditures with the regression estimate obtained from the frequentist analysis reported in the body of this report. Combining prior evidence from HCIA R1 with the estimate from the frequentist regression for FSCL led to a Bayesian estimate of the program's impact on total Medicare expenditures of 9 percent (an estimated increase of $248 per beneficiary per month) during the year after enrollment.

Table D.1. Comparing frequentist and Bayesian impact estimates for FSCL in the first year after enrollment

	Impact estimate (95 percent interval)		Percentage impacts		
Outcome	Frequentist	Bayesian	Prior	Frequentist	Bayesian
Total expenditures ($ PBPM)	601 (-73, 1,275)	464 (-63, 995)	7%	10%	8%

Source: Mathematica's analysis of information from awardee's finder file as of November 30, 2017, and Medicare claims and enrollment data as of August 31, 2019. The Bayesian analysis also incorporated HCIA R1 meta-analysis data.

Notes: ED visits include observation stays. Total expenditures include both Medicare Parts A and B spending. The Bayesian regression also incorporates assumptions about the likely distribution of impact estimates; these assumptions relied on data from the HCIA R1 evaluation.

Intervals for frequentist analysis results are traditional confidence intervals, calculated using the standard error of the impact estimate. Bayesian intervals are credible intervals calculated as the 2.5 and 97.5 quantiles of the posterior distribution for the impact.

ED = emergency department; FSCL = Four Seasons Compassion for Life; HCIA R1 = Round 1 of the Health Care Innovation Awards; PBPM = per beneficiary per month.

Because the frequentist results are imprecise, the Bayesian model gave more weight to the prior and produced somewhat more neutral estimates. Despite these differences, the Bayesian results substantively agree with the frequentist results in finding that FSCL's impact on total Medicare expenditures is statistically indistinguishable from zero.

To determine whether to continue the program, it is useful to know whether the estimated impact corresponds to a high probability of achieving policy targets, such as a 5 percent reduction in expenditures. For FSCL, there is less than a 3 percent probability of achieving a 1 percent

reduction in total Medicare expenditures, reaffirming the frequentist findings that the program did not meaningfully reduce costs.

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