Comprehensive End-Stage Renal Disease Care (CEC) Model

Performance Year 2 Annual Evaluation Report – Appendices

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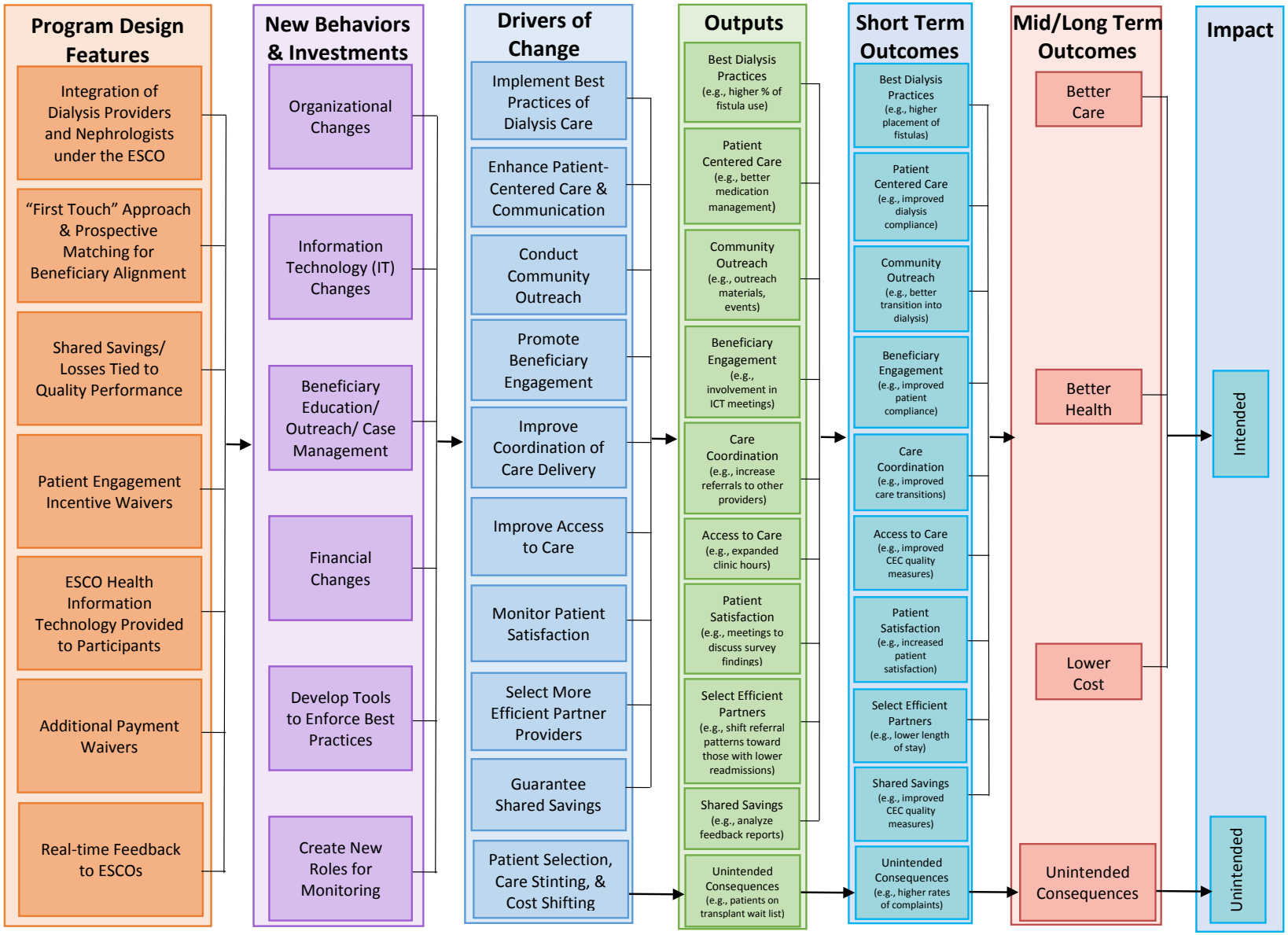
Appendix A: CEC Waivers

Waivers included in the Comprehensive End-Stage Renal Disease (ESRD) Care (CEC) Model:

- **Patient engagement incentive waivers.** These waivers allow ESRD Seamless Care Organizations (ESCOs) to provide in-kind items or services to CEC beneficiaries when related to their medical care. These include technology, oral nutrition supplements (ONS), and non-emergency transportation. Technology may be provided if the beneficiary does not possess or own similar technology and it is considered "medically necessary" in that it will either improve beneficiary-provider communication, health monitoring, or telehealth services; or improve beneficiary adherence to medications, their plan of care, or their management of chronic conditions and diseases. ONS may be provided free or discounted to beneficiaries only when their serum albumin level falls below the designated target level. Non-emergency transportation can be provided for beneficiaries to access medically necessary care if they meet certain pre-set requirements.
- **Performance-based payments to participant physicians.** ESCOs can provide incentives to participant providers for conducting certain medically necessary procedures or providing care that leads to better outcomes to CEC beneficiaries. These payments are based on performance-based metrics and are conditional to accurate reporting on such metrics.
- **ESCO health information technology provided to participants.** Participating providers and facilities may receive health information technology (IT) but usage of this waiver must not be based upon referrals and other business generated between the participant and other parties. ESCOs must provide a consistent rationale for providing health IT based on a participant's overall use, quality reporting standards and other performance-based metrics, and care coordination activities.
- **Care coordination arrangements.** Care coordination arrangements include ESCO clinical support services (i.e., case managers, care coordinators, and clinical training), the ability to have care coordination staff onsite at a dialysis facility, and other items or services to improve care coordination (i.e., administrative, quality management, and data services necessary to the delivery, documentation, and assessment of care coordination services).
- **Remuneration furnished by the company/organization to the ESCO.** Remuneration by the dialysis organization (DaVita, Fresenius, Dialysis Clinic, Inc. [DCI], Rogosin, Atlantic, Centers for Dialysis Care [CDC], Northwest Kidney Centers [NKC]) for ESCO support (which includes clinical support services, location and rounding accommodations, and other items or services to improve care coordination), ESCO health IT, and patient engagement incentives can be provided to the ESCO as a whole, not to individuals, participants, or entities.

Appendix B: CEC Evaluation Logic Model



Appendix C: Site Visit Selection and Protocol

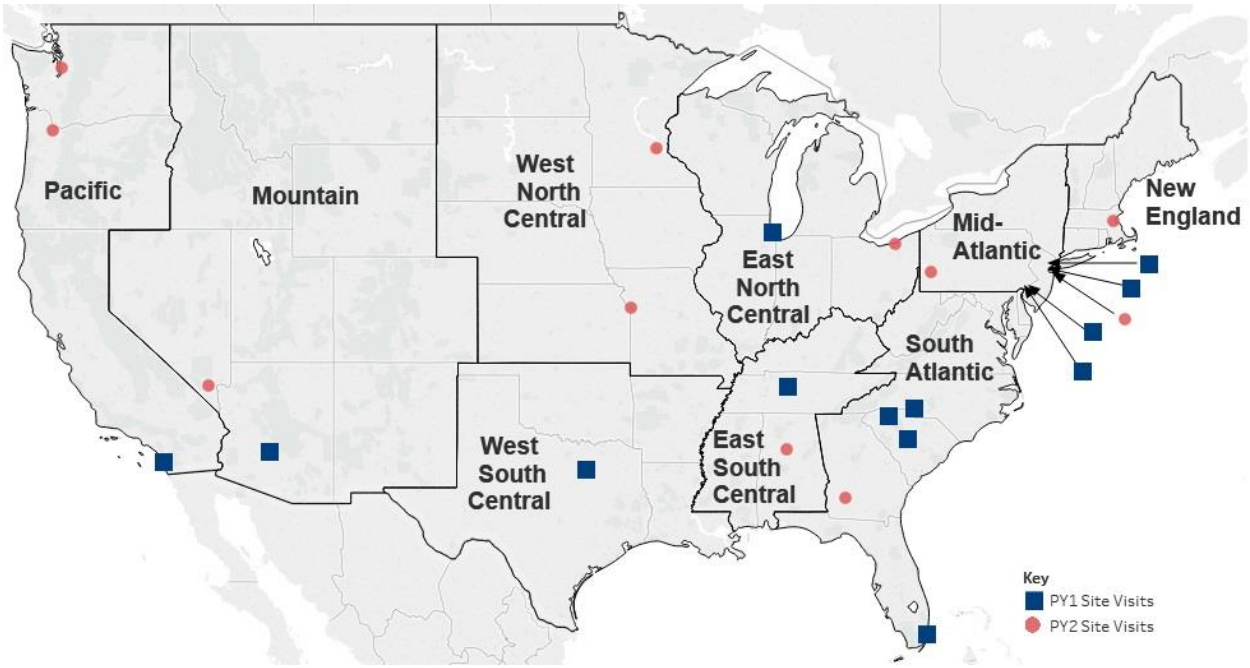
A. Selection Criteria and Analysis

On January 1, 2017, a second wave of 24 new ESCOs joined the CEC Model. Of the Wave 2 ESCOs, 18 were started by Fresenius, three were started by DCI, and three were started by non-large dialysis organizations (non-LDOs). For this report, we visited a sample of 11 of the 24 Wave 2 ESCOs. The sample included all the new non-LDO ESCOs and DCI ESCOs, and five of the 18 new Fresenius ESCOs. Geographic diversity was the primary criterion used to select the sample of Fresenius ESCOs. We selected Fresenius ESCOs based on United States (US) Census Divisions that did not have a Fresenius ESCO in Wave 1. We also selected an additional Fresenius site (Portland) in the Pacific US Census Division, despite having a Fresenius site visit (Fresenius San Diego) in the Pacific division in Wave 1, as we had not yet visited a Fresenius ESCO in the Pacific Northwest.

Exhibit C-1. Representation of US Census Divisions by Wave 1 and Wave 2 ESCO Site Visits

US Census Division (Region)	Wave 1 ESCOs	Wave 2 ESCOs
1: New England (Northeast)		Fresenius Massachusetts
2: Mid-Atlantic (Northeast)	Non-LDO Rogosin DCI Metropolitan Fresenius Philadelphia DaVita Philadelphia-Camden	Non-LDO Gotham City DCI Independence
3: East North Central (Midwest)	Fresenius Chicago	Non-LDO Northeast Ohio
4: West North Central (Midwest)		DCI Heart of America Fresenius Minneapolis
5: South Atlantic (South)	DCI Palmetto Fresenius Charlotte Fresenius Columbia DaVita South Florida	DCI Georgia Pines
6: East South Central (South)	DCI Music City	Fresenius Central Alabama
7: West South Central (South)	Fresenius Dallas	
8: Mountain (West)	DaVita Phoenix-Tucson	Fresenius Las Vegas
9: Pacific (West)	Fresenius San Diego	Non-LDO NKC Fresenius Portland

Exhibit C-2. Wave 1 and Wave 2 ESCO Site Visits by US Census Division



We used three criteria to select two to three dialysis facilities for each ESCO site visit: average Medicare costs per beneficiary per month (PBPM), patient volume, and quality of patient care according to publicly reported standardized measures[1] (e.g., standardized mortality ratio [SMR], standardized readmission ratio [SRR]). Most dialysis facilities selected were "typical" cases with average Medicare costs per beneficiary close to the mean. However, these dialysis facilities varied on patient volume and quality measure performance. The majority of facilities were near the mean, but a small proportion of sites were selected for their relatively high or low characteristics regarding volume or quality.

Dialysis organizations and ESCO staff were asked to identify staff members involved in ESCO care redesign, clinical and managerial implementation of the ESCO, development of IT and other administrative infrastructure and support services.

Corporate site visits included two 90-minute interview sessions: one with executive leaders and the other with data, quality, and financial management staff. Each ESCO dialysis facility visit included three 45- to 75-minute interview sessions with physician leaders, facility operations staff, and case managers. Each interview was audio recorded. Site visit interview notes and transcripts were managed and analyzed in ATLAS.ti version 7.5.16,[2] a commercially available qualitative data analysis software package. An initial set of codes was developed deductively using the logic model developed for this evaluation (shown in **Appendix B**), site visit protocols, and Wave 1 site visit findings. This initial code list was then refined inductively based on coding of a small, diverse set of transcripts, examining content of interviewee comments about various topics or issues, and discussions among the evaluation team in routine post-site visit debrief meetings. A final list of codes was then used to code all remaining interviews and to identify major patterns and themes in

[1] Measures obtained from Dialysis Facility Compare at https://www.medicare.gov/dialysisfacilitycompare/
[2] ATLAS.ti.

interviewees' responses as well as any differences by dialysis organization and/or associated ESCOs and facilities.

B. Protocol Development

Separate interview protocols were developed for each type of respondent, as shown in **Exhibit C-3**. Separate protocols ensure that questions are framed appropriately for each interviewee type, improve consistency in question delivery, and facilitate comparison of interview findings across sites. Protocols were approved by the Centers for Medicare & Medicaid Services (CMS) prior to conducting the site visits.

Exhibit C-3. Interview Types and Content Addressed

Corporate-Level Interviews

Executive Leadership
- Model Entry Determinants
- Goals for the CEC Model
- Preparations (i.e., Partnerships and Investments) for the CEC Model
- Major Care Redesign Strategies
- Successes and Challenges

ESCO Quality, Data, and Finance Staff
- Quality & Data Management
- IT Tools
- Financial Management
- Risk Arrangements
- Successes and Challenges

Facility-Level Interviews

Case Management Staff
- Care Redesign Strategies
- Case Management Roles
- Case Management Outcomes
- CEC Waivers
- Successes and Challenges

Physician Leadership
- Model Entry Determinants
- Care Redesign Strategies
- Care Redesign Outcomes
- Financial Arrangements
- Successes and Challenges

Facility Leadership and Operations
- Goals for the CEC Model
- Care Redesign Strategies
- Partnerships
- CEC Waivers
- Successes and Challenges

Appendix D: Beneficiary Focus Group Structure and Discussion Overview

A. Selection Criteria and Analysis

ESCO leadership selected facilities for focus group participation based on space availability among the subset of dialysis facilities chosen for site visits. Although each focus group was conducted at only one facility within the ESCO, participants may have been from any ESCO-participating facility. The three beneficiary focus groups took place at the three new non-LDO ESCOs that joined the CEC Model on January 1, 2017. These were The Gotham City Kidney Care ESCO (Atlantic), the Northeast Ohio Renal Alliance ESCO (CDC), and the Northwest Kidney Care Alliance ESCO (NKC). We chose to talk only to beneficiaries at the three non-LDOs since there was only a single non-LDO participant during Wave 1. We believed there was little new information we could glean from interviewing Fresenius and DCI beneficiaries during this round of site visits because we had conducted focus groups with Fresenius and DCI beneficiaries during Wave 1. Therefore, we opted to focus on the new organizations that joined the model in Wave 2 (i.e., the three new non-LDOs).

To facilitate recruitment, an ESCO staff member provided the Lewin staff member who did the focus group recruiting with a list of CEC beneficiaries who received dialysis treatment from the facility holding the focus group or from a nearby CEC facility. The list was shared several weeks prior to the focus group session. The focus group recruiter contacted the beneficiaries via telephone and used a screening questionnaire to solicit their eligibility for and interest in participating in the focus group. An attempt was made to schedule participants who were not having dialysis on the day of the focus group. The primary screening criterion for beneficiary recruitment was dialysis modality; the three focus groups only recruited beneficiaries who received in-center hemodialysis as Wave 1 site visits and focus groups showed that the care for home dialysis patients was relatively unaffected by the CEC Model.

There was an attempt to recruit 10 beneficiaries from each ESCO to ensure six to eight beneficiaries participated in each focus group. Transportation to and from the focus group location was provided upon request.

Each focus group session lasted approximately 90 minutes and occurred around lunchtime.

Research team members observed the focus groups and sat at the periphery of the group. When there were about 10 minutes remaining in the focus group, they were given the opportunity to request additional questions, or clarifications of answers, by the facilitator.

All focus groups were audio recorded and transcripts were produced from the recordings. The facilitator reviewed and summarized focus group transcripts to identify the main themes across the focus groups.

1. Beneficiary Focus Group Structure

Exhibit D-1 displays the structure of the beneficiary focus group sessions.

Exhibit D-1. Beneficiary Focus Group Discussion Flow

Activity	Descriptions
Welcome and Moderator Introduction	The Facilitator explained that she was employed by an independent company, that information was only being collected for research purposes, and obtained participant permission to record the session.
Established Ground Rules	The Facilitator encouraged maximum participation, reminded participants that there were no right or wrong answers as we were obtaining opinions, to speak one at a time so that we could hear and reflect on all comments, and that their anonymity would be preserved.
Participant Introductions	Participants introduced themselves by first name only and shared one personal thing about themselves.
Opened Discussion	The Facilitator encouraged participants to discuss their likes and dislikes about the care they receive (dialysis care and total health care).
Discussion of the CEC Model	The Facilitator showed participants communications they may have seen or received from their ESCO and asked participants to discuss their awareness and understanding of the CEC Model and any changes that they may have noticed in their care.
Closed Discussion	The Facilitator ended the session by summarizing the key points heard during the discussion and offered an opportunity for participants to ask any final questions, then the group was closed.

B. Beneficiary Focus Group Discussion Overview

Research Objectives *(Timing: 90 minutes):*

- To identify and explore the challenges patients face living with ESRD
- To obtain insights into how the CEC Model may be affecting the patient care experience

1. ***Introduction and General Background (10 minutes)***
2. ***Satisfaction with Current Dialysis Care (35 minutes)***
    - ***Part 1: Perceptions***
    - ***Part 2: Coordination of Care for Other Health Conditions***
    - ***Part 3: Communications with Dialysis Facility Staff***
    - ***Part 4: Supportive Care***
3. ***Awareness/Understanding of the CEC Model (35 minutes)***
4. ***Impact of the CEC Model (10 minutes)***

Appendix E: Kidney Disease Quality of Life (KDQOL) Analysis Supplement

The Kidney Disease Quality of Life (KDQOL-36) analysis combined survey data from the CEC beneficiary sample and a matched comparison group of beneficiaries.

A. CEC Beneficiary Sample

The KDQOL-36 sample of CEC beneficiaries was selected from the cohort of beneficiaries who were both aligned to a CEC facility and satisfied the CEC eligibility criteria as of March 31, 2017. Among ESCOs with less than 500 aligned beneficiaries, all aligned and eligible beneficiaries were included in the survey sample. Among ESCOs with 500 or more aligned beneficiaries, beneficiaries were sampled to ensure representativeness of the survey sample across select characteristics (i.e., age, race/ethnicity, ZIP code, and gender) relative to the population of aligned CEC beneficiaries in the ESCO.

B. Comparison Group Sample

The KDQOL-36 comparison group sample was selected to minimize the differences between the pool of CEC and comparison beneficiaries receiving a survey and to maximize the number of comparison beneficiaries receiving a survey within the budgeted limit of 10,500 comparison surveys. The target number of comparison beneficiaries (n=10,500) was based largely on the sample size required to detect an increase in the average score of five points, with 80% power, and acceptable level of type 1 error set at 10% for a one-sided hypothesis test, with a 30% response rate.[3] Since the response rate could have been lower than we expected, we added a buffer to the power calculation result to ensure we would have enough responses. The methods below describe how we selected the comparison sample.

We used propensity score matching (PSM) and Mahalanobis distance matching (MDM), both without replacement, to select comparison beneficiaries for the KDQOL-36 survey sample. Each CEC beneficiary was matched to one distinct CEC-eligible beneficiary who was not aligned to a CEC facility. The beneficiary-level PSM models were stratified by organizational alignment (DaVita, DCI, Fresenius, CDC, Rogosin, NKC, and Atlantic) and dialysis history (i.e., patients new to Medicare versus existing patients) to maximize the quality of comparison matches within each cohort. Each stratum used a separate matching model that included only the pool of CEC-eligible beneficiaries applicable to that strata (i.e., total of 14 models). For example, a CEC stratum included existing beneficiaries aligned to a given organization (e.g., DaVita) while the potential comparison pool for that cohort included existing beneficiaries aligned to a non-CEC facility from the same organization (e.g., DaVita), based on the simulated alignment.[4]

PSM models were used for each cohort except when the pool of CEC and comparison beneficiaries were small. Models for new patients for CDC, Rogosin, NKC, and Atlantic were small and MDM was applied instead of PSM. The propensity score and Mahalanobis distance was based on beneficiary characteristics like demographics and comorbid conditions, facility

[3] Each of the five subscale models achieved the minimum sample size required to detect an increase in the average score of five points based on the stated sample size calculation criteria (i.e., 80% power, type 1 error level of 10% for a one-sided hypothesis test).

[4] We simulated alignment based on CEC Model rules (see **Appendix G** for additional detail).

characteristics, and market characteristics outlined in **Exhibits E-1** and **E-2**. The covariates for each model varied to accommodate strata with small sample sizes. In addition, we excluded characteristics from select models when there was little or no variation (e.g., no beneficiaries in a chronic condition category) that resulted in model convergence issues.

Exhibit E-1. Characteristics Included in Matching Models for Existing Beneficiaries

Model Type/Characteristics	DaVita	DCI	Fresenius	Rogosin	NKC	Atlantic	CDC
	PSM	PSM	PSM	PSM	PSM	PSM	PSM
Sex: Female	X	X	X	X	X	X	X
Age: 55 - 64	X	X	X	X	X	X	X
Age: 65 - 74	X	X	X	X	X	X	X
Age: 75+	X	X	X	X	X	X	X
Race/ Ethnicity: Black	X	X	X	X	X	X	X
Race/ Ethnicity: Hispanic	X	X	X	X	X	X	X
Race/ Ethnicity: Other	X	X	X	X	X	X	X
Hemodialysis Indicator	X	X	X	X	X	X	X
Peritoneal Indicator	X	X	X	X	X	X	X
Months on Dialysis	X	X	X	X	X	X	X
Alzheimer's Disease	X	X	X		X	X	X
Cancer	X	X	X		X	X	X
Diabetes	X	X	X		X	X	X
Glaucoma	X	X	X		X	X	X
Osteoporosis	X	X	X		X	X	X
Medicaid Indicator	X	X	X	X	X	X	X
Member Months (2016)	X	X	X	X	X	X	X
Original Reason for Entitlement Code (OREC): Aged into Medicare	X	X	X	X	X	X	X
OREC: ESRD into Medicare	X	X	X	X	X	X	X
OREC: Disabled into Medicare	X	X	X	X	X	X	X
OREC: Both ESRD & Disabled into Medicare	X	X	X	X	X	X	X
Facility: Patient Count	X	X	X		X	X	X
Facility: Profit Indicator	X	X	X		X	X	X
Facility: Late Shift Indicator	X	X	X			X	X
Facility: Peritoneal Dialysis Indicator	X	X	X			X	X
Facility: Home Hemodialysis Indicator	X	X	X			X	X
Facility: Percent Hemoglobin less than 10	X	X	X			X	
Facility: Percent Patients with Fistula	X	X	X			X	
Facility: Standardized Hospitalization Ratio (SHR)	X	X	X		X	X	X
Facility: Standardized Readmission Ratio (SRR)	X	X	X		X	X	X
Core-Based Statistical Area (CBSA): Median Household Income	X	X	X				
CBSA: Primary Care Providers (PCPs) per 10,000	X	X	X				
CBSA: Dual Beneficiaries per 10,000	X	X	X				

Exhibit E-2. Characteristics Included in Matching Models for New Beneficiaries

Model Type/Characteristics	DaVita	DCI	Fresenius	Rogosin	NKC	Atlantic	CDC
	PSM	PSM	PSM	MDM	MDM	MDM	MDM
Sex: Female	X	X	X	X	X	X	X
Age: 55 - 64	X	X	X	X	X	X	X
Age: 65 - 74	X	X	X	X	X	X	X
Age: 75+	X	X	X	X	X	X	X
Race/ Ethnicity: Black	X	X	X	X	X	X	X
Race/ Ethnicity: Hispanic	X	X	X	X	X	X	X
Race/ Ethnicity: Other	X	X	X	X	X	X	X
Hemodialysis Indicator	X	X	X				
Peritoneal Indicator	X	X	X				
Months on Dialysis	X	X	X				
Alzheimer's Disease	X	X	X				
Cancer	X	X	X				
Diabetes	X	X	X				
Glaucoma	X	X	X				
Osteoporosis	X	X	X				
Medicaid Indicator	X	X	X				
Member Months (2016)	X	X	X				
OREC: Aged into Medicare	X	X	X				
OREC: ESRD into Medicare	X	X	X				
OREC: Disabled Into Medicare	X	X	X				
OREC: Both ESRD and Disabled into Medicare	X	X	X				
Facility: Patient Count	X	X	X				
Facility: Profit Indicator	X	X	X	X	X	X	X
Facility: Late Shift Indicator	X	X	X				
Facility: Peritoneal Dialysis Indicator	X	X	X				
Facility: Home Hemodialysis Indicator	X	X	X				
Facility: Percent Hemoglobin less than 10	X	X	X				
Facility: Percent Patients with Fistula	X	X	X				
Facility: SHR	X	X	X	X	X	X	X
Facility: SRR	X		X	X	X	X	X
CBSA: Median Household Income	X		X				
CBSA: PCPs per 10,000	X		X				
CBSA: Dual Beneficiaries per 10,000	X		X				

From the group of 17,198 CEC beneficiaries receiving the survey, we identified 15,265 CEC beneficiaries that could be used in our matching models (88.8%). We required CEC beneficiaries to meet the following criteria: (1) non-missing beneficiary characteristics used in the matching models, (2) CEC-eligible as of March 2017, and (3) no evidence of death or kidney transplant through August 2017. Over all cohorts, we identified 183,329 beneficiaries eligible for the comparison pool. The potential comparison beneficiaries were aligned – based on simulated alignment – to non-CEC facilities and required to meet the same criteria.

After we ran the PSM models, we applied a caliper to exclude matches between CEC and comparison beneficiaries that had a difference in propensity score greater than 1/2 the standard

deviation of the log-odds propensity score. No distance restriction was applied to Mahalanobis models. The final result was 14,663 CEC beneficiaries (85%), each matched to a unique comparison beneficiary.

From the pool of 14,663 matched comparison beneficiaries, we applied a selection approach to meet the target comparison sample of 10,500 comparison beneficiaries. We maintained the distribution of comparison beneficiaries across ESCOs from the original matched comparison sample. Our sampling approach also favored comparison beneficiaries with phone information and a valid address in order to maximize the response rate. The sampling method had a number of steps. First, we identified which comparison beneficiaries had phone information and/or a valid address. We selected 9,065 with phone information and a valid address within a caliper of 1/2 of the standard deviation of the log-odds propensity score. No caliper or distance restriction was applied to MDM models. Next, we randomly sampled comparison beneficiaries with a valid address but no phone information within a 1/2 caliper. After the first two stages of selection, we identified 10,220 comparison beneficiaries. The remaining 280 beneficiaries were sampled from comparison beneficiaries with a valid address that fell outside of a 1/2 caliper. Our final sample included 10,500 comparison beneficiaries. Each beneficiary had a valid address and 9,313 (89%) also had phone information.

Exhibit E-3. Standardized Mean Differences between CEC Beneficiaries Included in Matching Models and Sampled Non-CEC Comparison Beneficiaries

Characteristics	CEC Beneficiaries (N=15,265)		Comparison Beneficiaries (N=10,500)		Std. Mean Diff.
	Mean	Std. Dev.	Mean	Std. Dev.	
Sex: Female	0.45	0.50	0.45	0.50	0.00
Age: 55-64	0.25	0.44	0.24	0.43	0.02
Age: 65-74	0.25	0.44	0.27	0.44	-0.03
Age: 75+	0.20	0.40	0.22	0.41	-0.05
Race/Ethnicity: Black	0.46	0.50	0.45	0.50	0.03
Race/Ethnicity: Hispanic	0.06	0.24	0.05	0.22	0.05
Race/Ethnicity: Other	0.08	0.27	0.08	0.26	0.01
Hemodialysis Indicator	0.93	0.25	0.94	0.24	-0.01
Peritoneal Indicator	0.10	0.30	0.10	0.30	0.01
Months on Dialysis	66.8	65.28	65.8	65.5	0.03
Alzheimer's Disease	0.02	0.14	0.02	0.15	-0.01
Cancer	0.06	0.24	0.07	0.25	-0.02
Diabetes	0.64	0.48	0.65	0.48	-0.01
Glaucoma	0.04	0.19	0.04	0.20	-0.01
Osteoporosis	0.03	0.17	0.03	0.18	-0.01
Medicaid Indicator	0.53	0.50	0.51	0.50	0.06
Member Months (2016)	11.6	1.8	11.6	1.7	-0.01
OREC: Aged into Medicare	0.28	0.45	0.31	0.46	-0.05
OREC: ESRD into Medicare	0.28	0.45	0.27	0.44	0.04
OREC: Disabled Into Medicare	0.21	0.40	0.21	0.41	0.00
OREC: Both ESRD and Disabled into Medicare	0.22	0.42	0.22	0.41	0.01
Facility: Beneficiary Count	123.1	93.9	109.7	52.4	0.18
Facility: Profit Indicator	0.80	0.40	0.78	0.42	0.06
Facility: Late Shift Indicator	0.34	0.47	0.31	0.46	0.06
Facility: Peritoneal Dialysis Indicator	0.45	0.50	0.48	0.50	-0.06
Facility: Home Hemodialysis Indicator	0.32	0.47	0.32	0.46	0.01
Facility: Percent Hemoglobin less than 10	0.13	0.07	0.13	0.08	0.01
Facility: Percent Patients with Fistula	0.64	0.10	0.64	0.11	-0.02
Facility: SHR	0.95	0.28	0.96	0.30	-0.04
Facility: SRR	0.96	0.28	0.97	0.28	-0.02
CBSA: Median Household Income	$57,628	$10,454	$57,237	$11,023	0.04
CBSA: PCPs per 10,000	7.8	1.6	7.9	1.5	-0.03
CBSA: Dual Beneficiaries per 10,000	279.7	97.8	284.1	85.2	-0.05

To assess the quality of the matching, we compared the standardized mean differences (SMDs) between the pool of CEC beneficiaries receiving the survey who were included in the matching models to the selected comparison pool. **Exhibit E-3** shows the mean and standard deviation of the CEC and comparison groups as well as the SMDs. All but one of the characteristics, facility beneficiary count, used in matching had a small difference in means leading to absolute SMDs at

or below 0.06.[5] The characteristic indicating the volume of patients at a facility, or generally facility size, was about 11% lower in the selected comparison group. The difference in facility size is not of a magnitude that presents a meaningful difference. Overall, the survey recipients among each group were very similar.

C. KDQOL-36 Administration

The KDQOL-36 survey was administered to two beneficiary groups by separate contractors following a similar protocol. The first group included a sample of beneficiaries who were aligned to a CEC facility by the end of March 2017 (i.e., including claims through March 2017 available in April 2017). These beneficiaries were surveyed by the CEC implementation contractor from May 5 through August 28, 2017. The comparison group was surveyed by the CEC evaluation contractor following a similar survey protocol and included beneficiaries who were matched on clinical and demographic characteristics as CEC beneficiaries. The data collection for the 10,500 matched beneficiaries in the comparison group occurred from September 5 through November 29, 2017 with 59% of the comparison group surveys completed by September 28, 2017 and 85% of the surveys completed by October 26, 2017.

To administer the KDQOL-36, data were collected via mailed survey with telephone follow-up for non-responders. Beneficiaries received up to five mailings. An advance-notice letter first informed beneficiaries they would receive the KDQOL-36 survey. The survey packet was sent within roughly one week and included a postage-paid return envelope. Beneficiaries received a toll-free telephone number in the mailing for questions about the survey or to request a Spanish survey. Beneficiaries also received a web address that permitted completion of the survey online. All cover letters were sent in both English and Spanish. Mailings also included a Spanish survey for beneficiaries whose ZIP code was in an area identified as having a higher probability of being Spanish-speaking. A second survey packet was sent roughly one month following the first survey packet. Computer-Assisted Telephone Interviews (CATI)—available in both English and Spanish—began roughly one month after the second survey was mailed. A maximum of six telephone attempts were made—staggering time of day and day of week—prior to discontinuing further contact.

Exhibit E-4 shows the questions used on the KDQOL-36 survey for the Physical Component Summary (PCS) and the Mental Component Summary (MCS) scores. The SAS code, which is publicly available on the Research and Development Corporation (RAND) website,[6] was used for rescaling responses and deriving the scores.

[5] The gauge used to assess the quality of the comparison group matching model was as follows: <0.2 was interpreted as a good match, and <0.1 was interpreted as a very good match.

[6] https://www.rand.org/health/surveys_tools/kdqol.html

Exhibit E-4. KDQOL-36 Measures used in the PCS and the MCS Scores*

Question	Response
1. In general, would you say your health is:	(1) Excellent, (2) Very good, (3) Good, (4) Fair, (5) Poor
The following items are about activities you might do during a typical day. *Does your health now limit you in these activities? If so, how much?* 2. Moderate activities such as moving a table, pushing a vacuum cleaner, bowling or playing golf 3. Climbing several flights of stairs	(1) Yes, limited a lot, (2) Yes, limited a little, (3) No, not limited at all
During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health? 4. Accomplished less than you would like 5. Were limited in the kind of work or other activities	(1) Yes, (2) No
During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? 6. Accomplished less than you would like 7. Didn't do work or other activities as carefully as usual	(1) Yes, (2) No
8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?	(1) Not at all, (2) A little bit, (3) Moderately, (4) Quite a bit, (5) Extremely
These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks… 9. Have you felt calm and peaceful 10. Did you have a lot of energy 11. Have you felt downhearted and blue	(1) All of the time, (2) Most of the time, (3) A good bit of the time, (4) Some of the time, (5) A little of the time, (6) None of the time
12. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?	(1) All of the time, (2) Most of the time, (3) Some of the time, (4) A little of the time, (5) None of the time

Notes: * The PCS and MCS measures both use the same twelve questions; different weights are applied to the responses to derive the two scores.

Exhibit E-5 shows the questions used on the survey for the Burden of Kidney Disease, Symptoms and Problems, and Effects of Kidney Disease measures.

Exhibit E-5. KDQOL-36 Measures used in the Burden of Kidney Disease, Symptoms and Problems, and Effects of Kidney Disease Scale Scores

	Question	Response
Burden of Kidney Disease Questions	***How true or false is each of the following statements for you?*** 13. My kidney disease interferes too much with my life 14. Too much of my time is spent dealing with my kidney disease 15. I feel frustrated dealing with my kidney disease 16. I feel like a burden on my family	(1) Definitely true, (2) Mostly true, (3) Don't know, (4) Mostly false, (5) Definitely false
Symptoms and Problems Questions	***During the past 4 weeks, to what extent were you bothered by each of the following?*** 17. Soreness in your muscles 18. Chest pain 19. Cramps 20. Itchy skin 21. Dry skin 22. Shortness of breath 23. Faintness of breath 24. Lack of appetite 25. Washed out or drained 26. Numbness in hands or feet 27. Nausea or upset stomach 28. 28a. Problems with your access site [Hemodialysis] 28b. Problems with your catheter site [Peritoneal dialysis]	(1) Not at all bothered, (2) Somewhat bothered, (3) Moderately bothered, (4) Very much bothered, (5) Extremely bothered
Effects of Kidney Disease Questions	***Some people are bothered by the effects of kidney disease on their daily life, while others are not. How much does kidney disease bother you in each of the following areas?*** 29. Fluid restriction 30. Dietary restriction 31. Your ability to work around the house 32. Your ability to travel 33. Being dependent on doctors and other medical staff 34. Stress or worries caused by kidney disease 35. Your sex life 36. Your personal appearance	(1) Not at all bothered, (2) Somewhat bothered, (3) Moderately bothered, (4) Very much bothered, (5) Extremely bothered

D. Analysis

Associations between the KDQOL-36 measures with the CEC Model were estimated for CEC beneficiaries, relative to the matched comparison group, on each of five composite scores (PCS, MCS, Burden of Kidney Disease, Symptoms and Problems, and Effects of Kidney Disease) using an ordinary least squares (OLS) regression. Higher levels of the composite score denote higher levels of quality of life. The analysis used sample-balancing weights that were based on age, sex, and race/ethnicity to ensure the distribution of these characteristics among respondents was similar to that of the original surveyed sample to account for non-response bias.[7] In addition, models used clustering at the facility level to account for correlation among beneficiaries treated

[7] Deming, W. Edwards (1943), Statistical Adjustment of Data. New York: Wiley.

at the same facility, and robust standard errors.[8] Models explored controls for beneficiary characteristics (e.g., age, sex, race/ethnicity, and select clinical conditions[9]), facility characteristics (e.g., if facility had a late shift), and select geographic characteristics (e.g., median household income).[10] The variable selection process contained multiple steps including examining bivariate models and stepwise variable selection. Specifically, these characteristics were explored as covariates in the OLS models to assess independent relationships between each characteristic with each of the five composite scores. A characteristic was included in a final model when it was retained in the stepwise variable selection.[11] In addition, select characteristics were retained in the final models even when they would have to be not retained via stepwise variable selection process if the variable was important for research purposes (e.g., age, race/ethnicity, and sex). The coefficients and indicators for statistically significant associations are displayed in **Exhibit E-10**. The coefficients for the CEC Model in the final regression models show the independent associations of the CEC Model with the composite scores after adjusting for associations between all other covariates in the models. A positive coefficient would suggest the CEC Model is improving the quality of life measured by a particular score.

In addition, we conducted a sensitivity analysis with our final models to assess the extent comparison group beneficiaries who responded later in the year might have influenced results. There is some evidence in the literature suggesting researchers should account for seasonality when comparing data from different populations and periods.[12,13] The comparison group surveys were fielded later in the year than the CEC group surveys; therefore, we tested the hypothesis that responses closer to colder winter months might be correlated with poorer self-reported symptoms in the comparison group. This could artificially inflate differences between CEC and comparison groups. We assessed changes in the results of our final models when excluding comparison group beneficiaries who responded in Q4 2017 and the CEC beneficiaries to whom they were matched. Each of the models retained roughly 86% of the full final model samples. The sensitivity analysis largely yielded similar results as the original models.

E. Results

Exhibit E-6 shows response rates for CEC and comparison beneficiaries by demographic characteristics.

[8] Robust standard errors were derived using White's correction.

[9] Conditions were based on the CMS Chronic Conditions Data Warehouse (CCW) condition indicators, which are claims-based algorithms that identify beneficiaries with select clinical conditions; full criteria for all CCW conditions are available at https://www.ccwdata.org/web/guest/condition-categories.

[10] https://datawarehouse.hrsa.gov/topics/ahrf.aspx

[11] The Schwarz Bayesian information criterion was used in the stepwise variable selection to include variables that improved the fit of the model.

[12] Øyane et al. Increased health risk in subjects with high self-reported seasonality *PLOS One*. 2010; 5(3): e9498.

[13] Jia amd Lubetkin. Time trends and seasonal patterns of health-related quality of life among U.S. adults. *Public Health Report*. 2009; 124(5): 692-701.

Exhibit E-6. Response Rates by Demographic Characteristics

Characteristics		CEC (N=17,198)		Comparison (N=10,500)	
		N	%	N	%
Age	18 to 54	1,493	32.6	595	22.6
	55 to 64	1,799	42.7	880	35.3
	65 to 74	1,983	43.6	1,159	40.8
	75+	1,729	45.0	1,144	45.2
Race/ Ethnicity	Black	2,964	38.2	1,385	29.4
	Other	773	35.4	400	31.8
	White	3,165	45.3	1,969	44.4
Sex	Female	3,912	40.9	2,064	35.6
	Male	3,092	40.5	1,714	36.4
Total		**7,012**	**40.8**	**3,779**	**36.0**

Notes: Ns do not always sum to total due to missing values; Lewin computed CEC response rates from raw data provided by the CEC implementation contractor. Hispanic is included in the Other category in this table.

Exhibits E-7 and **E-8** display characteristics of respondents by group and weighted respondents.

Exhibit E-7. Characteristics by Respondent Group and Weighted Respondents

Characteristics		Total				CEC					Comparison				
		Surveyed (N=27,698)		Respondents (N=10,791)		Surveyed (N=17,198)		Respondents (N=7,012)			Surveyed (N=10,500)		Respondents (N=3,779)		
		N	%	N	%	N	%	N	%	$\%_W$	N	%	N	%	$\%_W$
Age	<65	13,922	50.3	4,767	44.2	8,795	51.1	3,292	46.9	51.2	5,127	48.8	1,475	39.0	48.8
	65 to 85	12,108	43.7	5,274	48.9	7,401	43.0	3,270	46.6	43.1	4,707	44.8	2,004	53.0	44.8
	85 +	1,654	6.0	741	6.9	989	5.8	442	6.3	5.8	665	6.3	299	7.9	6.3
Sex	Female	15,348	55.4	5,976	55.4	9,557	55.6	3,912	55.8	55.6	5,791	55.2	2,064	54.6	55.2
	Male	12,336	44.5	4,806	44.5	7,628	44.4	3,092	44.1	44.4	4,708	44.8	1,714	45.4	44.8
Race/ Ethnicity	Black	12,481	45.1	4,349	40.3	7,764	45.1	2,964	42.3	45.2	4,717	44.9	1,385	36.6	44.9
	White	11,426	41.3	5,134	47.6	6,988	40.6	3,165	45.1	40.7	4,438	42.3	1,969	52.1	42.3
	Hispanic	1,638	5.9	534	4.9	1,079	6.3	370	5.3	6.3	559	5.3	164	4.3	5.3
	Other	2,139	7.7	765	7.1	1,354	7.9	505	7.2	7.9	785	7.5	260	6.9	7.5
Body Mass Index (BMI)	Underweight (≤18.5)	970	3.5	335	3.1	663	3.9	236	3.4	3.4	307	2.9	99	2.6	2.6
	Healthy Weight (18.5 – 24.9)	7,059	25.5	2,671	24.8	4,401	25.6	1,721	24.5	24.5	2,658	25.3	950	25.1	24.8
	Overweight (25.0 – 29.9)	7,562	27.3	3,002	27.8	4,654	27.1	1,930	27.5	27.4	2,908	27.7	1,072	28.4	28.1
	Obese (30.0+)	12,094	43.7	4,775	44.2	7,468	43.4	3,118	44.5	44.6	4,626	44.1	1,657	43.8	44.4

Characteristics		Total				CEC					Comparison				
		Surveyed (N=27,698)		Respondents (N=10,791)		Surveyed (N=17,198)		Respondents (N=7,012)			Surveyed (N=10,500)		Respondents (N=3,779)		
		N	%	N	%	N	%	N	%	$\%_W$	N	%	N	%	$\%_W$
Conditions	Alzheimer's Disease and Related Conditions	4,740	17.1	1,326	12.3	3,008	17.5	886	12.6	12.1	1,732	16.5	440	11.6	10.4
	Asthma	2,490	9.0	900	8.3	1,542	9.0	598	8.5	8.6	948	9.0	302	8.0	8.4
	Chronic Obstructive Pulmonary Disease (COPD)	5,761	20.8	2,130	19.7	3,503	20.4	1,354	19.3	18.7	2,258	21.5	776	20.5	19.3
	Congestive Heart Failure (CHF)	16,289	58.8	6,052	56.1	10,034	58.3	3,950	56.3	55.8	6,255	59.6	2,102	55.6	54.4
	Depression	7,277	26.3	2,359	21.9	4,584	26.7	1,577	22.5	22.3	2,693	25.6	782	20.7	20.0
	Diabetes	18,742	67.7	7,169	66.4	11,612	67.5	4,690	66.9	66.7	7,130	67.9	2,479	65.6	65.2
	Hypertension	25,122	90.7	9,796	90.8	15,651	91.0	6,407	91.4	91.3	9,471	90.2	3,389	89.7	89.5
	Ischemic Heart Disease	16,909	61.0	6,517	60.4	10,429	60.6	4,228	60.3	59.3	6,480	61.7	2,289	60.6	58.3
	Rheumatoid Arthritis and Osteoarthritis	9,304	33.6	3,753	34.8	5,850	34.0	2,463	35.1	34.4	3,454	32.9	1,290	34.1	32.4
	Stroke	2,367	8.5	717	6.6	1,516	8.8	501	7.1	7.1	851	8.1	216	5.7	5.5

Notes: Ns do not always sum to total due to missing values. The W subscript (i.e., %w and Mean w) denote weighted responses; the analysis used sample-balancing weights to ensure the distribution of these characteristics (e.g., age, sex, and race/ ethnicity) was similar to the original surveyed samples to account for non-response. Conditions were based on the Chronic Conditions Data Warehouse (CCW) condition indicators, which are claims-based algorithms that identify beneficiaries with select clinical conditions; full criteria are available at https://www.ccwdata.org/web/guest/condition-categories.

Exhibit E-8. Characteristics by Respondent Group and Weighted Respondents

	Total				CEC					Comparison				
	Surveyed (N=27,698)		Respondents (N=10,791)		Surveyed (N=17,198)		Respondents (N=7,012)			Surveyed (N=10,500)		Respondents (N=3,779)		
	N	Mean	N	Mean	N	Mean	N	Mean	Mean $_W$	N	Mean	N	Mean	Mean$_W$
Hierarchical Condition Category (HCC) Score	26,102	2.9	10,196	2.8	16,170	2.9	6,604	2.8	2.8	9,932	2.9	3,592	2.9	2.8

Notes: Ns do not always sum to total due to missing values. The W subscript (i.e., %$_W$ and Mean $_W$) denote weighted responses; the analysis used sample-balancing weights to ensure the distribution of these characteristics (e.g., age, sex, and race/ ethnicity) was similar to the original surveyed samples to account for non-response. Conditions were based on the CCW condition indicators, which are claims-based algorithms that identify beneficiaries with select clinical conditions; full criteria are available at https://www.ccwdata.org/web/guest/condition-categories. Hierarchical Condition Category (HCC) scores were derived based on version 21.

Exhibit E-9 depicts the five main KDQOL-36 composite scores and the samples used for each in the final weighted regression models.

Exhibit E-9. Summary Statistics for KDQOL-36 Outcomes Based on Regression Sample (Weighted)

Measure	N	Mean	SD	Min	Max
Physical Component Summary (PCS)	8,144	34.2	16.2	10.6	61.8
Mental Component Summary (MCS)	8,640	47.6	17.8	12.0	71.4
Symptoms and Problems	9,908	71.7	29.0	0.0	100.0
Effect of Kidney Disease	9,889	63.6	37.9	0.0	100.0
Burden of Kidney Disease	9,954	44.2	46.5	0.0	100.0

Exhibit E-10 displays regression results for the five main KDQOL-36 measures.

Exhibit E-10. Regression Results for the Five KDQOL-36 Measures

Explanatory Variable	Category	Estimate+				
		PCS (N=8,144)	MCS (N=8,640)	Burden of Kidney Disease (N=9,954)	Effects of Kidney Disease (N=9,889)	Symptoms and Problems (N=9,908)
Intercept		39.7***	47.7***	49.6***	66.4***	75.4***
CEC (vs. Comparison)	CEC	0.5*	0.0	0.0	2.1***	1.6***
Age (vs. < 65)	65 to 84	0.1	1.3***	4.5***	6.3***	2.3***
	85 +	-2.5***	1.4***	3.4**	8.4***	2.6***
Sex (vs. Male)	Female	-1.4***	0.5*	3.4***	2.6***	-0.7*
Race / Ethnicity (vs. White)	Black	2.1***	1.0***	6.3***	4.6***	0.5
	Hispanic	0.4	-1.6***	-9.0***	-5.3***	-3.9***
	Other	0.7	-1.1**	-5.2***	-3.1***	-2.8***
HCC Score	Continuous	-0.4***	n/a	-0.5***	-0.5***	-0.4***
BMI (vs. Healthy Weight [18.5 – 24.9])	Underweight (≤ 18.5)	-0.2	n/a	n/a	n/a	n/a
	Overweight (25.0 – 29.9)	-0.4	n/a	n/a	n/a	n/a
	Obese (30.0+)	-1.8***	n/a	n/a	n/a	n/a
Conditions (vs. not having select condition)	Alzheimer's and Related Conditions	n/a	n/a	-4.9***	-3.2***	n/a
	Asthma	n/a	n/a	n/a	n/a	-2.3***
	COPD	-1.9***	-2.2***	-3.2***	-2.8***	-4.0***
	CHF	-1.2***	-1.1***	n/a	-3.0***	-3.1***
	Depression	-1.8***	n/a	-10.1***	-9.8***	-7.0***
	Diabetes	-1.1***	-1.1***	-3.6***	-2.2***	-2.0***
	Ischemic Heart Disease	-1.1***	n/a	n/a	n/a	n/a
	Hypertension	n/a	n/a	-3.7***	n/a	n/a
	Rheumatoid Arthritis and Osteoarthritis	-3.0***	-1.5***	-2.5***	-2.8***	-2.6***
	Stroke	n/a	-1.6***	n/a	n/a	n/a
Medicaid Status (vs. None)	Partial	n/a	-1.4***	n/a	n/a	-1.1*
	Full	n/a	-2.1***	n/a	n/a	-2.0***
Medicare Entitlement (vs. Age)	ESRD	0.1	n/a	0.9	n/a	n/a
	Disability	-1.5***	n/a	-2.8***	n/a	n/a
	Disability + ESRD	-0.4	n/a	2.2**	n/a	n/a
For Profit (vs. No)	Yes	n/a	n/a	n/a	-1.9***	n/a
PCPs per 10,000	Continuous	n/a	0.2***	n/a	n/a	0.4***

Notes: * = p ≤ 0.1, ** = p ≤ 0.05, *** p ≤ 0.01. (+) Estimates are the OLS regression coefficients. N/A denotes a variable that was not in a given model. The models retained characteristics selected via stepwise variable selection; demographic characteristics (i.e., age, race/ethnicity, and sex) and CEC were retained in all models for descriptive purposes. Conditions were based on the CCW condition indicators, which are claims-based algorithms that identify beneficiaries with select clinical conditions; full criteria are available at https://www.ccwdata.org/web/guest/condition-categories. HCC scores were derived based on version 21.

Among respondents, higher PCS measure scores were associated with CEC participation and Black race ($p \leq 0.1$). Lower PCS measure scores were associated with older age (≥ 85 years); female sex; higher comorbidity (higher Hierarchical Conditional Category [HCC] score); obesity (Body Mass Index [BMI] 30+); Congestive Heart Failure (CHF), Chronic Obstructive Pulmonary Disease (COPD), depression, diabetes, ischemic heart disease, and rheumatoid arthritis or osteoarthritis; and respondents whose Medicare entitlement originated from a disability ($p \leq 0.1$).

Higher MCS measure scores were found in respondents 65 years of age and older, female sex, Black race, and a higher rate of primary care providers (PCPs) in the respondent's Core-Based Statistical Area (CBSA) ($p \leq 0.1$). Lower MCS measure scores were associated with Hispanic ethnicity; other race/ethnicity (not White, Black, or Hispanic); respondents with CHF, COPD, diabetes, rheumatoid arthritis or osteoarthritis, and stroke; and respondents with full and partial Medicaid benefits ($p \leq 0.1$).

Being age 65 years or older, female sex, Black race, and Medicare entitlement due to both ESRD and disability were associated with greater Burden of Kidney Disease measure scores ($p \leq 0.1$). Lower Burden of Kidney Disease measure scores were associated with Hispanic ethnicity; other race/ethnicity (not White, Black, or Hispanic); higher comorbidity (higher HCC score); Alzheimer's disease and related disorders, COPD, depression, diabetes, hypertension, and rheumatoid arthritis or osteoarthritis; and Medicare entitlement due to disability ($p \leq 0.1$).

Larger Effects of Kidney Disease measure scores were associated with CEC participation, age 65 years and older, female sex, and Black race ($p \leq 0.1$). Smaller Effects of Kidney Disease measure scores were associated with Hispanic ethnicity; other race/ethnicity (not White, Black, or Hispanic); higher comorbidity (higher HCC score); Alzheimer's disease and related disorders, CHF, COPD, depression, diabetes, and rheumatoid arthritis or osteoarthritis; and respondents that were aligned to a for-profit facility ($p \leq 0.1$).

Higher Symptoms and Problems measure scores were associated with CEC participation, age 65 years and older, and a higher rate of PCPs in the respondent's CBSA ($p \leq 0.1$). Lower Symptoms and Problems measure scores were associated with female sex; Hispanic ethnicity; other race/ethnicity (not White, Black, or Hispanic); higher comorbidity (higher HCC score); asthma, CHF, COPD, depression, diabetes, and rheumatoid arthritis and osteoarthritis; and respondents with full and partial Medicaid benefits ($p \leq 0.1$).

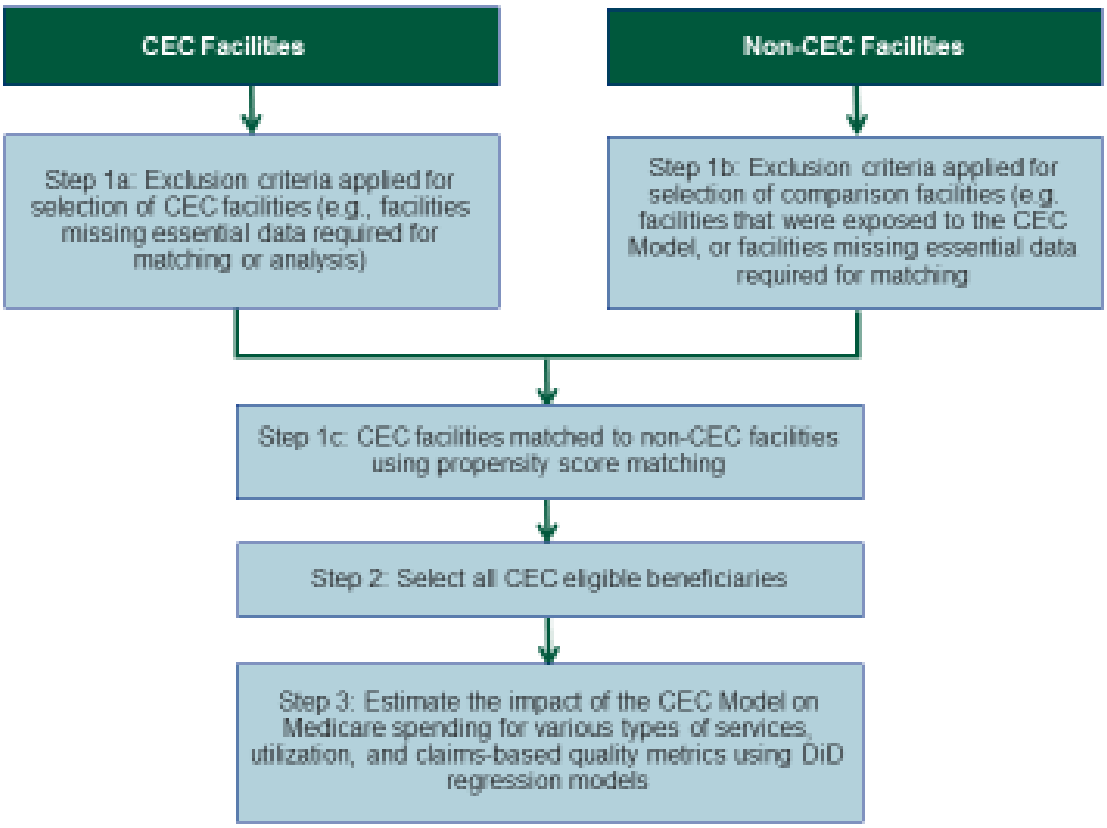
Finally, the sensitivity analysis largely yielded similar results as the original models. The PCS measure estimate decreased from a 1.4% difference ($p \leq 0.1$) in the mean score in the full analysis to a 0.9% difference ($p \geq 0.1$). The MCS measure estimate decreased from a 0.0% difference ($p \geq 0.1$) in the mean score in the full analysis to a -0.4% difference ($p \geq 0.1$). The Burden of Kidney Disease measure estimate declined from a 0.0% difference ($p \geq 0.1$) in the mean score to a -1.2% difference ($p \geq 0.1$) in the sensitivity analysis. The Effects of Kidney Disease measure estimate increased slightly from being 3.3% higher ($p \leq 0.01$) in the mean score in the full analysis to 3.4% higher in the sensitivity analysis. The Symptoms and Problems estimate decreased from being 2.3% higher ($p \leq 0.01$) to 1.5% higher ($p \leq 0.05$). While there was minor movement in the estimates, the magnitudes and direction of associations were consistent and therefore inferences are effectively unchanged. In conclusion, comparison group responses later in the year appeared to have little to no influence on results.

Appendix F: Difference-in-Differences (DiD) Approach

The evaluation model relies on a non-experimental design, which uses a comparison group of non-CEC facilities and beneficiaries who would have been aligned to them under CEC rules, to infer counterfactual outcomes for CEC beneficiaries. The difference-in-differences (DiD) approach used in the evaluation is a statistical technique that quantifies the impact of an intervention by comparing changes in the intervention group (CEC beneficiaries) to changes in the comparison group.

The DiD approach was implemented in several steps as shown in the flow chart in **Exhibit F-1**. First, we identified the pool of treatment and potential comparison facilities and used one-to-one PSM without replacement to select a comparison group of non-CEC facilities that is similar to the CEC facilities with respect to provider and market characteristics. Second, we applied the CEC Model rules to align eligible beneficiaries to both CEC and matched comparison facilities and assess their CEC eligibility status on a monthly basis. Beneficiaries aligned to either CEC participating or matched comparison facilities were included in our study population for every month they were also eligible for CEC. Finally, we used DiD regression models to identify the impact of the CEC Model on spending, utilization, and quality measures.

Exhibit F-1. DiD Implementation Steps



A. Data and Outcome Measures

Data used to evaluate the CEC Model is listed in **Exhibit F-2**.

Exhibit F-2. Data Sources

Data Source	Data Contents
▪ CEC Model Data	▪ CEC Participating Dialysis Facilities
▪ Master Data Management tool	▪ Beneficiary alignment to other shared savings programs (SSPs)
▪ CCW Virtual Research Data Center (VRDC) • Data from the CCW include Medicare claims for services provided between 1/1/2012 and 12/31/2017 that were processed by 3/30/2018[14]	▪ Claims for Medicare covered services
▪ Master Beneficiary Summary File (MBSF)	▪ Beneficiary characteristics, demographics, enrollment status, and chronic condition indicators[15,16]
▪ Consolidated Renal Operations in a Web-enabled Network (CROWNWeb)	▪ Complete patient histories at incidence of dialysis including: • Cause of ESRD • Information on dialysis care • Date of first dialysis • Pre-ESRD care
▪ Dialysis Facility Compare 2014-2017	▪ Facility Organization characteristics and quality metrics[17]
▪ Area Health Resource File (AHRF) (aggregated to CBSA defined by CMS Office of Management and Budget[18])	▪ Market Characteristics: • Population size • Economic and health care supply indicators
▪ The In-Center Hemodialysis Consumer Assessment of Healthcare Providers and Systems (ICH CAHPS)	▪ Patient experience with in-center hemodialysis care
▪ KDQOL-36 Questionnaire	▪ Quality of life metrics

Exhibit F-3 defines all the outcome measures evaluated in the report using a DiD methodology.

[14] Kidney transplants are an exception, which also included claims that ended in 2011 to assess the kidney transplant exclusion criterion in 2012 (i.e., excluded in the 12 months following the month of a transplant).
[15] The CCW condition indicators are claims-based algorithms that identify beneficiaries with select clinical conditions (e.g., diabetes, hyperlipidemia, hypertension, etc.) https://www.ccwdata.org/web/guest/condition-categories.
[16] The MBSF originates from the Common Medicare Environment (CME) tables.
[17] To minimize missing values, a facility's most recent Dialysis Facility Compare characteristics were used if a facility had no Dialysis Facility Compare data in a given year.
[18] We used the most recent version dated July 2016.

Exhibit F-3. DiD Measure Outcomes and Definitions

Outcome	Definition of the Outcomes
Admissions for Asthma or COPD in older adults	Monthly beneficiary flag indicating Acute Care Hospital (ACH) admission(s) with a principal diagnosis for COPD or asthma. ACH admissions are defined by Part A claims with claim type 60 or 61 and the 3rd digit of the CMS Certification Number (CCN) was 0, or the 3rd/4th digit of the CCN was 13. This measure follows the Agency for Healthcare Research and Quality (AHRQ) specifications for Prevention Quality Indicator (PQI) 05. International Classification of Disease, 10th Revision (ICD-10) codes are based on PQI 05 v7.0 AHRQ specifications, and International Classification of Diseases, 9th Revision (ICD-9) codes are based on v6.0 AHRQ specifications. This measure is restricted to beneficiaries who were identified with COPD or asthma and at least 40 years of age. COPD and asthma were defined using the CCW COPD_END and ASTHMA_END variables having a value of 1 or 3 (i.e., satisfied claims criteria to identify condition by the end of the calendar year [CY]). Admissions are assigned to the month on the claim thru date. See link https://www.qualityindicators.ahrq.gov/Downloads/Modules/PQI/V70/TechSpecs/PQI_05_Chronic_Obstructive_Pulmonary_Disease_(COPD)_or_Asthma_in_Older_Adults_Admission_Rate.pdf
Admissions for CHF	Monthly beneficiary flag indicating ACH admission(s) with a principal diagnosis for CHF. ACH admissions are defined by Part A claims with claim type 60 or 61 and the 3rd digit of the CCN was 0, or the 3rd/4th digit of the CCN was 13. This measure follows the AHRQ specifications for PQI 08. ICD-10 codes are based on PQI 08 v7.0 AHRQ specifications, and ICD-9 codes are based on v6.0 AHRQ specifications. This measure is restricted to beneficiaries who were identified with CHF and at least 18 years old. CHF was defined using the CCW CHF_END variable having a value of 1 or 3 (i.e., satisfied claims criteria to identify condition by the end of the CY). Admissions are assigned to the month on the claim thru date. See link https://www.qualityindicators.ahrq.gov/Downloads/Modules/PQI/V70/TechSpecs/PQI_08_Heart_Failure_Admission_Rate.pdf
Admissions for Long-Term Diabetes Complications	Monthly beneficiary flag indicating ACH admission(s) with a principal diagnosis for long-term diabetes complications. ACH admissions are defined by Part A claims with claim type 60 or 61 and the 3rd digit of the CCN was 0, or the 3rd/4th digit of the CCN was 13. This measure follows the AHRQ specifications for PQI 03. ICD-10 codes are based on PQI 03 v7.0 AHRQ specifications, and ICD-9 codes are based on v6.0 AHRQ specifications. This measure is restricted to beneficiaries who were identified with diabetes and at least 18 years old. Diabetes was defined using the CCW DIAB_END variable having a value of 1 or 3 (i.e., satisfied claims criteria to identify condition by the end of the CY). Admissions are assigned to the month on the claim thru date. See link https://www.qualityindicators.ahrq.gov/Downloads/Modules/PQI/V70/TechSpecs/PQI_03_Diabetes_Long-term_Complications_Admission_Rate.pdf
Admissions for Short-Term Diabetes Complications	Monthly beneficiary flag indicating ACH admission(s) with a principal diagnosis for short-term diabetes complications. ACH admissions are defined by Part A claims with claim type 60 or 61 and the 3rd digit of the CCN was 0, or the 3rd/4th digit of the CCN was 13. This measure follows the AHRQ specifications for PQI 01. ICD-10 codes are based on PQI 01 v7.0 AHRQ specifications, and ICD-9 codes are based on v6.0 AHRQ specifications. This measure is restricted to beneficiaries who were identified with diabetes and at least 18 years old. Diabetes was defined using the CCW DIAB_END variable having a value of 1 or 3 (i.e., satisfied claims criteria to identify condition by the end of the CY). Admissions are assigned to the month on the claim thru date. See link https://www.qualityindicators.ahrq.gov/Downloads/Modules/PQI/V70/TechSpecs/PQI_01_Diabetes_Short-term_Complications_Admission_Rate.pdf
Arteriovenous (AV) Fistula Use	Monthly beneficiary flag indicating a beneficiary used an AV fistula for vascular access. This outcome is restricted beneficiaries who had been 90 days or longer on dialysis and requires hemodialysis to be the most recent dialysis modality in the month.
Average Inpatient Length of Stay (in days)	Monthly beneficiary average number of acute inpatient days (length of stay). Average length of stay is calculated by dividing number of acute inpatient days by the number of admissions. The value is missing for beneficiaries with zero monthly admissions. Admission monthly counts include both ever admitted and readmissions.
Catheter Use	Monthly beneficiary flag indicating a beneficiary had used catheter for 90 days or longer. This outcome is restricted to only hemodialysis beneficiaries with at least 90 days of hemodialysis.

Outcome	Definition of the Outcomes
Contraindicated Medications	Monthly beneficiary flag indicating a beneficiary was prescribed a medication that is contraindicated in patients with ESRD. The list of contraindicated medications includes: Narcotic Analgesics and Narcotic Antagonists (Meperidine, Propoxyphene), Antihypertensive and Cardiovascular Agents (Nitroprusside, Acetazolamide, Amiloride, Indapamide, Chlorothiazide, Chlorthalidone, Ethacrinic acid, Hydrochlorthiazide, Hydroflumethiazide, Polythiazide, Spironolactone, Thiazides, Triamterene, Mecamylamine, Phenoxybenzamine), Antimicrobial Agents (Methenamine mandelate, Nitrofurantoin, Nalidixic acid, Intravenous Itraconazole, Trimetrexate, Abacavir/Lamivudine, Cidofovir, Emtricitabine/Tenofovir, Lamivudine/Zidovudine, Ribavirin, Tenofovir, Valgancyclovir), Antineoplastic Agents (Carmustine, Topotecan), Medications for Arthritis and Gout (Penicillamine), Hypoglycemic Agents (Chlorpropamide, Gliclazide, Metformin), Hypolipidemic Agents (Bezafibrate, Clofibrate), Neuromuscular Agents (Gallamine, Pancuronium, Tubocurarine) Sedatives, Hypnotics and Other Drugs Used in Psychiatry (Ehtchlorvynol), and Miscellaneous Drugs (Acetohydroxamic acid, Cisapride, Clodronate, Desferoxamine, Anistreplase, Sulfinpyrazone, Tranexamic acid, Methsuximide, Quinine sulfate). This list was provided by nephrologists at the University of Michigan, who based their analysis on *Drug Dosing in Renal Failure*, Brier Michael E. and Aronoff, George R., eds., 5th Ed., American College of Physicians, 2007.
Dialysis Payments	Monthly standardized payments for dialysis services included under Medicare Part B. Includes claim type 40 and bill type 72X (Part B Institutional dialysis) and claim types 71, 72 and first two digits of Berenson-Eggers Type of Services (BETOS)=P9 (Part B non-institutional dialysis).
Dilated Eye Exam	Yearly beneficiary flag restricted to diabetic beneficiaries with ESRD that indicates a beneficiary had at least one diabetic retinal eye exam. This indicator is based on Part B institutional and non-institutional claims with a diagnosis or procedure code for the exam. Month is based on the last expense date for non-institutional claims and revenue center date for institutional claims. These methods are intended to align with the US Renal Data System (USRDS) methods and are based on codes listed in the USRDS Annual Reports (2012+) Volume 2 ESRD Analytic Methods.
Emergency Department (ED) Visit	Monthly beneficiary flag indicating a beneficiary had at least one outpatient ED claims/visits (i.e., did not result in inpatient hospitalization). Based on Part B Institutional claims that have a claim line with a revenue center code starting with 045. ED visit counted in the month of the revenue center date on the claim line.
Number of ED Visits	Monthly beneficiary count of outpatient ED claims/visits (i.e., did not result in inpatient hospitalization). Based on Part B Institutional claims that have a claim line with a revenue center code starting with 045. ED visit counted in the month of the revenue center date on the claim line.
ED Visits within 30-days of an Acute Hospitalization	Beneficiary flag indicating a beneficiary had at least one outpatient ED claim/visit (i.e., did not result in inpatient hospitalization) within 30-days of an acute inpatient hospital stay. The 30-days is based on the difference between the discharge date on the inpatient hospitalization and the claim from date of the outpatient claim. When an ED visit occurred within 30-days of an inpatient hospitalization, the event is counted in the month of the claim thru date of the hospitalization. This outcome applies only to beneficiaries who had an inpatient hospitalization
Emergency Dialysis	Monthly beneficiary flag indicating that a beneficiary received at least one outpatient emergency dialysis service. These are identified on Part B Institutional claim lines with a G0257 procedure code (unscheduled or emergency dialysis treatment for a patient with ESRD in a hospital outpatient department that is not certified as an ESRD facility). Each claim line with the G0257 code is counted as one service.
Hospitalization for ESRD Complications	Monthly beneficiary flag indicating that a beneficiary had at least one admission with a principal diagnosis for ESRD complication. Admission was based on an inpatient claim (i.e., all claim types 60/61). Complications include volume depletion, hyperpotassemia, fluid overload, heart failure, and pulmonary edema. An ESRD complication was based on ICD-9 diagnosis codes 27650, 27651, 27652, 2767, 27669, 40403, 40413, 40493, 5184, 514, 4281, 428x (i.e., first three digits are 428) and ICD-10 diagnosis codes E860, E861, E869, E875, E8770, E8779, I132, J810, J811, I50x (i.e., first three digits are I50).

Outcome	Definition of the Outcomes
Payments for Hospitalization for ESRD Complications	Monthly standardized payments from inpatient admissions (i.e., all claim types 60/61) with a principal diagnosis for ESRD complication. Complications include volume depletion, hyperpotassemia, fluid overload, heart failure, and pulmonary edema. An ESRD complication was based on ICD-9 diagnosis codes 27650, 27651, 27652, 2767, 27669, 40403, 40413, 40493, 5184, 514, 4281, 428x (i.e., first three digits are 428) and ICD-10 diagnosis codes E860, E861, E869, E875, E8770, E8779, I132, J810, J811, I50x (i.e., first three digits are I50).
Flu Vaccination	Seasonal beneficiary influenza vaccination flag that indicates a beneficiary had at least one influenza vaccination during the flu season months (i.e., October through March), Influenza vaccinations are based on Part B institutional and non-institutional claims with a Healthcare Common Procedure Coding System (HCPCS).
Gap in Dialysis	Monthly beneficiary flag indicating a beneficiary had less than 12 dialysis sessions in the month and no observable reason in that month. Observable reasons for fewer dialysis sessions include: dialysis started in the month, beneficiary died in the month, kidney transplant in the month, resumption of dialysis in the month following a failed transplant, or inpatient admission in the month. Beneficiaries with at least one observable reason for fewer dialysis sessions during the month are excluded from the sample. Additionally, this measure is restricted to beneficiaries who are only on hemodialysis and have had at least 12 months of dialysis.
Hemoglobin A1c (HbA1c) Test	Yearly indicator restricted to diabetic beneficiaries with ESRD that indicates a beneficiary had at least one HbA1c test. This indicator is based on Part B institutional and non-institutional claims with a procedure code for the test. Month is based on the last expense date for non-institutional claims and revenue center date for institutional claims. These methods are intended to align with the USRDS methods and are based on codes listed in the USRDS Annual Reports (2012+) Volume 2 ESRD Analytic Methods.
Hemodialysis	Monthly beneficiary flag indicating that a beneficiary received at least one inpatient and or home hemodialysis services and is based on positive non-standardized hemodialysis dialysis payments.
Home Dialysis	Monthly beneficiary flag indicating a beneficiary had at least one home dialysis service. Home dialysis is based on a Part B Institutional claim with a related condition sequence code of 74, 75, or 80. 74 = Home - Billing is for a patient who received dialysis services at home. 75 = Home 100% reimbursement - (not to be used for services after 4/15/90) The billing is for home dialysis patient using a dialysis machine that was purchased under the 100% program. 80 = Home Dialysis - Nursing Facility - Home dialysis furnished in a skilled nursing facility (SNF) or nursing facility. (eff. 4/4/05) [SOURCE: https://www.resdac.org/cms-data/variables/claim-related-condition-code]
Home Health Payments	Monthly standardized payments for home health services (claim type 10).
Home Hemodialysis	Monthly beneficiary flag that indicates a beneficiary received at least one home hemodialysis services. The outcome is conditional on the beneficiary receiving hemodialysis services in the month and is based on positive non-standardized hemodialysis dialysis payments.
Hospice Payments	Monthly standardized payments for hospice services (claim type 50).
Hospital Outpatient Payments	Monthly standardized payments for Part B outpatient services. This measure includes all claim type 40 that are not imaging (P_B_IMG), dialysis (P_B_DIALYSIS), or therapy (P_B_THERAPY); this includes hospital outpatient (bill type 13x, 85x), clinics (bill type 71x, 73x, 77x), and all other Part B institutional services (services covered under Part B for inpatients that exhausted Part A coverage [bill type 12x], SNF [22x, 23x], community mental health center [76x], other Part B home health services [34x], home health services [14x], and Indian health services [83x]).
Hospitalizations	Monthly beneficiary indicator identifying a beneficiary was admitted and had at least one inpatient hospital stay in the month. Includes all inpatient claims based on claim type 60.
Number of Hospitalizations	Monthly beneficiary count of inpatient hospital stays in the month. Includes all inpatient claims based on claim type 60.

Outcome	Definition of the Outcomes
Low-Density Lipoprotein (LDL) Cholesterol Test	Yearly beneficiary indicator restricted to diabetic beneficiaries with ESRD that indicates a beneficiary had at least one LDL cholesterol test. This indicator is based on Part B institutional and non-institutional claims with a procedure code for the test. Month is based on the last expense date for non-institutional claims and revenue center date for institutional claims. These methods are intended to align with the USRDS methods and are based on codes listed in the USRDS Annual Reports (2012+) Volume 2 ESRD Analytic Methods.
Number of Office Visits	Monthly beneficiary count of office visits. Office visits are based on Part B non-institutional claim lines where the first character of the BETOS code = "M." A visit is a unique revenue center date with an Evaluation and Management (E&M) service (i.e., two lines with same date are counted as one visit). The month is based on the last expense date from the claim line.
Observational Stays	Monthly beneficiary flag that indicates a beneficiary had at least one observational stay in the month. The outpatient observation is based on a Part B Institutional claim with a HCPCS code of G0378 or G0379
Office Visits Payments	Monthly beneficiary sum of Part B non-institutional E&M non-standardized payments. Includes claim types 71, 72 (Part B non-Institutional) and first digit of BETOS is M.
Opioid Overutilization	Monthly beneficiary flag that indicates a beneficiary was taking an average morphine milligram equivalent (MME) dose greater than 50mg for active opioid prescription, adjusting for early refills (same generic name, strength, dosage, form). Excludes beneficiaries who are not covered under Medicare Part D, as well as cancer patients, and beneficiaries on hospice.
Number of Outpatient Dialysis Sessions	Monthly beneficiary count of dialysis services. This outcome is restricted to beneficiaries who are only on hemodialysis and have had at least 12 months of dialysis.
Hospice	Monthly beneficiary flag that indicates a beneficiary was receiving at least one hospice service in the month (claim type 50).
No Prior Nephrology Care	Monthly beneficiary flag that indicates a beneficiary had no prior nephrology care prior to the beneficiary's first month of dialysis. The month of first dialysis was based on data from the Renal Management Information System (REMIS). Prior dialysis care was based on CMS Form 2728 (i.e., Medical Evidence Report) data for Question 18 (prior erythropoietin in 6+ months, prior nephrologist care in 6+ months, prior kidney dietician care in 6+ months, first access type was a graft or fistula, first access type was not a fistula and had maturing fistula or maturing graft). A "no" response on any of the six questions and no "yes" responses defined no prior care. A "yes" response on any of the six questions defined prior care.
Peritoneal Dialysis	Monthly beneficiary flag that indicates a beneficiary received at least one peritoneal dialysis service in the month and is based on positive non-standardized peritoneal dialysis payments.
Phosphate Binder Adherence	Monthly beneficiary indicator identifying a beneficiary who received at least two phosphate binder prescriptions in a given year had a proportion of days covered greater than or equal to 80%, adjusting for early refills (same generic name, strength, dosage, form). Proportion of days covered is defined as the number of days per month that a beneficiary is covered by Medicare Part D prescription drug claims for the same medication or another phosphate binder, divided by the number of days in a given month. This measure does not include over-the-counter vitamins and supplements which may also be used as phosphate binders.
Readmission within 30-days of an Index Hospitalization Stay	Monthly beneficiary flag that indicates a beneficiary had at least one unplanned readmission hospitalization stay within 30-days of an index hospitalization stay. Hospitalization claims are based on select Part A claim type 60 (i.e., inpatient) claims; long-term care facilities (i.e., CCN between 2000 and 2299) and inpatient rehabilitation facilities (i.e., CCN between 3025 and 3099) are excluded.
Number of Readmissions	Monthly beneficiary count of unplanned readmission hospitalization stays within 30-days of an index hospitalization stay. Hospitalization claims are based on select Part A claim type 60 (i.e., inpatient) claims; long-term care facilities (i.e., CCN between 2000 and 2299) and inpatient rehabilitation facilities (i.e., CCN between 3025 and 3099) are excluded.
Acute Inpatient Payments	Monthly standardized payments for acute inpatient includes claim types 60/61 where 3rd digit of the CCN=0 (inpatient prospective payment system) or 3rd/4th digit of CCN=13 (critical access hospital).

Outcome	Definition of the Outcomes
Medicare Part A and Part B Payments	Monthly standardized payments included under Medicare Part A and Part B. Payments are counted in the month of the claim thru date for all Part A claims (i.e., acute, home health, hospice, SNFs, institutional rehabilitation facilities, long-term care hospitals, and other inpatient facilities) and Part B Institutional claims (i.e., hospital outpatient, imaging, therapy, and total dialysis). Payments are counted in the month of the last expense date for all Part B non-institutional claims (i.e., E&M services, Part B covered drugs, durable medical equipment, etc.). In addition, payments are standardized to remove the effects of wage differences and for teaching status and other policy adjustments.
Part B Medicare Payments	Monthly standardized payments included under Part B actual amounts. Payments are counted in the month of the last expense date for all Part B Institutional claims and non-institutional claims. For a given CY's Part B payments, payments were included when the claim thru date (i.e., year of annual RIF file) is in the given year and +/- 1 year and the last expense date were in the same year.
Part B Drug Payments	Monthly standardized payments of Part B non-institutional drug amounts. Includes claim types 71, 72 (Part B non-Institutional) and first two digits of BETOS is O1C, O1D, O1E, or O1G.
Part D Drug Cost	Sum of drug costs (i.e., ingredient costs, dispensing fee, sales tax, and vaccination fee if applicable) for all prescription drug events with date of service in the month. These costs are counted only for Medicare beneficiaries who are enrolled in Part D during the month.
Institutional Post-Acute Care (PAC) Payments	Monthly standardized payments for services incurred during that month at inpatient rehabilitation facilities, SNF, and long-term care hospitals. These correspond to claim types 60/61 where last 4 digits of the CCN are between 3025-3099 or 3rd digit of CCN is R or T, 20/30, 60/61 where 3rd/4th digits of CCN are 20, 21, 22.
Readmission Payments	Monthly standardized payments for services related to all cause hospital readmissions. A readmission occurs when a beneficiary had a claim from date of a subsequent inpatient stay that was less than or equal to 30-days after the claim through date of a prior stay (i.e., an index hospitalization) then the prior stay. A hospitalization with a discharge status code of 07 (left against medical advice) or 20 (died) is excluded from being an index admission; hospitalizations that occur within the 30-day period following an excluded index admission are not counted as a readmission.
Hospitalization for Vascular Access Complications	Monthly beneficiary flag indicating admission(s) with a principal diagnosis for a vascular access complication. Admission was based on an inpatient claim (i.e., all claim types 60/61). A vascular access complication was based on ICD-9 diagnosis codes 9961, 99656, 99673 and ICD-10 diagnosis codes T82318A, T82319A, T82328A, T82329A, T82338A, T82339A, T82398A, T82399A, T8241XA, T8242XA, T8243XA, T8249XA, T82510A, T82511A, T82518A, T82520A, T82521A, T82528A, T82529A, T82530A, T82531A, T82538A, T82590A, T82591A, T82598A, T85611A, T85621A, T85631A, T85691A, T82818A, T82828A, T82838A, T82848A, T82858A, T82868A, T82898A.

Notes: Payments, besides total Part D, are standardized and capped at the 99th percentile of all positive expenditure values associated with the outcome.

B. Comparison Group Construction

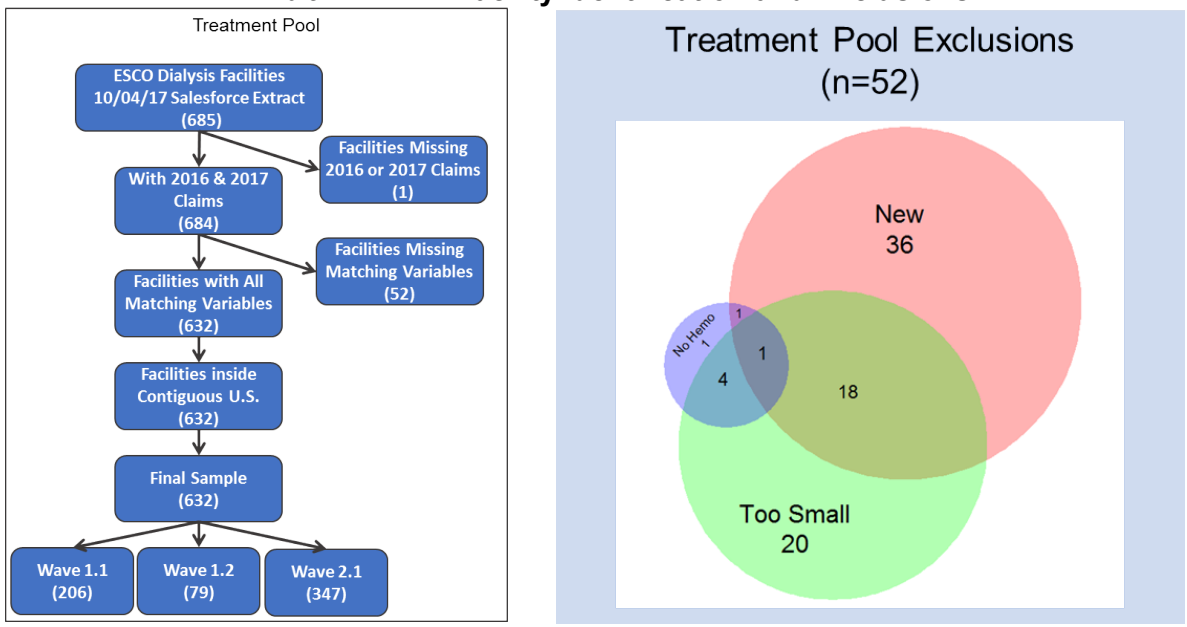
The construction of the comparison group was performed in two steps. First, eligible comparison facilities were identified by excluding facilities that were exposed to the intervention and those missing essential data. Second, PSM was used to select the final group of matched comparison facilities. Detailed descriptions of these steps follow below.

1. Identifying CEC Facilities

Participation data for CEC is maintained by the Center for Medicare & Medicaid Innovation (CMMI) and reposted in a web-based database, Salesforce. Using an extract of participation data from January 3, 2018, we identified 685 dialysis facilities participating through ESCOs on or prior to January 1, 2017.

A series of eligibility criteria were evaluated and applied to ensure the dialysis facilities could be included in the matching model. The criteria and number of exclusions are outlined in **Exhibit F-4**. CEC facilities met each criteria except for one facility with no dialysis claims in 2017 and 52 facilities without key matching characteristics, which are required to estimate matching models in subsequent steps.[19] The facilities that met the eligibility criteria (n=632) formed the treatment pool used in matching.

Exhibit F-4. CEC Facility Identification and Exclusions



The facilities with missing data were either too small, new since 2014, or did not provide hemodialysis services. A breakdown of excluded facilities by reason is provided the Venn diagram in **Exhibit F-4**.

CEC facility exclusions were not associated with a single organization and were generally proportional to number of facilities in CEC by organization (see **Exhibit F-5**). The 53 unmatched facilities were comparable to the 632 matched treatment facilities. Means of market and facility-level characteristics, for those characteristics where data was available for all 53 unmatched CEC facilities, showed no meaningful differences compared to facilities included in the analysis.

[19] **Exhibit F-7** details the data used for the selection of the comparison group of facilities.

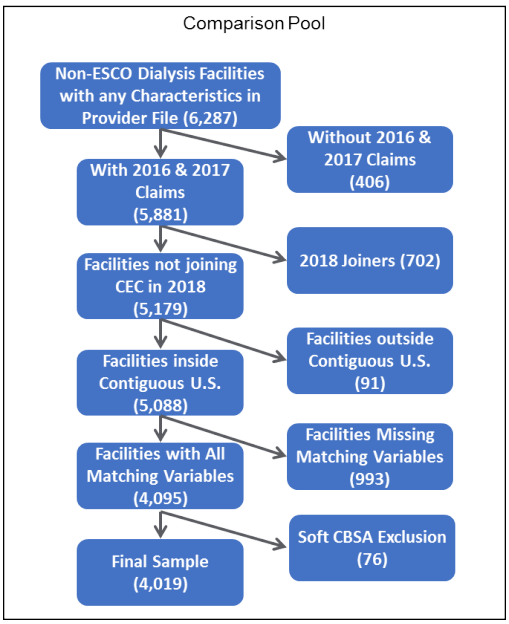
Exhibit F-5. Excluded Facilities by Organization

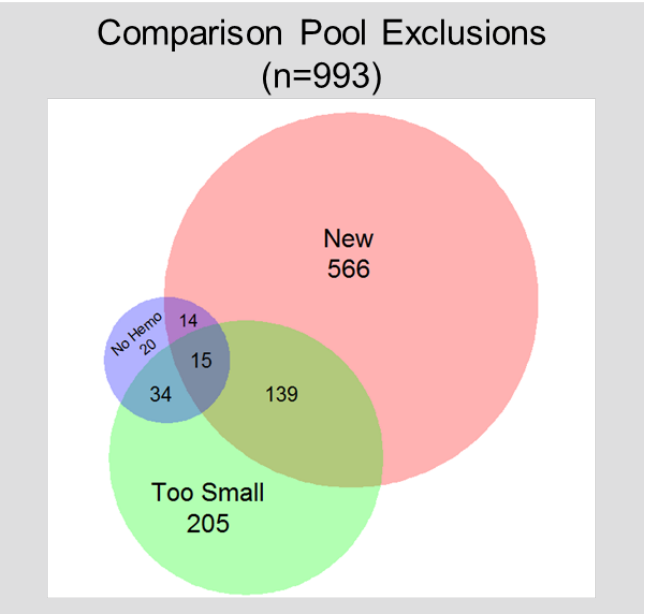
Organization	Number of CEC Facilities	Number of Excluded CEC Facilities
DaVita	107	12
DCI	63	3
Fresenius	496	37
CDC	6	0
Atlantic	5	1
NKC	6	0
Rogosin	2	0
Total	**685**	**53**

2. *Selecting Facilities Eligible to be Included in the Comparison Group Pool*

After removing the 685 dialysis facilities participating in CEC by January 1, 2017, the preliminary comparison pool contained 6,287 dialysis facilities. We applied the same series of eligibility criteria to ensure the comparison facilities could be included in the matching model and would have limited exposure to the CEC Model. The criteria and number of exclusions are outlined in **Exhibit F-6**.

Exhibit F-6. Treatment and Comparison Facility Identification and Exclusions





In calendar years (CYs) 2016 and 2017, 406 potential comparison facilities were excluded from matching because they did not have claims. Claims were not observed in the calendar years 2016 or 2017 for these facilities either because the facility changed ownership and CMS Certification Number (CCN), the unit at which facilities are identified and associated with claims; the facility was no longer providing care to Medicare patients; or the facility was new to Medicare in 2017 or later. An additional 702 dialysis facilities joining CEC on January 1, 2018 were removed from the comparison pool, since it is possible that these facilities began implementing changes in 2017 in anticipation of joining CEC, which could have biased the CEC impact estimate.

Remaining facilities were examined to identify those with missing data relevant to the analysis. There were 993 potential comparison facilities excluded because they were missing important facility characteristics used in the matching process. The missing data were mainly for facilities without claims in 2014, facilities without hemodialysis, or other facilities that did not regularly perform dialysis within their facility (see Venn diagram in **Exhibit F-6**). Because ESCO facilities were not observed in Alaska, Hawaii, Puerto Rico, or US Territories, an additional 91 potential comparison dialysis facilities in these areas were identified and excluded from the comparison pool.

In order to limit selection bias, we excluded dialysis facilities from the comparison group pool if an ESCO from their organization was operating in the same Medicare CBSA.[20] For example, Fresenius had ESCO facilities in the Chicago, IL CBSA so we excluded from the comparison pool all other Fresenius facilities in the Chicago CBSA. This exclusion reduces the number of eligible comparison facilities and could have a larger reduction on the number of comparison facilities in urban areas where CEC facilities are frequently located. However, by matching on a variety of market characteristics, we minimize imbalances in market characteristics that this exclusion could affect. Facilities joining in 2018 were counted as participants for the purpose of implementing this exclusion. This exclusion reduced the facilities that could potentially be included in the comparison group by 76 out of the remaining non-ESCO facilities. The final comparison pool, included 4,019 dialysis facilities.

3. Statistical Matching Approach

The next step in developing the comparison group involved implementing matching methods to identify the set of facilities in the comparison pool that are representative of CEC facilities and their patients. To this end, we first selected provider and market characteristics that were associated with CEC participation, and we then used matching methods to identify comparison facilities that that similar values in those characteristic. **Exhibit F-7** shows the data used to construct the characteristics used for the selection of the comparison group of facilities.

[20] Medicare CBSAs are Metropolitan CBSAs, with each CBSA Division separated, from the CMS Office of Management and Budget CBSA definition.

Exhibit F-7. Data Used for the Selection of the Comparison Group of Facilities

Dataset Name	Date Range	Dataset Contents	Use
AHRF	2012 – 2015	County-level data on population, environment, geography, health care facilities, and health care professionals	Descriptive analysis of CEC and non-CEC market characteristics. Predictors/characteristics were included in the comparison group selection modeling.
CEC Participant List	Extracted 1/3/2018; Facilities participating through ESCOs on or prior to 1/1/2017	ESCO names, IDs, provider names, National Provider Identifiers (NPIs), Taxpayer Identification Numbers (TINs), addresses, start dates, and stop dates	Identification of ESCO facilities and locations
Dialysis Facility Compare	2012 – 2017	Dialysis facilities' organizational characteristics and quality measures published on the CMS website	Used to identify facility characteristics incorporated into the DiD models and comparison groups
Master Data Management	2012 – 2017	Provider- and beneficiary-level information on participation in CMMI payment demonstration programs	Used to identify providers who are involved in Accountable Care Organizations (ACOs) and Medicare SSP
CCW	January 2012 – December 2017	Medicare Part A and Part B claims and beneficiary and enrollment information (MBSF, EDB, Common Medicare Environment [CME]), including beneficiary unique identifier, address, date of birth/death, sex, race, age, and Medicare enrollment status	Used to create outcome measures such as ED visits and total Medicare Part A and Part B standardized payments, identify eligibility for alignment, beneficiary demographic characteristics, and beneficiary eligibility for inclusion in the denominator for each of the outcome measures
Long Term Care Minimum Data Set (MDS)	2012 – 2017	Information about residence in nursing home	Used to create indicators for long-term institutional status used in risk adjustment
The ZIP Code File-SAS	January 2017	ZIP codes and CBSAs	Used to link ZIP codes to CBSAs
CROWNWeb	January 2012 – December 2017	Primary cause of renal failure, cause of renal failure groupings, height, race, dry weight, physician name, dialysis type, and incident comorbidities	Used to obtain patient demographic and medical information were extracted from the CMS ESRD Medical Evidence Report form (2728 form)

We explored many options for matching methods including Mahalanobis distance, coarsened exact matching, entropy balancing, and PSM.[21] The literature guided and the empirical analysis informed the matching methods used to select a comparison group for CEC facilities. Several methods were reviewed but ultimately the PSM approach was selected because it performed best according to multiple balance diagnostics. In the remainder of this section each methodological consideration for PSM is discussed, including a description of the estimated model.

Matching Method. The goal of matching both market- and facility-level characteristics led to the inclusion of many covariates in the matching model. Evidence from the literature indicates that, when matching on many covariates, PSM leads to better balance than other matching techniques.[22,23] In our testing, we also determined that a carefully selected PSM would yield strong diagnostic values. With these considerations and a series of model testing, we decided to proceed with PSM.

Propensity scores are defined as the probability of receiving treatment, conditional on a set of characteristics and is estimated using a logistic model. For the evaluation of the CEC Model, the key characteristics of interest in the logistic model are defined at the facility and market levels. Using the coefficients from the logistic regression model, the propensity score for each facility was then constructed as the log odds of the predicted probability of participating in CEC. Each CEC participant facility was matched to a single facility in the comparison group that was the closest in terms of propensity score and not yet matched to another CEC participant facility.

Pooled vs. Stratified Models. An important determinant of the success of propensity score modeling are the sizes of the treatment and control pools that enter the model. Stratifying models by organization yielded smaller treatment and control pools and generated weaker overall matches. However, given different practice patterns and cultures across organizations, using organization/organization type as a matching variable was necessary. This resulted in the construction of a pooled dataset for matching models that combined facilities across organization type and ownership (i.e., DaVita, Fresenius, and DCI).[24]

PY2 introduced two additional cohorts of dialysis facilities joining the model through ESCOs. The initial cohort of participants (Wave 1.1) was augmented by a large group of dialysis facilities starting in January 2017. Wave 1.2 added facilities to existing ESCOs, while Wave 2.1 introduced a new group of ESCOs, and therefore dialysis facilities, to the model. In order to provide a sufficient number of CEC facilities for matching, these cohorts were pooled into one matching model. This model ignores unique selection bias apparent in each cohort but provides a more straightforward approach to estimating the overall impact of CEC.

[21] Gu, X. S., & Rosenbaum, P. R. (1993). Comparison of multivariate matching methods: Structures, distances, and algorithms. *Journal of Computational and Graphical Statistics*, 2(4), 405-420

[22] Gu, X. S., & Rosenbaum, P. R. (1993). Comparison of multivariate matching methods: Structures, distances, and algorithms. *Journal of Computational and Graphical Statistics*, 2(4), 405-420.

[23] Stuart, E. A. (2010). Matching methods for causal inference: A review and a look forward. Statistical science: a review journal of the *Institute of Mathematical Statistics*, 25(1), 1.

[24] Propensity score models stratified by LDO were attempted, but the stratified models were outperformed by the pooled model in terms of balance diagnostics of the comparison group.

Caliper Selection. For distance matching models, calipers can be applied to limit the absolute distance in propensity scores between matches so that if a neighbor is outside of the caliper, it is not considered a good match. There is no consensus regarding a standard caliper and many caliper widths have been used in literature.[25] For propensity score modeling, many studies use a caliper that is proportional to the standard deviation of the predicted propensity score. After the propensity score model estimation, all participants could be matched to a unique neighbor that was closer than 0.75 standard deviations of the average propensity score.

Diagnostic Tests. The final step in selecting the comparison group involved using the results from PSM to conduct a series of diagnostic tests for the matched comparison samples to assess whether facilities were similar on observed covariates to the matched comparison sample. Diagnostics included defining the range of common support for the propensity score and for each covariate, evaluating SMDs for all covariates, and examining covariate distributions in quantile-quantile (QQ) plots. A comparison of the distributions of the propensity scores between the CEC and matched comparison facilities was used to assess whether observations in the matched comparison sample should be discarded. Results of the diagnostic tests between the CEC facilities and comparison group are shown in the next section.

The PSM model we estimated achieved a lower average SMD than average SMD before matching. The selected comparison group had mean values that were more similar to the CEC facilities than the entire group of non-CEC facilities and also had tighter variation of characteristics. The average SMD was considerably smaller after matching, decreasing by 0.16 (see **Exhibit F-8**).

Exhibit F-8. Average SMD Before and After Matching

Average SMD Before Matching	Average SMD After Matching
0.23	0.07

The SMDs for characteristics used in matching are displayed in **Exhibit F-9**. They are generally small, although eight are above 0.10. A standardized difference greater than 0.10 could indicate imbalance in characteristics. However, the absolute mean differences for these characteristics are generally small.[26] For example, the percent of the population over 65 years of age is 13% for both the treatment and matched comparison groups but the SMD is -0.21. Only two characteristics had means that clearly differed between the treatment and comparison group - organizational indicators for DaVita and Fresenius. While these means are slightly different, we observe a strong presence of both organizations in both the treatment and comparison group. These organizational indicators are also included as control variables in the DiD regression model.

[25] Austin, P. C. (2011). An introduction to propensity score methods for reducing the effects of confounding in observational studies. Multivariate behavioral research, 46(3), 399-424.

[26] Austin, P. C. (2009) "Balance diagnostics for comparing the distribution of baseline covariates between treatment groups in propensity-score matched samples." Statistics in medicine 28.25, 3083-3107.

Exhibit F-9. Means and SMD for Variables Included in the Matching Model[27]

	Characteristics	1. CEC Participating Facilities (N=632)		2. Non-CEC Comparison Pool (N=4,019)		3. Std Diff Before Matching	4. Selected Comparison Group Facilities (N=632)		5. Std Diff After Matching
		Mean	Std Dev	Mean	Std Dev		Mean	Std Dev	
Market Characteristics	ESRD Beneficiary Population >350 Indicator	0.96	0.20	0.79	0.40	0.52*	0.94	0.24	0.09
	Percent 65 and Older	0.13	0.02	0.13	0.03	-0.24*	0.13	0.03	-0.21*
	Percent Race White	0.59	0.14	0.63	0.19	-0.20	0.61	0.17	-0.09
	Percent Race Black	0.17	0.10	0.14	0.11	0.29*	0.16	0.11	0.17
	Percent No High School Diploma	0.14	0.04	0.15	0.05	-0.20	0.14	0.04	0.04
	Percent Single Parent Households with Children	0.33	0.05	0.34	0.06	-0.08	0.34	0.06	-0.05
	ESRD Percent	0.00	0.00	0.00	0.00	-0.11	0.00	0.00	0.03
	Percent Duals	0.03	0.01	0.03	0.01	-0.32*	0.03	0.01	-0.08
	Percent ESRD Duals	0.50	0.08	0.52	0.10	-0.14	0.51	0.10	-0.05
	Median Household Income	$56,008	$9,330	$52,283	$10,538	0.37*	$54,967	$12,147	0.10
	Medicare Advantage (MA) Penetration (percent)	0.28	0.14	0.27	0.13	0.05	0.29	0.13	-0.09
	PCPs per 10,000	7.74	1.54	7.61	1.70	0.08	7.69	1.44	0.03
	SNF Beds per 10,000	48.4	18.1	51.2	20.6	-0.14	49.5	19.6	-0.06
	Specialists per 10,000	11.4	4.8	10.1	4.6	0.27*	10.8	4.3	0.12
	Hospitals with Kidney Transplant Services per 10,000	0.01	0.01	0.01	0.01	0.05	0.01	0.01	0.00
	Rural Indicator	0.08	0.28	0.16	0.36	-0.23*	0.11	0.31	-0.10
	Extra-Rural Indicator	0.00	0.06	0.06	0.23	-0.32*	0.00	0.07	-0.03

[27] The post-matching means and SMDs for variables included in the matching model tables (see **Exhibit G-9**) provide information on the variation of characteristics used in the PSM models. The mean and standard deviation (Std Dev) are included to provide a higher degree of comparability between CEC facilities and their selected comparison.

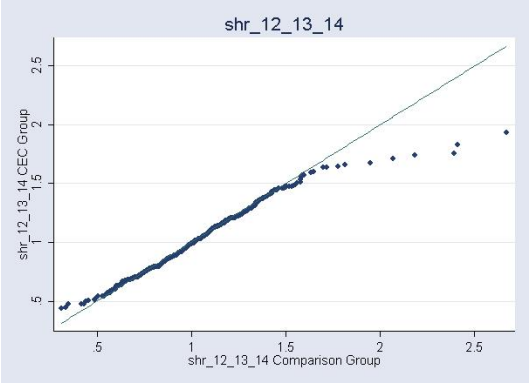
	Characteristics	1. CEC Participating Facilities (N=632)		2. Non-CEC Comparison Pool (N=4,019)		3. Std Diff Before Matching	4. Selected Comparison Group Facilities (N=632)		5. Std Diff After Matching
		Mean	Std Dev	Mean	Std Dev		Mean	Std Dev	
Facility Characteristics	Number of Dialysis Stations	20.4	8.0	18.4	7.7	0.26*	20.1	7.9	0.04
	Late Shift Indicator	0.23	0.42	0.18	0.38	0.13	0.23	0.42	0.00
	Peritoneal Indicator	0.46	0.50	0.60	0.49	-0.28*	0.53	0.50	-0.14
	Percent Hemodialysis	0.96	0.09	0.94	0.09	0.16	0.95	0.08	0.09
	Percent Peritoneal Dialysis	0.06	0.12	0.09	0.12	-0.18	0.08	0.10	-0.10
	Percent Patients with Vascular Catheter	0.10	0.05	0.11	0.07	-0.19	0.11	0.06	-0.16
	Percent Patients with AV Fistula	0.62	0.10	0.63	0.11	-0.14	0.63	0.11	-0.11
	SHR	0.99	0.25	0.99	0.27	0.01	1.01	0.28	-0.06
	SRR	0.96	0.28	0.97	0.30	-0.03	0.97	0.29	-0.04
	SMR	0.95	0.22	1.01	0.28	-0.27*	0.96	0.23	-0.06
	DaVita Indicator	0.15	0.36	0.44	0.50	-0.66*	0.22	0.41	-0.18
	DCI Indicator	0.09	0.29	0.03	0.16	0.29*	0.09	0.28	0.02
	Fresenius Indicator	0.73	0.45	0.21	0.41	1.21*	0.67	0.47	0.12
	Total Medicare Part A and Part B PBPM (2012-2014)	$7,690	$957	$7,733	$1,343	-0.04	$7,637	$1,124	0.05
	Percent Ever Crashed Into Dialysis	0.45	0.12	0.46	0.15	-0.08	0.45	0.14	0.00
	Percent New To Dialysis	0.10	0.06	0.12	0.09	-0.31*	0.10	0.06	-0.08
	Facility CBSA PBPM Ratio	1.00	0.10	1.02	0.15	-0.16	1.00	0.12	0.01

Notes: The standardized difference is calculated by the following equation: Std. Diff = $(\mu 1 - \mu 2)/\sqrt{(\sigma_1^2 + \sigma_2^2)/2}$. Any value below 0.1 is considered to be a negligible difference.
* Indicates a standardized mean difference greater than 0.2 in absolute value.

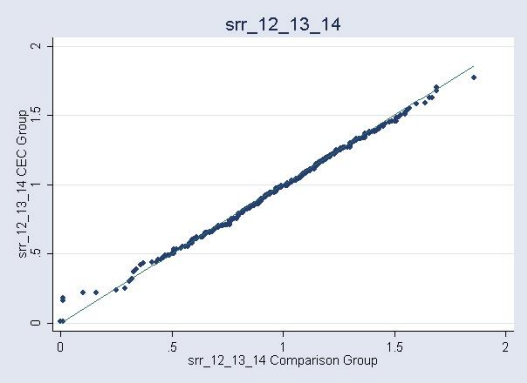
Exhibits F-10 to **F-11** provide additional diagnostic exhibits used to assess the quality of the match between the comparison and CEC treatment groups for each wave. The QQ plot (see **Exhibit F-10**) offers a graphical description that helps determine if two data sets contain similar distribution for a continuous characteristic. Points along the 45-degree diagonal reference line indicate that the two groups follow a similar distribution. If most points on the exhibit are near the diagonal, we consider the distributions to be similar. These plots reveal that for the majority of characteristics the distribution falls near the ideal 45-degree diagonal. However, for a few characteristics, the tails of the distribution stray from the ideal 45-degree line. These cases are infrequent and due to outlier characteristics among facilities.

Exhibit F-10. Quantile-Quantile (QQ) Plots

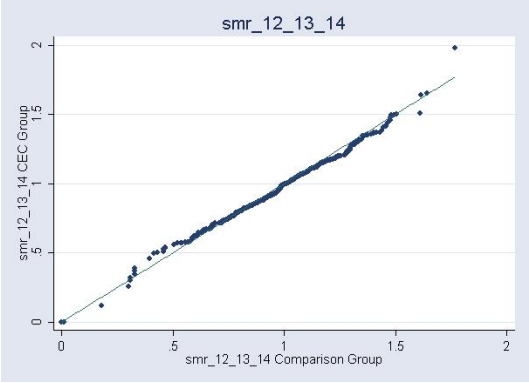
Standardized Hospitalization Ratio



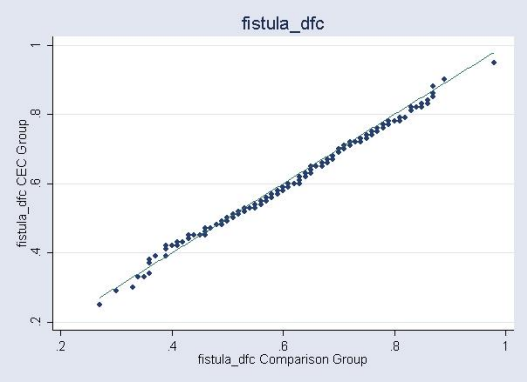
Standardized Readmission Ratio



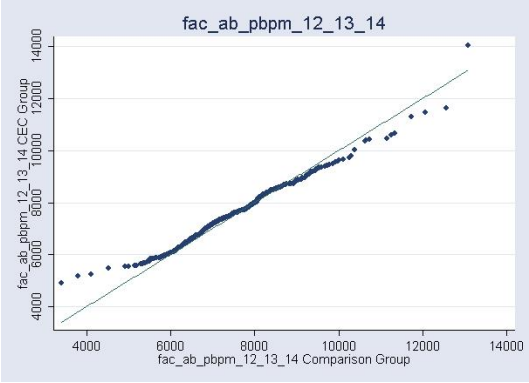
Standardized Mortality Ratio



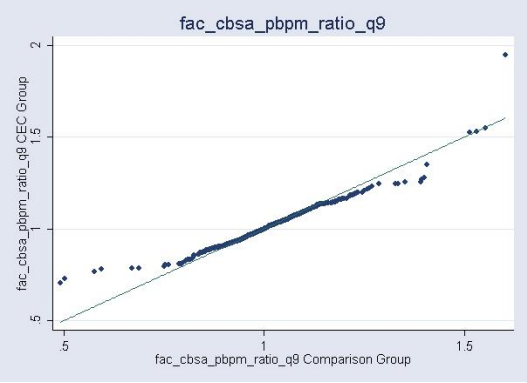
Percent of Patients with Fistula



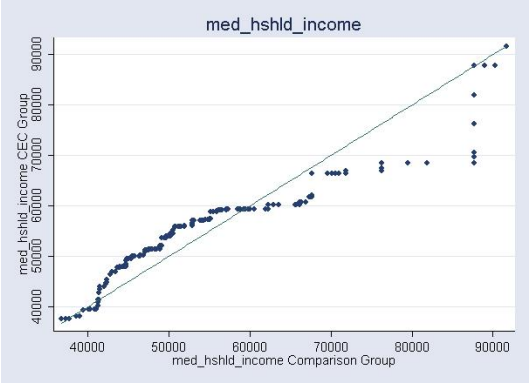
Standardized Facility Total Medicare Part A and Part B PBPM



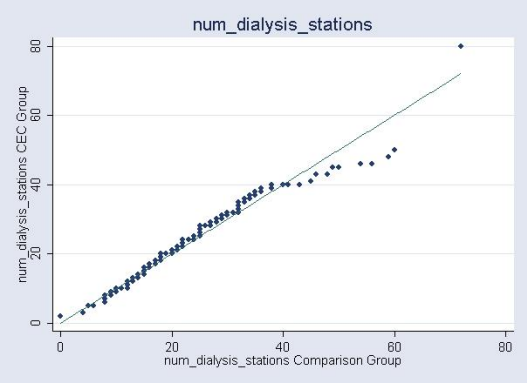
Facility CBSA Total Medicare Part A and Part B PBPM Ratio



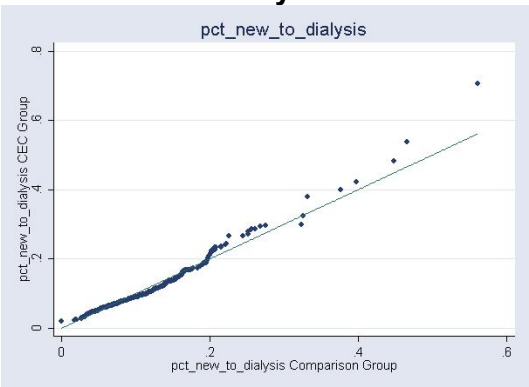
Median Household Income



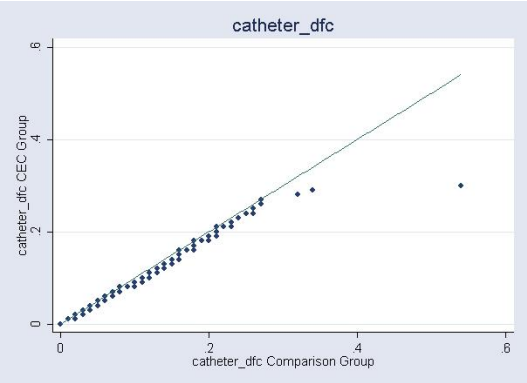
Number of Dialysis Stations



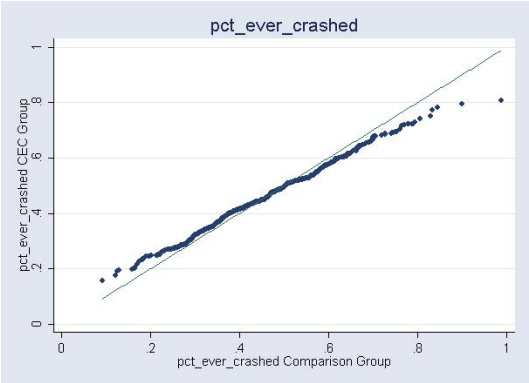
Percent New to Dialysis



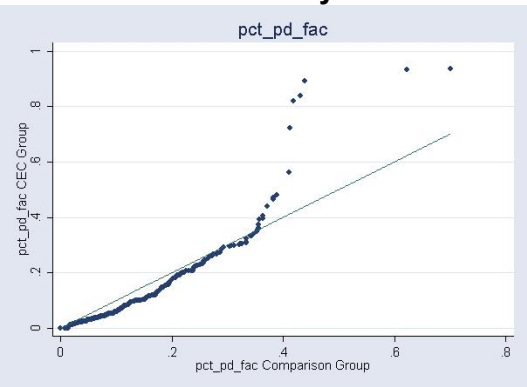
Percent of Patients with Catheter



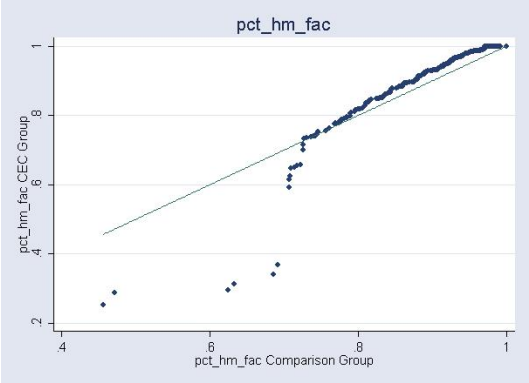
Percent with No Prior ESRD Care



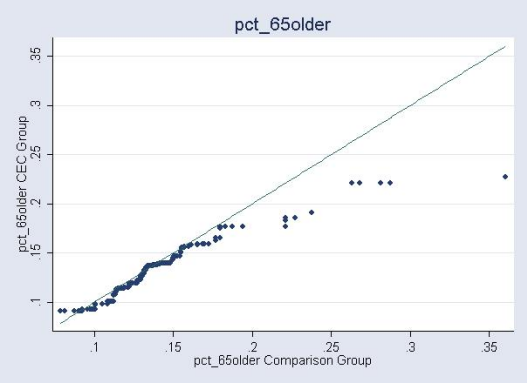
Percent Peritoneal Dialysis



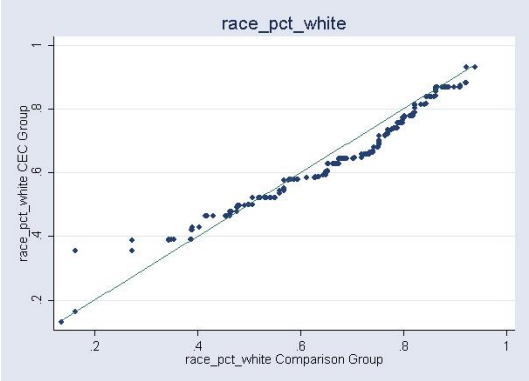
Percent Hemodialysis



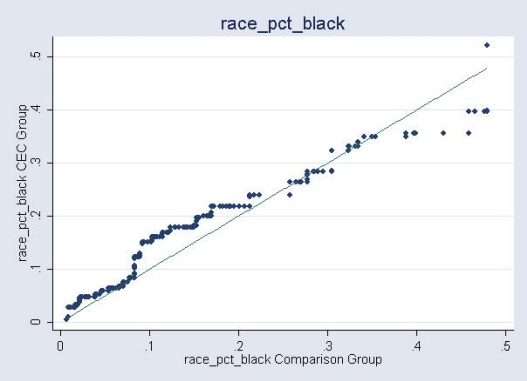
Percent 65 & Older



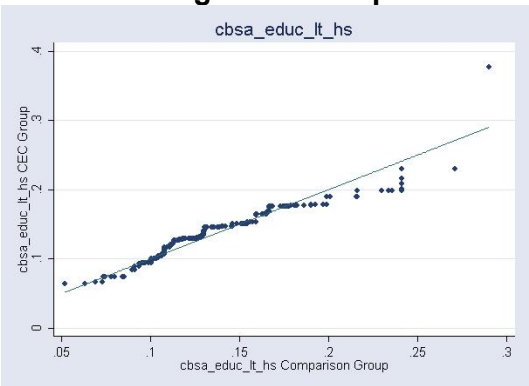
Percent Race White



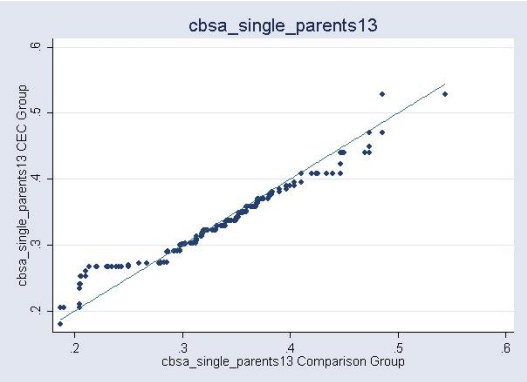
Percent Race Black



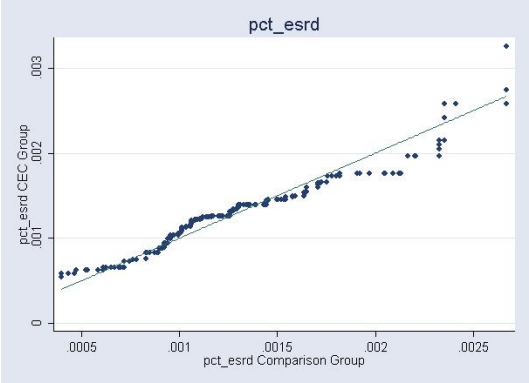
Percent No High School Diploma



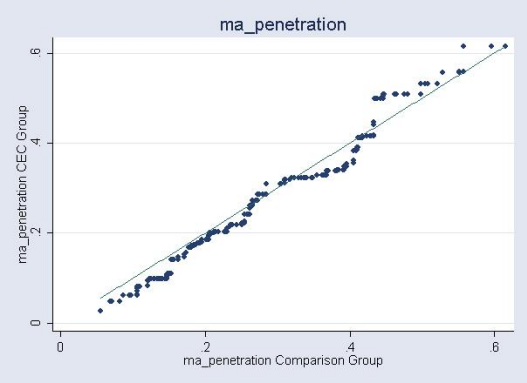
Percent Single Parent Households with Children



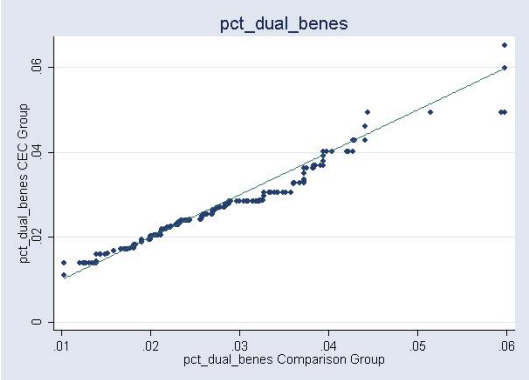
Percent ESRD



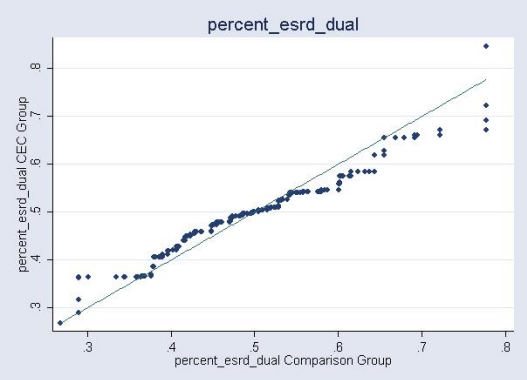
MA Penetration Percent



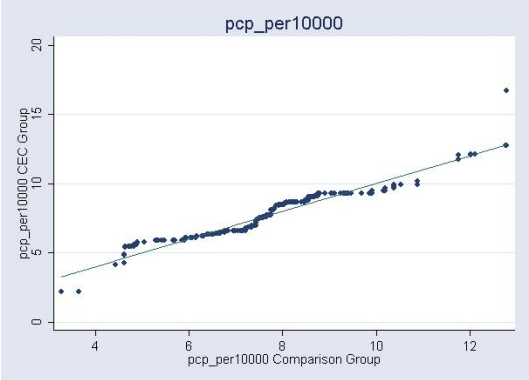
Percent Duals



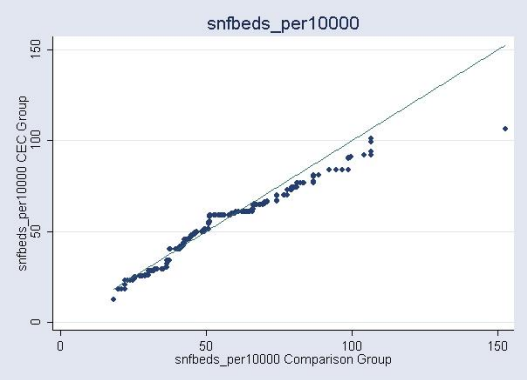
Percent ESRD Duals



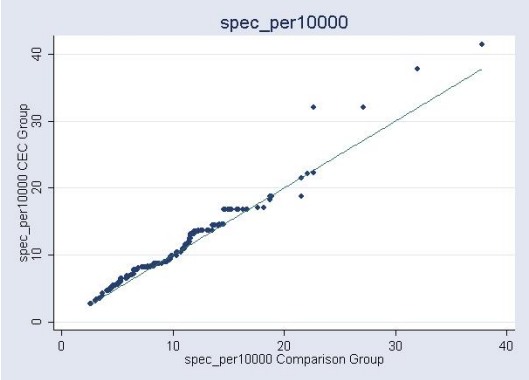
PCPs per 10,000



SNF Beds per 10,000



Specialists per 10,000



Hospitals with Kidney Transplant Services per 10,000

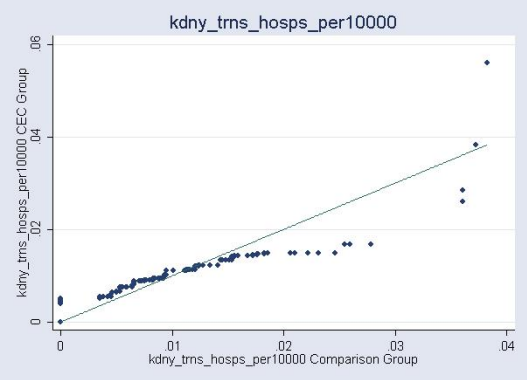
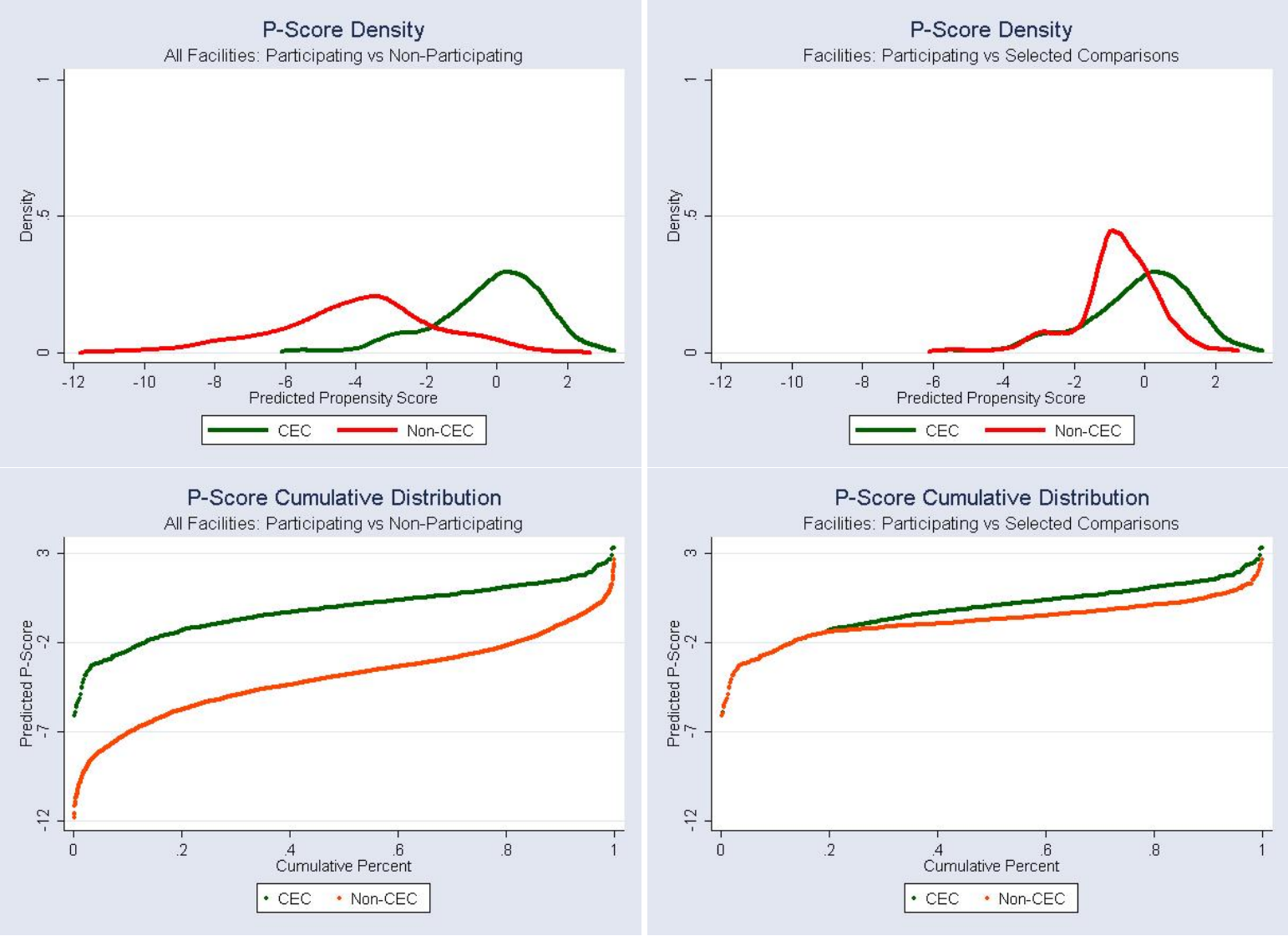


Exhibit F-11 displays the comparison of the propensity score density and distribution before and after matching and shows the overlap of propensity scores in two states, before obtaining one-to-one matches and after matching each CEC facility to a non-CEC facility. From these densities and distributions, we can observe the effect of matching. Prior to matching, distributions of treatment and comparison tend to be normally distributed but with offset peaks. After matching, a good model will have density and distribution that overlap closely with peaks that are closer. These distributions also show that not all of the CEC facilities are on common support before matching. Out of the 632 matched CEC facilities, seven facilities are outside the common support. The maximum predicted propensity score was 3.33 for CEC facilities and 2.64 for non-CEC facilities. Despite these large scores, these facilities were included in the analysis since the maximum difference was less than one half of the propensity score's standard deviation.

Exhibit F-11. Propensity Score Density and Distribution Before and After Matching



4. Comparison Group Changes between the First Annual Report (AR1) and the Second Annual Report (AR2)

The comparison group for the second annual report (AR2) changed from the comparison group used in the first annual report (AR1) in order to accommodate the growth in CEC facilities overtime from 216 in PY1 to 685 in PY2, and 1,066 in PY3. For AR2, we estimated a new PSM for the 685 CEC facilities participating in PY2 and we excluded additional facilities from the comparison pool that were not excluded from the AR1 comparison pool. We considered facilities that started in PY2 when we constructed the comparison group in AR1, but additional restrictions were required to account for facilities that started in PY3. In particular, we excluded 103 additional facilities from the comparison pool in AR2, 27 of them that joined the CEC Model in PY3 and 76 were located in a CBSA where an ESCO from their organization was participating PY3.

C. Beneficiary Alignment and Eligibility

To identify comparison beneficiaries for inclusion in this analysis, we simulated alignment based on the CEC Model rules. We first applied the CEC eligibility criteria (see **Exhibit F-12**) to construct monthly eligibility indicators. This required data from the Common Medicare Environment (CME), the Master Data Management database, and the CCW. We combined the monthly eligibility indicators with bill type 72X dialysis facility claims to align eligible beneficiaries to ESCOs and comparison group facilities using a two-step approach. First, each month starting in January 2012, CEC eligible beneficiaries were aligned to an ESCO if the first touch dialysis service belonged to an ESCO and the beneficiary satisfied the eligibility criteria in that month. The first touch dialysis service is the earliest dialysis service based on the claim thru date on the dialysis facility claims. Beneficiaries were prospectively aligned through December 2017.[28] Beneficiaries could subsequently become unaligned in the second step of the alignment process, reconciliation, if they no longer meet the criteria to be aligned. The first step was repeated every month through December 2017 to align new beneficiaries who had their first touch dialysis after January 2012; each monthly alignment was run among beneficiaries not currently aligned. Beneficiaries not treated at an ESCO facility at any time during the study period (i.e., January 2012 through December 2017) were aligned to a comparison group facility if the first touch provider was in a facility in the matched comparison group. The second step simulated the CEC reconciliation process by which beneficiaries were de-aligned from their ESCO due to death, kidney transplant, the 50% CBSA rule, alignment to another shared savings program (SSP), and/or no longer receiving treatment at an ESCO (see **Exhibit F-13**).[29] We applied annual de-alignments after each CY using claims process through March 31, 2018. Finally, beneficiaries who were de-aligned could be realigned to any ESCO or facility in the comparison group at a later time if they met the eligibility criteria at the time of first touch.

[28] We simulate alignment of beneficiaries prior to the start of the CEC. This provides information on beneficiaries who would have been aligned—based on identical methods—during this earlier period and allows us to assess changes in ESCOs from before and after CEC implementation.

[29] The simulated reconciliation was applied to CYs 2012 through 2017. We apply the simulated reconciliation to these previous years to ensure consistency with the program methods (e.g., remove a beneficiary from alignment if they received less than 50% of their dialysis services in the aligned facility's market in that year).

Exhibit F-12. Monthly Eligibility Criteria

- ***Alive (inclusion criterion).*** If a beneficiary had no death date or a validated death date that was on or after the 1st of the month, the beneficiary met the alive criterion for the month of interest.
- ***Enrolled in Medicare Part A and Part B (inclusion criterion)***. A beneficiary met this criterion if he/she was enrolled in both Medicare Part A and Part B in the month.
- ***Not enrolled in MA (i.e., Health Maintenance Organization [HMO], managed care, or Medicare Part C) (exclusion criterion)***. A beneficiary met this exclusion criterion if he/she was enrolled in a MA plan during the month.
- ***Over age 18 (inclusion criterion).*** A beneficiary met this criterion if he/she was at least 18 years of age prior to the first day of the month.
- ***Kidney transplant (exclusion criterion).*** A beneficiary met this exclusion criterion during the month of a kidney transplant and the 12 months following that month.
- ***Resided in US (inclusion criterion***). A beneficiary met this criterion for the month of interest if he/she did not have a residential Social Security Administration state code—based on the CME address history table—outside of the US at any time in the month.
- ***Not enrolled in a designated SSP (exclusion criterion).*** A beneficiary met this exclusion criterion if he/she was aligned with another SSP in a given month, as noted in the Master Data Management database. The SSP criteria differed for the period prior to CY 2016. For the pre-2016 period, this exclusion encompassed alignment with the Independence at Home (IAH) Demonstration (i.e., program code 01), Pioneer ACO Model (i.e., program code 07), and the Medicare-Medicaid Coordination Office Financial Alignment Initiative (FAI) (i.e., program code 11). For the 2016 and later period, this exclusion encompassed alignment with the IAH Demonstration, Pioneer ACO Model, Medicare SSP (i.e., program code 08) when the beneficiary was categorized as Track 3, FAI, and the NGACO Model (i.e., program code 21). SSP beneficiaries were identified as Track 3 when they were aligned with a Track 3 SSP ACO.
- ***Medicare as a secondary payer (exclusion criterion).*** A beneficiary met this exclusion criterion if he/she had Medicare as a secondary payer at any time during the month.

Exhibit F-13. Reasons for De-alignment

- ***Death.*** An aligned beneficiary who died in the CY was de-aligned at the end of the CY (i.e., alignment ended on December 31 of the CY). For example, a beneficiary who was aligned in January 2012 and died in October 2012, would have an alignment start date of January 1, 2012 and an alignment end date of December 31, 2012. However, this beneficiary will be aligned and CEC eligible from January 2012 through October 2012.
- ***First touch.*** A first touch is a dialysis facility claim at an ESCO facility, where the beneficiary was CEC eligible in the month of the claim thru date. For each beneficiary CY, we evaluated if the beneficiary had a first touch at a facility that belonged to the ESCO to which they were aligned. If the beneficiary did not have a first touch in the CY at a facility that belonged to the ESCO, then the beneficiary was de-aligned from the CY. We applied the rule similarly to the comparison group based solely on the aligned facility (i.e., no comparison group ESCOs).
- ***Kidney transplant.*** An aligned beneficiary who had a kidney transplant in the CY was de-aligned at the end of the CY (i.e., alignment ended on December 31 of the CY). For example, a beneficiary who was aligned in January 2012 and had a kidney transplant in October 2012 would have an alignment start date of January 1, 2012 and an alignment end date of December 31, 2012.
- ***SSP.*** If a beneficiary was aligned to a Medicare SSP that can take beneficiaries from CEC (i.e., only IAH) following the start of the CEC alignment, then the beneficiary was de-aligned from CEC for the CY.
- ***Dialysis in provider market (CBSA Rule).*** If a beneficiary had at least one dialysis service in a CY and less than 50% of dialysis services in the CY were from the market of the ESCO, then the beneficiary was de-aligned from the CY. The percentage of dialysis services per CY that occurred in the ESCO's market was computed based on (1) the total number of dialysis services with claim thru date in that CY after alignment started (i.e., denominator) and (2) the total number of dialysis services after alignment started that were provided in the ESCO market (i.e., numerator); that is, the dialysis service occurred in a CBSA that belonged to the ESCO's market, or if not in a CBSA (i.e., rural), the county belonged to the ESCO's market. We applied the rule similarly to the comparison group based on the aligned facility (i.e., no ESCO market).

D. CEC and Comparison Group Populations

Exhibit F-14 compares patient characteristics for aligned and CEC eligible beneficiaries from ESCOs and matched comparison facilities for the first month the beneficiary is aligned. There are more beneficiaries aligned and eligible in the CEC group than in the comparison group, but in general, characteristics differ only slightly between the two groups.

On average, CEC and comparison beneficiaries are very similar. They differ only on a few characteristics. The percent of White beneficiaries is four percentage points lower for CEC and the percent of Black beneficiaries is four percentage points higher. The average facility beneficiary count is about twelve beneficiaries higher for CEC facilities. We also see differences in the large dialysis organizations (LDOs) to which beneficiaries are aligned. About 72% of CEC beneficiaries are aligned to Fresenius facilities and 15% are aligned to DaVita facilities. For comparison beneficiaries, 65% are aligned to Fresenius facilities and 24% to DaVita facilities. These organizational indicators are also included as control variables in the DiD regression model.

Exhibit F-14. CEC and Comparison Population Average Characteristics

Characteristics		Wave 1 CEC (Mean) N=35,801	Wave 2 CEC (Mean) N=37,293	Comparison (Mean) N=60,464
Beneficiary Characteristics	Age	63.4	62.8	63.7
	Female	43%	44%	44%
	BMI (kg/m^2)	29.6	30.1	29.8
	White	43%	46%	49%
	Black	41%	42%	38%
	Other	16%	12%	14%
	Aged into Medicare	35%	33%	35%
	Disabled into Medicare	22%	22%	22%
	ESRD into Medicare	23%	25%	23%
	Disabled & ESRD into Medicare	20%	20%	20%
	Full Dual Eligibility	38%	33%	35%
	Partial Dual Eligibility	8%	10%	10%
	ESRD Cause: Diabetes	43%	43%	44%
	ESRD Cause: Hypertension	33%	31%	31%
	ESRD Cause: Other	22%	24%	23%
	ESRD Cause: Unknown	2%	2%	2%
	Months on Dialysis	45.0	45.2	43.4
	Hemodialysis	93%	92%	92%
	Peritoneal Dialysis	7%	8%	8%
	Both Hemodialysis/Peritoneal Dialysis	1%	1%	1%
	Other Dialysis	1%	0%	1%
Facility Characteristics	Beneficiary Count	121	131	114
	Late Shift Indicator	23%	39%	29%
	For Profit Indicator	90%	87%	91%
	CDC	0%	4%	0%
	DaVita	30%	0%	24%
	DCI	8%	8%	8%
	Fresenius	61%	82%	66%
	Atlantic	0%	2%	0%
	NKC	0%	4%	0%
	Other	0%	0%	2%
	Rogosin	2%	0%	0%
Market Characteristics	Median Household Income	$60,032	$59,680	$58,851
	MA Penetration	29.9	32.0	31.4
	Dual Per 10,000	296.5	290.5	307.8
	PCPs Per 10,000	7.9	7.8	7.9

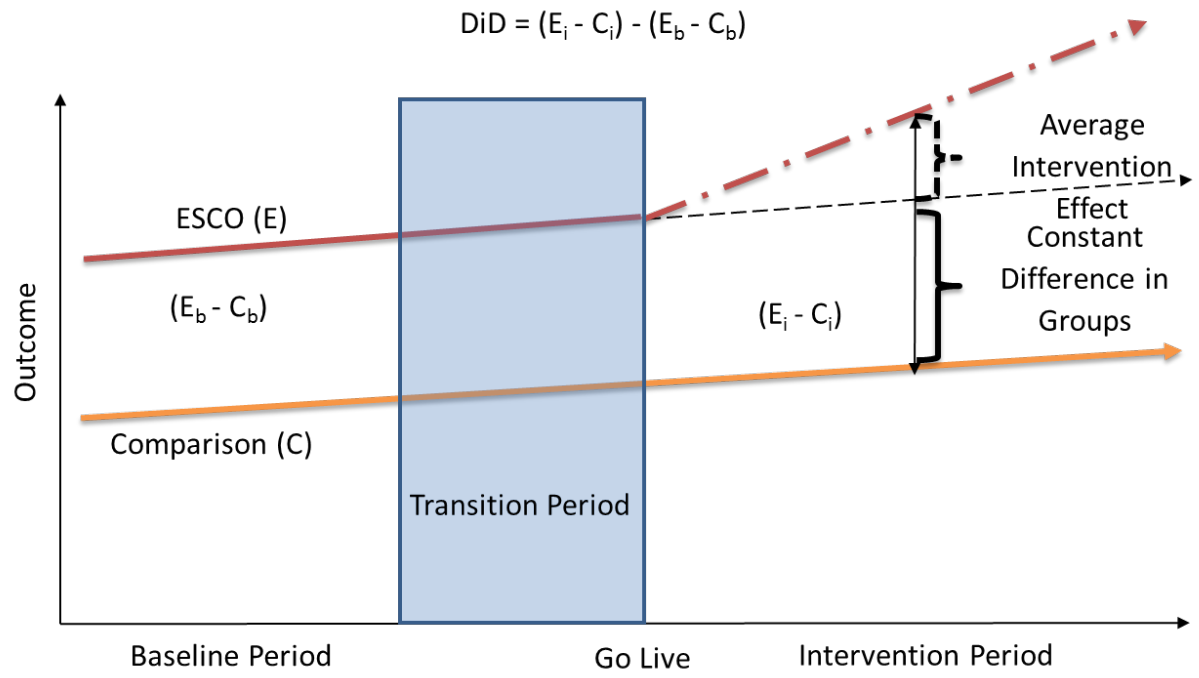
Notes: Additional controls such as seasonal, region, and CBSA costs decile indicators are not presented in this table.

E. DiD Regression Model and Estimated CEC Impacts

The DiD approach quantifies the impact of the CEC Model by comparing changes in outcomes for the CEC population before and after CEC with changes in outcomes for the comparison population before and after CEC. This approach eliminates biases from time invariant differences between the

CEC and comparison populations, and controls for common trends in both groups. The DiD method applied to our outcomes of interest is presented visually in **Exhibit F-15**.

Exhibit F-15. DiD Method Illustration



The DiD model uses data over time from patients with ESRD aligned to facilities in the comparison group to obtain an appropriate counterfactual of what would happen to patients with ESRD at ESCO facilities if their aligned facility was not participating in CEC. To estimate a casual effect of the CEC Model, the DiD contrasts changes in outcomes among CEC beneficiaries against this counterfactual. As seen in the exhibit, the DiD model first evaluates the difference between the ESCO (E) and comparison (C) groups over the pre-CEC period (E_b-C_b), depicted by the red and orange lines, for each outcome of interest. The DiD model assumes that if the CEC Model did not exist the two groups would continue to follow the same parallel trends during the post-CEC period (shown by the black dotted (E) and orange line (C), respectively). Therefore, any observed difference in outcomes between the pre-CEC period (E_b-C_b) and post-CEC period (E_i-C_i) is driven by the CEC Model. Thus, the resulting DiD estimate of the average intervention effect is (E_i-C_i) - (E_b-C_b).

Waves, Pre-CEC, Transition, and Post-CEC Periods. PY2 of the CEC evaluation introduced additional ESCOs and facilities participating in the CEC Model. To identify the overall impact of the CEC Model and the impact for each wave, we estimated two separate DiD models - one which includes a single intervention group to estimate the cumulative impact of the CEC Model for all 37 ESCOs and one which includes separate indicators for each wave and performance year to identify wave specific intervention effects for the original 13 ESCOs (Wave 1) in performance year one (PY1) and performance year two (PY2), and the additional 24 ESCOs (Wave 2) in PY2.

The two waves of ESCOs comprise participating facilities with varying start dates. Wave 1 ESCOs include facilities that started participating in PY1 and new participating facilities that

were added in PY2. Wave 2 ESCOs include only facilities that started participating in new ESCOs in PY2. Participating facilities are designated pre-CEC, transition, and post-CEC periods depending on their start date. **Exhibit F-16** describes the periods of analysis for all groups. Specifically, Q1 2014 represent the first calendar quarter of the baseline period, i.e., January 2014 for all participating facilities. The baseline period ends in March 2015 for participating facilities starting in PY1 and in June 2016 for participating facilities starting in PY2. For participating facilities starting in PY1, the transition period takes into consideration the delayed start of the CEC Model, which was originally scheduled for April 2015. The transition period for participating facilities starting in PY2 includes months from the application deadline (July 2016) to the start of PY2. The transition periods are represented by the two yellow quarters for each group. The transition period for participating facilities starting in PY1 is April 2015 through September 2015, and the transition period for participating facilities starting in PY2 is July 2016 through December 2016. Finally, the area shaded in orange represents the intervention period for each group.

Exhibit F-16. Waves, Pre-CEC, Transition, and Post-CEC Periods

Facility Group								Performance Year 1					Performance Year 2			
Wave 1, PY1 starters	Pre-CEC					Transition		Post-CEC								
Wave 1, PY2 starters	Pre-CEC										Transition		Post-CEC			
Wave 2, PY2 starters	Pre-CEC										Transition		Post-CEC			
Matched Comparison Group	Pre-CEC															
	Q1 2014	Q2 2014	Q3 2014	Q4 2014	Q1 2015	Q2 2015	Q3 2015	Q4 2015	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017

Model Specification. Our generalized DiD estimates the impact of the CEC Model for all ESCOs allowing for different start times for each participating facility. To illustrate the DiD regression framework, consider the linear model shown below:[30]

$$Y_{ijt} = b_0 + b_1\, Quarter_{it} + b_2\, ESCO_{ij} + b_3\, ESCO\_Post_{ijt} + \lambda' X_{ijt} + e_{ijt} \qquad (1)$$

where subscripts *i*, *j*, and *t* denote individuals, facilities, and time, respectively. *Quarter* (0,1) is a vector of calendar quarter dummies that captures aggregate factors that could cause changes in outcome *Y* over time that are common across CEC and comparison beneficiaries. *ESCO* (0,1) is a time-invariant treatment group identifier which identifies the group of CEC eligible beneficiaries aligned at an ESCO in a given month.[31] *ESCO_Post* (0,1) is indexed to *i*, *j*, and *t*, takes the value of 0 for beneficiaries in the pre-CEC and transition period and switches to =1 for CEC beneficiaries when their aligned facility starts participating. *ESCO_Post* is always 0 for the

[30] Two-part models were implemented for standardized Medicare allowed charge outcomes when a large share of the sample experienced zero charges. The DiD result, obtained from the two-part models, estimated the unconditional marginal impact of the CEC Model and standard errors are adjusted for the multiple stages of estimation.

[31] Rather than using the list of aligned beneficiaries produced by the implementation contractor, we simulate alignment using the program rules described above. This allows us to align beneficiaries during the pre-CEC period and apply the same methods for CEC and comparison beneficiaries.

comparison group. Thus, b_3 is the primary coefficient of interest and predicts the average cumulative (PY1 + PY2) effect of the CEC Model effect across all ESCOs.[32]

Next, we illustrate the DiD regression framework used to estimate the CEC Model effects for each ESCO wave and PY.

$$Y_{ijt} = b_0 + b_1 Quarter_{it} + b_2 ESCO_{ij} + b_3 ESCO\_Post\_PY1\_W1_{ijt} + b_4 ESCO\_Post\_PY2\_W1_{ijt} + b_5 ESCO\_Post\_PY2\_W2_{ijt} + \lambda' X_{ijt} + e_{ijt} \quad (2)$$

Equation (2) is identical to equation (1) except now the post-treatment indicators, represented by *ESCO_Post_PY1_W1, ESCO_Post_PY2_W1,* and *ESCO_Post_PY2_W2,* separate CEC beneficiaries by wave and by PY.

The DiD designs control for time-varying changes that are common to all beneficiaries and that occur during the implementation of the CEC Model, as well as time-invariant unmeasured differences between beneficiaries not otherwise captured by the model. **Exhibit F-17** details the variables we specified in the DiD models to control for time-invariant and time-varying differences in patients, markets, and facilities that are outside the control of ESCOs. Market and facility variables are representative of the facility to which the beneficiary was assigned based on first-touch assignment. The regression model includes only beneficiary health conditions that are not likely to be affected by the CEC Model (i.e., cancer, reason for ESRD) since their inclusion would bias estimates of the impact the CEC Model had on ESRD care. Furthermore, we estimated stratified DiD models similar to the specification described by equation (1), but observations were restricted to our stratified samples of interest. Specifically, we investigated the extent to which the CEC Model had a differential impact on subgroups of Medicare beneficiaries with ESRD varying in their demographic characteristics and their time in dialysis.

Exhibit F-17. Control Variables Included in the DiD Model

Beneficiary Level	Facility Level	Market Level
OREC: Age, Disabled, ESRD, ESRD and Disabled Reason for ESRD: Hypertension, diabetes, or other Female Age BMI at ESRD incidence Months on dialysis Cancer indicator (annual) Type of dialysis indicator: Hemodialysis, peritoneal dialysis, other (monthly) Race indicators: White, Black, Other Medicaid status indicators: None, full, or partial (monthly)	LDO Facilities indicators: Fresenius, DCI, and DaVita Small Dialysis Facility (SDO/ non-LDO) indicator Facility beneficiary count (annual) Profit: for profit, not for profit Late shift indicator (facility offers dialysis after 5PM) Rural Urban indicators (Metro, Urban, Rural)	CBSA median household income (annual) CBSA Dual enrollees (Medicaid & Medicare) per 100,000 population in CBSA (annual) CBSA MA penetration (annual) CBSA geographic rate of PCPs per 10,000 population (annual) Region indicators Percent of ACO Beneficiaries in a Market

[32] The DiD regression frameworks also include an indicator that identifies the treatment transition period observations. This indicator controls the transition period effect on outcomes and effectively exclude this time period from the DiD estimate. For brevity the indicator was omitted from the equations.

Computation of Standard Errors. In general, estimated standard errors of the DiD estimate are calculated using two-way clusters at beneficiary and service facility levels.[33,34] Two-way clusters account for intra-cluster correlation among beneficiaries receiving services from the same facility (service facility cluster) and correlation across observations from the same beneficiary across time (beneficiary cluster).

Parallel Trends Tests. A pivotal assumption of the DiD model is that the ESCO and comparison groups have the same trend in outcomes prior to the intervention (see **Exhibit F-15** for the illustration of the parallel trends assumption during the pre-CEC period). Formally, the parallel trend tests involved assessing the significance of the coefficient corresponding to the time and treatment dummy interaction term at $p \leq 0.10$, using data prior to the start of the CEC Model. If the outcome trends between treatment and comparison group are the same prior to the start of the CEC Model, then the interaction coefficient should be near zero and insignificant, i.e., the difference in trends is not significantly different between the two groups in the pre-CEC period. Similar to equation (1) and (2), the parallel trend test for each DiD estimate includes a full set of patient, facility, and market risk adjusters that are included in the DiD specification. We test trends over the common period where all treatment and matched comparison groups are within the baseline period (i.e., the first four quarters of data January 2014 through December 2014).[35] We conducted parallel trend tests for every outcome and every group of CEC facilities evaluated in this report (i.e., All ESCOs, Wave 1 ESCOs, and Wave 2 ESCOs). DiD estimates that failed parallel trend test are identified in **Exhibits F-18** through **F-30** with the symbol ‡. Parallel trend tests failed for 33 of the 414 DiD estimates presented in this report. Notably, catheter use failed parallel trend testing for CEC facilities in the All ESCOs and Wave 1 groups. Given that catheter use is a key quality measure, additional testing was done to ensure the interpretability of the DiD results. Specifically, since catheter did not pass statistical testing of the parallel trends assumption, we also visually inspected the trend graph which compared trends between the treatment (CEC) and comparison group and observed no obvious differences. Additionally, the coefficient on the difference in trends at baseline, although significant, equals 0.00046.

[33] Cameron, A., & Gelbach, J. D. Miller, 2011, "Robust Inference with Multiway Clustering." *Journal of Business & Economic Statistics*, 29(2).

[34] Two-part expenditure models apply one-way cluster methods. Standard errors for these models are clustered by service facility.

[35] Trend tests for the overall all ESCO DiD result compare trends of the pooled treatment and comparison groups, whereas, trend test for the wave specific DiD estimate compare each wave specific treatment group (Wave 1 and Wave 2) relative to the trends of the pooled comparison group.

Exhibit F-18. Impact of the CEC Model on Dialysis Care, All ESCOs

Measures		Performance Year (PY)	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Dialysis Care	Fistula Use (percent of beneficiaries in a given month who had a fistula and had at least 90 days of dialysis)	PY1 & PY2	64.6%	64.5%	64.2%	64.8%	-0.64	-1.5	0.19	-0.99%
		PY1	64.6%	63.6%	64.3%	64.8%	-1.5**	-2.7	-0.29	-2.3%
		PY2	64.6%	65.1%	64.3%	64.5%	0.28	-0.39	0.96	0.44%
	Catheter Use (percent of beneficiaries in a given month who had a catheter for 90 days or longer)	PY1 & PY2	9.3%	9.4%	11.4%	12.2%	-0.78***‡	-1.3	-0.28	-8.3%
		PY1	9.4%	9.1%	11.4%	12.1%	-1.0**‡	-1.7	-0.33	-10.7%
		PY2	9.4%	9.7%	11.4%	12.2%	-0.50*‡	-1.0	-0.04	-5.4%
	Hemodialysis (percent with at least one)	PY1 & PY2	92.1%	91.2%	91.5%	90.3%	0.42	-0.52	1.4	0.45%
		PY1	92.1%	92.0%	91.5%	90.6%	0.78	-0.64	2.2	0.85%
		PY2	92.1%	90.6%	91.5%	90.1%	-0.04	-0.64	0.57	-0.04%
	Peritoneal Dialysis (percent with at least one)	PY1 & PY2	6.4%	6.6%	6.9%	7.4%	-0.28	-1.3	0.69	-4.4%
		PY1	6.4%	6.2%	6.9%	7.4%	-0.60	-2.1	0.87	-9.4%
		PY2	6.4%	7.0%	6.9%	7.4%	0.09	-0.50	0.68	1.4%
	Home Hemodialysis (percent with at least one)	PY1 & PY2	1.5%	1.7%	1.4%	1.4%	0.25	-0.17	0.68	17.0%
		PY1	1.5%	1.8%	1.4%	1.4%	0.38	-0.25	1.0	26.0%
		PY2	1.5%	1.5%	1.4%	1.4%	0.11	-0.18	0.41	7.6%
	Home Dialysis (percent with at least one)	PY1 & PY2	8.1%	8.3%	8.1%	8.0%	0.24	-0.15	0.63	2.9%
		PY1	8.1%	8.4%	8.0%	8.0%	0.36	-0.22	0.95	4.5%
		PY2	8.1%	8.1%	8.0%	8.0%	0.11	-0.16	0.37	1.3%
	Emergency Dialysis (percent with at least one)	PY1 & PY2	1.8%	1.8%	1.9%	2.0%	-0.01	-0.14	0.11	-0.71%
		PY1	1.8%	2.0%	1.9%	2.0%	0.10	-0.09	0.28	5.5%
		PY2	1.8%	1.8%	1.9%	2.1%	-0.16**	-0.27	-0.06	-9.3%

Measures		Performance Year (PY)	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Dialysis Care (cont'd)	Gap in Dialysis (percent)	PY1 & PY2	8.7%	8.5%	9.2%	9.2%	-0.20‡	-0.52	0.12	-2.3%
		PY1	8.7%	7.9%	9.2%	8.6%	-0.19‡	-0.63	0.25	-2.2%
		PY2	8.7%	9.1%	9.2%	9.7%	-0.20‡	-0.54	0.14	-2.3%
	Number of Outpatient Dialysis Sessions per 1,000 Beneficiaries per Month	PY1 & PY2	12,254	12,319	12,263	12,257	71.3***	34.4	108.2	0.58%
		PY1	12,253	12,339	12,262	12,266	76.1**	38.3	126.0	0.62%
		PY2	12,253	12,269	12,262	12,214	62.9***	33.2	92.5	0.51%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. A weighted average of the wave performance years may not exactly equal the All ESCO result because the All ESCO and wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-19. Impact of the CEC Model on Dialysis Care, Wave 1

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Dialysis Care	Fistula Use (percent of beneficiaries in a given month who had a fistula and had at least 90 days of dialysis)	PY1 & PY2	64.6%	64.2%	64.3%	64.7%	-0.78	-1.8	0.23	-1.2%
		PY1	64.6%	63.6%	64.3%	64.8%	-1.5**	-2.7	-0.29	-2.3%
		PY2	64.6%	64.7%	64.3%	64.5%	-0.08	-1.1	0.91	-0.12%
	Catheter Use (percent of beneficiaries in a given month who had a catheter for 90 days or longer)	PY1 & PY2	9.4%	9.2%	11.4%	12.2%	-0.93***‡	-1.5	-0.34	-9.9%
		PY1	9.4%	9.1%	11.4%	12.1%	-1.0**‡	-1.7	-0.33	-10.7%
		PY2	9.4%	9.3%	11.4%	12.2%	-0.87**‡	-1.5	-0.23	-9.2%
	Hemodialysis (percent with at least one)	PY1 & PY2	92.1%	91.5%	91.5%	90.4%	0.54	-0.68	1.8	0.59%
		PY1	92.1%	92.0%	91.5%	90.6%	0.78	-0.64	2.2	0.85%
		PY2	92.1%	90.9%	91.5%	90.1%	0.30	-0.84	1.4	0.33%
	Peritoneal Dialysis (percent with at least one)	PY1 & PY2	6.4%	6.5%	6.9%	7.4%	-0.34	-1.6	0.92	-5.3%
		PY1	6.4%	6.2%	6.9%	7.4%	-0.60	-2.1	0.87	-9.4%
		PY2	6.4%	6.8%	6.9%	7.4%	-0.08	-1.2	1.1	-1.3%
	Home Hemodialysis (percent with at least one)	PY1 & PY2	1.5%	1.8%	1.4%	1.4%	0.36	-0.19	0.90	24.2%
		PY1	1.5%	1.8%	1.4%	1.4%	0.38	-0.25	1.0	26.0%
		PY2	1.5%	1.8%	1.4%	1.4%	0.33	-0.22	0.88	22.4%
	Home Dialysis (percent with at least one)	PY1 & PY2	8.1%	8.4%	8.0%	8.0%	0.34	-0.16	0.85	4.3%
		PY1	8.1%	8.4%	8.0%	8.0%	0.36	-0.22	0.95	4.5%
		PY2	8.1%	8.3%	8.0%	8.0%	0.33	-0.18	0.83	4.0%

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Dialysis Care (cont'd)	Emergency Dialysis (percent with at least one)	PY1 & PY2	1.8%	1.9%	1.9%	2.1%	0.02	-0.13	0.17	1.0%
		PY1	1.8%	2.0%	1.9%	2.0%	0.10	-0.09	0.28	5.5%
		PY2	1.8%	1.9%	1.9%	2.1%	-0.06	-0.21	0.09	-3.4%
	Gap in Dialysis (percent)	PY1 & PY2	8.7%	8.4%	9.2%	9.1%	-0.27‡	-0.65	0.11	-3.1%
		PY1	8.7%	7.9%	9.2%	8.6%	-0.19‡	-0.63	0.25	-2.2%
		PY2	8.7%	8.9%	9.2%	9.7%	-0.35‡	-0.78	0.09	-4.0%
	Number of Outpatient Dialysis Sessions per 1,000 Beneficiaries per Month	PY1 & PY2	12,253	12,339	12,262	12,266	82.1***	38.3	126.0	0.67%
		PY1	12,253	12,374	12,262	12,306	76.1**	22.6	129.7	0.62%
		PY2	12,253	12,294	12,262	12,214	88.0***	46.2	129.8	0.72%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-20. Impact of the CEC Model on Dialysis Care, Wave 2

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Dialysis Care	Fistula Use (percent of beneficiaries in a given month who had a fistula and had at least 90 days of dialysis)	PY2	64.7%	65.5%	64.4%	64.5%	0.64	-0.16	1.44	0.99%
	Catheter Use (percent of beneficiaries in a given month who had a catheter for 90 days or longer)	PY2	9.6%	10.0%	11.6%	12.2%	-0.15	-0.66	0.37	-1.5%
	Hemodialysis (percent with at least one)	PY2	91.8%	90.3%	91.2%	90.1%	-0.36	-1.2	0.42	-0.40%
	Peritoneal Dialysis (percent with at least one)	PY2	6.5%	7.1%	7.1%	7.4%	0.26	-0.50	1.0	4.0%
	Home Hemodialysis (percent with at least one)	PY2	1.5%	1.3%	1.4%	1.4%	-0.10	-0.42	0.22	-7.1%
	Home Dialysis (percent with at least one)	PY2	8.1%	7.9%	8.0%	8.0%	-0.11	-0.40	0.18	-1.3%
	Emergency Dialysis (percent with at least one)	PY2	1.8%	1.7%	2.0%	2.1%	-0.27***	-0.39	-0.14	-14.7%
	Gap in Dialysis (percent)	PY2	8.5%	9.2%	9.0%	9.7%	-0.06‡	-0.46	0.35	-0.68%
	Number of Outpatient Dialysis Sessions per 1,000 Beneficiaries per Month	PY2	12,264	12,244	12,273	12,214	37.8*	2.1	73.5	0.31%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-21. Impact of the CEC Model on Coordination of Care beyond Dialysis, All ESCOs

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Coordination of Care beyond Dialysis	Percent of Diabetic Beneficiaries Receiving at Least One Dilated Eye Exam in a Given Year	PY1 & PY2	40.0%	41.6%	40.7%	41.0%	1.4**	0.38	2.4	3.5%
		PY1	40.0%	41.8%	40.6%	41.6%	0.81	-0.59	2.2	2.0%
		PY2	40.0%	41.8%	40.6%	41.1%	1.3**	0.27	2.4	3.3%
	Percent of Beneficiaries Receiving at Least One LDL Cholesterol Test in a Given Year	PY1 & PY2	55.2%	57.9%	56.0%	50.1%	8.5***	6.5	10.5	15.4%
		PY1	55.0%	62.1%	55.2%	51.6%	10.6***	7.7	13.5	19.3%
		PY2	55.0%	56.1%	55.2%	51.4%	4.9***	3.3	6.6	8.9%
	Percent of Beneficiaries Receiving at Least One HbA1c Test in a Given Year	PY1 & PY2	75.8%	76.3%	77.5%	74.0%	4.0***	2.6	5.5	5.3%
		PY1	75.7%	75.9%	77.4%	73.3%	4.3***	2.1	6.4	5.6%
		PY2	75.7%	76.1%	77.4%	74.3%	3.5***	2.4	4.7	4.6%
	Number of E&M Office Visits per 1,000 Beneficiaries per Month	PY1 & PY2	2,471.8	2,446.7	2,432.9	2,464.2	-56.5**	-102.4	-10.6	-2.3%
		PY1	2,473.2	2,439.3	2,432.2	2,463.9	-34.9	-122.0	-9.2	-1.4%
		PY2	2,473.3	2,444.1	2,432.2	2,480.3	-77.3***	-120.6	-34.0	-3.1%
	Percent of Beneficiaries Receiving Hospice Services in a Given Month	PY1 & PY2	0.88%	0.78%	0.86%	0.75%	0.01	-0.05	0.07	1.1%
		PY1	0.88%	0.81%	0.86%	0.78%	0.01	-0.07	0.08	0.65%
		PY2	0.88%	0.74%	0.86%	0.70%	0.02	-0.06	0.10	2.3%
	Percent of Beneficiaries with Greater than 50 mg Average MME in a Given Month	PY1 & PY2	6.0%	5.4%	6.0%	5.8%	-0.38*	-0.73	-0.04	-6.4%
		PY1	6.0%	5.6%	6.1%	6.1%	-0.53*	-1.00	-0.07	-8.8%
		PY2	6.0%	5.2%	6.1%	5.4%	-0.17	-0.49	0.15	-2.9%
	Percent of Beneficiaries with Greater than 80% of Days Covered for Phosphate Binder Prescription in a Given Month	PY1 & PY2	34.3%	36.3%	34.4%	35.1%	1.2***	0.53	2.0	3.6%
		PY1	34.3%	36.6%	34.4%	35.6%	1.1*	0.11	2.0	3.1%
		PY2	34.3%	36.0%	34.4%	34.7%	1.3***	0.61	2.1	3.9%

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Coordination of Care beyond Dialysis (cont'd)	Percent of Beneficiaries with at Least One Contraindicated Medication Prescription Fill in a Given Month	PY1 & PY2	3.5%	3.8%	3.4%	3.7%	-0.02	-0.28	0.23	-0.66%
		PY1	3.5%	3.7%	3.4%	3.7%	-0.09	-0.42	0.25	-2.5%
		PY2	3.5%	3.8%	3.4%	3.7%	0.01	-0.24	0.27	0.42%
	Percent of Beneficiaries Starting Dialysis with No Prior Nephrology Care	PY1 & PY2	25.4%	23.5%	28.5%	26.4%	0.16	-2.4	2.7	0.62%
		PY1	25.3%	23.6%	28.5%	27.3%	-0.53	-4.0	2.9	-2.1%
		PY2	25.3%	22.9%	28.5%	25.2%	0.84	-2.3	4.0	3.3%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-22. Impact of the CEC Model on Coordination of Care beyond Dialysis, Wave 1

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Coordination of Care beyond Dialysis	Percent of Beneficiaries Receiving Flu Vaccinations (Wave 1.1 only)	PY1 & PY2	40.3%	40.0%	40.8%	39.7%	0.84	-1.8	3.5	2.1%
	Percent of Diabetic Beneficiaries Receiving at Least One Dilated Eye Exam in a Given Year	PY1 & PY2	40.0%	42.4%	40.6%	41.1%	1.9***	0.77	3.0	4.8%
		PY1	40.0%	41.8%	40.6%	41.6%	0.81	-0.59	2.2	2.0%
		PY2	40.0%	43.3%	40.6%	41.2%	2.8***	1.5	4.0	6.9%
	Percent of Beneficiaries Receiving at Least One LDL Cholesterol Test in a Given Year	PY1 & PY2	55.0%	62.4%	55.2%	51.4%	11.2***	8.8	13.5	20.3%
		PY1	55.0%	62.1%	55.2%	51.6%	10.6***	7.7	13.5	19.3%
		PY2	55.0%	62.9%	55.2%	51.4%	11.6***	9.3	13.9	21.1%
	Percent of Beneficiaries Receiving at Least One HbA1c Test in a Given Year	PY1 & PY2	75.7%	77.4%	77.4%	74.3%	4.9***	3.2	6.6	6.4%
		PY1	75.7%	75.9%	77.4%	73.3%	4.3***	2.1	6.4	5.6%
		PY2	75.7%	77.8%	77.4%	74.1%	5.4***	3.8	7.0	7.1%
	Number of E&M Office Visits per 1,000 Beneficiaries per Month	PY1 & PY2	2,473.2	2,439.3	2,432.2	2,463.9	-65.6*	-122.0	-9.2	-2.7%
		PY1	2,473.1	2,457.1	2,432.2	2,451.1	-34.9	-97.5	27.7	-1.4%
		PY2	2,473.3	2,425.1	2,432.2	2,480.4	-96.4**	-160.1	-32.7	-3.9%
	Percent of Beneficiaries Receiving Hospice Services in a Given Month	PY1 & PY2	0.88%	0.73%	0.86%	0.75%	-0.03	-0.10	0.04	-3.8%
		PY1	0.88%	0.81%	0.86%	0.78%	0.01	-0.07	0.08	0.65%
		PY2	0.88%	0.65%	0.86%	0.70%	-0.07	-0.16	0.02	-8.2%
	Percent of Beneficiaries with Greater than 50 mg Average MME in a Given Month	PY1 & PY2	6.0%	5.2%	6.1%	5.8%	-0.54**	-0.95	-0.14	-9.0%
		PY1	6.0%	5.6%	6.1%	6.1%	-0.53*	-1.0	-0.07	-8.8%
		PY2	6.0%	4.8%	6.1%	5.4%	-0.56**	-0.98	-0.13	-9.2%
	Percent of Beneficiaries with Greater than 80% of Days Covered for Phosphate Binder Prescription in a Given Month	PY1 & PY2	34.3%	36.4%	34.4%	35.2%	1.3***	0.48	2.2	3.8%
		PY1	34.3%	36.6%	34.4%	35.6%	1.1*	0.11	2.0	3.1%
		PY2	34.3%	36.2%	34.4%	34.7%	1.6***	0.61	2.5	4.6%

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Coordination of Care beyond Dialysis (cont'd)	Percent of Beneficiaries with at Least One Contraindicated Medication Prescription Fill in a Given Month	PY1 & PY2	3.5%	3.8%	3.4%	3.7%	0.03	-0.28	0.33	0.74%
		PY1	3.5%	3.7%	3.4%	3.7%	-0.09	-0.42	0.25	-2.5%
		PY2	3.5%	3.9%	3.4%	3.7%	0.14	-0.21	0.48	3.9%
	Percent of Beneficiaries Starting Dialysis with No Prior Nephrology Care	PY1 & PY2	25.3%	24.1%	28.5%	26.5%	0.8	-2.1	3.7	3.2%
		PY1	25.3%	23.6%	28.5%	27.3%	-0.5	-4.0	2.9	-2.1%
		PY2	25.3%	24.5%	28.5%	25.3%	2.4	-1.4	6.2	9.4%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-23. Impact of the CEC Model on Coordination of Care beyond Dialysis, Wave 2

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Coordination of Care beyond Dialysis	Percent of Diabetic Beneficiaries Receiving at Least One Dilated Eye Exam in a Given Year	PY2	40.2%	40.1%	40.8%	40.8%	-0.09	-1.3	1.2	-0.2%
	Percent of Beneficiaries Receiving at Least One LDL Cholesterol Test in a Given Year	PY2	54.3%	49.4%	54.5%	51.2%	-1.7	-3.6	0.26	-3.1%
	Percent of Beneficiaries Receiving at Least One HbA1c Test in a Given Year	PY2	74.9%	74.9%	76.6%	74.9%	1.7**	0.40	3.0	2.2%
	Number of E&M Office Visits per 1,000 Beneficiaries per Month	PY2	2,480.1	2,462.8	2,438.9	2,480.2	-58.5**	-106.7	-10.3	-2.4%
	Percent of Beneficiaries Receiving Hospice Services in a Given Month	PY2	0.85%	0.83%	0.84%	0.70%	0.11*	0.02	0.20	12.9%
	Percent of Beneficiaries with Greater than 50 mg Average MME in a Given Month	PY2	6.1%	5.5%	6.1%	5.4%	0.21	-0.15	0.57	3.4%
	Percent of Beneficiaries with Greater than 80% of Days Covered for Phosphate Binder Prescription in a Given Month	PY2	34.7%	35.7%	34.8%	34.7%	1.1**	0.32	1.9	3.2%
	Percent of Beneficiaries with at Least One Contraindicated Medication Prescription Fill in a Given Month	PY2	3.6%	3.7%	3.5%	3.7%	-0.11	-0.39	0.18	-3.0%
	Percent of Beneficiaries Starting Dialysis with No Prior Nephrology Care	PY2	24.9%	21.5%	28.1%	25.2%	-0.61	-4.2	3.0	-2.4%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-24. Impact of the CEC Model on Hospitalizations and Emergency Department (ED) Visits, All ESCOs

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Hospitalizations and Emergency Department Visits	Percent of Beneficiaries with at Least One Hospitalization in a Given Month	PY1 & PY2	11.2%	10.9%	11.4%	11.5%	-0.47***	-0.71	-0.23	-4.2%
		PY1	11.3%	10.8%	11.4%	11.4%	-0.46**	-0.79	-0.13	-4.1%
		PY2	11.3%	11.0%	11.4%	11.6%	-0.44***	-0.68	-0.20	-3.9%
	Number of Hospitalizations per 1,000 Beneficiaries per Month	PY1 & PY2	126.6	123.1	128.6	130.1	-5.0***	-7.9	-2.1	-4.0%
		PY1	126.7	122.0	128.8	129.0	-5.1**	-9.0	-1.1	-4.0%
		PY2	126.7	124.3	128.8	130.9	-4.6***	-7.5	-1.7	-3.6%
	Percent of Beneficiaries with at Least One Readmission within 30-days of an Index Hospitalization Stay in a Given Month~	PY1 & PY2	29.5%	28.8%	29.5%	29.5%	-0.71*	-1.40	-0.03	-2.4%
		PY1	29.5%	28.8%	29.5%	29.3%	-0.55	-1.4	0.29	-1.9%
		PY2	29.5%	28.9%	29.5%	29.8%	-0.88*	-1.74	-0.03	-3.0%
	Number of Readmissions per 1,000 Beneficiaries per Month~	PY1 & PY2	347.9	340.5	349.7	348.5	-6.2	-15.1	2.8	-1.8%
		PY1	347.9	340.1	349.6	345.7	-4.0	-15.2	7.2	-1.1%
		PY2	347.9	342.8	349.6	353.5	-9.0	-20.0	2.3	-2.6%
	Percent of Beneficiaries with at Least One ED Visit in a Given Month	PY1 & PY2	10.9%	11.3%	11.2%	11.9%	-0.29*	-0.54	-0.05	-2.7%
		PY1	10.9%	11.1%	11.2%	11.7%	-0.32	-0.67	0.02	-3.0%
		PY2	10.9%	11.5%	11.2%	12.0%	-0.21	-0.44	0.01	-2.0%
	Number of ED Visits per 1,000 Beneficiaries per Month	PY1 & PY2	137.7	144.0	142.1	152.3	-3.9	-7.9	0.22	-2.8%
		PY1	137.8	141.5	142.4	149.8	-3.7	-9.2	1.9	-2.7%
		PY2	137.8	146.7	142.4	154.7	-3.3	-7.3	0.64	-2.4%
	Percent of Beneficiaries with at Least One Observational Stay in a Given Month	PY1 & PY2	2.3%	2.5%	2.3%	2.5%	0.02	-0.10	0.13	0.74%
		PY1	2.3%	2.6%	2.3%	2.4%	0.12	-0.04	0.29	5.2%
		PY2	2.3%	2.5%	2.3%	2.5%	-0.12*	-0.22	-0.01	-5.0%
	Percent of Beneficiaries with at Least One ED Visit within 30-days of an Acute Hospitalization in a Given Month	PY1 & PY2	19.9%	20.3%	20.3%	21.0%	-0.31	-0.01	0.24	-1.6%
		PY1	19.9%	20.4%	20.3%	21.3%	-0.46	-1.19	0.28	-2.3%
		PY2	19.9%	20.2%	20.3%	20.7%	-0.17	-0.01	0.47	-0.85%

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Hospitalizations and Emergency Department Visits (cont'd)	Average Inpatient Length of Stay (in days)	PY1 & PY2	6.2	6.1	6.3	6.2	0.01	-0.09	0.10	0.12%
		PY1	6.2	6.2	6.3	6.2	0.08	-0.05	0.21	1.2%
		PY2	6.2	6.0	6.3	6.2	-0.06	-0.17	0.05	-1.0%
	Percent of Beneficiaries with at Least One Hospitalization for Vascular Access Complications in a Given Month	PY1 & PY2	0.58%	0.61%	0.63%	0.66%	0.003	-0.04	0.04	0.50%
		PY1	0.57%	0.59%	0.63%	0.66%	-0.02	-0.07	0.04	-3.1%
		PY2	0.57%	0.61%	0.63%	0.65%	0.02	-0.02	0.07	3.7%
	Percent of Beneficiaries with at Least One Hospitalization for ESRD Complications in a Given Month	PY1 & PY2	1.8%	1.8%	1.8%	1.9%	-0.11**	-0.19	-0.04	-6.4%
		PY1	1.8%	1.7%	1.8%	1.8%	-0.15**	-0.24	-0.05	-8.3%
		PY2	1.8%	2.0%	1.8%	2.1%	-0.07	-0.16	0.02	-4.0%
	Percent of Beneficiaries with at Least One Admission for Diabetes Short-Term Complications in a Given Month	PY1 & PY2	0.12%	0.10%	0.14%	0.10%	0.01	-0.01	0.03	9.3%
		PY1	0.12%	0.08%	0.14%	0.10%	-0.01‡	-0.03	0.02	-4.6%
		PY2	0.12%	0.11%	0.14%	0.09%	0.03**	0.01	0.06	26.8%
	Percent of Beneficiaries with at Least One Admission for Diabetes Long-Term Complications in a Given Month	PY1 & PY2	0.77%	0.66%	0.77%	0.68%	-0.01	-0.06	0.04	-1.9%
		PY1	0.77%	0.62%	0.77%	0.59%	0.02	-0.04	0.09	3.2%
		PY2	0.77%	0.74%	0.77%	0.79%	-0.06	-0.12	0.01	-7.3%
	Percent of Beneficiaries with at Least One Admission for Asthma or COPD in Older Adults in a Given Month	PY1 & PY2	0.68%	0.78%	0.70%	0.74%	0.06	-0.02	0.14	9.0%
		PY1	0.68%	0.74%	0.69%	0.64%	0.10*	0.001	0.20	14.9%
		PY2	0.68%	0.87%	0.69%	0.86%	0.01	-0.09	0.11	1.8%
	Percent of Beneficiaries with at Least One Admission for CHF in a Given Month	PY1 & PY2	1.5%	1.6%	1.6%	1.8%	-0.08	-0.16	0.01	-5.3%
		PY1	1.5%	1.4%	1.6%	1.6%	-0.10	-0.20	0.004	-6.8%
		PY2	1.5%	1.9%	1.6%	2.1%	-0.06	-0.16	0.05	-3.8%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ~ Readmission drops the last quarter of intervention data to account for a lag in claims to prevent an underestimation due to a lack of claims maturity. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-25. Impact of the CEC Model on Hospitalizations and Emergency Department (ED) Visits, Wave 1

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Hospitalizations and Emergency Department Visits	Percent of Beneficiaries with at Least One Hospitalization in a Given Month	PY1 & PY2	11.3%	10.8%	11.4%	11.5%	-0.55***	-0.83	-0.27	-4.9%
		PY1	11.3%	10.8%	11.4%	11.4%	-0.46**	-0.79	-0.13	-4.1%
		PY2	11.3%	10.8%	11.4%	11.6%	-0.63***	-0.96	-0.31	-5.6%
	Number of Hospitalizations per 1,000 Beneficiaries per Month	PY1 & PY2	126.7	122.0	128.8	129.8	-5.8***	-9.2	-2.4	-4.6%
		PY1	126.7	121.9	128.8	129.0	-5.1**	-9.0	-1.1	-4.0%
		PY2	126.7	122.2	128.8	130.9	-6.6***	-10.5	-2.7	-5.2%
	Percent of Beneficiaries with at Least One Readmission within 30-days of an Index Hospitalization Stay in a Given Month~	PY1 & PY2	29.5%	28.9%	29.5%	29.5%	-0.64	-1.4	0.09	-2.2%
		PY1	29.5%	28.8%	29.5%	29.3%	-0.55	-1.4	0.29	-1.9%
		PY2	29.5%	29.0%	29.5%	29.8%	-0.76	-1.8	0.24	-2.6%
	Number of Readmissions per 1,000 Beneficiaries per Month ~	PY1 & PY2	347.9	341.0	349.6	348.6	-5.9	-15.7	3.8	-1.7%
		PY1	347.9	340.1	349.6	345.7	-4.0	-15.2	7.2	-1.1%
		PY2	347.9	343.2	349.6	353.5	-8.6	-22.0	4.8	-2.5%
	Percent of Beneficiaries with at Least One ED Visit in a Given Month	PY1 & PY2	10.9%	11.1%	11.2%	11.8%	-0.40**	-0.70	-0.10	-3.7%
		PY1	10.9%	11.1%	11.2%	11.7%	-0.32	-0.67	0.02	-3.0%
		PY2	10.9%	11.2%	11.2%	12.0%	-0.47**	-0.79	-0.16	-4.4%
	Number of ED Visits per 1,000 Beneficiaries per Month	PY1 & PY2	137.8	142.0	142.4	151.9	-5.3*	-10.1	-0.40	-3.8%
		PY1	137.8	141.5	142.4	149.8	-3.7	-9.2	1.9	-2.7%
		PY2	137.8	143.1	142.4	154.7	-6.9**	-12.2	-1.6	-5.0%
	Percent of Beneficiaries with at Least One Observational Stay in a Given Month	PY1 & PY2	2.3%	2.6%	2.3%	2.5%	0.05	-0.09	0.19	2.2%
		PY1	2.3%	2.6%	2.3%	2.4%	0.12	-0.04	0.29	5.2%
		PY2	2.3%	2.6%	2.3%	2.5%	-0.02	-0.16	0.13	-0.74%
	Percent of Beneficiaries with at Least One ED Visit within 30-days of an Acute Hospitalization in a Given Month	PY1 & PY2	19.9%	20.1%	20.3%	21.0%	-0.53	-1.15	0.10	-2.6%
		PY1	19.9%	20.4%	20.3%	21.3%	-0.46	-1.19	0.28	-2.3%
		PY2	19.9%	19.8%	20.3%	20.8%	-0.59	-1.37	0.19	-3.0%

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Hospitalizations and Emergency Department Visits (cont'd)	Average Inpatient Length of Stay (in days)	PY1 & PY2	6.2	6.1	6.3	6.2	-0.004	-0.11	0.10	-0.07%
		PY1	6.2	6.2	6.3	6.2	0.08	-0.05	0.21	1.2%
		PY2	6.2	6.0	6.3	6.2	-0.09	-0.23	0.05	-1.4%
	Percent of Beneficiaries with at Least One Hospitalization for Vascular Access Complications in a Given Month	PY1 & PY2	0.57%	0.59%	0.63%	0.66%	-0.01	-0.05	0.04	-1.5%
		PY1	0.57%	0.59%	0.63%	0.66%	-0.02	-0.07	0.04	-3.1%
		PY2	0.57%	0.59%	0.63%	0.65%	0.0004	-0.06	0.06	0.07%
	Percent of Beneficiaries with at Least One Hospitalization for ESRD Complications in a Given Month	PY1 & PY2	1.8%	1.8%	1.8%	1.9%	-0.13**	-0.21	-0.04	-7.2%
		PY1	1.8%	1.7%	1.8%	1.8%	-0.15**	-0.24	-0.05	-8.3%
		PY2	1.8%	2.0%	1.8%	2.1%	-0.11*	-0.22	-0.004	-6.2%
	Percent of Beneficiaries with at Least One Admission for Diabetes Short-Term Complications in a Given Month	PY1 & PY2	0.12%	0.10%	0.14%	0.10%	0.01‡	-0.01	0.04	11.6%
		PY1	0.12%	0.08%	0.14%	0.10%	-0.01‡	-0.03	0.02	-4.6%
		PY2	0.12%	0.11%	0.14%	0.09%	0.03*‡	0.003	0.06	27.5%
	Percent of Beneficiaries with at Least One Admission for Diabetes Long-Term Complications in a Given Month	PY1 & PY2	0.77%	0.68%	0.77%	0.68%	-0.01	-0.06	0.05	-1.2%
		PY1	0.77%	0.62%	0.77%	0.59%	0.02	-0.04	0.09	3.2%
		PY2	0.77%	0.75%	0.77%	0.79%	-0.04	-0.12	0.03	-5.5%
	Percent of Beneficiaries with at Least One Admission for Asthma or COPD in Older Adults in a Given Month	PY1 & PY2	0.68%	0.81%	0.69%	0.74%	0.08	-0.01	0.17	11.8%
		PY1	0.68%	0.74%	0.69%	0.64%	0.10*	0.001	0.20	14.9%
		PY2	0.68%	0.91%	0.69%	0.86%	0.06	-0.06	0.18	8.7%
	Percent of Beneficiaries with at Least One Admission for CHF in a Given Month	PY1 & PY2	1.5%	1.6%	1.6%	1.8%	-0.11**	-0.21	-0.02	-7.7%
		PY1	1.5%	1.4%	1.6%	1.6%	-0.10	-0.20	0.004	-6.8%
		PY2	1.5%	1.8%	1.6%	2.1%	-0.12*	-0.25	0.0006	-8.5%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ~ Readmission drops the last quarter of intervention data to account for a lag in claims to prevent an underestimation due to a lack of claims maturity. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-26. Impact of the CEC Model on Hospitalizations and Emergency Department (ED) Visits, Wave 2

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Hospitalizations and Emergency Department Visits	Percent of Beneficiaries with at Least One Hospitalization in a Given Month	PY2	11.3%	11.2%	11.4%	11.6%	-0.25	-0.52	0.03	-2.2%
	Number of Hospitalizations per 1,000 Beneficiaries per Month	PY2	126.8	126.3	128.9	130.9	-2.6	-6.0	0.83	-2.0%
	Percent of Beneficiaries with at Least One Readmission within 30-days of an Index Hospitalization Stay in a Given Month~	PY2	29.5%	28.8%	29.5%	29.8%	-1.0‡	-2.01	0.02	-3.4%
	Number of Readmissions per 1,000 Beneficiaries per Month~	PY2	346.6	342.4	348.3	353.5	-9.4	-22.9	4.1	-2.7%
	Percent of Beneficiaries with at Least One ED Visit in a Given Month	PY2	11.0%	11.7%	11.4%	12.0%	0.04	-0.23	0.31	0.36%
	Number of ED Visits per 1,000 Beneficiaries per Month	PY2	140.0	150.2	144.8	154.7	0.23	-4.6	5.1	0.16%
	Percent of Beneficiaries with at Least One Observational Stay in a Given Month	PY2	2.4%	2.4%	2.3%	2.5%	-0.21***	-0.34	-0.09	-9.0%
	Percent of Beneficiaries with at Least One ED Visit within 30-days of an Acute Hospitalization in a Given Month	PY2	20.2%	20.6%	20.6%	20.8%	0.24	-0.50	0.98	1.19%
	Average Inpatient Length of Stay (in days)	PY2	6.1	6.0	6.2	6.2	-0.04	-0.16	0.08	-0.69%
	Percent of Beneficiaries with at Least One Hospitalization for Vascular Access Complications in a Given Month	PY2	0.59%	0.63%	0.64%	0.65%	0.04	-0.01	0.10	7.2%
	Percent of Beneficiaries with at Least One Hospitalization for ESRD Complications in a Given Month	PY2	1.8%	2.1%	1.8%	2.1%	-0.03	-0.14	0.07	-1.9%
	Percent of Beneficiaries with at Least One Admission for Diabetes Short-Term Complications in a Given Month	PY2	0.11%	0.11%	0.13%	0.09%	0.03*	0.004	0.06	28.6%

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Hospitalizations and Emergency Department Visits (cont'd)	Percent of Beneficiaries with at Least One Admission for Diabetes Long-Term Complications in a Given Month	PY2	0.71%	0.72%	0.71%	0.79%	-0.07	-0.14	0.001	-9.9%
	Percent of Beneficiaries with at Least One Admission for Asthma or COPD in Older Adults in a Given Month	PY2	0.67%	0.82%	0.67%	0.86%	-0.03	-0.15	0.08	-4.9%
	Percent of Beneficiaries with at Least One Admission for CHF in a Given Month	PY2	1.5%	2.0%	1.6%	2.1%	0.01	-0.11	0.14	0.8%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ~ Readmission drops the last quarter of intervention data to account for a lag in claims to prevent an underestimation due to a lack of claims maturity. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-27. Impact of the CEC Model on Medicare Spending across the Continuum of Care, All ESCOs

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Medicare Spending across the Continuum of Care	Total Part A and Part B PBPM	PY1 & PY2	$6,315	$6,199	$6,317	$6,315	-$114**	-$188	-$40	-1.8%
		PY1	$6,316	$6,228	$6,319	$6,354	-$123**	-$223	-$24	-2.0%
		PY2	$6,316	$6,158	$6,319	$6,263	-$102**	-$174	-$30	-1.6%
	Acute Inpatient PBPM	PY1 & PY2	$1,634	$1,636	$1,669	$1,739	-$68***	-$105	-$31	-4.1%
		PY1	$1,635	$1,639	$1,670	$1,737	-$64**	-$115	-$13	-3.9%
		PY2	$1,635	$1,633	$1,670	$1,737	-$69***	-$108	-$30	-4.2%
	Readmissions PBPM~	PY1 & PY2	$563	$567	$573	$607	-$29**	-$53	-$6	-5.2%
		PY1	$563	$561	$574	$603	-$32*	-$62	-$2	-5.7%
		PY2	$563	$574	$574	$610	-$25	-$51	$1	-4.4%
	Home Health PBPM	PY1 & PY2	$178	$175	$173	$161	$10**	$2	$18	5.5%
		PY1	$178	$188	$172	$163	$19***‡	$8	$31	10.9%
		PY2	$178	$165	$172	$162	-$3	-$9	$3	-1.5%
	Hospice PBPM	PY1 & PY2	$24	$21	$23	$20	$0.00	-$2	$2	0.01%
		PY1	$24	$22	$23	$21	-$0.15	-$3	$2	-0.64%
		PY2	$24	$20	$23	$19	$0.39	-$2	$3	1.6%
	Institutional Post-Acute Care PBPM	PY1 & PY2	$572	$521	$541	$549	-$59***	-$89	-$30	-10.4%
		PY1	$571	$514	$542	$566	-$81***	-$120	-$43	-14.2%
		PY2	$571	$516	$542	$521	-$35**	-$63	-$6	-6.0%
	Hospital Outpatient PBPM	PY1 & PY2	$368	$385	$401	$422	-$4‡	-$15	$7	-1.2%
		PY1	$369	$363	$402	$408	-$12‡	-$28	$4	-3.2%
		PY2	$368	$406	$402	$436	$5‡	-$5	$15	1.3%
	Total Part B PBPM	PY1 & PY2	$4,034	$3,963	$4,036	$3,974	-$9	-$37	$19	-0.22%
		PY1	$4,035	$3,977	$4,037	$3,998	-$18	-$55	$19	-0.45%
		PY2	$4,035	$3,941	$4,037	$3,942	$2	-$26	$30	0.05%

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Medicare Spending across the Continuum of Care (cont'd)	Office Visits PBPM	PY1 & PY2	$310	$306	$300	$306	-$11***	-$17	-$4	-3.5%
		PY1	$310	$309	$299	$305	-$6	-$15	$3	-2.0%
		PY2	$310	$304	$299	$310	-$16***	-$22	-$10	-5.2%
	Total Dialysis PBPM	PY1 & PY2	$2,595	$2,591	$2,599	$2,580	$15***	$8	$22	0.59%
		PY1	$2,595	$2,611	$2,598	$2,600	$14***	$6	$23	0.55%
		PY2	$2,595	$2,570	$2,598	$2,558	$15***	$7	$24	0.60%
	Hospitalizations for ESRD Complications PBPM	PY1 & PY2	$149	$163	$148	$171	-$10**	-$17	-$2	-6.5%
		PY1	$149	$145	$148	$160	-$16***	-$25	-$6	-10.5%
		PY2	$149	$181	$148	$185	-$4	-$14	$5	-2.9%
	Part B Drug PBPM	PY1 & PY2	$25	$33	$23	$30	$0.72	-$2	$4	2.9%
		PY1	$25	$33	$23	$29	$2	-$2	$6	7.2%
		PY2	$25	$33	$23	$32	-$0.37	-$4	$3	-1.5%
Unintended Consequences	Total Part D Drug Cost PBPM	PY1 & PY2	$820	$1,119	$836	$1,123	$12‡	-$9	$34	1.5%
		PY1	$819	$1,078	$835	$1,091	$2‡	-$26	$31	0.3%
		PY2	$819	$1,169	$835	$1,165	$20‡	-$1	$42	2.5%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ~ Readmission expenditures are included in the overall acute inpatient spending and drops the last quarter of intervention data to account for a lag in claims to prevent an underestimation due to a lack of claims maturity. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-28. Impact of the CEC Model on Medicare Spending across the Continuum of Care, Wave 1

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Medicare Spending across the Continuum of Care	Total Part A and Part B PBPM	PY1 & PY2	$6,316	$6,161	$6,319	$6,314	-$150***	-$238	-$61	-2.4%
		PY1	$6,316	$6,228	$6,319	$6,354	-$123**	-$223	-$24	-2.0%
		PY2	$6,316	$6,084	$6,319	$6,263	-$176***	-$277	-$75	-2.8%
	Acute Inpatient PBPM	PY1 & PY2	$1,635	$1,617	$1,670	$1,737	-$85***	-$128	-$42	-5.2%
		PY1	$1,635	$1,639	$1,670	$1,737	-$64**	-$115	-$13	-3.9%
		PY2	$1,635	$1,597	$1,670	$1,737	-$106***	-$156	-$55	-6.5%
	Readmissions PBPM~	PY1 & PY2	$563	$558	$574	$606	-$38**	-$64	-$12	-6.7%
		PY1	$563	$561	$574	$603	-$32*	-$62	-$2	-5.7%
		PY2	$563	$554	$574	$610	-$45**	-$78	-$13	-8.1%
	Home Health PBPM	PY1 & PY2	$178	$183	$172	$163	$14**‡	$5	$24	8.0%
		PY1	$178	$188	$172	$163	$19***‡	$8	$31	10.9%
		PY2	$178	$177	$172	$162	$9*‡	$0.22	$18	5.1%
	Hospice PBPM	PY1 & PY2	$24	$21	$23	$20	-$0.77	-$3	$1	-3.2%
		PY1	$24	$22	$23	$21	-$0.15	-$3	$2	-0.64%
		PY2	$24	$19	$23	$19	-$1	-$4	$1	-5.5%
	Institutional Post-Acute Care PBPM	PY1 & PY2	$571	$504	$542	$546	-$71***	-$107	-$36	-12.5%
		PY1	$571	$514	$542	$566	-$81***	-$120	-$43	-14.2%
		PY2	$571	$489	$542	$521	-$61**	-$102	-$20	-10.7%
	Hospital Outpatient PBPM	PY1 & PY2	$368	$378	$402	$420	-$8‡	-$22	$6	-2.2%
		PY1	$369	$363	$402	$408	-$12‡	-$28	$4	-3.2%
		PY2	$368	$397	$402	$436	-$4‡	-$20	$11	-1.2%
	Total Part B PBPM	PY1 & PY2	$4,035	$3,949	$4,037	$3,973	-$22	-$55	$11	-0.54%
		PY1	$4,035	$3,977	$4,037	$3,998	-$18	-$55	$19	-0.45%
		PY2	$4,035	$3,914	$4,037	$3,942	-$26	-$60	$9	-0.63%

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Medicare Spending across the Continuum of Care (cont'd)	Office Visits PBPM	PY1 & PY2	$310	$306	$299	$307	-$11**	-$19	-$3	-3.6%
		PY1	$310	$309	$299	$305	-$6	-$15	$3	-2.0%
		PY2	$310	$304	$299	$310	-$16***	-$25	-$7	-5.2%
	Total Dialysis PBPM	PY1 & PY2	$2,595	$2,595	$2,598	$2,581	$17***	$8	$25	0.65%
		PY1	$2,595	$2,611	$2,598	$2,600	$14***	$6	$23	0.55%
		PY2	$2,595	$2,575	$2,598	$2,558	$19***	$9	$30	0.75%
	Hospitalizations for ESRD Complications PBPM	PY1 & PY2	$149	$159	$148	$170	-$12**	-$21	-$4	-8.3%
		PY1	$149	$145	$148	$160	-$16***	-$25	-$6	-10.5%
		PY2	$149	$177	$148	$185	-$9	-$20	$3	-5.8%
	Part B Drug PBPM	PY1 & PY2	$25	$34	$23	$30	$2	-$1	$6	9.0%
		PY1	$25	$33	$23	$29	$2	-$2	$6	7.2%
		PY2	$25	$36	$23	$32	$3	-$1	$7	10.9%
Unintended Consequences	Total Part D Drug Cost PBPM	PY1 & PY2	$819	$1,122	$835	$1,124	$14‡	-$13	$41	1.7%
		PY1	$819	$1,078	$835	$1,091	$2‡	-$26	$31	0.30%
		PY2	$819	$1,174	$835	$1,165	$26‡	-$5	$56	3.2%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ~ Readmission expenditures are included in the overall acute inpatient spending and drops the last quarter of intervention data to account for a lag in claims to prevent an underestimation due to a lack of claims maturity. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-29. Impact of the CEC Model on Medicare Spending across the Continuum of Care, Wave 2

Measures		Performance Year	CEC		Comparison		Difference-in-Differences Estimate			
			Pre-CEC Mean	PY Mean	Pre-CEC Mean	PY Mean	DiD	90% Lower CI	90% Upper CI	Percent Change
Medicare Spending across the Continuum of Care	Total Part A and Part B PBPM	PY2	$6,329	$6,230	$6,331	$6,263	-$31	-$110	$49	-0.48%
	Acute Inpatient PBPM	PY2	$1,657	$1,669	$1,693	$1,737	-$33	-$78	$12	-2.0%
	Readmission PBPM~	PY2	$573	$595	$583	$610	-$5	-$36	$27	-0.81%
	Home Health PBPM	PY2	$175	$154	$169	$162	-$14***	-$21	-$6	-7.8%
	Hospice PBPM	PY2	$23	$22	$22	$19	$2	-$0.54	$5	9.2%
	Institutional Post-Acute Care PBPM	PY2	$579	$543	$551	$521	-$8	-$39	$24	-1.3%
	Hospital Outpatient PBPM	PY2	$370	$415	$404	$436	$14*‡	$0.83	$27	3.7%
	Total Part B PBPM	PY2	$4,022	$3,968	$4,025	$3,942	$29	-$3	$61	0.73%
	Office Visits PBPM	PY2	$311	$304	$301	$310	-$16***	-$23	-$9	-5.1%
	Total Dialysis PBPM	PY2	$2,595	$2,566	$2,598	$2,558	$11*	$1	$22	0.44%
	Hospitalizations for ESRD Complications PBPM	PY2	$152	$186	$151	$185	-$0.19	-$12	$11	-0.12%
	Part B Drug PBPM	PY2	$27	$30	$25	$32	-$4	-$8	$0.18	-13.8%
Unintended Consequences	Total Part D Drug Cost PBPM	PY2	$899	$1,163	$915	$1,165	$15‡	-$11	$40	1.6%

Notes: PY1 covers October 2015 - December 2016, PY2 covers January 2017 - December 2017. All ESCOs estimates include both waves from October 2015 - December 2017. The estimate of All ESCOs is the combined cumulative impact of CEC, accounting for different lengths of exposure to the model. About 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December 2017 (four quarters). A weighted average of the performance years by wave may not exactly equal the All ESCO result because the All ESCO and by-wave performance year estimates ware generated by regression models estimated separately for all ESCOs or by wave. Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Significance of the DiD impact estimate is indicated next to each outcome where * implies significance at the 10% level, ** at the 5% level, and *** at the 1% level assuming a two-tailed test. ~ Readmission expenditures are included in the overall acute inpatient spending and drops the last quarter of intervention data to account for a lag in claims to prevent an underestimation due to a lack of claims maturity. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Exhibit F-30. Impact of the CEC Model on Core Measures for Selected Beneficiary Subgroups, PY1 & PY2, All ESCOs

		Total Part A and Part B PBPM	Percent of Beneficiaries with at Least One Hospitalization in a Given Month	Percent of Beneficiaries with at Least One Readmission within 30-days of an Index Hospitalization Stay in a Given Month~	Percent of Beneficiaries with at Least One ED Visit in a Given Month	Fistula Use (percent of beneficiaries in a given month who had a fistula and had at least 90 days of dialysis)	Catheter Use (percent of beneficiaries in a given month who had a catheter for 90 days or longer)
Race	White	-$181***	-0.62***	-1.0*	-0.48**	0.09	-1.2***‡
	Black	-$49	-0.24	0.11	-0.17	-0.77	-0.57
	Other	-$139*	-0.67**	-2.3**	-0.13	-2.5***	-0.02
Sex	Male	-$145***	-0.47***	-0.70	-0.42**	-0.21	-0.58*
	Female	-$82	-0.49**	-0.71	-0.15	-1.1*	-1.0**
OREC	Age	-$68	-0.17	-0.6	-0.23	-0.13	-1.0** ‡
	Disabled	-$168**	-0.88***	-0.3	-0.46*	-0.65	-0.75
	ESRD	-$43	-0.31 ‡	-1.0	0.04	-0.77	-0.78
	ESRD and Disabled	-$187***	-0.64***	-1.1 ‡	-0.56**	-1.1	-0.44
Dual Medicaid Medicare Status	Partial	-$98 ‡	-0.8**	0.52	0.12	-1.1	-0.53
	Full	-$129*	-0.54**	-1.4*** ‡	-0.69***	-1.6**	-0.66
Months on Dialysis	≤ six months	-$95	0.32	0.85	0.26	0.46	-0.62
	> six months	-$110**	-0.51***	-0.94**	-0.34**	-0.76	-0.70** ‡

Notes: All ESCOs estimates include both waves from October 2015 - December 2017. About, 33% of facilities have nine quarters of CEC participation (October 2015 to December 2017); the remaining 67% participated in CEC from January 2017 to December to 2017 (four quarters). Each impact estimate is based on a DiD analysis, and reflects the difference in the regression-adjusted mean outcome for beneficiaries in CEC facilities for the intervention period with baseline relative to the same difference over time for beneficiaries in matched comparison facilities. Medicare payment outcomes are standardized to remove the effect of geographic and other adjustments. CI = confidence interval, ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1. (*) Other race includes all non-White and non-Black beneficiaries with the majority of beneficiaries being Hispanic or Asian races. For more details on OREC see https://www.cms.gov/Regulations-and-Guidance/Guidance/Manuals/downloads/mc86c07.pdf. ~ Readmission expenditures are included in the overall acute inpatient spending and drops the last quarter of intervention data to account for a lag in claims to prevent an underestimation due to a lack of claims maturity. ‡ Data from the baseline period showed intervention and matched comparison facilities were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Appendix G: Power Calculation Methodology

In this section we describe our power calculation methodology and our findings concerning the ability of our model to detect changes in Medicare payments. Power calculations provide essential information for researchers to determine the smallest detectable difference, with a given sample size, in the average of the outcome variable between treatment and control groups. An equally important consideration in study designs is to control the type 1 error, which is the probability of falsely rejecting the null hypothesis when it is in fact true, or in other words claiming treatment efficacy when in fact it does not exist. We set an acceptable level of type 1 error to be 0.1, and compute power under this specification.

To compute power, we use a STATA user command called "clsampsi," developed by Batistatou et al. (2014).[36] The authors use a formula based on a non-central F distribution as described by Moser et al. (1989).[37]

$$1-\beta = (\Phi\left[\frac{\delta}{\sqrt{\left[\frac{\sigma_t^2}{N_t}\left\{1+\left(\bar{m}+\frac{\sigma_{\bar{m}t}^2}{\bar{m}}-1\right)\rho_t\right\}+\frac{\sigma_c^2}{N_c}\left\{1+\left(\bar{m}+\frac{\sigma_{\bar{m}c}^2}{\bar{m}}-1\right)\rho_c\right\}\right]}}-z_\alpha\right]) \qquad (1)$$

Here, δ denotes various effect sizes for potential predicted reductions in payments, ρ_t and ρ_c are intra-cluster correlation coefficients (ICC) (which measure how related the clustered observations are) for the treatment and control group, respectively. Clustered practices are standard in DiD designs.[38] Furthermore, we also consider how the fit of an estimation would impact power by adjusting the variance and ICC factors using an assumed R^2 of 0.3.[39] The term $\frac{\sigma_{\bar{m}t,c}^2}{\bar{m}}$ corresponds to the variation in the size of clusters which has been shown by Guittet et al. (2006) to heavily influence power, when there is large variation.[40] Additionally, $\bar{m}$ refers to the average number of individuals per cluster. Finally, σ_t^2, N_t, σ_c^2, and N_c, are the variance outcome and the total sample size for each trial arm (t: treatment, c: control), respectively, and z_α is the one-tail z statistic. Combining these factors, we are able to generate two terms commonly referred to as the design effect.

We calculate values of the factors discussed above for the outcome variable Medicare payments using the matched beneficiary data. A key component of Equation (1) is the ICC, which depends on how observations are clustered. For each group we cluster observations by their aligned facility to identify individual beneficiary observations. Specifically, we cluster by aligned ESCO and comparison facilities identified in the matched sets which corresponds to 1,264 clusters units. As a

[36] Batistatou, E., Roberts, C., & Roberts, S. (2014). Sample size and power calculations for trials and quasi-experimental studies with clustering. *Stata J*, 14(1), 159-75.

[37] Moser, B. K., Stevens, G. R., & Watts, C. L. (1989). The two-sample t test versus Satterthwaite's approximate F test. Communications in Statistics-Theory and Methods, 18(11), 3963-3975.

[38] Bertrand, M., Duflo, E., Mullainathan, S., (2004). "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics*, 119(1), pp. 249-75.

[39] The R^2 value provides an indication of how well the covariates of regression estimate the outcome of interest. Thus, the greater the value of R^2 the lower the necessary sample size needed to reach a desired level of power.

[40] Guittet, L., Ravaud, P., & Giraudeau, B. (2006). Planning a cluster randomized trial with unequal cluster sizes: practical issues involving continuous outcomes. *BMC medical research methodology*, 6(1), 1.

result, the power calculations do not take into consideration the repeated nature of the data, which would only improve power if all other calculations and assumptions were maintained.

For the second year evaluation of the CEC Model, the number of dialysis facilities and patients provides reasonable confidence that the analysis will detect modest impacts on Medicare service use and costs for all beneficiaries. Specifically, the combined PY1 and PY2 estimates of power using one-tailed tests at the 10% significance level and adjustments for goodness of fit from the regression models imply that the evaluation has 80% power to detect impacts on standardized Medicare payments of 1.5% or more.

Appendix H: ICH CAHPS Analysis Supplement

Data: The In-Center Hemodialysis Consumer Assessment of Healthcare Providers and Systems (ICH CAHPS®) survey is administered twice annually. This analysis included results from the fall 2014 through the fall 2017 surveys. The ICH CAHPS survey periods, included as pre-CEC (i.e., baseline period) or post-CEC (i.e., intervention period) in the analysis, differed based on when the facility began CEC participation. Among facilities that began CEC participation in the first PY1, the analysis included results from the fall 2014 and spring 2015 surveys for the pre-CEC period and results from the fall 2015, spring 2016, fall 2016, spring 2017, and fall 2017 surveys for the post-CEC period. Among facilities that began CEC participation in PY2, the analysis included results from the fall 2014, spring 2015, fall 2015, spring 2016, and fall 2016 surveys for the pre-CEC period and results from the spring 2017 and fall 2017 surveys for the post-CEC period. We received risk-adjusted facility-level ICH CAHPS data from CMS to prevent any potential beneficiary confidentiality concerns. Measures were risk adjusted following the methodology for publicly reporting ICH CAHPS survey results on the Dialysis Facility Compare website.[41] The risk adjustment methods account for the following characteristics: mode of survey administration; overall health; overall mental health; heart disease; deafness or serious difficulty hearing; blindness or serious difficulty seeing; difficulty concentrating, remembering, or making decisions; difficulty dressing or bathing; age; sex; education; language; assistance with the survey; and number of years on dialysis. We weighted results from each ICH CAHPS survey wave (e.g., fall or spring) by the number of respondents to pool risk adjusted measures within a facility across survey periods (e.g., pooling the fall 2014 and spring 2015 surveys for pre-CEC period values among facilities that began CEC participation in PY1).

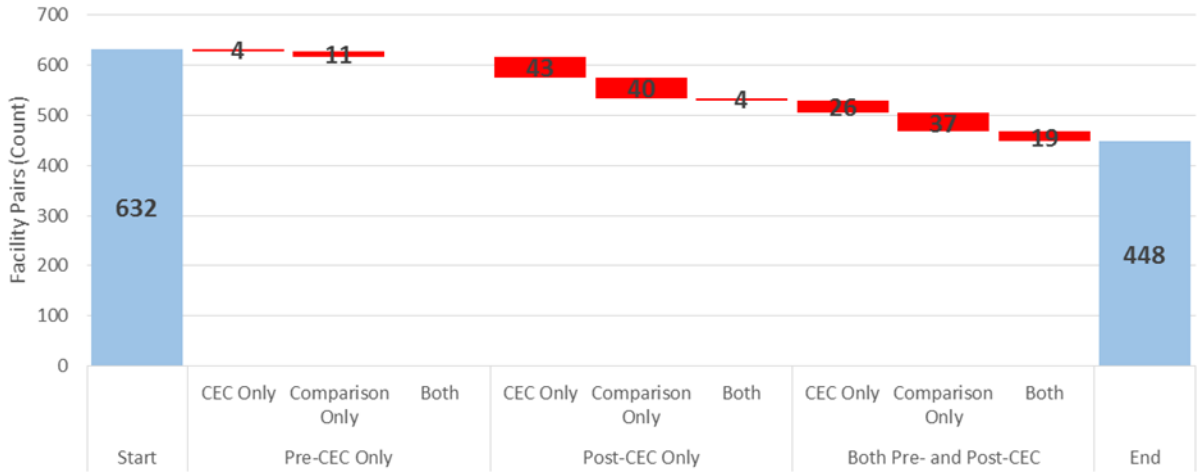
Study Population: The analytic dataset included survey data from samples of beneficiaries receiving dialysis treatment from ESCO and comparison facilities during each semiannual survey period. Beneficiaries eligible for CMS' sampling (i.e., who would receive the ICH CAHPs survey) received dialysis at a specific facility for at least three months, were at least 18 years of age, and were not institutionalized, deceased, or receiving hospice care. Among facilities with more than 200 beneficiaries meeting these criteria, 200 beneficiaries were randomly sampled. Among facilities with 200 or fewer beneficiaries, all beneficiaries were included in the sample. This analysis encompassed beneficiary responses from 632 ESCO facilities and 632 matched comparison group facilities. The pool of comparison group facilities for this analysis was the same used in the other analyses for PY2 in this second annual report. (See **Appendix F** for a description of the methods for selecting comparison facilities.) We received data that had already applied ICH CAHPS suppression rules (i.e., suppressing facility results when there were 10 or fewer respondents), which ensure beneficiary confidentiality, and that reduced the number of facilities available for the analysis by 184 pairs. **Exhibit H-1** summarizes if the facility pair was excluded due to (1) the CEC facility, the comparison group facility, or both and (2) if the facility pair was excluded in the pre-CEC period, the post-CEC period, or both.[42] Specifically, 15 facility pairs were excluded because either a CEC facility (four pairs) or a matched comparison facility (11 pairs) did not have pre-CEC data. Eighty-seven pairs

[41] https://www.medicare.gov/dialysisfacilitycompare/#

[42] A facility pair was excluded if either facility had ten or fewer respondents in all periods in either the pre-CEC or post-CEC period.

were excluded because a CEC facility (43 pairs), a matched comparison facility (40 pairs) or both the CEC facility and the matched comparison facility (four pairs) had 10 or fewer respondents in the post-CEC period. Finally, 82 facility pairs were excluded because at least one facility in the pair (i.e., CEC or matched comparison or both) did not have data in both the pre- and post-CEC periods. On average, the excluded CEC facilities were slightly smaller, having fewer dialysis stations compared to the included CEC facilities (17 vs. 22), with a SMD of 0.6. Similarly, the excluded comparison facilities were slightly smaller on average, having fewer dialysis stations compared to included comparison facilities (18 vs. 21), with a SMD of 0.3. Across the seven LDOs and non-LDOs, the proportion of excluded facilities averaged 28% and ranged between 0% and 50%; Fresenius facilities accounted for the majority of excluded facilities (n=133 [72%]).

Exhibit H-1. Summary of ICH CAHPS Facility Pair Exclusions



Analysis: We employed OLS regression to derive the DiD estimates. The dependent variables were the risk-adjusted, facility-level values, with no additional adjustment for other covariates. Dialysis facilities in the regression were weighted by the number of aligned beneficiaries at each facility from the corresponding CEC periods. The beneficiary counts included in the pre and post-CEC periods differed based on when the facility began CEC participation. Among facilities that began CEC participation in PY1, the pre-CEC counts included quarter four (Q4) 2014 through Q1 2015 and post-CEC counts included Q4 2015 through Q4 2017. Among facilities that began CEC participation in PY2, the pre-CEC counts included Q4 2014 through Q2 2016 and post-CEC counts included Q1 2017 through Q4 2017. All measures included results for 448 of the total 632 matched pairs of facilities (i.e., excluded 184 pairs) except the measure assessing if beneficiaries received an explanation of transplant ineligibility, which included 446 matched pairs of facilities (i.e., excluded 186 pairs).[43]

[43] The question regarding explanation of transplant ineligibility had fewer observations because this survey question is restricted to beneficiaries who responded "yes" to the preceding question, "Are you eligible for a kidney transplant?" Therefore, some additional facilities were excluded if they had 10 or fewer responses to this question, even if they had more than 10 beneficiary responses on all other questions.

Exhibits H-2 and **H-3** show the questions used from the ICH CAHPS survey for the global ratings measures, composite scores, and individual survey items.

Exhibit H-2. ICH CAHPS Global Ratings and Select Individual Questions

	Question	Response
Global Ratings	**Rating of Nephrologist (Q8):** Using any number from 0 to 10, where 0 is the worst kidney doctors possible and 10 is the best kidney doctors possible, what number would you use to rate the kidney doctors you have now?	0 = Worst to 10 = Best
	Rating of Dialysis Center Staff (Q32): Using any number from 0 to 10, where 0 is the worst dialysis center staff possible and 10 is the best dialysis center staff possible, what number would you use to rate your dialysis center staff?	0 = Worst to 10 = Best
	Rating of the Dialysis Center (Q35): Using any number from 0 to 10, where 0 is the worst dialysis center possible and 10 is the best dialysis center possible, what number would you use to rate this dialysis center?	0 = Worst to 10 = Best
Individual Items	**Q33:** In the last 3 months, when you arrived on time, how often did you get put on the dialysis machine within 15 minutes of your appointment or shift time?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q38: In the last 12 months, has a doctor or dialysis center staff explained to you why you are not eligible for a kidney transplant?	1 = Yes, 2 = No

Exhibit H-3. ICH CAHPS Questions Included in Composite Scores

	Question	Response
Nephrologists' Communication & Caring	**Q3:** In the last 3 months, how often did your kidney doctors listen carefully to you?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q4: In the last 3 months, how often did your kidney doctors explain things in a way that was easy for you to understand?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q5: In the last 3 months, how often did your kidney doctors show respect for what you had to say?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q6: In the last 3 months, how often did your kidney doctors spend enough time with you?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q7: In the last 3 months, how often did you feel your kidney doctors really cared about you as a person?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q9: Do your kidney doctors seem informed and up-to-date about the health care you receive from other doctors?	1 = Yes, 2 = No
Quality of Dialysis Center Care & Operations	**Q10:** In the last 3 months, how often did the dialysis center staff listen carefully to you?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q11: In the last 3 months, how often did the dialysis center staff explain things in a way that was easy for you to understand?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always

	Question	Response
Quality of Dialysis Center Care & Operations (cont'd)	**Q12:** In the last 3 months, how often did the dialysis center staff show respect for what you had to say?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q13: In the last 3 months, how often did the dialysis center staff spend enough time with you?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q14: In the last 3 months, how often did you feel the dialysis center staff really cared about you as a person?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q15: In the last 3 months, how often did dialysis center staff make you as comfortable as possible during dialysis?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q16: In the last 3 months, did dialysis center staff keep information about you and your health as private as possible from other patients?	1 = Yes, 2 = No
	Q17: In the last 3 months, did you feel comfortable asking the dialysis center staff everything you wanted about dialysis care?	1 = Yes, 2 = No
	Q21: In the last 3 months, how often did dialysis center staff insert your needles with as little pain as possible?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always, 5 = I insert my own needles
	Q22: In the last 3 months, how often did dialysis center staff check you as closely as you wanted while you were on the dialysis machine?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q24: In the last 3 months, how often was the dialysis center staff able to manage problems during your dialysis?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q25: In the last 3 months, how often did dialysis center staff behave in a professional manner?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q26: In the last 3 months, did dialysis center staff talk to you about what you should eat and drink?	1 = Yes, 2 = No
	Q27: In the last 3 months, how often did dialysis center staff explain blood test results in a way that was easy to understand?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q33: In the last 3 months, when you arrived on time, how often did you get put on the dialysis machine within 15 minutes of your appointment or shift time?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always

	Question	Response
Quality of Dialysis Center Care & Operations (cont'd)	**Q34:** In the last 3 months, how often was the dialysis center as clean as it could be?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
	Q43: In the last 12 months, how often were you satisfied with the way they handled these problems?	1 = Never, 2 = Sometimes, 3 = Usually, 4 = Always
Providing Information to Patients	**Q19:** The dialysis center staff can connect you to the dialysis machine through a graft, fistula, or catheter. Do you know how to take care of your graft, fistula, or catheter?	1 = Yes, 2 = No
	Q28: As a patient you have certain rights. For example, you have the right to be treated with respect and the right to privacy. Did this dialysis center ever give you any written information about your rights as a patient?	1 = Yes, 2 = No
	Q29: Did dialysis center staff at this center ever review your rights as a patient with you?	1 = Yes, 2 = No
	Q30: Has dialysis center staff ever told you what to do if you experience a health problem at home?	1 = Yes, 2 = No
	Q31: Has any dialysis center staff ever told you how to get off the machine if there is an emergency at the center?	1 = Yes, 2 = No
	Q36: You can treat kidney disease with dialysis at a center, a kidney transplant, or with dialysis at home. In the last 12 months, did your kidney doctors or dialysis center staff talk to you as much as you wanted about which treatment is right for you?	1 = Yes, 2 = No
	Q38: In the last 12 months, has a doctor or dialysis center staff explained to you why you are not eligible for a kidney transplant?	1 = Yes, 2 = No
	Q39: Peritoneal dialysis is dialysis given through the belly and is usually done at home. In the last 12 months, did either your kidney doctors or dialysis center staff talk to you about peritoneal dialysis?	1 = Yes, 2 = No
	Q40: In the last 12 months, were you as involved as much as you wanted in choosing the treatment for kidney disease that is right for you?	1 = Yes, 2 = No

Exhibit H-4 displays summary statistics and the regression results for the eight examined ICH CAHPS measures.

Exhibit H-4. Summary of Impact of CEC on ICH CAHPS Measures

Measure (Response)	ESCO Wave	Performance Year	Average Response[a]				DiD
			CEC Facilities[b]		Comparison Facilities[b]		
			Pre-CEC	Post-CEC	Pre-CEC	Post-CEC	
Rating of Kidney Doctors (Top - 9 or 10) [c]	1	PY1	54.6%	57.0%	59.0%	60.0%	1.5
	1	PY2	54.6%	58.0%	59.0%	60.1%	2.3*
	2	PY2	58.2%	58.0%	59.0%	60.1%	-1.2
Rating of Dialysis Center Staff (Top - 9 or 10) [c]	1	PY1	56.4%	57.8%	59.6%	59.6%	1.4
	1	PY2	56.4%	59.0%	59.6%	61.4%	0.8
	2	PY2	58.0%	58.9%	59.6%	61.4%	-0.9
Rating of Dialysis Center (Top - 9 or 10) [c]	1	PY1	61.6%	63.7%	64.7%	64.5%	2.2
	1	PY2	61.6%	64.1%	64.7%	66.4%	0.8
	2	PY2	62.7%	64.1%	64.7%	66.4%	-0.2
Seen within 15 Minutes (Always) [d]	1	PY1	36.7%	38.2%	39.3%	39.9%	0.9
	1	PY2	36.7%	40.6%	39.3%	42.1%	1.1
	2	PY2	39.2%	41.0%	39.3%	42.1%	-1.0
Explained Transplant Ineligibility (Yes) [d]	1	PY1	67.2%	68.7%	69.4%	69.3%	1.6
	1	PY2	67.2%	68.0%	69.4%	70.0%	0.2
	2	PY2	70.2%	69.5%	69.4%	70.0%	-1.3
Nephrologists' Communication & Caring (Always or Yes) [e]	1	PY1	64.6%	66.9%	66.4%	67.5%	1.2
	1	PY2	64.6%	67.1%	66.4%	67.2%	1.7
	2	PY2	66.9%	66.9%	66.4%	67.2%	-0.8
Quality of Dialysis Center Care & Operations (Always or Yes) [e]	1	PY1	58.9%	59.7%	60.4%	60.4%	0.7
	1	PY2	58.9%	60.7%	60.4%	61.9%	0.3
	2	PY2	59.9%	60.0%	60.4%	61.9%	-1.4
Providing Information to Patients (Yes) [e]	1	PY1	77.5%	78.0%	79.0%	78.8%	0.7
	1	PY2	77.5%	78.2%	79.0%	79.1%	0.5
	2	PY2	78.1%	77.9%	79.0%	79.1%	-0.4

Note: (a) Responses are weighted and risk adjusted facility-level averages (please see **B. Methods** above for additional detail); (b) all measures included results for 429 of 632 total matched facilities, except the Explained Transplant Ineligibility measure, which included 427 matched facilities; (c) denotes the three global ratings measures; (d) denotes the two individual survey items; (e) denotes the three composite score measures; asterisks denote varying levels of statistical significance: *** for $p \leq 0.01$, ** for $p \leq 0.05$, and * for $p \leq 0.1$.

Appendix I: Estimation of Probability of Impact

In addition to the DiD impact analyses above, we estimated the probability of CEC impacts, overall and by wave, for total standardized Medicare Part A and Part B payments (**Exhibit I-1**). Probability estimates are useful for addressing essential policy questions about the likelihood that a program had the intended or desired impacts (or conversely, unintended or undesired impacts). P-values associated with impact estimates do not provide this information,[44] and for many stakeholders, probability statements are easier to interpret.

We calculated probabilities for total standardized Medicare Part A and Part B payments. We evaluated two approaches for computing impact probabilities: (1) probabilities derived from a Bayesian analysis, and (2) an approximation of these probabilities based on our main "frequentist" impact analyses described above.

A Bayesian approach is often used to directly calculate probabilities. The Bayesian methodology assumes that model parameters are unknown quantities. As a result, the Bayesian methodology calculates a distribution of possible values for every model parameter. From this distribution, it is possible to directly compute the probability that an estimated coefficient lies within a range of values.

In contrast, a traditional frequentist approach assumes that all model parameters are fixed. Any variation that exists in a frequentist approach is entirely due to randomness in the data, and because parameters are believed to be fixed, it is not possible to directly calculate the probability that a parameter value lies within a certain range. Frequentist estimates and standard errors can be combined with a normal distribution to approximate the probabilities generated by a Bayesian model. In fact, research has shown that when there is minimum prior information incorporated into the Bayesian framework, the results obtained from a frequentist analysis closely approximate the results from a Bayesian approach. These conditions are true for the CEC evaluation, and when we compared Bayesian and frequentist regression analyses, the results were nearly identical.

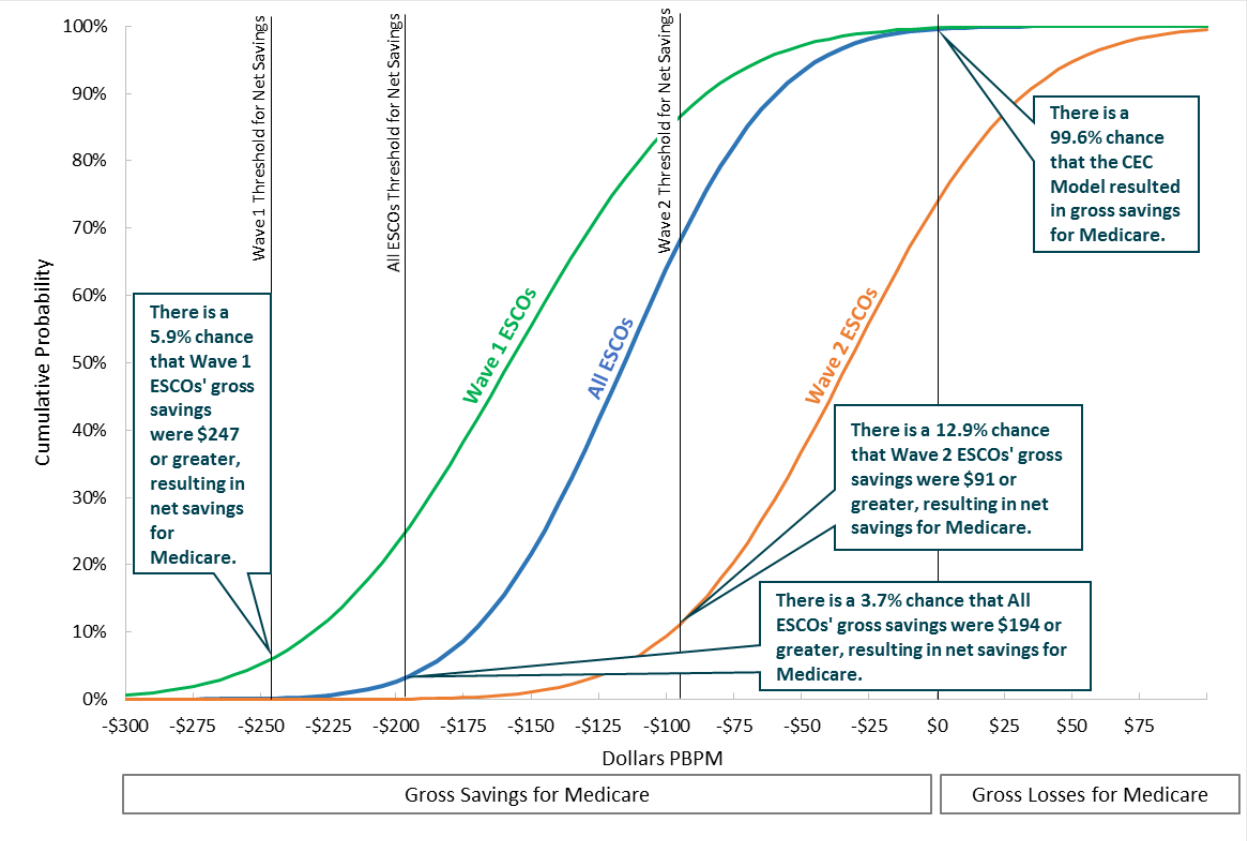
In the case of the CEC evaluation, there is an important advantage of estimating probabilities from frequentist results rather than directly calculating Bayesian probabilities: frequentist probabilities can take into account clustering at the beneficiary and facility level. Within a facility, there are likely common practice patterns or actions that can similarly affect outcomes (i.e., beneficiary outcomes are not independent and will be correlated at the facility level). In addition, when you observe the same beneficiary overtime, the data from the beneficiary are not likely to be independent observations. Clustering of beneficiary outcomes at the facility and beneficiary level is well documented. Not accounting for clustering of the data will produce standard errors that are smaller than the true standard errors, and tend to overstate the significance of findings.

The frequentist approach had several statistical and computational advantages, so the probabilities reported below were based on that approach. We estimated a distribution for each

[44] In contrast, the p-value indicates how well the data support the null hypothesis that there is no difference between groups (in this case, between CEC and comparison groups).

impact derived from the DiD analyses. Specifically, we estimated a normal distribution, with the mean and standard deviation equal to the DiD estimate and the corresponding standard error (with an adjustment to account for clustering), respectively. The probability that the impact was a particular value (e.g., fell above or below zero) was estimated from this distribution. **Exhibit I-1** displays the cumulative probability distribution associated with the impact of CEC on total non-standardized Medicare Part A and Part B payments, with and without factoring in the shared savings payments CMS made to ESCOs. We found that there is a high probability (99.6%) that total Medicare spending decreased by any amount. In other words, there were positive gross savings for Medicare. To assess the likelihood of net savings taking into account the shared savings payments to ESCOs, we estimated the probability that Medicare savings were greater than the average shared savings payments. We found that there is a low probability (3.7%) that all ESCOs were able to achieve the necessary savings to offset the average shared savings payments of $194 PBPM, and thus reach the threshold for net savings for Medicare. The likelihood of net savings varied by wave due to the differential impact each wave had on Medicare payments and the different shared savings amounts ESCOs in each wave received. On average, Wave 1 ESCOs received $247 PBPM in shared savings payments, while Wave 2 ESCOs received much less, $91 PBPM. As a result, whereas Wave 1 ESCOs had a 5.9% chance of generating net savings for Medicare, the probability was higher (12.9%) for Wave 2 ESCOs.

Exhibit I-1. Cumulative Probability Estimates for Changes in Total Medicare Part A and Part B Payments PBPM



Appendix J: Standardized Measures Methodology

This appendix defines the methodology used to create and evaluate standardized measures. Each measure is discussed individually with results summarized at the end of the section.

A. Standardized Measures

1. Data Sources

The CMS's CCW was the main data source for this annual report. We used Medicare claims data, beneficiary characteristics (e.g., demographics and enrollment), and CCW condition indicators.[45] This report includes CCW claims from January 1, 2014 through December 31, 2017 that were processed by March 31, 2018.[46] All CCW claims were final action claims and had a minimum of three months of run out.[47]

For the calculation of standardized measures, we used claims data from the CCW to identify hospitalization admission and discharge dates, primary diagnosis code for hospital admissions, and comprehensive listings of diagnosis codes across all institutional settings.

We also extracted patient data from Consolidated Renal Operations in a Web-enabled Network (CROWNWeb) to complete the patient history. For the second annual report, data were pulled from the January 2018 quarterly file (for data through December 2017) extracted from CROWNWeb.

Patient demographic and clinical information were extracted from the CMS ESRD Medical Evidence Report form (Form-2728). These data included, but were not limited to, primary cause of renal failure, cause of renal failure groupings, height, race, dry weight, physician name, dialysis type, and incident comorbidities.

The ESRD Death Notification form (Form-2746) provided data relating to primary causes of death for patients with ESRD.

The first service date was extracted from the Renal Management Information System (REMIS).

The Long-term Care Minimum Data Set (MDS) identified prior year nursing home status for adjustment to the models for mortality and hospitalization, respectively. For the annual report, the complete MDS 2017 assessments were obtained in the April 24, 2018 download from CMS.

[45] The CCW condition indicators are claims-based algorithms that identify beneficiaries with select clinical conditions (e.g., diabetes, hyperlipidemia, hypertension, etc.) https://www.ccwdata.org/web/guest/condition-categories.

[46] Kidney transplants are an exception, which also included claims that ended in 2011 to assess the kidney transplant exclusion criterion in 2012 (i.e., excluded in the 12 months following the month of a transplant).

[47] The analytic CCW claims files are based on final action claims. We used final action claims only to avoid internal data inconsistencies caused by use of original claims (e.g., we observed beneficiaries aligned based on original claims for whom we found no final action claims).

B. Methods

1. Monthly Patient Eligibility

Monthly eligibility criteria were incorporated into the standardized measures. Specifically, in the calculation of standardized hospitalization ratio (SHR) and SMR, if a patient is not eligible during the month, the time at risk and events that occur during the month (hospital admissions or deaths) are both excluded from the calculation. For SRR, hospital admissions that occur during an ineligible month are not counted as an index discharge, and the readmission associated with the ineligible index discharge is removed. However, if the readmission itself happens in an eligible month and it does not meet any of the exclusion criteria, then the readmission is kept as a new individual index discharge.

C. Standardized Hospitalization Ratio Methodology

This section reviews the techniques used to compute the SHR. First, we review patient assignment and development of measures used to compute the SHR. Then we describe the risk-adjusted model for the expected number of events during a given time period and the creation of the SHR measure.

1. Patient Assignment

Patient assignment to an ESCO begins after a patient has had ESRD for at least 90 days. A patient's time at risk is attributed to an ESCO after he/she has had ESRD for at least 90 days, and has been aligned in that ESCO for at least 60 days. If the patient had been treated in that ESCO for more than 60 days prior to January 1, 2012, that patient's time at risk is attributed to that ESCO as of January 1, 2012. If the patient had been treated for fewer than 60 days and aligned on January 1, 2012 to the ESCO, the patient's time at risk attributed to the ESCO facility would begin on day 61. Time at risk ends at the earliest occurrence of the following: three days prior to a transplant, date of death, end of ESCO alignment plus 60 days. As mentioned above, after we determine patient assignment, we exclude the ineligible time at risk and death events according to the monthly eligibility criteria.

Patient Exclusions:

- Beneficiaries with a missing ESRD Medical Evidence Form (Form-2728) in CROWNWeb
- Beneficiaries with a missing date of birth or sex

2. Ratio Calculation

a. Observed/Expected (O/E)

The SHR is calculated by dividing the observed total admissions (O) by the expected total admissions (E). It enables comparison of the ESCO's experience to the national average. A value of less than 1.0 indicates that the ESCO's total number of admissions was less than expected, based on national rates; whereas a value of greater than 1.0 indicates that the facility had total admissions higher than expected, based on national rates.

b. Observed Number of Hospital Admissions

O equals the observed number of hospital admissions among the patients assigned to this ESCO in the CY. Admissions are counted at the discharge date. When applicable, admissions are bridged according to the discharge dates and admission dates. When there is one day between a discharge and admission, these events are bridged and a single admission is counted. If there is more than one day between two hospitalization events, then both events would be counted as hospital admissions.

c. Expected Number of Hospital Admissions

The expected number of hospital admissions among patients assigned to this ESCO in a CY equals *E*. The expected number of hospital admissions is calculated based on national rates for hospital admissions in the same year using a Cox model adjusting for patient age, sex, diabetes, duration of ESRD, nursing home status, patient comorbidities at incidence, BMI at incidence, and CY. Duration of ESRD is divided into six intervals with cut points at six months, one year, two years, three years, and five years; hospitalization rates are estimated separately within each interval. The baseline rate is assumed to be constant within each of these six intervals and are denoted as $\alpha_1,\ldots,\alpha_6$.

For each patient, the time at risk in each ESRD interval is multiplied by the (adjusted) national admissions rate for that interval, and a sum over the intervals gives the expected number of admissions for each patient. Let *q* denote the number of patient characteristics being incorporated into the model, and note that these characteristics will include both main effect and interaction terms. Most covariates are fixed at entry for patients in the model, but some, such as nursing home status, can change over time. Let Z_{ijk} be the specific value of the *j*–th patient in the *i*–th ESRD within period *k*. The risk adjustment factor is given by

$$R_{ijk} = \exp(\beta^T Z_{ijk})$$

where β is the regression coefficient. Technical details for estimating β are provided below.

Let t_{ijk} represent the days at risk (until the current evaluation time) for patient *j* in ESCO *i* and in the kth interval with estimated rate α_k (defined in the first paragraph of this subsection). The corresponding expected number of hospital admissions in the kth interval for this patient j is calculated as

$$E_{ijk}=\alpha_k t_{ijk} R_{ijk}$$

It should be noted that t_{ijk} and hence can be 0 if patient *j* is never at risk during the *k*-th interval. Summing the E_{ijk} over all six intervals and all *N* patients in a given ESCO gives the expected number of hospital admissions during follow-up at that ESCO. Details for variables included in the models may be found in ***Model Variables section***, below.

d. Risk-Adjusted Model for Computing Expected Number of Hospital Admissions

The calculation of expected hospital admissions is based on a two-stage model. In the first stage, the Cox model with piecewise-constant baseline rates stratified by facilities is used to estimate regression parameters associated with $\hat{\beta}^T Z_{ij}$, e.g., the baseline hospitalization rate function for the *j*-th patient in the *i*-th facility is assumed as

$$\lambda_{ij}(t) = \lambda_0(t)\exp(\hat{\beta}^T Z_{ij}),$$

where Z_{ij} is a vector of adjustment covariates, β is the corresponding parameter, and $\lambda_{0i}(t)$ is the facility-specific baseline hospitalization rate function. This approach avoids complicated issues arising from, for example, interactions between patient characteristics and facility effects. In the second stage, the population baseline hospitalization rate function is computed through an unstratified Cox model using $\hat{\beta}^T Z_{ij}$ as an offset, i.e., the baseline hospitalization rate function for the *j*-th patient in the *i*-th facility is assumed as

$$\lambda_{ij}(t) = \lambda_0(t)\exp(\hat{\beta}^T Z_{ij}),$$

where $\lambda_0(t)$ is the common baseline hospitalization rate function. For computation purposes, we adopt piecewise constant baseline rates, i.e., the baseline rate is assumed to be a piecewise constant function with six intervals (91 days-six months, six months-one year, one-two years, two-three years, three-five years, or five or more years duration of ESRD) and a separate level or rate in each interval.[48] We denote the estimated rates obtained at stage 2 as $\alpha_1, \ldots, \alpha_6$.

D. Standardized Readmission Ratio Methodology

This section reviews the methods used to compute the SRR. First, we review patient assignment and development of measures used to compute the SRR. Then we describe the risk-adjusted model for the expected number of events during a given time period and the creation of the SRR measure.

1. Patient Assignment

The SRR measure for an ESCO is a measure of 30-day unplanned hospital readmission for dialysis patients discharged from any Acute Care Hospital (ACH). The SRR is defined to be the ratio of the number of index discharges for Medicare-covered dialysis patients from ACHs that resulted in an unplanned readmission to an ACH within 30-days of discharge to the number of readmissions that would be expected (considering the discharging hospitals, patient characteristics and national norm for dialysis facilities). Note that in this document, "hospital" always refers to ACH. Identification of an eligible *index hospital discharge* and a corresponding eligible readmission drives the SRR measure. When we consider eligibility of an event for SRR, monthly eligibility status in an ESCO determines the eligibility of an index discharge along with other criteria, as discussed in detail below.

[48] This specification was developed by Liu D, Kalbfleisch JD, Schaubel DE.Stat Biosci. 2014 May 1;6(1):19-37. Methods for Estimating Center Effects on Recurrent Events.

The SRR was calculated from January 1, 2014 to December 31, 2017. For the annual SRR measures, the eligible indexed discharge date determines the year in which any corresponding readmission would be counted. For example, if an eligible hospitalization began in December 30, 2014, with a corresponding discharge date on January 4, 2015, the index discharge would be counted in 2015. If an index discharge occurred in December 2014 but the eligible readmission occurred in January 2015, this readmission would be counted in 2014.

Monthly eligibility status guides if a discharge is considered to be an indexed discharge. For example, if an admission occurs during an ineligible month but the corresponding discharge date occurs during an eligible month, then the index discharge is eligible, assuming other criteria are met. If a readmission occurs during an ineligible month but the index discharge occurs during an eligible month, the readmission will count against that eligible index discharge.

Index discharges are restricted to Medicare-covered hospitalizations for inpatient care at short-term ACHs and critical access hospitals. Discharges from skilled nursing facilities (SNFs), long-term care hospitals, rehabilitation hospitals, and Prospective Payment System (PPS)-exempt cancer hospitals – as well as those from separate dedicated units for hospice, rehabilitation, and psychiatric care – are excluded. To be counted as an index discharge, the patient must be receiving dialysis treatment for ESRD at the time of discharge.

2. Patient Exclusions

In addition to monthly eligibility requirements, the SRR denominator (index discharge) excludes hospitalizations:

- For patients who died during the hospitalization (*Rationale: There was no opportunity for readmission*);
- That are followed within 30-days by the patient's death (and no readmission);
- For patients who were discharged against medical advice (*Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge*);
- That include a primary diagnosis of medical treatment of cancer, certain psychiatric conditions, or rehabilitation for prosthesis[49] (*Rationales: Admissions for medical treatment of cancer have a different mortality and readmission profile than the rest of the Medicare population, and outcomes for these admissions do not correlate well with outcomes for other admissions; patients admitted for psychiatric treatment are typically cared for in separate psychiatric or rehabilitation centers that are not comparable to short-term ACHs; rehabilitation for prosthesis admissions are not typically to a short-term ACH and are not for acute care*);
- That occur after a patient's 12th hospital admission in the time period *(Rationale: During the technical expert panel's review of the SRR measure, members were concerned that, especially for small facilities, allowing a patient at high risk of readmission (e.g., an HIV-positive patient) to contribute without limit to the denominator and numerator could unfairly skew that facility's measure. In response to this concern, hospitalizations following an individual patient's 12th discharge in the time period were excluded.*

[49] See http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp for descriptions of the AHRQ Clinical Classifications Software (CCS) used to identify these conditions.

Sensitivity analyses excluding this cap (representing 0.8% of 2012 hospital discharges) led to only small changes in the flagging rate for smaller facilities);

- That took place at PPS-exempt cancer hospitals *(Rationale: These hospitals care for a unique population of patients that cannot reasonably be compared to patients admitted to other hospitals);*[50]
- That result in a transfer to another acute care facility *(Rationale: For patients who are transferred between one ACH and another, the measure considers these multiple contiguous hospitalizations as a single acute episode of care, and readmission for transferred patients is attributed to the hospital that ultimately discharges the patient to a non-acute care setting).*

The event is defined as an unplanned readmission to an ACH, with exclusions as stated above, within 30-days of the discharge date for the index hospitalization. Planned and unplanned readmissions are identified using Version 1.0 of the algorithm developed by the Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation for the Hospital-Wide All-Cause Unplanned Readmission Measure that was endorsed in 2012 (National Quality Forum [NQF] #1789).[51] Hospitalizations are counted as events in the numerator if they meet the definition of an unplanned readmission that (a) occurred within 30-days of a hospital discharge and (b) was not preceded by a "planned" readmission that also occurred within 30-days of discharge. A readmission is considered "planned" under two scenarios:[52]

1. The patient undergoes a procedure that is always considered planned (e.g., bone marrow transplant) or has a primary diagnosis that always indicates the hospitalization is planned (e.g., maintenance chemotherapy). These are identified using Clinical Classifications Software (CCS) groupers (see http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp for descriptions of each Condition Category [CC]).
2. The patient undergoes a procedure that may be considered planned if it is not accompanied by an acute diagnosis. For example, a hospitalization involving a heart valve procedure accompanied by a primary diagnosis of diabetes would be considered planned, whereas a hospitalization involving a heart valve procedure accompanied by a primary diagnosis of acute myocardial infarction would be considered unplanned. These are identified using a combination of CCS groupers and individual International

[50] CMS 2016 All-Cause Hospital-Wide Measure Updates and Specifications Report: Hospital-Level 30-Day Risk Standardized Readmission Measure –Version 5.0, submitted by Yale New Haven Health Service Corporation/Center for Outcomes Research & Evaluation (YNHHSC/CORE), March 2016. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Downloads/Hospital-Visits-after-Hospital-Outpatient-Surgery-Measure.pdf In developing the SRR measure CMS wanted the Dialysis Facility SRR to align with the Hospital Wide Readmission (HWR) measure to the greatest extend possible. To that end the SRR adopted the exclusion criteria applied in the HWR measure by Yale Center for Outcomes Research, the measure developer.

[51] Hospital-Wide All-Cause Unplanned Readmission Measure Final Technical Report. Contract number: HHSM-500-2008-0025I/HHSM-500-T0001, Modification No. 000007. Prepared For: Centers for Medicare & Medicaid Services (CMS). July 2012. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Measure-Methodology.html

[52] Report for the Standardized Readmission Ratio. Contract number: HHSM-500-2013-13017I. Prepared for Centers for Medicare & Medicaid Services (CMS). June 2014. https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/ESRDQIP/Downloads/MeasureMethodologyReportfortheProposedSRRMeasure.pdf

Classification of Diseases (ICD) codes (9th Revision [ICD-9]: before October 2015; 10th Revision [ICD-10]: after October 2015).

A planned admission itself can be an index discharge; however, it will never be considered a planned readmission.

3. Additional Patient Exclusions:

- Beneficiaries with a missing ESRD Medical Evidence Form (Form-2728) in CROWNWeb
- Beneficiaries with a missing date of birth or sex

4. Ratio Calculation

a. Observed/Expected

The SRR measure is useful for examining whether facility-specific readmission rates are in line with the national average across all dialysis facilities (adjusted for case mix). The SRR reflects the number of readmission events for patients in an ESCO, relative to the number of readmission events that would be expected, based on overall national rates, and the characteristics of the patients at that ESCO as well as the number of discharges. An ESCO that experienced readmissions at a rate higher than the national average will see its SRR larger than 1.0. In contrast, an ESCO experiencing readmissions at a rate lower than the national average will see its SRR smaller than 1.0.

b. Observed Number of Readmissions

Observed event: the actual number of readmission events over a specified time period. Please see the details above.

Expected event: the number of readmission events that would be expected if patients at the facility experienced readmission events at the national median rate for patients with similar characteristics.

To monitor readmission rates, let X_{ij} denote the observed outcome for the *j*-th discharge within the *i*-th facility. To compute SRR, *j* is sorted based on the time of discharge. Furthermore, X_{ij}=1 if the *j*-th discharge in ESCO *i* results in a readmission within 30-days, and X_{ij}=0 otherwise. The observed number of events (until the *t*-th observations) for the ESCO is given by

$$O_{it} = \sum_{j=1}^{t} X_{ij}$$

c. Expected Number of Readmissions

The expected number of events in one ESCO until the *t*-th discharge is computed as $\sum_{j=1}^{t} P_{ijM}$, where P_{ijM} represents the expected probability if the ESCO under investigation has the same

effects as the population average (benchmark: defined as the median facility effect across all dialysis facilities), e.g.,

$$P_{ijM} = \frac{\exp(\gamma_M + \beta^T Z_{ij})}{1 + \exp(\gamma_M + \beta^T Z_{ij})}$$

with γ_M being the median population effect. The estimates for β and γ_M are calculated by fitting a logistic regression model. Regression adjustments include age, race, ethnicity, sex, duration of ESRD, diabetes as cause of ESRD, BMI at incidence, days hospitalized during index hospitalization, past-year comorbidities, high-risk diagnosis groups, and CY. Details for variables included in the models may be found in ***Model Variables section***, below.

5. Risk-Adjusted Model for Computing Expected Number of Readmissions

We consider a logistic model in which facilities are represented as fixed effects. This leads to a regression model of the form:

$$logit(P_{ij}) = \log\left(\frac{P_{ij}}{1-P_{ij}}\right) = \gamma_i + \beta^T Z_{ij}, \quad (1C)$$

where P_{ij} is the probability of readmission for the *j*-th discharge assigned to facility *i*, Z_{ijk} is a vector of adjustment covariates for this discharge and β are the corresponding coefficients. The parameter γ_i corresponds to the fixed facility effects in the sense that a large value of γ_i would indicate that the *i*-th facility performs more poorly.

E. Standardized Mortality Ratio Methodology

This section presents the methods used to compute the SMR. First, we review patient assignment and development of measures used to compute the SMR. Then we describe the risk-adjusted model for the expected number of events during a given time period and the creation of the SMR measure.

1. Patient Assignment

For SMR, patient time at risk determines the duration of time over which the death of a patient would be attributed to that particular ESCO, therefore counting as an observed event. Patient time at risk is attributed to an ESCO after he/she has had ESRD for at least 90 days, and has been aligned to that ESCO for at least 60 days.[53] If the patient had been treated in that ESCO for more than 60 days prior to January 1, 2012, that patient's time at risk would be attributed to that ESCO

[53] Since a patient's follow-up in the database can be incomplete during the first 90 days of ESRD therapy, we only include a patient's follow-up into the measure after that patient has received chronic renal replacement therapy for at least 90 days. This minimum 90-day period also assures that most patients are eligible for Medicare, either as their primary or secondary insurer. It also excludes from analysis patients who die or recover renal function during the first 90 days of ESRD. In order to exclude patients who only received temporary dialysis therapy, we assign patients to a facility only after they have been on dialysis there for the past 60 days. This 60-day period is used both for patients who started ESRD for the first time and for those who returned to dialysis after a transplant. For additional details see https://dialysisdata.org/sites/default/files/content/ESRD_Measures/nqf/SMR%20MIF.pdf

as of January 1, 2012. If the patient had been treated for fewer than 60 days at the ESCO and aligned on January 1, 2012, the patient's time at risk attributed to the ESCO facility would begin on day 61. Time at risk ends at the earliest occurrence of the following: one day prior to a transplant, date of death, end of ESCO alignment plus 60 days.[54] As mentioned above, after we determine patient assignment, we exclude the ineligible time at risk and death events according to the monthly eligibility criteria.

Patient exclusions:

- Beneficiaries with a missing ESRD Medical Evidence Form (Form-2728) in CROWNWeb
- Beneficiaries with a missing date of birth or sex

2. Ratio Calculation

a. Observed/Expected

The SMR is useful for examining whether facility-specific mortality rates are in line with the national average across all dialysis facilities (adjusted for case mix) and provides additional assurance that the CEC Model is not adversely impacting patient survival. The annual SMR is the actual number of deaths divided by the expected number of deaths during the CY. An ESCO that experienced deaths at a rate higher than the national average will see its SMR larger than 1.0. In contrast, an ESCO experiencing deaths at a rate lower than the national average will see its SMR smaller than 1.0.

b. Observed Number of Deaths

O equals the observed number of deaths among the patients attributed to an ESCO during the CY. This count does not include deaths from street drugs or accidents unrelated to treatment. Cause of death data are obtained from the CMS ESRD Death Notification form (Form-2746). Deaths from street drugs or accidents unrelated to treatment vary by facility, with certain facilities (in particular, urban facilities that treated large numbers of male and young patients) reporting proportionally higher number of deaths from these causes when compared to other facilities.[55] Since these deaths are unlikely to have been due to treatment facility characteristics, we excluded them from the observed number of deaths calculations.

[54] This rule is used in the mortality (SMR), hospitalization (SHR), and transfusion standardized outcome measures publically reported on Dialysis Facility Compare. It applies to both discharging dialysis and admitting facilities. Patient outcomes continue to be attributed to a dialysis facility for up to 60 days after the patient leaves that facility and, therefore, are not attributed to a patient's new facility until 60 days after their admission date. The rule attempts to acknowledge the delayed clinical consequences of dialysis facility care provided in the recent past (e.g., cumulative infection risk associated with specific vascular access use, cumulative risks of inadequate dialysis or fluid management).

[55] Turenne MN, Loos ME, Port FK, Emmert G, Hulbert-Shearon TE, Wolfe RA, Levine GN, Daugirdas JT, Agodoa LYC, Held PJ. The impact of deaths due to AIDS, accidents, and street drugs on standardized mortality ratios (SMRs) by facility. U.S. Renal Data System and University of Michigan, Ann Arbor. Poster presented at the American Society of Nephrology, New Orleans, LA, November 1996. Abstracts –*J Am. Soc Nephrol* 1996;7:1467.

c. Expected Number of Deaths

E equals the expected number of death events among the patients assigned to this ESCO during the CY. The expected number of deaths is calculated based on a Cox risk model, adjusting for patient age, race, ethnicity, sex, diabetes, duration of ESRD, nursing home status, patient comorbidities at incidence, patient BMI at incidence, and CY. The model also controls for age-adjusted population death rates by state and race, based on the US population in 2012-2014.[56]

For mortality, the expected number of events is computed as

$$E_i(t) = \sum_{j=1}^{n_i} \int_0^t Y_{ij}(u) \exp\left(\hat{\beta}^T Z_{ij}\right) d\,\hat{\Lambda}_0\left(u;\hat{\beta}\right),$$

where β is the at risk indicator at time *u*, Z_{ij} is the covariate vector for the *j*-th patient in ESCO *i*, $Y_{ij}(u)$ is the estimated coefficients for adjustment variables and $\hat{\Lambda}_0(t;\hat{\beta})$ is the estimated national average cumulative baseline hazard (benchmark is defined as the average facility effect across all dialysis facilities). Details for variables included in the models may be found in ***Model Variables section***, below.

3. Risk-Adjusted Model to Compute the Expected Mortality

The risk-adjusted model used to compute the expected number of deaths is discussed below.

Subscript *i* represents the facility and subscript *j* represents the individual patient-level values. Let *F* be the total number of facilities. The total number of patients is denoted by $n = \sum_{i=1}^{F} n_i$, where n_i is the number of subjects in facility *i*. Let T_{ij} represent the survival time and C_{ij} represent censoring time[57] (transplant; move out of facility; end of study period) for the *j*-th patient in facility *i*. Observation times are denoted by $X_{ij} = T_{ij} \wedge C_{ij}$, with at risk indicator $Y_{ij}(t) = I(X_{ij} \geq t)$, where $a \wedge b = \min(a, b)$ and $I(A)$ is an indicator function taking the value 1 when condition A holds and 0 otherwise. The observed death indicators are denoted by $\Delta_{ij} = I(T_{ij} \leq C_{ij})$, and the death counting process is defined as $N_{ij}(t) = \Delta_{ij} I(X_{ij} \leq t)$. The observed data consist of *n* independent vectors, $(X_{ij}, \Delta_{ij}, Z_{ij})$, where Z_{ij} is a vector of adjustment covariates.

The computation of E_{ij} (here, expected mortality for the *j*-th patient in the *i*-th facility) is done in a two-stage model. In the first stage, a Cox model stratified by dialysis facilities is used to estimate regression parameters associated with Z_{ij}, e.g., the hazard function for the *j*-th patient in the *i*-th facility is assumed as

$$\lambda_{ij}(t) = \lambda_0(t) \exp\left(\hat{\beta}^T Z_{ij}\right),$$

[56] Table 16, Health, United States, 2016 (http://www.cdc.gov/nchs/data/hus/2015/016.pdf).
[57] Censored at transplant; ineligibility/removal from ESCO; end of study period.

where β is the coefficients for adjustment variables and $\lambda_{0i}(t)$ is the facility-specific baseline hazard function. This approach avoids any problems that might arise with confounding between patient characteristics and facility effects.

In the second stage, the population average cumulative baseline hazard is computed through a stratified Cox model (with no covariates) using $\hat{\beta}^T Z_{ij}$ as an offset, i.e., the hazard function for the *j*-th patient in the *i*-th facility is assumed as

$$\lambda_{ij}(t) = \lambda_0(t)\exp(\hat{\beta}^T Z_{ij}),$$

where β is the estimated coefficients for adjustment variables and $\lambda_0(t)$ is the common baseline hazard function. The corresponding estimated cumulative baseline hazard is

$$\hat{\Lambda}_0(t;\hat{\beta}) = \sum_{j=1}^{n_i} \int_0^t \frac{dN_{ij}(u)}{\sum_{j=1}^{n_i} Y_{ij}(u)\exp(\hat{\beta}^T Z_{ij})},$$

where β is estimated from stage 1, i.e., the stratified Cox model.

F. Model Variables: Adjustors and Data Sources for the Mortality, Readmission, and Hospitalization Risk-Adjustment Models

The following are details on the risk adjustors and data sources for the mortality, readmission, and hospitalization risk-adjustment models used to calculate the respective expected values. All three models use each covariate unless otherwise indicated.

- ***Age*:** Patient age is derived from the date of birth in the Master Beneficiary Summary File (MBSF).
- ***Race and ethnicity*:** Race and ethnicity are determined from CMS's Medical Evidence Report form (2728 form) at the time of ESRD incidence. Race and ethnicity (i.e., Hispanic versus non-Hispanic) are included as separate covariates. These two covariates are included only in the mortality model.
- ***Sex*:** Patient sex is obtained from the MBSF.
- ***Diabetes as cause of ESRD*:** Patient primary cause of ESRD is obtained from his/her CMS 2728 form. When cause of ESRD is missing, it is assumed diabetes is not the cause of ESRD.
- ***Years with ESRD*:** Each patient's length of time on dialysis is determined using the first service date from the REMIS database.
- ***Nursing home status*:** In the mortality and hospitalization models, the MDS is used to determine if a patient was in a nursing home in the previous year.
- ***Comorbidities at incidence*:** Determined using a selection of comorbidities reported on the CMS 2728 form, namely alcohol dependence, atherosclerotic heart disease, cerebrovascular disease, COPD, CHF, diabetes (includes currently on insulin, on oral medications, without medications, and diabetic retinopathy), drug dependence, inability to ambulate, inability to transfer, malignant neoplasm, cancer, other cardiac disease,

peripheral vascular disease, and tobacco use (current smoker). Each comorbidity is included as a separate covariate in the mortality and hospitalization models.

- ***BMI at incidence*:** Patient BMI is based on the height and weight provided on his/her CMS 2728 form. When height and/or weight are missing, a BMI is imputed for the patient based on the average BMI of all patients—specific to sex, race, diabetic status, and age at ESRD incidence.
- ***CY***
- ***Population death rates*:** In the mortality model, age-adjusted population death rates (per 100,000) by state and race in 2012 to 2014 are obtained from the US Centers for Disease Control National Center for Health Statistics.[58]
- ***Days hospitalized during index hospitalization*:** In the readmissions model, each hospitalization's length is determined by taking the difference between the date of admission and the date of discharge available on the inpatient claim. For patients who are transferred between one ACH and another, the measure considers these multiple contiguous hospitalizations as a single acute episode of care, and the length is calculated by taking the difference between the date of admission for the first hospitalization and the date of discharge from the last hospitalization included.
- ***Past-year comorbidities (risk variables):*** In the readmissions model, all unique ICD diagnosis codes are identified for each patient reported on Medicare claims in the 365 days preceding (and inclusive of) the index discharge date. Note that SRR was developed to align with the risk adjustment approach of the CMS Hospital Wide All-Cause Readmission Measure. As part of this SRR includes risk adjustment for prevalent comorbidities (in the prior year) that are specifically associated with readmissions.[59] Five available claim types for codes are examined: inpatient, outpatient, SNF, hospice, and home health claims. These diagnosis codes are grouped by diagnosis area using CMS's HCCs.[60] The Condition Categories (CCs) used in the calculation of the readmissions model are:
    - CCs 177 and 178: Amputation status
    - CC 108: COPD
    - CC 79: Cardiorespiratory failure/shock
    - CC 46: Coagulation defects & other specified hematologic disorders
    - CCs 51 and 52: Drug and alcohol disorders
    - CCs 25 and 26: End-stage liver disease
    - CC 109: Fibrosis of lung or other chronic lung disorders

[58] Table 16, Health, United States, 2016 (http://www.cdc.gov/nchs/data/hus/2015/016.pdf)

[59] The SMR and SHR are the current production models in use. When they were originally developed they only included adjustment for a set of comorbidities at ESRD incidence. Note that the current SMR and SHR were updated in 2016 to include prevalent comorbidity adjustment however these measures are not in production and have not yet been implemented by CMS. They received final NQF endorsement in early 2017.

[60] Evaluation of the CMS-HCC Risk Adjustment Model Final Report, prepared by RTI International, March 2011 (https://www.cms.gov/Medicare/HealthPlans/MedicareAdvtgSpecRateStats/downloads/evaluation_risk_adj_model_2011.pdf)

- CCs 67-69, 100, and 101: Hemiplegia, paraplegia, paralysis
- CC 158: Hip fracture/dislocation
- CC 174: Major organ transplant (excluding kidney)
- CC 7: Metastatic cancer/acute leukemia
- CC 44: Other hematological disorders
- CCs 6 and 111-113: Other infectious disease & pneumonias
- CCs 10-12: Other major cancers
- CC 32: Pancreatic disease
- CCs 54-56, 58, and 60: Psychiatric comorbidity
- CC 77: Respirator dependence/tracheostomy status
- CC 38: Rheumatoid arthritis & inflammatory connective tissue disease
- CC 74: Seizure disorders & convulsions
- CC 2: Septicemia/shock
- CCs 8 and 9: Severe cancer
- CCs 1 and 3-5: Severe infection
- CCs 148 and 149: Ulcers

- ***Discharged with High-Risk Condition*:** In the readmissions model, a high-risk diagnosis is defined as any diagnosis area (grouped by the Agency for Healthcare Research and Quality [AHRQ] CCS) that was rare in the population but had a 30-day readmission rate of at least 40%. Note that high-risk diagnosis groups related to cancer or mental health are not index discharges, and so such diagnoses are not included. The CCS areas identified as high-risk are:
  - CCS 5: HIV infection
  - CCS 6: Hepatitis
  - CCS 56: Cystic fibrosis
  - CCS 57: Immunity disorders
  - CCS 61: Sickle cell anemia
  - CCS 190: Fetal distress and abnormal forces of labor
  - CCS 151: Other liver diseases
  - CCS 182: Hemorrhage during pregnancy; abruptio placenta; placenta previa
  - CCS 186: Diabetes or abnormal glucose tolerance complicating pregnancy; childbirth; or the puerperium
  - CCS 210: Systemic lupus erythematosus and connective tissue disorders
  - CCS 243: Poisoning by nonmedicinal substances

1. Standardized Measures Limitations

These measures utilize indirect standardization. While statistically appropriate for the data structure encountered with these outcomes, the resulting ambiguity in determining whether observed changes over time are due to changes in risk-adjusted expected events, observed events, or both, creates some difficulty. In addition, how these complex models, based on multiple years of data, adjust for the declining mortality and hospitalization relative to other risk adjusters is uncertain. Comparisons of standardized measures performance between the ESCOs and the comparison group within a given year can give a clearer picture, particularly when matching is used to select comparison groups.

In addition, the SRR has complex risk-adjustment and exclusion components based on diagnoses derived from Medicare claims data. The predictive models that calculate the expected re-hospitalization values were developed using ICD-9 diagnosis coding system several years prior to implementation in the CEC Evaluation. On October 1, 2015, CMS mandated conversion to ICD-10 based diagnosis coding. Initial crosswalks were developed, based on CMS-recommended General Equivalence Mappings (GEM) reference databases for ICD-9 to ICD-10 conversion. These crosswalks have been implemented in the SRR reported publicly on Dialysis Facility Compare in 2016. Additional changes to the crosswalk are planned, based on the initial experience with the crosswalk, including an interim step of adding additional ICD-10 codes from the GEM ICD-10 to ICD-9 reference, as well as additional clinical review of the resulting crosswalk and coding results. Given the uncertainty inherent in conversion to a new coding tool, results for any measure dependent on complex claims-based risk adjustment should be interpreted with caution in the initial time period after implementation of the new tool. Such is the case for SRR, particularly for changes in SRR from 2014 through 2016, given that ICD-9 was used exclusively in 2014, both ICD-9 and ICD-10 systems were used for parts of 2015, and ICD-10 is being used as the sole coding instrument for 2016 data.

Exhibits J-1 through **J-3** display a summary of each standardized measure by year for all ESCOs and the comparison group.

Exhibit J-1. Standardized Hospitalization Ratio for All ESCOs and Comparison Group

ESCO	Statistic	Standardized Hospitalization Ratio (Admissions) Summary			
		2014	2015	2016	2017
Comparison Group	Patient-years at risk	19,435	18,756	18,015	19,114
	Observed number of hospital admissions	30,472	29,460	28,585	31,045
	Expected number of hospital admissions	34,483	33,372	32,623	34,690
	SHR	**0.88**	**0.88**	**0.88**	**0.89**
All ESCOs	Patient-years at risk	28,807	28,635	28,376	31,768
	Observed number of hospital admissions	45,206	44,399	43,697	48,760
	Expected number of hospital admissions	50,694	50,554	50,778	56,797
	SHR	**0.89**	**0.88**	**0.86**	**0.86**

Exhibit J-2. Standardized Readmission Ratio for All ESCOs and Comparison Group

ESCO	Statistic	Standardized Readmission Ratio Summary			
		2014	2015	2016	2017*
Comparison Group	Index discharges	9023	8856	8455	9322
	Observed number of readmissions	11155	2672	2591	2214
	Expected number of readmissions	12402	2972	2999	3341
	SRR	**0.90**	**0.90**	**0.86**	**0.66**
All ESCOs	Index discharges	11456	11335	11251	12145
	Observed number of readmissions	13930	3496	3403	2923
	Expected number of readmissions	15195	3834	4008	4346
	SRR	**0.92**	**0.91**	**0.85**	**0.67**

* Data for 2017 readmissions are incomplete

Exhibit J-3. Standardized Mortality Ratio for All ESCOs and Comparison Group

ESCO	Statistic	Standardized Mortality Ratio Summary			
		2014	2015	2016	2017
Comparison Group	Patient years at risk	19,439	18,760	18,019	19,117
	Observed number of deaths	3,515	3,395	3,325	3,535
	Expected number of deaths	3,517	3,444	3,351	3,560
	SMR	**1.0**	**0.99**	**0.99**	**0.99**
All ESCOs	Patient years at risk	28,812	28,639	28,380	31,771
	Observed number of deaths	4,782	4,874	4,623	5,208
	Expected number of deaths	5,073	5,138	5,117	5,719
	SMR	**0.94**	**0.95**	**0.90**	**0.91**

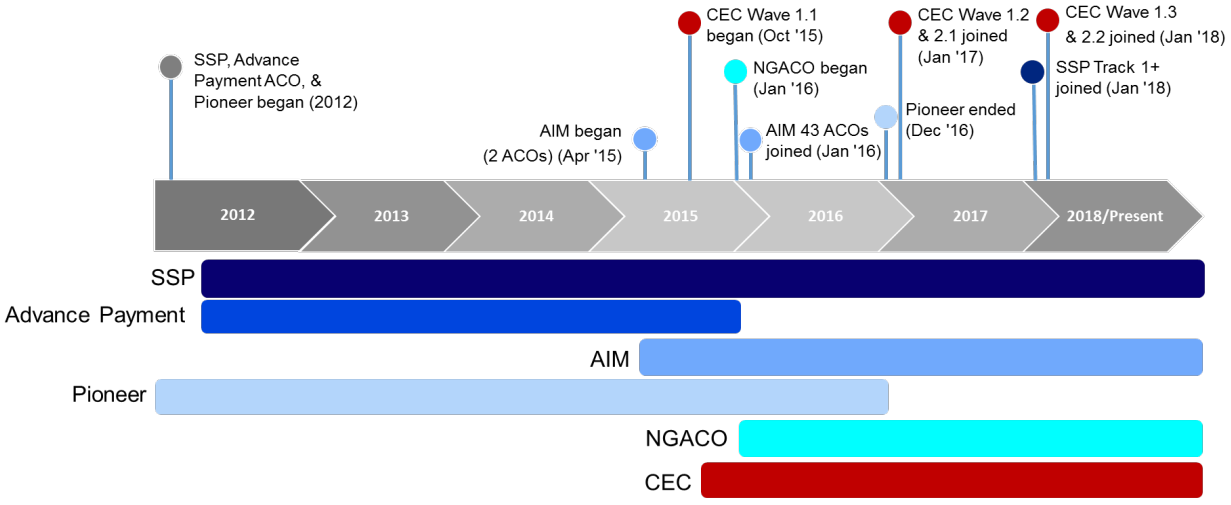
Appendix K: Methods for Comparing CEC Model to Primary Care-Based ACOs

This section describes the DiD approach for assessing whether CEC provided better results for beneficiaries with ESRD than primary care-based ACOs. The DiD approach compared the experiences of beneficiaries with ESRD over time, before and after they transitioned into either CEC or a primary care-based ACO, relative to beneficiaries with ESRD who remained in Medicare FFS. We estimated the DiD impact of CEC relative to FFS and the DiD impact of primary care-based ACOs relative to FFS, and compared the results of the two types of care models.

A. ACO and ESCO Risk-Sharing Programs and Alignment Rules

In addition to CEC, a specialty-oriented Accountable Care Organization (ACO), Medicare beneficiaries with ESRD could become aligned to one of the following primary care-based ACOs: Medicare Shared Savings Program (SSP), which has four different risk-sharing tracks, Advanced Payment, ACO Investment Model (AIM),[61] Pioneer, and Next Generation (NGACO). In terms of size, SSP is by far the largest program, with 561 ACOs that are responsible for an estimated 10.5 million assigned beneficiaries. NGACO consists of 51 ACOs, Pioneer began with 32 and ended with nine, and there are currently 37 ESCOs. These models overlap with CEC as shown in **Exhibit K-1**.

Exhibit K-1. ACO and CEC Timeline



[61] Although included in **Exhibit K-1**, we did not consider Advanced Payment or AIM ACOs in this analysis because they have a unique structure compared to the primary care-based ACOs previously listed and ESCOs. Specifically, ACOs in both these models receive an upfront fixed payment, upfront variable payment, and an ongoing monthly payment to encourage participation by rural providers and smaller practices with less access to upfront capital.

Risk Arrangements: The ACOs and ESCOs we considered in this analysis receive financial incentives for care coordination based on the level of risk they are willing to bear. There are two types of risk-arrangements:

- **One-sided (upside) risk:** ACOs that reduce health care costs below a target receive a percentage of the difference between the actual and target costs.

- **Two-sided (upside and downside) risk:** In a two-sided risk model ACOs receive a percentage of savings and are also at risk for a portion of spending over the target. The two-sided risk structure encourages a higher level of accountability by financially penalizing ACOs that incur costs above the set benchmark. To help compensate for the downside risk, two-sided risk participants who reduce costs below the benchmark receive a larger financial gain relative to one-sided risk.

The three primary care-based ACO programs and the CEC Model vary in their risk-sharing arrangements. Pioneer ACOs and NGACO are under a two-sided risk arrangement. The NGACO Model has two varying levels of two-sided risk arrangements: shared savings/losses of A) up to 80% and B) up to 100%. In the Pioneer program, ACOs are offered the five payment arrangement options, which share savings and losses of up to 60-75%. In SSP, the risk arrangement varies with the program track. Track 1 offers one-sided risk – only shared savings – while Track 2 and Track 3 offer two-sided risk (shared savings/losses). Track 3 offers the highest sharing rate and includes the most risk. An SSP ACO may opt for a one-sided or two-sided model for its first three-year agreement period. Newly introduced in January 2018, SSP ACOs are also able to sign up for Track 1+, which is a model that has some downside financial risk. However, the risk is less than the risk associated with Tracks 2 and 3. An ACO that selects the one-sided model in its first agreement period may apply for a second agreement period with one-sided risk. In the CEC Model, the 37 ESCOs associated with LDOs have to assume two-sided risk while non-LDOs can choose one-sided or two-sided risk.

Participation in the different risk arrangements varies for primary care-based ACOs and CEC ESCOs. Most of the ESCOs are subject to downside risk. However, the majority of ACOs participate in one-sided risk models. This difference is important in understanding how the design features of ESCOs compare to design features of ACOs and, in turn, how differences may contribute to better or worse results. In addition to earning potential shared savings and losses adjusted for quality performance, SSP (Track 1+, Track 2, and Track 3), NGACO, and CEC that have two-sided risk are all considered Advanced Alternative Payment Models (A-APMs) and are given additional financial rewards (5%) for taking on more risk and going further in improving patient care.[62] **Exhibit K-2** summarizes the number of ACOs by model and risk track.

[62] The incentive payment is 5% of the estimated aggregate payment amounts for Medicare Part B covered professional services furnished by the quality performance in the year preceding the payment year. The 5% incentive is earned if: the participant receives 25% of their Medicare Part B payments through an A-APM or sees 20% of their Medicare patients through an A-APM. (The percentages rise to 50%/35% in 2019 and to 75%/50% in 2021.)

Exhibit K-2. Summary of Risk Track Participants (Current or by Program End)

ACO Model	Current Number of ACOs by Risk-Arrangement Participation	
	One-Sided Risk	Two-Sided Risk
SSP	460 (Track 1)	55 (Track 1+) 8 (Track 2) 38 (Track 3)
Advance Payment	34	1
AIM	45	0
Pioneer	0	9
NGACO	0	51 (A&B)
CEC	3	34

ACOs with two-sided risk are similar to ESCOs made up of LDO facilities, while ACOs that do not accept downside risk are relatively similar to the three out of four non-LDO ESCOs that opted for one-sided risk tracks (with the notable difference that the ACOs are able to decide whether to accept downside risk, while the ESCO's acceptance of risk is determined first by organizational membership, then choice). Ideally, the incentive structures of the ACOs included in the analysis should align with the majority of ESCOs (two-sided risk) to be able to disentangle the driving factors that generate differences in patient outcomes. In the current analysis, due to sample considerations, we considered all risk tracks. The number of newly aligned ACO beneficiaries that met the criteria to be included in the sample was 56,454 beneficiaries. If we restricted to two-sided risk ACOs only, this number would be 10,004. We will monitor the sample sizes and reevaluate whether or not to restrict to only two-sided risk ACOs in future reports.

Alignment Rules. Though Pioneer ACOs, SSP ACOs, NGACO, and the CEC Model all utilize claims-based prospective alignment when assigning beneficiaries, there are differences in beneficiary alignment between the programs. Under SSP, alignment is based on plurality of services. This means that a beneficiary is assigned to an ACO if he or she receives a greater proportion of primary care services (measured in allowed charges) within the ACO than the proportion of services received at any other organization outside the ACO or if the beneficiary receives a plurality of services from PCPs or certain professionals within the ACO. This may be less than a majority of total services. For Tracks 1 and 2 of SSP, CMS uses prospective beneficiary assignment along with retrospective reconciliation (retrospective assignment for each performance year which removes anyone who is not alignment-eligible in that year). For Track 1+ and Track 3, on the other hand, CMS uses only prospective beneficiary alignment.

Two ACO Models have started to use voluntary alignment. The Pioneer ACO Model began testing voluntary alignment in PY4 (2015). While the NGACO Model used claims-based alignment in PY1 (2016), an option for voluntary alignment was added in PY2 (2017). Under voluntary alignment, beneficiaries can choose to be aligned to an ACO. In the Pioneer Model they may be aligned even if they are not aligned through claims. Voluntary alignment provides beneficiaries the opportunity to confirm or deny their care relationships with certain NGACO/Pioneer participants.

In the CEC Model, eligible beneficiaries are assigned to an ESCO after their first visit to a dialysis facility participating in an ESCO. If a beneficiary receives more than 50% of their care

from another dialysis facility outside of the CBSA market in a performance year or receives a transplant, is aligned to another SSP, and/or no longer receiving treatment at an ESCO, then the beneficiary is removed from the ESCO's alignment list in subsequent performance years.

B. Methods

Regarding comparison group construction, unlike our core evaluation where we match dialysis facilities, the CEC Model and the primary care-based ACOs do not share a common provider type. Therefore, we constructed a patient-level comparison group. Specifically, we matched CEC and ACO beneficiaries to fee-for-service (FFS) beneficiaries with ESRD that would have been ACO and CEC eligible. We generated a propensity score by including characteristics that may influence outcomes including time since start of dialysis, reasons for ESRD, non-renal comorbidities and demographic factors such as age and sex. Rather than following providers pre- and post-intervention, the DiD strategy for the patient-level match followed beneficiaries with ESRD as they transitioned from usual care FFS to different payment models (i.e., ACO, CEC) and compared changes in outcomes before and after alignment. The identifying assumption of the DiD model in this patient-level match was that beneficiaries who remained in usual FFS are a good approximation of what would have happened to transitioning beneficiaries if they would have stayed in usual FFS.

We narrowed our study population to beneficiaries who were newly aligned to an ACO or ESCO. We selected four potential alignment dates where a beneficiary could be newly aligned to a either ACO or CEC: 1) January 2015 (ACO newly aligned), 2) October 2015 (CEC newly aligned start date of Wave 1 ESCOs), 3) January 2016 (ACO newly aligned), and 4) January 2017 (ACO and CEC newly aligned; start date of Wave 2 ESCOs and late starting Wave 1 ESCO facilities). These alignment dates were used to identify intervention and comparison beneficiaries. ACO participation status was determined using the Master Data Management file, while CEC participation status is determined using CEC alignment criteria.
We considered how the length of the pre- and post-alignment periods affects our sample. In general, a larger pre-alignment period (baseline) could improve our model's ability to predict outcomes after a beneficiary's status changed. However, there are trade-offs. First, the number of beneficiaries eligible for inclusion decreases as the length of baseline period increases. For instance, the number of beneficiaries with ESRD who were newly aligned to ACOs dropped from 56,454 to 42,207 when a baseline of 12-month consecutive enrollment was required. In addition, due to the high mortality rate in the ESRD population, the share of beneficiaries with better odds of survival in the analysis sample increases as we extend the number of baseline months required for inclusion. This is because beneficiaries would have to be enrolled in FFS for at least the duration of the baseline period to be included in the study. Since surviving beneficiaries may be inherently different than a typical beneficiary with ESRD, extending the number of required months for inclusion would affect our ability to generalize our result to the average beneficiary with ESRD. Given the considerations discussed above, we did not require consecutive baseline enrollment months and instead required a beneficiary to be enrolled and eligible the month before the change in alignment. For each of the beneficiaries meeting this criterion, up to 12 months of baseline data were included in the analysis. If a beneficiary had less than 12 months of data, the populated months were included. This method

provided a sufficient baseline length to predict pre-intervention outcomes and also avoided using a selected sample.

Comparison Group Construction. We used PSM to select comparison beneficiaries that best resembled newly aligned ACO and CEC beneficiaries in key characteristics listed in **Exhibit K-3**. We used average values for all of the baseline characteristics with the exception of Medicare Part A and Part B payments, which were aggregated to an annual total. Any beneficiaries who had missing values for the matching characteristics were excluded from the matching process and from all subsequent analysis.

Exhibit K-3. Matching Covariates

Beneficiary	Facility	Market
Sex Indicator	LDO Indicators	Dual Beneficiaries per 10,000
Over 65 Indicator	Profit Indicator	ESRD Beneficiary Count
Race: Black Indicator	Percent Hemoglobin less than 10	MA Penetration
Hemodialysis Indicator	Percent Catheter	Median Household Income
Total Monthly Standardized Part A and Part B Payments	Percent Fistula	
ESRD into Medicare Indicator	Standardized Transfusion Ratio	
Disabled into Medicare Indicator	SHR	
ESRD and Disabled into Medicare Indicator	SRR	
Dialysis Months as of 2014	SMR	
Medicare Member Months	Late Shift Indicator	
	Peritoneal Dialysis Indicator	
	Home Hemodialysis Indicator	

We used a multinomial logit model to estimate the probability that an individual was aligned to either an ESCO or ACO. Once the two predicted probabilities were calculated, we separated newly aligned CEC and ACO beneficiaries into four different groups based on the first month of alignment. CEC and ACO beneficiaries were required to have at least two consecutive months of data, one entry in the month before alignment and another in the month after alignment. We also assigned non-aligned beneficiaries into four comparison pools, if they had two consecutive months of data before and after each potential alignment date, and if they were never aligned to either an ESCO or ACO. This allocation resulted in some non-aligned beneficiaries being included in multiple comparison pools. Within each group defined by either the alignment or potential alignment date, ACO and CEC beneficiaries were matched to the closest comparison non-aligned beneficiary based on the predicted probabilities. The predicted probability of becoming a newly aligned ACO beneficiary was used to match ACO beneficiaries to non-aligned beneficiaries. Similarly, the predicted probability of becoming a newly aligned CEC beneficiary was used to match CEC beneficiaries to non-aligned beneficiaries. A caliper was applied to ensure that only beneficiaries with a close match were included in the model. When there were two treatment types in one group, CEC and ACO treatment beneficiaries were randomly ordered, and then iteratively, each newly aligned beneficiary was matched to the closest comparison beneficiary if one existed within the caliper. If a match existed, the CEC or ACO treatment and the matched comparison beneficiary were removed from the matching pool. If a match did not exist, only the CEC or ACO treatment beneficiary was removed. This iterative process repeated for each newly aligned beneficiary until all CEC and ACO beneficiaries were considered.

Comparison of Pre and Post Matching Result. Exhibits K-4 through **K-8** provide a comparison of ACO to usual care FFS and CEC to usual care FFS beneficiaries before and after matching using SMDs for each alignment date. The before-matching population of ACO beneficiaries matched usual FFS beneficiaries better than the before-matching comparison of CEC beneficiaries and usual FFS beneficiaries. After matching, the differences between both groups decreased substantially. However, the differences between CEC beneficiaries and their matches were still larger than the differences between ACO beneficiaries and their matches. The results show that only the DaVita indicator had a SMD greater than 0.2. This is due to the high association between being aligned to a Fresenius facility and being aligned to CEC. To mitigate this difference, we included LDO organization variables in the DiD regression analysis.

Exhibit K-4. Descriptive Statistics and Standardized Mean Differences (Usual FFS to ACO, January 2015)

Characteristics	ACO Benes with a match (01/2015 switch) N=21,363		FFS Comparison Pool N=118,095		Std Diff Before Matching	FFS Comparison Group N=21,363		Std Diff After Matching
	Mean	Std Dev	Mean	Std Dev		Mean	Std Dev	
Gender: Female	0.44	0.50	0.45	0.50	-0.02	0.46	0.50	-0.03
Age: 65+	0.48	0.50	0.47	0.50	0.02	0.50	0.50	-0.04
Race: Black	0.38	0.48	0.39	0.49	-0.03	0.38	0.49	-0.01
Percent Months Hemodialysis	0.91	0.28	0.92	0.27	-0.03	0.91	0.28	0.01
Medicare Member Months	11.4	2.0	11.6	1.7	-0.07	11.4	2.0	0.01
OREC: Disabled Into Medicare	0.19	0.39	0.20	0.40	-0.02	0.21	0.40	-0.03
OREC: ESRD Into Medicare	0.21	0.41	0.22	0.41	-0.02	0.20	0.40	0.02
OREC: Both ESRD & Disabled into Medicare	0.28	0.45	0.28	0.45	-0.01	0.26	0.44	0.03
Months on Dialysis	58.4	63.7	58.8	61.7	-0.01	56.9	60.9	0.02
Standardized Total Part A&B Payments	$60,535	$40,483	$73,670	$45,880	-0.01	$62,301	$41,660	-0.04
Facility: DaVita Indicator	0.36	0.48	0.35	0.48	0.01	0.36	0.48	-0.01
Facility: DCI Indicator	0.03	0.17	0.04	0.18	-0.03	0.02	0.15	0.05
Facility: Fresenius Indicator	0.34	0.47	0.33	0.47	0.03	0.33	0.47	0.01
Facility: Profit Indicator	0.89	0.32	0.89	0.31	-0.01	0.89	0.31	-0.02
Facility: Percent Hemoglobin less than 10	0.13	0.10	0.13	0.09	0.08	0.13	0.10	-0.01
Facility: Percent Catheter	0.11	0.06	0.11	0.06	0.08	0.11	0.06	0.02
Facility: Percent Fistula	0.63	0.10	0.63	0.11	0.00	0.63	0.10	-0.01
Facility: Standardized Transfusion Ratio	0.98	0.46	0.98	0.49	0.01	1.00	0.50	-0.03
Facility: SHR	0.99	0.24	0.96	0.24	0.14	0.99	0.25	0.00
Facility: SRR	1.00	0.27	0.97	0.28	0.08	1.00	0.27	0.00
Facility: SMR	0.98	0.22	1.00	0.24	-0.11	0.98	0.23	-0.03
Facility: Late Shift Indicator	0.28	0.45	0.24	0.42	0.11	0.26	0.44	0.05
Facility: Peritoneal Dialysis Indicator	0.66	0.47	0.65	0.48	0.02	0.66	0.47	0.00
Facility: Home Hemodialysis Indicator	0.89	0.31	0.87	0.34	0.09	0.89	0.31	0.01
CBSA: Dual Beneficiaries per 10,000	331	110	331	107	0.00	331	107	0.01
CBSA: ESRD Beneficiary Count	3,750	4,035	3,023	3,399	0.19	3,542	3,810	0.05
CBSA: MA Penetration	30.8	12.6	29.8	13.0	0.07	30.4	12.9	0.03
CBSA: Median Household Income	$56,918	$11,910	$54,835	$11,971	0.17	$56,294	$12,472	0.05

Notes: The standardized difference was calculated by the following equation: $\text{Std. Diff} = (\mu 1 - \mu 2)/\sqrt{(\sigma_1^2 + \sigma_2^2)/2}$. Any value below 0.1 is considered to be a negligible difference.
* Indicates a standardized mean difference greater than 0.2 in absolute value.

Exhibit K-5. Descriptive Statistics and Standardized Mean Differences (Usual FFS to CEC, October 2015)

Characteristics	CEC Benes with a match (10/2015 switch) N=11,633		FFS Comparison Pool N=130,028		Std Diff Before Matching	FFS Comparison Group N=11,633		Std Diff After Matching
	Mean	Std Dev	Mean	Std Dev		Mean	Std Dev	
Gender: Female	0.44	0.50	0.45	0.50	-0.01	0.44	0.50	0.01
Age: 65+	0.47	0.50	0.48	0.50	0.00	0.47	0.50	0.01
Race: Black	0.48	0.50	0.38	0.49	0.20	0.44	0.50	0.08
Percent Months Hemodialysis	0.93	0.23	0.90	0.27	0.10	0.92	0.26	0.06
Medicare Member Months	11.6	1.2	11.6	1.3	0.04	11.6	1.3	0.05
OREC: Disabled Into Medicare	0.20	0.40	0.21	0.41	-0.02	0.21	0.41	-0.03
OREC: ESRD Into Medicare	0.22	0.42	0.24	0.42	-0.03	0.25	0.43	-0.07
OREC: Both ESRD & Disabled into Medicare	0.27	0.44	0.26	0.44	0.02	0.24	0.43	0.07
Months on Dialysis	63.1	64.5	58.5	62.2	0.07	62.2	65.0	0.01
Standardized Total Part A&B Payments	$58,633	$39,717	$59,801	$39,876	-0.03	$59,195	$40,207	-0.01
Facility: DaVita Indicator	0.32	0.47	0.36	0.48	-0.08	0.19	0.39	0.30*
Facility: DCI Indicator	0.10	0.29	0.03	0.18	0.25*	0.09	0.29	0.01
Facility: Fresenius Indicator	0.55	0.50	0.32	0.47	0.48*	0.65	0.48	-0.20
Facility: Profit Indicator	0.87	0.34	0.89	0.31	-0.07	0.87	0.34	0.00
Facility: Percent Hemoglobin less than 10	0.11	0.06	0.13	0.09	-0.24*	0.11	0.08	-0.05
Facility: Percent Catheter	0.09	0.05	0.11	0.06	-0.29*	0.09	0.05	-0.06
Facility: Percent Fistula	0.60	0.10	0.63	0.11	-0.27*	0.62	0.11	-0.17
Facility: Standardized Transfusion Ratio	0.86	0.37	0.99	0.49	-0.30*	0.87	0.42	-0.04
Facility: SHR	1.00	0.22	0.96	0.24	0.17	0.97	0.25	0.13
Facility: SRR	1.00	0.23	0.98	0.28	0.08	0.97	0.29	0.11
Facility: SMR	0.97	0.19	1.00	0.24	-0.16	0.95	0.21	0.08
Facility: Late Shift Indicator	0.26	0.44	0.24	0.42	0.05	0.30	0.45	-0.09
Facility: Peritoneal Dialysis Indicator	0.51	0.50	0.65	0.48	-0.29*	0.53	0.50	-0.03
Facility: Home Hemodialysis Indicator	0.97	0.17	0.86	0.34	0.39*	0.96	0.21	0.08
CBSA: Dual Beneficiaries per 10,000	284	68	330	107	-0.52*	297	98	-0.16
CBSA: ESRD Beneficiary Count	5,007	3,610	3,055	3,455	0.55*	4,593	4,091	0.11
CBSA: MA Penetration	31.2	10.0	31.1	13.2	0.02	32.6	12.4	-0.12
CBSA: Median Household Income	$60,993	$6,710	$56,526	$12,470	0.45*	$61,267	$12,806	-0.03

Notes: The standardized difference was calculated by the following equation: $\text{Std. Diff} = (\mu 1 - \mu 2)/\sqrt{(\sigma_1^2 + \sigma_2^2)/2}$. Any value below 0.1 is considered to be a negligible difference.
* Indicates a standardized mean difference greater than 0.2 in absolute value.

Exhibit K-6. Descriptive Statistics and Standardized Mean Differences (Usual FFS to ACO, January 2016)

Characteristics	ACO Benes with a match (01/2016 switch) N=19,206		FFS Comparison Pool N=111,951		Std Diff Before Matching	FFS Comparison Group N=19,206		Std Diff After Matching
	Mean	Std Dev	Mean	Std Dev		Mean	Std Dev	
Gender: Female	0.46	0.50	0.45	0.50	0.02	0.45	0.50	0.01
Age: 65+	0.49	0.50	0.47	0.50	0.04	0.49	0.50	0.00
Race: Black	0.41	0.49	0.39	0.49	0.04	0.38	0.49	0.05
Percent Months Hemodialysis	0.91	0.27	0.92	0.26	0.00	0.91	0.27	0.00
Medicare Member Months	11.4	2.0	11.5	1.8	-0.07	11.4	2.0	-0.02
OREC: Disabled Into Medicare	0.21	0.41	0.21	0.41	0.01	0.20	0.40	0.01
OREC: ESRD Into Medicare	0.24	0.42	0.24	0.43	-0.02	0.23	0.42	0.00
OREC: Both ESRD & Disabled into Medicare	0.24	0.43	0.26	0.44	-0.03	0.25	0.43	-0.01
Months on Dialysis	59.1	63.7	60.0	62.9	-0.01	59.8	63.5	-0.01
Standardized Total Part A&B Payments	$60,700	$41,323	$60,195	$39,403	0.01	$61,012	$40,470	-0.01
Facility: DaVita Indicator	0.34	0.47	0.37	0.48	-0.05	0.37	0.48	-0.07
Facility: DCI Indicator	0.03	0.16	0.03	0.18	-0.05	0.03	0.16	0.00
Facility: Fresenius Indicator	0.36	0.48	0.32	0.47	0.10	0.32	0.47	0.09
Facility: Profit Indicator	0.90	0.29	0.89	0.31	0.04	0.89	0.31	0.03
Facility: Percent Hemoglobin less than 10	0.13	0.10	0.13	0.09	0.07	0.13	0.10	0.02
Facility: Percent Catheter	0.10	0.06	0.11	0.06	-0.01	0.11	0.06	-0.04
Facility: Percent Fistula	0.63	0.10	0.63	0.11	0.00	0.63	0.11	0.00
Facility: Standardized Transfusion Ratio	0.99	0.48	0.98	0.49	0.02	0.99	0.50	0.00
Facility: SHR	0.98	0.24	0.96	0.24	0.08	0.98	0.25	-0.01
Facility: SRR	0.99	0.27	0.97	0.27	0.06	0.99	0.27	0.00
Facility: SMR	0.99	0.23	1.00	0.24	-0.06	0.99	0.23	0.00
Facility: Late Shift Indicator	0.26	0.44	0.24	0.42	0.05	0.26	0.44	0.00
Facility: Peritoneal Dialysis Indicator	0.64	0.48	0.65	0.48	-0.02	0.66	0.47	-0.04
Facility: Home Hemodialysis Indicator	0.88	0.33	0.86	0.35	0.05	0.88	0.33	0.00
CBSA: Dual Beneficiaries per 10,000	333	115	331	108	0.02	331	108	0.02
CBSA: ESRD Beneficiary Count	3,504	3,806	3,029	3,442	0.13	3,336	3,677	0.04
CBSA: MA Penetration	31.0	13.1	31.3	13.2	-0.02	31.6	13.3	-0.04
CBSA: Median Household Income	$57,786	$12,640	$56,705	$12,531	0.09	$57,630	$12,786	0.01

Notes: The standardized difference was calculated by the following equation: $\text{Std. Diff} = (\mu 1 - \mu 2)/\sqrt{(\sigma_1^2 + \sigma_2^2)/2}$. Any value below 0.1 is considered to be a negligible difference.
* Indicates a standardized mean difference greater than 0.2 in absolute value.

Exhibit K-7. Descriptive Statistics and Standardized Mean Differences (Usual FFS to ACO, January 2017)

Characteristics	ACO Benes with a match (01/2017 switch) N=15,885		FFS Comparison Pool N=109,297		Std Diff Before Matching	FFS Comparison Group N=15,885		Std Diff After Matching
	Mean	Std Dev	Mean	Std Dev		Mean	Std Dev	
Gender: Female	0.46	0.50	0.45	0.50	0.03	0.45	0.50	0.02
Age: 65+	0.52	0.50	0.47	0.50	0.10	0.48	0.50	0.06
Race: Black	0.37	0.48	0.38	0.49	-0.03	0.38	0.49	-0.02
Percent Months Hemodialysis	0.91	0.27	0.92	0.26	-0.02	0.91	0.27	0.00
Medicare Member Months	11.4	1.9	11.4	2.0	0.00	11.4	2.1	0.04
OREC: Disabled Into Medicare	0.23	0.42	0.21	0.41	0.04	0.21	0.41	0.04
OREC: ESRD Into Medicare	0.24	0.43	0.27	0.45	-0.07	0.26	0.44	-0.03
OREC: Both ESRD & Disabled into Medicare	0.20	0.40	0.23	0.42	-0.07	0.23	0.42	-0.07
Months on Dialysis	57.6	64.2	60.7	64.1	-0.05	59.1	62.4	-0.02
Standardized Total Part A&B Payments	$61,934	$41,553	$59,424	$39,747	0.06	$60,007	$40,725	0.05
Facility: DaVita Indicator	0.41	0.49	0.38	0.48	0.06	0.40	0.49	0.01
Facility: DCI Indicator	0.03	0.16	0.03	0.18	-0.03	0.02	0.15	0.04
Facility: Fresenius Indicator	0.31	0.46	0.31	0.46	0.00	0.29	0.45	0.05
Facility: Profit Indicator	0.90	0.31	0.90	0.31	0.00	0.90	0.30	-0.02
Facility: Percent Hemoglobin less than 10	0.13	0.10	0.13	0.10	0.02	0.13	0.10	-0.03
Facility: Percent Catheter	0.11	0.06	0.11	0.06	0.00	0.11	0.06	-0.03
Facility: Percent Fistula	0.63	0.10	0.63	0.11	0.00	0.63	0.10	-0.01
Facility: Standardized Transfusion Ratio	0.98	0.47	0.99	0.49	-0.02	1.00	0.50	-0.06
Facility: SHR	0.98	0.23	0.96	0.24	0.08	0.98	0.24	0.01
Facility: SRR	0.99	0.26	0.98	0.27	0.03	0.99	0.27	-0.02
Facility: SMR	1.00	0.24	1.01	0.24	-0.04	1.00	0.24	-0.02
Facility: Late Shift Indicator	0.25	0.43	0.24	0.43	0.01	0.26	0.44	-0.03
Facility: Peritoneal Dialysis Indicator	0.67	0.47	0.66	0.48	0.02	0.67	0.47	-0.01
Facility: Home Hemodialysis Indicator	0.88	0.32	0.86	0.35	0.08	0.86	0.35	0.07
CBSA: Dual Beneficiaries per 10,000	323	109	332	108	-0.08	331	108	-0.07
CBSA: ESRD Beneficiary Count	3,235	3,648	3,066	3,510	0.05	3,155	3,557	0.02
CBSA: MA Penetration	32.6	12.3	32.2	12.9	0.03	32.1	12.9	0.03
CBSA: Median Household Income	$57,806	$12,360	$56,701	$12,515	0.09	$57,348	$12,726	0.04

Notes: The standardized difference was calculated by the following equation: $\text{Std. Diff} = (\mu 1 - \mu 2)/\sqrt{(\sigma_1^2 + \sigma_2^2)/2}$. Any value below 0.1 is considered to be a negligible difference.
* Indicates a standardized mean difference greater than 0.2 in absolute value.

Exhibit K-8. Descriptive Statistics and Standardized Mean Differences (FFS to CEC January 2017)

Characteristics	CEC Benes with a match (01/2017 switch) N=11,950		FFS Comparison Pool N=109,297		Std Diff Before Matching	FFS Comparison Group N=11,950		Std Diff After Matching
	Mean	Std Dev	Mean	Std Dev		Mean	Std Dev	
Gender: Female	0.44	0.50	0.45	0.50	-0.01	0.43	0.49	0.02
Age: 65+	0.45	0.50	0.47	0.50	-0.03	0.45	0.50	0.00
Race: Black	0.43	0.50	0.38	0.49	0.09	0.46	0.50	-0.06
Percent Months Hemodialysis	0.92	0.26	0.92	0.26	0.01	0.93	0.25	-0.03
Medicare Member Months	11.4	2.0	11.4	2.0	-0.01	11.5	2.0	-0.02
OREC: Disabled Into Medicare	0.21	0.41	0.21	0.41	0.00	0.22	0.41	-0.01
OREC: ESRD Into Medicare	0.29	0.45	0.27	0.45	0.03	0.29	0.45	-0.01
OREC: Both ESRD & Disabled into Medicare	0.22	0.42	0.23	0.42	-0.01	0.21	0.41	0.02
Months on Dialysis	62.9	65.5	60.7	64.1	0.03	65.5	68.4	-0.04
Standardized Total Part A&B Payments	$59,718	$41,418	$59,424	$39,747	0.01	$57,664	$38,431	0.05
Facility: DaVita Indicator	0.04	0.19	0.38	0.48	-0.93*	0.18	0.38	-0.47*
Facility: DCI Indicator	0.10	0.30	0.03	0.18	0.26*	0.11	0.31	-0.03
Facility: Fresenius Indicator	0.80	0.40	0.31	0.46	1.15*	0.67	0.47	0.31*
Facility: Profit Indicator	0.88	0.33	0.90	0.31	-0.05	0.86	0.35	0.06
Facility: Percent Hemoglobin less than 10	0.12	0.08	0.13	0.10	-0.14	0.11	0.07	0.10
Facility: Percent Catheter	0.10	0.05	0.11	0.06	-0.12	0.09	0.05	0.08
Facility: Percent Fistula	0.63	0.09	0.63	0.11	-0.02	0.62	0.11	0.12
Facility: Standardized Transfusion Ratio	0.91	0.41	0.99	0.49	-0.18	0.88	0.41	0.05
Facility: SHR	0.95	0.24	0.96	0.24	-0.06	0.98	0.25	-0.12
Facility: SRR	0.94	0.30	0.98	0.27	-0.14	0.97	0.28	-0.12
Facility: SMR	0.94	0.18	1.01	0.24	-0.29*	0.95	0.22	-0.06
Facility: Late Shift Indicator	0.33	0.47	0.24	0.43	0.20	0.29	0.45	0.09
Facility: Peritoneal Dialysis Indicator	0.56	0.50	0.66	0.48	-0.20	0.55	0.50	0.02
Facility: Home Hemodialysis Indicator	0.94	0.24	0.86	0.35	0.28*	0.95	0.22	-0.04
CBSA: Dual Beneficiaries per 10,000	309	126	332	108	-0.20	298	96	0.10
CBSA: ESRD Beneficiary Count	3,755	3,629	3,066	3,510	0.19	4,256	3,996	-0.13
CBSA: MA Penetration	33.0	13.5	32.2	12.9	0.06	33.9	11.8	-0.07
CBSA: Median Household Income	$59,509	$11,592	$56,701	$12,515	0.23*	$60,371	$11,997	-0.07

Notes: The standardized difference was calculated by the following equation: $\text{Std. Diff} = (\mu 1 - \mu 2)/\sqrt{(\sigma_1^2 + \sigma_2^2)/2}$. Any value below 0.1 is considered to be a negligible difference.
* Indicates a standardized mean difference greater than 0.2 in absolute value.

Model Specification. To perform the DiD analysis, all of the pre- and post-alignment periods of the newly aligned treatment and their matched comparison beneficiary, for each of the four alignments, were stacked together. Effectively, this normalized the observations around the individual alignment dates. We then compared treated and comparison outcomes for each of the four alignment groups (cohort) in a pooled regression framework.

The basic analysis again takes the form of a stacked DiD fixed-effects model:

$$Y_{ict} = \alpha + \beta_{ct}T_{tc} + \eta_{1c}ACO_{ic} + \eta_{2c}CEC_{ic} + \delta_1 Post\_ACO_{ict} + \delta_2 Post\_CEC_{ict} + \lambda' X_{ict} + \varepsilon_{ict} \quad (1)$$

where subscripts *i*, *c*, and *t* denote individual, cohort of alignment date, and month. T represents alignment date by month specific fixed effects four each of the four alignment dates. ACO and CEC are separate indicator variables that identify the group of individuals who are considered treated regardless of time for each of the treatment cohorts (i.e., each alignment date). They take the form of 0 for comparison beneficiaries and 1 for treatment beneficiary who belong to a specific alignment date cohort. Post_ACO and Post_CEC are the DiD post-treatment indicators for each of our treatment groups. The variables were coded 0 for all comparison and treatment baseline months and 1 for individuals who were aligned to an ACO or CEC Model after the alignment date. Thus, δ_1 and δ_2 are the primary coefficients of interest.

Finally, X was a vector of additional variable characteristics that controls for time-varying differences in beneficiary, facility, and market characteristics and are the same controls used in previous analysis. Market and facility controls were based on where the beneficiary received the majority of their care. All estimated standard errors of the DiD estimate were calculated using two-way clusters at beneficiary and service facility levels.[63]

To assess whether the treatment and comparison group follow similar pre-intervention trends we estimated a regression model similar to equation (1) but included group specific linear time trends. Specifically, the model was defined as follows:

$$Y_{ict} = \alpha + \beta_{ct}T_{tc} + \eta_{1c}ACO_{ic} + \eta_{2c}CEC_{ic} + \eta_{3c}(CEC*t) + \eta_{4c}(ACO*t) + \delta_1 Post\_ACO_{ict} + \delta_2 Post\_CEC_{ict} + \lambda' X_{ict} + \varepsilon_{ict} \quad (2)$$

The group specific time trends were constructed by interacting the group specific indicators with a linear time trend. Inclusion of these terms in the DiD model allows for the treatment and comparison groups to follow different trends. By comparing the treatment effects (Post_ACO and Post_CEC) of equation (1) to equation (2) we were able to determine that the parallel trends assumption was satisfied if the estimated impacts of the core DiD estimates under specification (1) were robust to the addition of group specific trends.[64]

Exhibits K-9 and **K-10** show the DiD estimates of all outcomes considered in the ACO analysis, for both intervention groups, along with DiD results that include group specific linear time trends.

[63] Cameron, A., & Gelbach, J. D. Miller, 2011, "Robust Inference with Multiway Clustering." *Journal of Business & Economic Statistics*, 29(2).

[64] Angrist, J. D., & Pischke, J. S. 2008, "Mostly harmless econometrics: An empiricist's companion." Princeton university press

Exhibit K-9. Impact Estimates for Newly Aligned ACO Beneficiaries

Measures	Number of Observations	Group Specific Time Trend: NO				Group Specific Time Trend: YES			
		DiD	90% Lower CI	90% Upper CI	Percent Change	DiD	90% Lower CI	90% Upper CI	Percent Change
Total Part A and Part B Standardized Medicare Payments	3,368,513	$22	-$16	$60	0.37%	$29	-$30	$87	0.49%
Number of ED Visits per 1,000 Beneficiaries per Month	3,368,513	1.7	-0.9	4.3	1.3%	2.2	-2.1	6.4	1.6%
Percent of Beneficiaries with at Least One ED Visit in a Given Month	3,368,513	0.10%	-0.04%	0.24%	0.90%	0.12%	-0.12%	0.37%	1.1%
Fistula Use (percent of beneficiaries in a given month who had a fistula and had at least 90 days of dialysis)	2,925,378	-0.18%	-0.50%	0.13%	-0.27%	0.00%	-0.30%	0.29%	0.00%
Catheter Use (percent of beneficiaries in a given month who had a catheter for 90 days or longer)	2,925,378	-0.02%	-0.25%	0.21%	-0.17%	0.10%	-0.16%	0.35%	0.95%
Number of Hospitalizations per 1,000 Beneficiaries per Month	1,721,386	1.1‡	-1.7	3.8	0.51%	10.2***	4.8	15.6	5.0%
Percent of Beneficiaries with at Least One Hospitalization in a Given Month	1,721,386	0.04%‡	-0.19%	0.26%	0.20%	0.73%**	0.26%	1.2%	4.0%
Number of Readmissions per 1,000 Beneficiaries per Month	312,460	-1.4	-11.4	8.6	-0.49%	-3.0	-20.9	14.9	-1.0%
Percent of Beneficiaries with at Least One Readmission in a Given Month	312,460	-0.13%	-0.76%	0.49%	-0.54%	-0.58%	-1.7%	0.56%	-2.4%

Notes: Each impact estimate was based on retrospective cohort study that evaluated changes in outcomes for up to 12 months before and after following alignment into an ESCO or ACO care model relative to matched comparison groups of beneficiaries who did not transition from usual FFS care. Group specific time trends were included to test robustness of the results and to test the parallel trends assumption. If the impact estimate did not change much with the inclusion of these trends, the parallel trend test was likely satisfied. CI= confidence interval, ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1.

Exhibit K-10. Impact Estimates for Newly Aligned CEC Beneficiaries

Measures	Number of Observations	Group Specific Time Trend: NO				Group Specific Time Trend: YES			
		DiD	90% Lower CI	90% Upper CI	Percent Change	DiD	90% Lower CI	90% Upper CI	Percent Change
Total Part A and Part B Standardized Medicare Payments	3,368,513	-$110***	-$166	-$55	-1.9%	-$87*	-$169	-$6	-1.5%
Number of ED Visits per 1,000 Beneficiaries per Month	3,368,513	-6.0 ***	-9.8	-2.3	-4.6%	-11.3***	-16.5	-6.2	-8.3%
Percent of Beneficiaries with at Least One ED Visit in a Given Month	3,368,513	-0.43%***	-0.63%	-0.23%	-4.1%	-0.59%**	-0.94%	-0.24%	-5.5%
Fistula Use (percent of beneficiaries in a given month who had a fistula and had at least 90 days of dialysis)	2,925,378	0.19%	-0.22%	0.60%	0.29%	-0.13%	-0.46%	0.21%	-0.19%
Catheter Use (percent of beneficiaries in a given month who had a catheter for 90 days or longer)	2,925,378	0.08%	-0.23%	0.38%	0.82%	0.18%	-0.14%	0.51%	1.8%
Number of Hospitalizations per 1,000 Beneficiaries per Month	1,721,386	-10.2***	-14.4	-6.0	-5.0%	-7.9*	-14.9	-0.9	-3.9%
Percent of Beneficiaries with at Least One Hospitalization in a Given Month	1,721,386	-1.0%***	-1.3%	-0.66%	-5.5%	-0.93%**	-1.6%	-0.26%	-5.1%
Number of Readmissions per 1,000 Beneficiaries per Month	312,460	-26.7***‡	-42.6	-10.8	-9.1%	-11.9	-37.1	13.3	-4.2%
Percent of Beneficiaries with at Least One Readmission in a Given Month	312,460	-2.1%***‡	-3.0%	-1.1%	-8.3%	-1.0%	-26%	0.57%	-4.1%

Notes: Each impact estimate was based on retrospective cohort study that evaluated changes in outcomes for up to 12 months before and after following alignment into an ESCO or ACO care model relative to matched comparison groups of beneficiaries who did not transition from usual FFS care. Group specific time trends were included to test robustness of the results and to test the parallel trends assumption. If the impact estimate did not change much with the inclusion of these trends, the parallel trend test was likely satisfied. CI= confidence interval, *** $p \leq 0.01$, **$p \leq 0.05$, *$p \leq 0.1$. ‡ Data from the baseline period showed intervention and matched comparison beneficiaries were not on parallel trends for this outcome, which is required for an unbiased impact estimate.

Power Calculations. Finally, power calculations of the primary care-based ACO and CEC intervention groups, relative to the comparison group were calculated using the same methodology as the CEC Model evaluation presented in the earlier sections of the report. See **Appendix G**, for details and equations of power methods.

For the first year of the ACO analysis, the number of ACO and CEC newly aligned beneficiaries gives reasonable confidence that the analysis will detect modest impacts on Medicare service use and costs for all beneficiaries. Specifically, estimates of power using one-tailed tests at the 10% significance level and adjustments for goodness of fit from the regression models imply that the evaluation has 80% power to detect impacts on standardized Medicare payment of 2.5% or more for CEC and 2% or more for ACO newly aligned beneficiaries.

Appendix L: Unintended Consequences

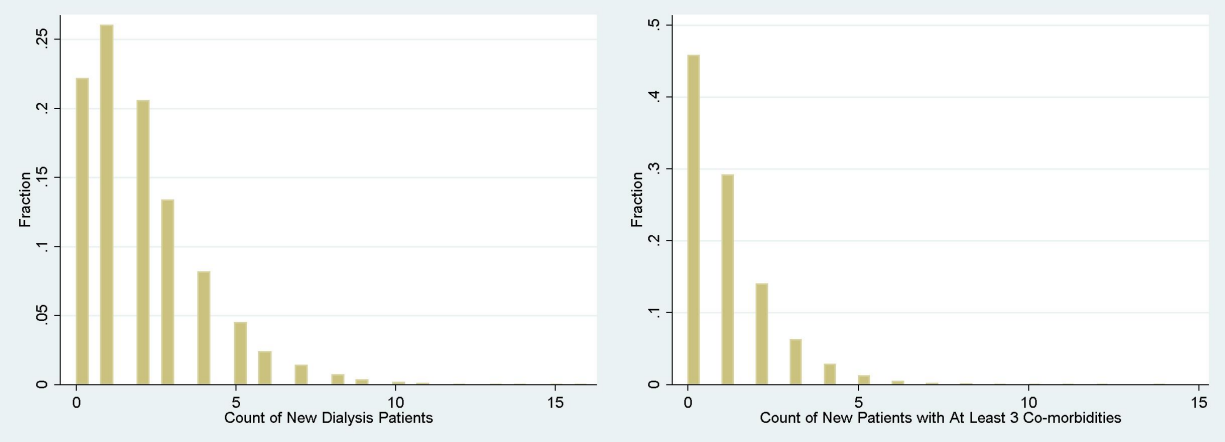
A. Patient Selection

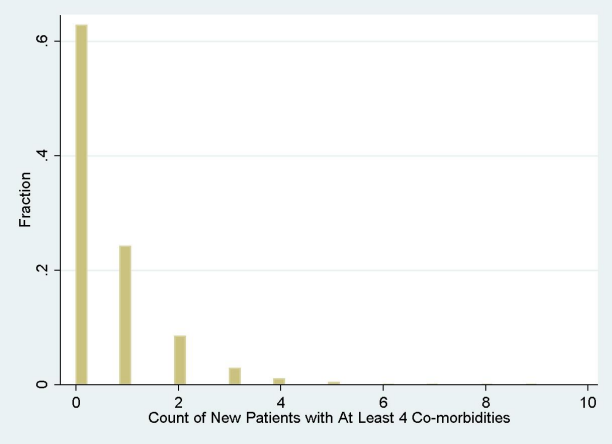
Descriptive Counts of New Dialysis Patients and Comorbidities. Patients new to dialysis are identified as any beneficiaries whose first observation, from December 2013 to December 2017, indicates they had zero, one, two, or three months of dialysis. We included new dialysis patients up to their third month of dialysis to (1) limit beneficiaries who had previous dialysis, a gap, and then began dialysis during our sample period and also to (2) include beneficiaries that become eligible for Medicare as a result of having ESRD. About half the patients in our sample were Medicare eligible as a result of ESRD, and most already had three months of dialysis when they were observed in the claims data.

To measure patients' health status, we required a measure of patient health that was reasonably observed by the referring nephrologist prior to the referral happening. Nephrologists likely do not observe patients' claims history, and such claims history is not available for about half of the beneficiaries with ESRD who qualify for Medicare as a result of ESRD. As such, we used data from CMS Form 2728 to identify beneficiaries who had comorbid conditions. This form is completed by the physician within 45 days for patients beginning a regular course of dialysis. Therefore, this information is likely to be salient to the referring physician at the time dialysis is started. We used data from CMS Form 2728 to identify beneficiaries who had any of 19 comorbid conditions listed on the form, including: CHF; atherosclerotic heart disease; other cardiac disease; cerebrovascular disease; peripheral vascular disease; history of hypertension; amputation; diabetes; COPD; current smoker/tobacco use; malignant neoplasm, cancer; toxic nephropathy; alcohol dependence; drug dependence; inability to ambulate; inability to transfer; needs assistance with daily activities; institutionalized (assisted living, nursing home, or other institution); and non-renal congenital abnormality.

We aggregated the beneficiary-month level data to the aligned facility-quarter level. The analytic sample consisted of 8,846 facility-quarter observations from CEC facilities and 8,846 facility-quarterly observations from non-CEC comparison facilities over the period of January 2014 through December 2017. Therefore, for each CEC and matched comparison facility, we observed the number of beneficiaries with ESRD who were new to dialysis and who were new to dialysis and had at least two, three, four, and five comorbid conditions in each quarter. In our main analysis, we focused on new dialysis patients and those with three and four comorbid conditions. In **Exhibit L-1**, we present the distribution of these outcomes across facilities and quarters. The median facility and quarter had two beneficiaries with ESRD that were new to dialysis, one with at least three comorbidities, and none with at least four comorbidities. We can see that the counts of outcomes of interest can be characterized by a very small number of beneficiaries.

Exhibit L-1. Distribution of Number of Beneficiaries with ESRD New to Dialysis and with a Given Number of Comorbidities, across Facilities and Quarter





Model Specification. As described in the previous section, a challenge in determining whether or not CEC facilities had fewer patients with comorbidities is the small number of new dialysis beneficiaries for a given facility and quarter. The natural starting point to model the number of new dialysis patients with multiple comorbidities would be to estimate a Poisson regression specification.[65] The number of new dialysis patients with comorbidities are interpreted as "counts" that follow a Poisson distribution, and this specification assumes that the logarithm of these counts can be modeled by a linear combination of parameters. The estimating equation then is:

$$Log(Y_{jmq}) = \beta CEC_j * Post_{jq} + \gamma CEC_j + \alpha X_{mq} + \lambda Z_{jq} + \delta_q$$

where Y_{jmq} is the count of patients new to dialysis with comorbidity(ies) at facility *j* in market *m*°quarter q, CEC_j is the CEC status of facility *j* and $Post_{jq}$ indicates the post CEC period for facility *j* in quarter *q*. X_{mq} includes market characteristics and Z_{jq} includes facility characteristics, and δ_q are quarterly dummies.

[65] Modeling these outcomes with a normally distributed error by estimating OLS models is not appropriate in our particular case.

There are several well-known limitations to the Poisson model. The most restrictive assumption of the model is that the mean and the variance of the dependent variable are assumed to be equal (or 'equidispersion'). In addition, because of this restrictive assumption, there is the 'excess zeros problem', in which the model predicts the probability of a zero count to be considerably less than is actually observed in the sample. The negative binomial model circumvents the limitations of the Poisson model since it has the same mean as the Poisson, but the conditional variance is quadratic in the mean, and consequently it does not impose that the mean and variance are equal.

For each outcome, we estimated Poisson and negative binomial models. In deciding the most appropriate model between the Poisson and negative binomial models, we performed a statistical test for whether 'equidispersion' was a problem in our data. For all our outcomes, the likelihood ratio test suggested that the negative binomial model was a more appropriate model.[66] We included in the model the following facility characteristics: beneficiary count, whether the facility offers a late shift, profit status, LDO status, rural/urban status, and dummies for region. Market characteristics included: median household income, dual eligible population, PCPs per 10,000 population, Medicare Advantage (MA) penetration, ACO penetration, and percent of Medicare beneficiaries in the CBSA that had ESRD at baseline. The estimation results from the Poisson model are shown in **Exhibit L-2**, below. The Poisson specification shows that the magnitude and sign of the DiD estimates are similar to the negative binomial specification results presented in the report. They do not suggest a significant association between CEC and the number of new patients with multiple comorbidities.

Exhibit L-2. Number of Additional Patients with Comorbidities at CEC Facilities vs Comparison Facilities, Poisson Model

Model: Poisson	CEC		Comparison		DiD Estimate			
Outcome	Pre-CEC	Post-CEC	Pre-CEC	Post-CEC	DiD	90% Lower CI	90% Upper CI	Percent Change
New Dialysis Patients	2.1	2.0	2.1	1.9	0.06	-0.04	0.16	3.1%
New Patients with at Least Three Comorbidities	1.0	1.0	1.0	1.0	0.03	-0.04	0.10	3.4%
New Patients with at Least Four Comorbidities	0.5	0.6	0.6	0.6	-0.04	-0.07	0.04	-3.5%

Notes: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1.

B. Transplant Waitlist Participation

Yearly DiD Strategy for Waitlist Participation. Due to the infrequency with which beneficiaries were added to the waiting list, the unit of observation in this analysis was beneficiary-year instead of a beneficiary-month. The new data structure required a modification of the approach presented in **Appendix G**. The differences between these two approaches are highlighted in this section.

Exhibit L-3 summarizes the yearly waiting list participation for the larger ESRD population of beneficiaries that were active on the transplant waiting list. A waitlist entry refers to a

[66] For all outcomes, the 'overdisperson' parameter had a p-value ≤0.000.

registration at a transplant center. A beneficiary may have multiple entries in a year at multiple centers. The exhibit shows that the raw yearly number of entries that were added or removed varied over time. Specifically, we observed a decrease in the overall number of entries added to the transplant waitlist and an increase in the number of entries removed from the waitlist in recent years. Beneficiaries are removed from a center's waitlist if they receive a transplant at any center, experience a health status change, die, refuse transplant, or if the center is unable to contact them.

Exhibit L-3. Number of Raw Annual Transplant Waitlist Entries Added and Removed

Year	Number of Entries Added	Number of Entries Removed
2014	38,350	35,582
2015	37,233	38,342
2016	37,553	39,715
2017	37,811	40,400

Notes: The entries shown above include multiple waitlist records for beneficiaries active in multiple transplant centers. Data source: Scientific Registry of Transplant Recipients kidney/pancreas waiting list.

Waves, Pre-CEC, Transition, and Post-CEC Periods. Because the unit of analysis for this measure was beneficiary-year, the pre-CEC, transition, and post-CEC periods were redefined to include full CYs. For PY1 starters, this change resulted in a shorter pre-CEC period (no longer includes the first quarter of 2015) and shorter post-CEC period (excludes the first intervention quarter). For PY2 starters, this change reallocated the first two quarters of 2015 from the pre-CEC to the transition period, with no change in the post-CEC period. **Exhibit L-4** assigns each CY to these periods for the comparison and CEC groups.

Exhibit L-4. Waves, Pre-CEC, Transition, and Post-CEC Years

Facility Group	Baseline		Performance Year 1	Performance Year 2
	2014	2015	2016	2017
Wave 1, PY1 Starters	Pre-CEC	Transition	Post-CEC	
Wave 1, PY2 Starters	Pre-CEC		Transition	Post-CEC
Wave 2, PY2 Starters	Pre-CEC		Transition	Post-CEC
Matched Comparison Group	Pre-CEC		Post-CEC	

Model Specification. We used two different regressions models, one that included a single treatment group to estimate the impact of the CEC Model and one that includes separate indicators for each CEC wave and PY. The regression model used to estimate the impact of treatment for all ESCOs is outlined below:

$$Y_{ikt} = \alpha + Year_t + \delta_1 ESCO_{ik} + \delta_2 Transition_{tk} + \delta_3 (Post_t * ESCO_{ik}) + \lambda' X_{ikt} + \varepsilon_{ikt} \quad (1)$$

where subscripts *i*, *k*, and *t* denote beneficiaries, facilities, and years, respectively. The outcome of interest, Y_{ikt} is the waiting list participation of a beneficiary. This variable takes on the value of 1 if individual *i*, who is aligned to facility *k*, is active on the waiting list anytime in year *t* and takes

on a value of 0 otherwise. $ESCO_{i,k}$ is an indicator variable that identifies the group of CEC eligible beneficiaries who are aligned to an ESCO in a given year. $Year_t$ represents yearly fixed effects. These fixed effects control for any possible trend that is common among the study population. $Transition_{tk}$ is an indicator variable that controls for the transition years. Additionally, $Post_t$ * $ESCO_{ik}$ takes the value of 0 for all ESCO aligned beneficiaries during the baseline period and 1 for ESCO aligned beneficiaries when facility k is participating in the CEC Model. Beneficiaries in the comparison group who do not receive treatment at an ESCO facility will receive a 0 for this indicator variable in both years. Thus, δ_3 reveals the effect of CEC on waiting list participation and is the primary coefficient of interest.

Finally, X_{ikt} is a vector of characteristics that have been shown to affect waiting list participation.[67] This term controls for changes in the beneficiary population, markets, and facilities that could potentially affect waiting list participation and are outside the control of both ESCOs and comparison facilities. **Exhibit L-5** summarizes the variables included in the model.

Exhibit L-5. Control Variables Included in the DiD Model

Variable Type	Variable
Beneficiary Level	Female; Age; BMI at ESRD Incidence; Months on Dialysis; Cancer Indicator; Type of Dialysis: Hemodialysis, Peritoneal Dialysis, Other; Race: Black, White, Other; Medicaid Status: None, Full, or Partial
Facility Level	Profit Indicator: For Profit, Not for Profit
Market Level	Region Indicators; Urban/ Rural Indicator: Metro Area, Urban Area, Rural Area; Number of Kidney Transplant Hospitals per 10,000 population (measured in 2011)

To separately identify treatment for each ESCO wave we use the following model:

$$Y_{ikt} = \alpha + Year_t + \delta_1 ESCO_{ik} + \delta_2 TransitionW1_{tk} + \delta_3 (Post_t * ESCOW1_{ik}) +$$
$$+ \delta_4 TransitionW2_{tk} + \delta_5 (Post_t * ESCOW2_{ik}) + \lambda' X_{ikt} + \varepsilon_{ikt} \quad (2)$$

Equation (2) is identical to equation (1) except now the covariate of interest and the transition indicators are specific to the CEC wave. The new covariates of interest are represented by

[67] See: Abecassis M, Bartlett ST, Collins AJ, et al. Kidney transplantation as primary therapy for end-stage renal disease: a National Kidney Foundation/Kidney Disease Outcomes Quality Initiative (NKF/KDOQITM) conference. *Clinical journal of the American Society of Nephrology*: CJASN 2008 3(2):471-80.
Balhara KS, Kucirka LM, Jaar BG, Segev DL. Disparities in provision of transplant education by profit status of the dialysis center. *American journal of transplantation*: official journal of the American Society of Transplantation and the American Society of Transplant Surgeons 2012 12(11):3104-10.
Grams ME, Chen BP, Coresh, J, Segev DL. Preemptive deceased donor kidney transplantation: considerations of equity and utility. *Clinical journal of the American Society of Nephrology*: CJASN 2013 8(4):575-82.
Segev DL, Kucirka LM, Oberai P, et al. Age and comorbidities are effect modifiers of gender disparities in renal transplantation. *Journal of the American Society of Nephrology*: JASN 2009 20(3):621-8.
Segev DL, Simpkins CW, Thompson RE, Let al. Obesity impacts access to kidney transplantation. *Journal of the American Society of Nephrology*: JASN 2008 19(2):349-55.

$(Post_t * ESCOW1_{ik})$ $Post_t * ESCOW1_{ik}$ and $Post_t * ESCOW2_{ik}$. The coefficients of interest, δ_3 and δ_5, reveal the wave specific effect of CEC on waiting list participation.

The results of the DiD regression analysis are summarized in **Exhibit L-6**. The estimated impact of CEC was not statistically significant in either the analysis for the overall impact or the analysis separating Wave 1 and Wave 2 ESCOs by PY. Therefore, we conclude that there is no evidence that CEC changed the waiting list participation.

Parallel Trends. A pivotal assumption of the DiD model is that the ESCO and comparison groups have the same trend in outcomes prior to the intervention. Since our analysis is restricted to only one year of data before the intervention, we constructed an expanded baseline by adding information on years 2012 and 2013 to test this assumption.[68] Using the expanded baseline of 2012-2014, parallel trends were assessed graphically and using a formal statistical test. Both of these methods suggested the trends between the two groups were virtually identical before the CEC start date.

Exhibit L-6. Impact of the CEC Model on Waiting List Participation

Group	Performance Year	CEC		Comparison		DiD Estimate			
		Pre-CEC	Post-CEC	Pre-CEC	Post-CEC	DiD	90% Lower CI	90% Upper CI	Percent Change
All ESCOs	PY1 & PY2	28.3%	25.9%	24.9%	22.1%	0.36%	-0.68%	1.4%	1.3%
Wave 1	PY1 & PY2	28.3%	26.3%	24.9%	22.2%	0.61%	-0.62%	1.8%	2.1%
Wave 1	PY1	28.3%	26.9%	24.9%	22.9%	0.55%	-0.92%	2.0%	1.9%
Wave 1	PY2	28.3%	25.6%	24.9%	21.5%	0.66%	-0.56%	1.9%	2.3%
Wave 2	PY2	28.0%	24.8%	24.5%	21.5%	-0.18%	-1.2%	0.79%	-0.64%
All ESCOs	PY2	28.3%	25.2%	24.9%	21.5%	0.22%	-0.61%	1.1%	0.79%

Notes: ***p ≤ 0.01, **p ≤ 0.05, *p ≤ 0.1.

[68] This expanded baseline data was not included in the main analysis in order to maintain consistency with the rest of the report. Inclusion of these years in the main analysis does not significantly change any of the results presented in this section.