

## Supplementary Online Content

Nyweide DJ, Lee W, Cuerdon TT, Pham HH, Cox M, Rajkumar R, Conway PH. Association of Pioneer accountable care organizations vs traditional Medicare fee for service with spending, utilization, and patient experience. *JAMA*. doi:10.1001/jama.2015.4930.

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This supplementary material has been provided by the authors to give readers additional information about their work.

**eFigure 1. Pioneer ACO Alignment, Baseline, and Performance Years in the Study**

	2008	2009	2010	2011	2012	2013
Performance year 2013			Alignment 1 (E&M charges weighted by 10%)	Alignment 2 (E&M charges weighted by 30%)	Alignment 3 (E&M charges weighted 60%)	Performance 2013 (PY2)
Performance year 2012		Alignment 1 (E&M charges weighted by 10%)	Alignment 2 (E&M charges weighted by 30%)	Alignment 3 (E&M charges weighted 60%)	Performance 2012 (PY1)	
Baseline year 2011		Alignment 1 (E&M charges weighted by 35%)	Alignment 2 (E&M charges weighted by 65%)	Baseline 2011		
Baseline year 2010	Alignment 1 (E&M charges weighted by 70% since half year is truncated)	Alignment 2 (E&M charges weighted by 65%)	Baseline 2010			

The figure illustrates beneficiary alignment algorithm in performance and baseline years. Beneficiaries who were aligned to Pioneer ACOs each performance year (2012 and 2013) were aligned using weighted qualifying evaluation & management (E&M) allowed charges in 3 alignment years, staggered 6 months before the start of each performance year to provide more claims run-out at the time of prospective alignment. Similarly, baseline populations of beneficiaries who would have been aligned to 2012 ACO clinicians in 2010 and 2011 were constructed according to weighted qualifying E&M allowed charges in 2 staggered alignment years. Alignment years could not precede 2008 because National Provider Identifiers (NPIs) used for alignment were not reliably used by physicians on claims.

**eTable 1. CAHPS Questions and Domains**

<b>ACO Item #</b>	<b>ACO Item Text</b>	<b>FFS &amp; MA Item #</b>	<b>Fee-for-service and Medicare Advantage Item (FFS &amp; MA) Text</b>
<b>Getting Timely Care, Appointments and Information</b>			
6	In the last 6 months, when you phoned this provider's office to get an appointment for care you needed right away, how often did you get an appointment as soon as you needed?	4	In the last 6 months, when you needed care right away, how often did you get care as soon as you thought you needed?
8	In the last 6 months, when you made an appointment for a check-up or routine care with this provider, how often did you get an appointment as soon as you needed?	6	In the last 6 months, not counting the times you needed care right away, how often did you get an appointment for your health care at a doctor's office or clinic as soon as you thought you needed?
12	In the last 6 months, when you phoned this provider's office after regular office hours, how often did you get an answer to your medical question as soon as you needed?	10	In the last 6 months, when you phoned a doctor's office or clinic after regular office hours, how often did you get an answer to your medical question as soon as you needed?
15	Wait time includes time spent in the waiting room and exam room. In the last 6 months, how often did you see this provider within 15 minutes of your appointment time?	8	Wait time includes time spent in the waiting room and exam room. In the last 6 months. How often did you see the person you came to see within 15 minutes of your appointment time?
<b>Ease of Getting Care</b>			
53	In the last 6 months, how often was it easy to get the care, tests or treatment you thought you needed?	39	In the last 6 months, how often was it easy to get the care, tests or treatment you thought you needed through your health plan?
<b>How Well Providers Communicate</b>			
16	In the last 6 months, how often did this provider explain things in a way that was easy to understand?	17	In the last 6 months, how often did your personal doctor explain things in a way that was easy to understand?
17	In the last 6 months, how often did this provider listen carefully to you?	18	In the last 6 months, how often did your personal doctor listen carefully to you?
22	In the last 6 months, how often did this provider show respect for what you had to say?	19	In the last 6 months, how often did your personal doctor show respect for what you had to say?
23	In the last 6 months, how often did this provider spend enough time with you?	20	In the last 6 months, how often did your personal doctor spend enough time with you?
<b>Access to Specialists</b>			
46	In the last 6 months, how often was it easy to get appointments with specialists?	34	In the last 6 months, how often was it easy to get appointments with specialists?

**eTable 2A.** Changes in Spending and Utilization Between Intervention and Comparison Groups for 23 ACOs Participating Full Second Year, 2012 and 2013

	Intervention Group			Comparison Group			Difference-in-Differences			
	Conditional Means			Conditional Means			2012		2013	
	Baseline Period (2010-2011)	Performance Year 1 (2012)	Performance Year 2 (2013)	Baseline Period (2010-2011)	Performance Year 1 (2012)	Performance Year 2 (2013)	Estimate	95% CIs	Estimate	95% CIs
Total beneficiary months (PBPM)	11,567,193	6,067,057	7,198,063	226,038,548	104,322,665	95,649,945	-		-	
Medicare spending per beneficiary month										
Total Medicare expenditures	\$924.85	\$931.54	\$958.88	\$874.64	\$918.07	\$926.05	<b>-\$36.73</b>	<b>-\$41.14 to -\$32.32</b>	<b>-\$17.38</b>	<b>-\$21.93 to -\$12.82</b>
All inpatient hospital (Part A)	\$348.07	\$341.01	\$350.37	\$325.28	\$333.21	\$336.61	<b>-\$15.00</b>	<b>-\$25.83 to -\$4.17</b>	<b>-\$9.03</b>	<b>-\$11.77 to -\$6.29</b>
Physician (Part B)	\$215.67	\$227.38	\$230.13	\$202.55	\$221.14	\$220.12	<b>-\$6.88</b>	<b>-\$7.91 to -\$5.84</b>	<b>-\$3.11</b>	<b>-\$4.21 to -\$2.01</b>
Hospital outpatient	\$139.91	\$153.71	\$163.49	\$137.34	\$157.88	\$162.68	<b>-\$6.74</b>	<b>-\$7.69 to -\$5.79</b>	<b>-\$1.76</b>	<b>-\$2.77 to -\$0.74</b>
SNF	\$97.58	\$86.66	\$89.71	\$94.46	\$85.99	\$88.73	<b>-\$2.45</b>	<b>-\$3.63 to -\$1.28</b>	<b>-\$2.14</b>	<b>-\$3.40 to -\$0.88</b>
Home health	\$51.22	\$48.61	\$51.94	\$46.64	\$45.48	\$47.34	<b>-\$1.44</b>	<b>-\$1.91 to -\$0.97</b>	\$0.02	-\$0.51 to \$0.55
Hospice	\$29.72	\$32.48	\$33.34	\$28.60	\$32.88	\$31.67	<b>-\$1.51</b>	<b>-\$2.27 to -\$0.76</b>	\$0.55	-\$0.27 to \$1.38
Durable medical equipment	\$19.22	\$19.49	\$16.88	\$17.56	\$18.82	\$15.97	<b>-\$0.99</b>	<b>-\$1.19 to -\$0.79</b>	<b>-\$0.76</b>	<b>-\$0.96 to -\$0.56</b>
Inpatient-related utilization per 1,000 beneficiary months										
Acute inpatient days	1.5	1.4	1.4	1.4	1.4	1.3	-0.05	-0.49 to 0.40	-0.02	-0.46 to 0.41
Inpatient admissions through emergency department	0.23	0.22	0.21	0.21	0.21	0.20	-0.005	-0.02 to 0.01	-0.01	-0.02 to 0.01
Inpatient rehabilitation or long-term care facility days	0.22	0.20	0.21	0.20	0.20	0.20	-0.01	-0.09 to 0.06	-0.01	-0.09 to 0.06
All-cause 30-day readmissions per 1,000 discharges	168.8	164.9	161.8	170.5	168.9	161.4	-2.30	-5.43 to 0.83	1.96	-1.2 to 5.1
Post-discharge physician visits per 1,000 discharges										
Within 7 days	416.7	531.9	544.1	405.8	502.1	519.0	<b>18.8</b>	<b>12.6 to 25.0</b>	<b>14.2</b>	<b>8.3 to 20.1</b>
Within 14 days	622.0	687.2	705.8	601.2	662.4	676.3	<b>4.0</b>	<b>-1.9 to 9.9</b>	<b>8.7</b>	<b>3.2 to 14.2</b>
Within 30 days	788.1	826.8	840.6	764.1	804.0	816.3	-1.3	-6.2 to 3.5	0.30	-4.1 to 4.7
Physician-related utilization per 100 beneficiary months										
Primary care evaluation and management visits	30.7	28.9	28.0	26.8	27.6	27.0	<b>-2.7</b>	<b>-3.0 to -2.4</b>	<b>-2.9</b>	<b>-3.2 to -2.6</b>
Procedures	61.1	63.3	63.4	57.1	62.0	61.6	<b>-2.7</b>	<b>-4.1 to -1.3</b>	<b>-2.2</b>	<b>-3.4 to -1.0</b>
Imaging services	42.8	41.9	42.5	40.2	40.7	40.9	<b>-1.4</b>	<b>-2.0 to -0.9</b>	<b>-1.0</b>	<b>-1.6 to -0.5</b>
Tests	134.6	137.5	136.8	121.2	127.2	127.8	<b>-3.0</b>	<b>-4.4 to -1.6</b>	<b>-4.4</b>	<b>-5.8 to -3.1</b>
Outpatient, post-acute, or hospice utilization per 100 beneficiary months										
Emergency department visits	4.0	4.3	4.3	3.9	4.3	4.3	<b>-0.19</b>	<b>-0.22 to -0.16</b>	<b>-0.19</b>	<b>-0.22 to -0.16</b>
Observation stays	0.58	0.68	0.75	0.55	0.66	0.73	<b>-0.01</b>	<b>-0.02 to -0.005</b>	<b>-0.02</b>	<b>-0.03 to -0.01</b>
Skilled nursing facility days	22.2	20.6	20.6	21.9	19.8	19.9	<b>0.45</b>	<b>0.17 to 0.72</b>	<b>0.43</b>	<b>0.15 to 0.72</b>
Home health visits	29.4	27.4	29.1	27.2	26.4	26.9	<b>-1.11</b>	<b>-1.47 to -0.75</b>	0.09	-0.32 to 0.51
Hospice days	17.8	18.9	19.6	17.2	19.2	18.7	<b>-0.94</b>	<b>-1.39 to -0.49</b>	0.28	-0.22 to 0.78

Analysis of Medicare claims data from the Chronic Conditions Warehouse Research Identifiable Files. Conditional means and difference-in-differences results are estimates for the 23 Pioneer ACOs participating through 2013 and their comparison populations. Conditional means are averages across ACOs and are the basis for the difference-in-differences estimates, while the difference-in-

differences results for all 32 ACOs in the main analyses were from pooling individual beneficiaries across all ACOs. Negative values indicate differentially lower spending or utilization. Estimates in bold indicate statistical significance at the  $P < 0.05$  level. All results were regression-adjusted for age, sex, race, Medicaid dual eligibility status, end stage renal disease, mortality, and indicator variables for acute myocardial infarction, hip fracture, colorectal cancer, lung cancer, and stroke and with Oaxaca-Blinder reweighting. Procedures, imaging services, and tests are categorized according to Berenson-Eggers Type of Service (BETOS).

**eTable 2B.** Changes in Spending and Utilization Between Intervention and Comparison Groups for 9 ACOs Participating Partial Second Year, 2012 and 2013

	Intervention Group			Comparison Group			Difference-in-Differences			
	Conditional Means			Conditional Means			2012		2013	
	Baseline Period (2010-2011)	Performance Year 1 (2012)	Performance Year 2 (2013)	Baseline Period (2010-2011)	Performance Year 1 (2012)	Performance Year 2 (2013)	Estimate	95% CIs	Estimate	95% CIs
Total beneficiary months (PBPM)	3,519,388	1,784,556	2,151,661	103,738,894	49,126,608	44,670,559	-		-	
Medicare spending per beneficiary month										
Total Medicare expenditures	\$904.15	\$913.87	\$943.24	\$869.82	\$916.99	\$923.47	<b>-\$37.45</b>	<b>-\$42.18 to -\$32.73</b>	<b>-\$14.56</b>	<b>-\$19.52 to -\$9.60</b>
All inpatient hospital (Part A)	\$325.37	\$318.51	\$326.64	\$312.13	\$317.55	\$320.48	<b>-\$12.27</b>	<b>-\$23.17 to -\$1.37</b>	<b>-\$7.08</b>	<b>-\$10.04 to -\$4.11</b>
Physician (Part B)	\$246.97	\$261.48	\$268.35	\$231.25	\$255.19	\$254.88	<b>-\$9.43</b>	<b>-\$10.89 to -\$7.97</b>	<b>-\$2.25</b>	<b>-\$3.80 to -\$0.70</b>
Hospital outpatient	\$118.43	\$128.84	\$140.54	\$115.54	\$133.43	\$136.36	<b>-\$7.47</b>	<b>-\$8.39 to -\$6.56</b>	<b>\$1.30</b>	<b>\$0.37 to \$2.22</b>
SNF	\$76.81	\$68.25	\$72.41	\$76.50	\$72.46	\$74.81	<b>-\$4.52</b>	<b>-\$5.62 to -\$3.41</b>	<b>-\$2.71</b>	<b>-\$3.92 to -\$1.50</b>
Home health	\$63.09	\$61.06	\$62.78	\$61.28	\$60.40	\$62.10	<b>-\$1.14</b>	<b>-\$1.81 to -\$0.47</b>	<b>-\$1.13</b>	<b>-\$1.84 to -\$0.41</b>
Hospice	\$28.38	\$31.66	\$31.37	\$30.91	\$35.10	\$34.92	<b>-\$0.92</b>	<b>-\$1.72 to -\$0.11</b>	<b>-\$1.02</b>	<b>-\$1.88 to -\$0.17</b>
Durable medical equipment	\$24.92	\$23.45	\$20.12	\$21.79	\$22.32	\$18.93	<b>-\$2.00</b>	<b>-\$2.26 to -\$1.75</b>	<b>-\$1.94</b>	<b>-\$2.18 to -\$1.69</b>
Inpatient-related utilization per 1,000 beneficiary months										
Acute inpatient days	1.4	1.3	1.3	1.3	1.3	1.3	-0.06	-0.52 to 0.40	-0.03	-0.48 to 0.43
Inpatient admissions through emergency department	0.21	0.21	0.21	0.20	0.20	0.20	-0.01	-0.03 to 0.01	-0.004	-0.021 to 0.013
Inpatient rehabilitation or long-term care facility days	0.36	0.37	0.34	0.30	0.33	0.31	-0.01	-0.12 to 0.10	-0.03	-0.13 to 0.08
All-cause 30-day readmissions per 1,000 discharges	166.5	170.6	155.6	164.1	163.3	157.9	<b>4.8</b>	<b>1.3 to 8.3</b>	<b>-4.8</b>	<b>-8.3 to -1.3</b>
Post-discharge physician visits per 1,000 discharges										
Within 7 days	430.5	546.8	578.0	406.3	525.2	536.6	-2.5	-10.4 to 5.4	17.2	10.1 to 24.3
Within 14 days	634.0	707.6	737.8	603.7	680.4	692.9	-3.2	-10.6 to 4.1	14.6	8.2 to 21.0
Within 30 days	796.9	841.1	859.1	767.5	816.6	829.9	-5.0	-10.7 to 0.8	-0.29	-5.4 to 4.8
Physician-related utilization per 100 beneficiary months										
Primary care evaluation and management visits	33.4	31.2	31.2	28.4	29.1	28.4	<b>-2.9</b>	<b>-3.2 to -2.6</b>	<b>-2.2</b>	<b>-2.5 to -1.8</b>
Procedures	63.4	64.8	66.4	61.3	66.7	66.7	<b>-4.0</b>	<b>-5.6 to -2.3</b>	<b>-2.4</b>	<b>-3.9 to -0.9</b>
Imaging services	45.3	44.1	45.2	43.0	43.8	44.0	<b>-2.1</b>	<b>-2.7 to -1.4</b>	<b>-1.1</b>	<b>-1.8 to -0.5</b>
Tests	150.8	155.9	163.9	144.9	157.1	158.3	<b>-7.1</b>	<b>-9.0 to -5.3</b>	-0.29	-2.16 to 1.47
Outpatient, post-acute, or hospice utilization per 100										
Emergency department visits	3.5	3.7	3.9	3.4	3.8	3.9	<b>-0.12</b>	<b>-0.15 to -0.09</b>	-0.01	-0.04 to 0.03
Observation stays	0.53	0.56	0.63	0.51	0.57	0.61	<b>-0.03</b>	<b>-0.04 to -0.02</b>	-0.005	-0.014 to 0.005
Skilled nursing facility days	17.8	16.4	17.1	18.1	17.8	17.9	<b>-1.04</b>	<b>-1.30 to -0.77</b>	<b>-0.47</b>	<b>-0.76 to -0.18</b>
Home health visits	38.9	37.7	37.6	38.4	37.2	37.6	0.01	-0.57 to 0.58	-0.54	-1.16 to 0.07
Hospice days	16.7	18.0	18.2	19.0	20.9	21.0	<b>-0.69</b>	<b>-1.19 to -0.20</b>	<b>-0.55</b>	<b>-1.08 to -0.01</b>

Analysis of Medicare claims data from the Chronic Conditions Warehouse Research Identifiable Files. Conditional means and difference-in-differences results are estimates for the 9 Pioneer ACOs not participating through 2013 and their comparison populations. Conditional means are averages across ACOs and are the basis for the difference-in-differences estimates, while the difference-in-differences results for all 32 ACOs in the main analyses were from pooling individual beneficiaries across all ACOs. Negative values indicate differentially lower spending or utilization. Estimates in bold indicate statistical significance at the P < 0.05 level. All results were regression-adjusted for age, sex, race, Medicaid dual eligibility status, end stage renal disease, mortality, and

indicator variables for acute myocardial infarction, hip fracture, colorectal cancer, lung cancer, and stroke and with Oaxaca-Blinder reweighting. Procedures, imaging services, and tests are categorized according to Berenson-Eggers Type of Service (BETOS).

**eTable 3. Separate Markets**

ACO Market City	ACO Market State	Number of Pioneer ACOs	Matched Market City	Matched Market State	Type
Appleton	Wisconsin	1	Wausau	Wisconsin	HRR
Bangor	Maine	1	Pittsfield	Massachusetts	CBSA
Boston	Massachusetts	5	Worcester	Massachusetts	HRR
Des Moines	Iowa	1	Sioux Falls	South Dakota	HRR
Detroit	Michigan	1	Cleveland	Ohio	CBSA
Indianapolis	Indiana	1	Rockford	Illinois	HRR
Los Angeles	California	2	San Jose	California	CBSA
Manchester	New Hampshire	1	Norwich	Connecticut	CBSA
Minneapolis	Minnesota	3	Omaha	Nebraska	HRR
New York	New York	1	Chicago	Illinois	CBSA
Peoria	Illinois	1	Urbana	Illinois	HRR
Philadelphia	Pennsylvania	1	Camden	New Jersey	HRR
Phoenix	Arizona	1	Ogden	Utah	CBSA
San Diego	California	1	Portland	Oregon	HRR
San Francisco	California	1	Santa Cruz	California	HRR

Separate markets of alignment-eligible beneficiaries were either hospital referral regions (HRRs) or core-based statistical areas (CBSAs) that best matched the ACO HRR or CBSA characteristics:

1. Natural logarithm of population (2010);
2. Unemployment rate (2010);
3. Herfindahl-Hirschman Index (HHI) of hospital charges (2011);
4. Median household income (2010);
5. Age-, sex-, and race-adjusted Medicare spending per beneficiary (2009);
6. Percent of the population of white race (2010); and
7. Medicare managed care penetration rate (2011).

The closest market according to Euclidean distance was selected, the notable exception being Chicago as New York's separate market. Separate markets were ineligible if they contained another Pioneer ACO or Medicare Shared Savings Program ACO in 2012 or if more than 5% of beneficiaries residing in a separate market were aligned with a Pioneer ACO in 2012.



**eTable 4.** Risk Adjustment Sensitivity Analyses

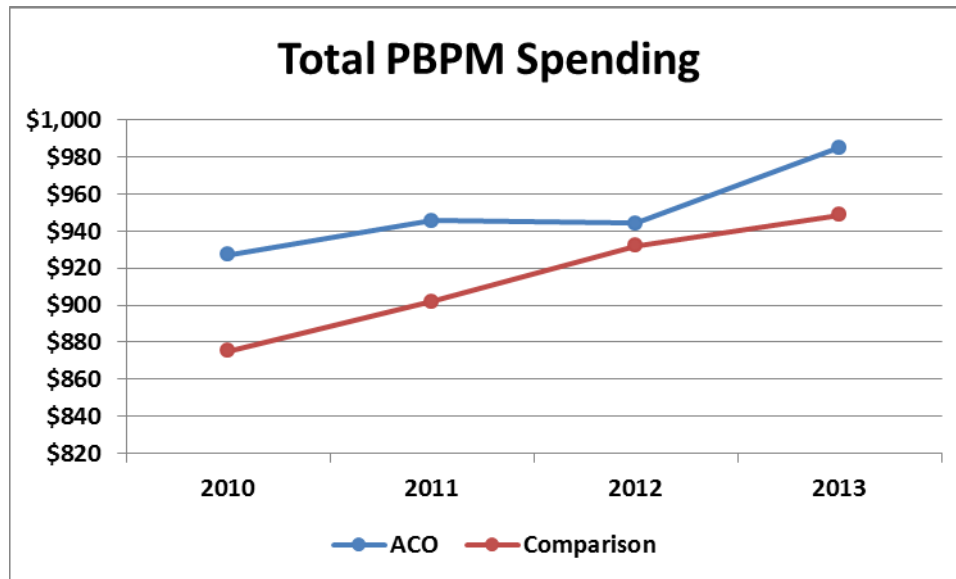
Model	(1) Demographic and Enrollment Characteristics Only	(2) Demographic and Enrollment Characteristics with Current-year Hip Fracture, Colorectal Cancer, Stroke, AMI, or Lung Cancer	(3) Demographic and Enrollment Characteristics with HCC Score	(4) Demographic and Enrollment Characteristics with Elixhauser	(5) Demographic and Enrollment Characteristics with Any-year Hip Fracture, Colorectal Cancer, Stroke, AMI, or Lung Cancer and HCC score and Elixhauser
1	1.000	0.995	0.761	0.710	0.792
2	0.995	1.000	0.766	0.710	0.796
3	0.761	0.766	1.000	0.705	0.800
4	0.710	0.710	0.705	1.000	0.925
5	0.792	0.796	0.800	0.925	1.000

As a sensitivity analysis, 5 different total per-beneficiary-per-month spending model permutations were analyzed for beneficiaries eligible for Pioneer ACO alignment in 2011. Hierarchical condition category (HCC) scores and 31 Elixhauser condition indicators were analyzed in the current year.<sup>1,2</sup> The table shows that the intraclass correlation coefficients were mainly between 0.7 and 0.8, indicating that the risk adjustment model used in the main analyses performed comparably to other risk adjustment methods. These similarities appear to be driven by the presence of demographic and enrollment characteristics in all the models and the large number of observations (~15 million). AMI denotes acute myocardial infarction.

<sup>1</sup> Quan H, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. *Medical Care*. 2005;43(11):1130-1139.

<sup>2</sup> Pope G.C., Kautter J., Ellis R.P., et al. Risk adjustment of Medicare capitation payments using the CMS-HCC model. *Health Care Financing Review*. 25(4):2004, 119-41.

**eFigure 2.** Adjusted Conditional Means in Baseline and Performance Years



The figure of adjusted conditional means of total PBPM spending for each year shows that the relatively large decreases in spending in the first Pioneer ACO performance year were largely driven by the spending of beneficiaries aligned with Pioneer ACOs flattening in 2012, while the spending trend of the comparison population continued upward. In the baseline years (2010 and 2011), the spending trends for both ACO and comparison populations were parallel, as would be expected. In 2013, the spending for ACO beneficiaries increased, but at the same time, the spending for the comparison population attenuated, which is consistent with broader trends in the fee-for-service Medicare program.

The higher spending for beneficiaries who were aligned with ACOs may be an artifact of the alignment algorithm. Since it depends on attributing beneficiaries according to the plurality of their E&M allowed charges, patients aligned with ACOs probably have a relatively large amount of charges (and, hence, spending) compared with all other eligible but unaligned beneficiaries. The difference-in-differences approach renders this difference in spending levels moot since it subtracts the difference in conditional means between the ACO beneficiaries and their baseline from the difference in conditional means between the comparison population of beneficiaries and their baseline.