

Supplementary Table S1. Detailed definition of covariates

Patient-level variables	Definition	Data Source
Age	The beneficiary's age in years as of the end of the calendar year or for beneficiaries who died during the year, age as of the date of death (AGE_AT_END_REF_YR)	MBSF
Sex	The sex of the beneficiary (Male, Female) (SEX_IDENT_CD)	MBSF
Race/Ethnicity	Beneficiary race code measured through RTI algorithm, which enhanced race/ethnicity designation based on first and last name algorithms (NH Whites, Black, Hispanics, Others , missing) (RTI_RACE_CD)	MBSF
Comorbid conditions	Individual Charlson comorbid conditions with at least one inpatient claim or two different physician or outpatient claims that are more than 30 days apart (https://healthcaredelivery.cancer.gov/seermedicare/considerations/macro-2014.html)	Medpar, Outpatient, Carrier
Dual eligibility	Ever Medicare-Medicaid dual eligible in 2017 (DUAL_STUS_CD_01-DUAL_STUS_CD_12: full – '02','04', '08' or partial – '01','03','05','06')	MBSF
Original reason for entitlement	Original reason for Medicare entitlement (age, disability, ESRD, or disability+ESRD)(ENTLMT_RSN_ORIG)	MBSF
Medical Care Utilization in 2016		
# Hospitalizations	Number of hospitalization discharge (NCH_CLM_TYPE_CD='60')	Medpar
# ED visits	Number of outpatient ED visits (associated with revenue center codes REV_CNTR 045X and 0981)	Outpatient
# ICU stays	Number of hospitalization with ICU stay.(associated with NCH_CLM_TYPE_CD='60' inpatient claims and ICU_IND_CD between '0'-9')	Medpar
# Home-away days	Number of inpatient days and SNF days in 2016	Medpar
# Home Health Service episodes	Number of HHA episodes (associated with revenue center codes 042X, 043X, 044X, 055X, 056X, 057X, 058X, and 059X).	HHA
# SNF stays	Number of SNF stay (associated with NCH_CLM_TYPE_CD='20' or '30' or SS_LS_SNF_IND_CD='N'). We excluded SNF claims missed both admission date or discharge date (2908 claims).	Medpar
Regional-level variables (HRR)	HRR assigned based on beneficiaries' residence	
Hospitals beds per 1,000 beneficiaries	Measured by sum of AHA beds (Dartmouth Hospital Track File 2016) over number of 65+ Medicare beneficiaries by HRR (CMS geographic public-use file 2016)	CMS geographic public-use file 2017; Dartmouth Hospital Track File 2016
Emergency department visits per 1,000 beneficiaries	Emergency Department Visits per 1000 65+ beneficiaries by HRR	CMS geographic public-use file 2017
% beneficiaries using hospice	% beneficiaries using hospice by HRR	CMS geographic public-use file 2017

Standardized per capita costs	Standardized per capita costs by HRR	CMS geographic public-use file 2017
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Supplementary Table S2. Demographic, clinical and regional characteristics of the total population and of those died within the first three months of 2017 and those who did not die within the first three months of 2017

	Total	Early Death	No early death	
	N (row%)	N (row%)	N (row%)	
	N=1323331 (100)	N=13970 (1.06)	N=1309361 (98.94)	
	N (col%)	N (col%)	N (col%)	Chi-square p value
ACP in 2017	32137 (2.4)	539 (3.9)	31598 (2.4)	<.0001
No ACP in 2017	1291194 (97.6)	13431 (96.1)	1277763 (97.6)	
Patient Level	Mean (SD)	Mean (SD)	Mean (SD)	T test p value
Age	76.1 (7.7)	82.3 (9.1)	76.0 (7.6)	<.0001
Sex	N (col%)	N (col%)	N (col%)	Chi-square p value
Male	602695 (45.5)	6717 (48.1)	595978 (45.5)	<.0001
Female	720636 (54.5)	7253 (51.9)	713383 (54.5)	
Race/Ethnicity				
NH White	1078540 (81.5)	11677 (83.6)	1066863 (81.5)	<.0001
Black	97517 (7.4)	1165 (8.3)	96352 (7.4)	
Hispanics	69602 (5.3)	643 (4.6)	68960 (5.3)	
Others	56818 (4.3)	421 (3.0)	56397 (4.3)	
Unknown	20854 (1.6)	65 (0.5)	20789 (1.6)	
Dual Eligibility	155091 (11.7)	3516 (25.2)	151575 (11.6)	<.0001
Original Medicare Eligible Reason				
old age	1207753 (91.3)	12090 (86.5)	1195663 (91.3)	<.0001
disability	113342 (8.6)	1785 (12.8)	111557 (8.5)	
ESRD	1286 (0.1)	51 (0.4)	1235 (0.1)	
both disability and ESRD	950 (0.1)	44 (0.3)	906 (0.1)	
Medical Care Utilization in 2016	Mean (SD)	Mean (SD)	Mean (SD)	T test p value
# hospitalization	0.22 (0.7)	1.04 (1.6)	0.21 (0.7)	<.0001
# ED visits	0.34 (0.9)	0.92 (1.8)	0.33 (0.9)	<.0001
# ICU visits	0.06 (0.3)	0.32 (0.8)	0.05 (0.3)	<.0001
# HHA episode	0.15 (0.7)	0.66 (1.3)	0.15 (0.7)	<.0001
# SNF stays	0.05 (0.3)	0.4 (0.9)	0.05 (0.3)	<.0001
# Home-away days	1.54 (15.3)	10 (11.4)	1.42 (1.5)	<.0001
Charlson Comorbidity Scores	N (col%)	N (col%)	N (col%)	Chi-square p value
0	738947 (55.8)	2674 (19.1)	736273 (56.2)	<.0001
1	205813 (15.6)	1787 (12.8)	204026 (15.6)	
2+	378571 (28.6)	9509 (68.1)	269062 (28.2)	
Comorbid conditions in 2016				
Acute MI (w/ or w/o history of MI)	12243 (0.9)	634 (4.5)	11609 (0.9)	<.0001
History of MI (no Acute MI in 2016)	22136 (1.7)	781 (5.6)	21355 (1.6)	<.0001
CHF	92797 (7.0)	4286 (31.4)	88411 (6.8)	<.0001
PVD	109231 (8.3)	3776 (27.0)	105455 (8.1)	<.0001
CVD	66671 (5.0)	2082 (14.9)	64589 (4.9)	<.0001
COPD	137676 (10.4)	4072 (29.2)	133604 (10.2)	<.0001
Dementia	59253 (4.5)	3733 (26.7)	55520 (4.2)	<.0001
Paralysis	7935 (0.6)	411 (2.9)	7524 (0.6)	<.0001
Diabetes	138793 (10.5)	1624 (11.6)	137169 (10.5)	<.0001
Diabetes w/ complications	130621 (9.9)	3001 (21.5)	127620 (9.8)	<.0001
renal disease	116441 (8.8)	3994 (28.6)	112447 (8.6)	<.0001
mild liver disease	15591 (1.2)	386 (2.8)	15205 (1.2)	<.0001
moderate/severe liver disease	2311 (0.2)	176 (1.3)	2135 (0.2)	<.0001
ulcers	7480 (0.6)	296 (2.1)	7184 (0.6)	<.0001
rheum disease	43288 (3.3)	702 (5.0)	42586 (3.3)	<.0001
aids	955 (0.1)	13 (0.1)	942 (0.1)	0.3553
Metastatic solid tumor	11848 (0.9)	964 (6.9)	10884 (0.8)	<.0001
Other cancer	90042 (6.8)	1656 (11.9)	88386 (6.8)	<.0001
Regional Level (HRR)	Mean (SD)	Mean (SD)	Mean (SD)	T test p value
# Hospital beds per 1000 65+ Medicare beneficiaries	15.8 (4.2)	16.0 (4.2)	15.9 (4.2)	<.0001
# Emergency Department visits per 1000 65+ Medicare beneficiaries	589.7 (64.5)	594.4 (64.8)	589.7 (64.5)	<.0001
% beneficiaries using hospice	2.5 (1.5)	2.5 (1.5)	2.5 (1.5)	0.3833
Standardized Per Capita Costs	9553.5 (1158.8)	9582.7 (1143.2)	9553.1 (1158.9)	0.0027
# Hospital beds per 1000 65+ Medicare beneficiaries	N (col%)	N (col%)	N (col%)	Chi-square p value
1st quintile (\leq 11.9)	223318 (16.9)	2177 (15.6)	221141 (16.9)	0.0001
2nd quintile (11.91-14.3)	313197 (23.7)	3266 (23.4)	309931 (23.7)	

3rd quintile (14.31-16.2)	258217 (19.5)	2761 (19.8)	255456 (19.5)	
4th quintile (16.21-19.5)	306093 (23.1)	3294 (23.6)	302799 (23.1)	
5th quintile (>19.5)	222506 (16.8)	2472 (17.7)	220034 (16.8)	
# Emergency Department visits per 1000 65+ Medicare beneficiaries				
1st quintile (≤533)	303613 (22.9)	2834 (20.3)	300779 (23.0)	<.0001
2nd quintile (534-578)	287426 (21.7)	2958 (21.2)	284468 (21.7)	
3rd quintile (579-620)	314874 (23.8)	3405 (24.4)	311469 (23.8)	
4th quintile (621-655)	232302 (17.6)	2625 (18.8)	229677 (17.5)	
5th quintile (>655)	185116 (14.0)	2148 (15.4)	182968 (14.0)	
% beneficiaries using hospice				
1st quintile (≤0.0385)	291819 (22.1)	3148 (22.5)	288671 (22.1)	0.1501
2nd quintile (0.0386-2.81999)	244764 (18.5)	2554 (18.3)	242210 (18.5)	
3rd quintile (2.82-3.25)	318635 (24.1)	3254 (23.3)	315381 (24.1)	
4th quintile (3.26-3.74)	267588 (20.2)	2850 (20.4)	264738 (20.2)	
5th quintile (>3.74)	200525 (15.2)	2164 (15.5)	198361 (15.2)	
Standardized Per Capita Costs				
1st quintile (≤\$8319.23)	199767 (15.1)	1945 (13.9)	197822 (15.1)	0.0004
2nd quintile (\$8319.24-\$9102.01)	246970 (18.7)	2623 (18.8)	244347 (18.7)	
3rd quintile (\$9102.02-\$9768.95)	283258 (21.4)	3059 (21.9)	280199 (21.4)	
4th quintile (\$9768.96-\$10464.18)	306669 (23.2)	3365 (24.1)	303304 (23.2)	
5th quintile (>\$10464.18)	286667 (21.7)	2978 (21.3)	283689 (21.7)	

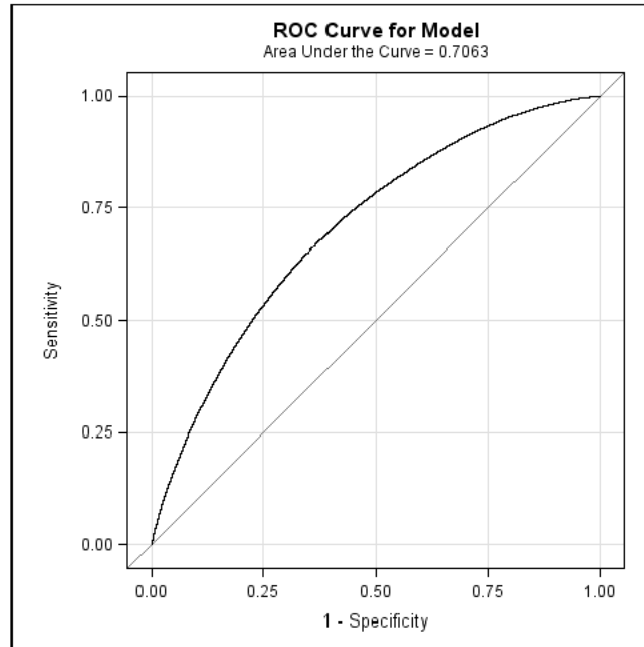
Supplementary Table S3. Multivariate logistic regression predicting receipt of ACP visits among Medicare beneficiaries who did not die within the first three months of 2017

	OR (95% CI)	p value
Patient Level		
Age	1.027 (1.025-1.028)	<.0001
Sex		
Male	1 (reference)	
Female	1.18 (1.15-1.2)	<.0001
Race/Ethnicity		
NH White	1 (reference)	
Black	0.84 (0.81-0.88)	<.0001
Hispanics	0.84 (0.8-0.89)	<.0001
Others	0.97 (0.91-1.02)	0.2346
Unknown	0.79 (0.71-0.89)	<.0001
Dual Eligibility		
No	1 (reference)	
Yes	1.15 (1.11-1.19)	<.0001
Original Medicare Eligible Reason		
old age	1 (reference)	
disability	1.08 (1.04-1.13)	<.0001
ESRD	1.31 (0.98-1.75)	0.0728
both disability and ESRD	1.25 (0.89-1.77)	0.2059
Medical care utilization in 2016		
# Hospitalization	1.01 (0.99-1.03)	0.4977
# ED visits	1.03 (1.03-1.04)	<.0001
# ICU visits	0.97 (0.94-1.01)	0.1335
# HHA episode	1.09 (1.08-1.1)	<.0001
# SNF stays	1.04 (1.01-1.08)	0.0174
# Home away days	1 (0.999-1)	0.8401
Comorbid conditions in 2016		
Acute MI (w/ or w/o history of MI)	1 (0.91-1.11)	0.9327
History of MI (no Acute MI in 2016)	1.06 (0.98-1.14)	0.1324
CHF	1.2 (1.15-1.25)	<.0001
PVD	1.2 (1.15-1.24)	<.0001
CVD	1.16 (1.11-1.21)	<.0001
COPD	1.33 (1.28-1.37)	<.0001
Dementia	1.17 (1.12-1.23)	<.0001
Paralysis	1.09 (0.97-1.22)	0.1565
Diabetes	1.22 (1.18-1.26)	<.0001
Diabetes w/ complications	1.4 (1.36-1.45)	<.0001
renal disease	1.26 (1.21-1.3)	<.0001
mild liver disease	1.17 (1.08-1.28)	0.0003
moderate/severe liver disease	1.68 (1.39-2.04)	<.0001
ulcers	1.04 (0.92-1.17)	0.5407
rheum disease	1.16 (1.09-1.22)	<.0001
aids	1.07 (0.72-1.57)	0.7453
Metastatic solid tumor	1.89 (1.73-2.07)	<.0001
Other cancer	1.34 (1.29-1.39)	<.0001
Regional Level		
# Hospital beds per 1000 65+ Medicare beneficiaries		
1st quintile (low)	1 (reference)	
2nd quintile	0.82 (0.62-1.07)	0.1422
3rd quintile	0.77 (0.58-1.02)	0.0644
4th quintile	0.77 (0.57-1.04)	0.0828
5th quintile (high)	0.74 (0.55-1.02)	0.0621
# Emergency Department visits per 1000 65+ Medicare beneficiaries		
1st quintile (low)	1 (reference)	
2nd quintile	0.91 (0.7-1.19)	0.489
3rd quintile	0.8 (0.61-1.06)	0.1167
4th quintile	1.01 (0.76-1.35)	0.9262
5th quintile (high)	0.64 (0.47-0.87)	0.0042
% beneficiaries using hospice		
1st quintile (low)	1 (reference)	
2nd quintile	0.97 (0.75-1.25)	0.7843
3rd quintile	0.98 (0.75-1.28)	0.887
4th quintile	0.75 (0.57-0.98)	0.0316
5th quintile (high)	0.74 (0.56-0.98)	0.0343

Standardized Per Capita Costs

1st quintile (low)	1 (reference)	
2nd quintile	1.11 (0.84-1.48)	0.4627
3rd quintile	1.49 (1.1-2.02)	0.0101
4th quintile	1.75 (1.27-2.4)	0.0006
5th quintile (high)	2.11 (1.5-2.97)	<.0001

Supplementary Figure 1. ROC curve for model predicting the odds of receiving ACP services in 2017



*ROC: Receiver Operating Characteristic