Figure S4. Kernal Density Plots Before and After Matching

Later Consultations—Initial Consultation ≤ 30 Days before Death

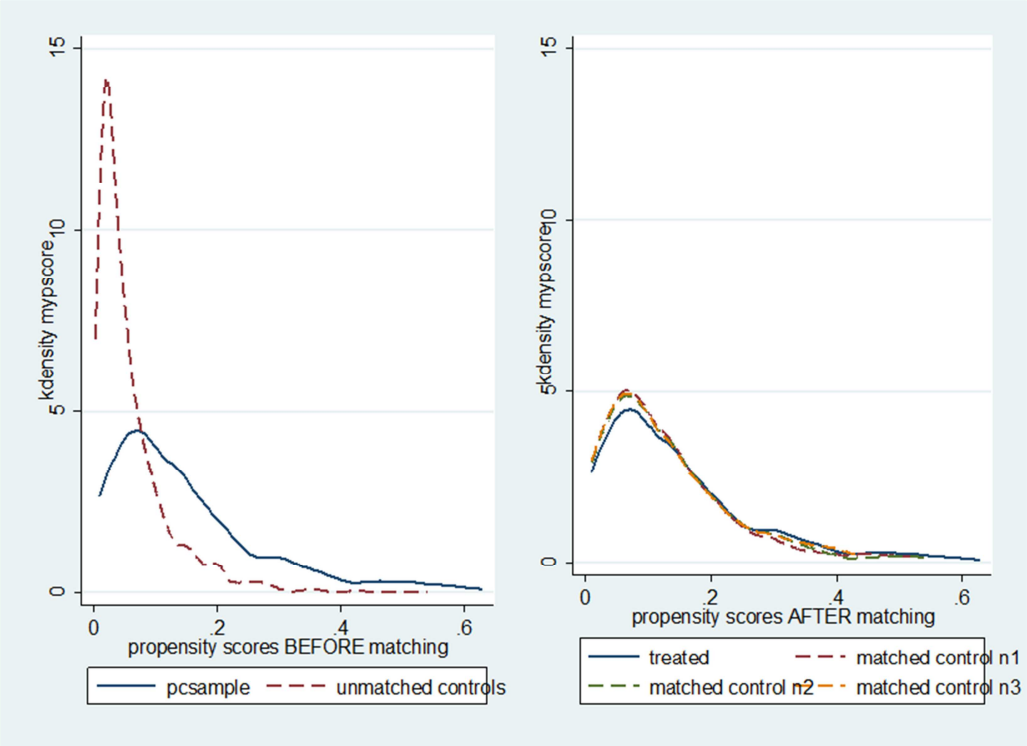
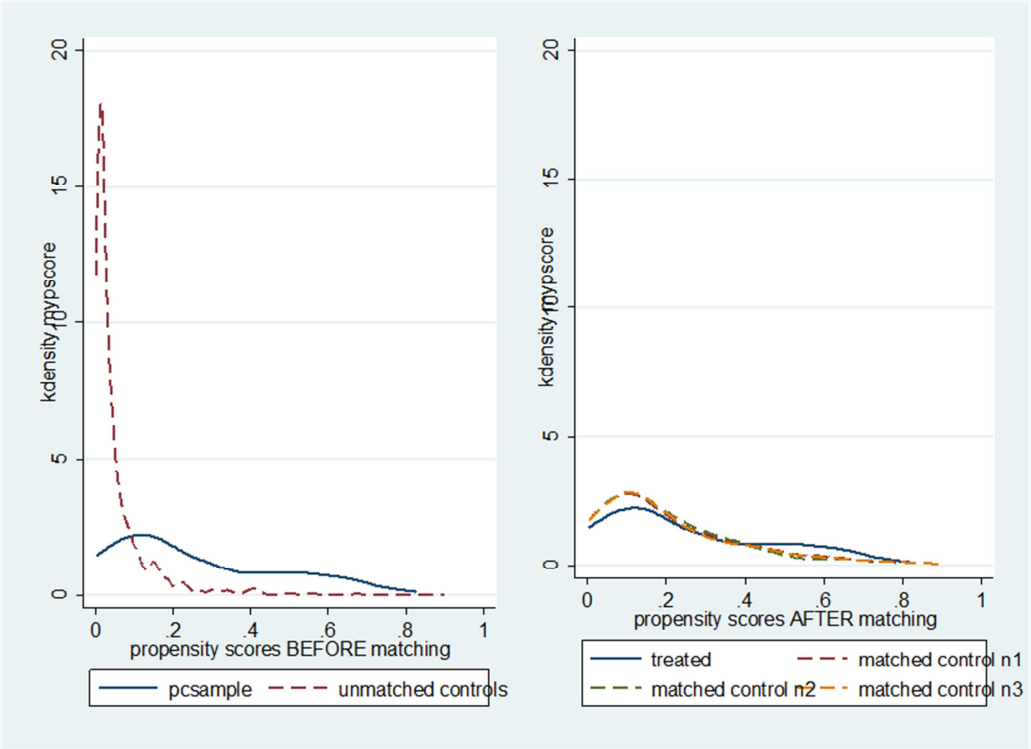


Figure S5. Kernal Density Plots Before and After Matching

Later Consultations—Initial Consultation 31-180 Days before Death



Supplemental Digital Content

Text, S.1

Propensity-Score Matching

Identifying Potential Controls

Recall from the paper that we looked separately at two groups of individuals (n=204) defined by the days from their first NH palliative care consultation to time of death: Earlier initial consultations (31-180 days before death) and later initial consultations (1-30 days before death). The median time between the initial palliative care consultations and the baseline MDS's chosen was 10 days among those with later consultations and 21 days among those with earlier consultations. We performed propensity score (pscore) matching procedures on these two groups separately. Specific steps are described below.

We selected our potential group of controls from the underlying populations of decedents at the 31 study NHs. We balanced potential bias versus efficiency associated with differing matching approaches by choosing 1-3 matching (to increase efficiency), using replacement (to decrease bias), and by requiring the propensity score of matches to be within a pre-prescribed caliper or range of the treatment individual's propensity score (to decrease bias). Like residents with NH palliative care consultations, all potential matches had to have dementia as defined in the main text. They had to have been Medicare eligible and not have used Medicare Advantage in the year prior to death, and had to have an available MDS from which to identify baseline characteristics. The dates on baseline MDSs were required to be of similar distances from death as observed for residents within the consultation groups. Specifically, for each of the two consultation groups we chose baseline MDSs for potential controls that were within the timeframes described below.

- Later initial consultations: MDS at least a day prior to death and closest to 30 days prior to death (before or after)

- Earlier initial consultations: An MDS at least 31 or more days prior to death and closest to 120 days before death (before or after)

Since this study focused on decedents with NH palliative care consultations up to 180 days before death, residents with first consultations more than 180 days before death were dropped altogether and not allowed to be potential controls. Potential controls who had NH hospice at baseline were retained so the controls would accurately represent the underlying population of decedents without palliative care consultations.(1) Between 19.8% – 26.3% of decedents within each group of potential controls had hospice prior to the baseline MDS. Relating to this, we included baseline variables known to be associated with both hospice election (e.g., the presence of DNR and DNH orders), and reflective of hospice enrollment (e.g., any hospitalizations in the 90 days prior to the baseline assessment) in all analyses. Still, this is a conservative approach and the effect of palliative care consultations would likely have potentially been higher had we removed potential controls with NH hospice at baseline.

Estimating Propensity-scores and Choosing Matches

Propensity scores for residents in each palliative care group and for potential controls were obtained as the predicted probability from logistic regression models where the receipt of palliative care consultations was the outcome. Tables S2 and S3 list the covariates used in the models, which are described in the paper. We selected patient and NH facility characteristics that have been found to be associated with hospice use and end-of-life acute care use.(2-6) We also included time between the baseline MDS and death, a state indicator, and year of death. Any resident with missing information on any of these covariates was excluded because of our inability to use their pscores for matching. To achieve balance within each pscore model, we tested numerous interactions between variables and variable transformations. We relied on Garrido and colleagues (7) for guidance in the process. Final pscore balanced models varied slightly across treatment groups. For example, among the later consultation group, a facility

level race variable was not included in the model, but a quadratic term for functional limitation status was. Stata pscore and psmatch2(8) procedures were used.

We used *k*-nearest neighbor with caliper pscore matching with replacement allowing for the possibility of ties to choose the three closest controls whose logit pscore fell within one-fifth of the standard deviation of the mean logit pscore for each consultation recipient.(9) A normalized weight was assigned to each treatment and match during Stata's psmatch2 procedure. This weight was later used in our outcome analyses. All non-matches were dropped from further analyses.

References:

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7. Garrido MM, Kelley AS, Paris J, et al. Methods for constructing and assessing propensity scores. Health Serv Res 2014;49:1701-1720.

8. Leuven E, Sianesi B. “PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing. http://ideas.repec.org/c/boc/bocode/s432001.html. Version 4.0.11.

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Table S2. Later Initial Palliative Care (PC) Consultations (≤ 30 Days before Death): Pre- and Post-Match Comparisons

	Later Initial Palliative Consultations			
Characteristics	**Potential Matches[a] (n=1586)**	**PC Consultation (n=112)**	**Matched, No Consultation (n=259)**	**Standardized % Differences Consultation vs. Matched Controls**
Palliative Care Consultations	No	Yes	No	
Age at baseline				
40 to 74	6.1%	4.5%	5.7%	-5.3
75 to 79	9.6%	16.1%	16.1 %	0.0
79 to 84	18.6%	25.0%	26.2%	-2.9
85 to 89	26.4%	17.0%	17.0%	0.0
90 to 94	26.0%	28.6%	27.1%	3.3
95 and older	13.2%	8.9%	8.0%	2.8
Male	33.2%	42.9%	42.3%	1.2
Non-White	3.4%	6.3%	7.7%	-6.9
Married	23.6%	31.3%	29.5%	4.0
Do-Not-Resuscitate Order	80.0%	80.4%	79.5%	2.2
Do-Not-Hospitalize Order	16.1%	8.0%	9.5%	-4.6
Cancer	16.6%	19.6%	22.3%	-6.9
Cognitive Performance Scale				
Intact (0-2)	58.3%	66.1%	69.3%	-6.8
Mild/Moderate Impairment (3-4)	20.0%	21.4%	19.0%	5.9
Severe Impairment (5-6)	21.8%	12.5%	11.6%	2.4
ADL score[b]	21.82	20.98	21.06	-1.4

	Later Initial Palliative Consultations			
Characteristics	Potential Matches[a] (n=1586)	PC Consultation (n=112)	Matched, No Consultation (n=259)	Standardized % Differences Consultation vs. Matched Controls
ADL score squared	506.02	470.93	473.56	-1.3
Short NH Stay (<90 days)	25.1%	40.2%	40.8	-1.3
Cognitive/ADL change[c]	73.9%	78.6%	77.1%	3.5
Days between MDS and death				
0 to 30 days	41.1%	54.5%	55.4%	-1.8
31 to 60 days	34.3%	24.1%	25.3%	-2.6
61 to 90 days	20.2%	12.5%	11.0%	4.0
91 to 180 days	4.4%	8.9%	8.3%	2.4
Any hospitalizations in 90 day prior to baseline	31.4%	51.8%	52.4%	-1.2
NH and Other Characteristics				
% Medicaid NH residents	60.3%	59.5%	61.1%	-8.4
% Medicare NH residents	1.3%	1.5%	1.5%	1.1
Any Alzheimer's Unit	36.2%	33.0%	32.7	0.6
% Dementia Over Median	51.9%	57.1%	56.8%	0.6
Average casemix (RUGS) score*100	81.12	84.14	83.94	2.8
Multisite facility (chain)	63.7 %	79.5%	75.9%	8.0
For-profit facility	75.2%	80.4%	80.7%	-0.7
Any NP/PA	40.6%	56.3%	57.1%	-1.8
Distance between facility and closest hospital (miles) (mean)	3.33	2.72	2.55	6.7

Characteristics	Potential Matches[a] (n=1586)	Later Initial Palliative Consultations: PC Consultation (n=112)	Later Initial Palliative Consultations: Matched, No Consultation (n=259)	Standardized % Differences Consultation vs. Matched Controls
Rhode Island	62.0%	34.8%	34.8%	0.0
Year of Death				
2006	24.8%	21.4%	22.0%	-1.4
2007	24.5%	25.0%	22.6%	5.5
2008	20.4%	24.1%	23.5%	1.4
2009	17.0%	21.4%	22.9%	-3.8
2010	13.4%	8.0%	8.9%	-2.9
Summaries				
Mean Standardized Differences compared to treatment group	18.4		3.1	

Abbreviations: ADL, activities of daily living; MDS, minimum data set; NH, nursing home; NP, nurse practitioners; PA, physician assistants; RUGS, resource utilization groups

[a] Residents who died in the same study years and nursing homes and had the requisite Minimum Data Set assessment

[b] ADL score ranges from 0-28 where 0=independent and 28=totally dependent.

[c] Cognitive/ADL change represents unstable, worsening, or declining status.

Table S3. Earlier Initial Palliative Care (PC) Consultations (31 to 180 Days before Death): Pre- and Post-Match Comparisons

	Earlier Initial Palliative Consultations			
Characteristics	**Potential Matches[a] (n=1170)**	**PC Consultation (n=91)**	**Matched, No Consultation (n=170)**	**Standardized % Differences Consultation vs. Matched Controls**
Palliative Care Consultation	No	Yes	No	
Age at baseline				
40 to 74	5.6%	15.4%	14.7%	2.4
75 to 79	8.5%	11.0%	15.4%	-14.8
79 to 84	19.2%	27.5%	27.5%	0.0
85 to 89	27.0%	23.1%	22.0%	2.5
90 to 94	25.7%	16.5%	14.3%	5.4
95 and older	13.9%	6.6%	6.2%	1.2
Male	29.1%	33.0%	30.0%	6.3
Non-White	3.6%	7.7%	8.1%	-1.6
Married	21.7%	20.9%	20.1%	1.8
Do-Not-Resuscitate Order	81.3%	76.9%	76.6%	0.9
Do-Not-Hospitalize Order	12.6%	4.4%	4.8%	-1.3
Cancer	14.7%	9.9%	11.4%	-4.5
Cognitive Performance Scale				
Intact/Mild/Moderate Impairment (0-4)	67.4%	80.2%	81.7%	-3.4
Severe Impairment (5-6)	32.6%	19.8%	18.3%	3.4
ADL score[b]	20.42	19.28	19.00	4.6

Characteristics	Earlier Initial Palliative Consultations			
	Potential Matches[a] (n=1170)	PC Consultation (n=91)	Matched No Consultation (n=170)	Standardized % Differences Consultation vs. Matched Controls
Short NH Stay (<90 days)	13.6%	11.0%	11.0%	0
Cognitive/ADL change[c]	69.3 %	84.6%	85.0%	-0.9
Days between MDS and death				
≤ 90 days	24.0%	37.4%	37.0%	0.8
91 to 120 days	33.2%	14.3%	17.6%	-7.9
121 to 160 days	38.4%	23.1%	23.8%	-1.6
161 to 301 days	4.4%	25.3%	21.6%	10.7
Any hospitalizations in 90 day prior to baseline	28.1%	52.7%	55.7%	-6.1
NH and Other Characteristics				
% Medicaid NH residents	60.7%	58.7%	59.7%	-5.1
% Medicare NH residents	13.1%	15.7%	16.2%	-5.1
% non-White NH residents	5.8%	10.4%	11.4%	-12.8
% Dementia Over Median	51.9%	46.2%	45.1%	2.2
Any Alzheimer's Unit	47.1%	39.6%	36.6%	0.0
Average casemix (RUGS) score*100	80.73	83.55	83.47	1.2
Multisite facility (chain)	60.4%	81.3%	83.9%	-5.8
For-profit facility	69.0%	83.5%	82.8%	1.7
Any NP/PA	42.2%	59.3%	63.7%	-8.9
Distance between facility and closest hospital (miles) (mean)	2.78	2.79	2.77	0.5

	Earlier Initial Palliative Care Consultations			
Characteristics	**Potential Matches [a] (n=1170)**	**PC Consultation (n=91)**	**Matched, No Consultation (n=170)**	**Standardized % Differences Consultation vs. Matched Controls**
Rhode Island	56.5%	28.6%	25.3%	6.9
Year of Death				
2006-2007	46.9%	42.9%	41.8%	2.2
2008-2010	53.1%	57.1%	58.2%	-2.2
Summaries				
Mean Standardized Differences compared to treatment group	25.6		3.9	

Abbreviations: ADL, activities of daily living; MDS, minimum data set; NH, nursing home; NP, nurse practitioners; PA, physician assistants; RUGS, resource utilization groups

[a] Residents who died in the same study years and nursing homes and had the requisite Minimum Data Set assessment

[b] ADL score ranges from 0-28 where 0=independent and 28=totally dependent.

[c] Cognitive/ADL change represents unstable, worsening, or declining status.