Association of Inpatient Palliative Care with Health Care Utilization and Postdischarge Outcomes among Medicare Beneficiaries with End Stage Kidney Disease

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Abstract

Background and objectives Palliative care may improve quality of life and reduce the cost of care for patients with chronic illness, but utilization and cost implications of palliative care in ESKD have not been evaluated. We sought to determine the association of inpatient palliative care with health care utilization and postdischarge outcomes in ESKD.

Design, setting, participants, & measurements In analyses stratified by whether patients died during the index hospitalization, we identified Medicare beneficiaries with ESKD who received inpatient palliative care, ascertained by provider specialty codes, between 2012 and 2013. These patients were matched to hospitalized patients who received usual care using propensity scores. Primary outcomes were length of stay and hospitalization costs. Secondary outcomes were 30-day readmission and hospice enrollment.

Results Inpatient palliative care occurred in <1% of hospitalizations lasting >2 days. Among the decedent cohort (n=1308), inpatient palliative care was associated with a 21% shorter length of stay (−4.2 days; 95% confidence interval, −5.6 to −2.9 days) and 14% lower hospitalization costs (−$10,698; 95% confidence interval, −$17,553 to −$3843) compared with usual care. Among the nondecedent cohort (n=5024), inpatient palliative care was associated with no difference in length of stay (0.4 days; 95% confidence interval, −0.3 to 1.0 days) and 11% higher hospitalization costs ($4275; 95% confidence interval, $1984 to $6567) compared with usual care. In the 30-day postdischarge period, patients who received inpatient palliative care had higher likelihood of hospice enrollment (hazard ratio, 8.3; 95% confidence interval, 6.6 to 10.5) and lower likelihood of rehospitalization (hazard ratio, 0.8; 95% confidence interval, 0.7 to 0.9).

Conclusions Among patients with ESKD who died in the hospital, inpatient palliative care was associated with shorter hospitalizations and lower costs. Among those who survived to discharge, inpatient palliative care was associated with no difference in length of stay and higher hospitalization costs but markedly higher hospice use and fewer readmissions after discharge.

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Introduction

A growing body of evidence supports the use of inpatient palliative care to promote patient-centered care for patients with chronic illness (1,2). Previous studies have found that inpatient palliative care is also associated with lower hospitalization costs under most circumstances (3–6), an effect attributed to limiting use of expensive care practices intended to prolong life when these are not aligned with the patient's goals and preferences.

Patients receiving dialysis for treatment of ESKD are among the costliest in the United States health care system. Individuals with ESKD make up <1% of all Medicare enrollees but account for 6% of Medicare spending (7,8). Forty percent of Medicare expenditures for patients with ESKD are attributable to inpatient costs (9). In spite of this intensive investment in health care services, patients with ESKD have high mortality rates (10) and poor quality of life (11–13). More than 80% of patients with ESKD are hospitalized during the last 3 months of life (14). These intensive, inpatient-focused patterns of care are associated with lower satisfaction and quality of care as reported by bereaved family members, and they may be inconsistent with patient goals and preferences (15).

Expansion of inpatient palliative care services shows promise as a strategy for improving quality and reducing costs of ESKD care (16,17). However, the degree to which access to palliative care should be prioritized in the current climate of finite health care resources and overburdened health care delivery systems is uncertain. To address this question, we sought to compare length of stay, hospitalization costs, and postdischarge outcomes among a nationally representative cohort of hospitalized Medicare beneficiaries receiving maintenance dialysis on the basis of whether they received subspecialist-delivered inpatient palliative care.

Materials and Methods

Data Source

We used data from the US Renal Data System (USRDS), a national registry of patients treated for ESKD with dialysis or kidney transplant in the United States. The Stanford University School of Medicine Internal Review Board approved the study.

Study Population

We used the USRDS Medicare Physician Supplier and Institutional Claims files to identify all hospitalizations of 3 or more days occurring between January 1, 2012 and December 31, 2013 among adult Medicare beneficiaries who had received maintenance dialysis for at least 90 days on the admission day of the hospitalization (index date of hospitalization). We excluded patients who were age <18 or >110 years old, lacked continuous Medicare A and B coverage from 6 months preceding the index date to 30 days postdischarge, had no Medicare claims in the previous 6 months, were admitted to an inpatient rehabilitation facility, received hospice and/or palliative care within the 90 days before index date, received a kidney transplant or recovered kidney function, had uncertain treatment modality, or were lost to follow-up.

The analytic sample was composed of 723,913 hospitalizations occurring among 232,452 patients. We stratified eligible hospitalizations according to whether the patient survived to discharge into a decedent cohort (n=25,847) and a nondecedent cohort (n=698,066) to account for important differences in costs, utilization, and relevant outcome measures for terminal versus other hospitalizations (3,5,6,18) (Supplemental Figures 1–3).

Outcomes

We analyzed length of inpatient hospitalization and hospitalization cost for both the decedent and the nondecedent groups. We constructed the cost variable by applying Medicare-specific, facility (hospital)–level cost-to-charge ratios from the Centers for Medicare and Medicaid Services (CMS) Inpatient Prospective Payment System Impact files for the relevant year to the facility charges for each hospitalization using validated methods recommended by the CMS (19–21). We added provider payments to the hospital cost to determine the total cost of each hospitalization. A small fraction of hospitalizations were missing hospital cost-to-charge ratios in the CMS Impact File (4% decedent cohort and 3% nondecedent cohort).

For the nondecedent cohort, we examined the competing events of hospice enrollment, rehospitalization, and mortality in the 30-day postdischarge period. We categorized deaths on the basis of whether they were preceded by dialysis discontinuation. We ascertained rehospitalization and hospice enrollment from the USRDS Institutional Claims file and dialysis discontinuation from the USRDS Patients file.

Exposure

We identified inpatient palliative care consultations using provider specialty code 17 from the Physician/Supplier Claims File, because it represents care delivered by a physician with specialized training in palliative care (22), whereas other administrative codes for palliative care services are applied to a heterogeneous group of services delivered by providers with varied levels of licensure and palliative care expertise. Among hospitalizations in which the patient did not receive an inpatient palliative care consultation (henceforth described as "usual care hospitalizations"), we excluded those with a palliative care V code. After excluding hospitalizations with discharge dates after December 1, 2013 to allow for ascertainment of 30-day postdischarge outcomes, we identified 3166 hospitalizations with a first inpatient palliative care consultation: 654 in the decedent cohort and 2512 in the nondecedent cohort.

Patient Characteristics

We ascertained age, sex, race, time since dialysis initiation, dialysis modality, and Medicare/Medicaid eligibility from the USRDS Patients, Treatment History, and Payer History Files at the time of the index date. We ascertained ability to ambulate or transfer from the USRDS Medical Evidence Form (2728). We identified the comorbidities listed in Table 1 using the International Classification of Diseases Ninth Revision (ICD-9) (Supplemental Table 1) from the USRDS Institutional and Physician Supplier Files, with a look-back window of 6 months before the index date. We also determined the number of days spent in the hospital during the 6-month period before the index date, whether the patient experienced a serious infection in the month before the index hospitalization, and whether the patient was in a nursing facility or custodial care center during this time. We characterized the index hospitalization as critical care admission, surgical admission, and/or admission through the emergency department using Current Procedural Terminology and ICD-9 codes (Supplemental Table 1). We assigned patients to hospital referral regions on the basis of the zip code of the facility in which their index hospitalization occurred. We categorized hospital referral regions by quintiles of average Medicare spending per decedent in the last 2 years of life (23).

Analyses

Propensity Score Matching. Using the variables listed in Table 1, we fit logistic regression models to estimate the propensity score, which represents an individual's probability of receiving inpatient palliative care, during a hospitalization. We constructed separate propensity score models for the decedent and nondecedent cohorts. Using the propensity scores, we matched hospitalizations in which patients received inpatient palliative care one to one with hospitalizations in which patients received usual care. Hospitalizations were "hard matched" for characteristics deemed to be defining traits: nursing home residence, surgical admission, and hospital length of stay equal to or greater than the hospitalization day on which the palliative care consult took place. We defined the maximum acceptable difference in the matched pair propensity score as 0.0005 in the decedent cohort and 0.0001 in the nondecedent cohort. If the hospital cost-to-charge ratio was unavailable for the matched usual care hospitalization, we rematched with the next closest usual care hospitalization. After a matched pair was identified, we removed all other hospital records of that patient from the matching pool to

Table 1. Characteristics of decedent and nondecedent cohorts after matching

Patient Characteristics	Decedent Cohort			Nondecedent Cohort		
	Palliative Care, %, *n*=654	Usual Care, %, *n*=654	Std Diff[a]	Palliative Care, %, *n*=2512	Usual Care, %, *n*=2512	Std Diff[a]
Age at admission, yr	67±13	67±13	4.3	66±15	65±14	4.0
Age category, yr						
18–50	10	12	−4.4	14	15	−1.0
51–60	18	19	1.6	18	18	−1.1
61–70	28	28	1.0	26	28	−4.1
71–80	28	26	5.9	25	24	2.7
>80	15	16	−3.0	17	16	3.9
Women	46	49	−5.8	50	50	0.2
Race						
White	67	65	3.9	64	62	4.7
Black	29	31	−3.0	32	34	−4.1
Other[b]	4	4	−2.4	4	5	−1.7
Index date in 2012 (versus 2013)	47	52	−9.1	48	49	−2.9
Years receiving dialysis						
<1	10	10	0.5	12	11	1.1
1–3	28	27	1.4	31	29	5.2
>3	62	63	−1.6	57	60	−5.6
Dual eligibility (Medicare/Medicaid)	39	42	−7.1	40	41	−2.4
Dialysis type						
Hemodialysis (versus peritoneal dialysis)	89	89	2.4	89	89	−0.4
Hospital-based outpatient dialysis clinic (versus freestanding)	7	8	2.3	7	7	−1.1
Hospital referral region spending quintile (lowest to highest)						
1	23	25	−4.7	26	28	−0.6
2	15	16	4.2	19	18	3.3
3	23	20	7.8	18	18	1.4
4	22	21	2.2	21	20	2.0
5	18	19	−1.6	16	19	−6.1
Nursing home resident	40	40	0.0	36	36	0.0
Inability to ambulate or transfer[c]	6	5	4.1	6	7	−3.1
Admission characteristics						
Emergency room admission	88	86	6.4	87	88	−3.3
Surgical admission	28	28	0.0	23	23	0.0
Critical care admission	2	2	2.2	1	1	0.4
Comorbidities						
Diabetes	82	80	5.8	79	80	−3.2
Atrial fibrillation	47	47	0.0	45	44	0.2
Myocardial infarction	31	28	6.7	28	29	−1.6
Heart failure	83	81	5.6	80	81	−3.8
Peripheral vascular disease	67	64	4.8	63	65	−3.7
Stroke	24	24	1.4	29	30	−3.1
Liver disease	37	39	−2.5	34	36	−4.6
Lung disease	60	67	5.0	59	61	−2.4
Cancer	24	23	1.1	25	24	0.8
Dementia	17	21	−8.2	19	18	1.0
Depression	47	49	−3.4	50	49	2.0
Gastrointestinal bleeding	45	44	1.2	42	44	−2.7
Peptic ulcer disease	14	15	−2.6	12	12	−0.1
Failed transplant	5.5	5.2	1.4	6	7	−5.8
History of infection in the month before admission	56	55	0.9	52	53	−2.7
No. of hospital days in prior 6 mo	20±23	22±26	−5.7	20±23	21±24	−4.7

Results are presented as mean±SD or percentages as appropriate. Std Diff, standardized difference.
[a]Std Diff >10 is considered to indicate covariate imbalance.
[b]Other races include Asian, Native American, and other.
[c]Ascertained at the start of dialysis.

ensure that each hospitalization included in the cohort occurred in a unique individual.

We compared the characteristics of inpatient palliative care and usual care hospitalizations using standardized differences. We considered standardized differences higher than 10% to be indicative of covariate imbalance (24). Because of baseline differences between the inpatient palliative care and usual care groups, we conducted all

Table 2. Association of inpatient palliative care with length of stay, hospitalization costs, and Medicare payments

Outcomes	Decedent Cohort		Nondecedent Cohort	
	Usual Care, Mean±SD	Estimated Mean Difference Associated with Palliative Care[a] (95% CI)	Usual Care, Mean±SD	Estimated Mean Difference Associated with Palliative Care[a] (95% CI)
Length of stay, d	20.4±21.2	−4.2 (−5.6 to −2.9)	13.9±18.7	0.4 (−0.3 to 1)
Total hospitalization cost, $	78,336±91,058	−10,698 (−17,553 to −3843)	40,351±54,276	4275 (1984 to 6567)
Hospital (facility) costs	59,078±71,110	−9679 (−15,125 to −4232)	29,427±42,559	2654 (885 to 4422)
Total Medicare expenditures, $	43,086±52,372	−6612 (−10,370 to −2853)	23,533±29,830	1069 (−197 to 2334)
Payment to hospitals	38,021±48,080	−5798 (−9303 to −2892)	20,743±27,440	794 (−388 to 1975)
Payment to providers	5065±5495	−814 (−1234 to −394)	2789±4090	275 (139 to 411)

In the decedent cohort, there were n=1308 patients included in the length of stay analysis and n=1260 patients included for costs and expenditure. In the nondecedent cohort, there were n=5024 patients included in the length of stay analysis and n=4868 patients included for costs and expenditures. Cost is not reported for providers, because cost data are not available. Total hospitalization cost uses provider charges plus cost-to-charge ratio–adjusted hospital charges. 95% CI, 95% confidence interval.
[a]Negative values indicate reduction in length of stay, costs, and payments in comparison with usual care.

analyses in the propensity score matched cohorts. This method yielded a decedent cohort of 1308 patients and a nondecedent cohort of 5024 patients. After matching, both decedent and nondecedent cohorts were well balanced on all characteristics (Table 1).

Outcome Analyses. The propensity score models balanced all measured characteristics between the two groups in both cohorts, and therefore, subsequent analyses were not further adjusted. We used a generalized linear model (γ-family with log link) with robust SEM adjusted for matched pairs to estimate the marginal mean difference in length of stay and hospitalization costs between the two groups (25). In addition to total hospital costs and total hospital payments, we analyzed the facility and provider charges separately. On the basis of the supposition that timing of inpatient palliative care might moderate the association between palliative care and health care resource utilization, we assessed length of stay and cost according to the hospital day on which the initial inpatient palliative care consultation occurred (within the first 2 days, 3–7 days, or after seventh day of hospitalization).

In the nondecedent cohort, we computed the median (25th–75th percentile) survival time and performed the log rank test looking at overall mortality postdischarge, censoring at the end of the study on December 31, 2014. We graphically depicted the cumulative incidence of the first discharge event: rehospitalization, hospice enrollment, and death with or without dialysis discontinuation in the first 30 days after discharge from the index hospitalization. We then estimated the subdistribution hazard ratio (HR) and 95% confidence interval (95% CI) for each of these outcomes in a competing risk framework using a Fine and Gray model (26). Statistical analyses were performed using SAS version 9.4 (SAS Institute, Inc., Cary, NC) and Stata version 13.1 (StataCorp, College Station, TX).

Results

Decedent Cohort—Length of Stay and Hospitalization Costs

Among the 1308 patients in the decedent cohort, length of stay was 21% shorter (−4.2 days; 95% CI, −5.6 to −2.9 days) and hospitalization costs were 14% lower (−$10,698; 95% CI, −$17,553 to −$3843) among patients who received inpatient palliative care compared with those who received usual care (Table 2). In addition, inpatient palliative care was associated with 15% lower total Medicare expenditures (−$6612; 95% CI, −$10,370 to −$2853) compared with usual care, including lower payments to hospitals and providers. The association between inpatient palliative care and length of stay, total hospitalization costs, and total Medicare expenditures did not differ according to the timing of inpatient palliative care in the decedent or nondecedent cohort (Table 3).

Nondecedent Cohort—Length of Stay and Hospitalization Costs

Among the 5024 patients in the nondecedent cohort, there was no significant difference in length of stay for patients who received inpatient palliative care compared with those who received usual care (Table 2). For patients who received inpatient palliative care, total hospitalization costs were 11% higher ($4275; 95% CI, $1984 to $6567) than for patients who received usual care (Table 2). Among patients who received inpatient palliative care, total Medicare expenditures were higher, although the difference was not statistically significant ($1069; 95% CI, −$197 to $2334), including slightly higher (nonsignificant) payments to hospitals and 10% higher payments to providers ($275; 95% CI, $139 to $411) compared with patients who received usual care.

Nondecedent Cohort—Postdischarge Outcomes

Median survival after discharge was 88 days (25th–75th percentile, 78–103 days) among patients who received

Table 3. Association of inpatient palliative care with length of stay, hospitalization costs, and hospitalization payments by timing of first palliative care consultation stratified by cohort

Outcomes	Timing of First Inpatient Palliative Care Consultation			*P* Value[a]
	Days 1 and 2 Estimated Mean Difference (95% CI)	Days 3–7 Estimated Mean Difference (95% CI)	After Day 7 Estimated Mean Difference (95% CI)	
Decedent cohort	*n*=172	*n*=504	*n*=584	
Length of stay, d	−1.7 (−3.8 to 0.4)	−2.6 (−4.4 to −0.8)	−6.3 (−8.7 to −4)	0.97
Total hospitalization costs, $	−9329 (−17,718 to −940)	−8977 (−17,764 to −190)	−12,587 (−25,039 to −135)	0.40
Total Medicare expenditures for hospitalization, $	−4942 (−11,394 to 1510)	−3813 (−8984 to 1359)	−9519 (−16,001 to −3036)	0.87
Nondecedent cohort	*n*=1198	*n*=2098	*n*=1572	
Length of stay, d	0.7 (0.0 to 1.3)	0.4 (−0.1 to 0.9)	0.0 (−1.7 to 1.6)	0.30
Total hospitalization costs, $	3130 (203 to 6059)	2480 (482 to 4478)	7543 (1363 to 13,723)	0.86
Total Medicare expenditures for hospitalization, $	1115 (−683 to 2913)	521 (−557 to 1600)	1765 (−1612 to 5141)	0.84

There were 1260 patients in the decedent cohort and 4868 patients in the nondecedent cohort who had cost and expenditure outcomes available. 95% CI, 95% confidence interval.
[a]*P* value for interaction between palliative care and timing of palliative care.

inpatient palliative care and 420 days (25th–75th percentile, 388–453 days) among patients who received usual care (log rank test *P* value <0.001). The cumulative incidence of the first event to occur in the 30-day postdischarge period is depicted in Figure 1, and the event distribution during this period is shown in Figure 2. When we accounted for these outcomes in a competing risk analysis, inpatient palliative care was associated with a lower rate of rehospitalization (HR, 0.8; 95% CI, 0.7 to 0.9) and higher rates of hospice enrollment (HR, 8.3; 95% CI, 6.6 to 10.5) and death (HR, 2.6; 95% CI, 2.1 to 3.3) compared with usual care. Among patients whose first postdischarge event was death (*n*=312) in the 30-day postdischarge period, 33% were preceded by dialysis discontinuation for patients who received inpatient palliative care compared with 9% among those who received usual care.

Discussion

In this study of hospitalized Medicare beneficiaries with ESKD, inpatient palliative care during a terminal hospitalization was associated with shorter length of stay and lower hospitalization costs compared with usual care. Among patients who survived to discharge, inpatient palliative care was associated with no difference in length of stay and modestly higher total hospitalization costs compared with those who received usual care, but these patients were less likely to be readmitted, more likely to enroll in hospice, and more likely to discontinue dialysis in the month after discharge. Taken together, these findings suggest that expanded access to inpatient palliative care, currently used in <1% of ESKD hospitalizations, may meaningfully reduce inpatient utilization and alter the intensity of care delivered after discharge, reducing readmissions and perhaps smoothing transitions to hospice among patients with ESKD who are nearing the end of life.

Our study is consistent with reports of cost-savings from inpatient palliative care during a terminal hospitalization and extends these findings to patients with ESKD: a population targeted for payment and policy reforms to improve quality and reduce costs of care (3,4,6). We observed larger differences in costs associated with inpatient palliative care in the decedent cohort than the nondecedent cohort (3,6,27). In the decedent cohort, lower costs were accompanied by shorter length of stay, an important outcome for health care systems independent of cost due to its influence on hospital crowding and patient experience (28). These associations were similar in magnitude when stratified by timing of palliative care consultation, which suggests that inpatient palliative care may yield similar results irrespective of when it occurs during a hospitalization.

Few studies have examined the association between inpatient palliative care and Medicare expenditures. In addition to lower costs, we observed lower Medicare expenditures among patients who received inpatient palliative care in the decedent cohort compared with usual care. The mean cost borne by hospitals and providers ($78,336) was considerably higher than the mean Medicare reimbursement ($43,086), indicating that hospitals and providers realize a net loss when caring for this population. In the decedent group, hospitalization costs were lowered by a larger extent than Medicare reimbursement, implying that inpatient palliative care simultaneously reduced Medicare expenditures and attenuated hospital and provider losses.

Although similar findings were not observed among patients who survived to discharge, postdischarge utilization patterns raise the possibility that inpatient palliative care may both promote goal concordant care and reduce total health care costs due to higher use of hospice and fewer readmissions. Providing access to palliative care services during a hospitalization may help patients gain access to hospice and address goals of care beyond discharge. In a previous study of patients who withdrew

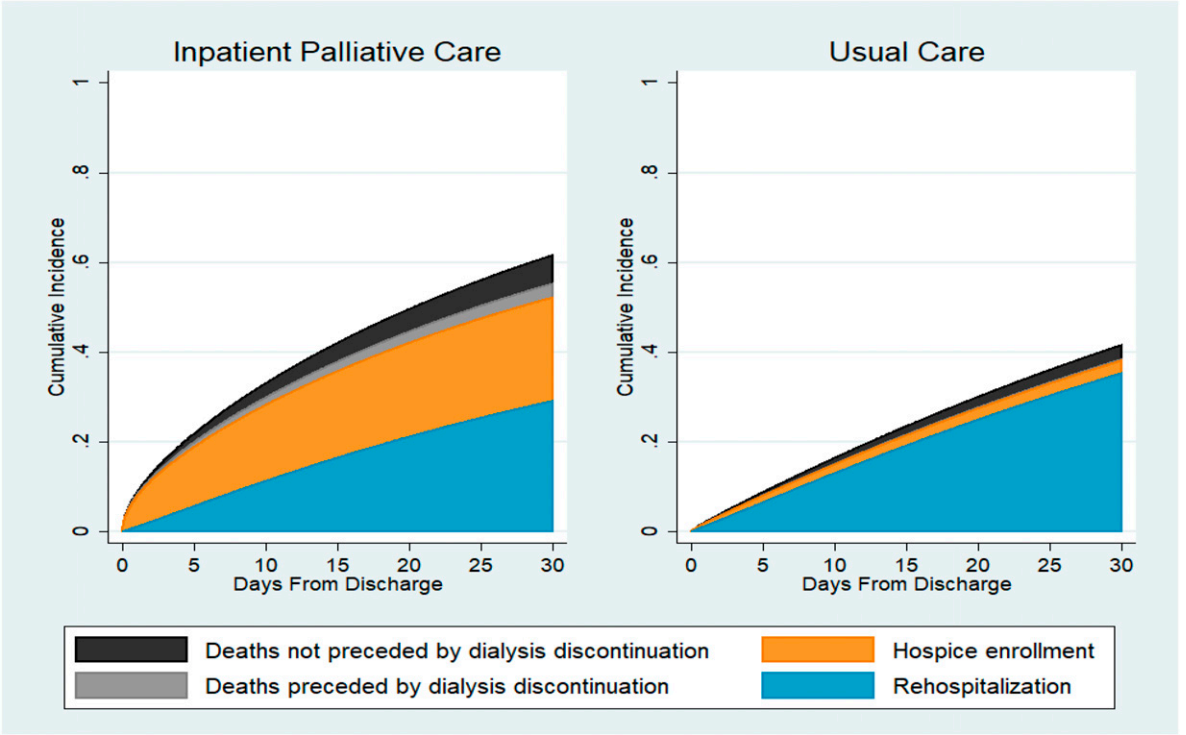

Figure 1. | **Patients who received inpatient palliative care had a higher cumulative incidence of hospice enrollment and death and a lower incidence of rehospitalization as the first post-discharge event compared to patients who received usual care.**

from dialysis between 2001 and 2002, median expenditures were $3020 lower in the last week of life for hospice users compared with nonusers, primarily attributable to lower rates of hospitalization among hospice users (29).

More frequent hospice use and dialysis discontinuation before death for patients who received inpatient palliative care suggest that the higher frequency of death that we observed reflects goal-concordant care (28). In this context, the efficacy of medical therapy in maximizing quality of life and improving patient centered outcomes is the salient research focus. In a study of veterans, Wachterman *et al.* (15) found that patients who died from ESKD experienced poorer-quality end-of-life care compared with patients dying from dementia or cancer. These differences were largely explained by differences in the frequency of inpatient palliative care, do not resuscitate orders, and the setting of death. This work coupled with our findings suggest that expanded use of inpatient palliative care may improve the quality of end-of-life care for patients with ESKD.

The association between inpatient palliative care and 30-day readmissions is inconsistent in the literature (1,28,30). Using a competing risk framework, we found substantially lower 30-day readmissions among patients who received inpatient palliative care. This finding has important policy implications, because 30-day readmissions are a quality metric for the Medicare ESKD program. Dialysis facilities experience payment reductions if 30-day readmission rates are above the expected range (31). As Medicare shifts from fee-for-service reimbursement to value-based payments, policymakers are seeking to reward provision of high-value care by incentivizing health care delivery systems that increase quality and decrease costs. Our study suggests that expanded use of inpatient palliative care services for patients with ESKD, currently used in <1% of all hospitalizations, could be beneficial to both patients who wish to avoid readmission and health care systems (and payers) from a resource utilization and cost perspective. Broader use of palliative care has been advocated among patients with uncontrolled symptoms, frequent hospitalizations, and/or unclear goals of care (32). The infrequent use of palliative care among patients with ESKD suggests a need to understand access and implementation barriers.

Our study's strengths include the examination of a nationally representative population of patients with ESKD and comprehensive ascertainment of hospitalizations and postdischarge outcomes. We took advantage of the opportunity afforded by our retrospective design to improve the validity of comparison between inpatient palliative care and usual care by requiring that the patient with usual care in each matched pair had a length of stay at least as long as the day on which the first inpatient palliative care consultation took place for the patients with palliative care. By doing so, we avoided spurious comparisons among paired patients. Our study also has several important limitations. Because of our study's retrospective design, we cannot determine the reason for palliative care referrals or whether receipt of palliative care directly led to the observed outcomes. To reduce potential confounding from selection bias, we used propensity scores to identity pairs of patients closely matched on measured

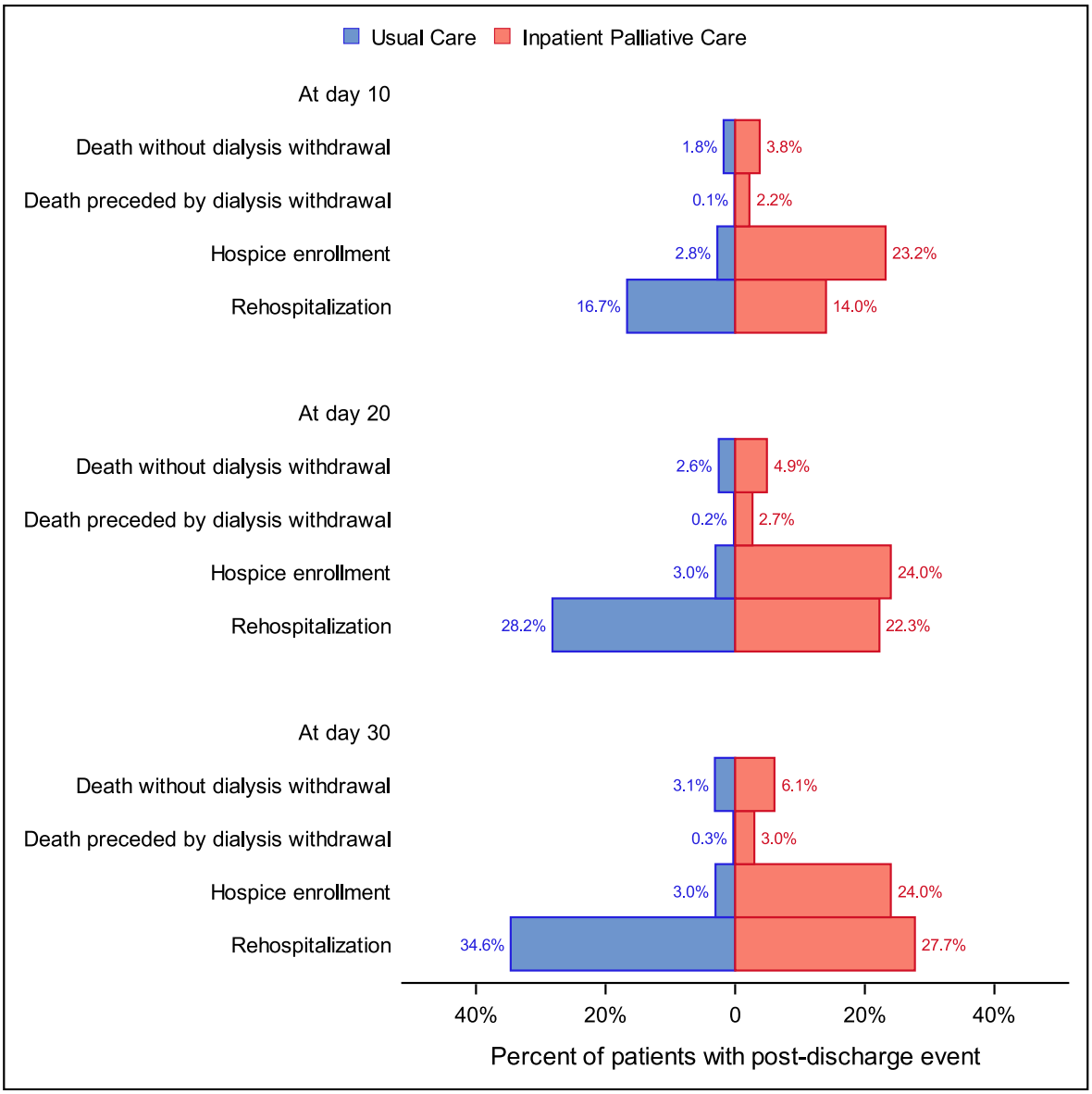

Figure 2. | Patients who received inpatient palliative care were less likely to be rehospitalized at days 10, 20, and 30 after discharge, compared to patients who received usual care.

characteristics. Propensity score matching creates a setting within which "treatment effects" can be estimated without making major parametric assumptions; however, matching depends on observed variables, and unmeasured patient, provider, health system, or regional characteristics that affect health care utilization may differ between matched pairs. For example, because of the low frequency of inpatient palliative care, we were unable to account for center effects. In addition, we were unable to determine whether inpatient palliative care reduced *per diem* hospitalization costs or out-of-pocket costs. Finally, we could not determine what palliative care interventions were delivered and whether inpatient palliative care enhanced goal-concordant care or improved the patient's experience.

In summary, our study provides a strong rationale for health care systems to expand access to inpatient palliative care for patients with ESKD. As systems of ESKD care are redesigned around new payment models that hold providers and health care systems accountable for improving value (33), inpatient palliative care may be a resource-efficient mechanism to provide health care that is patient centered and focused on improving the experience of patients and their families at the end of life.

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Disclosures

None.

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Supplemental Material

Appendix

Table A1. Codes used to define comorbid conditions

	ICD-9 and CPT Codes
Comorbidities	
Diabetes mellitus	249.x, 250.x, 357.2, 362.0x
Atrial fibrillation	427.3x
Prior myocardial infarction	410.x
Heart failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.13, 404.91, 428.x,
Peripheral vascular disease	38.03, 38.04, 38.05, 38.08, 38.33-38.48, 39.22-39.29, 440.2x, 440.3x, 440.4x, 441.x, 443.x, 445.x, 447.10, 557.10, 557.90, v43.4,
Stroke	433.x, 434.x, 436.00
Chronic liver disease	070.x, 456.1, 456.21, 570-573.x, v42.7
Chronic lung disease	490, 491.x-496, 500-505, 506.4, 516.x
Cancer	140.x-165.x, 170.x-172.x, 174.x, 175.x, 180.x-209.x, 238.6, 273.3
Dementia	290.x, 294.1x, 331.x
Depression	296.2x, 296.3x, 296.5x, 296.82, 300.40, 301.12, 309.0, 309.10, 311
Gastrointestinal bleed	456.00, 456.0, 456.20, 530.21, 530.70, 530.82, 531.0x, 531.2x, 531.4x, 531.6x, 532.2x, 532.4x, 532.6x, 533.0x, 533.2x, 534.0x, 534.2x, 534.4x, 534.6x, 535.x1, 537.83, 537.84, 562.02, 562.03, 562.12, 562.13, 569.3, 569.85, 578.x
Peptic ulcer disease	531.7, 531.0, 531.71, 531.9, 531.90, 531.91, 532.7, 532.70, 532.71, 532.9x, 533.7x, 534.7x, 534.9x
Admission type	
Surgical	Exhaustive list of surgical ICD9 codes, previously validated in the literature[37]
Critical care	99291 or 99292
Emergency room	0450, 0451, 0452, 0453, 0454, 0455, 0456, 0457, 0458, 0459

Note: We classified admission type based on codes present on index date.

Figure A1. Study Flow Chart

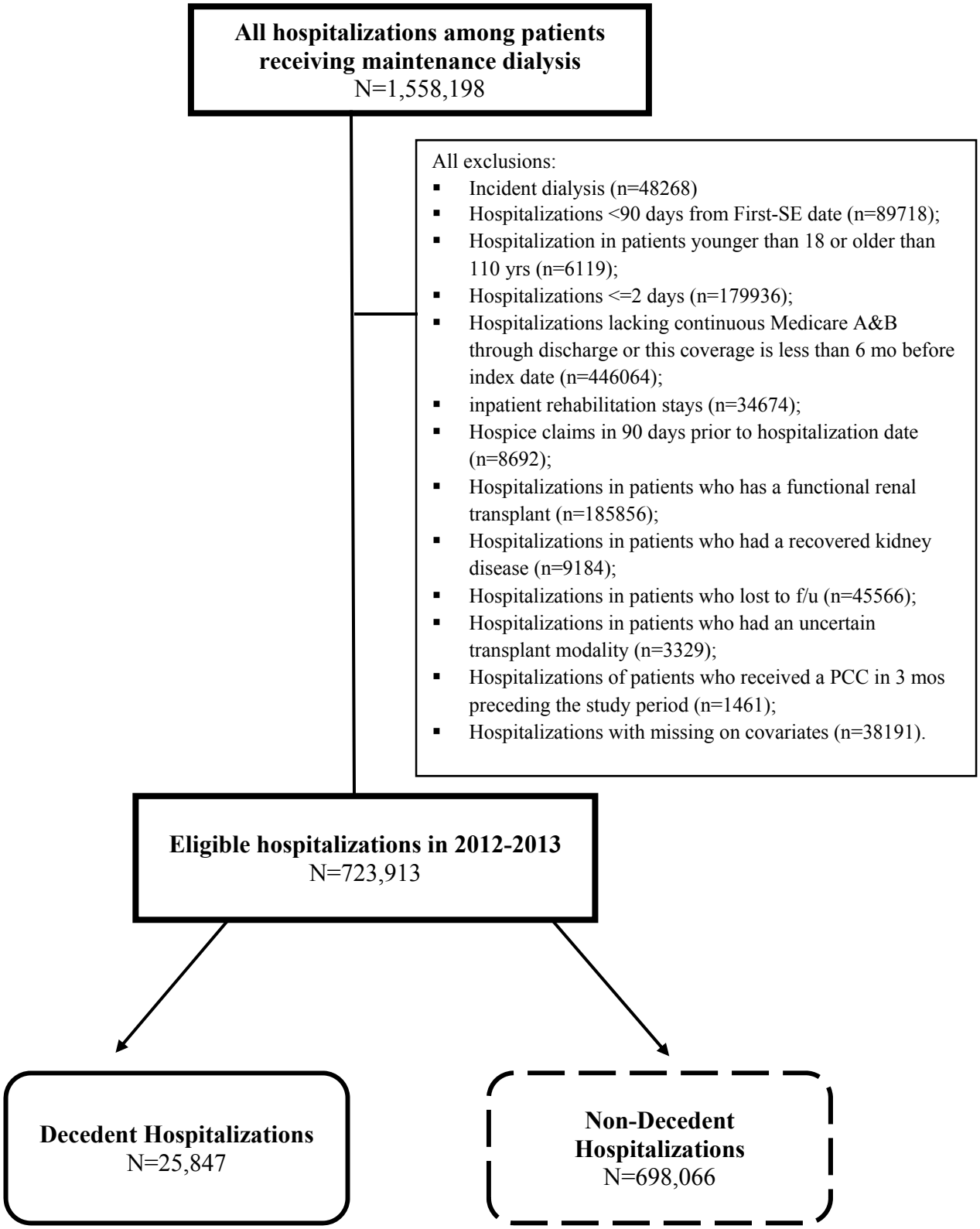

Figure A2. Matching procedure for decedent cohort

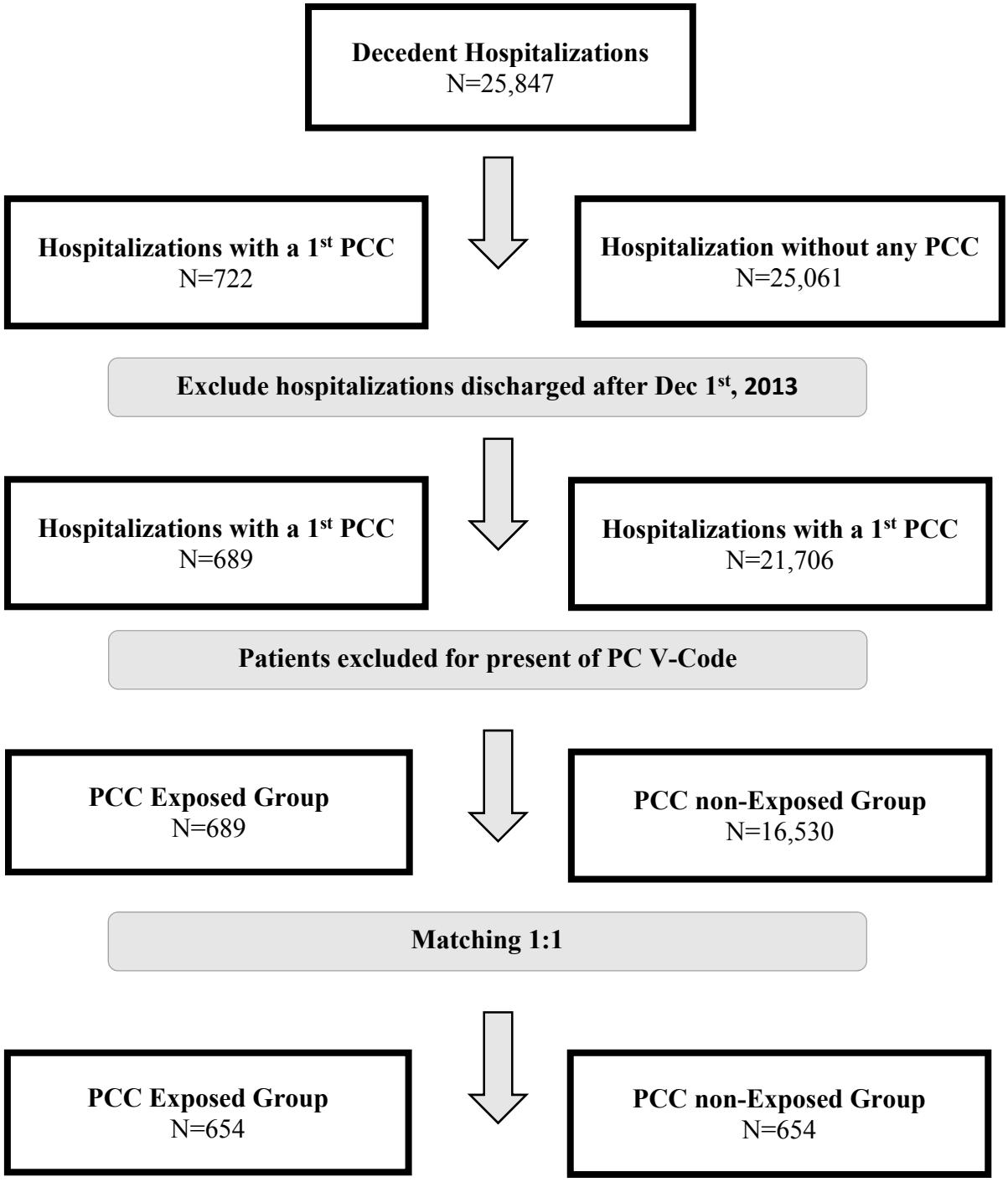

Figure A3. Matching procedure for non-decedent cohort