The Value of Hospice Care: Evidence from Facility Openings

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Abstract

We study how hospice services affect health care spending and end-of-life well-being among older adults. Exploiting 1,518 quasi-random hospice facility openings across U.S. counties between 1999 and 2019, we estimate that each new facility increases per-beneficiary hospice spending by $4.3 (7.1%) but reduces non-hospice Medicare spending by $8.8 per quarter—representing nearly two dollars saved for every additional dollar of hospice spending. Savings stem mainly from lower inpatient and skilled-nursing facility spending. We find no adverse effects on pain, functional status, or mortality, despite reductions in high-intensity interventions such as feeding tubes and catheters and increases in comfort-oriented medications. Patients spend a lower share of their last days of life in institutions and are more likely to die at home. These gains persist across conditions, yet hospice take-up remains highly uneven. To distinguish whether this heterogeneity reflects efficient sorting by patient severity, capacity constraints, or financial incentives, we develop and estimate a model of hospice referral. We find that physician incentives—reflecting foregone curative revenue—play a major role in hospice underutilization. We then consider counterfactual policies that expand hospice capacity and mitigate financial incentives.

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A substantial share of health spending is concentrated in the final months of life, often on aggressive treatments with mixed clinical benefit (Medicare Payment Advisory Commission, 2004). Globally, between 8% to 25% of total health care spending occurs in the last 12 months of an individual's life (Riley and Lubitz 2010, French et al. 2017). These patterns have prompted policy debates over how end-of-life care should be organized and financed, and have motivated interest in models of care that emphasize comfort and quality of life rather than the mere extension of life.

Hospice care has emerged as one such model. It provides palliative services to patients with terminal illnesses who choose to forgo curative treatment, delivered primarily in the patient's home and focused on symptom management and psychosocial support. In the United States, hospice use has expanded rapidly: over half of all Medicare beneficiaries now receive hospice care before death, compared with about one-quarter in 2000 (Medicare Payment Advisory Commission 2014; Medicare Payment Advisory Commission 2022).

Despite its promise, the decision to enter hospice care involves a fundamental trade-off. Patients must forgo curative treatment in exchange for palliative support — a shift that may improve comfort, but could also limit access to potentially beneficial care. Furthermore, while hospice is designed to enhance quality of life, its effects on patient well-being remain poorly understood. Unlike outcomes such as service use or mortality, which are readily measured in administrative data, comfort and symptom relief are rarely documented in a systematic way. As a result, there is limited large-scale evidence on how hospice affects the patient experience in the final months of life, particularly along the dimensions it is intended to improve.

This paper brings new evidence to bear on these questions by studying the impact of expanded hospice availability. We construct a stacked difference-in-differences design centered on 1,518 county-level "experiments", each encompassing a treated county—a county with hospice facility entry—and matched control counties. We combine over 20 years of Medicare claims with detailed nursing home assessment records (Minimum Data Set, or MDS), creating a comprehensive panel of older adults across thousands of U.S. counties. For patients residing in a nursing facility, which covers approximately 40% of all hospice patients[1], these data allow us to observe not only health care utilization, but also rarely captured indicators of patient comfort, including pain levels, diet, and mobility.

[1] Author's analysis of the MDS and Medicare claims data in 2019.

We find that each additional hospice entry leads to a $4.3 increase in per beneficiary-quarter hospice spending in the county, a 7.1% increase relative to baseline. This increase is more than offset by a corresponding reduction in total non-hospice Medicare spending (-$8.8). That is, for each additional dollar of hospice spending, Medicare saves nearly two dollars in return. This reduction is driven by reduced inpatient (-$5.44) and skilled nursing facility (-$2.08) expenditures, with no statistically significant changes in outpatient, physician, or prescription drug spending.

Beyond cost savings, we document a shift in the nature of end-of-life care among nursing home residents: patients are less likely to receive high-intensity interventions such as catheters (-1.6%) or physical restraints (-4.8%), and more likely to receive comfort-oriented services like speech therapy (to help with swallowing, 2.7%) and hypnotic-class medications for sleep (4%). Patients are also less likely to die in a hospital (-1.2%) or skilled nursing facility (-1.7%) and are more likely to die at home with hospice care (+3.1%). Importantly, we find no adverse effects on mortality, pain, or functional outcomes.

These results show that expanding hospice availability leads to lower Medicare spending and measurable improvements in end-of-life care. Yet the pattern of effects across conditions is strikingly uneven. The first-stage increase in hospice use varies widely by diagnosis: Alzheimer's shows large gains, while cancer and stroke have more modest responses. The degree of spending offset also differs sharply. For Alzheimer's and related dementias, each additional dollar of hospice spending roughly breaks even in total Medicare savings, whereas for conditions such as ischemic heart disease or COPD, total non-hospice spending falls by about three dollars for every additional dollar spent on hospice.

Despite this heterogeneity in take-up and substitution, the benefits to patients appear consistent. Hospice has no adverse mortality effect on any condition, and improvements in comfort across all major conditions. The puzzle is therefore not whether hospice improves outcomes, but why some patients and conditions take up hospice at higher rates than others following an expansion of hospice availability.

We consider likely mechanisms that could explain these differences. First, variation could reflect differences in clinical outlook or disease severity: patients with better disease progression or viable curative options may rationally opt out of hospice use. The observed heterogeneity in hospice use would be efficient if it were purely driven by disease severity. Second, physicians face financial incentives that vary across conditions depending on how

much revenue they forgo by referring patients to hospice and giving up curative treatment. When referring a patient entails a larger revenue loss, physicians may avoid hospice referral even when it would raise patient well-being. If the observed heterogeneity in hospice use reflected physician financial incentives, we would be worried about inefficient allocation of hospice services.

In addition to these factors, the discrete jump in hospice participation following new facility entry points to binding capacity constraints: even willing physicians and patients may be unable to access hospice when local availability is limited. Capacity constraints further push utilization away from the socially optimal level.

To quantitatively assess the importance of these channels, and to generate policy counterfactuals where we correct them, we develop and estimate a model of hospice referral that links physician decision-making to patient severity, financial incentives, and capacity. In this model, the physician receives a signal about each patient's prognosis and choose whether to recommend hospice or continued curative treatment. They value both patient well-being and the financial returns associated with each option. The model yields a simple cutoff rule: physicians refer patients to hospice once the expected benefit to the patient, weighted by the physician's altruism, exceeds the revenue they forgo from the referral. Capacity constraints at hospice facilities further exclude comparatively less severe patients on the margin.

We estimate the model using condition-level data on hospice participation, mortality, and our estimated responses of hospice use and provider revenue to increases in hospice capacity. The estimated parameters allow us to quantify the relative importance of each mechanism in shaping hospice use and to simulate how participation, spending, and welfare would change under counterfactual policies that remove financial disincentives or expand capacity. We estimate that physicians refer to hospice when quarterly mortality exceeds 12.9% on average, although this cutoff varies between 10.1% and 18.1% across conditions. We find that severity cutoff rules vary systematically with physician incentives: conditions with greater revenue losses have higher cutoffs for hospice referral; on average, each hospice referral reduces provider revenue by $22,549. We estimate that physicians respond to patient severity, each 1 percentage point increase in mortality risk offsets $3,000 in lost revenue. These estimates, combined with our empirical finding that hospice use does not increase mortality, suggest that hospice care is currently underutilized. We then consider

counterfactual policies that expand hospice capacity and mitigate financial incentives.

This paper contributes to several related literatures.

Most narrowly, it contributes to the literature on hospice care. The economics literature on hospice care is relatively sparse but a growing stream of work has examined the fiscal implications of hospice care expansion (Gruber et al., 2025), as well as the financial incentives created by the Medicare payment system (Coe and Rosenkranz 2025, Alam 2025). Gruber et al. [2025] shows that for-profit hospice entry reduces Medicare spending among patients with Alzheimer's and related dementias (ADRD) by offsetting more intensive end-of-life care. Coe and Rosenkranz [2025] finds that hospice agencies nearing Medicare's annual aggregate cap modestly increase end-of-year enrollment and live discharge rates, consistent with revenue-driven churning. Alam [2025] examines quality competition among hospice providers and its implication for the design of Medicare reimbursement. Dalton and Bradford [2019] shows that the coexistence of nonprofit and for-profit hospices lead to a wider range of patients served. We contribute to this literature by providing, to our knowledge, the first large-scale quasi-experimental evidence on the effects of hospice care on patient well-being in addition to spending outcomes. By jointly examining both clinical and spending impacts in the same setting, our findings offer a more comprehensive view of how hospice care shapes end-of-life experiences.

More broadly, this paper contributes to the economics literature on end-of-life care. Empirical work shows that although spending in the last year of life is substantial, it is concentrated among patients whose needs are hard to predict ex ante, making targeted cost containment difficult (Einav et al., 2018; Zeltzer et al., 2023). On the theoretical side, Becker et al. [2007] and Philipson et al. [2010] develop models in which willingness to pay for marginal life prolongation can exceed standard value-of-statistical-life benchmarks, helping to rationalize high end-of-life spending. We advance this literature by pinpointing which specific services hospice replaces and quantifying how those shifts translate into both cost savings and measurable gains in patient well-being at life's end.

Literature outside of economics has also found that individuals electing hospice have lower end of life spending (Kelley et al., 2013, Obermeyer et al., 2014), higher self-reported quality of care (Harrison et al., 2022, Shega et al., 2008), and higher rates of dying at home rather than in the hospital.(Shega et al., 2008,Miller et al., 2012) However, patients who enroll in hospice are likely to differ in unobservable ways that may be correlated with

both spending behavior and goals of care (e.g., comfort versus aggressive treatment). A key randomized trial of palliative care in patients with metastatic lung cancer showed improvements in quality of life, depressive symptoms, as well as survival (Temel et al., 2010). That study integrated palliative care with standard oncologic interventions; however, current Medicare regulations explicitly require patients electing hospice to forgo additional curative treatment. Our study provides additional causal evidence for the effects of hospice care on spending and quality of life within the current regulatory framework, at the national level, and for health conditions other than cancer.

The rest of the paper proceeds as follows. Section 1 introduces the setting. Section 2 describes our data and sample. Section 3 describes our reduced-form empirical strategy. Section 4 presents our reduced-form results. Section 5 introduces and estimates our model. Section 6 concludes.

1 Hospice Care in the United States

Hospice care provides palliative medical services, pain management, and psychosocial support to patients nearing the end of life. Covered services include physician and nursing visits, medications, durable medical equipment (e.g., hospital beds, wheelchairs), symptom management, grief counseling, and 24/7 on-call support (NHPCO, 2024). In the United States, hospice care is delivered mainly in patients' homes and nursing facilities, and it is financed chiefly through the Medicare Hospice Benefit, authorized by the Tax Equity and Fiscal Responsibility Act of 1982 and first implemented in 1983 (Medicare Payment Advisory Commission, 2019). Although daily per diem rates vary by level of care—routine home care, continuous home care, inpatient respite care, and general inpatient care—routine home care accounts for 98.8% of hospice days and receives the lowest payment rate (MedPAC, 2025).

To be eligible for Medicare hospice coverage, patients must be certified by a physician as terminally ill with a life expectancy of six months or less and must elect to forgo curative treatment for their terminal condition (Medicare Payment Advisory Commission, 2019). Once enrolled, patients receive care from an interdisciplinary team, including physicians, nurses, social workers, and chaplains, under a fixed daily payment per beneficiary that is intended to cover all related services. Beneficiaries face only minimal cost-sharing,

limited to a nominal copayment (no more than $5) for outpatient prescriptions and 5% coinsurance for inpatient respite care. (Medicare Payment Advisory Commission, 2019)

Over the past two decades, the use of hospice care has expanded dramatically, particularly among patients with non-cancer diagnoses such as Alzheimer's disease and heart failure (De Vleminck et al., 2018). This growth has coincided with a surge in the number of Medicare-certified hospice providers, driven largely by for-profit entrants (Medicare Payment Advisory Commission, 2021). Between 2000 and 2019, the total number of Medicare hospice providers more than doubled, with a large share consisting of for-profit hospices.

2 Data and Sample

2.1 Data Sources

We combine administrative Medicare claims and clinical assessment data to evaluate the effects of hospice facility entry on health care utilization and patient well-being. The primary data sources include 100% samples of Medicare inpatient (IP), outpatient (OP), skilled nursing facility (SNF), home health agency (HHA), and hospice (HOS) claims for the years 1999–2019. These are complemented by 20% random samples of the Carrier (physician office visits) and Part D prescription drug event (PDE) files, as well as the Medicare Beneficiary Summary File (BSF), which provides quarterly enrollment and demographic information. To ensure consistency across files, we restrict analyses to beneficiaries who are alive and enrolled in fee-for-service (FFS) Medicare at the start of each quarter-year. For analyses involving drug spending, we additionally require enrollment in a Part D plan.

To measure clinical outcomes and care intensity among nursing home residents, we use data from the Minimum Data Set (MDS) assessments. The MDS provides rich, standardized information on patient health status, functional limitations, service utilization, and care plans in nursing homes.

Hospice facility entries and characteristics are obtained from the Medicare Provider of Services (POS) file and linked to county-level identifiers.

2.2 Sample Construction and Key Variables

We examine a broad set of outcomes across several domains.

Hospice utilization Hospice spending is measured as Medicare hospice expenditures per beneficiary-quarter. We also analyze the share of discharges to hospice from inpatient and SNF settings.

Non-hospice Medicare Spending For non-hospice Medicare spending, we evaluate component-specific spending per beneficiary-quarter, using data from inpatient, skilled nursing facility, outpatient, carrier (physician office), and home health agency fee-for-service claims files from 1999-2019.

For Part D prescription drug spending, we compute Part D spending per beneficiary-quarter using the Part D event file, available from 2006-2019, which includes data from standalone Part D plans as well as Medicare Advantage plans. We conduct analyses both with and without restricting the sample to FFS beneficiaries.

We conduct subgroup analyses by chronic condition, including ADRD, cancer, COPD, stroke, ischemic heart disease, and chronic kidney disease.

Patient Care and Clinical Outcomes For patients residing in a nursing home, we measure their clinical outcomes using assessment data from the Minimum Data Set (MDS). Outcomes include use of feeding tubes, parenteral feeding, indwelling catheters, physical and chemical restraints, dialysis, IV medications, and various therapy services (speech, respiratory, physical, occupational, psychological). Clinical outcomes include pain scores and frequency, ADL functioning, cognitive and mood assessments, psychosocial well-being, and indicators of falls, incontinence, and pressure ulcers. We only include regularly scheduled assessments (conducted on admission, annually, and quarterly) and exclude assessments conducted due to significant changes in health status and those conducted upon discharge. Where necessary, we harmonize survey questions that were modified between the two MDS versions (MDS 2.0, used from 1999-2010 and MDS 3.0, used from 2010-2019). Details on the custruction of MDS outcomes are in Appendix Section A.

2.3 Summary Statistics - Hospice Facility Entrants

Between 1999 and 2019, the number of Medicare-certified hospice facilities in the United States more than doubled, rising from just under 2,000 providers in 1999 to over 4,500 by

2019 (Appendix Figure A1). This expansion was widespread but spatially heterogeneous. As shown in Appendix Figure A2, many counties experienced net increases in the number of hospice facilities over the two-decade period, with particularly pronounced growth in parts of the South, West, and Northeast. At the same time, a substantial number of counties saw little or no change.

Table 1 summarizes the characteristics of hospice facilities in 2019. On average, facilities employed 28 staff members, with incumbents substantially larger than entrants (47 vs. 19 employees). This size differential is consistent across staff categories: incumbent facilities have more registered nurses (16.2 vs. 5.5), home health aides (9.7 vs. 4.4), and other personnel. Entrants in the baseline sample are somewhat larger than the full entrant group. Ownership structures also differ: nearly 60% of incumbents are non-profit, compared to just 16% of entrants and 21% of those in our baseline sample. Finally, co-location patterns vary substantially—92% of entrants and 89% of those in our baseline sample operate as free-standing hospices, compared to only 59% of incumbents, while incumbents are more likely to be located at hospitals or other health care facilities.

2.4 Summary Statistics - Medicare Beneficiaries

Table 2 presents summary statistics for Medicare beneficiaries in treatment counties during the year prior to hospice facility entry. Excluding prescription drugs, which is not covered for all beneficiaries, average quarterly Medicare spending per fee-for-service beneficiary totaled $1,588.63, of which $60.77 (3.8%) was attributable to hospice care. Inpatient spending was the largest component, averaging $731.73 per quarter, followed by physician services ($469.40), outpatient care ($254.69), and skilled nursing facility services ($129.07). Home health and prescription drug spending averaged $100.87 and $441.64 per quarter, respectively. Mortality rates in the sample averaged 11.56 deaths per 1,000 beneficiaries per quarter.

3 Empirical Strategy

We construct our empirical design using a stacked difference-in-differences framework centered on 1,518 hospice facility entry events, each defining a unique "experiment." For each

treated county experiencing a facility entry, we identify two control counties matched on pre-entry trends and levels in the number of Medicare beneficiaries. We require that both treated and control counties have no hospice facility entries in the 4 quarters prior to the quarter of facility entry in the treatment county. Control counties additionally lack facility entry in the quarter of facility entry and are drawn from the set of ever-treated counties. Details on the matching algorithm are provided in Appendix Section B.

Starting from 1,820 initial entry events, we require at least one matched control county and impose a balanced panel, restricting to hospice facility entry events for which we observe at least one year prior to facility entry and five years after facility entry. These restrictions bring us to our final sample of 1,518 hospice facility entry events.

To ensure clean identification, we exclude counties with any hospice facility entry in the year prior to the quarter of entry. However, we do not restrict entry in the post-period, allowing us to retain a larger sample and avoid selection on post-period entry, which may be affected by treatment. This design implies that the estimated treatment effects represent the average impact of approximately 1.5 hospice entrants over five years, rather than a strict single-entry effect. By avoiding post-treatment selection, our approach maintains comparability across counties while maximizing the number of usable experiments.

We estimate the effects of hospice facility entry using an event study framework implemented in a stacked difference-in-differences design. Our unit of observation is the county-experiment-quarter, where each "experiment" corresponds to a newly opened hospice provider. For each experiment, we identify a treated county (where a hospice facility enters) and a set of matched control counties based on pre-entry Medicare population size and trajectory.

Our baseline specification is as follows:

$$Y_{ect} = \alpha_{ec} + \gamma_{et} + \sum_{k \neq -1} \beta_k \cdot \mathbb{1}[t = k] \cdot \mathbb{1}[D_{ec} = 1] + \varepsilon_{ect} \tag{1}$$

where Y_{ect} denotes the outcome of interest for experiment e, county c, and event time t (measured in quarters relative to hospice entry); α_{ec} are county-by-experiment fixed effects to account for persistent differences across counties within each experiment; γ_{et} are experiment-by-time fixed effects that flexibly absorb shared shocks across treated and control counties; and the event-time coefficients β_k capture the differential evolution of out-

comes in treated counties relative to controls. The omitted category is $k = -1$, the quarter immediately preceding hospice facility entry. Standard errors are clustered at the experiment level.

4 Results

4.1 Effects on Health Care Spending

4.1.1 First-Stage Estimates

We begin by documenting the first-stage relationship between hospice facility entry and subsequent hospice utilization. Consistent with our identification strategy, the opening of a new hospice facility within a county leads to a statistically significant and economically meaningful increase in the use of hospice services among Medicare beneficiaries. Figure 1 presents the event study estimates from the first-stage regression, where the dependent variable measures hospice spending per beneficiary-quarter in the treatment county. We observe a sharp and immediate increase in hospice spending beginning in the month of facility entry, with no evidence of differential pre-trends between treated and control counties. The point estimates imply an increase in hospice use that peaks at approximately 9% of baseline hospice use three years after facility entry.

Table 3 reports the corresponding difference-in-differences estimates. In our baseline specification, hospice spending increases by \$4.3 per beneficiary-quarter relative to a pre-entry mean of \$60.8, corresponding to a 7.1% increase (SE = 0.62, $p < 0.001$).

Table A1 confirms that the first-stage response is broad-based but strongest in the chronic, non-cancer conditions that have driven recent hospice growth. Across most disease groups, hospice spending rises by roughly 6–7 percent, mirroring the 7.1 percent overall effect; the largest absolute increases occur for Alzheimer's disease (\$37.1 per beneficiary-quarter) and the broader category of Alzheimer's disease and related dementias (\$28.3). Chronic kidney disease, chronic obstructive pulmonary disease (COPD), congestive heart failure, and ischemic heart disease each show \$7–\$12 gains, again around 6–7 percent of baseline. In contrast, cancer patients see a smaller first-stage effect (5.2%) that is not statistically significant once broken down by cancer type, although the latter likely reflects limited power in smaller samples. Finally, the first stage effect for stroke/transient is-

chemic attack (TIA) patients is both economically small and statistically insignificant. Taken together, these patterns indicate that new facility entry expands hospice access most for beneficiaries with progressive, non-cancer conditions—exactly the groups for whom there are fewer clear "curative" therapies that would need to be foregone upon electing hospice. In subsequent analysis, we only report subgroup analysis for those with a statistically significant first stage.

4.1.2 Effect of Hospice Use on Medicare Spending

We next examine the impact of hospice facility entry on total non-hospice Medicare spending (per beneficiary quarter) and its component parts, including inpatient (IP), skilled nursing facility (SNF), outpatient (OP), physician service (Carrier), and home health agency (HHA). We analyzed prescription drug spending in Medicare Part D separately, given Part D coverage is privately administered via Medicare Advantage and standalone prescription drug plans.

Figure 3 and Table 3 summarize our difference-in-differences estimates across the following major categories of Medicare payments.

Total spending: We find that total Medicare spending (excluding hospice and Part D) declines by \$8.8, relative to a baseline of \$1,588 per beneficiary-quarter. That is, an additional hospice facility entry is associated with a 0.56% reduction in Medicare spending in that county. For each dollar of additional hospice spending, total Medicare spending (including hospice) declines by \$8.62/\$4.35 = \$1.98.

Figure A5 and Table A3 show heterogeneity in the effects of hospice facility entry on total spending, stratified by chronic condition subgroup. Across all groups, hospice entry led reductions in spending, though the magnitude and significance of these effects vary. The largest spending declines are observed among patients with Alzheimer's (\$38.0) and Congestive Heart Failure (\$33.0). Patients with ADRD (which includes Alzheimer's and other related dementias), COPD, and ischemic heart disease also experience sizable average spending reductions of \$20.9, \$27.9, and \$23.1, respectively. In contrast, no statistically significant spending reduction was detected for patients with chronic kidney disease or for those with cancer.

Relative to the first stage increase in hospice spending, patients with ischemic heart

disease saw the largest substitution effect: for every additional dollar spent on hospice care, total non-hospice spending declined by \$23.1/\$7.2=\$3.2. Patients with COPD and CHF also show close to 1-for-3 substitution. In contrast, patients with Alzheimer's and ADRD roughly break even. This pattern may reflect the fact that for Alzheimer's and ADRD, there are essentially no curative treatments that the patient must forgo in order to receive hospice care.

Spending on Inpatient Hospitalizations: The largest component of the observed decline in Medicare spending is attributable to reductions in inpatient hospital expenditures. Following hospice facility entry, inpatient spending falls by \$5.4 per beneficiary-quarter, relative to a baseline of \$732, representing a 0.7% decline. This reduction is consistent with the hypothesis that greater availability of hospice services leads to substitution away from high-intensity hospital-based care. These spending changes are economically significant when considered in light of our first-stage estimates. Our estimates imply that each additional dollar in hospice spending corresponds to a \$1.3 decline in inpatient spending, outweighing the additional hospice spending.

Spending on Skilled Nursing Facility Care: We also find meaningful reductions in Medicare spending on skilled nursing facility (SNF) care. SNF spending falls by \$2.08 per beneficiary-quarter (SE = 0.62, $p < 0.001$), relative to a baseline of \$129, corresponding to a 1.61% decline. Considered in the context of our first-stage estimates, each additional dollar in hospice spending corresponds to a \$0.49 reduction in SNF spending.

Outpatient, home health, and physician services: We find no significant change in Medicare spending on outpatient, physician services, and home health care spending. The point estimates—0.04, -0.56, and -1.7 per beneficiary-quarter, respectively—are statistically insignificant and economically small relative to the pre-period means of \$255, \$101, and \$469.

Part D Prescription Drug Spending: Spending on prescription drugs covered under Medicare Part D is not significantly decreased by hospice facility entry. Average drug spending per beneficiary-quarter is \$442 at baseline and is reduced by a statistically insignificant \$0.75.

Robustness Tests: Hospice facilities tend to enter larger counties, which may also exhibit faster growth in per-beneficiary spending. We addressed this by selecting matched control counties with similar numbers and trajectories of beneficiaries in the pre-period.

To validate our matching process, we confirmed that there were no differential changes in Medicare enrollment in treatment relative to control counties following hospice facility entry (Figure A7).

4.2 Effects on Patient Well-being

4.2.1 Effect on Mortality

We find no evidence that increased hospice availability affects patient mortality. As shown in Figure 4, there is no statistically significant change in all-cause mortality rates following hospice facility entry. The first row of Table A2 reports the difference-in-differences estimate. The point estimate for all-cause mortality is –0.017 deaths per 1,000 beneficiary-quarters (SE = 0.023), allowing us to rule out changes in mortality larger than about 0.06 deaths per 1,000—or roughly half a percent of the baseline rate. This result holds when disaggregating by chronic condition subgroups (Table A2), with no statistically significant effects on mortality for any chronic condition subgroup.

4.2.2 Effect on Interventions and Patient Comfort

We next examine how increased hospice availability affects the intensity and nature of care provided to Medicare beneficiaries residing in nursing homes. Using Minimum Data Set (MDS) assessments, we analyze the use of clinical interventions that reflect more aggressive care goals as opposed to prioritizing patient comfort. Two prominent examples are feeding tubes and indwelling urinary catheters: tubes can maintain caloric intake and lower aspiration risk, and catheters can prevent urinary retention, yet both introduce substantial discomfort and infection risk [Estrada et al., 2025]. By contrast, hospice and palliative care philosophies encourage symptom-directed measures, including more liberal use of comfort medications such as hypnotics for sleep. Our analysis therefore compares changes in these invasive interventions to shifts toward palliative treatments in the wake of hospice entry. Table 4 reports results for interventions affecting patient comfort among nursing home residents with MDS assessment data.

Feeding Tubes. Poor eating and drinking is a significant challenge near the end of life, due to poor appetite, difficulty swallowing, and choking risk. While feeding tubes can help

guarantee adequate nutritional intake and reduce choking and food aspiration, their placement and use can involve significant patient discomfort.

Following hospice facility entry, we find a statistically significant decline in the probability that a resident has a feeding tube in place (Figure A3a). The baseline prevalence of feeding tube use is 7%, and we estimate a reduction of -.09 percentage points. While the aggregate effect across all follow-up periods is not significant, later periods consistently show stronger effects, suggesting a growing impact over time as facility penetration deepens.

Consistent with attempts to allow patients to feed themselves, we find a statistically significant increase in the use of speech therapy, which is a service provided to assess and rehabilitate independent swallowing function. We estimate an increase of 0.42 minutes per resident-quarter, from a baseline of 15.6 minutes, an increase of 2.7% (Figure A3).

Catheter Use. Indwelling urinary catheters help manage bladder function, but they are often uncomfortable, limit mobility, and raise the risk of infection. We find a modest decline in the share of nursing home residents with an indwelling urinary catheters following hospice facility entry. Use declines by -0.13 percentage points from a baseline of 8%, a 1.6% decrease.

Importantly, we observe no significant change in urinary continence (Appendix Table A7) or toileting scores (Appendix Table A6), suggesting that this decline does not reflect a shift in patient needs but rather a change in care practices aligned with hospice goals.

Use of Restraints. Trunk restraints—such as belts or vests that restrict movement of the upper body—are sometimes used in nursing homes to prevent falls or maintain safety for residents with cognitive impairment or physical instability. However, their use is controversial, as restraints can cause discomfort, agitation, loss of dignity, and even physical harm.

We find evidence that hospice facility entry is associated with a reduction in the use of trunk restraints in nursing home settings (Figure A3d, Table 4). Trunk restraints, which include belts or vests that limit torso movement, are used in 6.37% of resident-quarters at baseline. Following hospice entry, we estimate a decline of 0.29 percentage points (SE = 0.11), a 4.49% decrease.

High-risk medication use. We observe a selective increase in the use of hypnotic medications in nursing home patients following hospice facility entry. The probability of receiving any hypnotic medication during a nursing home stay increases by 0.21 percentage points (baseline = 6.25%, $p = 0.005$), a 3.4% increase, and the number of days on hypnotics increases by 0.0144 days per resident-quarter (baseline = 0.338 days, $p = 0.001$), a 4.3% increase (Figure A3e-f, Table 4). This may reflect greater emphasis on symptom relief for patients experiencing agitation or insomnia.

In contrast, we find no statistically significant changes in the use of antidepressants, antipsychotics, anxiolytics, or intravenous medications (Table A5). Both the extensive and intensive margins of use remain stable across all specifications, with point estimates near zero. These null results indicate that increased hospice use does not systematically alter psychotropic medication regimens outside the specific domain of hypnotic agents.

Summary. These findings suggest that expanded access to hospice services leads to a targeted reduction in more intensive or invasive interventions, such as catheters, feeding tubes, and physical restraints, while preserving or even increasing the use of supportive therapies like speech therapy. This pattern reflects a shift in care goals rather than a blanket reduction in service intensity, suggesting that hospice promotes selective de-escalation aligned with comfort and quality of life.

4.2.3 Outcomes Not Affected by Hospice

Although hospice re-focuses health care interventions around patient comfort, we find little evidence that hospice significantly impacts mental and physical health outcomes, including measures of patient pain, cognitive or functional status, or overall physical condition.

Mental Health Outcomes. As shown in Table A4, we detect no significant changes in pain-related variables, including frequency, intensity, and interference with daily activities. Mood scores and memory function also remain unchanged. Delirium indicators also remain stable, although we note a trend toward increased inattention in later post-entry periods.

Physical and Functional Outcomes. Table A7 shows results for physical health outcomes. We observe no effects on the incidence of falls, pressure ulcers, or incontinence.

While the share of individuals gaining weight declined (absolute change -0.00171, baseline 6.4%, $p = 0.013$), there was no significant effect on the share of patients losing weight.

Functional outcomes related to activities of daily living (ADLs) are generally flat, with one marginally significant increase in the share of patients requiring support with eating, consistent with our finding of reduced feeding tube use (Table A6). No ADL self-performance measures showed statistically significant changes.

Taken together, these findings suggest that while hospice entry affects specific interventions and treatment intensity, it does not lead to systematic changes in underlying patient condition as recorded in routine nursing home assessments.

4.2.4 End of Life Treatment and Place of Death

Table 5 reports the estimated effects of hospice facility entry on treatment modality at the end of life and on the place of death. Panel A shows that facility entry led to a statistically significant decline in the use of institutional care during the last 180 days of life, driven by reductions in both inpatient and skilled nursing facility stays. Panel B indicates a corresponding shift in the place of death away from institutional settings and toward home. The share of deaths occurring in institutions fell by 1.2%, while deaths at home increased by 0.7% and were more likely to be accompanied by hospice care. At-home deaths with hospice care rose by roughly 3%, whereas home deaths without hospice care declined by 1.7%. Overall, these patterns suggest that expanded hospice availability reduced institutionalization in the last six months of life in favor of home-based, hospice-supported end-of-life care.

Deaths occurring at home and lower rates of hospitalization near death are commonly used metrics of goal-concordant or high-quality end-of-life care. The estimated reductions in institutional care and the corresponding increase in home deaths with hospice therefore indicate that hospice facility entry produced measurable changes along these quality dimensions, substituting hospice-supported home care for hospital and nursing facility use.

5 A Model of Hospice Use at the End of Life

Our reduced-form analysis shows that hospice facility entry leads to sizable reductions in Medicare spending and measurable improvements in the quality of end-of-life care. How-

ever, the gains from hospice expansion are not uniform across conditions. Both baseline hospice use and the first-stage response to new facility entry vary widely: some chronic conditions show large increases in hospice enrollment, while others respond little or not at all. A key question is whether this heterogeneity reflects efficient differences in patient prognosis or inefficiencies driven by incentives and capacity constraints.

First, variation in hospice use could reflect differences in clinical outlook or disease progression. Patients with certain diagnoses may have longer expected survival or a higher likelihood of responding to curative treatment, making hospice enrollment less appropriate. In this case, cross-condition heterogeneity would be largely efficient and reflect optimal targeting of hospice resources. Second, physicians face different financial incentives across conditions depending on how Medicare reimburses curative and hospice services. If physicians lose more revenue when referring a patient to hospice, they may delay or avoid referral even when hospice would improve patient well-being. Such behavior would generate inefficient underuse of hospice care. Third, the discrete jump in hospice participation following new facility entry suggests that capacity constraints are binding in many markets. Limited availability can prevent eligible patients from enrolling even when both patient and physician preferences favor hospice, representing another form of inefficiency.

To distinguish between these mechanisms, we develop a model in which hospice referrals arise from physicians' joint consideration of patient severity, financial incentives, and local capacity constraints. The model allows us to quantify the extent to which the observed heterogeneity in hospice use across conditions reflects efficient selection based on prognosis versus distortions induced by financial and capacity factors. Importantly, the estimated model can be used to simulate counterfactuals that relax these constraints, providing an internally consistent way to assess how hospice participation and welfare would change in a system without financial disincentives or capacity limits.

5.1 Model Setup

We model a physician's decision to refer a patient to hospice as a function of patient severity and the physician's financial incentives, and subject to hospice capacity constraints in the local market.

A patient with latent clinical severity $\theta \in \Theta \subset \mathbb{R}_+$ faces two care pathways: hospice

(H) or continued curative treatment (C). The physician privately observes a signal $s \in S$ about θ that satisfies the monotone likelihood ratio property (MLRP), so that higher s indicates a worse prognosis under curative care. Patients do not observe s and follow the recommendation.[2]

Patient welfare. Patient utility from choice $d \in \{H, C\}$ is

$$U_P(d \mid \theta) = Q_d(\theta) - K_d,$$

where $Q_d(\theta)$ is quality-adjusted well-being (longevity and symptoms) and K_d is non-clinical burden such as logistical or emotional costs. The difference in patient utility between hospice and curative care (the net hospice advantage),

$$\Delta U_P(\theta) \equiv U_P(H \mid \theta) - U_P(C \mid \theta)$$

is increasing in severity: $\partial_\theta \Delta U_P(\theta) > 0$. Intuitively, as prognosis worsens, the relative value of palliative care rises because the expected benefit of continued curative treatment declines.

Physician's objective. Following Ellis and McGuire [1986], the physician is partially altruistic, valuing both patient welfare and practice revenues:

$$V_M(d \mid \theta) = w\, U_P(d \mid \theta) + R_d,$$

where $w > 0$ measures the physician's weight on patient utility and R_d denotes the financial return associated with treatment. Let $\Delta R \equiv R_C - R_H \geq 0$ denote revenue forgone by referring to hospice. The incremental value of hospice to the physician is

$$\Delta V_M(\theta) = w\, \Delta U_P(\theta) - \Delta R.$$

[2]Even if a patient wished to go on hospice against their physician's recommendation, this is usually not possible as hospice requires physician referral.

Given signal s, the physician recommends hospice when the expected incremental value is nonnegative:

$$E[\Delta V_M(\theta) \mid s] = w\, E[\Delta U_P(\theta) \mid s] - \Delta R \;\geq\; 0. \tag{2}$$

Under MLRP there exists a unique cutoff s^* such that hospice is recommended iff $s \geq s^*$.

Let $g(s)$ denote the cross-patient density of s, then under unconstrained hospice availability, the referral mass is $D(s^*) = \int_{s^*}^{\infty} g(s)\, ds$. In practice, hospice capacity is limited. When capacity binds, the realized cutoff tightens to $\tilde{s} > s^*$ so that admissions equal available slots. We summarize the wedge by $\kappa \geq 0$ and write

$$\tilde{s} = s^* + \kappa.$$

This stylized framework highlights two mechanisms that can distort hospice use. First, physician financial incentives may create a wedge between patient-optimal and physician-recommended care: physicians facing larger revenue losses refer fewer patients. Second, limited hospice capacity further restricts access by forcing physicians to prioritize the most severe cases.

5.2 Parametrization

To link the model to the data, we adopt a parsimonious parametrization of severity, preferences, and financial incentives. For each chronic condition c, the physician's private signal of severity is assumed to follow a normal distribution,

$$s \sim \mathcal{N}(\mu_{s,c}, \sigma^2_{s,c}),$$

where $\mu_{s,c}$ and $\sigma^2_{s,c}$ capture the mean and dispersion of clinical severity. We use condition-level mortality rates per quarter to anchor the scale of s, interpreting higher mortality as greater clinical severity.

We approximate the expected patient benefit of hospice relative to curative care as increasing linearly with severity (mortality rate):

$$E[\Delta U_P(\theta) \mid s] = U_0 + \lambda s.$$

Substituting this form into the physician's decision rule in Equation (2) yields a simple linear threshold condition,

$$\beta_0 + \omega s - \delta_{R,c} \geq 0,$$

where $\beta_0 = wU_0$ is the baseline nonfinancial utility from hospice, $\omega = w\lambda$ captures the physician's weight on patient benefit relative to financial incentives, and $\delta_{R,c}$ is the per-beneficiary revenue loss from referring a patient with condition c to hospice. The condition-specific severity threshold for hospice referral is then

$$\tilde{s}_c = \frac{\delta_{R,c} - \beta_0}{\omega} + \kappa_c, \tag{3}$$

where $\kappa_c \geq 0$ reflects the degree to which hospice capacity is binding.

Given the estimated severity distribution, the share of patients in hospice and the density at the margin are

$$D_c = 1 - \Phi(\tilde{s}_c; \mu_{s,c}, \sigma^2_{s,c}), \quad \text{and} \quad g_{s,c} = \varphi(\tilde{s}_c; \mu_{s,c}, \sigma^2_{s,c}),$$

where Φ and φ denote the normal CDF and PDF. Empirically, D_c corresponds to the share of beneficiaries in hospice each quarter for condition c, and $g_{s,c}$ is identified from changes in D_c when local hospice capacity expands following facility entry (corresponding to our first-stage estimates). Formal derivations are provided in Appendix C.

5.3 Identification and Estimation

Identification leverages cross-condition variation in three observed quantities—hospice use, mortality risk, and provider financial incentives—and the parametric structure in Section 5.2. The mortality distribution anchors $(\mu_{s,c}, \sigma_{s,c})$. The hospice participation rate D_c and its responsiveness to capacity expansions $g_{s,c}$ locate the effective threshold $\tilde{s}_c$ within that distribution. Reduced-form differences in Medicare spending between curative care and hospice yield $\delta_{R,c}$, the incentive term entering the physician's decision rule.[3]

Intuitively, conditions with larger financial losses from hospice enrollment should dis-

[3]We define $\delta_{R,c}$ as the change in total Medicare spending following hospice facility entry, excluding Part D prescription drug spending and hospice, divided by the change in D_c following hospice facility entry.

play higher severity thresholds: physicians are only willing to refer patients who are very sick. The slope of the relationship between $\delta_{R,c}$ and $\tilde{s}_c$ across conditions identifies ω, the marginal weight placed on patient benefit relative to revenue; the intercept identifies β_0, the baseline non-financial utility from hospice for minimally severe patients. Because hospice capacity can bind, the observed thresholds $\tilde{s}_c$ may exceed unconstrained levels. We therefore impose inequalities implied by the model—$\kappa_c \geq 0$ and the requirement that observed hospice shares cannot exceed their unconstrained counterparts—to restrict (β_0, ω) to the region consistent with the data. Formal statements of these inequalities appear in Appendix C.

Estimation proceeds in three steps. *First*, we estimate condition-specific primitives $(D_c, g_{s,c}, \mu_{s,c}, \delta_{R,c})$ from observed hospice utilization, first-stage responses to facility entry, mortality rates, and reduced-form spending regressions. *Second*, we recover the variance of the severity distribution $\sigma^2_{s,c}$, and the location of the severity threshold $\tilde{s}_c$ by matching the observed and model-implied hospice share and marginal density $(D_c, g_{s,c})$. *Third*, we estimate the common parameters (β_0, ω) using a moment-inequality approach and back out condition-specific capacity wedges κ_c via Equation (3). Standard errors are computed by bootstrapping over conditions. Full moment inequality conditions and computational details are provided in Appendix C.

5.4 Model Results

Condition-specific Parameters. Our estimation sample includes N=11 serious chronic conditions: Alzheimer's disease, ADRD, Chronic Kidney Disease, Ischemic Heart Disease, Congestive Heart Failure, Chronic Obstructive Pulmonary Disease (COPD), Stroke, Breast cancer, Colorectal cancer, Prostate cancer, and Lung cancer. The condition-specific parameters reported in Panel (a) of Table 6 reveal substantial heterogeneity across chronic conditions in both underlying severity and hospice utilization patterns. Mean severity levels $(\mu_{s,c})$, representing average quarterly mortality rates per 1000 beneficiaries, range from 16 to 102 with an average of 42. The dispersion parameters $(\sigma_{s,c})$ vary widely, indicating that severity distributions differ across diseases. Of note, the conditions we include are all quite severe; the average mortality rate of 4.2% per quarter implies a 16% annual mortality rate, with the most deadly chronic condition (lung cancer) having a 35% annual

mortality rate. Hospice shares (D_c) average 0.037 and range from 0.014 to 0.091, consistent with large variation in end-of-life care use across conditions. Marginal hospice densities $g_{s,c}$ average 0.002 and ranged widely from 0.001 to 0.004, reflecting differences in the share of patients near the severity threshold across conditions. Revenue losses ($\delta_{R,c}$) average \$22,549 per patient switching to hospice, ranging from \$3,842 to \$36,710 across conditions. Observed severity thresholds ($\tilde{s}_c$) also varied across conditions, reflecting differences in both financial incentives and capacity constraints. On average, physicians recommended hospice for quarterly mortality rates above 12.9%, but this ranged from 10.1% to 18.1%. The estimated capacity constraints (κ_c) are positive for most conditions and average 28.2, suggesting that hospice slots are scarce and that physicians must ration access by referring only the most severe patients. Together, these cross-condition patterns provide the empirical foundation for estimating the utility parameters that govern physicians' hospice referral decisions.

Physician Altruism Estimates. The moment inequalities estimate of ω is $\hat{\omega}_{MI} = 0.30$ (SE = 0.11). Baseline utility is estimated less precisely, with $\hat{\beta}_{0,MI} = -7.90$ (SE = 15.2). The interpretation of the physician utility moment inequality estimates is that for every 1% increase in quarterly mortality (severity), the utility placed on hospice by the physician increases by \$3,000. This compares to an estimated mean (physician) utility of \$36,600 per patient in hospice at baseline.

Relationships Between Model Parameters. Figure A8 plots the pairwise relationships among key empirical objects: average mortality (our estimate of mean severity $\mu_{s,c}$), estimates of severity dispersion ($\sigma_{s,c}$), estimated hospice severity thresholds ($\tilde{s}_c$), the baseline hospice share (D_c), marginal hospice densities ($g_{s,c}$), and provider revenue losses associated with hospice referral for each condition ($\delta_{R,c}$). Each panel includes a fitted regression line and correlation coefficient, illustrating how patient severity, hospice use, and provider incentives covary across conditions.

The most salient relationship appears between *revenue loss* and the *observed hospice threshold*. As shown in Figure 5, conditions with larger provider revenue losses (δ_R) exhibit higher severity cutoffs ($\tilde{s}_c$), meaning that patients must reach greater illness severity before hospice is utilized. Figure A9 shows that conditions with larger financial incentives against

hospice are also less capacity constrained, consistent with hospice underutilization. From Equation 3, this suggests that $\omega > 0$: physicians consider patient severity when making hospice decisions. The larger the empirical relationship between revenue losses and severity cutoffs, the larger the weight on patient severity. If hospice thresholds were not correlated with revenue losses, then this would be consistent with *either* $\omega = 0$ or $\omega \to \infty$. Notably, revenue loss is uncorrelated with mean severity ($\mu_{s,c}$), indicating that variation in provider incentives does not reflect underlying clinical burden (Figure A8, Row 3, Column 1). That is, conditions may be severe but not profitable, and vice versa.

We find a positive relationship between mean severity and baseline hospice use (D_c) (Figure 6). In contrast, mean severity is not significantly correlated with severity thresholds (Figure A8). This pattern is consistent with a downward-sloping hospice benefit curve: more severe patients tend to enter hospice first, but patients are not prioritized by chronic condition. Put another way, patients with similar mortality risk have similar likelihood of being referred to hospice regardless of whether they have cancer or heart disease. Of note, Alzheimer's disease and related dementias have particularly high baseline rates of hospice use that are not fully explained by mean severity alone.

Together, these relationships suggest that provider revenue losses (δ_R) incentivize providers to set higher severity thresholds, resulting in capacity constraints being less binding for these conditions. While more severe conditions have higher baseline hospice participation and responsiveness to capacity, this is because more patients are both inframarginal and marginal to these severity cutoffs. Severity thresholds themselves are relatively uncorrelated with mean severity.

5.5 Counterfactuals

We simulate three counterfactual scenarios:

1. **Baseline**: This case represents the status quo. It maintains observed capacity-constrained thresholds and provider financial incentives, using the estimated $\tilde{s}_c$ values

2. **No capacity constraint**: This case removes the hospice capacity constraint, allowing $\tilde{s}_c$ to equal the unconstrained s_c^*. Hospice utilization adjusts accordingly.

3. **No capacity constraints + no physician incentives**: This case sets $\delta_{R,c} = 0$

in addition to removing the capacity constraint, reflecting a world in which both capacity constraints and financial disincentives are eliminated. In this case, patients continue to enter hospice as long as patient utility from hospice is positive.

Counterfactual Simulation Results (PRELIMINARY). The counterfactual simulations show that both hospice capacity and financial incentives strongly shape participation and welfare outcomes (Table 7). Under the baseline constrained equilibrium, the mean hospice participation share per quarter is 0.04 across condition and rises to 0.19 when capacity limits are removed and to 0.63 when both capacity and financial disincentives are eliminated. This expansion occurs through a leftward shift in the hospice-entry threshold $\tilde{s}_c$, which declines from an average of 128.7 to 100.5 under unconstrained entry and to 26.1 when physicians are reimbursed for their revenue losses.[4] Average utility among hospice users decreases as entry expands (from \$36,600 to \$13,630), reflecting diminishing marginal benefits from admitting less severe patients. However, aggregate hospice utility, computed over all eligible patients, increases from 1.38 to 8.92. These patterns are consistent with hospice care being beneficial for most beneficiaries with serious chronic conditions, despite falling marginal utility.

The large increases in hospice use implied by the model are striking; however, they are consistent with our empirical findings that receiving hospice services has few downsides for the marginal patient, especially if there are no clear "curative treatments" that need to be foregone. For our sample of patients with severe chronic conditions, it is potentially plausible that 63% of them would derive positive benefits from receiving additional hospice services. In practice, however, hospice referral requires physicians to attest to a high probability of death within six months, and long-stay patients are penalized via Medicare limits on annual per-patient reimbursements. These real-world restrictions likely comprise a large portion of our estimated capacity constraints.

Lastly, a full accounting of social welfare would require including estimates of Medicare's cost function for providing hospice services, which may be net-positive for less severe patients. Reimbursing physicians for lost revenue would also increase Medicare costs, especially as this would also apply to inframarginal patients. Overall, while a large share of

[4]Note that removing both capacity constraints and financial incentives results in a constant severity threshold across all conditions.

patients may benefit from additional services provided by hospice, social costs may outweigh these benefits for low-severity patients.

6 Discussion

In this paper, we find that expanding hospice capacity lowers end-of-life spending while improving care quality. Across more than 1,500 hospice openings between 1999 and 2019, we observe substantial reductions in Medicare expenditures concurrent with higher hospice use, with savings concentrated in inpatient and skilled-nursing care. Indicators of patient comfort also improve, as care shifts from aggressive to comfort-focused services, and mortality remains unchanged. On average, each dollar spent on hospice yields nearly two dollars in Medicare savings. The magnitude of these effects, however, varies by condition: spending offsets are largest for COPD and heart disease, and smaller for dementia and cancer. To explain this heterogeneity, we develop a model in which physicians balance patient well-being against financial incentives and capacity limits. We estimate that each hospice referral reduces provider revenue by about $22,500, and that physicians refer only when patients' quarterly mortality risk exceeds roughly 13%. These distortions—financial disincentives and supply constraints—together contribute to the underuse of hospice relative to the social optimum.

Our findings leave open several avenues for future research. First, the estimated effects reflect hospice expansions over a two-decade period during which the industry shifted from predominantly nonprofit to largely for-profit ownership. Future work could examine how organizational form and entry composition mediate the welfare gains from hospice growth, and whether competitive dynamics among providers alter the efficiency–quality trade-off. Second, our estimates identify the response of marginal patients whose hospice use increases with local capacity. Understanding how these effects extend to inframarginal patients—and how the shape of the hospice demand curve varies across populations—would help clarify the aggregate welfare implications of expansion. Third, while our quality measures draw on detailed nursing home assessments, extending the analysis to home-based settings would provide a more comprehensive view of comfort and care quality near the end of life. Finally, our model emphasizes physician decision-making under financial and capacity constraints; integrating patient and family preferences into this framework could

yield richer insights into how demand- and supply-side factors jointly determine hospice utilization and welfare.

Taken together, the evidence presented here suggests that, on the margin, the U.S. health care system devotes too few resources to palliative care relative to its social value. Expanding hospice capacity and aligning payment incentives with patient well-being could simultaneously improve quality of life at the end of life and reduce overall Medicare spending. More broadly, these results illustrate how targeted expansions of lower-intensity care can yield welfare gains by reallocating resources from treatments that prolong life toward services that make life's final months more comfortable.

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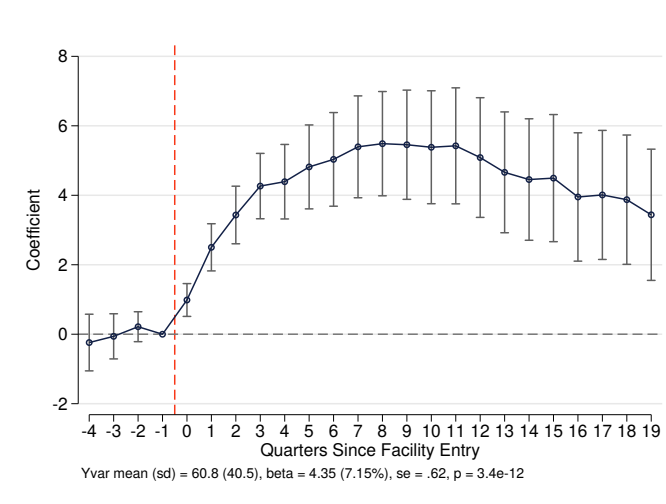
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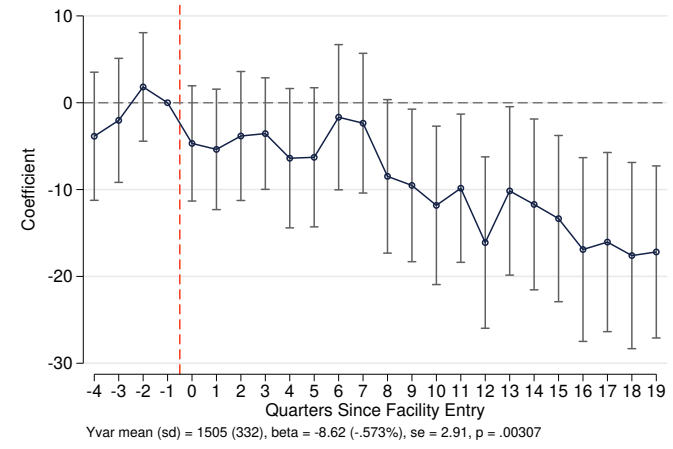
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Figure 1. Event Study: Hospice Spending.



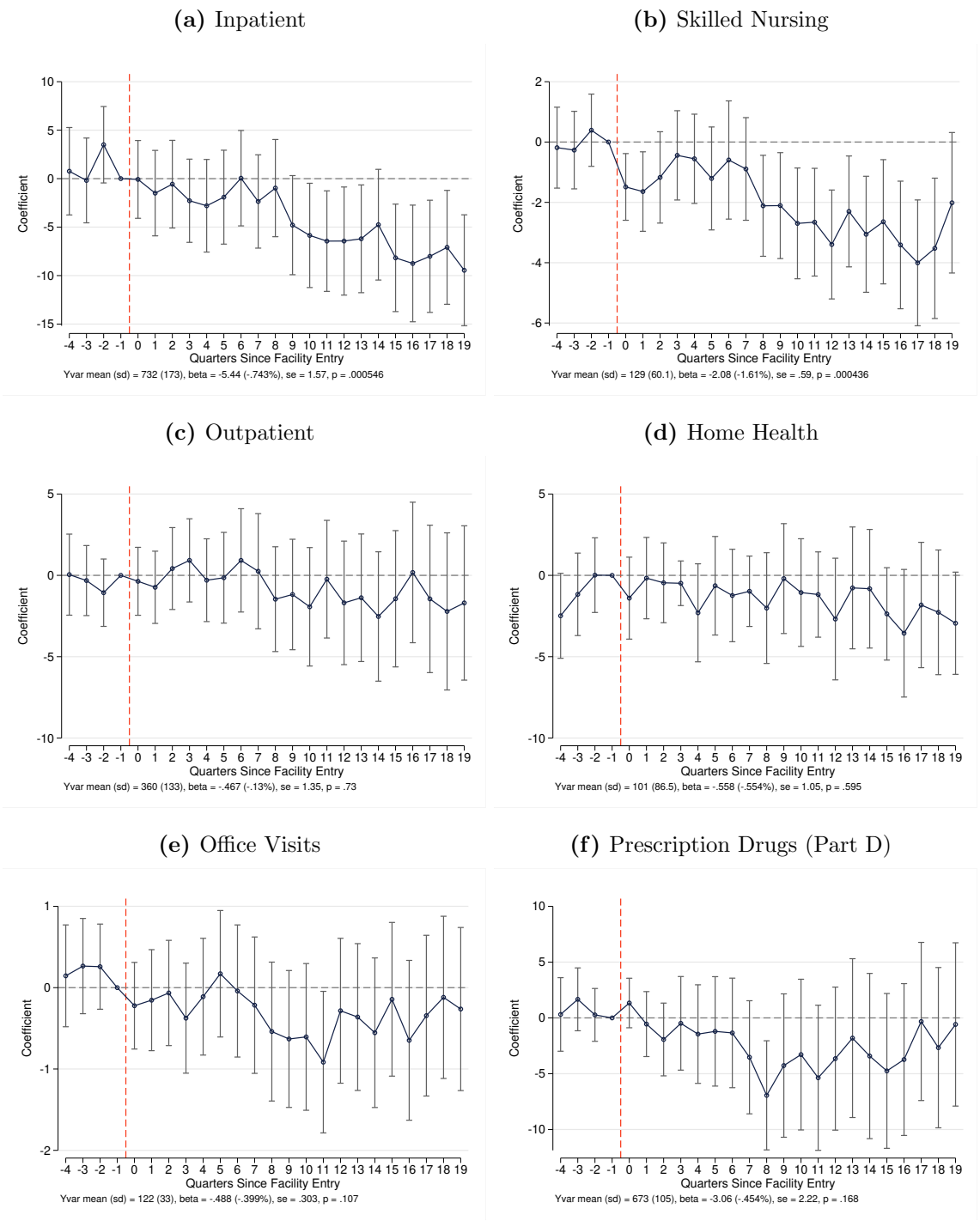
Note: This figure presents the estimated effect of hospice facility entry on Medicare hospice spending per beneficiary per quarter. Estimates are based on a stacked difference-in-differences event study design using 1,518 hospice facility entries, each defining a separate experiment with one treated county and up to two matched control counties selected based on pre-entry Medicare beneficiary levels and trends. The outcome is measured at the county-experiment-quarter level and modeled with county-by-experiment and experiment-by-time fixed effects. Event-time coefficients represent differences between treated and control counties, normalized to zero in the quarter prior to entry ($k = -1$). The red dashed line marks the timing of facility entry. Standard errors are clustered at the county level and shown as 95% confidence intervals.

Figure 2. Event Study: Total Medicare Spending, Excluding Part D and Hospice



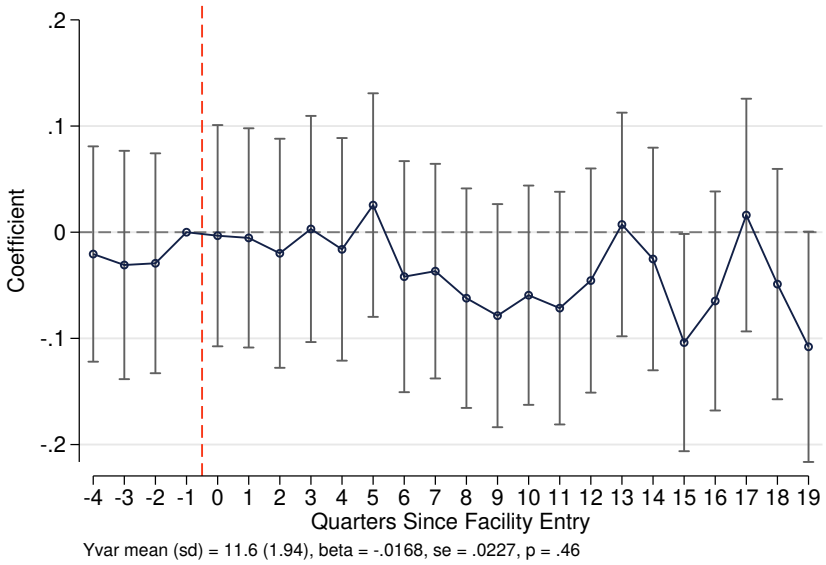
Note: This figure displays the estimated effect of hospice facility entry on total quarterly Medicare fee-for-service spending per beneficiary, excluding spending on hospice and Part D. Estimates are from a stacked difference-in-differences event study design using 1,518 hospice facility entries, each defining a separate experiment with one treated county and up to two matched control counties based on pre-entry Medicare population size and trends. The outcome is modeled at the county-experiment-quarter level with county-by-experiment and experiment-by-time fixed effects. Coefficients represent the average difference in spending between treated and matched control counties, relative to the quarter before entry ($k = -1$). The red dashed line marks the quarter of facility entry. Error bars indicate 95% confidence intervals based on standard errors clustered at the county level.

Figure 3. Event Study: Medicare Spending, by Type.



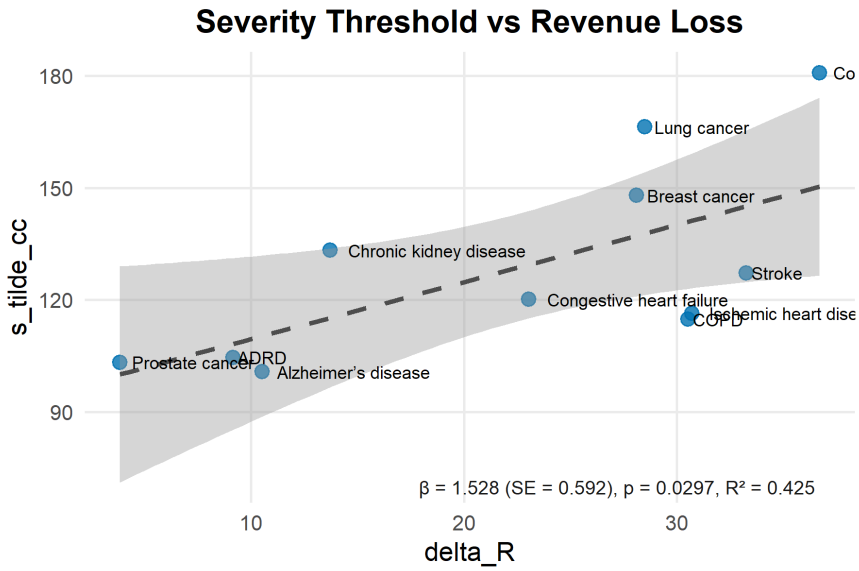
Note: This figure shows the estimated effects of hospice facility entry on Medicare fee-for-service spending by care setting: (a) inpatient, (b) skilled nursing facility (SNF), (c) outpatient, (d) home health, (e) office visits (Carrier) (f) prescription drugs (Part D). Results are from a stacked difference-in-differences event study design using 1,518 hospice facility entries, each defining a separate experiment with one treated county and up to two matched control counties based on pre-entry Medicare population levels and trends. The outcome is modeled at the county-experiment-quarter level with county-by-experiment and experiment-by-time fixed effects. Coefficients represent differential changes in treated counties relative to matched controls, normalized to zero in the quarter prior to entry ($k = -1$). The red dashed line denotes the quarter of facility entry. Standard errors, clustered at the county level, are plotted as 95% confidence intervals.

Figure 4. Event Study: Overall Mortality



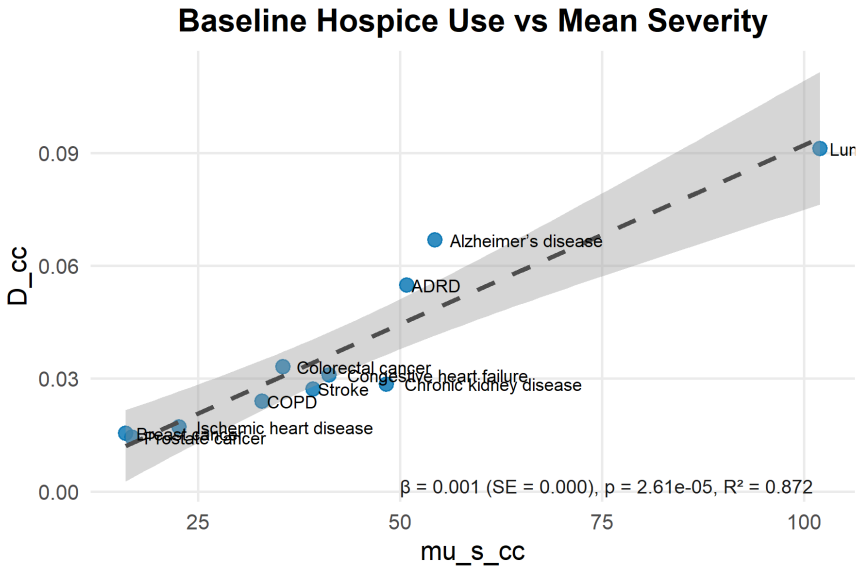
Note: This figure displays the estimated effect of hospice facility entry on total quarterly deaths per 1,000 beneficiaries. Estimates are from a stacked difference-in-differences event study design using 1,518 hospice facility entries, each defining a separate experiment with one treated county and up to two matched control counties based on pre-entry Medicare population size and trends. The outcome is modeled at the county-experiment-quarter level with county-by-experiment and experiment-by-time fixed effects. Coefficients represent the average difference in spending between treated and matched control counties, relative to the quarter before entry ($k = -1$). The red dashed line marks the quarter of facility entry. Error bars indicate 95% confidence intervals based on standard errors clustered at the county level.

Figure 5. Severity threshold $\tilde{s}_c$ vs. revenue loss $\log(\delta_R)$.



Note: Conditions with larger provider revenue losses exhibit higher severity thresholds, implying that financial incentives shift the cutoff for hospice inclusion.

Figure 6. Baseline hospice share D_c vs. mean severity $\mu_{s,c}$.



Note: Conditions with higher average severity have higher baseline hospice participation.

Table 1. Summary Statistics of Hospice Facilities

Variable	All	Incumbents	Entrants	Entrants in Baseline Sample
Number of Employees	28.13	47.38	18.62	24.68
RNs	9.07	16.24	5.53	7.71
LPNs	2.07	3.21	1.50	1.54
Physicians	1.09	1.33	0.97	1.07
HH Aids	6.14	9.73	4.36	6.14
Homemakers	0.64	1.01	0.46	0.55
Counselors	1.61	2.20	1.31	1.54
Medical Social Workers	2.22	3.62	1.52	1.90
Other	5.30	10.03	2.96	4.23
Type of Ownership				
Non-Profit	0.30	0.58	0.16	0.22
For-Profit	0.58	0.30	0.72	0.64
Government	0.12	0.12	0.12	0.14
Co-location with Other Health Care Facilities				
Free-Standing Independent Ownership	0.74	0.51	0.86	0.81
Owned by a Home Health Agency	0.19	0.35	0.12	0.15
Owned by a Skilled Nursing Facility	0.02	0.03	0.01	0.02
Owned by a Nursing Facility	0.004	0.007	0.002	0.003
Owned by a Hospital	0.09	0.22	0.03	0.05
Number of Facilities	6,516	2,154	4,362	1,574
Number of County-Quarters	4,529	1,278	1,820	1,518

Notes: This table reports summary statistics for hospice facilities in 2019. The 'all' column includes all hospice facilities in the Medicare Provider of Services (POS) file as of 2019. The 'incumbents' column includes all facilities in operation at the beginning of the study period (1999), and the 'entrants' column includes all facilities that started billing Medicare during our study period (1999 to 2019). The 'entrants in baseline sample' column includes hospice facility entrants that are in our baseline sample. Co-location is defined based on the listed facility code and address of each facility.

Table 2. Summary Statistics of Medicare Beneficiaries

Variable	Mean	SD	p25	p50	p75
Panel A: Health care spending (per beneficiary-quarter)					
Hospice	60.77	40.02	29.88	53.90	83.70
Inpatient	731.73	160.94	627.14	723.19	830.02
Skilled Nursing	129.07	58.39	87.82	120.77	163.14
Outpatient	254.69	96.69	184.82	239.31	319.05
Home health	100.87	77.96	56.85	78.21	117.49
Physician Services	469.40	130.24	379.70	468.37	554.59
Total excl. Prescription Drugs	1588.63	351.24	1339.88	1597.22	1827.21
Prescription Drugs (Part D)	441.64	80.00	394.09	439.96	482.64
Panel B: Health outcomes					
Mortality (per 1000)	11.56	1.47	10.64	11.61	12.50

Notes: This table reports summary statistics for the main analysis sample, restricting to treatment counties in the year prior to hospice entry and aggregated to the county by entry-year level. All spending variables in Panel A represent average Medicare expenditures per fee-for-service beneficiary per quarter. Total FFS spending excludes Part D. Mortality in Panel B is reported as the number of deaths per 1,000 beneficiaries per quarter. N = 771 county-quarters for prescription drugs (Part D) and N = 1518 county-quarters for all other rows.

Table 3. Change in Health Care Spending

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Hospice	60.8	4.3***	7.1%
		(0.62)	
Total, Excluding Part D and Hospice	1588	−8.8***	-0.6%
		(2.5)	
Inpatient	732	−5.4***	-0.7%
		(1.6)	
Skilled Nursing	129	−2.1***	-1.6%
		(0.59)	
Outpatient	255	0.04	0.02%
		(0.79)	
Home Health	101	−0.56	-0.56%
		(1.1)	
Physician Services	469	−1.7	-0.4%
		(1.2)	
Prescription Drugs (Part D)	442	−0.75	-0.17%
		(2.5)	

Notes: This table reports estimates from event study regressions evaluating the effects of hospice facility entry on quarterly Medicare spending per beneficiary, including total spending (excluding Part D and hospice) and component categories: inpatient, skilled nursing, outpatient, home health, office visits, and prescription drugs (Part D). Estimates are based on a stacked difference-in-differences design with experiment-by-county and experiment-by-time fixed effects. Column (1) reports the pre-entry sample mean of the outcome in the treatment county. Column (2) reports the estimated average change in the outcome in the five years after hospice facility entry. Column (3) expresses the estimate as a percent change relative to the pre-entry mean. Standard errors, clustered at the county level, are reported in parentheses.
$^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.

Table 4. Change in Interventions and Patient Comfort

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Has Feeding Tube	0.07	−0.0009	-1.3%
		(0.0006)	
Speech Therapy (Swallowing), Minutes	15.6	0.42**	2.7%
		(0.17)	
Has Catheter	0.08	−0.0013**	-1.6%
		(0.0005)	
Has Trunk Restraint	0.06	−0.0029***	-4.8%
		(0.0011)	
Any Hypnotic Drug Use	0.06	0.0021***	3.5%
		(0.0008)	
Days of Hypnotic Drug Use	0.34	0.014***	4.1%
		(0.004)	

Notes: This table reports estimates from event study regressions evaluating the effects of hospice facility entry on interventions associated with patient comfort, measured using MDS assessment data for nursing home residents. Estimates are based on a stacked difference-in-differences design with experiment-by-county and experiment-by-time fixed effects. Columns are defined as in Table 3.
$^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.

Table 5. Change in End-of-Life Treatment Modality and Place of Death

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Panel A: Institutional Care in the Last 180 Days of Life			
Any Institutional Care	0.13	-0.001^{**} (0.0004)	-1.0%
Inpatient	0.07	-0.0004^{*} (0.0002)	-0.6%
Skilled Nursing	0.06	-0.0009^{**} (0.0003)	-1.6%
Panel B: Place of Death			
Institution	0.36	-0.004^{***} (0.001)	-1.2%
Inpatient Facility	0.29	-0.003^{**} (0.001)	-1.2%
Skilled Nursing Facility	0.07	$-0.001^{\dagger}$ (0.0007)	-1.7%
Home	0.64	0.004^{***} (0.001)	0.7%
Home with Hospice Care	0.32	0.010^{***} (0.001)	3.1%
Home without Hospice Care	0.32	-0.005^{***} (0.001)	-1.7%

Notes: This table reports estimates from event study regressions evaluating the effects of hospice facility entry on institutional care utilization in the last days of life and on the place of death. Estimates are based on a stacked difference-in-differences design with experiment-by-county and experiment-by-time fixed effects. Columns are defined as in Table 3.
$^{\dagger}p < 0.1$ $^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.

Table 6. Parameter Estimates

Parameter	Mean	SD	Min	Max
Panel (a): Condition-specific Parameters				
Mean severity ($\mu_{s,c}$)	41.78	23.85	16.00	102.00
Severity dispersion ($\sigma_{s,c}$)	46.45	13.37	30.98	79.10
Hospice share (D_c)	0.037	0.024	0.014	0.091
Marginal hospice density ($g_{s,c}$)	0.002	0.001	0.001	0.004
Revenue loss, $ thousands ($\delta_{R,c}$)	22.55	11.25	3.84	36.71
Severity threshold ($\tilde{s}_c$)	128.70	26.36	100.78	180.82
Capacity constraint (κ_c)	28.23	28.21	-11.96	64.57
Panel (b): Utility Function Parameters				
Baseline hospice utility (MI $\hat{\beta}_0$)	-7.90			
	(15.16)			
Physician altruism (MI $\hat{\omega}$)	0.303			
	(0.108)			

Notes: Parameters are estimated for N=11 chronic conditions: Alzheimer's disease, ADRD, Chronic Kidney Disease, Ischemic Heart Disease, Congestive Heart Failure, Chronic Obstructive Pulmonary Disease (COPD), Stroke, Breast cancer, Colorectal cancer, Prostate cancer, and Lung cancer. Severity s has units of deaths per 1,000 beneficiaries per quarter. Hospice share D_c represents the share of beneficiaries in hospice each quarter. Revenue loss $\delta_{R,c}$ is the amount of Medicare spending offset per quarter for each new beneficiary in hospice in that quarter. Bootstrap standard errors are based on 200 condition resamples.

Table 7. Counterfactual Hospice Utilization and Patient Utilities

Outcome	Scenario	Mean	SD	Min	Max
D_c (Hospice Share)	Constrained (Baseline)	0.04	0.02	0.01	0.09
D_c (Hospice Share)	No capacity constraint	0.19	0.17	0.01	0.44
D_c (Hospice Share)	No capacity + no incentives	0.63	0.17	0.41	0.94
Mean Utility, Hospice Users	Constrained (Baseline)	36.60	9.50	26.76	56.31
Mean Utility, Hospice Users	No capacity constraint	29.68	11.29	11.36	47.55
Mean Utility, Hospice Users	No capacity + no incentives	13.63	4.73	8.62	24.80
Total Utility	Constrained (Baseline)	1.38	1.14	0.40	4.49
Total Utility	No capacity constraint	4.28	4.08	0.32	13.57
Total Utility	No capacity + no incentives	8.92	5.28	3.51	23.37
$\tilde{s}_c$ (Observed Threshold)	Constrained (Baseline)	128.70	26.36	100.78	180.82
$\tilde{s}_c$ (Observed Threshold)	No capacity constraint	100.47	37.10	38.74	147.20
$\tilde{s}_c$ (Observed Threshold)	No capacity + no incentives	26.06	0.00	26.06	26.06

Notes:This table reports summary statistics from counterfactual simulations of the hospice entry model under three policy scenarios. Outcomes include the hospice participation share (D_c), mean utility among hospice users, total utility across all patients, and the estimated severity threshold $\tilde{s}_c$. Each cell reports the mean, standard deviation, minimum, and maximum across chronic conditions. Utilities are measured in normalized units and exclude $\delta_{R,c}$ to reflect only nonfinancial components of physician decisionmaking ($\beta_0 + \omega s$).

Online Appendix

A Construction of MDS Outcomes

Information on care and clinical outcomes for nursing home residents comes from the Minimum Data Set (MDS) [Centers for Medicare & Medicaid Services, 1999, 2010]. The MDS is a screening survey that assesses the health status of residents in Medicare and Medicaid certified nursing homes. Assessments are conducted on admission, discharge, or when there is a significant change in health status as well as annually and quarterly. We only include scheduled assessments: admission, annual, and quarterly. We use MDS data from 1999 through 2019. In October of 2010, the assessment transitioned from MDS 2.0 to MDS 3.0; some assessment measures were updated at this time. In these cases, we harmonize the survey question(s) to allow us to use all of the years of the data.

A.1 Variable definitions and harmonization

Feeding tube use: The assessment records a binary variable for whether the patient has any recorded presence of any type of tube that can deliver nutrition, fluids, or medications directly into the gastrointestinal system (e.g., nasogastric tubes, gastronomy tubes, PEG tubes, etc.) in the previous 7 days.
Catheter use: The assessment records a binary variable for whether the patient has any use of an indwelling catheter (i.e., a catheter maintained within the bladder for the purpose of continuous drainage) over the past 14 (MDS 2.0) or 7 (MDS 3.0) days.
Trunk restraint: Trunk restraints include any manual method, device, or equipment attached or adjacent to the patient's body such that the resident cannot easily remove that restricts movement or access to his or her body. The assessment records one of the following values based on frequency of use over the previous 7 days, coded as follows: 0 (trunk restraints not used), 1 (used less than daily), or 2 (used daily).
Therapies: For each of the following types of therapy provided by a licensed provider, the assessment records (1) the number of days on which the patient received 15 minutes or more of therapy out of the previous 7 days and (2) the number of minutes of therapy the patient received. In MDS 3.0, the latter is further disaggregated by mutually exclusive setting (e.g., individual therapy, group therapy, etc.); we take the sum of minutes across therapy settings to harmonize the data across MDS 2.0 and 3.0. We analyzed the following types of therapy:

- Speech therapy: services address swallowing disorders (dysphagia) through assessment and interventions such as oral–motor strengthening, compensatory strategies, and therapeutic exercises to improve safety and efficiency of oral intake. Services may also include management of communication and cognitive-communication disorders when present.

- Respiratory therapy: services for the assessment, treatment, or monitoring of patients with pulmonary function difficulties including coughing, deep breathing, heated nebulizers, mechanical ventilation, etc.

- Physical therapy: diagnostic and management services to address movement dysfunction such as therapeutic exercise, functional training, assistive and adaptive devices, etc.
- Occupational therapy: interventions intended to address deficits in physical, cognitive, psychosocial, sensory, and other aspects of performance relevant to functioning in everyday life.
- Psychological therapy: treatment of mental and emotional disorders using psychological techniques.

Drug use: For each of hypnotics, antidepressants, anxiolytics, antipsychotics, and diuretics, the assessment records how many out of the previous 7 days the patient received any amount of the relevant drug type. In the MDS 2.0 version, this includes days prior to admission for assessments conducted less than a week after admission. In the MDS 3.0, days prior to admission are excluded.
ADLs: For each of the following activities of daily living (ADLs), the assessment records two versions: one to reflect self-performance and another reflecting supported performance. For both measures, higher values reflect worse performance (more assistance required). For self-performance, individuals receive a numeric score of 0 (independent), 1 (with supervision such as encouragement or cueing), 2 (limited assistance including guiding or non-weight-bearing assistance), 3 (extensive assistance including weight-bearing support), or 4 (total dependence) based on the highest level of assistance required 3 or more times over the previous week. For the supported version of the outcomes, the codes are 0 (no help or oversight), 1 (setup help only), 2 (one person assists), or 3 (two or more people assist). There are also codes for the activity occurring fewer than 3 times, which we treat as missing values.

- Bed mobility: performance in moving to or from a lying position, turning side to side and positioning self in bed
- Transfer: performance moving between surfaces or planes
- Walking in room: walking in own room, with or without assistive devices.
- Walking in corridor: walking in corridor of facility, with or without assistive devices
- Locomotion on unit: mobility within facility
- Locomotion off unit: mobility outside of facility
- Eating: how the resident eats and drinks, excluding medication pass but including nourishment by means like tube feeding or IV fluids.
- Toileting: how the resident uses the toilet room, commode, bedpan, or urinal including transfers, self-cleansing, management of catheter, etc.
- Personal hygiene: maintenance of personal hygiene including combing hair, brushing teeth, shaving, etc. excluding bathing and showering.
- Bathing: how the resident takes a full-body bath, shower, or sponge bath and transfers in or out of tub/shower.

Falls: The assessment records information about falls in the previous month and in the previous 2-6 months.[5] For each outcome, we use a binary indicator for having any fall in the specified time window (last 30 days or last 31-180 days). We also use another fall-related outcome: a binary indicator for having a fracture related to a fall in the previous 6 months.

Pressure ulcers: The assessment records whether the patient has any unhealed pressure ulcers. The MDS 2.0 asks about how many unhealed pressure ulcers the patient has at each stage, ranging from stage 1 through stage 4. The MDS 3.0 first asks about whether the patient has any unhealed pressure ulcers and then if so, records how many are at each stage. We take this information and generate two outcomes: a binary indicator for any unhealed pressure ulcers and a numeric outcome indicating the worst (highest) stage.

Incontinence: Bowel and urinary incontinence are reported separately. MDS 2.0 categorizes continence into the following groups: 0 (always continent), 1 (usually continent), 2 (occasionally incontinent), 3 (frequently incontinent), and 4 (always incontinent). The MDS 3.0 uses different categories: 0 (always continent), 1 (occasionally incontinent), 2 (frequently incontinent), and 3 (always incontinent). To harmonize the two versions, we recode the MDS 2.0 categories to pool groups 1 and 2 into group 1, then decrement the categories that were originally encoded 3 and 4 by one. Our harmonized variables are coded as follows: 0 (always continent), 1 (occasionally incontinent), 2 (frequently incontinent), 3 (always incontinent).

Weight changes: The assessment records binary indicators for whether the patient has gain or lost significant amounts of weight, where significant is defined as a change of 5% or more in the last month or 10% or more in the last 6 months.

Pain: Both versions of the MDS ask about frequency of pain and intensity of worst pain. However, the MDS 2.0 asks about pain over the previous 7 days while the MDS 3.0 asks about previous 5 days.

Pain Frequency: MDS 2.0 and 3.0 differ in how they categorize pain frequency. MDS 2.0 uses a 3-point scale (never, less than daily, daily) while MDS 3.0 asks on a 4-point scale (rarely, occasionally, frequently, almost constant), with a separate binary question about any pain at all. We rescale the MDS 2.0 frequency measure to 4-point scale, such that the final frequency outcome is a 5-point scale with higher values indicating more frequent pain: 0 (never), 1 (rarely), 2 (occasionally), 3 (less than daily/frequently), 4 (daily/almost constant) . We also construct a binary indicator for experiencing any pain in the previous 7 days in MDS 2.0 and 5 days in MDS 3.0.

Pain Intensity: For pain intensity, MDS 2.0 uses a 3-point scale (mild, moderate, horrible/excruciating). MDS 3.0 records either a 4-point scale (mild, moderate, severe, very severe/horrible) or integer values 0-10. For MDS 3.0, we recast the 0-10 intensity scale to match the distribution of the pain intensity score from MDS 2.0. Our final harmonized scale takes the following values: 1 (mild/[0-4]), 2 (moderate/[5-8]), 3 (severe/[9]), 4 (horrible/excruciating/[10]).

Mood: Mood-related questions differ between assessment versions. First, the MDS 2.0 asks about previous 30 days while MDS 3.0 asks about previous 2 weeks. The MDS 3.0 uses questions from the PHQ9, a validated screening tool [Kroenke et al., 2001], where individual questions measure symptom frequency: 0 ($\leq$ 1 day) to 3 (almost every day). We take the sum of the 9 questions comprising the PHQ9 for a score ranging from 0 to 27.

[5] The MDS 3.0 asks about 1 month and 2-6 months. The MDS 2.0 version asks specifically about previous 30 days and previous 31-180 days.

The MDS 2.0 also measures symptom frequency (from 0 to 2); however, it predated the creation of the PHQ9 and thus asks different mood-related questions. For MDS 2.0, we generate a numeric score equal to the sum of the 12 mood-related questions reported in Table 3 of Burrows et al. [2000]. This score ranges from 0 to 24. Finally, to harmonize between MDS 2.0 and 3.0, we transformed the numeric scores to z-scores within each year. We use patients' self reported data unless it's unavailable, in which case we use the staff reports.

Memory: In the MDS 3.0, we use memory interview questions from items C0200, C0300, and C0400, which reflect immediate word recall, temporal orientation (year, month, day), and short term word recall, respectively. If the patient is unable to perform this interview, staff assess whether the resident was able to normally recall the current season, location of their own room, staff names/faces, and that they are in a nursing home. From MDS 2.0, only these staff reports are available (item B3, recall of current season, location of their own room, staff names/faces, and that they are in a nursing home). For both MDS 2.0 and 3.0, we take the sum of scores across individual questions, where higher scores represent better recall. We convert sums to z-scores using the mean and standard deviation within each year and interview type.

Inattention: Cognitive outcomes included inattention (item B5a in MDS 2.0, C1310B in MDS 3.0), disorganized thinking (B5c and C1310C), and level of consciousness/lethargy (B5E and D1310D). These are worded similarly between MDS 2.0 and 3.0. MDS 2.0 encodes each behavior as: 0 (not present), 1 (present but not of recent onset), or 3 (present and a recent change from usual functioning). MDS 3.0 encodes the behavior as: 0 (not present), 1 (continuously present), or 2 (present but fluctuating). We recode both versions to be binary by pooling the second and third categories within each outcome.

Dialysis: Both MDS 2.0 and 3.0 include binary outcomes indicating whether the patient has received any dialysis treatment in the previous 14 days.

IV Medications: Both MDS 2.0 and 3.0 include binary outcomes indicating whether the patient has received any IV medications in the previous 14 days.

B Matching

This section describes our algorithm for matching control and treatment counties.

We computed the following distance statistics for the trends and levels in the number of pre-period beneficiaries in the treatment and control counties:

1. Levels: denoting the treated and control group preperiod beneficiary counts as n_t and n_c, respectively, we defined:

$$n_{dist} \equiv \frac{|n_t - n_c|}{\frac{1}{2}(n_t + n_c)},$$

2. Slopes: denoting the growth rate in the number of beneficiaries as g_t and g_c for the treated and control groups respectively, we defined:

$$g_{dist} \equiv \frac{|g_t - g_c|}{\frac{1}{2}(g_t + g_c)},$$

We then required that control counties satisfy the following requirements:

1. The control county cannot share a border with the treatment county

2. The number of beneficiaries in the treatment and control groups must be similar enough, such that $n_{dist} < 1$.[6]

Among the resulting candidate treatment-control county pairs, we standardized n_{dist} and g_{dist} to have mean 0 and standard deviation 1, and then chose the two control counties per treated county with the lowest sum $d \equiv n_{dist} + g_{dist}$, with the constraint that d is less than the 95th percentile.

C Details on the Model Estimation

To take our model to the data, we make the parametric assumption that physician signal is normally distributed within condition:

$$s \sim \mathcal{N}(\mu_{s,c}, \sigma^2_{s,c}).$$

We use condition-level mortality rate per beneficiary-quarter as our severity signal measure to anchor the scale of s and recover $(\mu_{s,c}, \sigma^2_{s,c})$. Let $\tilde{s}_c$ denote the realized cutoff with capacity in condition c. The hospice participation share and marginal density at the threshold are

$$D_c = 1 - \Phi\big(\tilde{s}_c; \mu_{s,c}, \sigma^2_{s,c}\big), \tag{4}$$

$$g_{s,c} = \varphi\big(\tilde{s}_c; \mu_{s,c}, \sigma^2_{s,c}\big), \tag{5}$$

where Φ and φ are the normal CDF and PDF. Empirically, D_c is the beneficiary-quarter hospice rate; $g_{s,c}$ is identified from the first-stage change in D_c when capacity expands (e.g., new facility entry).

To connect Equation 2 to observables, we impose an affine approximation to expected hospice benefit:

$$E[\Delta U_P(\theta) \mid s] = U_0 + \lambda s, \quad \lambda > 0.$$

Define $\beta_0 \equiv wU_0$ and $\omega \equiv w\lambda$. Let $\delta_{R,c}$ denote the condition-specific revenue differential ΔR. The implied (unconstrained) cutoff and realized cutoff are

$$s^*_c = \frac{\delta_{R,c} - \beta_0}{\omega}, \qquad \tilde{s}_c = \frac{\delta_{R,c} - \beta_0}{\omega} + \kappa_c. \tag{6}$$

Parameter ω is the *dollar* value physicians place on the utility of hospice for a marginally more severe patient, directly comparable to $\delta_{R,c}$; β_0 is the dollar value of hospice for an individual with zero severity; κ_c captures the tightness of the capacity constraint (in severity units, i.e., quarterly mortality per 1,000 beneficiaries).

Estimation. For each c: we observe $D_c, g_{s,c}, \mu_{s,c}$, and $\delta_{R,c}$ in the data as the baseline share of beneficiaries using hospice each quarter, the first-stage change in hospice use after hospice facility entry, the quarterly mortality rate per 1,000 beneficiaries, and the change

[6] This is mathematically equivalent to the requirement that the larger of the two counties is less than 50% larger than the smaller county.

in non-hospice, non-prescription drug Medicare spending per new beneficiary on hospice, respectively. We recover $(\tilde{s}_c, \sigma^2_{s,c})$ by matching observed and model-implied values for Equations (4) and (5), using just-identified General Method of Moments (GMM). With the condition-specific parameter estimates in hand, we then use moment inequalities to recover (β_0, ω).

The first inequality is a lower bound on the value of the threshold $\tilde{s}_c$, which follows from (6) and $\kappa_c \geq 0$:

$$\tilde{s}_c \geq \frac{\delta_{R,cc} - \beta_0}{\omega}. \tag{7}$$

Substituting this lower bound on $\tilde{s}_c$ into (4) for hospice participation and noting that $\Phi(\cdot)$ is strictly increasing, we arrive at an upper bound on the predicted hospice share:

$$D_c \leq 1 - \Phi\left(\frac{\delta_{R,c} - \beta_0}{\omega};\, \mu_{s,c}, \sigma^2_{s,c}\right). \tag{8}$$

Equivalently, applying the inverse normal CDF and rearranging gives

$$\beta_0 \leq \delta_{R,c} - \omega\, \Phi^{-1}\big(1 - D_c;\, \mu_{s,c}, \sigma^2_{s,c}\big), \tag{9}$$

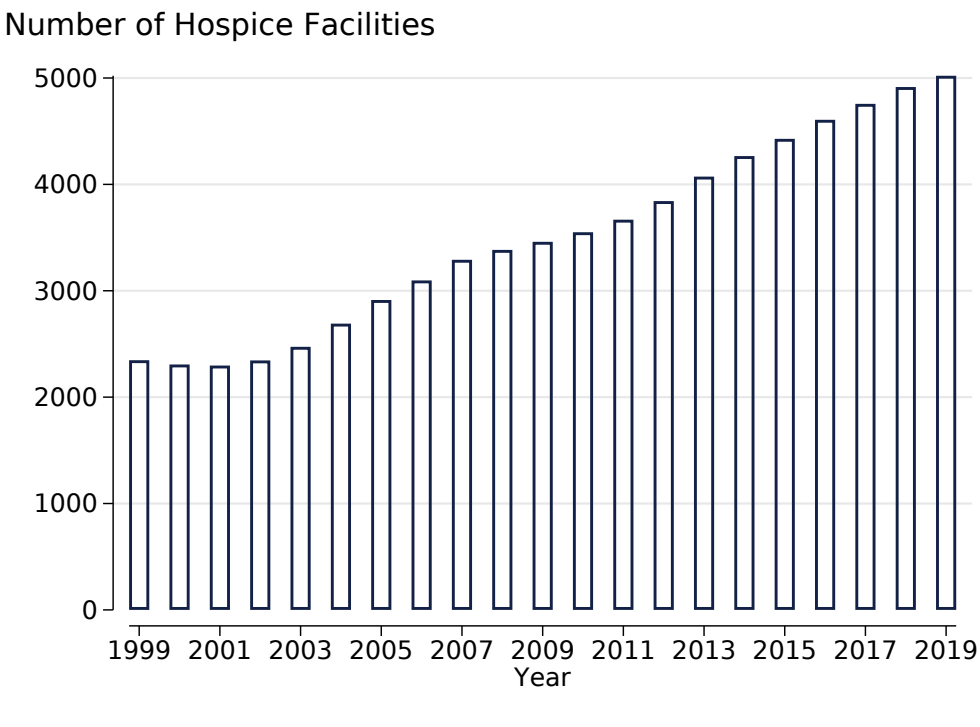
which shows that, for any given physician weight ω, the observed hospice share D_c places an *upper bound* on the baseline hospice utility β_0. These equations define a set of two moment inequalities per condition:

$$\begin{aligned} m_c^{(1)}(\beta_0, \omega) &= \tilde{s}_c - \frac{\delta_{R,c} - \beta_0}{\omega} \geq 0, \\ m_c^{(2)}(\beta_0, \omega) &= \delta_{R,c} - \omega\, \Phi^{-1}\big(1 - D_c;\, \mu_{s,c}, \sigma^2_{s,c}\big) - \beta_0 \geq 0, \end{aligned} \qquad \forall c. \tag{10}$$

For each c, the realized cutoff yields a lower bound on β_0 (given ω), while the observed share yields an upper bound. The identified set for (β_0, ω) comprises all pairs satisfying these inequalities across conditions. Given $(\hat{\beta}_0, \hat{\omega})$, we back out κ_c from (3). Inference uses a numerical Hessian and condition-level bootstrap.

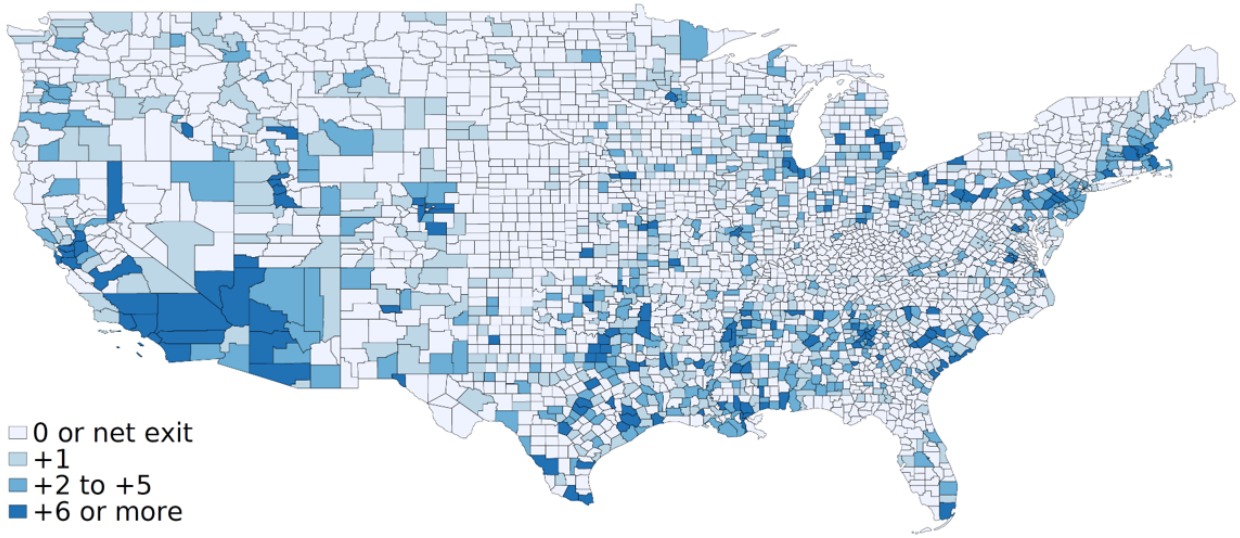
D Appendix Figures and Tables

Figure A1. Number of hospice facilities over time



Note: This figure shows the total number of active Medicare-certified hospice providers in the United States from 1999 to 2019. Data are drawn from the CMS Provider of Services (POS) file.

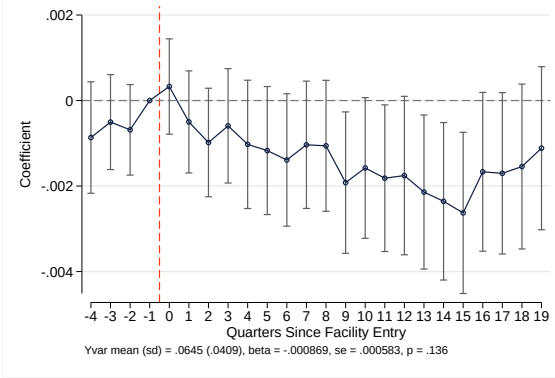
Figure A2. Change in the number of hospice facilities between 1999 and 2019



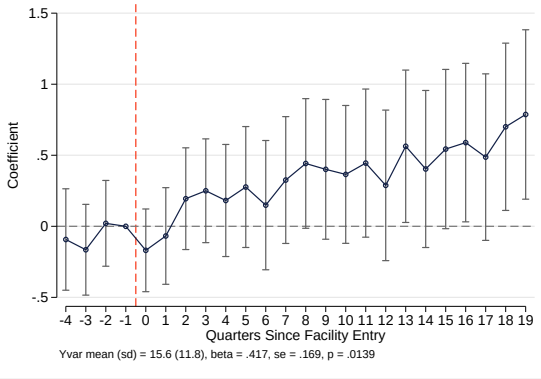
Note: This map shows net change in the number of Medicare-certified hospice facilities by county over the period 1999–2019. Counties are shaded based on the total net increase in facilities during the period. Data shown are from the CMS Provider of Services (POS) file.

Figure A3. Event Study: Interventions Affecting Patient Comfort.

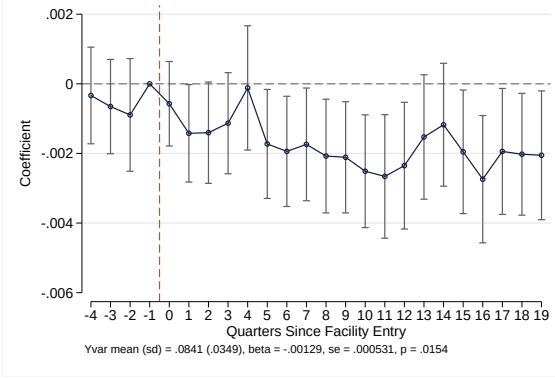
(a) Feeding Tube



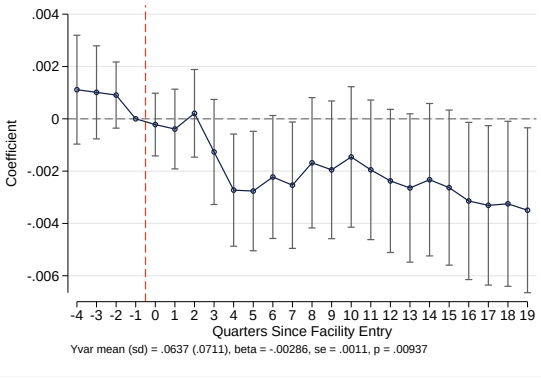
(b) Speech Therapy (Swallowing)



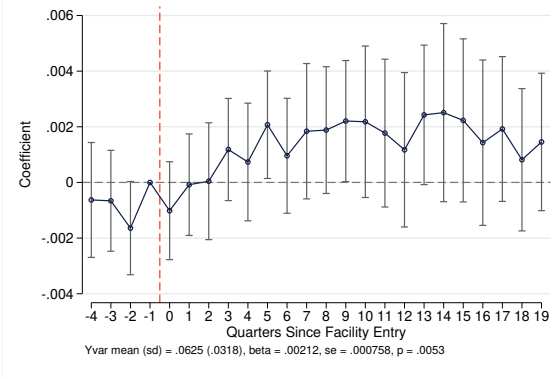
(c) Catheter



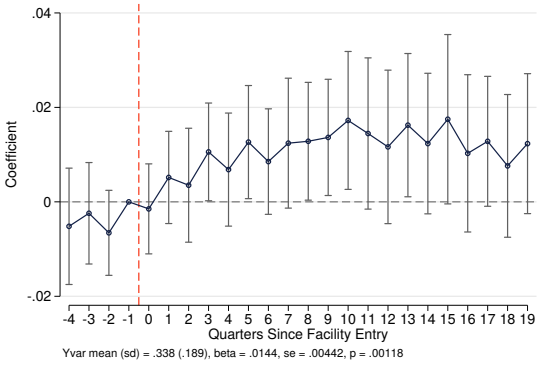
(d) Trunk Restraint



(e) Hypnotic Use (any)

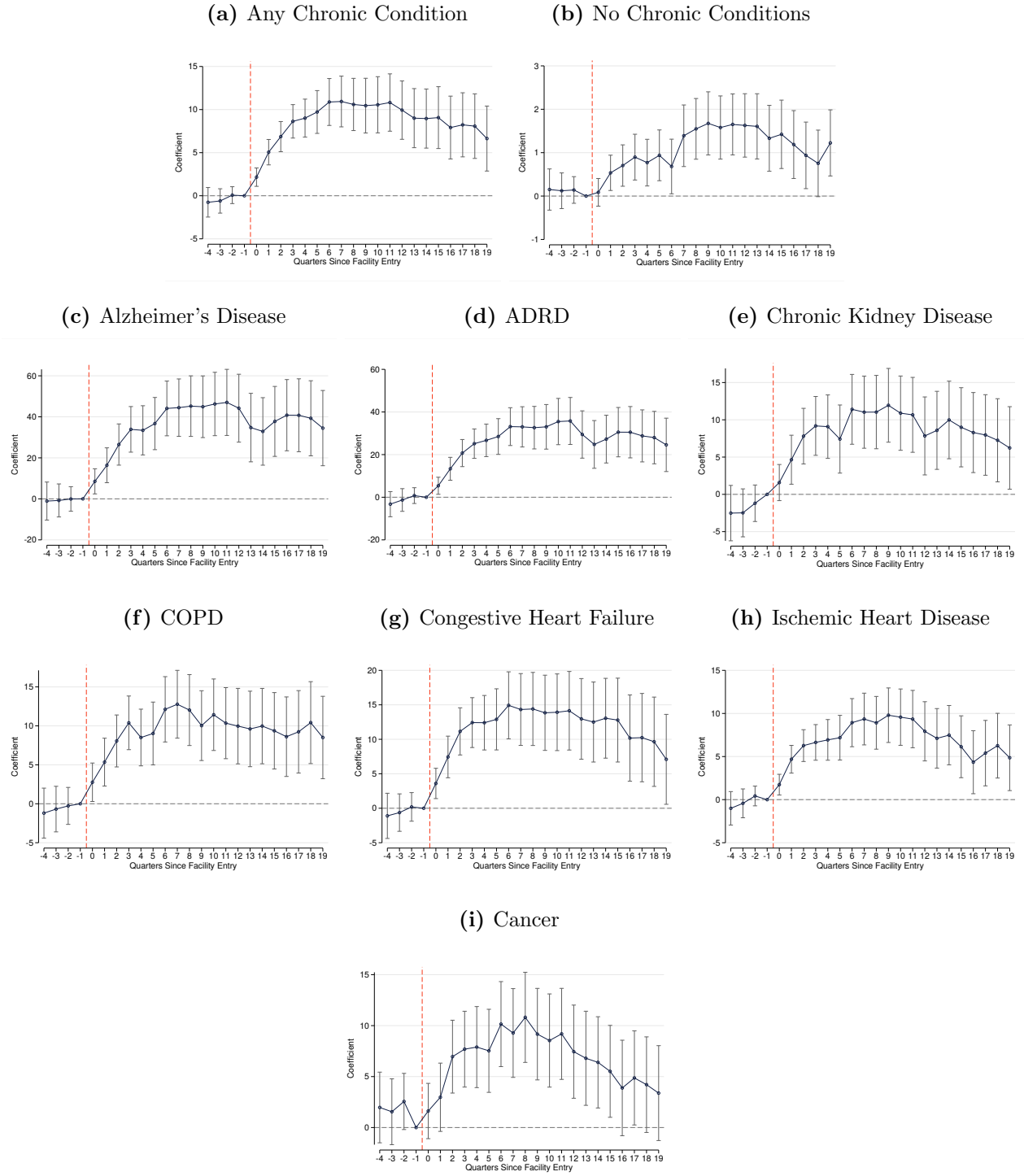


(f) Hypnotic Use (days)



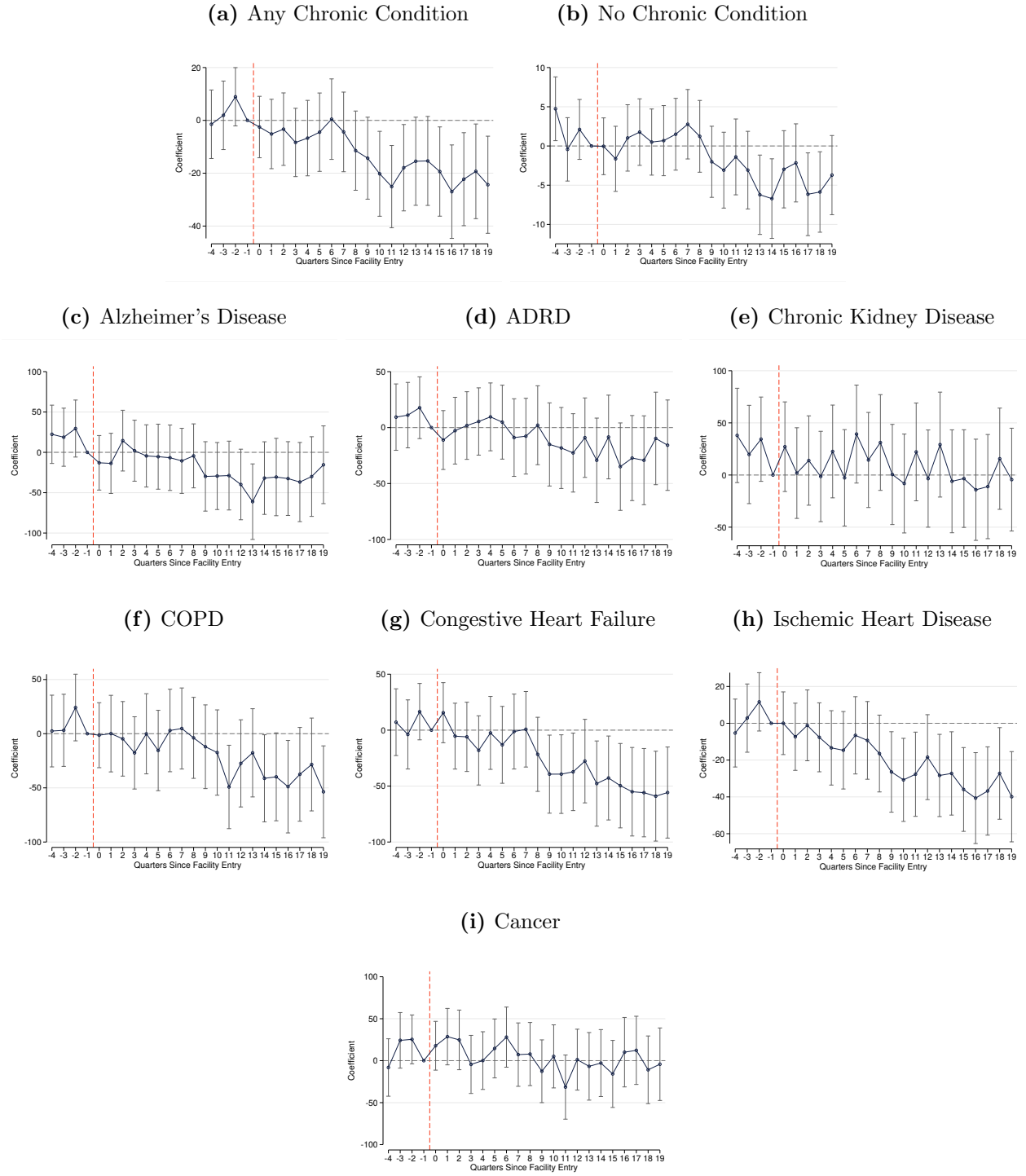
Note: This figure presents estimated effects of hospice facility entry on the use of interventions relevant to patient comfort: (a) feeding tubes, (b) speech therapy for swallowing, (c) catheters, (d) trunk restraints, (e-f) use of hypnotic medications. Estimates are from a stacked difference-in-differences event study design using 1,518 hospice facility entries. Each event defines a separate experiment with one treated county and up to two control counties matched on pre-entry Medicare beneficiary counts and trends. The outcome is modeled at the county-experiment-quarter level with county-by-experiment and experiment-by-time fixed effects. Coefficients represent differential changes in treated counties relative to matched controls, normalized to zero in the quarter prior to entry ($k = -1$). Vertical red dashed lines denote the timing of facility entry. Standard errors, clustered at the county level, are shown as 95% confidence intervals.

Figure A4. Event Study: Hospice Spending by Chronic Condition Subgroup.



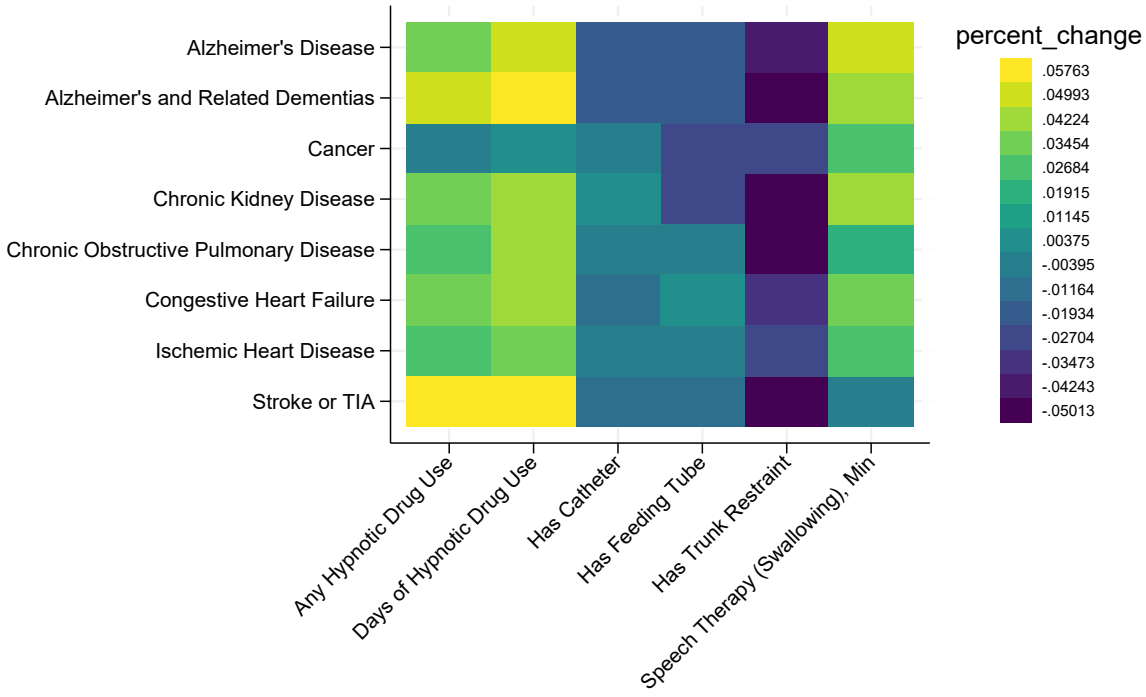
Note: This figure displays estimated effects of hospice facility entry on hospice spending per beneficiary-quarter, stratified by chronic condition subgroup. Estimates are obtained using a stacked difference-in-differences event study framework. Each panel shows coefficients from regressions with experiment-by-county and experiment-by-time fixed effects, normalized to zero in the quarter prior to entry ($k = -1$). Vertical red dashed lines denote the quarter of hospice facility entry. Standard errors, clustered at the county level, are shown as 95% confidence intervals.

Figure A5. Event Study: Total Spending by Chronic Condition Subgroup.



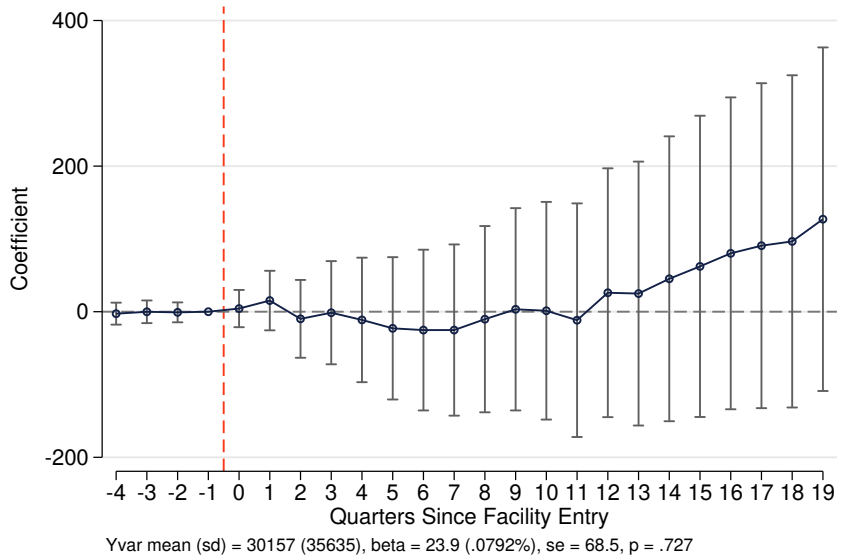
Note: This figure displays estimated effects of hospice facility entry on total non-Part D Medicare spending per beneficiary-quarter, stratified by chronic condition subgroup. Estimates are obtained using a stacked difference-in-differences event study framework. Each panel shows coefficients from regressions with experiment-by-county and experiment-by-time fixed effects, normalized to zero in the quarter prior to entry ($k = -1$). Vertical red dashed lines denote the quarter of hospice facility entry. Standard errors, clustered at the county level, are shown as 95% confidence intervals.

Figure A6. Event Study: Change in Interventions and Patient Comfort by Chronic Condition Subgroup.



Note: This figure reports regression coefficients as percent changes relative to baseline means, by chronic condition subgroup and by measures of intervention and patient comfort. Estimates are based on a stacked difference-in-differences design with experiment-by-county and experiment-by-time fixed effects. The heatmap shows that for each measure (column), the changes appear similar across chronic conditions.

Figure A7. Event Study: Number of Beneficiaries per County



Note: This figure displays event study estimates for the number of beneficiaries per county over time relative to hospice facility entry. Coefficients are estimated using a stacked difference-in-differences framework with experiment-by-county and experiment-by-time fixed effects. The omitted reference period is the quarter immediately prior to facility entry ($k = -1$). The vertical red dashed line marks the quarter of entry. Confidence intervals reflect standard errors clustered at the county level. Stable pre-trends and lack of post-entry discontinuity suggest that hospice entry is not associated with changes in underlying population size.

Figure A8. Scatter plots and pairwise correlations between model variables: mean severity ($\mu_{s,c}$), dispersion ($\sigma_{s,c}$), hospice threshold ($\tilde{s}_c$), baseline hospice share (D_c), marginal hospice density ($g_{s,c}$), and provider revenue loss ($\delta_{R,c}$). In each scatterplot, the variable in the column is plotted on the x-axis (independent variable), and the variable in the row is plotted on the y-axis (dependent variable). Linear fits (black lines) are shown for each pair.

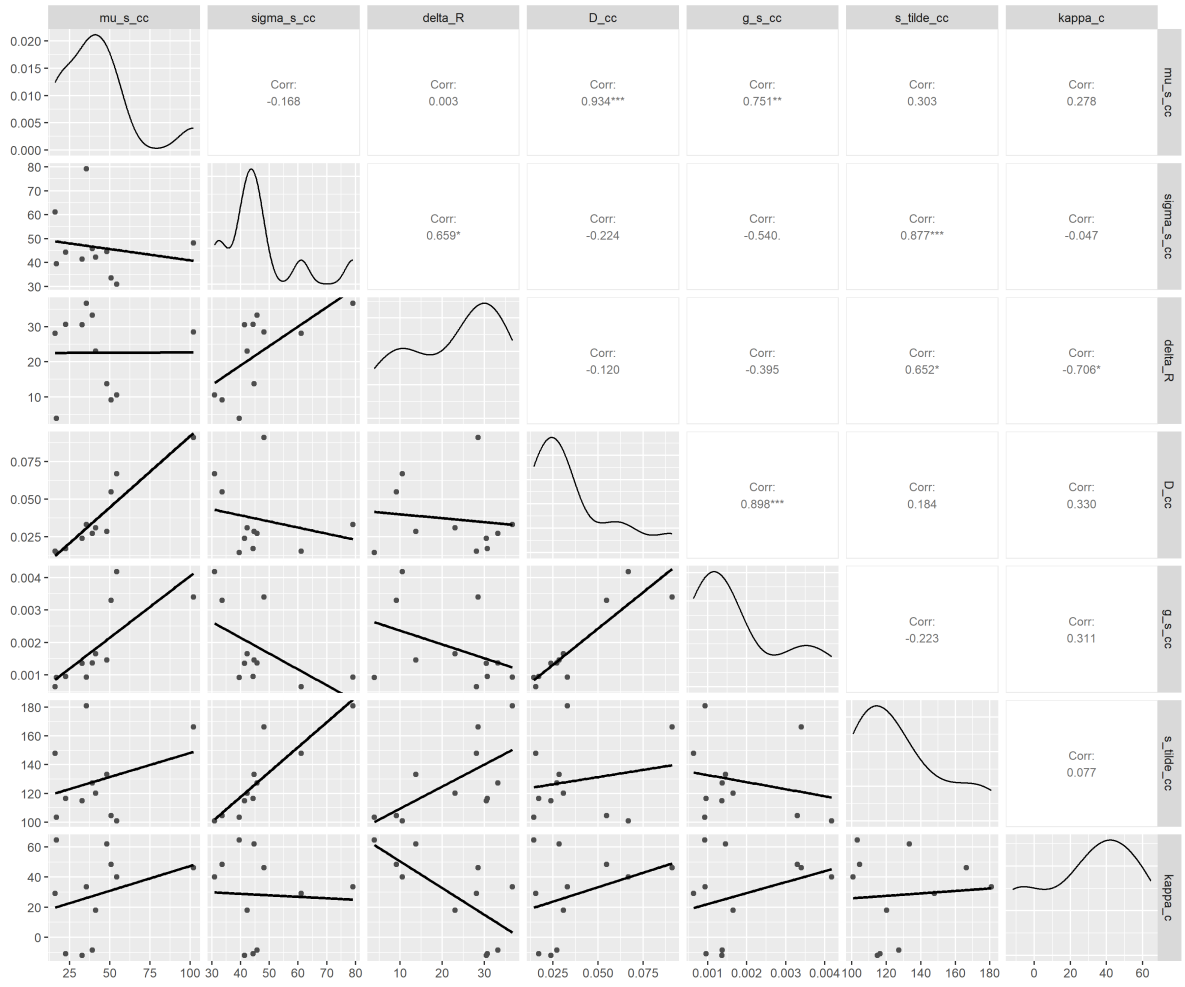


Figure A9. Correlations between capacity constraints and selected model parameters.

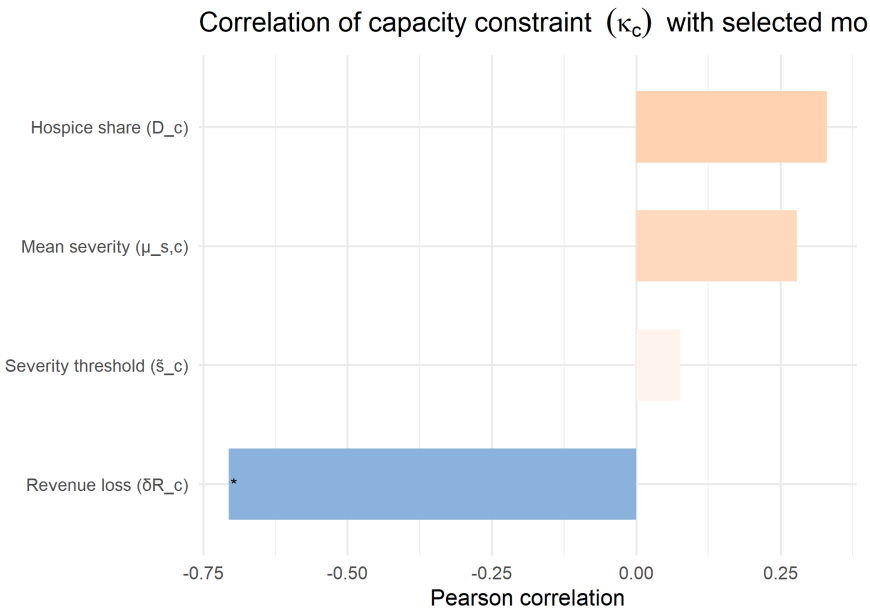


Table A1. Effects of Hospice Entry on Hospice Spending by Chronic Condition

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Overall	60.8	4.34***	7.1%
		(0.62)	
Any Chronic Condition	125	9.00***	7.2%
		(1.22)	
No Chronic Conditions	14.7	1.02***	6.9%
		(0.25)	
Alzheimer's Disease	514	37.10***	7.2%
		(5.63)	
Alzheimer's and Related Dementias	393	28.30***	7.2%
		(3.97)	
Chronic Kidney Disease	161	10.10***	6.3%
		(1.76)	
Chronic Obstructive Pulmonary Disease	141	9.96***	7.1%
		(1.61)	
Congestive Heart Failure	194	12.10***	6.2%
		(2.04)	
Ischemic Heart Disease	106	7.20***	6.8%
		(1.17)	
Stroke or TIA	165	3.36	2.0%
		(2.11)	
Any Cancer	130	5.20***	4.0%
		(1.36)	
Breast Cancer	88	1.77	2.0%
		(1.31)	
Colorectal Cancer	179	1.27	0.7%
		(2.55)	
Prostate Cancer	76.2	1.31	1.7%
		(1.31)	
Lung Cancer	432	5.44	1.3%
		(4.80)	
Endometrial Cancer	136	1.77	1.3%
		(5.82)	

Notes: This table reports average treatment effects of hospice facility entry on hospice spending per beneficiary-quarter, estimated using event study regressions stratified by chronic condition and cancer type. Column 2 shows the estimated average post-entry change. Standard errors are clustered at the county level. $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table A2. Changes in Mortality by Chronic Condition

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Mortality (per 1000 beneficiaries per quarter)			
Overall Mortality	11.6	−0.017	-0.15%
		(0.023)	
Any Chronic Condition	23.1	−0.044	-0.19%
		(0.051)	
No Chronic Conditions	3.22	0.0017	0.05%
		(0.015)	
Alzheimer's Disease	54.3	−0.33	-0.61%
		(0.25)	
Alzheimer's and Related Dementias	50.8	−0.22	-0.43%
		(0.17)	
Chronic Kidney Disease	48.3	−0.11	-0.22%
		(0.18)	
Chronic Obstructive Pulmonary Disease (COPD)	32.9	−0.030	-0.091%
		(0.12)	
Congestive Heart Failure	41.2	−0.19	-0.47%
		(0.11)	
Ischemic Heart Disease	22.6	0.029	0.13%
		(0.064)	
Stroke or TIA	39.2	−0.33	-0.84%
		(0.21)	
Cancer	27.9	0.079	0.28%
		(0.13)	
Breast cancer	16.0	0.07	0.42%
		(0.18)	
Colorectal cancer	35.5	−0.18	-0.50%
		(0.36)	
Prostate cancer	16.8	0.21	1.26%
		(0.16)	
Lung cancer	102.0	0.14	0.14%
		(0.70)	
Endometrial cancer	27.0	−0.30	-1.12%
		(0.77)	

Notes: This table reports estimates from event study regressions evaluating the effects of hospice facility entry on mortality, measured as the number of quarterly deaths per 1,000 beneficiaries in each county, separately by chronic condition. Column (1) reports the pre-entry sample mean of the outcome in the treatment county. Column (2) reports the estimated average change in the outcome in the five years after hospice facility entry. Column (3) expresses the estimate as a percent change relative to the pre-entry mean. Standard errors, clustered at the county level, are reported in parentheses.
$^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.

Table A3. Effects of Hospice Entry on Total Spending Excluding Part D and Hospice, by Chronic Condition

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Overall	1588	-8.84***	-0.6%
		(2.49)	
Any Chronic Condition	2954	-15.70**	-0.5%
		(4.98)	
No Chronic Condition	591	-3.39**	-0.6%
		(1.35)	
Alzheimer's Disease	3366	-38.00***	-1.1%
		(11.60)	
Alzheimer's and Related Dementias	3663	-20.90*	-0.6%
		(9.78)	
Chronic Kidney Disease	5882	-14.90	-0.3%
		(14.80)	
Chronic Obstructive Pulmonary Disease	4606	-27.90**	-0.6%
		(10.80)	
Congestive Heart Failure	4694	-33.00***	-0.7%
		(10.20)	
Ischemic Heart Disease	3271	-23.10***	-0.7%
		(6.53)	
Any Cancer	3712	-6.93	-0.2%
		(11.00)	

Notes: This table reports estimates from event study regressions evaluating the effects of hospice facility entry on total Medicare non-hospice, non-Part D spending per beneficiary-quarter, stratified by chronic condition. Column 2 presents the average treatment effect in the five years following entry. Standard errors are clustered at the county level.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table A4. Changes in Mental Health Outcomes Following Hospice Facility Entry

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Mental Health and Cognitive Outcomes			
Pain (Any)	0.40	-0.0008	-0.20%
		(0.002)	
Pain (Numeric Scale)	0.03	-0.00001	-0.03%
		(0.003)	
Pain (Frequency)	1.0	-0.001	-0.10%
		(0.003)	
Mood Score (higher = worse)	0.64	-0.005	-0.78%
		(0.007)	
Memory Score (higher = better)	0.56	0.002	0.41%
		(0.003)	
Inattention	0.19	0.003	1.8%
		(0.002)	

Notes: This table reports estimates from event study regressions evaluating the effects of hospice facility entry on mental health and cognitive outcomes, averaging over assessments within each beneficiary-quarter. Column (1) reports the pre-entry sample mean of the outcome in the treatment counties. Column (2) reports the average post-entry change in the outcome over the five years following hospice facility entry. Column (3) expresses the estimate as a percent change relative to the outcome mean. Standard errors, clustered at the county level, are shown in parentheses.
$^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.

Table A5. Changes in Use of Medications Following Hospice Entry

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Antidepressants (Share)	0.45	−0.0006	-0.13%
		(0.0015)	
Antidepressants (Days)	3.03	−0.0059	-0.19%
		(0.013)	
Anxiolytics (Share)	0.17	−0.0001	-0.08%
		(0.0013)	
Anxiolytics (Days)	1.02	−0.0026	-0.25%
		(0.007)	
Antipsychotics (Share)	0.24	−0.0004	-0.17%
		(0.0013)	
Antipsychotics (Days)	1.64	0.0035	0.21%
		(0.0086)	
Diuretics (Share)	0.36	−0.0019	-0.53%
		(0.0013)	
Diuretics (Days)	2.55	−0.015	-0.58%
		(0.0092)	
IV Medication (Any)	0.0194	0.0005	2.6%
		(0.0004)	

Notes: This table reports estimates from event study regressions evaluating the effects of hospice facility entry on use of selected medication classes and interventions, as reported in the Minimum Data Set (MDS). Column (1) reports the pre-entry sample mean in the treatment county. Column (2) reports the average change in the five years following hospice facility entry. Column (3) expresses the estimate as a percent change relative to the pre-entry mean. Outcomes are measured either as binary indicators (Share) or average number of days of use (Days). Standard errors, clustered at the county level, are reported in parentheses. None of the estimates in this table are statistically significant at the $p < 0.05$ level.

Table A6. Changes in ADL Support Needs Following Hospice Facility Entry

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
ADL Support Code (0 to 4 scale)			
Bed Mobility	1.68	0.0024	0.14%
		(0.0036)	
Transfer	1.93	−0.0001	-0.01%
		(0.0029)	
Walk in Room	1.33	−0.0013	-0.10%
		(0.0040)	
Walk in Corridor	1.36	0.0017	0.13%
		(0.0038)	
Locomotion On Unit	1.43	−0.0012	-0.08%
		(0.0029)	
Locomotion Off Unit	1.51	−0.0004	-0.03%
		(0.0028)	
Dressing	1.86	0.0030	0.16%
		(0.0020)	
Eating	1.22	0.0052*	0.43%
		(0.0024)	
Toileting	1.75	−0.0029	-0.17%
		(0.0039)	
Personal Hygiene	1.73	−0.0046	-0.27%
		(0.0034)	
Bathing	2.05	−0.0020	-0.10%
		(0.0016)	

Notes: This table reports estimates from event study regressions evaluating the effects of hospice facility entry on support needs for activities of daily living (ADLs), measured as the ADL support code (ranging from 0, independent, to 4, totally dependent on external support) from the MDS. Column (1) reports the pre-entry sample mean of the outcome in the treatment county. Column (2) reports the estimated average change in the outcome in the five years after hospice facility entry. Column (3) expresses the estimate as a percent change relative to the pre-entry mean. Standard errors, clustered at the county level, are reported in parentheses.
$^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.

Table A7. Changes in Physical Health Outcomes Following Hospice Facility Entry

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Fall and Injury Outcomes			
Fracture in Last 6 Months	0.003	0.0001 (0.0001)	3.2%
Fracture in Last 6 Months (excl. admission)	0.0012	0.000002 (0.00007)	0.15%
Fall in Last 30 Days	0.36	0.0013 (0.0014)	0.36%
Fall in Last 31–180 Days	0.15	0.0012 (0.0012)	0.79%
Pressure Ulcers			
Any Pressure Ulcer	0.05	0.0005 (0.0004)	1.0%
Worst Ulcer Stage (1–4)	0.25	0.0007 (0.0013)	0.28%
Continence Outcomes (0–3 scale)			
Bowel Continence	1.29	0.0002 (0.0030)	0.02%
Urinary Continence	1.56	0.0041 (0.0033)	0.26%
Nutrition Outcomes			
Weight Loss	0.09	0.0001 (0.0006)	0.12%
Weight Gain	0.06	-0.0017^{*} (0.0007)	-2.7%

Notes: This table reports estimates from event study regressions evaluating the effects of hospice facility entry on adverse outcomes related to safety and physical health. "Fracture in Last 6 Months" indicates the presence of any fall-related fracture. The version "excluding admission" omits initial assessments to isolate changes over time. "Fall in Last 30 Days" and "Fall in Last 31–180 Days" are indicators of recent and subacute fall history. "Any Pressure Ulcer" measures presence of any ulcer, while "Worst Ulcer Stage" ranges from 0 (no ulcer), 1 (least severe), to 4 (most severe). Bowel and urinary continence scores range from 0 (always continent) to 3 (always incontinent). "Weight Loss" and "Weight Gain" are binary indicators of significant change in body weight since the last assessment. Column (1) reports the pre-entry sample mean of the outcome. Column (2) reports the estimated average change in the outcome in the five years after hospice facility entry. Column (3) expresses the estimate as a percent change relative to the pre-entry mean. Standard errors, clustered at the county level, are reported in parentheses.
$^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.