Dying Better: Hospice Care and the End of Life

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Abstract

End-of-life care represents a major fiscal and social challenge facing aging economies across the globe. We study how expanding hospice services affects public spending and patient well-being near the end of life. Using 1,518 hospice facility openings across U.S. counties between 1999 and 2019, we estimate that increased access to end-of-life hospice care generates a roughly 2-to-1 fiscal return: each new facility increases hospice spending by $4.26 per Medicare beneficiary-quarter (7.1% relative to baseline) but reduces total non-hospice spending by $9.00, primarily through reduced hospitalizations and post-acute care. Patients spend fewer of their final days in institutions, receive less intensive and more comfort-oriented care, and are more likely to die at home as opposed to in an institution. We find no adverse effects on pain, functional status, or mortality. Despite these benefits, hospice utilization varies widely across conditions. A simple framework relating utilization to patient severity, provider incentives, and capacity constraints suggests that relaxing supply-side barriers—particularly capacity constraints—could improve social welfare.

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Across aging societies—from Europe to East Asia to the United States—end-of-life (EOL) care spending has become a growing pressure point for policymakers. (OECD, 2024) People are living longer with complex chronic conditions, the returns to late-life medical care are often uncertain, and the choices families confront are deeply personal. Because governments finance most of the care received in the final years of life, these pressures fall directly on public budgets. In the United States, medical care in the last year of life accounts for up to 25% of Medicare spending (Riley and Lubitz, 2010; French et al., 2017), or over $250 billion annually—more than the federal budgets of SNAP, TANF, and SSI combined.[1]

A substantial share of late-life medical care involves high-intensity, hospital-based treatment, even as clinical benefits are often uncertain. In the final 30 days of life, over half of older Americans are hospitalized and more than one-quarter are treated in an intensive care unit (ICU), despite many reporting that they value comfort and the ability to remain at home (Gomes et al., 2013; Teno et al., 2013). Hospice care emerged in part to address this disconnect, providing palliative services that emphasize symptom management, psychosocial support, and quality of life rather than further curative treatment, typically in patients' homes. Its use has expanded rapidly: more than half of elderly decedents now receive hospice services, up from roughly 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.

[1]Medicare total expenditure was $1,122$ billion in 2024 (Centers for Medicare & Medicaid Services, 2025). SNAP: Supplemental Nutrition Assistance Program; TANF: Temporary Assistance for Needy Families; SSI: Supplemental Security Income. SNAP budget was 100.3 billion in 2024, the federal TANF block grant was 16.5 billion, and SSI was 63 billion. (Congressional Research Service, 2024, U.S. Department of Health and Human Services, 2024, Social Security Administration, 2024)

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 the 40% of hospice patients that reside in a nursing facility,[2] 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.

We find that each additional hospice entry leads to a $4.26 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 (-$9.00). That is, for each additional dollar of hospice spending, Medicare saves nearly two dollars in return. This reduction is driven by reduced inpatient (-$5.29) and skilled nursing facility (-$2.12) 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.

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

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 outline several mechanisms that could generate such variation. One possibility is clinical heterogeneity: when patients face different prognoses or viable curative options, their willingness to enter hospice could reasonably diverge. In this case, variation in take-up would largely reflect efficient differences in disease severity. A second channel is provider financial incentives. Because referring a patient to hospice requires physicians to forgo curative billing opportunities that differ across conditions, hospice may be recommended less often in conditions where referrals entail larger revenue losses. Finally, the discrete jump in hospice use following facility openings points to capacity constraints: even patients and physicians inclined toward hospice may be unable to access it when local availability is limited.

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 chooses 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 patient-group-level data—defined by demographic and clinical profiles—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 11.7% on average, although this

cutoff varies between 6.7% and 17.4% across patient groups. 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 $36,474. We estimate that physicians respond to patient severity, each 0.1 percentage point increase in mortality risk offsets $5,811 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 and 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). The economics literature on hospice care is relatively sparse. Recent work highlights how supply-side incentives shape hospice providers' behavior: providers adjust enrollment as they come close to Medicare's reimbursement cap (Coe and Rosenkranz, 2025), Medicare reimbursement schemes affect provider incentive for quality (Alam, 2025), and ownership structure influences the types of patients hospices serve (Dalton and Bradford, 2019). Most closely related to this paper, 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. We expand this literature by providing, to our knowledge, the first large-scale quasi-experimental evidence on how hospice affects both Medicare spending and patient well-being across a wide range of conditions.[3]

More broadly, this paper contributes to the economics literatures on high medical spending and the fiscal impacts of government policies. This includes work showing that supply-side incentives, practice styles, and the use of intensive, low-value care are central drivers of U.S. health care costs (Finkelstein, Gentzkow and Williams, 2016; Molitor, 2018; Cutler

[3]The medical literature includes several correlational studies on hospice care (Kelley et al., 2013; Obermeyer et al., 2014; Harrison et al., 2022; Shega et al., 2008; Miller, Lima and Mitchell, 2012), but these comparisons are subject to selection bias, as patients choosing hospice may differ in unobserved ways from those pursuing more intensive treatment. A randomized trial of palliative care for metastatic lung cancer showed improvements in quality of life, mood, and survival (Temel et al., 2010), but this model integrated palliative support with ongoing curative treatment, whereas Medicare requires hospice enrollees to forgo such care. Our study provides national quasi-experimental evidence on hospice's effects under current Medicare rules.

et al., 2019; Clemens and Gottlieb, 2014) and that many Medicare-finance services deliver limited marginal benefits at very high costs (Doyle Jr, Graves and Gruber, 2017; Einav, Finkelstein and Mahoney, 2023). Building on this prior work, we show that provider incentives contribute to the underutilization of this cost-saving service. On government policies more generally, prior work has shown that a small subset pay for themselves; of these, most are childhood education and health interventions that recoup their expenditures via higher net taxes collected (Hendren and Sprung-Keyser, 2020). Against this backdrop, hospice expansion provides a rare example of a health care service for the elderly that delivers improvements in patient experience while also reducing net public expenditures.

The rest of the paper proceeds as follows. Section 1 introduces the setting. Section 2 describes our data and sample. Section 3 describes our empirical strategy. Section 4 presents our 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 (Medicare Payment Advisory Commission, 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 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 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 focus on FFS beneficiaries in our baseline analysis and find similar results when including MA.

We conduct subgroup analyses by chronic condition, including Alzheimer's, 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. 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 30 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 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 $2390.69, of which $60.04 (2.5%) was attributable to hospice care. Inpatient spending was the largest component, averaging $752.95 per quarter, followed by physician services ($469.40), outpatient care ($254.69), and skilled nursing facility services ($128.99). Home health and prescription drug spending averaged $116.18 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 for which we observe at least one year prior and four years after the entry, 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 outcomes 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 experi-

ment 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 each county-quarter. 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. As a robustness check, in Figure A4 we replicate the first stage figure requiring a longer pre-period of 8 quarters without entry. This longer pre-period restriction reduces the number of experiments we analyze from 1,518 to 1,147. We find similar and if anything marginally larger effects.

Table 3 reports the difference-in-differences estimates corresponding to Figure 1. In our baseline specification, hospice spending increases by \$4.26 per beneficiary-quarter relative to a pre-entry mean of \$60.0, corresponding to a 7.1% increase (SE = 0.62, $p < 0.001$).

Table A2 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 (\$37.40 per beneficiary-quarter) and the broader category of Alzheimer's disease and related dementias (\$28.10). Chronic kidney disease, chronic obstructive pulmonary disease (COPD), congestive heart failure, ischemic heart disease, and stroke/transient ischemic attack (TIA) each show \$7–\$13 gains, again around 6–8 percent of baseline. In contrast, cancer patients see a smaller first-stage effect (5.1%) with additional variation once broken down by cancer type, with in-

significant results for the rarest cancers we study possibly due to limited power in the smaller samples. 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.

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 $9.00, relative to a baseline of $1,712 per beneficiary-quarter. That is, an additional hospice facility entry is associated with a 0.53% reduction in Medicare spending in that county. For each dollar of additional hospice spending, total Medicare spending (excluding hospice) declines by $9.00/$4.26 = $2.11.

Figure A8 and Table A4 show heterogeneity in the effects of hospice facility entry on total spending, stratified by chronic condition subgroup. Across nearly 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 ($38.40), Congestive Heart Failure ($33.0), and stroke/TIA ($47.60). Patients with COPD, and ischemic heart disease also experience sizable average spending reductions of $26.50, and $22.50, 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 strokes/TIA saw the largest substitution effect: for every additional dollar spent on hospice care, total non-hospice spending declined by $47.60/$9.71=$4.90. Patients with ischemic heart disease,

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 $5.29 per beneficiary-quarter, relative to a baseline of $753, 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 $1.24 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 $2.12 per beneficiary-quarter (SE = 0.59, $p < 0.001$), relative to a baseline of $129, corresponding to a 1.6% decline. Considered in the context of our first-stage estimates, each additional dollar in hospice spending corresponds to a $0.50 reduction in SNF spending. Since Medicare requires an inpatient stay prior to admission by a SNF, reduced inpatient use likely contributed to the 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, -1.67, and -0.57 per beneficiary-quarter, respectively——are statistically insignificant and economically small relative to the pre-period means of $255, $469, and $116.

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 A10).

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 A3 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 A3), 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, Malani and Vitale, 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 visible decline in the probability that a resident has a feeding tube in place (Figure A6a). 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 A6).

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 A9) or toileting scores (Appendix Table A8), 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 A6d, 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 4.5% 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 A6e-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 A7). 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.

In contrast with the heterogeneity we see in spending outcomes, we find very little heterogeneity across conditions in change in intervention and patient comfort. Figure A9 shows that for each outcome (column), the point estimates across conditions (rows) is very similar. In other words, patients of all major conditions appear to benefit from hospice services.

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 A6, we detect no significant changes in pain-related variables, including frequency and intensity. 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 A9 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%, $p = 0.013$), which is consistent with the reduction in feeding tube use, 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 A8). 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 6 reports the estimated effects of hospice facility entry on the place of death. The outcomes are measured as quarterly deaths per 1,000 beneficiaries in a county, partitioned by location. Deaths in an institution decline by 0.063 per 1,000 beneficiaries per quarter (–1.34%), driven primarily by fewer deaths in inpatient facilities (–0.049 per 1,000, –1.34%) and, to a lesser extent, skilled nursing facilities (–0.013 per 1,000, –1.34%). Deaths at home increase modestly overall (0.042 per 1,000, 0.59%), reflecting a substantial rise in deaths at home with hospice care (0.107 per 1,000, 3.05%) and a corresponding decline in deaths at home without hospice care (–0.065 per 1,000, –1.85%).[4] Overall, these patterns suggest that expanded hospice availability reduced institutional deaths and shifted end-of-life care toward home-based, hospice-supported settings.

Figure 1 indicates that increased hospice availability following provider entry increases the share of beneficiaries using hospice by 5.62% (0.0532 percentage points from a mean of 0.947%). As shown in Column (4) of Table 6, this suggests that going onto hospice lowers the chance of dying in an institution by 11.8 percentage points.[5] This is driven by a 9.2 percentage point decrease in inpatient deaths. The corresponding increase in the chance of dying at home is 7.9 percentage points, which is a combination of a 12.2 percentage point decrease in the chance of dying at home without hospice and a 20.1 percentage point increase for dying at home with hospice care. Table 5 presents the effect of hospice availability on institutionalization at end of life and death settings as a share of beneficiary deaths

[4]Deaths at home include all deaths occurring outside of inpatient facilities or skilled nursing facilities, which may include hospice facilities, nursing homes, or community-based homes.

[5]Calculated as $-0.063/0.532 = -0.1184$

(rather than as a share of beneficiaries overall). These results suggest that in addition to shifting where beneficiaries die, expanded hospice availability also changes where beneficiaries receive their final days of care more generally.

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 deaths 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. However, 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 the efficient allocation of patients with poorer prognoses to hospice 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. 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 refer-

rals 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, 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 physicians' recommendations.[6]

Patient welfare. Denote patient utility from choice $d \in \{H, C\}$ as $U(d \mid \theta)$. The difference in patient utility between hospice and curative care (the net hospice advantage) is

$$\Delta U(\theta) \equiv U(H \mid \theta) - U(C \mid \theta),$$

which is increasing in severity ($\partial_\theta \Delta U(\theta) > 0$). 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 and values both patient welfare and revenues:

$$V(d \mid \theta) = w\, U(d \mid \theta) + R_d,$$

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

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 the revenue loss from referring to hospice. The incremental value of hospice to the physician is therefore

$$\Delta V(\theta) = w\,\Delta U(\theta) - \Delta R.$$

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

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

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

Let $g(s)$ denote the density of s. Under unconstrained hospice availability, the share of patients in hospice 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 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. To capture heterogeneity in illness severity and prognosis near the end of life, we partition beneficiaries into a set of 18 patient groups, indexed by c, defined using demographic characteristics and chronic conditions following the procedure in Section C.1. These groups are designed to be clinically meaningful and differ in expected severity. Appendix Table A10 lists the groups in detail. For each group, the physician's private signal of severity is assumed to follow a log normal distribution,

$$\ln s \sim \mathcal{N}(\mu_c, \sigma_c^2),$$

where μ_c and σ_c^2 capture the mean and dispersion of clinical severity. We take severity s to be represent each beneficiary's probability of dying in a given quarter, interpreting higher mortality as greater clinical severity.

We approximate patients' expected benefit of hospice relative to curative care as increasing linearly as a function of severity:

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

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

$$\beta_0 + \omega s - \delta_c \geq 0,$$

where $\beta_0 \equiv wU_0$ is the baseline nonfinancial utility from hospice for a hypothetical patient with zero severity, $\omega \equiv w\lambda$ captures the physician's weight on patient benefit relative to financial incentives, and δ_c is the revenue loss per beneficiary-quarter from referring a patient to hospice, which we allow to vary across groups. We directly calculate δ_c as the absolute value of the ratio between the reduced-form effect of hospice entry on total non-hospice spending and the first-stage effect of hospice entry on the hospice participation rate.

Physicians would like to refer all beneficiaries to hospice whose severity satisfies $s \geq s_c^* = \frac{\delta_c - \beta_0}{\omega}$. However, there may be additional capacity constraints that limit hospice use. The group-specific severity threshold for hospice referral is then

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

where $\kappa_c \geq 0$ reflects the degree to which hospice capacity is constrained for group c.

Given the above severity distribution, the share of patients in hospice is given by

$$D_c = 1 - F(\tilde{s}_c; \mu_c, \sigma_c^2),$$

where F denotes the CDF of the log-normal severity distribution and D_c corresponds to the observed baseline share of beneficiaries using hospice each quarter for group c. Given

the parameters (μ_c, σ_c^2), this equation pins down $\tilde{s}_c$.

5.3 Estimation

Estimation proceeds in two steps, described briefly here and in detail in Appendix Section C. *First*, we fit the group-specific parameters $(\tilde{s}_c, \mu_c, \sigma_c^2)$ using observed hospice utilization, average mortality rates, and stacked event-study estimates of the effect of hospice entry on hospice use, total non-hospice spending, and average mortality rates among hospice users and non-users.

Second, we estimate the common parameters governing the physician utility function (β_0, ω) using a GMM approach using moment inequalities and moment equalities, backing out condition-specific capacity wedges κ_c via (3).

Identification. Identification leverages cross-condition variation in four observed quantities: hospice use, the first-stage effect of hospice entry on hospice use, mortality rates, and provider financial incentives. The first three quantities anchor the severity distribution parameters $(\tilde{s}_c, \mu_c, \sigma_c)$.

These parameters, along with the fourth observed quantity δ_c, are used to identify the physician utility parameters (β_0, ω). Intuitively, conditions with larger financial losses from hospice enrollment should display higher severity thresholds: for more profitable conditions, physicians are only willing to refer the sickest patients. The slope of the relationship between δ_c and $\tilde{s}_c$ across conditions helps to pin down ω, which is the marginal weight placed on patient benefit relative to revenue.

The final parameter, β_0, represents the baseline non-financial utility from hospice for the hypothetical patient with zero severity. Identification of β_0 is complicated by the existence of the capacity constraints κ_c. In the model, average hospice use may be low either because β_0 is very negative (hospice confers negative utility for healthy patients) or because κ_c is large (hospice facilities are significantly capacity constrained). Without external data on the absolute magnitude of capacity constraints, β_0 and κ_c cannot be separately identified. We surmount this issue by normalizing $\kappa_c = 0$ for the subset of groups with the smallest model-implied capacity constraints. This affects the interpretation of counterfactual simulations: at most, we can only simulate the effect of increasing capacity up to the

least-constrained (normalized) groups.

5.4 Model Results

Group-specific Parameters. Panel A of Table 7 shows our group-specific parameter estimates. The results show substantial heterogeneity in both underlying severity and hospice utilization. Mean severity, measured as average quarterly mortality rates per 1000 beneficiaries, averaged 22 across groups (a 2.2% quarterly mortality rate, or 8.5% annually). The lowest group had a quarterly mortality rate of 0.3%, whereas the highest quarterly mortality rate was 7.7% (corresponding to an annual probability of death of a 27%).

Hospice shares (D_c) average 1.8% and range from 0.3% to 6.2%, consistent with large variation in end-of-life care use across groups. First-stage effects of hospice entry on use average +0.11 percentage points and ranged widely from 0.01 to 0.34 percentage points, reflecting differences in the share of patients near the severity threshold across conditions. Provider revenue losses (δ_c) average \$36,474 per patient switching to hospice, with a standard deviation of \$69,292.

Estimated severity thresholds ($\tilde{s}_c$) also vary across conditions, reflecting differences in both financial incentives and capacity constraints. On average, physicians recommended hospice for quarterly mortality rates above 11.7%, but this ranged from 6.7% to 17.4%. The estimated capacity constraints (κ_c) are positive for most conditions and average 39.7 (corresponding to a 4 percentage point difference in quarterly mortality), suggesting that hospice slots are scarce and that physicians must ration access by referring only the most severe patients. A small number of groups have slightly negative estimates of κ_c, which arise from sampling variation and the estimates should be interpreted as indicating very weak capacity constraints.

Physician Altruism Estimates. Our estimate of ω is 5.8 (SE = 1.7). Thus, for every 10 unit increase in severity (1 percentage points of quarterly mortality), the physician's utility of placing the patient on hospice increases by about \$58,000. To put our estimate of ω in context, a physician without financial incentives values the marginal hospice referral at approximately \$267,000.[7]

[7]We calculate this as \$1,000 times $\hat{\beta}_0 + \hat{\omega}E[\tilde{s}_c]$, where $E[\tilde{s}_c]$ is the average severity threshold across groups.

Our estimate of β_0 is -411 (SE = 146), which implies that a beneficiary must have a severity of at least $-\hat{\beta}_0/\hat{\omega} = 70.8$ (a 7.1% chance of dying per quarter) in order to derive positive utility from hospice.

Relationships Between Model Parameters. Figure 5 Panel (a) shows a strongly positive relationship between baseline hospice use (D_c) and mean severity, suggesting that a significant portion of the variation in hospice use across conditions is related to differences in patient severity. Higher severity drives hospice use, because increasing a condition's mean severity results in more patients exceeding any given severity threshold. That said, holding mean severity fixed, hospice use may still vary due to variation in the ideal severity threshold s_c^* (due financial incentives) or variation in capacity constraints κ_c.

To disentangle these two explanations (financial incentives versus capacity constraints), we compare the estimated hospice severity thresholds $\tilde{s}_c$ with revenue losses δ_c and estimated capacity constraints κ_c. Of note, revenue losses are not significantly correlated with mean severity, indicating that variation in provider incentives does not reflect underlying clinical burden. That is, conditions may be severe but not profitable, and vice versa.

As shown in Figure 5 Panel (b), conditions with larger provider revenue losses (δ_c) exhibit higher severity cutoffs ($\tilde{s}_c$), meaning that patients must reach greater illness severity before hospice is utilized. That said, the relationship is not statistically significant, suggesting that variation in provider incentives does not significantly affect physician behavior. Figure 5 Panel (c) shows that severity thresholds are significantly positively correlated with capacity constraints. Interestingly, capacity constraints are significantly positively correlated with mean severity (correlation coefficient of 0.73). This is consistent with hospice facilities being more capacity constrained for more severe conditions.

Overall, while higher revenue losses (δ_c) do induce providers to set higher severity thresholds, this effect is relatively modest compared to the influences of individual patient severity and capacity constraints. While more severe conditions have higher baseline hospice participation, this is primarily because a higher share of patients exceed the severity threshold. Severity thresholds themselves are actually positively correlated with mean severity, primarily due to capacity constraints. This suggests that relaxing capacity constraints would have the largest impacts on high-severity conditions.

Overall, our findings are consistent with a downward-sloping hospice benefit curve:

more severe patients tend to enter hospice first; however, patients with less-severe conditions appear to be prioritized in the form of smaller capacity constraints. Put another way, patients with similar mortality risk may face different hospice admission thresholds depending on their clinical profile. In our estimates, groups with similar mortality risk nevertheless face different capacity constraints, leading to systematic differences in hospice use across patient groups. This heterogeneity may help explain the broader shift toward greater hospice utilization among non-cancer populations over time.

5.5 Counterfactuals

We simulate four 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 physician incentives**: This case removes physician incentives by setting $\delta_c = 0$ for all groups, while holding $\hat{\kappa}_c$ constant.

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

4. **No capacity constraints + no physician incentives**: This case sets $\delta_c = 0$ 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 The counterfactual simulations show capacity constraints play a bigger role than financial incentives in shaping hospice participation and welfare (Table 8). Under the baseline equilibrium, the mean quarterly hospice participation share is 1.8% across groups. Average hospice participation rises to 2.0% when incentives are removed, 6.9% when capacity constraints are removed, and 7.5% when both incentives and capacity constraints are removed. These expansions occur through leftward shifts in the hospice-entry threshold $\tilde{s}_c$, which declines from an average of 116.8 at

baseline, to 110.5 with the removal of incentives, to 77.1 with the removal of capacity constraints, and finally to 70.8 when both incentives and capacity constraints are removed.[8]

Table 8 also reports changes in the average utility of hospice users and total beneficiary utility. All utility calculations exclude δ_c to reflect only the nonfinancial components of physician decisionmaking. That is, the hospice utility for a beneficiary with severity s is $\hat{\beta}_0 + \hat{\omega}s$. Of note, we can only identify the *level* of utility for physicians, not beneficiaries; however, utility *ratios* across counterfactual scenarios do reflect the true preferences of beneficiaries, since the physician scaling factor w cancels out. Taking the ratio between the case without capacity constraints or incentives and the status quo, we see that utility among hospice users decreases by about 50% as hospice participation expands, reflecting diminishing marginal benefits from admitting less severe patients. Total hospice utility, computed over all eligible patients, increases by about 63.6%, with the bulk of this increase due to removal of capacity constraints. These estimates suggest that removing capacity constraints could significantly increase the welfare benefits of hospice to patients.

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. Our results suggest that 7.5% of the beneficiaries in our estimation sample 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.

One limitation of our analysis is that our measure of δ_c may not be completely encompass physicians' true financial incentives or the incentives of the health care systems they work for. Individual physicians and organizations may also differ in the types of spending they value and may also differ in their degree of altruism ω. Lastly, δ_c may also encode patient preferences that physicians consider when making referral decisions. For example, some patients may *prefer* hospice if it allows them to stay out of the hospital, whereas other patients may see reduced skilled nursing spending as a downside of hospice election.

[8]Note that removing both capacity constraints and financial incentives results in a constant severity threshold across all conditions. Any residual difference in hospice participation is due to severity alone.

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 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 just over two dollars in Medicare savings. The magnitude of these effects, however, varies by condition: spending offsets are largest for stroke/TIA, COPD, and heart disease, and smaller for AD/ADRD 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 $36,000, and that physicians refer only when patients' quarterly mortality risk exceeds roughly 12%. 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 mea-

sures 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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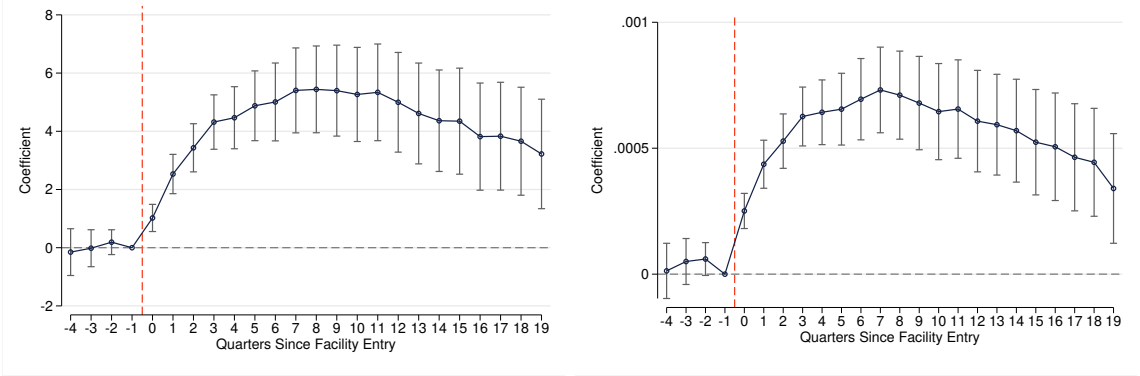
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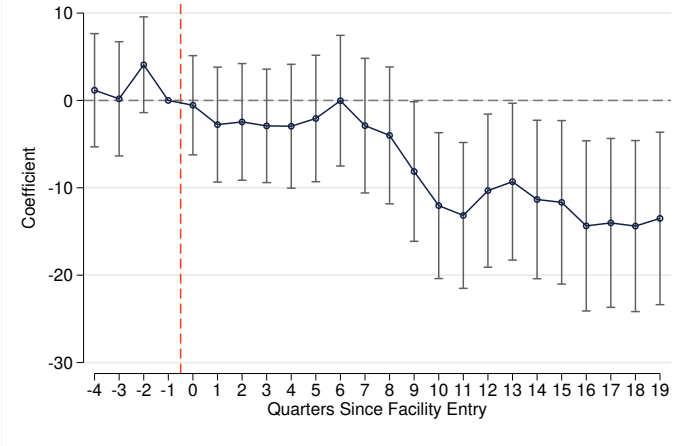
Figure 1. Event Study: Hospice Utilization.

(a) Hospice spending **(b)** Hospice use



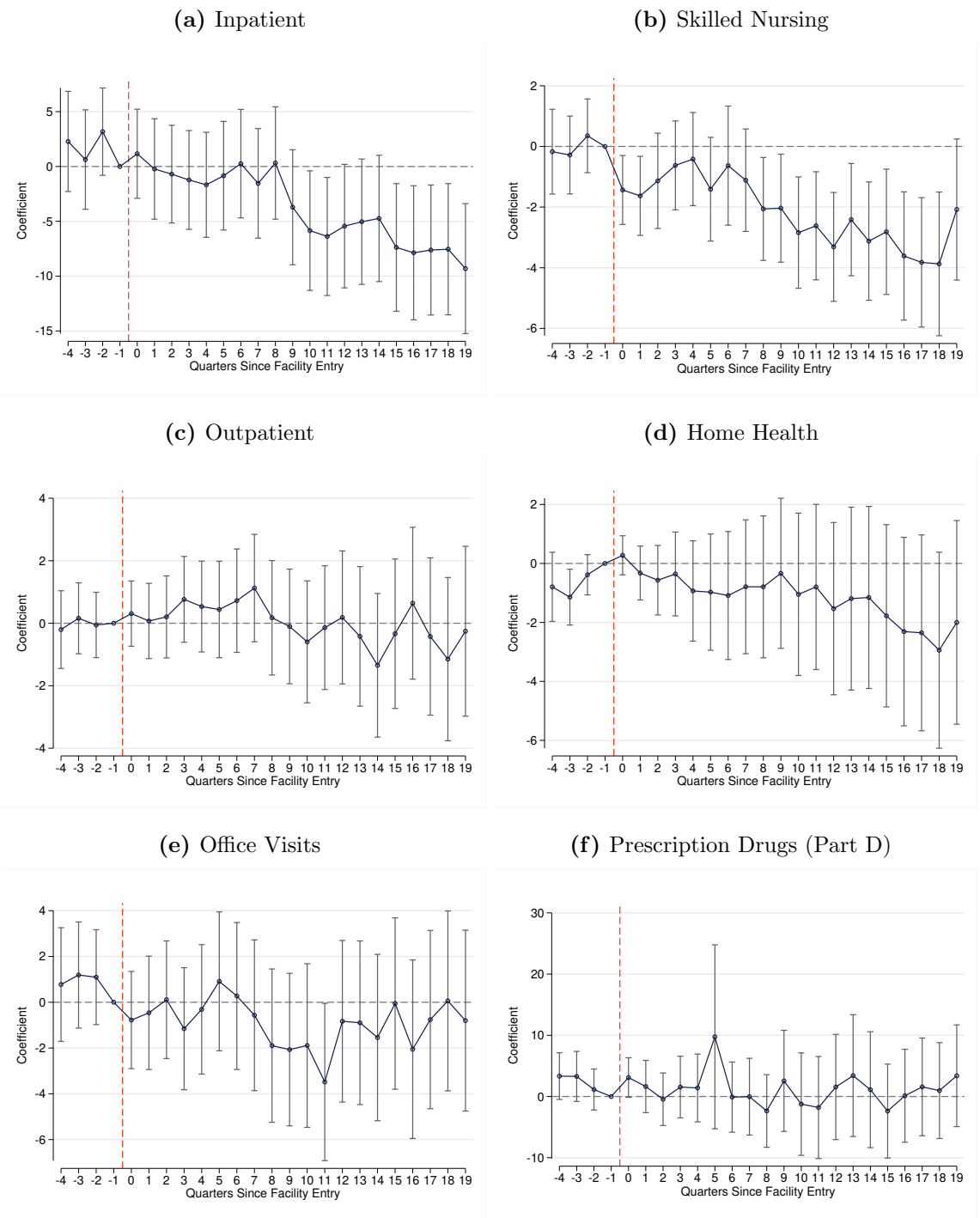
Note: This figure presents the estimated effect of hospice facility entry on Medicare hospice spending per beneficiary per quarter. Hospice use is measured in two ways: Panel (a) presents the effect of facility entry on hospice spending per beneficiary and Panel (b) presents the effect on the share of beneficiaries who use any hospice care. 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 experiment level and shown as 95% confidence intervals.

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



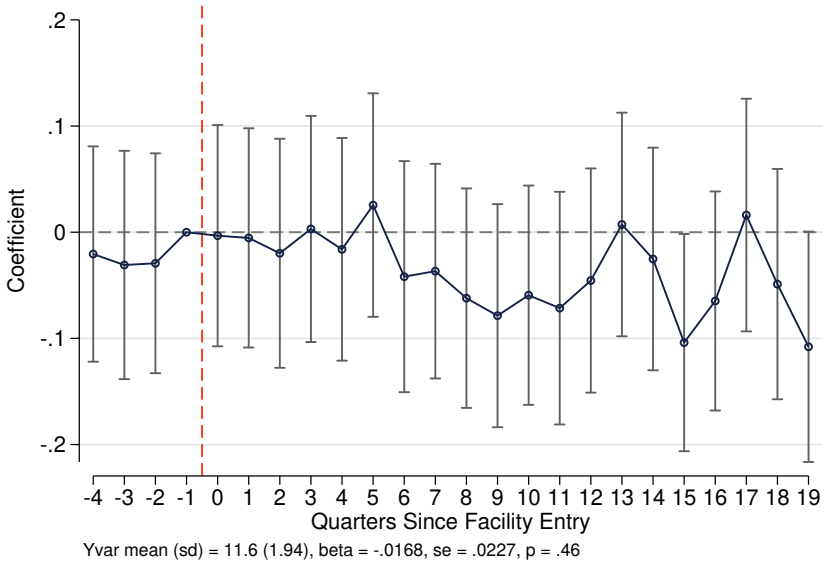
Note: This figure displays the estimated effect of hospice facility entry on total quarterly Medicare fee-for-service spending per beneficiary, excluding spending on hospice and Part D. Estimates are from a stacked difference-in-differences event study design using 1,518 hospice facility entries, each 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 experiment 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. Shaded regions show 95% confidence intervals constructed from standard errors clustered at the experiment level.

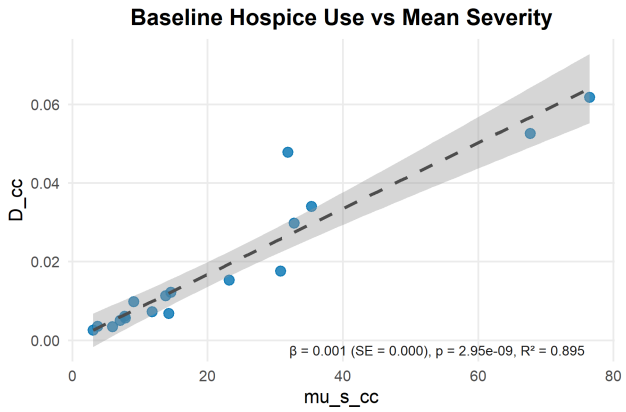
Figure 4. Event Study: Overall Mortality



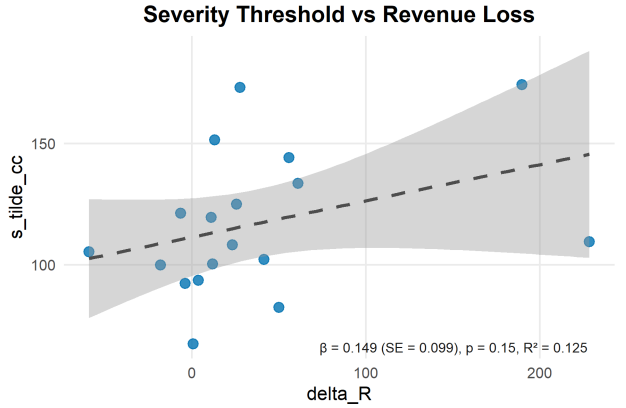
Note: This figure displays the estimated effect of hospice facility entry on total quarterly deaths per 1,000 beneficiaries. Estimates are from a stacked difference-in-differences event study design using 1,518 hospice facility entries, each defining a separate experiment with one treated county and 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 experiment level.

Figure 5. Relationships between hospice use, severity thresholds, financial incentives, and capacity constraints.

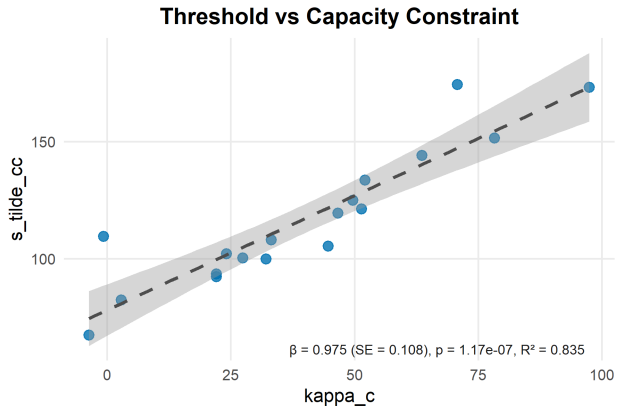
(a) Baseline hospice share D_c vs. mean severity $\mu_{s,c}$.



(b) Severity threshold $\tilde{s}_c$ vs. revenue loss $\delta_{R,c}$.



(c) Severity threshold $\tilde{s}_c$ vs. capacity constraints κ_c.



Note: This figure reports correlations between several key model parameters, across conditions. Panel (a) shows that conditions with higher average severity have higher baseline hospice participation. Panel (b) shows that conditions with larger provider revenue losses exhibit higher severity thresholds, indicating that financial incentives shift the cutoff for hospice inclusion. Panel (c) shows that conditions with more binding capacity constraints also exhibit higher severity thresholds, indicating that capacity constraints shift the cutoff for hospice inclusion.

Table 1. Summary Statistics of Hospice Facilities

Variable	All	Incumbents	Entrants	Entrants in Baseline Sample
Number of Employees	29.94	47.38	18.62	24.68
RNs	2.19	3.21	1.50	1.54
LPNs	9.79	16.24	5.53	7.71
Physicians	1.09	1.33	0.97	1.07
HH Aids	6.56	9.73	4.36	6.14
Homemakers	0.62	1.01	0.46	0.55
Counselors	1.68	2.20	1.31	1.54
Medical Social Workers	2.34	3.62	1.52	1.90
Other	5.67	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	0.75	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	0.003	0.007	0.002	0.003
Owned by a Hospital	0.09	0.22	0.03	0.05
Number of Facilities	5,513	2,154	4,362	1,574
Number of County-Quarters	3,802	1,276	3,253	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	60.04	40.35	28.73	53.26	83.15
Inpatient	752.95	167.44	643.72	744.18	854.74
Skilled Nursing	128.99	59.11	87.77	120.99	163.26
Outpatient	254.69	96.69	184.82	239.31	319.05
Home Health	116.18	91.84	63.87	89.36	134.31
Physician Services	469.40	130.24	379.70	468.37	554.59
Total excl. Part D and Hospice	1711.74	417.57	1420.56	1702.01	1982.35
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 entry events for prescription drugs (Part D) and N = 1518 entry events for all other rows.

Table 3. Change in Health Care Utilization

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Panel A: Spending			
Hospice	60.0	4.26*** (0.62)	7.1%
Total, Excluding Part D and Hospice	1712	−9.00** (2.90)	-0.53%
Inpatient	753	−5.29** (1.63)	-0.7%
Skilled Nursing	129	−2.12*** (0.59)	-1.6%
Outpatient	255	0.04 (0.79)	0.02%
Home Health	116	−0.57 (1.22)	-0.49%
Physician Services	469	−1.67 (1.20)	-0.36%
Prescription Drugs (Part D)	442	−0.75 (2.46)	-0.17%
Panel B: Any utilization			
Hospice	0.0095	0.0005*** (0.0001)	5.3%

Notes: Panel A of 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. Panel B reports estimates of the effect of hospice facility entry on the share of Medicare beneficiaries who have any hospice use in a quarter. 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 experiment 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: Share of Days in Institutional Care in the Last 180 Days of Life			
Any Institutional Care	0.13	-0.001^{**}	-1.1%
		(0.0004)	
Inpatient	0.07	-0.0004^{*}	-0.6%
		(0.0002)	
Skilled Nursing	0.06	-0.0009^{**}	-1.6%
		(0.0003)	
Panel B: Place of Death			
Institution	0.36	-0.004^{***}	-1.2%
		(0.001)	
Inpatient Facility	0.29	-0.003^{**}	-1.2%
		(0.001)	
Skilled Nursing Facility	0.07	$-0.001^{\dagger}$	-1.7%
		(0.0007)	
Home	0.64	0.004^{***}	0.7%
		(0.001)	
Home with Hospice Care	0.32	0.010^{***}	3.1%
		(0.001)	
Home without Hospice Care	0.32	-0.005^{***}	-1.7%
		(0.001)	

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. We partition beneficiary deaths as occurring either in an institution (inpatient versus skilled nursing facility) or home (with or without hospice care). The denominator is the total number of beneficiary deaths in the county-quarter; thus, outcome means for institution and home sum to one. 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. Change in Place of Death

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change	(4) IV
Quarterly Deaths per 1,000 Beneficiaries by Location				
Institution	4.68	-0.063^{***}	-1.34%	-0.118
		(0.016)		
Inpatient Facility	3.68	-0.049^{***}	-1.34%	-0.092
		(0.013)		
Skilled Nursing Facility	0.99	-0.013	-1.34%	-0.024
		(0.013)		
Home	7.05	0.042^{*}	0.59%	0.079
		(0.019)		
Home with Hospice Care	3.51	0.107^{***}	3.05%	0.201
		(0.017)		
Home without Hospice Care	3.54	-0.065^{***}	-1.85%	-0.122
		(0.014)		

Notes: This table reports estimates from event study regressions evaluating the effects of hospice facility entry on the place of death. We partition beneficiary deaths as occurring either in an institution (inpatient or skilled nursing facility) or home (with or without hospice care). The outcome is measured as deaths per 1,000 beneficiaries in the corresponding county-quarter. Estimates are based on a stacked difference-in-differences design with experiment-by-county and experiment-by-time fixed effects. Columns (1)-(3) are defined as in Table 3. Column (4) divides the estimated coefficients by the estimated effect of hospice entry on the share of beneficiaries with any hospice utilization in a county-quarter.
$^{\dagger}p < 0.1$ $^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.

Table 7. Parameter Estimates

Parameter	Mean	SD	Min	Max
Panel (a): Condition-specific Parameters				
Mean severity ($E[s]_c$)	22.079	21.083	3.080	76.500
Severity dispersion ($SD[s]_c$)	45.339	72.955	14.559	333.537
Hospice share (D_c)	0.018	0.019	0.003	0.062
Effect of Hospice Entry on Use ($\eta \cdot g_{s,c}$)	0.0011	0.0011	0.0001	0.0034
Revenue loss ($\delta_{R,c}$)	36.474	69.292	-59.081	228.542
Severity threshold ($\tilde{s}_c$)	116.783	29.310	67.306	174.274
Capacity constraint (κ_c)	39.699	27.463	-3.640	97.516

Panel (b): Common Parameters	
Hospice entry effect on threshold ($\hat{\eta}$)	2.784
	(0.704)
Baseline hospice utility ($\hat{\beta}_0$)	-411.486
	(146.171)
Physician altruism ($\hat{\omega}$)	5.811
	(1.680)

Notes: Parameters are estimated for N=18 mutually exclusive groups, constructed following Section C.1. Rows 1 and 2 of Panel (a) report the means and standard deviation of severity s across conditions, where s has units of deaths per 1,000 beneficiaries per quarter. Hospice share D_c represents the share of beneficiaries in hospice each quarter. The effect of hospice entry on use $\eta \cdot g_{s,c}$ corresponds to our first-stage estimate of hospice entry on the quarterly hospice share. Revenue loss $\delta_{R,c}$ is the amount of Medicare spending (excluding hospice spending) offset per quarter for each new beneficiary in hospice in that quarter, measured in thousands of dollars. $\tilde{s}_c$ denotes the severity threshold, above which a beneficiary is referred to hospice. The capacity constraint κ_c denotes the difference between $\tilde{s}_c$ and the unconstrained threshold s_c^*. $\hat{\eta}$ denotes the effect of a hospice entry event on the referral threshold, assumed to be common across groups. $\hat{\beta}_0$ and $\hat{\omega}$ denote the baseline hospice utility and physician altruism parameters. Standard errors are computed using the heteroskedasticity-robust GMM sandwich estimator for $\hat{\eta}$ and using the Bayesian bootstrap with 200 iterations over groups for $\hat{\beta}_0$ and $\hat{\omega}$.

Table 8. Counterfactual Hospice Utilization and Patient Utilities

Outcome	Scenario	Mean	SD	Min	Max
D_c (Hospice Share)	Constrained (Baseline)	0.018	0.019	0.003	0.062
D_c (Hospice Share)	No incentives	0.020	0.020	0.003	0.067
D_c (Hospice Share)	No capacity constraint	0.069	0.109	0.002	0.374
D_c (Hospice Share)	No capacity + no incentives	0.075	0.117	0.005	0.410
Mean Utility, Hospice Users	Constrained (Baseline)	833.5	808.7	207.3	3972.4
Mean Utility, Hospice Users	No incentives	755.2	663.1	206.2	3311.1
Mean Utility, Hospice Users	No capacity constraint	477.5	534.1	236.3	2505.7
Mean Utility, Hospice Users	No capacity + no incentives	395.4	353.6	235.2	1776.0
Total Utility	Constrained (Baseline)	14.0	15.8	1.973	61.3
Total Utility	No incentives	14.5	16.5	1.998	64.3
Total Utility	No capacity constraint	22.8	33.9	2.020	130.8
Total Utility	No capacity + no incentives	22.9	34.0	2.045	131.3
$s_{\tilde{c}}$ (Observed Threshold)	Constrained (Baseline)	116.8	29.3	67.3	174.3
$s_{\tilde{c}}$ (Observed Threshold)	No incentives	110.5	27.5	67.2	168.3
$s_{\tilde{c}}$ (Observed Threshold)	No capacity constraint	77.1	11.9	60.6	110.1
$s_{\tilde{c}}$ (Observed Threshold)	No capacity + no incentives	70.8	0.000	70.8	70.8

Notes: This table reports summary statistics from counterfactual simulations of the hospice entry model under the four policy scenarios described in 5.5. Outcomes include the hospice participation share (D_c), mean utility among hospice users (in $thousands), total utility across all patients (in $thousands), and the estimated severity threshold $\tilde{s}_c$ (units of quarterly mortality per 1,000 beneficiaries). Each cell reports the mean, standard deviation, minimum, and maximum across chronic conditions. All utility calculations exclude $\delta_{R,c}$ to reflect only the nonfinancial components of physician decisionmaking. That is, the hospice utility for a beneficiary with severity s is $\hat{\beta}_0 + \hat{\omega}s$.

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.[9] 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, Spitzer and Williams, 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

[9]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.

from 0 to 27. 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 $n_{dist} < 1$.

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 Model Estimation

C.1 Grouping Beneficiary Types

Tables and show that hospice entry has heterogeneous effects on hospice use and non-hospice spending across beneficiaries with different chronic conditions. In addition to differences in the degree to which electing hospice offsets other spending, beneficiaries also differ in terms of their underlying mortality rates. Finally, different types of beneficiaries may face heterogeneous capacity constraints.

To incorporate these dimensions of heterogeneity, we partition beneficiaries into a finite number of groups based on a binary characteristic vector consisting of their age group (below 65, 65-69, 70-74, 75-79, 80-84, and 85+), sex, and vector of 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). Because there are about 16,000 unique characteristic vectors, we group beneficiaries with similar characteristics. Specifically, we calculate weighted Hamming distances across characteristic vectors (hereafter, "types"). The weights we use come from an OLS regression of average mortality on each binary characteristic. Thus, distances are smaller between types that only differ in a small set of characteristics that are not important for predicting mortality.

In order to ensure sufficient sample sizes for each group, we require that each group has at least 75 million observations at the beneficiary-county-quarter level between 1999 and 2019. We use a greedy merging algorithm. First, we set aside types that already satisfy the sample size threshold. Then, starting with the type with the fewest observations, we merge in the most similar types (those with the smallest weighted Hamming distances) until the sample size threshold is satisfied. Then, we proceed with the next smallest type that remains. This continues until we have formed groups that all satisfy the sample size threshold, or no un-merged types remain.

C.2 Group-level Empirical Moments

For each merged group, we then obtain the empirical moments we use in the estimation procedure described in the following section. These moments include the baseline hospice participation rate (defined as the share of beneficiaries using hospice in a given quarter), the mean mortality rate, and stacked difference-in-differences estimates of the effect of hospice entry on hospice participation, the effect of hospice entry on non-hospice spending (divided by the first-stage effect on hospice participation), and the effect of hospice entry on average mortality rates among hospice users and non-users. While we do not find

any causal effects of hospice on mortality, moving beneficiaries onto hospice will change the mortality composition of both hospice users and non-users. We use these mortality changes when estimating our model.

A sample size threshold of 75 million yields 27 groups. However, we exclude 9 groups with first-stage estimates below 0.0001 (0.01 percentage points). Hospice use is rare for these groups, and excluding them ensures that our estimates of non-hospice spending offsets are not skewed by noisy first-stage estimates in the denominator. Thus, our model estimates are based on the 18 remaining groups. The resulting groups are shown in Appendix Table A10.

C.3 Estimating Patient Severity Distributions

To take our model to the data, we combine the above empirical moments with the parametric assumption that physician severity signal s is log normally distributed within each group c:

$$\ln s \sim \mathcal{N}(\mu_c, \sigma_c^2).$$

We assume that severity s represents a beneficiary's mortality rate (per 1000) in a given quarter. Thus, $E[s]_c$ represents the average mortality rate in group c. We let $\tilde{s}_c$ denote the realized severity cutoff for group c, accounting for capacity constraints. Beneficiaries are admitted to hospice if $s > \tilde{s}_c$. We recover the parameters $(\tilde{s}_c, \mu_c, \sigma_c^2)$ as follows.

First, note that for a log-normal distribution, the observed average mortality for group c has the following closed-form relationship with the parameters (μ_c, σ_c^2):

$$E[s]_c = \exp\left(\mu_c + \frac{1}{2}\sigma_c^2\right). \tag{4}$$

Next, note that the hospice participation share is given by

$$D_c \equiv 1 - F(\tilde{s}_c; \mu_c, \sigma_c^2), \tag{5}$$

where F denotes the CDF of the log-normal severity distribution. Empirically, we take D_c to be the share of beneficiaries with group c with any hospice use in a given quarter during the baseline period prior to hospice facility entry.

We also observe the first-stage change in D_c when a new hospice facility enters the market, which represents the effect of decreasing the capacity constraint κ_c on the hospice participation share D_c. Denoting the hospice entry event by Z, and given the definition of D_c, $\tilde{s}_c = s_c^* + \kappa_c$, and $\kappa_c > 0$, it is straightforward to show that

$$\frac{dD_c}{dZ} = -\frac{dF(\tilde{s}_c)}{d\tilde{s}_c}\frac{d\tilde{s}_c}{dZ} = f(\tilde{s}_c; \mu_c, \sigma_c^2) \cdot \eta, \tag{6}$$

where $f(\tilde{s}_c; \mu_c, \sigma_c^2)$ is the log-normal density evaluated at $\tilde{s}_c$ and $\eta \equiv -\frac{d\tilde{s}_c}{dZ}$ is the effect of hospice entry on the referral threshold $\tilde{s}_c$, or equivalently, on the capacity constraint κ_c. We assume that η is constant across groups for tractability.

Note that for any candidate value of η, Equations (4), (5), and (6) can be directly solved for $(\tilde{s}_c, \mu_c, \sigma_c^2)$, because we directly observe D_c, the group-specific mean severity $E[s]_c$, and the first-stage effects $\frac{dD_c}{dZ}$.

To estimate η, we use the intuition that shifting the threshold $\tilde{s}_c$ will change the average

mortality of beneficiaries admitted to hospice and those remaining outside hospice. Let $s'_c \equiv \tilde{s}_c - \eta$ denote the new referral threshold following hospice entry.
Because severity s corresponds to a beneficiary's mortality rate, the change in observed mortality among hospice users following hospice entry reflects the change in the expected severity of individuals above the admission threshold. Specifically, the change in hospice mortality for group c is given by

$$\Delta m_c^{\text{hos}} = E[s \mid s > s'_c] - E[s \mid s > \tilde{s}_c]. \tag{7}$$

Similarly, hospice entry also changes the composition of individuals who remain outside hospice. The change in mortality among non-hospice beneficiaries is therefore

$$\Delta m_c^{\text{non}} = E[s \mid s \leq s'_c] - E[s \mid s \leq \tilde{s}_c]. \tag{8}$$

Under the log-normal severity assumption, the conditional expectations in Equations (7) and (8) have closed-form expressions as functions of $(\tilde{s}_c, \mu_c, \sigma_c^2)$ and the shifted threshold s'_c. Thus, for any candidate value of η, we can compute the implied mortality changes $(\Delta m_c^{\text{hos}}, \Delta m_c^{\text{non}})$ for each group c.
Empirically, we used our stacked difference-in-differences framework to estimate the corresponding reduced-form effects of hospice entry on mortality among hospice and non-hospice beneficiaries, denoted $(\widehat{\Delta m_c}^{\text{hos}}, \widehat{\Delta m_c}^{\text{non}})$. We therefore estimate η by choosing the value that minimizes the discrepancy between the model-implied and empirically observed mortality changes across groups. Specifically, we estimate η using a generalized method of moments estimator that minimizes

$$\hat{\eta} = \arg\min_{\eta} \sum_c \mathbf{g}_c(\eta)' W \mathbf{g}_c(\eta), \tag{9}$$

where

$$\mathbf{g}_c(\eta) = \begin{pmatrix} \Delta m_c^{\text{hos}}(\eta) - \widehat{\Delta m_c}^{\text{hos}} \\ \Delta m_c^{\text{non}}(\eta) - \widehat{\Delta m_c}^{\text{non}} \end{pmatrix},$$

and W is a weighting matrix. In practice we use a two-step GMM estimator with a heteroskedasticity-robust weighting matrix. Standard errors are computed using the corresponding GMM sandwich variance estimator.
Below, we describe how we use these estimates of $(\tilde{s}_c, \mu_c, \sigma_c^2)$ and η in a second estimation step to separately identify the physician's ideal threshold s_c^* and the capacity constraint κ_c.

C.4 Estimating Physician Utility Parameters

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

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

Also, we allow the revenue differential ΔR to vary by group, and denote this by δ_c. Plugging these terms into (2) and solving for the value of s that equates the expected value of

hospice to zero yields the unconstrained cutoff

$$s_c^* = \frac{\delta_c - wU_0}{w\lambda} = \frac{\delta_c - \beta_0}{\omega}, \tag{10}$$

where we define $\beta_0 \equiv wU_0$ and $\omega \equiv w\lambda$. We measure δ_c in units of thousands of dollars per beneficiary in hospice in a given quarter. Also recall that we measure severity s
Thus, the parameter ω is the value (in thousands of dollars) that physicians place on the utility of hospice for a marginally more severe patient. β_0 is the dollar value of hospice for an individual with zero severity.
The realized cutoff is the unconstrained cutoff adjusted by a group-specific capacity constraint:

$$\tilde{s}_c = \frac{\delta_c - \beta_0}{\omega} + \kappa_c. \tag{11}$$

κ_c captures the tightness of the capacity constraint (in severity units, i.e., quarterly mortality per 1,000 beneficiaries). For example, a value of $\kappa_c = 10$ means that the mortality threshold needed to qualify for hospice is 1 percentage point higher than the physician's ideal threshold s_c^*.

With the group-specific parameter estimates in hand, we then use a combination of moment equalities and inequalities to recover (β_0, ω).
The first set of moment inequalities is a lower bound on the value of the threshold $\tilde{s}_c$, which follows from (10) and $\kappa_c \geq 0$:

$$\tilde{s}_c \geq \frac{\delta_c - \beta_0}{\omega}. \tag{12}$$

We require this moment inequality to hold for groups where the capacity constraint is binding, that is, $\kappa_c > 0$. This moment defines a lower bound on the hospice utility parameters; thus limiting valid parameters to the upper right region of (β_0, ω)-space.
In order to pin down the average level of κ_c, we normalize $\kappa_c = 0$ for a small subset of groups. For these groups, we require that (12) holds with equality. This assists with achieving point identification, because it defines a line in (β_0, ω) space. In practice, we normalize 3 out of 18 groups; the identity of these groups is chosen by the estimation procedure as those with the smallest differences between $\tilde{s}_c - s_c^*$.
Finally, we impose a 3rd moment inequality that requires the log normal density at the unconstrained threshold s_c^* to exceed the density at the observed (capacity–constrained) threshold $\tilde{s}_c$. This group exploits the fact that baseline hospice use is relatively rare across all groups, such that the shape of the log normal density is declining from s_c^* to $\tilde{s}_c$. This enforces an upper bound on the unconstrained hospice utility.

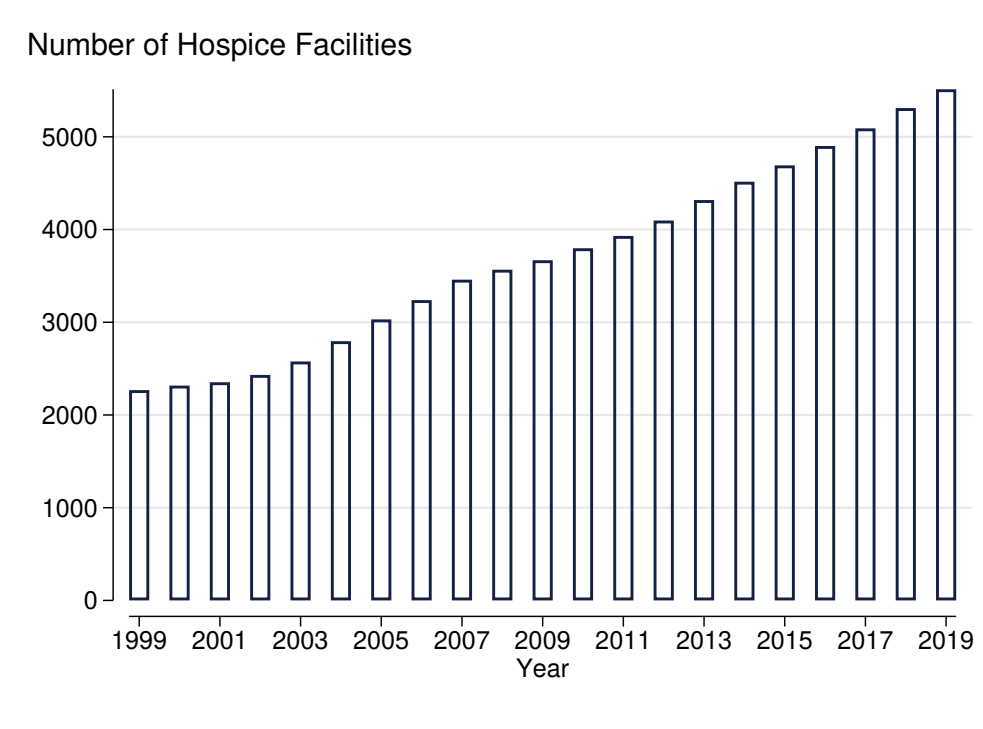
Identification . The above moments define the following set of moment inequalities or equalities for every group.

$$\begin{aligned} m^{(1)}_{c,\kappa_c \geq 0}(\beta_0, \omega) &= \tilde{s}_c - \frac{\delta_c - \beta_0}{\omega} \geq 0, \\ m^{(1)}_{c,\kappa_c = 0}(\beta_0, \omega) &= \tilde{s}_c - \frac{\delta_c - \beta_0}{\omega} = 0, \qquad \forall c. \\ m^{(2)}_c(\beta_0, \omega) &= f(s_c^*; \mu_c, \sigma_c^2) - f(\tilde{s}_c; \mu_c, \sigma_c^2) \geq 0. \end{aligned} \tag{13}$$

Identification of the utility parameters depends on the intersection of the allowed regions defined by the moments. The moment inequality $m^{(1)}_{c,\kappa_c>0}$ defines an allowed region in the upper right of the (β_0, ω) space while the moment inequality $m^{(2)}_c(\beta_0, \omega)$ allows the lower-left region. In practice, these two moment conditions achieve only set-identification of a diagonal region, where increasing ω can be rationalized by decreasing β_0. In order to achieve point identification, the moment equality $m^{(1)}_{c,\kappa_c=0}(\beta_0, \omega)$ defines a line in (β_0, ω) space, which is intersected with the above diagonal region. Figure A11 shows the resulting moment violation surface. To obtain standard errors, we employ a Bayesian bootstrap over groups, using 200 bootstrap iterations.

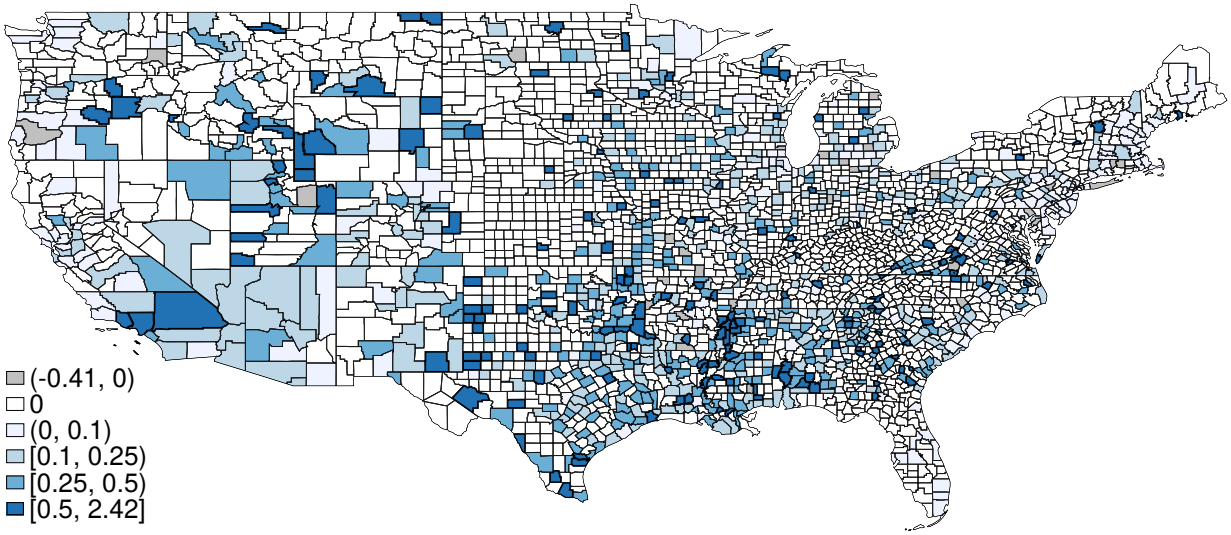
D Appendix Figures and Tables

Figure A1. Number of hospice facilities over time



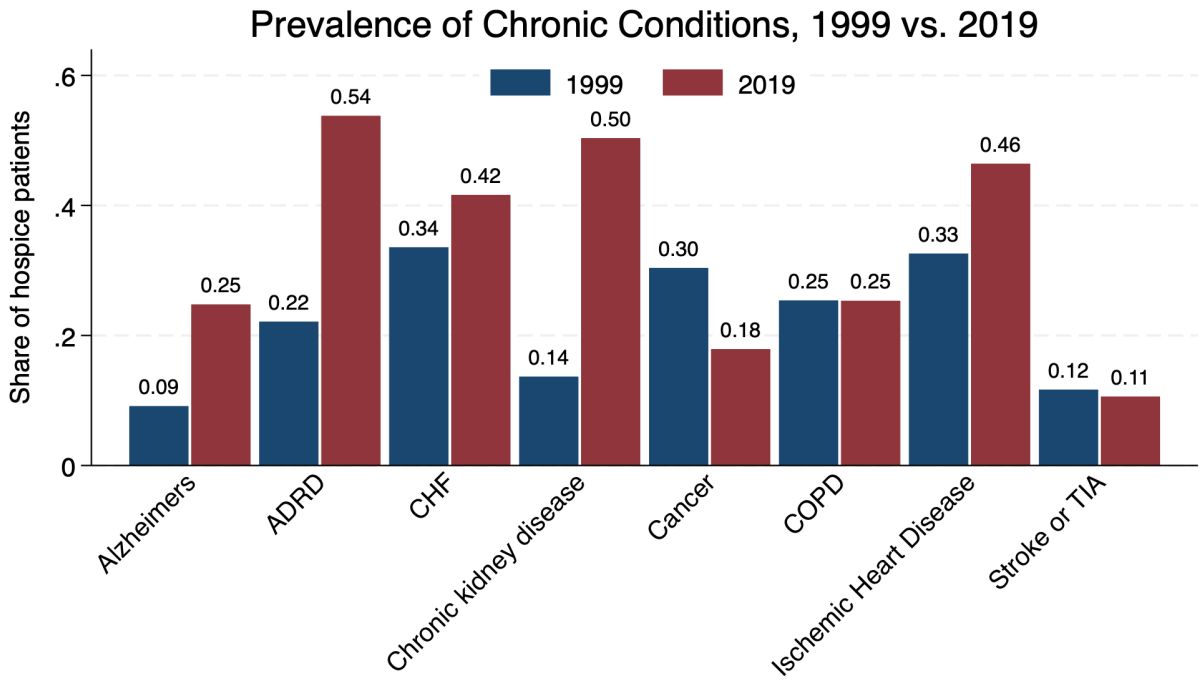
Note: This figure shows the total number of active Medicare-certified hospice providers in the United States from 1999 to 2019. Data are drawn from the CMS Provider of Services (POS) file.

Figure A2. Change in the number of hospice facilities per 1,000 beneficiaries between 1999 and 2019



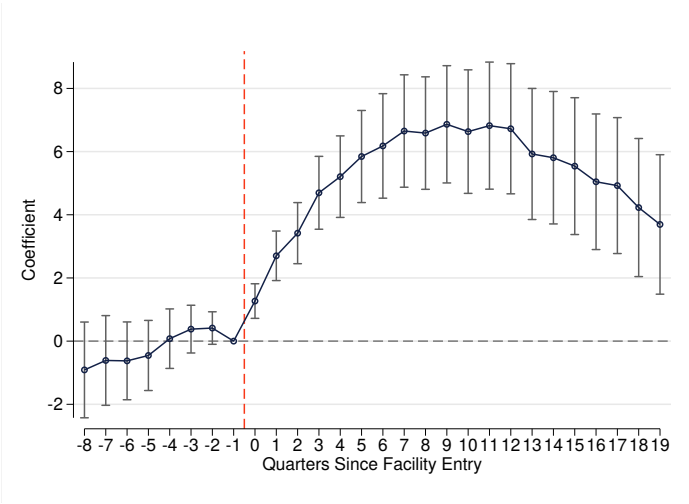
Note: This map shows net change in the number of Medicare-certified hospice facilities ber 1,000 beneficiaries by county over the period 1999–2019. Counties are shaded based on the total net increase in facilities per 1,000 beneficiaries during the period. Data shown are from the CMS Provider of Services (POS) file.

Figure A3. Chronic condition incidence among hospice users



Note: This figure shows the incidence of various chronic conditions among Medicare beneficiaries using hospice in 1999 and 2019. A beneficiary can have more than one chronic condition. Conditions shown are Alzheimer's, Alzheimer's Disease and Related Dementias (ADRD), Congestive Heart Failure (CHF), chronic kidney disease, cancer, Chronic Obstructive Pulmonary Disorder (COPD), ischemic heart disease, and stroke or Transient Ischemic Attack (TIA). Incidence is based on whether a beneficiary has a condition as indicated by the end-of-year flags, which are in turn based on the individual's claim history and corresponding diagnosis codes.

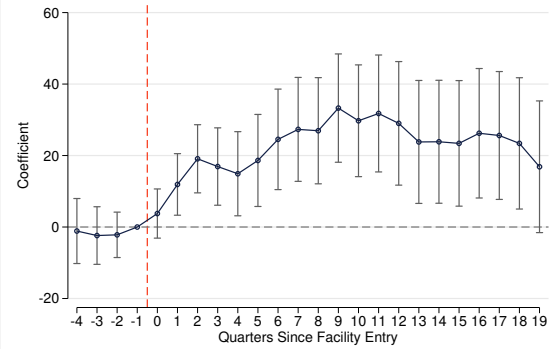
Figure A4. Event Study: Hospice Spending (Longer Pre-Period).



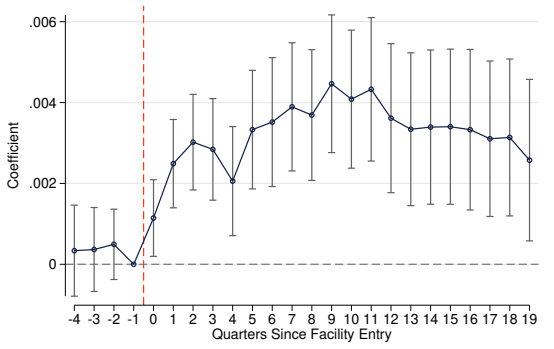
Note: This figure replicates Figure 1 but uses a sample that requires no entry in the 8 quarters prior, instead of 4 quarters as in the baseline. The sample includes 1,147 of the 1,518 experiments analyzed in the baseline analysis.

Figure A5. Event Study: Hospice Utilization Among Beneficiaries in Nursing Homes.

(a) Hospice spending



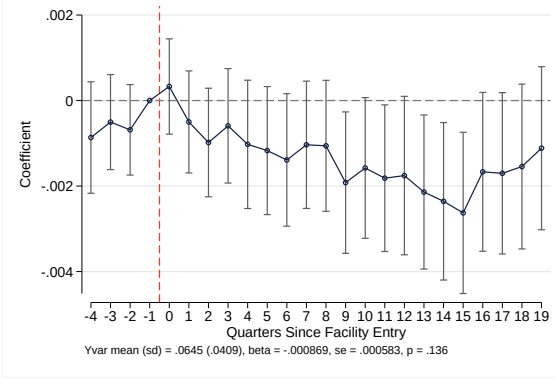
(b) Hospice use



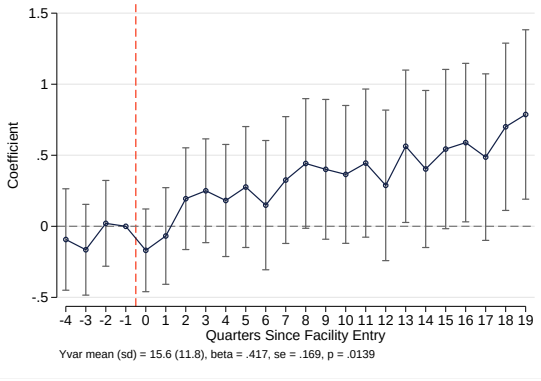
Note: This figure presents estimated effects of hospice facility entry on the use of hospice care among beneficiaries in nursing homes. Hospice use is measured in two ways: Panel (a) presents the effect of facility entry on hospice spending per beneficiary and Panel (b) presents the effect on the share of beneficiaries who use any hospice care. The sample represented here is identified as the subset of beneficiaries who appear in the MDS assessments administered to nursing home residents. 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 experiment level, are shown as 95% confidence intervals.

Figure A6. Event Study: Interventions Affecting Patient Comfort.

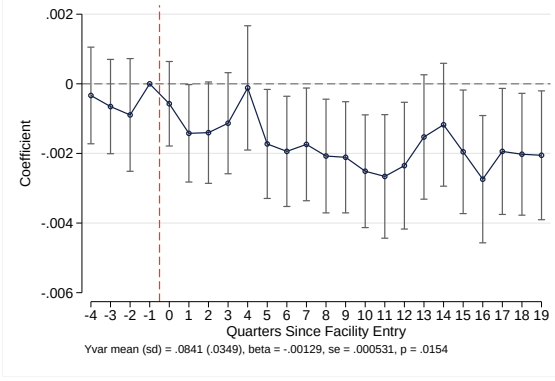
(a) Feeding Tube



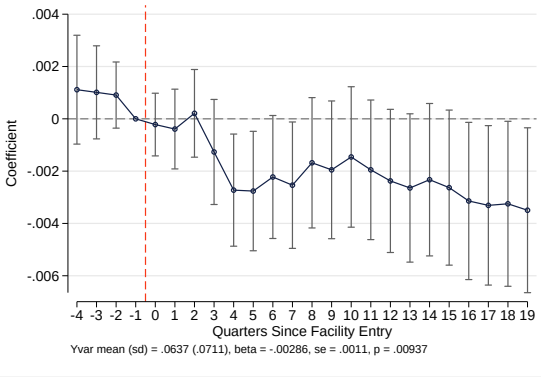
(b) Speech Therapy (Swallowing)



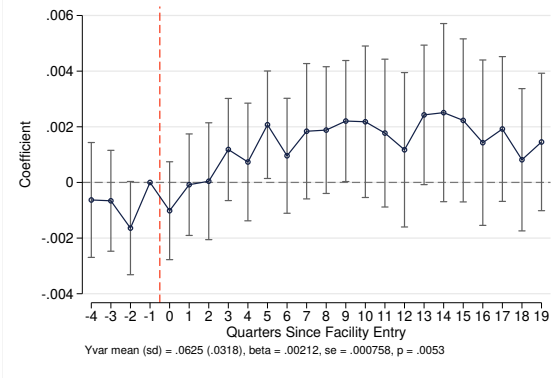
(c) Catheter



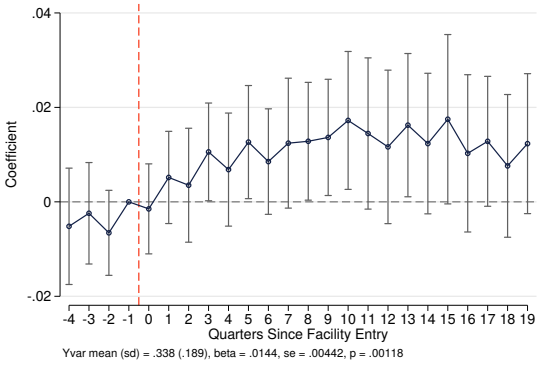
(d) Trunk Restraint



(e) Hypnotic Use (any)

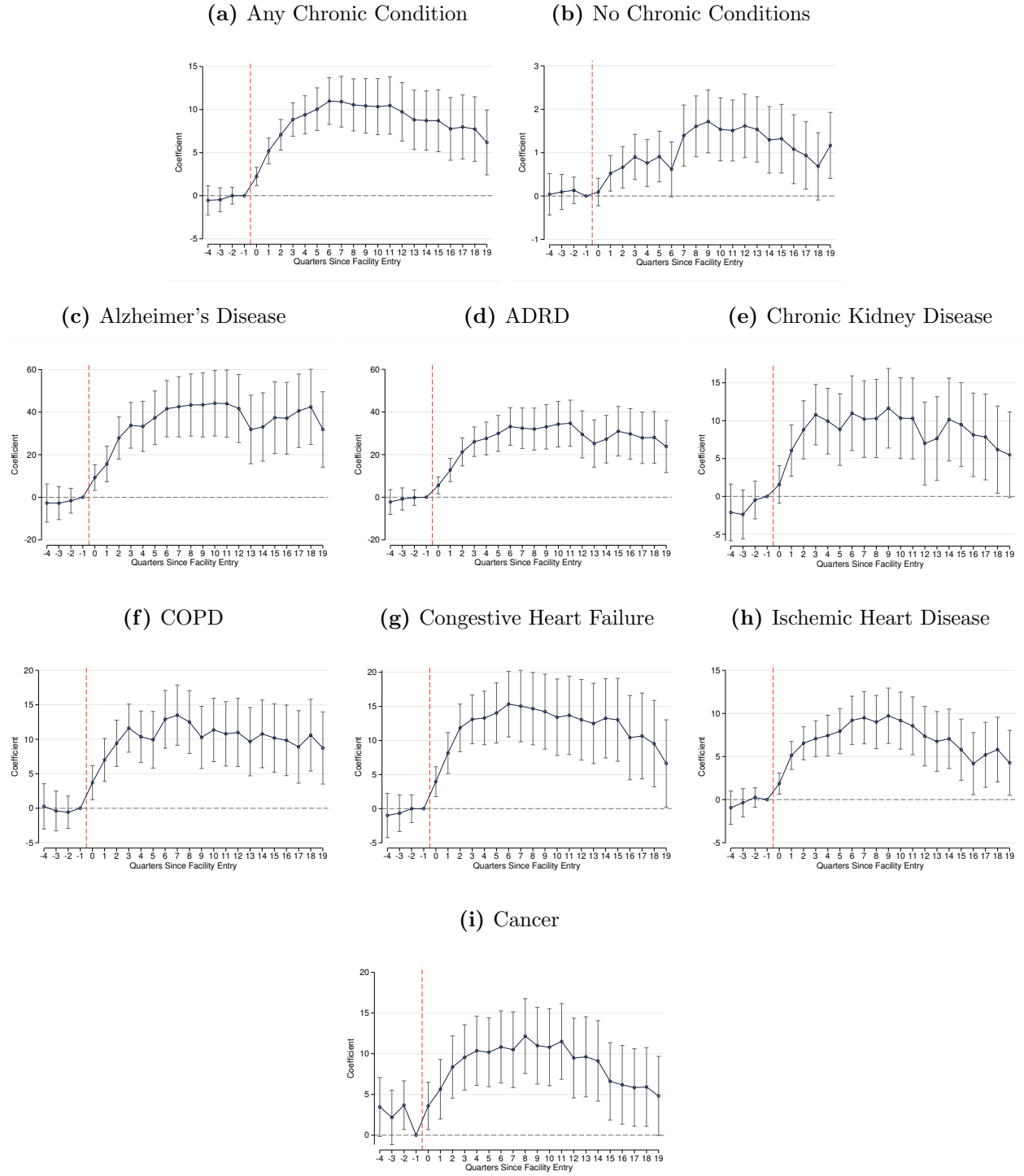


(f) Hypnotic Use (days)



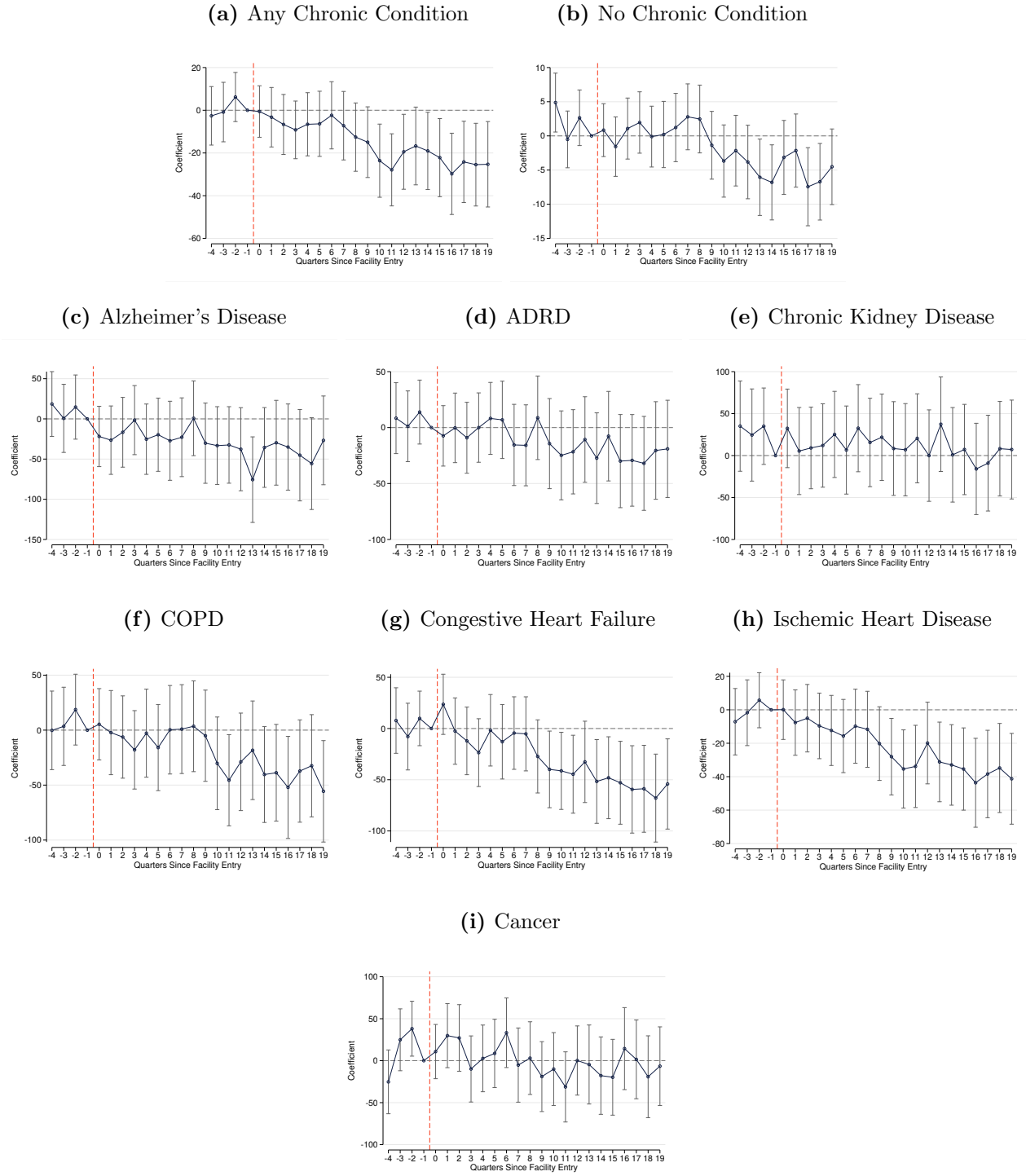
Note: This figure presents estimated effects of hospice facility entry on the use of interventions relevant to patient comfort: (a) feeding tubes, (b) speech therapy for swallowing, (c) catheters, (d) trunk restraints, (e-f) use of hypnotic medications. Estimates are from a stacked difference-in-differences 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 experiment level, are shown as 95% confidence intervals.

Figure A7. Event Study: Hospice Spending by Chronic Condition Subgroup.



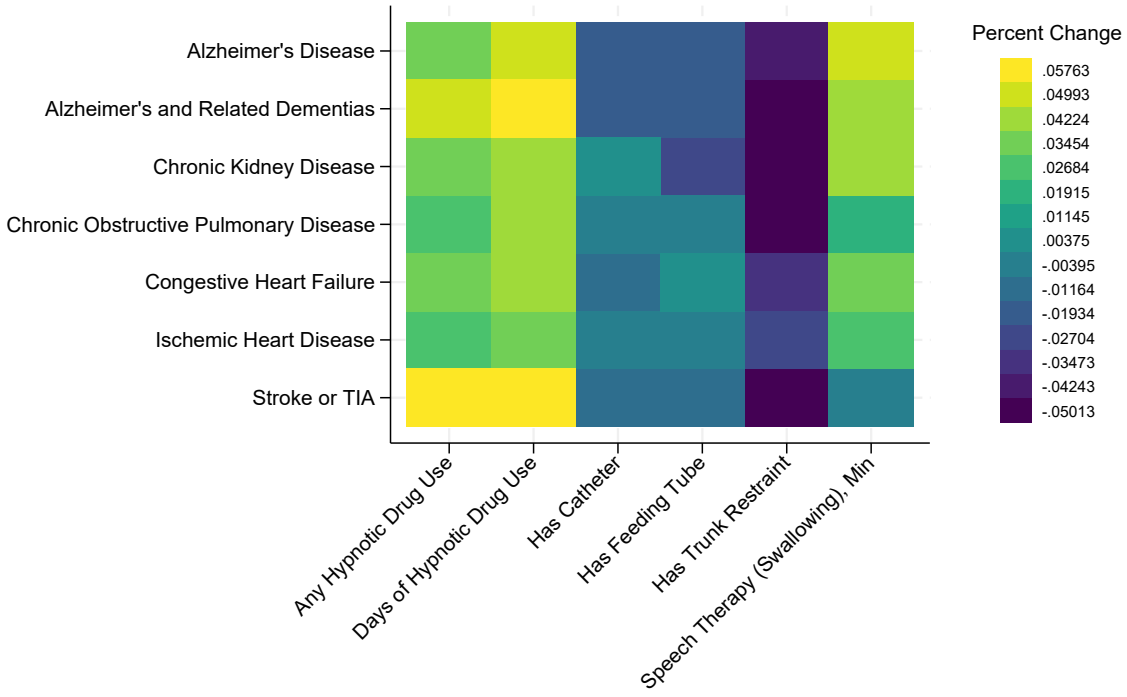
Note: This figure displays estimated effects of hospice facility entry on hospice spending per beneficiary-quarter, stratified by chronic condition subgroup. Estimates are obtained using a stacked difference-in-differences event study framework. Each panel shows coefficients from regressions with experiment-by-county 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 experiment level, are shown as 95% confidence intervals.

Figure A8. Event Study: Total Spending by Chronic Condition Subgroup.



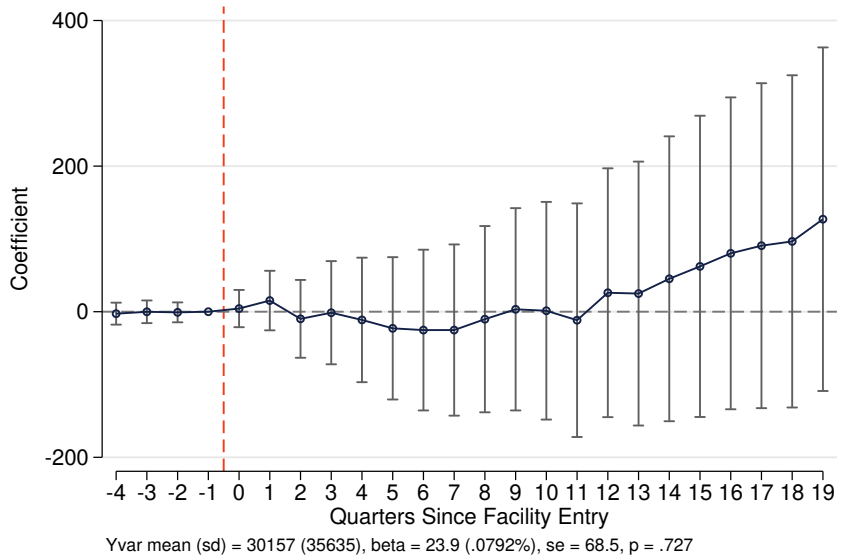
Note: This figure displays estimated effects of hospice facility entry on total non-Part D Medicare spending per beneficiary-quarter, stratified by chronic condition subgroup. Estimates are obtained using a stacked difference-in-differences event study framework. Each panel shows coefficients from regressions 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 experiment level, are shown as 95% confidence intervals.

Figure A9. Event Study: Change in Interventions and Patient Comfort by Chronic Condition Subgroup.



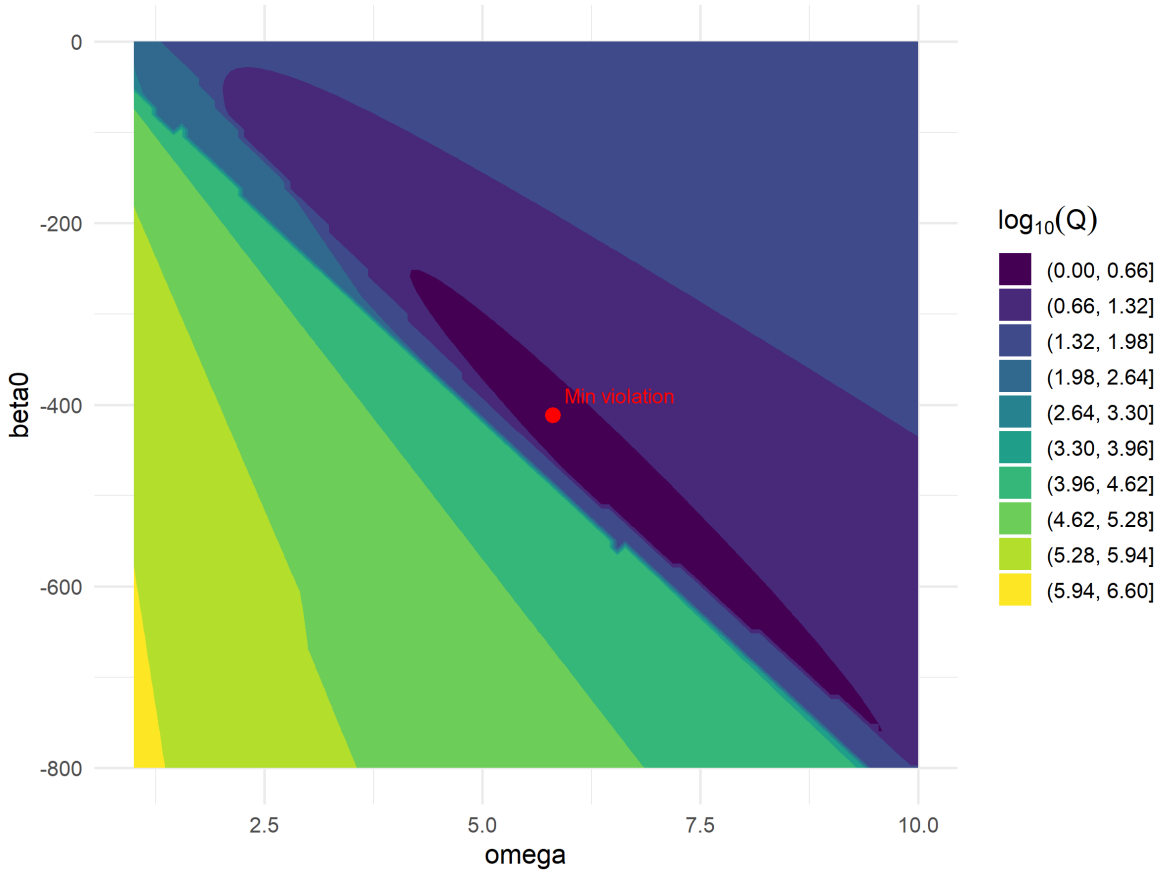
Note: This figure reports regression coefficients as percent changes relative to baseline means, by chronic condition subgroup and by measures of intervention and patient comfort. Estimates are based on a stacked difference-in-differences design with experiment-by-county and experiment-by-time fixed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

Figure A10. 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 experiment level. Stable pre-trends and lack of post-entry discontinuity suggest that hospice entry is not associated with changes in underlying population size.

Figure A11. GMM Estimation of Hospice Utility Parameters



Note: Contour plot shows the (log) GMM objective function across values of the hospice utility parameters β_0 and ω. The GMM estimate is shown as the "Min violation" point on the contour plot. See Appendix Section C for more details.

Table A1. County Characteristics

	(1) All Counties	(2) Baseline Counties
Facilities per 1,000 people		
Hospice	0.01 (0.03)	0.01 (0.03)
Skilled Nursing Facility	0.09 (0.09)	0.07 (0.06)
Home Health Agency	0.05 (0.08)	0.05 (0.05)
Demographics		
White (%)	84.37 (16.67)	79.95 (16.34)
Age 65+ (%)	14.74 (4.19)	13.36 (3.71)
Population (1000s)	89.57 (292.42)	190.29 (343.01)
Household Characteristics		
Mean Household Size	2.54 (0.21)	2.57 (0.21)
Median Household Income ($1000s)	36.34 (9.07)	39.00 (10.69)
Chronic Conditions (per 1000 beneficiaries)		
Alzheimer's Disease	27.77 (8.28)	29.18 (7.65)
Alzheimer's and Related Dementias	67.62 (14.27)	69.04 (13.15)
Chronic Kidney Disease	43.64 (11.82)	44.57 (10.63)
Chronic Obstructive Pulmonary Disease	100.16 (27.54)	97.42 (25.60)
Congestive Heart Failure	159.16 (32.67)	153.69 (31.43)
Ischemic Heart Disease	252.33 (51.25)	249.52 (51.51)
Stroke or TIA	42.85 (11.08)	44.52 (9.94)
Cancer	64.04 (12.16)	64.33 (10.32)
N	3142	891

Notes: This table reports summary statistics on counties as of 2000. Column (1) shows the mean value of the listed variables across all counties in the US with the standard deviation in parentheses. Column (2) shows the same statistics for the set of treated counties in our experiments. Data shown on facilities, demographics, and household characteristics are from the Area Health Resource Files and the 2000 US Census. Chronic condition rates among Medicare are from the Chronic Conditions segment of the Beneficiary Summary File. Chronic condition incidence is defined using the end of year indicators and is calculated only across counties that had at least 10 beneficiaries.

Table A2. Effects of Hospice Entry on Hospice Spending by Chronic Condition

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Overall	60.0	4.26***	7.1%
		(0.62)	
Any Chronic Condition	123	8.85***	7.2%
		(1.22)	
No Chronic Conditions	14.5	1.03***	7.1%
		(0.25)	
Alzheimer's Disease	477	37.40***	7.8%
		(5.49)	
Alzheimer's and Related Dementias	377	28.1***	7.4%
		(3.94)	
Chronic Kidney Disease	152	9.83***	7.8%
		(1.81)	
Chronic Obstructive Pulmonary Disease	135	10.03***	7.6%
		(1.61)	
Congestive Heart Failure	189	12.40***	6.6%
		(2.03)	
Ischemic Heart Disease	104	7.14***	6.9%
		(1.17)	
Stroke or TIA	149	9.7***	6.5%
		(2.11)	
Cancer	125	6.27***	5.1%
		(1.40)	
Breast Cancer	82.8	4.81**	5.8%
		(1.75)	
Colorectal Cancer	172	2.93	1.7%
		(3.36)	
Prostate Cancer	75.3	5.61**	7.4%
		(1.67)	
Lung Cancer	412	16.3**	4.0%
		(5.97)	

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 experiment level.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table A3. 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)	

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 experiment level, are reported in parentheses.
$^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.

Table A4. Effects of Hospice Entry on Total Spending Excluding Part D and Hospice, by Chronic Condition

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Overall	1712	-9.00**	-0.5%
		(2.90)	
Any Chronic Condition	3192	-15.80**	-0.5%
		(5.62)	
No Chronic Condition	629	-3.70*	-0.6%
		(1.51)	
Alzheimer's Disease	3709	-38.40**	-1.0%
		(13.30)	
Alzheimer's and Related Dementias	4047	-18.90†	-0.5%
		(11.00)	
Chronic Kidney Disease	6300	-12.00	-0.2%
		(16.4)	
Chronic Obstructive Pulmonary Disease	4970	-26.50*	-0.5%
		(11.80)	
Congestive Heart Failure	5104	-33.30**	-0.7%
		(11.30)	
Ischemic Heart Disease	3525	-22.50**	-0.6%
		(7.19)	
Stroke or TIA	5939	-47.60**	-0.8%
		(18.00)	
Cancer	3896	-10.00	-0.3%
		(13.20)	
Breast Cancer	3222	-14.50	-0.5%
		(17.20)	
Colorectal Cancer	5434	-11.40	-0.2%
		(31.20)	
Prostate Cancer	3123	-3.05	-0.1%
		(16.40)	
Lung Cancer	7387	-51.70	-0.7%
		(37.90)	

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 experiment level.
$^{\dagger}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table A5. Effects of Hospice Entry on Hospice Utilization for Beneficiaries in a Nursing Home

	(1) Outcome Mean	(2) Estimate (SE)	(3) % Change
Hospice Spending	471	24.000*** (5.900)	5.1%
Any Hospice	0.065	0.003*** (0.001)	4.5%

Notes: This table reports average treatment effects of hospice facility entry on hospice spending and use per beneficiary-quarter among beneficiaries who appear in the MDS assessments administered to nursing home residents, estimated using event study regressions. Column 2 shows the estimated average post-entry change. Standard errors are clustered at the experiment level.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table A6. 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 experiment level, are shown in parentheses.
$^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.

Table A7. Changes in Use of Medications Following Hospice Entry

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

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 experiment level, are reported in parentheses. None of the estimates in this table are statistically significant at the $p < 0.05$ level.

Table A8. 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 experiment level, are reported in parentheses.
$^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.

Table A9. 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 experiment level, are reported in parentheses.
$^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.001$.

Table A10. Patient Groups in Model Estimation

Group	Clinical Profile	Quarterly Mortality per 1000
1	Heart failure–ischemic heart disease–chronic kidney disease multimorbidity, frequently with lung cancer and/or COPD	76.5
2	Heart failure-COPD-AD/ADRD multimorbidity, age 85+	67.7
3	Heart failure with AD/ADRD, age 85+	35.4
4	AD/ADRD with chronic kidney disease, age 85+	32.8
5	AD/ADRD without major comorbidity, age 85+	31.9
6	Heart failure with ischemic heart disease	30.8
7	Heart failure with COPD	23.2
8	Chronic kidney disease-COPD-ischemic heart disease multimorbidity	14.6
9	Chronic kidney disease with either COPD or ischemic heart disease	14.3
10	COPD with stroke/TIA	13.8
11	Chronic kidney disease with ischemic heart disease	11.8
12	No major chronic conditions, age 85+	9.1
13	COPD with ischemic heart disease	7.9
14	Breast or prostate cancer with cardiovascular disease	7.7
15	Prostate cancer without major comorbidity	7.1
16	Ischemic heart disease with limited comorbidity	6.0
17	No major chronic conditions, age 65-84	3.7
18	Ischemic heart disease without comorbidity	3.1

Notes: Groups are formed following the algorithm described in Appendix Section C.1. The clinical profiles summarize the dominant conditions describing each group.