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Hospital Proximity and Emergency Department Use Among Assisted Living Residents

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Abstract

Objectives: To examine the relation between AL communities' distance to the nearest hospital and residents' rates of ED use. We hypothesize that when access to an ED is more convenient, as measured by a shorter distance, AL-to-ED transfers are more common, particularly for non-emergent conditions.

Design: Retrospective cohort study where the main exposure of interest was the distance between each AL and the nearest hospital.

Setting and Participants: 2018–2019 Medicare claims were used to identify fee-for-service Medicare beneficiaries aged 55 and older residing in AL communities.

Methods: The primary outcome of interest was ED visit rates, classified into those that resulted in an inpatient hospital admission and those that did not (i.e., ED treat-and-release visits). ED treat-and-release visits were further classified, based on the NYU ED Algorithm, as: 1) non-emergent, 2) emergent, primary-care treatable, 3) emergent, not primary-care treatable and 4) injury-related. Linear regression models adjusting for resident characteristics and hospital referral region fixed effects were used to estimate the relationship between distance to the nearest hospital and AL resident ED use rates.

Results: Among 540,944 resident-years from 16,514 AL communities, median distance to the nearest hospital was 2.5 miles. After adjustment, a doubling of distance to the nearest hospital was associated with 43.5 fewer ED treat-and-release visits per 1,000 resident years (95% confidence interval [CI]: −53.1, −33.7) and no significant difference in the rate of ED visits resulting in an inpatient admission. Among ED treat-and-release visits, a doubling of distance was associated with a 3.0% (95% CI: −4.1, −1.9) decline in visits classified as non-emergent, and a 1.6% (95% CI: −2.4%, −0.8%) decline in visits classified as emergent, not primary-care treatable.

Conclusions and Implications: Distance to the nearest hospital is an important predictor of ED use rates among AL residents, particularly for visits that are potentially avoidable. AL

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facilities may rely on nearby EDs to provide non-emergent primary care to residents, potentially placing residents at risk of iatrogenic events and generating wasteful Medicare spending.

Summary

Residing in an AL located relatively close to a hospital is associated with higher rates of ED use, especially for ED visits that could be avoided with better onsite primary care, consistent with ALs using nearby ED departments to provide non-emergent medical care.

Keywords

Assisted Living; Emergency Department Use; Hospitalizations; Medicare; Geriatrics; Long-Term Care

Introduction

Over one-third of all residential long-term care beds are in assisted living (AL) communities[1,2]—congregate residential settings that provide or coordinate personal services, 24-hour supervision and assistance, activities, and some health-related services.[3,4] These settings have become an increasingly important part of the long-term care landscape as older adults and their families seek less restrictive and lower-cost alternatives to nursing homes.

Despite their apparent popularity, little is known about the quality of care delivered by AL communities. Available evidence, although limited by convenience samples and the absence of comparison groups, is suggestive of quality concerns, including high rates of state citations for quality-of-care deficiencies, low staffing rates, problems with medication administration, high rates of transfers to nursing homes, and declining functional status.[5–9]

A major quality-related concern is whether AL communities are able to meet the medical needs of its residents. The average AL resident has become more clinically complex over time as communities have been willing to accept sicker and more disabled individuals.[10–12] Yet, AL communities typically have limited on-site medical staffing (i.e., nurses, nurse-practitioners, physicians),[13] due, in part, to the fact that AL communities would typically not be reimbursed for providing clinical services. These dynamics create the potential for AL communities to rely on transfers to hospital emergency departments (ED) to provide diagnostic services and medical care when the residents' own physicians are not immediately available. Such transfers are likely disruptive and potentially harmful to residents by increasing their risk for unnecessary hospitalization, iatrogenic events, and development of delirium.[14,15] They may also represent an important source of wasteful health care spending as the ED is a relatively expensive care setting.[16]

Prior research has demonstrated that the transfer of AL residents to hospital EDs is common. Estimates indicate that half of traditional Medicare beneficiaries residing in an AL have at least one ED visit in a year and more than a quarter have at least one inpatient hospitalization.[17,18] Furthermore, ED use among AL residents was shown to vary substantially across states, providing suggestive evidence that AL practices, rather than

clinical need, are driving a significant portion of AL-to-ED transfers.[17,19] The purpose of the present study is to further explore the degree to which current rates of ED use among AL resident may be the result of AL practice patterns and therefore potentially avoidable through better access to onsite medical consultation and primary care. Specifically, this study examines the relationship between AL communities' distance from the nearest hospital and residents' rates of ED use.

Distance has previously been shown to be a strong predictor of both where an individual receives health services and the amount of care they receive.[20–25] In the context of AL, communities located close to hospitals may face relatively lower non-financial costs, in terms of ambulance response time, travel time between the AL and hospital, and burden on the AL resident, in comparison to facilities located farther away. These lower non-financial costs may make AL communities and their staff more willing to rely on hospital EDs to provide fast, non-emergent medical care and less likely to invest in any onsite primary care or triaging capabilities. This study examines whether AL resident ED use is associated with the proximity of nearest hospital, and the extent to which AL-to-hospital transfers may be discretionary and not strictly based on clinical need. More specifically, we estimate whether AL residents residing in communities located closer to a hospital are more likely to have an ED visit, and whether the influence of distance varies across types of ED visits.

Methods

Data

The primary sources for this retrospective cohort study are 2018–2019 Medicare claims and enrollment data. Using a previously described method, we used the Master Beneficiary Summary File to identify Medicare beneficiaries residing in AL by matching their 9-digit ZIP code of residence to a national directory of AL communities.[26] Medicare Provider Analysis and Review (MedPAR) file was used to identify inpatient hospitalizations, including those that originated in the emergency department. Finally, Medicare outpatient claims data were used to identify ED visits that did not result in a hospitalization (i.e., ED treat-and-release visits).

A previously collected national registry of AL communities was used to obtain AL addresses,[26] and the Centers for Medicare and Medicaid Services (CMS) Hospital Compare General Information File was used to obtain hospital addresses.[27]

Sample

The analytic sample included Medicare fee-for-service beneficiaries aged 55 and older identified as spending at least 7 days in an AL in 2018 or 2019. Beneficiaries enrolled in Medicare Advantage at any point in a given year were excluded due to a lack of claims data, and beneficiaries younger than 55 were excluded to limit the inclusion of individuals residing in AL communities that primarily serve individuals with intellectual disabilities.

Measures

OUTCOMES—ED visits were defined as any inpatient or outpatient hospital-based claim with a revenue center code of 0450–0452, 0456, 0459, or 098. ED visits that resulted in an inpatient admission were identified through claims found in the inpatient (i.e., MedPAR) file, while ED treat-and-release visits (i.e., those that did not result in an inpatient admission) were identified with claims found only in the outpatient file. ED treat-and-release visits, by definition, represent AL-to-hospital transfers that did not require an inpatient level of care, and may therefore have been avoidable. As such, we further classified ED treat-and-release visits into the following categories using the NYU Algorithm for ED visits: 1) non-emergent, 2) emergent, primary-care treatable, 3) emergent (including care that may have been avoidable with better ambulatory care), and 4) injury-related.[28,29] The NYU Algorithm was developed from detailed reviews of complete medical records for nearly 6,000 ED visits by a team of ED and primary care physicians. Visits were classified into the 4 categories mentioned previously by the expert panel. Researchers then estimated the relationship between ED-visit information observable in claims data (i.e., diagnostic codes) and the likelihood of being assigned to each of the visit-type categories.[30] The NYU algorithm has been widely used to identify potentially unnecessary ED visits, and it has been found to be strongly predictive of ED visit severity and patient outcomes.[28,31] Annual rates for all outcomes were calculated as the number of outcomes divided by the number of days in which a resident resided in an AL in a given year. Values were Winsorized at the 99th percentile to account for outliers.

KEY INDEPENDENT COVARIATE - DISTANCE TO HOSPITAL—All hospital and AL addresses were geocoded to allow for the calculation of the shortest distance (defined as the shortest path between the two points on a reference ellipsoid) between every AL and every U.S. hospital. For each AL, the distance, in kilometers (KM), of the nearest hospital was retained. Distances were Winsorized at the 1st and 99th percentiles to remove extreme values. Distance was inverse hyperbolic sine transformed to normalize the sample distribution of nearest distances. This transformation is similar to log transformations but is identified at 0.

OTHER COVARIATES—Medicare enrollment files were used to generate a number of individual-level covariates. These included beneficiary age (categorized as: <65, 65–74, 75–84, 85–90, 91+), sex, race/ethnicity (categorized as: White, non-Hispanic, Black, non-Hispanic, Hispanic, Asian/Pacific Islander, and other),[32] and dual-eligibility status (=1 if the beneficiary was enrolled in Medicaid in any month in the year). The Chronic Condition Warehouse file was also used to produce a count of chronic conditions (range: 0–27) and indicators for key conditions of interest, including Alzheimer's disease and related dementias (ADRD), chronic kidney disease, chronic obstructive pulmonary disease, congestive heart failure, diabetes, osteoporosis, stroke, and mobility impairment.

The national AL directory contained information about AL bed size. Using data from the Dartmouth Atlas Institute, we identified the hospital referral region (HRR) in which each sample AL resided for the purpose on constructing HRR fixed effects.[33]

ANALYSIS—To examine the relationship between AL distance to the nearest hospital and rates of hospital use, we used linear regression models with hospital referral region fixed effects to account for local practice patterns with respect to hospital use.[34] As such, resulting estimates are derived from within-HRR variation in distance to the nearest hospital only. Equation 1 summarized our analytic approach.

$$Y_{i,a} = D_a + X_i + V_a + \gamma + \delta + \varepsilon_{i,a} \quad \text{Eq. 1}$$

$Y_{i,a}$ is the inpatient/ED use rate of interest for beneficiary i in AL a, D_a is the distance to the nearest hospital for AL a, X_i is a vector of beneficiary-level controls, V_a is a measure of AL community size (number of beds), γ is a hospital-referral region fixed effect, and δ is a year fixed effect. $\varepsilon_{i,a}$ is the error term clustered at the AL level.

A key assumption of our analytic approach is that AL residents do not select ALs based, in part, on their proximity to a hospital. It is possible, however, that sicker AL residents may prefer AL communities that are near or directly affiliated with a hospital. We test for evidence of such selection by estimating a version of Equation 1 where select resident characteristics are used as outcomes. The absence of a significant relationship between distance and observable resident characteristics would help reduce concerns of this potential source of bias.

We test the robustness of our results using a number of alternate specifications. We use logs of distance and deciles of actual distance as the independent variables. We also estimate versions of our base model using Poisson regression and using county, instead of HRR, fixed effects. The use of county-level fixed effects ensures any estimated differences are not driven by state-level policy differences, as well as restricts comparisons to more geographically similar areas. This study was reviewed and approved by the Institutional Review Board.

Results

The sample consisted of 540,944 resident-years in 16,514 AL communities. Table 1 details sample characteristics for residents who resided in AL communities relatively closer to the nearest hospital (i.e., at or below the median distance) and those who resided relatively further away. Resident's characteristics were generally similar between the two groups with some notable differences. Those closer to the nearest hospital were more likely to be dual-eligible (25.2% vs. 22.1%), less likely to be White, non-Hispanic race (89.1 vs. 92.2), and less likely to have been diagnosed with ADRD (32.7% vs. 33.4%).

Figure 1 displays the full distribution of calculated distances between sample ALs and the nearest hospital. The median AL was located 4.0 KM (2.5 miles) from the nearest hospital with an interquartile range of 1.9 to 7.6 KM. The use of an inverse hyperbolic sine transformation of distance normalized this distribution (eFigure 1). Within HRR and year, little association was found between mean age (eFigure 2, Panel A), mean chronic condition count (eFigure 2, Panel B), the percent dual-eligible (eFigure 2, Panel C), or the percent with an ADRD diagnosis (eFigure 2, Panel D).

In adjusted analyses, distance to the nearest hospital was negatively associated with the ED visit rate. A doubling (i.e., 100% increase) in distance was associated with 47.8 fewer ED visits per 1,000 AL resident years (95% confidence interval [CI]: −61.1, −34.5) (Table 2). This association was concentrated almost entirely in ED treat-and-release visits. A doubling of distance was associated with 43.5 fewer visits (95% CI: −53.1, −33.7) while no significant association was found between distance and ED visits resulting in an inpatient admission.

The above estimates indicate that being close to a hospital (i.e., at the 10th percentile of distance) increases the ED treat-and-release visit rate by 6.2% (95% CI: 4.5%, 7.9%) relative to the sample mean, while being relatively far from a hospital (i.e., 90th percentile of distance) decreases the ED treat-and-release visit rate by 5.4% (95% CI: −6.9%, −4.0%) (Figure 2). Little difference is noted across the distribution of distance in the rate of ED visits resulting in an admission. These results indicate that if all AL communities in our sample had ED treat-and-release visit rates equivalent to communities located at the 90th percentile of distance to the nearest hospital, 21,450 fewer ED treat-and-release visits would have been observed over our 2-year study window (see eMethods for details). Recent estimates indicate that the average ED visit for an individual aged 65 or older costs $690, suggesting a potential cost savings to Medicare of approximately $7.4 million per year.[35]

Among ED treat-and-release visits, the association with distance was largest for visits that were classified as potentially avoidable according to the NYU algorithm. Doubling the distance from the nearest hospital was associated with a 3.0% (95% CI: −4.1, −1.9) decrease in non-emergent ED visits and a 2.4% (95% CI: −3.0%, −1.0%) decrease in visits that were emergent but could have been effectively treated in a primary care setting (Figure 3). In comparison, doubling the distance from the hospital was associated with a 1.6% (95% CI: −2.4%, −0.8%) decrease in the rate of visits deemed emergent and not treatable in primary care settings. No significant relationship between distance and the rate of ED visits for injuries was found.

Results were consistent when using logged distance and indicators for deciles of distance as the independent variables in models, as well as when using Poisson regression models and linear models with county fixed effects (eTable 1, eTable 2).

Discussion

Older adults residing in an AL community located close to a hospital had more ED treat-and-release visits than those living in ALs that are further away. This difference does not appear to be driven by differences in health status. Resident characteristics do not appear to be correlated with proximity to the hospital, and distance was not associated with the likelihood of an ED visit that resulted in an inpatient admission, an indication of a clear clinical need to visit a hospital. Furthermore, the impact of distance on ED visit rates was the largest for ED treat-and-release visits that are potentially unnecessary—non-emergent and primary care treatable visits as defined by the NYU algorithm.

Results are consistent with earlier research demonstrating substantial geographic variation in AL ED visit rates after accounting resident characteristics, which may indicate that factors other than emergent clinical needs contribute to AL-to-ED transfers.[17] Our findings support the concern that ALs may rely on EDs to provide non-emergent resident care that is not offered on site.[36] Shorter distances likely reduce the inconvenience of AL-to-hospital transfers and may therefore make ALs less likely to invest in onsite treatment and diagnostic services that could prevent these avoidable visits. Coupled with a desire to avoid legal liability for making clinical decisions regarding resident care needs, the use of nearby hospitals as a substitute for primary care may be a much more economically attractive option for AL operators.[37,38]

Several interventions have shown promise in reducing AL-to-hospital transfers, including the use of telemedicine visits and shared decision-making consultations between paramedics and primary care physicians.[38–40] Additionally, there is growing interest in increasing ALs' clinical capabilities through greater employment of medically-focused staff, including nurses, nurse practitioners, and physician assistants, and the establishment of an AL medical director position.[41] All of these potential interventions would require greater financial investment on the part of ALs, particularly because many ALs do not currently have any onsite or on-call medical staff.[42] Presently, there appears to be little incentive for ALs to incur these costs. As such, reducing wasteful AL-to-hospital transfers may require policy reforms, including increased staffing and/or admission and retention requirements for ALs at the state level or creative payment models that would allow ALs to share in some of the cost savings accrued by Medicare when ED visits are prevented.[43]

This study has limitations. Due to lack of data, Medicare Advantage enrollees were not included. It is unclear whether our findings generalize to this growing portion of Medicare AL population. Consistent with prior research demonstrating reduced access to health care services in rural areas,[44–46] ALs located relatively far from hospitals could have lower ED use rates that are attributable to service availability (e.g., ambulance transport services)[47] as opposed to AL discretion. The absence of a clear relationship between distance and ED visits that result in an inpatient admission, which would \be expected to similarly be affected by access issues, suggests this explanation is not the primary driver of our observed relationship. Furthermore, our results are robust to an alternate specification that restricts comparisons to ALs located in the same county that likely face similar levels of service availability. Finally, this study is observational in nature; despite efforts to control for resident characteristics, it is possible that additional unobserved factors are associated with both ED use and proximity to the hospital, which could bias our findings. The lack of a clear association between observable resident traits and distance bolsters our confidence that risk of this potential source of bias is small.

Conclusions and Implications

Distance to the nearest hospital is an important predictor of ED use rates among AL residents, particularly for non-emergent visits. This finding supports the notion that AL facilities may rely on nearby EDs to provide non-emergent primary care for their residents, potentially placing residents at risk of iatrogenic events and generating wasteful Medicare

spending. Policy reforms are needed to incentivize AL investment in better onsite clinical services.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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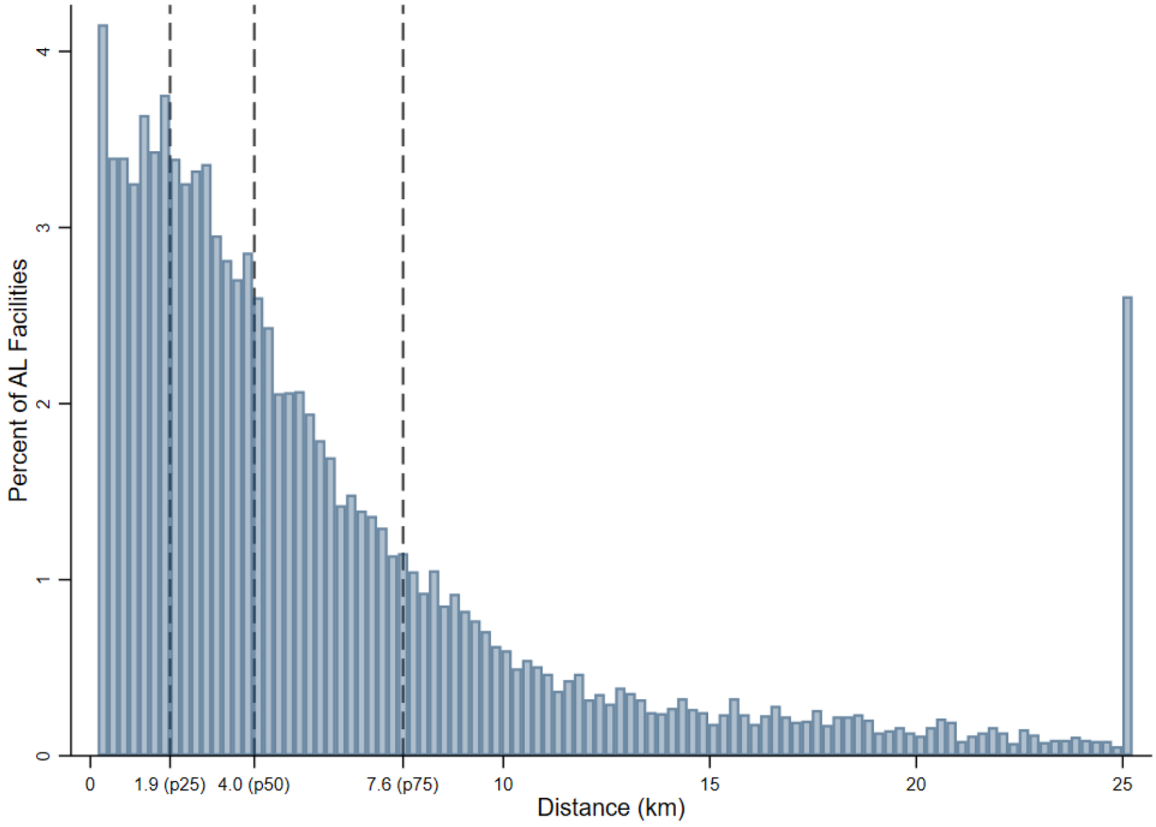

Figure 1-
Distribution of Distance to Nearest Hospital
Notes: Dashed lines denote 25th, 50th, 75th percentiles of distance from each sample assisted living community to the nearest hospital

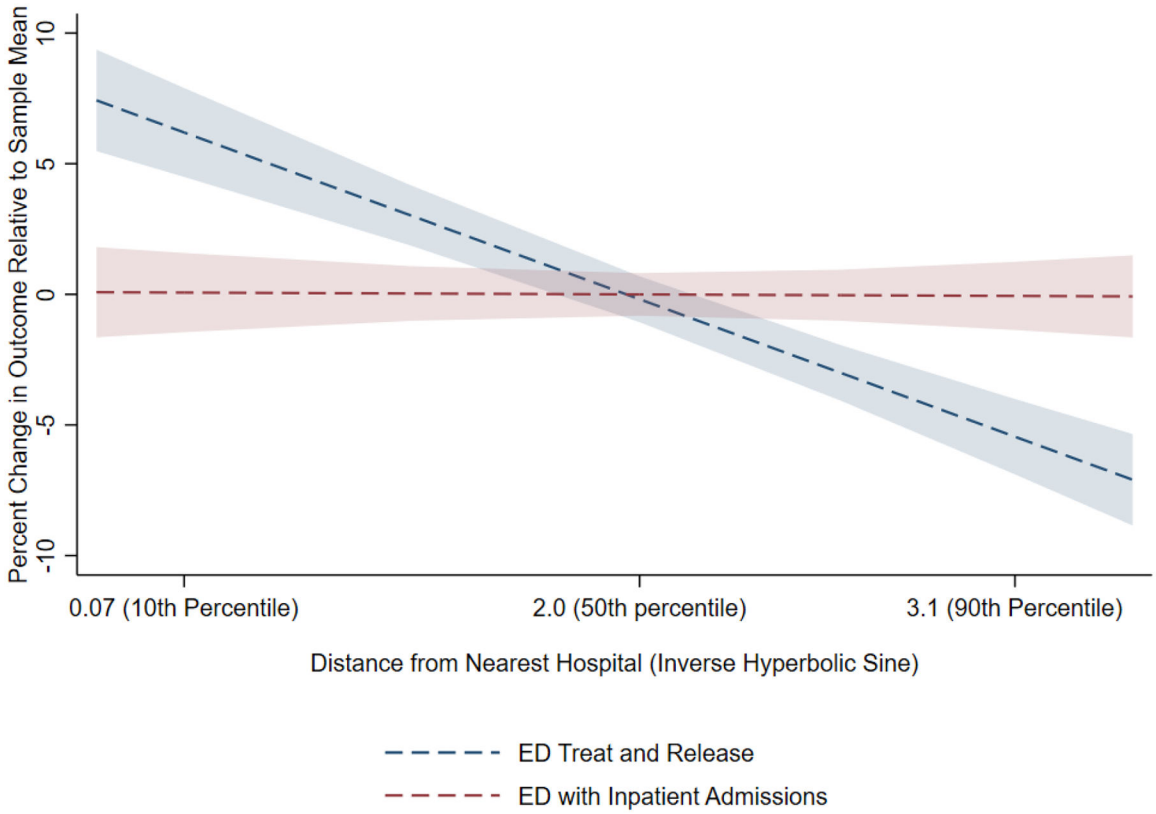

Figure 2-

Estimated change in ED use rates relative to sample means across distribution of distance to the nearest hospital by ED visit type

Notes: Estimates based on the regression estimates displayed in Table 2.

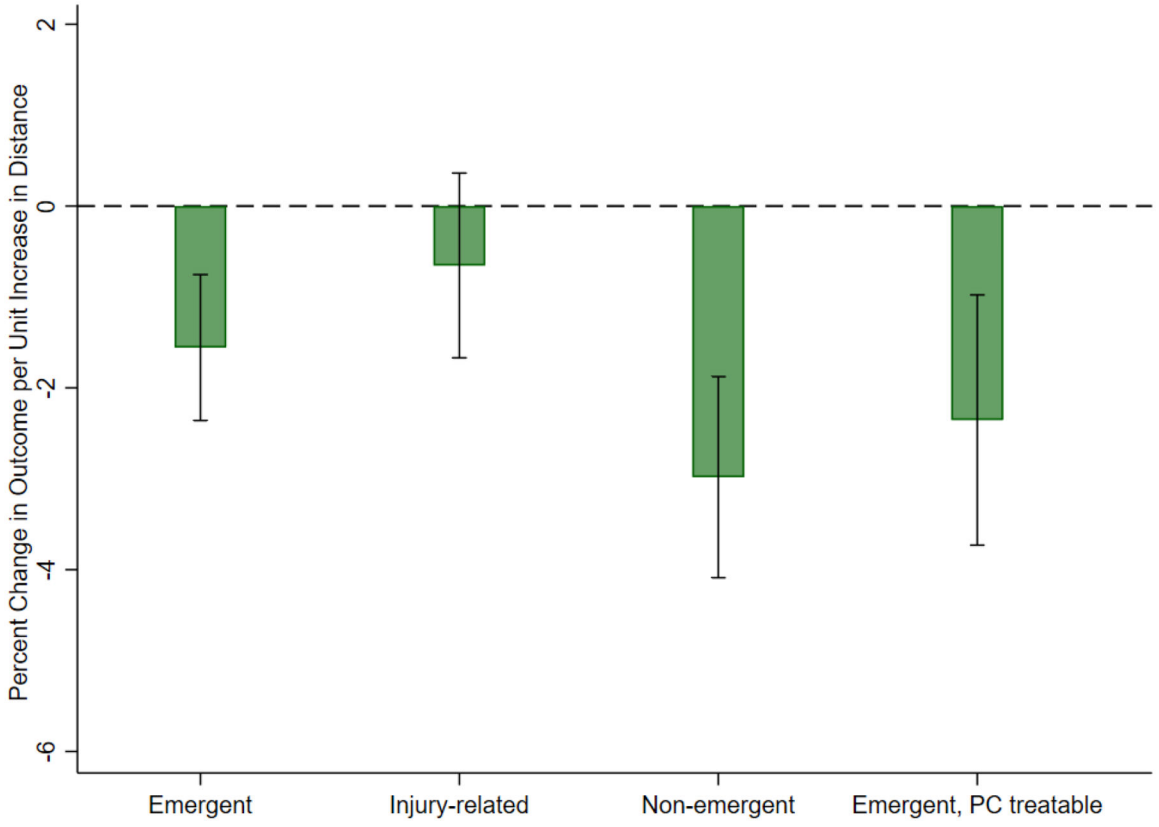

Figure 3-

Association of distance to nearest hospital and ED treat-and-release visit rates by visit types

Notes: Estimates obtained from a linear regression that controls for a number of resident characteristics, AL size, and year and hospital referral region fixed effects. Error bars represent 95% confidence intervals based on standard errors clustered at the facility level. Visit types are determined using the NYU algorithm for identifying avoidable ED visits.

Table 1-

Sample Characteristics

		Distance to the Nearest Hospital	
		<= Median Distance (closer to nearest hospital)	*> Median (further from nearest hospital)*
N (resident-years)		284,628	256,316
Total Emergency Department Visits per 1,000 Resident Years, mean (SD)		1,660.56 (2800.92)	1,602.28 (2757.14)
Distance to nearest hospital (KM), mean (SD)		1.90 (1.05)	8.41 (4.90)
Sex, N (%)	Male	96,455 (33.9%)	86,085 (33.6%)
	Female	188,173 (66.1%)	170,231 (66.4%)
Dual-eligible, N (%)		71,599 (25.2%)	56,672 (22.1%)
Age, N (%)	<65	11,686 (4.1%)	10,514 (4.1%)
	65 – 74	42,563 (15.0%)	35,551 (13.9%)
	75 – 84	73,891 (26.0%)	67,571 (26.4%)
	84 – 90	79,961 (28.1%)	74,001 (28.9%)
	91+	76,527 (26.9%)	68,679 (26.8%)
Race/Ethnicity, N (%)	White	253,680 (89.1%)	23,6380 (92.2%)
	Black, non-Hispanic	13,902 (4.9%)	9,601 (3.7%)
	Hispanic	8,241 (2.9%)	4,692 (1.8%)
	Asian/Pacific Islander	5,200 (1.8%)	3,007 (1.2%)
	Other	3,605 (1.3%)	2,636 (1.0%)
Number of Chronic Conditions [†], mean (SD)		11.98 (6.33)	12.01 (6.18)
Ever diagnosed with chronic kidney disease, N (%)		107,913 (37.9%)	97,546 (38.1%)
Ever diagnosed with chronic obstructive pulmonary disease, N (%)		90,406 (31.8%)	81,027 (31.6%)
Ever diagnosed with congestive heart failure, N (%)		102,283 (35.9%)	90,700 (35.4%)
Ever diagnosed with osteoporosis, N (%)		102,610 (36.1%)	92,488 (36.1%)
Ever diagnosed with stroke, N (%)		69,592 (24.5%)	63,181 (24.6%)
Ever diagnosed with Alzheimer's Disease and related dementias, N (%)		92,976 (32.7%)	85,514 (33.4%)
Ever diagnosed with a mobility impairment, N (%)		24,411 (8.6%)	21,781 (8.5%)
Assisted living length of stay per year, mean (SD)		291.28 (113.28)	289.21 (114.29)
Assisted living community Bed Size, N[≠] (%)	<25	2,070 (27.2%)	2,646 (29.7%)
	25–49	1,461 (19.2%)	1,690 (19.0%)
	50–74	1,446 (19.0%)	1,562 (17.5%)
	75–99	983 (12.9%)	1,218 (13.7%)
	100–149	1,135 (14.9%)	1,268 (14.2%)
	150–199	316 (4.2%)	336 (3.8%)
	200+	191 (2.5%)	192 (2.2%)

[†]Count of chronic conditions identified in the chronic condition and other condition chronic condition warehouse files at any point in the resident's Medicare tenure. Range: 0–66

[‡]Count of Assisted Living Communities in each category

Table 2-

Estimated Association between Assisted Living Community Distance to the Nearest Hospital and Emergency Department Visit Rates by Type of Visit

	(1)	(2)	(3)
	Total ED Visits per 1,000 AL Resident Years	**ED Treat and Release Visits per 1,000 AL Resident Years**	**ED Visits Resulting in an Inpatient Admission**
Distance to nearest hospital (inverse hyperbolic sine)	−47.8***	−43.5***	−0.37
	(−61.1, −34.5)	(−53.2, −33.7)	(−7.0, 6.3)

Notes: Estimates obtained from a linear regression that controls for resident characteristics, AL size, and year and hospital referral region fixed effects. 95% confidence intervals are reported in parentheses and are based on standard errors clustered at the facility level.

*** p<0.01,

** p<0.05,

* p<0.1