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Decomposing Urban and Rural Disparities of Preventable ED Visits Among Patients with Alzheimer's Disease and Related Dementias: Evidence of the Availability of Health Care Resources

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Abstract

Purpose: The purpose of this study was to examine the urban and rural differences in the frequency of preventable Emergency Department (ED) visits among Alzheimer's Disease and Related Dementias (ADRD) patients, with a focus on the availability of health care resources in urban and rural areas.

Methods: Linked datasets of 2015 State Emergency Department Databases from the Healthcare Cost and Utilization Project and the Area Health Resource File were used. ED discharges of 7 states were included in our analysis. We performed a state fixed-effect multivariable logistic regression to estimate the variation of preventable EDs by urban and rural areas. Individual characteristics and county-level health care resources were included in the estimation. The Oaxaca decomposition was used to quantify the association of county-level health care resources and urban/rural disparities.

Findings: Rural patients with ADRD had 1.23 higher adjusted odds ($P < .001$) of going to the ED for a preventable visit compared to urban counterparts. The decomposition results showed that the model specification explained 49.2% of the differences between urban and rural patients. Patient residence in a mental health professional shortage area is one of the driving factors (contributing to 27%−48%) that explained the urban and rural disparities.

Conclusions: Our study demonstrates the importance of improving health care resources in rural areas to improve health care quality and outcomes among ADRD patients who reside in rural areas. Future research and data collection on unobserved factors, such as health care quality, will be helpful in explaining the geographic differences.

Keywords

access to care; dementia; emergency department; health disparities; preventable hospitalizations

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The number of persons 65 years of age and older with Alzheimer's disease and related dementias (ADRD) in the United States is expected to reach 13.8 million by 2050, up from roughly 5.8 million persons (of all ages) in 2019.[1] In 2012, more than 70% of the aging population with ADRD had a minimum of 3 co-occurring conditions.[2] In addition, elderly individuals with Medicare who have ADRD are found to be at a higher risk of potentially avoidable hospitalizations than those without ADRD—this is further exacerbated with more difficult management of comorbidities.[3]

Based on the 2008 Health and Retirement Survey (HRS), almost 5 million Medicare beneficiaries had a minimum of 1 outpatient ED visit that year.[4] Nineteen percent of these individuals had at a minimum 1 preventable emergency department (ED) visit that was considered "potentially avoidable." Among this subset of beneficiaries with potentially avoidable ED visits, 32% were cited as having a cognitive impairment, including nearly 309,000 community-based and institutionalized persons.[4] These avoidable ED visits decrease the quality of life of beneficiaries and are an added expense to Medicare.[4] Dementia is also experienced by persons younger than 65 years of age who comprise 5% to 6% of all Alzheimer's Disease cases.[5,6]

Residing in a rural area is associated with an increased risk for an ED visit.[7] Medicare beneficiaries who reside in large and small rural areas were at a higher risk of an ED visit during 30 days after hospital discharge as compared to urban Medicare beneficiaries.[7] Additionally, being discharged from a rural hospital was associated with an increased risk of hospital readmission.[7,8] Factors such as poor health status, low socioeconomic status, and follow-up difficulties were considered as leading risks for rural residents compared to urban cohorts.[7]

Prevalence rates of dementia were significantly higher in rural areas in addition to chronic conditions and diseases (e.g., diabetes, hypertension), which have been considered as risk factors for cognitive impairment.[9] Furthermore, some studies have cited socioeconomic status as a mechanism impacting urban and rural disparities. For example, education has been recognized as improving the cognitive health of older persons.[9–11] One study found that rural residents were less likely to have college and graduate degrees as compared to their urban counterparts.[9] Individuals with low educational attainment have a higher incidence of dementia, and persons with lower educational levels live with dementia for a greater period of time and for a larger share of their life.[10]

Persons with ADRD commonly experience a mental illness.[12,13] In rural regions, mental health conditions are commonly treated in a primary care physician's (PCP) office, given the scarcity of mental health specialists.[14] Rural regions also have a shortage of health care providers with the skillset to conduct cognitive assessments and consequently provide dementia-appropriate care.[9] Aside from a shortage of medical professionals, rural residents experience challenges in managing their care. In low-resource rural areas, one potential factor driving low compliance with follow-up care (e.g., medical visits) is the dearth of transportation available, or it may be the inability to afford gas to drive long distances to medical appointments.[15] Given the multifaceted challenges in managing healthcare needs, a multisector strategy is necessary.

A multidisciplinary approach to care coordination was employed through the establishment of a community care team (CCT) in a rural Minnesota community, with a goal to improve health outcomes and decrease ED visits. Disciplines involved to improve care coordination efforts included healthcare providers and community-based organizations (e.g., those providing social services). The creation of the CCT resulted in a decline in health care utilization (e.g., ED visits) for persons with complex health conditions.[16] Rural communities should capitalize on what resources are available (i.e., providers and community organizations) to develop a collaborative team-based approach in ADRD care delivery. If individuals' care is not managed adequately, it may lead to increased utilization of health care services such as the ED.

Emerging research has focused on the social determinants of health and the availability of health care resources in rural communities. For example, the scarcity of primary care providers to facilitate follow-ups in rural areas is generally viewed as one of the major reasons for increasing the risk of an ED visit post-hospital discharge.[7] In addition, the lack of health care resources also contribute to higher financial and travel-time costs for rural residents seeking specialized care.[17] Finally, previous findings have demonstrated that rural areas experience a deficit of preventive services, which can lead to avoidable hospitalizations.[18] To our knowledge, there have been no studies focusing on the urban/rural disparities in the availability of health care resources and the difference in preventable ED visits among ADRD patients. To fill the gap in the literature, the objective of this study was to assess the urban and rural differences in preventable ED visits among ADRD patients, with a focus on the availability of health care resources in urban and rural areas. Therefore, we hypothesize that the lack of health care resources, such as the shortage of mental health care providers, is one of the major reasons that rural areas have higher rates of preventable ED visits. Such evidence is critical given that ADRD rates are increasing and there is a lack of medical resources in rural areas. We expect our findings to improve the understanding of geographic variations, specifically rural-urban differences, related to ED visits among persons with ADRD.

Methods

Data

We used the State Emergency Department Databases (SEDD) from HCUP (Healthcare Cost and Utilization Project) as administered by the Agency for Healthcare Research and Quality (AHRQ).[19] The 2015 SEDD dataset captured all ED discharge information for states' emergency departments in the year 2015. Discharges of 7 states (Arizona, Florida, Kentucky, Maryland, North Carolina, Vermont, and Wisconsin) were included based on these states having both urban and rural counties as well as the availability of the SEDD files and necessary variables, such as patients' race/ethnicity and county of residence. We further linked the SEDD data with the 2017–2018 Area Health Resources File (AHRF) to capture geographic variation at the county level.[20]

We used the ICD-9 codes in quarters 1–3 and ICD-10 in quarter 4 to code for ADRD diagnosis. The ICD-9 codes for any ADRD diagnosis code (primary, secondary, etc.) were found from the Alzheimer's Association and additional published studies.[21–23] The ICD-10 codes used for any ADRD diagnosis were cited by the Alzheimer's Association Cognitive Impairment Care Planning Toolkit.[24] All ICD-9 and ICD-10 codes used are available in Appendix 1 and 2, respectively (available online only).

Dependent Variable: Preventable ED Visits

We employed the New York University (NYU) ED visit algorithm to assess preventable ED visits based on the diagnoses as identified by ICD-9 codes[25] for quarters 1–3 and ICD-10 codes for quarter 4.[26] The NYU-ED visits algorithm classified each ED visit according to the categories of Non-emergent, Emergent/Primary Care Treatable, Emergent - ED Care Needed - Preventable/Avoidable, or Emergent - ED Care Needed - Not Preventable/ Avoidable.[27] The algorithm has been independently evaluated to be valid[28] and was patched in 2017 to improve the classification of ED visits.[29] We defined preventable ED visits as the probability of having an emergent and ED care-needed preventable/avoidable ED visit of at least 50% based on an existing measure.[30]

Key Independent Variable: Urban/Rural County Status of the Patient

The key independent variable of our study was the urban/rural county status of the patient. This was determined using the 2013 Rural-Urban Continuum Codes (RUCC) as developed by the United States Department of Agriculture (USDA) Economic Research Service (ERS)[31] and is found in the 2017–2018 AHRF file.[20] There are 9 categories in the RUCC; we designated the first 3 categories (metropolitan counties of population ≥1,000,000; 250,000 – 1,000,000; and <250,000) as urban and the last 6 categories (nonmetropolitan counties of ≥20,000; 2,500 – 19,999; and <2,500) as rural. This measure of urban and rural status has been widely used in the literature.[32–34] We used the 2013 data on urban/rural status as this variable is only updated every 10 years.

Covariates

Our covariates were chosen based on the literature from ADRD[4] and rural health studies.[8] We also used the conceptual framework from the adapted Andersen Healthcare Utilization Model, which included geographic predictors.[35] We controlled for predisposing factors of patient race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic Asian or Pacific Islander, non-Hispanic Native American, and non-Hispanic other), age (30–49, 50–64, 65–74, and 75+), gender (male or female), need factors of Elixhauser Comorbidities (we created the categories of ≤2 and >2 comorbidities as provided in a paper by Balakrishnan et al.[36]), and enabling factors of primary insurance/payer ((Medicare, Medicaid, and other (including private insurance and self-pay)). We also controlled for the disposition place of the patient after discharge with the following categories: routine (home discharge); transfer to short-term hospital; transfer to other including Skilled Nursing Facility (SNF), Intermediate Care Facility (ICF), and another type of facility; Home Health Care (HHC); and against medical advice (AMA). A time index comparing the first 3 quarters of 2015 (when hospitals used ICD-9 diagnostic codes) and the last quarter of 2015 (when hospitals switched to ICD-10 diagnostic codes) was created.

Geographic characteristics included the median household income percentiles based on the patients' ZIP Codes, which were divided into 4 quartiles (0–25th: $1 - $41,999, 26th–50th:

$42,000 - $51,999, 51st–75th: $52,000 - $67,999, 76th–100th: $68,000+).[37] County percent African American was created by calculating the population of people in the county who are non-Hispanic black and then divided by the total population of that county in 2015. County low education status was defined as having more than 20% of residents ages 25–64 who do not have a high school degree as determined by the American Community Survey 5-year average data for 2008–2012, which was obtained from the 2017–2018 AHRF dataset.[20]

We used the following measures to assess the availability of health care resources: number of MDs per 1,000 residents and hospital beds per 1,000 residents. We also included the indicator of Health Professional Shortage Area (HPSA) and Mental HPSA (MHPSA), which were obtained from the 2017–2018 AHRF dataset and defined as the county having a population to full-time-equivalent primary care physician ratio of at least 3,500:1 and a population to core mental health professional ratio greater than or equal to 6,000:1, respectively.[20] We created indicators of whole county HPSA and MHPSA if the whole county was designated as a shortage area, and not or partial HPSA county otherwise.

There were a total of 21,835,737 emergency department visits from these states for the year 2015. There were 197,502 patients in our final dataset based on a subpopulation of patients who had ADRD and complete data (this excludes 6,882 ADRD patients who had incomplete information). We also took out the patients who died in the hospital or had an unknown disposition for our analysis.

Study Design

First, we compiled the characteristics of the ADRD patient population by urban/rural county status to compare the differences between the 2 populations. Second, we performed a logistic regression of preventable emergency department visits using the covariates listed above while including state fixed effects. We then used the Oaxaca decomposition to decompose the differences between urban and rural preventable ED visit rates. The Oaxaca decomposition has been widely employed to identify and quantify the contribution of the model and a specific factor to observed differences between 2 or multiple groups.[38–40] We used the decomposition approach to estimate the contribution of individual characteristics and the county health care resources to the observed differences in preventable ED visits in rural and urban areas for patients with ADRD.

We performed a sensitivity analysis using different cutoffs for preventable ED visits and for primary care-related emergency department utilization (PCR-ED).[41] We also performed sensitivity checks on different definitions of urban and rural areas based on the RUCC, analysis for only ages 65+, and included the patients who died in a hospital or had unknown dispositions. Finally, we performed another logistic regression and decomposition for only the patients who had a routine disposition as a sensitivity analysis to confirm that our results are robust.

Results

Demographic Characteristics

Table 1 presents the characteristics of urban and rural ADRD patients. The results showed significant differences in patients' characteristics by urban and rural status. Preventable ED rates were significantly higher in rural areas (7.86% vs. 5.21%, $P < .001$). Urban residents with ADRD were more likely to be black or Hispanic, and more likely to have a home discharge compared to rural counterparts. Over 60% of all rural ADRD patients live in a ZIP Code with a median household income from the lowest quartile compared to urban patients who are well balanced among the income quartiles. Also, very few of the urban patients reside in a low education county (0.94%) whereas 25.67% of rural patients do. In addition, the percentage of urban patients who live in an HPSA or mental health HPSA county (1.24% and 21.28%, respectively) is much lower compared to rural patients (15.65% and 59.56%, respectively).

Preventable ED Visits Characteristics

In Table 2 we present the results regarding the logistic regression of preventable emergency department visits using the covariates and state fixed effects. We found that rural patients experienced preventable ED visits at 1.23 higher odds (SE=0.06) than urban patients, and this was significant at the 0.05 significance level. Compared to white patients, black and Hispanic patients with ADRD were more likely to have preventable ED visits. Having more than 2 comorbidities was associated with a higher prevalence of preventable ED visits, as having 2 or more comorbidities increased the odds by 2.84 (SE=0.06). Finally, residing in a mental health HPSA county increased the odds of preventable ED visits by 1.17 (SE=0.04).

Decomposition Results

Table 3 presents the decomposition results for urban and rural preventable ED Visits. In model 1, we included the ADRD patients with all of the different disposition locations (routine, transfer to short-term hospital, transfer to other, home health care, and against medical advice). The disposition location was a significant determinant of preventable ED visit status, as non-routine discharges were associated with a higher risk of a preventable ED visit. These patients tend to suffer from more severe ailments that require further medical attention and yet they are also more likely to go to the ED for preventable reasons. Hence, we also applied our analysis among ADRD patients who were only discharged to routine care to get a more homogeneous sample (Model 2).

The decomposition method in model 1 explained 49.2% of the differences between urban and rural patients. As such, 50.8% of the observed difference of preventable ED visits by urban and rural status was unexplained by individual characteristics and county health care resources. The county mental HPSA explained 27.82% ($P < .001$) of the observed rural and urban difference. Significant state variations were also observed. Similar trends were observed in Model 2, which explained 42% of the difference. County mental HPSA was also the leading factor contributing to the observed urban-rural difference.

Discussion

Our study found significant differences in the availability of health care providers and state variations in rural and urban regions, and these differences were driving forces in explaining higher preventable ED visits among ADRD patients in rural counties, compared to urban ones. Our finding is consistent with the literature that shows a lack of health care providers with the skillset to conduct cognitive assessments and provide dementia-appropriate care in rural regions.[9]

Our findings also show that patients who visit a hospital in a county designated as a mental health HPSA are at a higher risk of having a preventable ED visit. This is significant since mental illness is common for ADRD patients.[12,13] Most older adults with dementia residing in the community will experience psychiatric symptoms—such as depression or anxiety—in a period of 5 years.[42] The majority of patients with dementia will develop a minimum of 1 behavioral and psychological symptom of dementia, which results in adverse outcomes, such as hospitalizations and even premature nursing home use.[43] It is likely that timely mental health treatment and prevention can improve care efficiency.[44]

Patients with more than 2 comorbidities in our sample had a significantly greater risk of preventable ED visits. Rural patients had higher rates of having more than 2 comorbidities, which reveals a disparity in general well-being. This finding emphasizes the importance of managing chronic conditions as they can exacerbate and increase the chances for preventable visits to the ED if not properly managed.

We used a diverse set of states in our sample, and there were significant state variations in preventable ED visits. This provides evidence that there may be state-level characteristics and policies that contribute to their differences. Some states, such as Kentucky, had variations that explained a significant amount of the differences between urban and rural patients. Previous research has found that states with higher rurality had more policy activity on the federal and state level rather than the local level.[45–47] Improving the understanding of state/regional differences, specifically related to factors that may increase the likelihood of an ED visit, may allow for better planning among health care providers in the area.

Various sensitivity analyses have been tested. We conducted a sensitivity analysis to investigate only routinely discharged patients since patients being discharged to nursing homes or other facilities tended to have more severe diseases. Our sensitivity analysis of only the patients who had a routine disposition showed that rural patients had 1.18 greater odds of a preventable ED visit (SE=0.05, $P < .001$) than urban patients (available online only). This shows that our results are robust to patients who underwent routine home discharges. We also created cutoffs of 40% and 60% to check for a robust definition of preventable ED visit as well as for PCR-ED utilization, and we found that our results are consistently significant (full results are available upon request).

Although we attempted to capture a comprehensive list of predictors of having a preventable ED, these variations only explained 49.2% of the urban and rural differences. Our decomposition shows that there was a remaining 50.8% of unobserved differences between urban and rural patients. This may be due to differing levels of illness severity and hospital measures such as quality of care and preference of hospitals that were not measured in this study. Further research can highlight this area as a possible explanation of prevailing disparities.

Limitations

There were a few limitations in our study. First, the discharge-level data uses a cross-sectional design, which limits our findings such that they cannot be used for causal inference of the outcome. Furthermore, the change from ICD-9 diagnostic codes in the first 3 quarters of 2015 to ICD-10 codes in the last quarter of 2015 can lead to diagnosing differences between ADRD patients depending on which quarter they went to the ED. Our study used hospital ED discharges from 7 states based on the availability of SEDD files and necessary variables, such as patients' race and ethnicity, as well as the AHRF geographic linkage, such as patient's county of residence, and as such the results may not be generalizable at the national level. Future research that analyzes geographic measures at a smaller scale, such as the census tract or ZIP Code level, can provide more accurate measures of the social determinants of health. Future research and data collection on unobserved factors, such as health care quality, patient preference, and provider characteristics will be helpful in explaining the geographic differences. Finally, there is the limitation of mental health measures not being classified as preventable in the NYU algorithm. In future studies, more specific measures should be designed to have a better understanding of ED use of the ADRD population, and especially those with mental health needs.

Policy Implications

Although we do not have direct empirical evidence, we speculate on some community and policy interventions to promote rural health for ADRD patients as follows.

Health Information Technology—Using telehealth in rural communities may help improve access to needed health care services. Providing broadband Internet access in rural regions has several benefits, including advancing the health of rural persons as well as its vital role in telemedicine.[48] The use of telemedicine in rural regions may expand access to health care services for beneficiaries and increase the quality of care.[49]

Workforce—More effort should be made to encourage health care providers to focus on geriatric care (e.g., through loan forgiveness) and to recruit and retain direct care workers.[50] In the next 20 years we will experience a dearth of several health care professions, such as primary care providers and geriatricians.[50] Additionally, providers with geriatric proficiency are less likely to work in rural settings. This is especially of concern to rural communities where aging adults make up a disproportionate number of the residents and tend to have worse health.[50] In addition, initiatives that support family caregivers—who furnish the majority of personal services to aging adults—have demonstrated success in decreasing nursing home admissions as well as utilization of acute care.[50] Hence, increased attention to the role of caregivers for rural beneficiaries may be a priority for health care providers.

Mental Health Integration—Our results support the promotion of public-private collaborations,[48] especially mental health integration. Given the high prevalence rate of mental illness among the aging population and those with dementia, early detection of mental illness and effective management of mental conditions can be cost-effective in terms of delaying cognitive impairment and improving the treatment for other co-existing conditions. Timely psychiatric treatment for age-related mental disorders and public health systems tailored for an age-friendly community can improve care efficiency.[51,52]

Care Coordination—Care coordination has the possibility to influence care outcomes as it takes into account medical and non-medical needs.[53] Given the shortage of health care personnel in rural areas, some communities are selecting to use emergency medical services (EMS) staff as care coordinators.[54] In rural areas, beneficiaries utilize the ED more often than non-rural regions, and these visits may avert the finite supply of paramedics from persons experiencing true emergencies. The Pennel study found that care coordination via an EMS model to be an encouraging mechanism to meet both the medical and non-medical needs of recurrent EMS users in rural communities.[54] The study also suggested that Accountable Care Organizations (ACOs), local health clinics, Patient-Centered Medical Homes, and others directly hire paramedics during off-hours to provide care coordination.[54] Rural communities should identify innovative ways to address care coordination challenges, with one being the use of EMS staff.

Our study demonstrates the importance of improving health care resources in rural areas in order to advance health care quality among ADRD patients who reside in rural areas. Further research can be performed to analyze policies that can be implemented to reduce the disparities and ameliorate the differences in preventable ED visits.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Study Population Characteristics of Patients with ADRD by Urban/Rural

Variable	Urban (%)	Rural (%)	*P* value
Preventable ED Visit Status			< .001
Not Preventable	154,598 (94.79)	31,707 (92.14)	
Preventable	8,492 (5.21)	2,705 (7.86)	
Race			< .001
Non-Hispanic White	123,930 (75.99)	28,649 (83.25)	
Non-Hispanic Black	22,499 (13.80)	4,093 (11.89)	
Hispanic	13,389 (8.21)	914 (2.66)	
Non-Hispanic Asian/Pacific Islander	1,206 (0.74)	52 (0.15)	
Non-Hispanic Native American	754 (0.46)	596 (1.73)	
Non-Hispanic Other	1,312 (0.80)	108 (0.31)	
Gender			.855
Male	58,317 (35.76)	12,287 (35.71)	
Female	104,773 (64.24)	22,125 (64.29)	
Age group			< .001
30–49 years old	1,420 (0.87)	297 (0.86)	
50–64 years old	7,971 (4.89)	1,737 (5.05)	
65–74 years old	22,186 (13.60)	5,429 (15.78)	
75+ years old	131,513 (80.64)	26,949 (78.31)	
Income Quartile by ZIP Code			< .001
0–25th percentile	48,609 (29.81)	21,406 (62.21)	
26th–50th percentile	46,882 (28.75)	9,843 (28.60)	
51th–75th percentile	37,965 (23.28)	2,977 (8.65)	
76th–100th percentile	29,634 (18.17)	186 (0.54)	
Disposition Location			< .001
Routine	122,892 (75.35)	23,152 (67.28)	
Transfer to Short-term Hospital	5,110 (3.13)	3,751 (10.90)	
Transfer to SNF/ICF/Other	28,999 (17.78)	6,681 (19.41)	
Home Health Care	4,912 (3.01)	702 (2.04)	
Against Medical Advice	1,177 (0.72)	126 (0.37)	
Primary Payer			< .001
Medicare	141,044 (86.48)	29,926 (86.96)	
Medicaid	3,737 (2.29)	748 (2.17)	
Other	18,309 (11.23)	3,738 (10.86)	
Elixhauser Comorbidities			< .001
≤2	112,591 (69.04)	22,711 (66.00)	
>2	50,499 (30.96)	11,701 (34.00)	
Time Index			< .001
Q1–Q3	122,881 (75.35)	26,238 (76.25)	
Q4	40,209 (24.65)	8,174 (23.75)	

Variable	Urban (%)	Rural (%)	*P* value
County Average Percent African American	15.37%	12.01%	< .001
County MD's per 1000 Residents	2.63	2.63	.530
County Hospitals Beds per 1000 Residents	2.80	2.37	< .001
County Health Professional Shortage Area			< .001
Not/Part of County HPSA	161,066 (98.76)	29,028 (84.35)	
Whole County HPSA	2,024 (1.24)	5,384 (15.65)	
County Mental Health Professional Shortage Area			< .001
Not/Part of County Mental Health HPSA	128,383 (78.72)	13,915 (40.44)	
Whole County Mental Health HPSA	34,707 (21.28)	20,497 (59.56)	
County Low Education Status (ages 25–64)			< .001
≥20% High School Graduate	161,555 (99.06)	25,577 (74.33)	
<20% High School Graduate	1,535 (0.94)	8,835 (25.67)	
States (% urban/rural patients of state in italics)			< .001
Arizona	21,183 (12.99)	929 (2.70)	
	95.80	*4.20*	
Florida	62,429 (38.28)	2,374 (6.90)	
	96.34	*3.66*	
Kentucky	8,954 (5.49)	8,350 (24.26)	
	51.75	*48.25*	
Maryland	20,228 (12.40)	896 (2.60)	
	95.76	*4.24*	
North Carolina	37,237 (22.83)	15,233 (44.27)	
	70.97	*29.03*	
Vermont	183 (0.11)	238 (0.69)	
	43.47	*56.53*	
Wisconsin	12,876 (7.90)	6,392 (18.57)	
	66.83	*33.17*	
Overall	163,090 (82.58)	34,412 (17.42)	< .001

Notes. Dataset: 2015 State Emergency Department Databases (SEDD) from HCUP (Healthcare Cost and Utilization Project) as administered by the Agency for Healthcare Research and Quality (AHRQ). *P* value is based on the $\chi 2$ test. The range for each income quartile is as follows; 0–25th: $1 - $41,999, 26th–50th: $42,000 - $51,999, 51st–75th: $52,000 - $67,999, 76th–100th: $68,000+. There were 204,384 observations before regression and 197,502 after taking out incomplete cases which results in 6,882 missing. Race/ethnicity is missing 1,197, gender is missing 23, insurance is missing 46, zip code income is missing 3,419, and disposition is missing 2,266 (these numbers are not mutually exclusive). The missing values make up only 3.3% of the total sample.

Table 2.

Logistic Regression of Preventable ED Visits for Patients with ADRD

Variable	Odds Ratio	Standard Error	*P* value
Urban/Rural Status			
Urban	Ref		
Rural	1.23	0.06	< .001
Race			
Non-Hispanic White	Ref		
Non-Hispanic Black	1.23	0.04	< .001
Hispanic	1.16	0.05	< .001
Non-Hispanic Asian/Pacific Islander	1.02	0.13	.863
Non-Hispanic Native American	0.81	0.11	.107
Non-Hispanic Other	0.97	0.12	.834
Gender			
Male	Ref		
Female	0.92	0.02	< .001
Age group			
30–49 years old	Ref		
50–64 years old	1.17	0.14	.177
65–74 years old	1.07	0.13	.547
75+ years old	0.96	0.11	.710
Income Quartile by ZIP Code			
0–25th percentile	Ref		
26th–50th percentile	0.96	0.03	.155
51st–75th percentile	0.96	0.03	.227
76th–100th percentile	0.97	0.04	.437
Disposition Location			
Routine	Ref		
Transfer to Short-term Hospital	1.79	0.07	< .001
Transfer to SNF/ICF/Other	0.89	0.02	< .001
Home Health Care	1.35	0.07	< .001
Against Medical Advice	1.18	0.14	.171
Primary Payer			
Medicare	Ref		
Medicaid	0.93	0.07	.340
Other	1.01	0.03	.721
Elixhauser Comorbidities			
≤2	Ref		
>2	2.84	0.06	< .001
Time Index			
Q1–Q3	Ref		
Q4	1.04	0.02	.100

Variable	**Odds Ratio**	**Standard Error**	***P* value**
County Average Percent African American	1.00	0.001	.554
County MD’s per 1000 Residents	0.99	0.01	.138
County Hospitals Beds per 1000 Residents	0.99	0.01	.150
County Health Professional Shortage Area			
Not/Part of County HPSA	Ref		
Whole County HPSA	1.04	0.05	.401
County Mental Health Professional Short Area			
Not/Part of County Mental Health HPSA	Ref		
Whole County Mental Health HPSA	1.17	0.04	< .001
County Low Education Status			
≥20% High School Graduate	Ref		
<20% High School Graduate	1.01	0.05	.720
State			
Florida	Ref		
Maryland	1.12	0.05	.008
Wisconsin	1.16	0.05	< .001
Arizona	0.90	0.04	.024
Kentucky	1.36	0.05	< .001
North Carolina	0.99	0.03	.732
Vermont	1.10	0.24	.676

Notes. Dataset: 2015 State Emergency Department Databases. Seven states (Florida, Maryland, Wisconsin, Arizona, Kentucky, North Carolina, Vermont) of SEDD data were included. This model passed the collinearity test. *P* value is based on the $\chi 2$ test.

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Table 3.

Decomposition Results to Explain Urban and Rural Disparities of Preventative ED Visits for Patients with ADRD

Full Sample (*n* = 197,502)				**Routine Discharge Only (*n* = 146,044)**		
Predicted Probability	Difference	%	*P* value	Difference	%	*P* value
Urban	. 0520694			. 0507926		
Rural	. 0786063			. 0666465		
Difference	−.0265369	100		−.0158539	100	
Difference Explained	−.0130439	49.2		−.0066538	42.0	
Difference Unexplained	−.0134930	50.8		−.0092002	58.0	
Explanatory factors of urban and rural disparities						
Non-Hispanic Black	.0002316	−1.78	< .001	.0001233	−1.85	< .001
Hispanic	.0004893	−3.75	< .001	.0003948	−5.93	.002
Non-Hispanic Asian/Pacific Islander	.0000079	−0.06	.862	.0000178	−0.27	.687
Non-Hispanic Native American	. 0001593	−1.22	.116	.0001892	−2.84	.116
Non-Hispanic Other	−.0000077	0.06	.835	−.0000283	0.43	.420
Female	.0000025	−0.02	.855	.0000005	−0.01	.975
50–64 years old	−.0000153	0.12	.364	−.0000280	1.40	.294
65–74 years old	−.0000918	0.70	.551	−.0000929	1.91	.618
75+ years old	−.0000597	0.46	.713	−.0001115	1.68	.600
26th–50th percentile ZIP Code Income	−.0000032	0.02	.618	−.0000117	0.18	.471
51st–75th percentile ZP Code Income	−.0003180	2.44	.228	−.0000693	1.04	.792
76th–100th percentile ZIP Code Income	−.0003057	2.34	.440	−.0001637	2.46	.686
Transfer to Short-term Hospital	−.0027184	20.84	< .001			
Transfer to SNF/ICF/Other	.0001183	−0.91	< .001			
Home Health Care	.0001755	−1.35	< .001			
Against Medical Advice	.0000348	−0.27	.174			
Medicaid	−.0000048	0.04	.440	.0000004	−0.01	.916
Other Insurance	.0000026	−0.02	.725	−.0000036	0.05	.566
>2 Comorbidities	−.0019013	14.58	< .001	−.0010359	15.57	< .001
Q4 Time Index	.0000202	−0.15	.135	.0000297	−0.45	.065
County Average Percent African American	.0001213	−0.93	.559	.0002268	−3.41	.176
County MDs per 1000 Residents	.0000039	−0.03	.641	−.0001090	1.64	.090
County Hospital Beds per 1000 Residents	−.0004793	3.67	.007	−.0000749	1.13	.682
Whole County HPSA	−.0003618	2.77	.401	−.0000448	0.67	.925
Whole County MHPSA	−.0036294	27.82	< .001	−.0032166	48.34	< .001
County Low Education	−.0002481	1.90	.719	−.0002815	4.23	.717
Maryland	.0006534	−5.01	.008	.0006366	−9.57	.008
Wisconsin	−.0009419	7.22	< .001	−.0003355	5.04	.118
Arizona	−.0006202	4.75	.026	−.0002133	3.21	.455
Kentucky	−.0033758	26.57	< .001	−.0025219	37.90	< .001
North Carolina	.0001394	−1.07	.736	.0001389	−2.09	.770

Full Sample (n = 197,502)				Routine Discharge Only (n = 146,044)		
Vermont	−.0000321	0.25	.667	−.0000694	1.04	.331

Notes. Dataset: 2015 State Emergency Department Databases. In the routine (home) discharge analysis, we excluded 51,458 discharges to Short-term Hospitals, Skilled Nursing Facility, Intermediate Care Facility, Another Type of Facility, Home Health Care, and Against Medical Advice.