Geographic Variation in United States Health Care Spending by Condition and Rurality, 2019

Abstract

Purpose: Health care spending varies substantially across U.S. counties, yet nationally, patterns across the rural-urban continuum are poorly understood. To fill this gap, we analyzed urban/rural health care spending disparities to identify drivers of variation and inform equitable health policy.

Methods: We analyzed county-level spending data for 2010 and 2019 from the Institute for Health Metrics and Evaluation Disease Expenditure Project (3,108 counties). Spending and utilization were age- and sex-standardized, categorized by type of care, payer, and 148 health conditions. Counties were classified as rural or urban using USDA Urban Influence Codes. Decomposition analyses assessed contributions of service utilization versus price/intensity to rural-urban spending differences.

Results: In 2019, per capita health care spending averaged $6,493, with rural counties spending 10.4% less than urban ($6,228 vs. $6,948). Relative to median household income, however, this spending represented a greater financial burden in rural counties (11.9% vs 10.6%). Spending differences persisted across all payers and most care types, with urban spending higher than rural spending, except nursing home care. Decomposition showed that both lower utilization and prices contributed to rural spending gaps, with variation by care type and region. For heart failure and Alzheimer's disease, rural counties spent more than urban.

Conclusions: Disparities in rural-urban spending reflect structural differences in access, utilization, and pricing, rather than lower health needs. Despite lower absolute spending, rural households face disproportionately higher economic burdens.

INTRODUCTION

In 2019, personal health care spending (i.e., health care spending on individuals rather than public health initiatives, capital investments, and public health) in the United States (U.S.) exceeded $3.8 trillion annually and accounted for over 17.7% of the national gross domestic product.[1] These expenditures, however, are not uniformly distributed throughout the country. Recent research identified substantial variation in health care spending across U.S. counties, with annual average age-standardized spending per capita estimates ranging from $3,410 in Clark County, Idaho, to $13,332 in Nassau County, New York.[2] Further analysis suggests that most of this variation is attributable to differences in health care utilization across the country.[3] However, the extent to which this geographic spending variation aligns with the rural-urban continuum, and what drives any such differences, remains poorly understood.

This gap in understanding is particularly consequential given well-documented disparities in rural health. Although rural areas may have lower health care spending, there is no shortage of need for care. Rural areas often experience greater burdens of disease and poorer health outcomes.[4] These populations are older on average, with 19.9% of rural residents aged 65 years or older compared to 16.0% among their urban counterparts.[5] Additionally, rural Americans have higher rates of mental health conditions, injuries, chronic diseases, disabilities, and mortality.[6] Indeed, a widening rural mortality penalty has been documented: since the mid-1980s, all-cause mortality has consistently been higher in rural versus urban areas, with the gap continuing to grow, driven by excess deaths from cardiovascular diseases, injuries, chronic respiratory diseases, and other conditions for which rural health care access may be insufficient.[7,8]

Rather than reflecting lower need, reduced health care spending in rural communities likely signals inadequate access to services. Rural communities experience shortages of primary care and specialist providers, with significantly fewer than in urban communities.[9,10] The scarcity of services and vast geographic distances often lead rural residents to rely on emergency departments for conditions that could be treated in lower-acuity settings,[10,11] or to travel long distances to access needed care, a trend that has worsened over time.[12] Compounding these challenges, rural residents are more likely than urban residents to be under- or uninsured, face financial hardship, experience transportation barriers (including

the absence of public transportation), and lack access to technology and reliable broadband internet for telehealth services than urban residents.[6,13,14]

Despite these well-documented differences between rural and urban communities in health outcomes, health care access, and socioeconomic factors, all of which influence health care spending, existing research on health care spending patterns across the rural-urban continuum remains limited. Specifically, a detailed analysis of spending by health condition and the factors driving spending differences across rurality is lacking. To address these gaps, we analyzed health care spending across rurality in the U.S., disaggregated by payer, type of health care service, and health condition from 2010 to 2019. Our goals were to measure rural-urban variation in age-standardized per capita health care spending, identify health conditions with the largest disparities in spending and utilization, and identify factors that contribute to variation in health care spending in rural and urban U.S. counties.

METHODS

We extracted data from the Institute for Health Metrics and Evaluation's Disease Expenditure (DEX) Project. This project generates spending and utilization estimates for 3,110 U.S. counties (counties with boundary changes were combined to ensure continuity across time). Estimates are stratified by age and sex (38 groups), type of care (7 types), payer (4 categories), and health condition (148 categories). The DEX project utilized health care spending data from multiple sources, including the Centers for Medicare and Medicaid Services (Medicare and Medicaid claims, Nursing Facility Cost reports, Geographic Variation Dataset, and National Expenditure Accounts), the Agency for Health care Research and Quality (Health care Cost and Utilization Project and Medical Expenditure Panel Survey), and private insurance data (e.g., Health Care Cost Institute, Kythera, and Market Scan). Costs were not available for durable medical equipment or Veterans Affairs Department, Indian Health Service, and Tricare. Data were obtained for 2010 and 2019; estimates were age- and sex-standardized and adjusted to 2019 U.S. dollars (USD). Detailed methods on data collection and harmonization have been reported elsewhere.[2,3]

Each encounter was assigned a type of care (ambulatory, dental, emergency department, home health, inpatient, nursing facility, or prescribed pharmaceuticals), payer (Medicare, Medicaid, private

insurance, or out-of-pocket), and health condition. Diagnosis codes associated with each encounter were categorized into 148 health conditions and also aggregated into 24 parent groups of health conditions (see previous publication[2] for detailed methods for identifying and categorizing health conditions).

Spending and utilization estimates were based on the patient's residence. Each health care encounter that did not report county of residence was probabilistically assigned to a county based on the proportion of residential addresses from its ZIP code that fell within each overlapping county.[2] Counties were assigned one of nine Census Divisions and categorized as rural or urban using the U.S. Department of Agriculture's Economic Research Service 2013 Urban Influence Codes (UIC) taxonomy. Counties with UIC 1-2 were coded as urban, and counties with UIC 3-12 were coded as rural. Because the parent study relied upon historical county boundaries, counties that later split remained merged in our dataset. Two counties with mixed rural-urban classifications (different UIC codes) were excluded from rural-urban comparisons. The final dataset included 3,108 counties total. Median household income (2019 USD) for each county was obtained from the Small Area Income and Poverty Estimates Program of the US Census Bureau and the Bureau of Labor Statistics.[15,16]

Primary outcomes of interest were county-level health care spending (2019 USD) and utilization (number of encounters, where an encounter is a visit, admission, or filled prescription). We compared the following measures between rural and urban counties: spending by payer and type of care, number of encounters by type of care (ambulatory, emergency department, inpatient, etc.), 2010-2019 annual growth rate in spending by health condition, and rank of health condition by total spending. Differences in spending across health conditions in rural versus urban counties were compared using t-tests. We conducted a Das Gupta decomposition analysis comparing health care spending per capita in rural versus urban counties within each Census Division. After standardizing for county-level age, sex, and disease prevalence, the analysis decomposed remaining spending differences into two components: (1) utilization of services and (2) service price and intensity.

RESULTS

The mean age- and sex-standardized per capita health care spending in the U.S. was $6,493 (95% confidence interval [CI]: 6,474-6,529) in 2019. Health care spending varied widely across rural and urban

counties (Figure 1, left panel), with some states showing substantial variation across counties in mean county-level age- and sex-standardized per capita spending (e.g., Colorado, Texas, Idaho), and others showing less variation (e.g., New York, California, Louisiana) (Supplemental Table 1). On average, health care spending in rural counties (n=1,962) was 10.4% lower than in urban counties (n=1,146) (rural $6,228 [95% CI: 6,204-6,256]; urban $6,948 [95% CI: 6,931-6,999]). Rural counties also exhibited less spending heterogeneity than urban counties (Figure 1, right panel; coefficient of variation: 0.097 vs. 0.127).

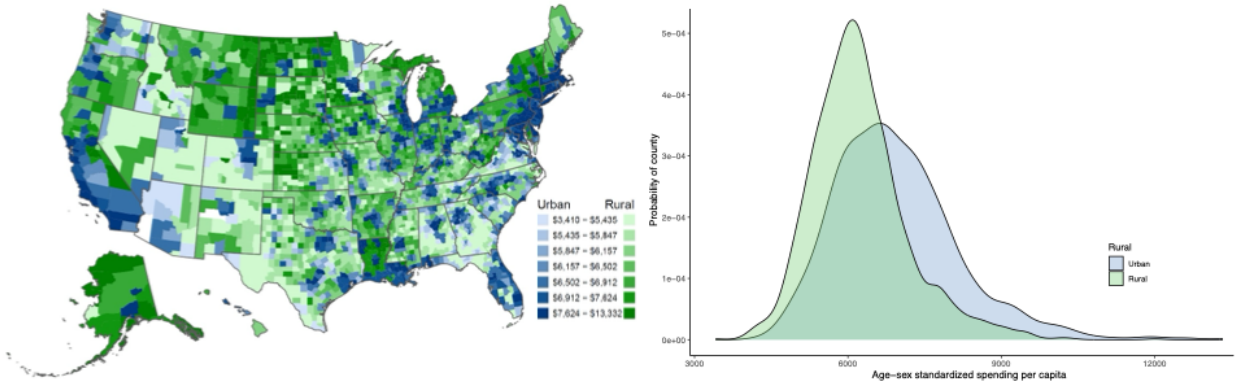


Figure 1. Geographic distribution and probability density of age- and sex-standardized per capita health care spending in rural and urban U.S. counties (2019 USD). Left panel: County-level geographic distribution of spending. White areas indicate historically merged counties based on 1980 boundaries in the parent dataset; these areas now comprise separate rural and urban counties but cannot be disaggregated in the present analysis. Right panel: Probability density distributions illustrating higher mean spending and greater variation in urban compared with rural counties.

Health Care Spending by Payer

Across all payer types, the inflation-adjusted, mean age-sex standardized spending per beneficiary remained significantly higher in urban counties than in rural counties ($p<0.05$), as shown in the boxplot in Figure 2 (left panel). Health care spending, however, accounted for a significantly higher share of median household income in rural counties than in urban counties, regardless of payer (Figure 2, right panel). Overall, health care spending for residents of rural counties comprised 11.9% (95%: CI: 11.9-12.0) of median household income, compared to 10.6% (95% CI: 10.6-10.7) for urban residents. Detailed estimates by payer are provided in Supplemental Table 2.

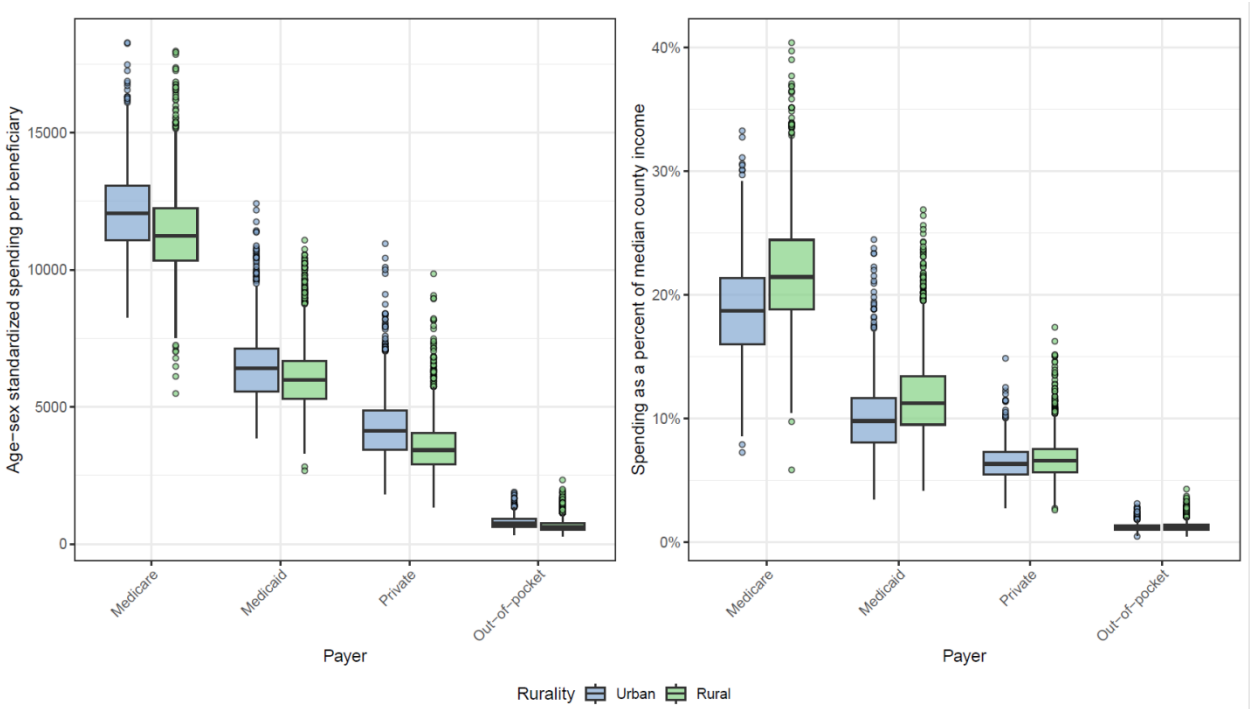


Figure 2. Boxplot distribution of health care spending (2019 USD, age- and sex-standardized) per capita in rural and urban U.S. counties across payer type (left) and spending by payer type as a percentage of 2019 median county income (right).

Health Care Spending and Utilization by Type of Care

Overall, ambulatory and inpatient care were the costliest types of care, with mean age- and sex-standardized per capita spending of $2,642 (95% CI: 2,634-2,649) and $1,682 (95% CI: (1,666-1,722) (Table 1). Spending was higher in urban counties compared to rural counties for all types of health care except nursing facility care, where per capita spending was higher in rural counties ($560; 95% CI: 557-564) than urban counties ($546; 95% CI: 545-548; p<0.01). The magnitude of rural-urban differences varied by type of care. The largest gaps were observed for dental visits, where rural spending was 70.0% of urban spending, and for prescription drugs (84.9%) and ambulatory care (86.4%). In contrast, emergency department (95.3%), inpatient (96.1%), and home health spending (91.5%) showed smaller rural-urban differences. Spending also varied across Census Divisions (Supplemental Table 3). New England had the highest ambulatory and dental spending, while the Middle Atlantic had the highest inpatient, home health, and nursing facility spending. Relative to the national mean spending estimates, the Middle Atlantic Census Division had the highest home health, inpatient, nursing facility, and

prescription drug spending, while the Mountain Census Division had the lowest home health, nursing facility, and prescription drug spending (Supplemental Figure 1).

Table 1. Inflation-adjusted, mean (95% CI) per capita age- and sex-standardized health care spending by care type in rural and urban U.S. counties (2019 USD)

	Ambulatory	Dental visits	Emergency department	Home health	Inpatient	Nursing facility	Prescription drugs
Overall (USA)	2,642 (2,634-2,649)	243 (241-245)	164 (163-164)	313 (311-318)	1,682 (1,666-1,722)	555 (552-558)	894 (891-897)
Rural Counties (n=1962)	2,497 (2,488-2,508)	210 (208-212)	161 (159-162)	303 (300-310)	1,658 (1,640-1,693)	560 (557-564)	839 (834-844)
Urban Counties (n=1146)	2,889 (2,885-2,893)	300 (299-301)	169 (168-170)	331 (330-332)	1,725 (1,710-1,774)	546 (545-548)	988 (987-989)
Rural-to-Urban Spending	86.4% (86.2 - 86.8)	69.9% (69.4 - 70.4)	95.3% (94.1 - 96.0)	91.6% (90.7 - 93.4)	96.1% (95.3 - 97.0)	102.6% (102.0 - 103.3)	84.9% (84.5 - 85.4)

Note: Rural-to-Urban Spending is average spending in rural counties as a percentage of average urban spending in urban counties ($\frac{Rural\ spending}{Urban\ spending} \times 100$).

Drivers of Health Care Spending

Decomposition analysis compares per-capita spending in rural versus urban counties within each Census Division, disaggregated by type of care and standardized for county-level age, sex, and disease prevalence (Figure 3). Rural-urban spending differences are influenced by both utilization patterns and price/intensity effects, though the relative contribution of these drivers varies across Census Divisions and types of care. For ambulatory care services, mean rural spending was consistently lower than urban spending across all Census Divisions; however, price/intensity effects were more pronounced in the Middle Atlantic Census Division compared to the Mountain Census Division, where utilization played a larger relative role. Nursing facility care showed striking regional variation: in the Middle Atlantic Census Division, mean rural and urban spending were roughly equivalent, whereas in the Mountain Census Division, rural spending substantially exceeded urban spending, driven primarily by price/intensity differences. In the Pacific Census Division, rural nursing facility spending also exceeded urban spending, but here, utilization of services was the dominant driver of the disparity, rather than price/intensity.

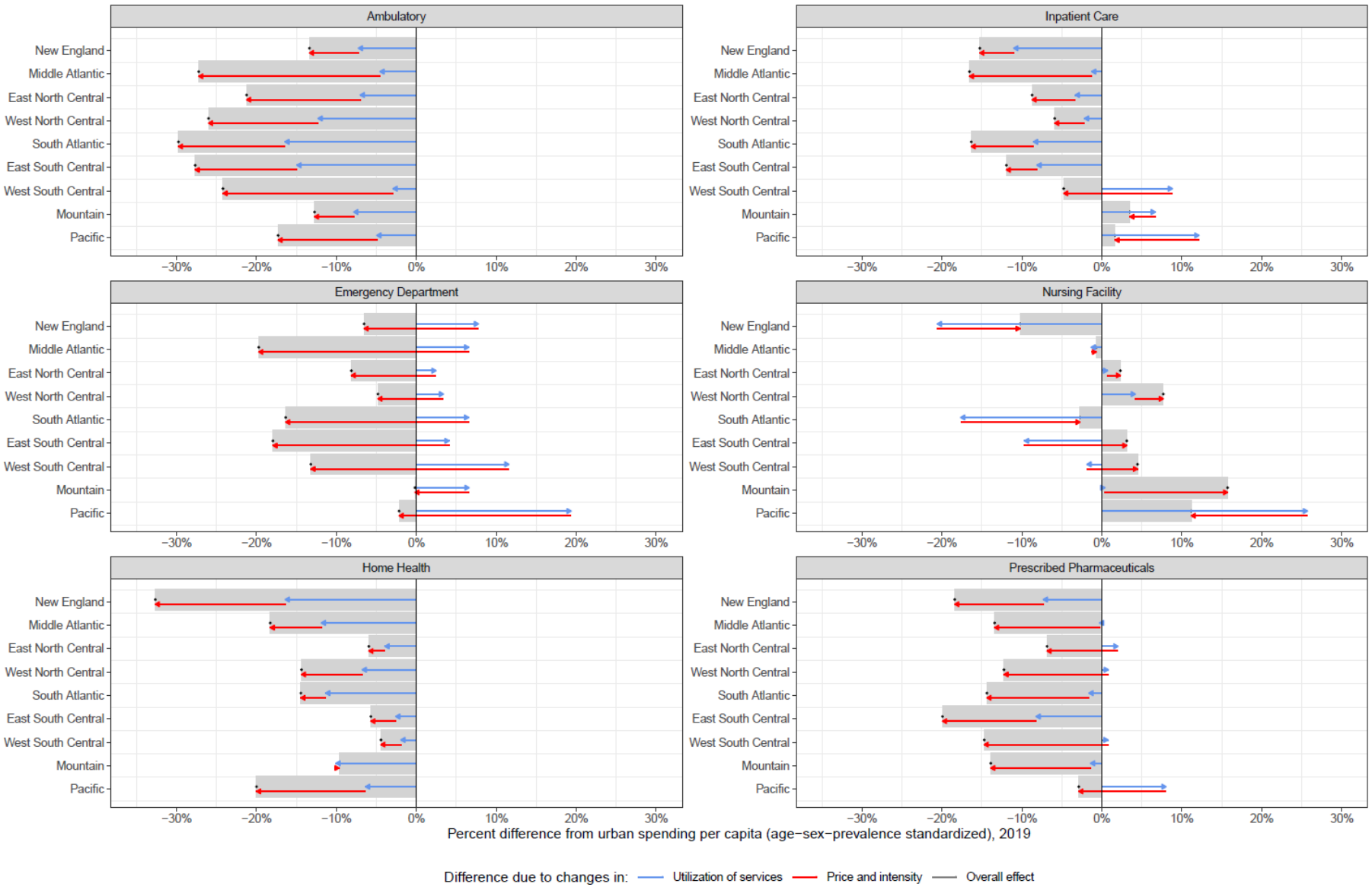


Figure 3. Health care spending decomposition comparing rural versus urban spending per capita across types of care and Census Division. For orientation, the black dot and size of the gray bar indicate the rural deviation in mean health care spending for each type of care, relative to the urban. The colored arrows represent the relative contribution of each type of spending driver (service utilization, and service price/intensity) to the deviation from the urban mean. The overall positive or negative effect of each arrow is indicated by its direction (left, drives spending down; right, drives spending up).

Spending by Health Condition

Across all aggregated groups of health condition, age- and sex-standardized per capita health care spending was significantly higher in urban than in rural counties ($p < 0.01$) (Table 2). Cardiovascular diseases accounted for the highest per capita spending in both rural and urban counties. From 2010 to 2019, annual growth in age- and sex-standardized per capita spending was similar in rural and urban counties and mirrored the overall U.S. trend (+0.9% annually). Spending on substance use disorders increased fastest rate over this period in both urban and rural counties (6.6% and 6.4% annual growth, respectively), followed by other infectious diseases and mental disorders. Several condition categories showed differential growth patterns by rurality. Namely, health care spending for other infectious diseases and neurological disorders was higher in rural than in urban counties, whereas spending growth for maternal and neonatal disorders was higher in urban than in rural counties.

Table 2. Inflation-adjusted, age- and sex-standardized health care spending per capita and annual growth rate from 2010 to 2019 in rural and urban U.S. counties, by aggregated health condition.

Aggregated health condition	Age-sex standardized spending per capita (2019 USD)			Annual growth rate 2010-2019 of age-sex standardized spending per capita		
	USA	Urban	Rural	USA	Urban	Rural
All causes	7373.61	7563.47	6261.19	+0.9	+0.9	+0.9
Cardiovascular diseases	804.25	815.98	743.7	-0.1	-0.2	+0.2
Neoplasms	784.18	809.57	643.62	+2.2	+2.1	+2.0
Musculoskeletal disorders	743.18	761.30	636.90	+1.1	+1.1	+0.9
Other non-communicable diseases	718.54	747.51	537.24	+0.7	+0.7	+0.4
Diabetes and kidney diseases	685.40	700.05	608.32	+2.0	+2.0	+2.3
Mental disorders	504.32	513.92	445.63	+2.5	+2.5	+2.3
Digestive diseases	408.57	417.46	356.54	+0.1	+0.1	-0.1
Neurological disorders	391.23	392.93	380.38	+0.6	+0.5	+1.1
Oral care	325.85	338.34	246.61	+0.7	+0.7	+0.7
Oral disorders	281.90	302.59	157.46	+1.1	+1.1	+0.8
Injuries	278.29	280.45	252.41	-0.5	-0.5	-0.7
Chronic respiratory diseases	236.72	239.96	216.16	-0.3	-0.3	-0.3
Respiratory infections and tuberculosis	228.38	232.63	206.29	-0.7	-0.7	-0.9
Skin and subcutaneous diseases	211.90	220.28	161.81	+0.6	+0.5	+0.5
Other infectious diseases	201.84	206.78	175.33	+2.6	+2.5	+3.2
Risk factors	192.76	196.89	170.62	-1.0	-1.0	-1.0
Sense organ diseases	140.66	143.35	125.87	+0.4	+0.3	+0.6
Substance use disorders	91.57	93.66	78.00	+6.6	+6.6	+6.4
Maternal and neonatal disorders	73.60	79.97	36.25	+0.8	+0.9	+0.2
HIV/AIDS & sexually transmitted infections	47.32	50.97	24.83	+1.4	+1.3	+1.2
Enteric infections	19.21	19.46	17.81	-1.0	-1.0	-0.8

Examining spending at a more granular characterization of health conditions (rather than the 24 aggregated groups) provides additional context. Across all geographies, diabetes mellitus type 2 ranked

first in age- and sex-standardized per capita spending, both overall and within rural and urban counties, followed by other musculoskeletal disorders (Table 3). Meaningful differences in rank by rurality were apparent for some conditions. Compared with urban counties, heart failure, as well as Alzheimer's disease and other dementias, ranked higher in rural counties, whereas oral disorders, endocrine, metabolic, blood, and immune disorders, gynecological diseases, dental care (oral disorders and preventive dental care), and breast cancer ranked lower.

Substantial regional variation in rank ordering of condition-specific spending was also observed across Census Divisions. For example, Alzheimer's disease and other dementias ranked relatively higher in the East South Central Census Division compared with the national ranking, but ranked lower in the Mountain and Pacific Census Divisions (Table 3).

Table 3. Rank order heatmap of health conditions by inflation-adjusted age- and sex-standardized health care spending per capita, by rurality and census division. Green [darker] cells indicate higher-ranked spending within each geographic column; white [lighter] cells indicate lower-ranked spending.

		Rurality		**Census Division**								
	All population	Rural	Urban	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
Diabetes mellitus type 2	1	1	1	1	1	1	1	1	1	1	1	1
Other musculoskeletal disorders	2	2	2	2	2	2	2	2	2	2	2	2
Oral disorders	3	10	3	3	4	3	3	3	4	3	3	3
Ischemic heart disease	4	3	4	5	3	4	4	4	3	4	4	4
Urinary diseases & male infertility	5	4	5	6	6	5	5	5	5	6	5	5
Skin and subcutaneous diseases	6	7	6	4	5	7	6	6	7	5	6	6
Heart Failure	7	5	7	8	7	6	7	7	9	10	17	10
Acute renal failure	8	8	8	28	9	8	13	8	6	7	19	8
Low back pain	9	9	10	16	15	9	8	10	10	9	7	11
Endocrine, metabolic, blood, & immune disorders	10	14	11	12	8	11	12	11	12	12	10	13
Gynecological diseases	11	28	9	11	11	13	19	9	17	14	11	9
Septicemia	12	12	12	21	10	14	15	16	13	11	9	7
Alzheimer's disease & other dementias	13	6	16	9	14	10	9	12	8	13	21	24
Osteoarthritis	14	11	15	14	16	12	10	15	15	20	12	15
Lower respiratory infections	15	13	14	19	12	16	17	18	11	8	14	17
Well dental	16	25	13	13	23	15	16	19	21	15	8	12
Upper digestive system diseases	17	17	18	18	17	18	20	14	14	17	15	18
Breast cancer	18	23	17	15	21	19	21	13	20	22	20	14
Stroke	19	16	19	20	13	20	22	17	16	16	22	20
Falls	20	15	20	17	18	21	14	20	19	18	13	18

DISCUSSION

This study reveals substantial variation in health care spending between rural and urban U.S. counties. On average, urban counties spent more per capita on health care than rural counties, and this pattern held across all payer types. Health care spending in rural counties was 10.4% below average urban spending. While health care spending in urban counties exceeded that of rural counties, spending as a percentage of median household income was higher in rural counties than in urban. This was the case not only for private insurance and Medicare, but also for Medicaid. This paradox (lower spending but higher relative household burden) illustrates how health care affordability challenges persist in rural communities. Even with lower health care utilization (which may have downstream effects on overall and long-term health status), economic hardship persists with constrained incomes. Addressing rural health equity requires attention to both health care access and the underlying economic conditions.

Nationally, higher urban spending relative to rural counties was consistent across all types of care, from ambulatory to home health, apart from nursing facility care, where average per capita spending in rural counties exceeded that of urban counties. The geographic heterogeneity in nursing facility spending patterns, with some regions showing parity and others sizable differences, suggests that rural long-term care markets may function differently depending on available infrastructure and alternative care (e.g., home-based). While statistically significant, the overall rural-urban difference in nursing facility spending was modest in absolute terms ($14 per capita). Nevertheless, these variations highlight the limitations of national-level data, which may mask important regional variation, and national policies that may not account for how rural health care delivery is shaped by local context.

Our spending estimates adjusted for demographics (age and sex) and disease prevalence, and therefore, the observed differences in health spending cannot be attributed simply to rural areas being older or sicker. Instead, the patterns revealed in this study are consistent with structural differences in how health care is accessed, delivered, and priced across rurality and the country more broadly. Utilization and price/intensity, as drivers of spending variation, suggest that factors beyond population health needs shape national health spending patterns. This finding aligns with decades of research on the geographic variation of health care spending, which shows that higher spending is not necessarily associated with

higher quality care or improved health outcomes, and that utilization patterns can explain the majority of spending variation across regions.[17,18] Regional variation in price/intensity and utilization effects may also partly reflect differences in health care market structure. For example, rural hospital closures have accelerated since 2010, and evidence suggests that closures increase utilization and prices at surviving facilities.[7,19,20]

Limited access to health care services also contributes to the patterns we observed in this study. Prior research has documented persistent rural shortages of primary care clinicians and specialists, longer travel distances, and higher rates of delayed or forgone care, all of which reduce amublatory and outpatient care utilization.[9,10,21,22] The lower ambulatory care spending in rural counties likely reflects these barriers rather than efficiencies in the delivery of services or lower needs in the community. This interpretation is supported by the outsized role of service utilization in driving lower ambulatory care spending.

The elevated ranking of heart failure and Alzheimer's disease spending in rural counties (compared to urban) warrants careful interpretation. While standardization controls for broad age and sex distributions, several mechanisms may explain why these conditions ranked higher in spending in rural counties, relative to other conditions, but did not in urban counties. Delayed diagnoses due to limited access to specialists,[22] combined with delays in initiating or sustaining treatment,[23,24] may result in more advanced disease states among rural residents that require resource-intensive episodes of care. Additionally, rural care delivery patterns may concentrate spending in institutional care settings for conditions that urban residents can manage through community- or home-based services, which are less likely to be available in rural areas.[25] These condition-specific spending patterns likely reflect the interplay of access barriers, care infrastructure, and disease management approaches rather than simple demographic differences.

Previous research supports these findings.[26-28] Studies have highlighted how poor access to care in rural communities contributes to lower utilization of services from obstetricians/gynecologists, with rural residents instead receiving proportionally more care from family medicine physicians and nurse practitioners/physician assistants.[26] Similarly, research has shown lower utilization of dental care in rural

areas than in urban areas.[27] Our findings align with this evidence, showing lower spending on oral preventive care in rural areas ($246.61 per capita rural versus $338.34 per capita urban).[28] Interestingly, some studies have shown that rural Medicare beneficiaries were more likely to receive restorative dental procedures than their urban counterparts, suggesting that when rural residents do access care, they may present with more advanced disease requiring more intensive intervention.[28]

The rapid increase in substance use disorder spending (6.4% and 6.6% annual growth in rural and urban counties, respectively) warrants particular attention. This growth coincides with the growing opioid and polysubstance use crisis between 2010 and 2019 (and beyond), which has disproportionately affected rural communities.[29,30] Although the similar growth rates might suggest comparable increases in treatment utilization, the context differs substantially. Rural counties entered the decade with far more limited treatment capacity, with more than half of small and remote rural counties lacking even a single provider waivered to prescribe medications for opioid use disorder.[31] Thus, similar percentage growth in rural areas does not imply equivalent access or utilization. Instead, the rural trend may represent incremental expansion from a constrained starting point, whereas the urban trend reflects growth within already more developed treatment systems. The persistence of this gap points to a continued need for attention to rural substance use disorder treatment infrastructure and workforce development.

This study showed that, overall, health care spending among residents of rural counties was lower than that of urban county residents. However, rural residents nonetheless face a substantial burden of health care spending, including medical debt.[32] Studies show that more than one-third of rural Americans forgo care due to costs, and more than one in five struggle to pay medical bills.[33] Recent research also suggests that, while rural residence is associated with greater difficulty covering health care costs, perceptions of unaffordability are complex, with heterogeneity across rurality attributed to factors such as income, insurance status, and race/ethnicity.[13] Compared to other countries, the U.S. as a whole outpaces its peers in health care unaffordability, with 22.5% of its residents reporting serious problems or an inability to pay medical bills, 2.3-5.7 times higher than in ten other high-income nations.[34] Beyond quantifiable health care spending, rural residents face non-financial burdens that less often affect urban residents, including long distances to care, longer time away from work for appointments, and limited

public transportation.[35,36] The substantially higher proportion of household income spent on health care in rural counties is exacerbated by these non-financial barriers, creating a compounding access challenge in which economic constraints are added to geographic and infrastructure-related barriers to obtaining needed care.

Understanding these expenditure patterns is critical for identifying cost drivers, prioritizing interventions, developing equitable health financing policies, and supporting a rural health workforce that addresses the unique needs of rural populations. Investments in rural care infrastructure, including rural hospitals, health clinics, and centers, and mobile services, could address access barriers.[37] Telehealth expansion, supported by improved broadband, could bridge specialty care gaps.[38,39] Developing home- and community-based alternatives to nursing facilities, including supports like home-delivered nutrition services, could better meet the needs of rural older adults, reduce costs, and support aging in place.[40,41]

This study has several limitations. First, no comprehensive health care spending or cost database exists in the U.S., and therefore, our methodological approaches may not fully account for biases or shortcomings of the available data. Second, data for this study are the most recent available, yet do not extend through the COVID-19 pandemic, when many health care spending patterns in the U.S. changed, at least temporarily. Since the time of this study, also, some county borders have shifted; more recent data aligning with contemporary challenges in accessing health care, recent changes in spending, and updated county structures are needed.[21,42] Third, this study does not include several data sources that were unavailable for analysis, including spending data for durable medical equipment and spending and utilization data from Veterans Affairs, Tricare, and Indian Health Services. As such, our findings will not fully capture or generalize to some rural counties with larger proportions of veterans or American Indian/Alaska Native residents. Fourth, data estimates for uninsured populations relied on hospital records and surveys rather than claims data, which may reduce the precision of out-of-pocket spending estimates, particularly in rural areas with higher uninsured rates. Also, decomposition analyses identify relative contributions of spending drivers but cannot establish causal relationships. Finally, spending estimates are based on a patient's residence rather than the location of care, which may introduce measurement bias in

regions where patients frequently travel across county lines for services, which may occur more frequently among rural patients seeking care in urban settings.

CONCLUSION

Rural-urban health care spending disparities reflect a complex relationship across population demographics, disease burden, service availability, and prices. After adjusting for age and sex, urban counties spent 10.4% more per capita than rural counties in 2019. After accounting for population age fraction and disease prevalence, this gap appears to be driven primarily by lower service utilization and reduced prices/intensity, particularly for ambulatory care. Lower spending in rural counties reflects access barriers and market characteristics rather than lower health needs or illness burden. Simultaneously, health care costs claim a disproportionate share of rural household budgets (compared to urban), creating economic pressures that may further limit care-seeking. Addressing the underlying structural inequities in rural-urban health care spending disparities requires targeted investments in rural health infrastructure and policies that recognize the unique challenges rural communities face, such as provider shortages, geographic barriers, and economic constraints.

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Supplemental Table 1. Inflation-adjusted, mean per capita age- and sex-standardized health care spending by payer and as a percentage of 2019 median household county , U.S. counties, nationally and by state, 2019 USD.

	Mean age-sex standardized per capita spending				Number of counties	
State	**Overall**	**Urban Counties**	**Rural Counties**	**Rural-to-Urban Spending %**	**Urban**	**Rural**
Overall (USA)	6493 (6474 - 6529)	6948 (6931 - 6999)	6228 (6204 - 6256)	89.6 (89.3 - 89.9)	1146	1962
Alabama	5906 (5878 - 5925)	6442 (6423 - 6459)	5497 (5461 - 5528)	85.3 (84.8 - 85.9)	29	38
Alaska	8437 (8292 - 8564)	9103 (9021 - 9164)	8326 (8161 - 8481)	91.5 (89.3 - 93.6)	3	18
Arizona	5494 (5462 - 5533)	5758 (5724 - 5798)	5187 (5134 - 5248)	90.1 (89.2 - 90.9)	7	6
Arkansas	6553 (6528 - 6579)	6999 (6974 - 7023)	6391 (6361 - 6424)	91.3 (90.9 - 91.7)	20	55
California	7492 (7444 - 7591)	7722 (7692 - 7767)	7086 (6979 - 7287)	91.8 (90.6 - 93.8)	37	21
Colorado	5441 (5407 - 5480)	6302 (6271 - 6342)	5240 (5201 - 5284)	83.1 (82.3 - 83.8)	11	47
Connecticut	8033 (8007 - 8071)	7986 (7963 - 8021)	8363 (8268 - 8472)	104.7 (103.5 - 106.2)	7	1
Delaware	8397 (8379 - 8418)	8397 (8379 - 8418)	-	-	3	0
District of Columbia	12534 (12488 - 12582)	12534 (12488 - 12582)	-	-	1	0
Florida	6158 (6124 - 6219)	6646 (6595 - 6732)	5225 (5172 - 5261)	78.6 (77.7 - 79.5)	44	23
Georgia	5632 (5598 - 5673)	6139 (6107 - 6173)	5190 (5148 - 5240)	84.5 (84.1 - 85)	74	85
Hawaii	6518 (6411 - 6614)	6649 (6557 - 6736)	6388 (6201 - 6559)	96.1 (93.5 - 99.6)	2	2
Idaho	5274 (5227 - 5314)	5512 (5473 - 5544)	5185 (5135 - 5232)	94.1 (93.2 - 95.1)	12	32
Illinois	6667 (6598 - 6859)	7168 (7111 - 7350)	6344 (6265 - 6543)	88.5 (88 - 89.1)	40	62
Indiana	6846 (6818 - 6889)	7251 (7221 - 7286)	6475 (6444 - 6527)	89.3 (88.9 - 89.7)	44	48
Iowa	6610 (6573 - 6656)	7265 (7225 - 7336)	6434 (6395 - 6482)	88.6 (88 - 89)	21	78
Kansas	6358 (6318 - 6409)	6271 (6230 - 6304)	6378 (6331 - 6436)	101.7 (100.4 - 102.6)	19	86
Kentucky	6393 (6366 - 6429)	7131 (7098 - 7177)	6090 (6060 - 6122)	85.4 (84.7 - 86)	35	85
Louisiana	7576 (7552 - 7604)	7588 (7567 - 7638)	7561 (7514 - 7608)	99.6 (98.7 - 100.3)	35	29
Maine	6701 (6674 - 6736)	7692 (7644 - 7742)	6251 (6206 - 6295)	81.3 (80.4 - 82)	5	11
Maryland	7348 (7302 - 7438)	7405 (7365 - 7486)	7139 (7049 - 7278)	96.4 (95.4 - 97.4)	18	5
Massachusetts	8724 (8680 - 8774)	8832 (8804 - 8877)	8329 (8180 - 8511)	94.3 (92.6 - 96.3)	11	3
Michigan	7125 (7065 - 7229)	7376 (7336 - 7459)	7011 (6935 - 7126)	95.1 (94.3 - 95.8)	26	57
Minnesota	7032 (6984 - 7119)	7316 (7282 - 7380)	6905 (6842 - 7016)	94.4 (93.6 - 95.4)	27	60
Mississippi	6169 (6147 - 6195)	6957 (6935 - 6986)	5963 (5935 - 5995)	85.7 (85.2 - 86.4)	17	65
Missouri	6226 (6186 - 6253)	6853 (6817 - 6890)	5962 (5919 - 5997)	87 (86.6 - 87.6)	34	81
Montana	6930 (6889 - 6998)	6745 (6674 - 6830)	6949 (6897 - 7023)	103 (101.5 - 104.4)	5	51
Nebraska	6626 (6571 - 6714)	6999 (6946 - 7050)	6566 (6501 - 6665)	93.8 (92.6 - 95.2)	13	80
Nevada	5560 (5490 - 5678)	5977 (5901 - 6045)	5431 (5354 - 5550)	90.9 (89.3 - 92.4)	4	13
New Hampshire	6831 (6804 - 6870)	7748 (7713 - 7790)	6439 (6385 - 6498)	83.1 (82.1 - 84.1)	3	7
New Jersey	8008 (7983 - 8059)	8008 (7983 - 8059)	-	-	21	0
New Mexico	5846 (5811 - 5900)	6298 (6269 - 6328)	5737 (5692 - 5805)	91.1 (90.2 - 92.2)	6	25
New York	7739 (7673 - 7875)	8130 (8070 - 8257)	7119 (7045 - 7272)	87.6 (87.1 - 88.1)	38	24
North Carolina	6244 (6215 - 6275)	6680 (6655 - 6705)	5873 (5835 - 5917)	87.9 (87.3 - 88.4)	46	54
North Dakota	7622 (7560 - 7677)	7394 (7311 - 7489)	7652 (7588 - 7716)	103.5 (101.7 - 105.2)	6	47
Ohio	6598 (6567 - 6637)	7184 (7162 - 7225)	6152 (6106 - 6193)	85.6 (85 - 86.2)	38	50
Oklahoma	6183 (6152 - 6227)	6851 (6819 - 6897)	5980 (5942 - 6033)	87.3 (86.7 - 87.9)	18	59

Oregon	6618 (6565 - 6681)	6985 (6957 - 7024)	6410 (6337 - 6484)	91.8 (90.7 - 92.7)	13	23
Pennsylvania	7171 (7138 - 7224)	7577 (7554 - 7621)	6671 (6617 - 6734)	88 (87.6 - 88.5)	37	30
Rhode Island	8071 (7936 - 8172)	8071 (7936 - 8172)	-	-	5	0
South Carolina	6039 (6012 - 6074)	6232 (6213 - 6255)	5789 (5749 - 5852)	92.9 (92.4 - 93.9)	26	20
South Dakota	6839 (6783 - 6903)	7703 (7647 - 7781)	6720 (6651 - 6796)	87.2 (85.8 - 88.4)	8	58
Tennessee	6062 (6039 - 6091)	6369 (6345 - 6396)	5819 (5786 - 5855)	91.4 (90.8 - 91.8)	42	53
Texas	5981 (5940 - 6015)	6421 (6388 - 6475)	5771 (5727 - 5809)	89.9 (89 - 90.4)	82	172
Utah	5442 (5402 - 5482)	6289 (6225 - 6340)	4996 (4947 - 5057)	79.4 (78.7 - 80.8)	10	19
Vermont	7497 (7462 - 7533)	7649 (7509 - 7830)	7456 (7403 - 7502)	97.5 (94.7 - 99.5)	3	11
Virginia	6035 (5995 - 6077)	6396 (6356 - 6458)	5520 (5475 - 5556)	86.3 (85.6 - 86.9)	70	49
Washington	6164 (6112 - 6282)	6207 (6167 - 6291)	6114 (6037 - 6271)	98.5 (97.6 - 99.7)	21	18
West Virginia	7210 (7190 - 7228)	7859 (7825 - 7897)	6808 (6775 - 6842)	86.6 (86 - 87.3)	21	34
Wisconsin	6506 (6472 - 6535)	7045 (7020 - 7073)	6202 (6158 - 6240)	88 (87.5 - 88.6)	26	46
Wyoming	7294 (7247 - 7339)	7267 (7175 - 7354)	7297 (7239 - 7356)	100.4 (98.4 - 102.2)	2	21

Note: Rural-to-Urban Spending is average spending in rural counties as a percentage of average urban spending in urban counties ($\frac{Rural\ spending}{Urban\ spending} \times 100$).

Supplemental Table 2. Inflation-adjusted, mean per capita age- and sex-standardized health care spending by payer and as a percentage of 2019 median household income, U.S. counties, nationally and by state, 2019 USD.

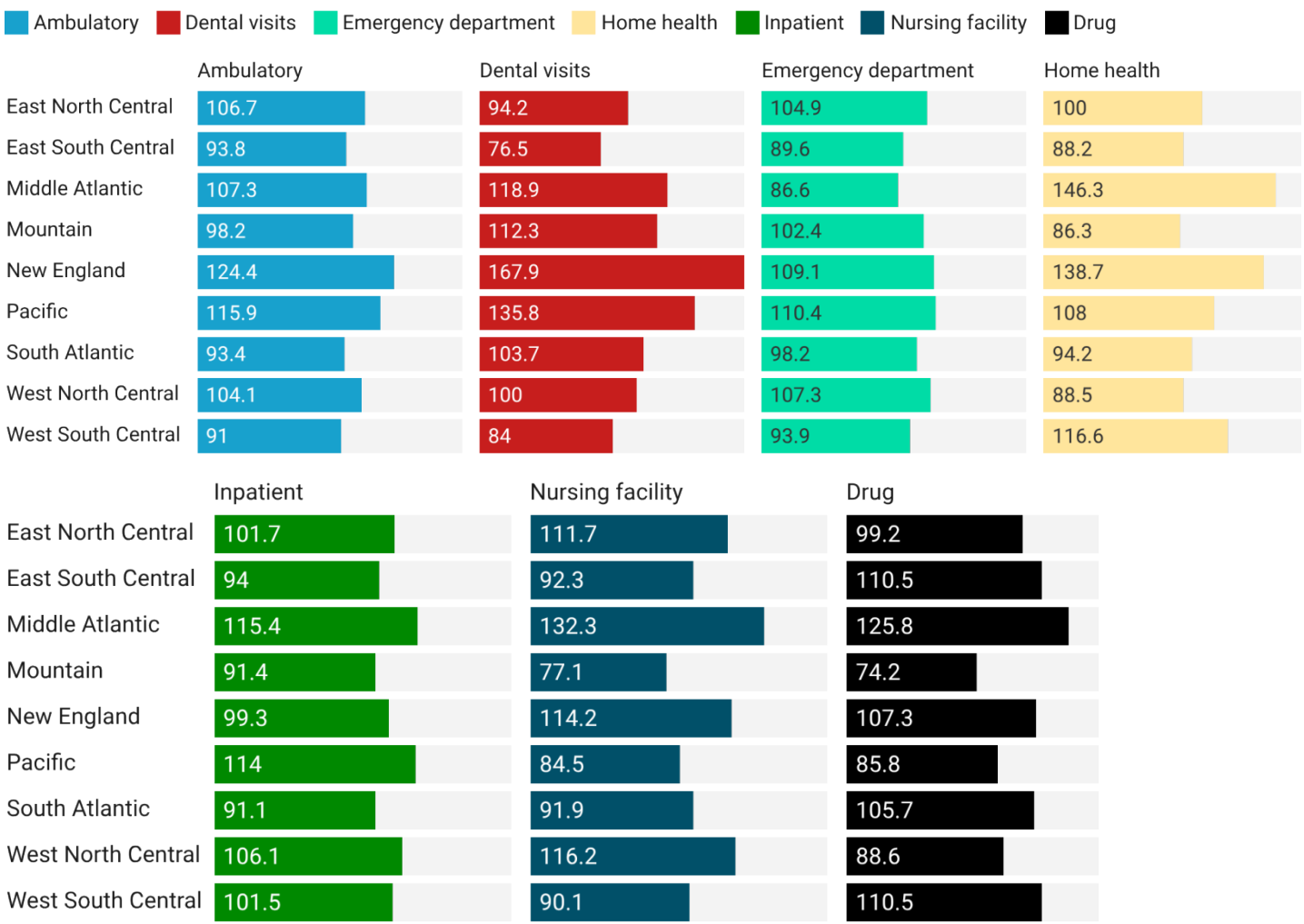
	Urban Counties		Rural Counties		P-value[a]
	Mean age-sex standardized spending per capita	Percentage of median household income	Mean age-sex standardized spending per capita	Percentage of median household income	
Overall (USA)	6,948 (6,931 - 6,999)	10.6 (10.6 - 10.7)	6,228 (6,204 - 6,256)	11.9 (11.9 - 12.0)	<0.001
Medicare	12,162 (12,132 - 12,219)	18.8 (18.7 - 18.9)	11,355 (11,310 - 11,413)	21.8 (21.7 - 21.9)	<0.001
Medicaid	6,471 (6,455 - 6,494)	10.1 (10.0 - 10.1)	6,078 (6,049 - 6,110)	11.7 (11.7 - 11.8)	<0.001
Private	4,289 (4,269 - 4,345)	6.5 (6.4 - 6.5)	3,594 (3,569 - 3,645)	6.8 (6.7 - 6.9)	<0.001
Out-of-Pocket	792 (790 - 794)	1.2 (1.2 - 1.2)	685 (679 - 690)	1.3 (1.3 - 1.3)	<0.001

[a] P-value indicates the level of statistical significance in the difference in the percentage of median household income taken up by health care spending comparing rural and urban counties (t-tests).

Supplemental Table 3. Inflation-adjusted, mean (95% CI) per capita age- and sex-standardized health care spending by care type in across Census Divisions (2019 USD)

	Ambulatory	Dental visits	Emergency department	Home health	Inpatient	Nursing facility	Drug
Overall (USA)	2642 (2634 - 2649)	243 (241 - 245)	164 (163 - 164)	313 (311 - 318)	1682 (1666 - 1722)	555 (552 - 558)	894 (891 - 897)
East North Central	3286 (3275 - 3298)	408 (405 - 416)	179 (177 - 180)	434 (431 - 437)	1671 (1657 - 1690)	634 (623 - 642)	959 (957 - 961)
East South Central	2835 (2826 - 2845)	288 (284 - 293)	142 (140 - 146)	458 (455 - 460)	1940 (1913 - 2020)	734 (729 - 741)	1125 (1121 - 1128)
Middle Atlantic	2820 (2806 - 2835)	229 (227 - 232)	172 (170 - 173)	314 (312 - 316)	1710 (1682 - 1799)	620 (615 - 624)	887 (884 - 890)
Mountain	2750 (2738 - 2761)	243 (240 - 247)	176 (173 - 178)	277 (274 - 282)	1786 (1768 - 1827)	645 (637 - 651)	792 (789 - 797)
New England	2468 (2459 - 2477)	252 (248 - 258)	161 (160 - 162)	295 (293 - 298)	1532 (1515 - 1566)	510 (507 - 513)	946 (942 - 949)
Pacific	2477 (2468 - 2486)	186 (181 - 193)	147 (146 - 148)	276 (274 - 280)	1581 (1571 - 1592)	512 (508 - 517)	988 (984 - 993)
South Atlantic	2405 (2391 - 2419)	204 (200 - 212)	154 (152 - 155)	365 (362 - 371)	1707 (1690 - 1728)	500 (494 - 505)	988 (983 - 996)
West North Central	2595 (2587 - 2601)	273 (271 - 276)	168 (166 - 170)	270 (266 - 279)	1538 (1522 - 1562)	428 (422 - 433)	663 (660 - 667)
West South Central	3063 (3042 - 3084)	330 (328 - 335)	181 (178 - 185)	338 (333 - 350)	1918 (1884 - 1988)	469 (463 - 477)	767 (764 - 773)

Supplemental Figure 1. Relative mean per capita spending by type of care across U.S. Census Divisions (2019 USD).



Note: Relative Mean Spending is the average spending within the specific census division expressed as a percentage of the national mean spending ($\frac{Census\ Division\ spending}{National\ spending} \times 100$)