

Nabil Natafqi; Peiyin Hung; Whitney E. Zahnd; Melinda A. Merrell; Gabriel A. Benavidez; Oyeleye J. Oyesode; Nicholas Yell; Oluranti Babalola; Elizabeth Crouch; Janice C. Probst; Jan M. Eberth

Availability Of Hospital-Based Emergency Department and Trauma Services in Minoritized Racial/Ethnic Group Areas

- **Minoritized Areas:** We use the term “minoritized” to refer to groups that have historically been marginalized by society and government institutions. ZIP Code Tabulation Areas (ZCTAs) were classified as being a top minoritized place if the proportion of persons in the ZCTA who identified as a specific minoritized racial/ethnic group (MRG) met or exceeded the 95th percentile for the proportion of those residents in all rural or all urban ZCTAs respectively. Top MRG ZCTAs are not necessarily “majority” non-white places but rather fall at the top of the distribution for the proportion of the population represented by that group.
- **Rural – urban differences:** The median distance to the nearest emergency department in rural ZCTAs with a top proportion of minoritized groups was 16.2 miles compared to 3.9 miles for urban ZCTAs of the same classification. Similarly, rural MRG ZCTAs were a median of 25.6 miles from trauma services versus 6.4 miles for urban MRG ZCTAs.
- **Minoritized differences:** Within rural ZCTAs, the ZCTAs at the top of the distribution for minoritized populations were slightly farther from an emergency department (median of 16.2 miles versus 13.4 miles for other ZCTAs). Similarly, MRG ZCTAs were slightly more distant from a trauma center than white/all other ZCTAs, a median of 25.6 miles versus 23.6 miles respectively.

The current findings brief is one of a series of briefs documenting disparities in access to health care services, measured as distance to the nearest facility, in places that have a relatively high proportion of residents from minoritized racial and ethnic groups (MRG). We use the term “minoritized” to refer to groups that have historically been marginalized by society and government institutions. This wording, rather than the terms “minority” or “minorities,” highlights the intentional social, economic, and political discrimination that these populations have experienced.¹ Work from this series has also been adapted into a web visualization and a peer-reviewed publication both of which appeared in *Health Affairs*.^{2,3}

INTRODUCTION

Emergency departments serve two key purposes. First, as the name implies, emergency departments provide rapid care for medical emergencies such as stroke or injury; emergency departments that have qualified as trauma service providers also offer the highest level of injury care. Second, subsequent to the Emergency Medical Treatment and Labor Act (EMTALA) of 1986, emergency departments provide assessment and stabilization of any health care problems.^{4,5} Both of these roles are crucial to maintaining health and life in rural America. Three of the top five causes of excess deaths in rural areas—injury, stroke, and heart conditions—require prompt emergency department or trauma care for survival.⁶ In addition, rural populations make more use of emergency department services. The 2019 emergency department visit rate for rural residents was 23 percent higher than the urban rate at 54 visits per 100 persons in rural counties versus 44 visits per 100 persons in urban counties.⁷

The geographic distribution of emergency department and trauma centers is important because distance can literally be a matter of life or death. Research in an urban community has identified distance to an emergency department as a factor associated with mortality using the phrase “trauma deserts” to identify isolated areas.⁸ Rural trauma patients are more likely to have died before reaching a hospital, whether at the scene or in transit, than are their urban peers.⁹ Rural American Indian/Alaska Native populations, in particular, die at higher rates from unintentional injury such as car crashes perhaps related to lower access to emergency department and trauma services.¹⁰

The availability, accessibility, and quality of healthcare services and infrastructure has been historically associated with race and ethnicity¹¹ with residential segregation contributing to reduced access to care among minoritized racial and ethnic groups.¹² Relatively little research has explored the availability of emergency department and trauma service accessibility across rural and urban areas in the U.S. and, in particular, the degree to which availability may be reduced in areas where a relatively large proportion of the population consists of historically minoritized racial/ethnic groups. An analysis of emergency department access conducted using 2003 data estimated that most people in the U.S. lived within 30 minutes of an emergency department but noted rural disparities.¹³ Similarly, a study of trauma center access using data from 2005 found that ZIP Codes located in rural areas, as well as those with proportionately high minoritized populations, were farther from trauma care than urban areas with a lower proportion of minoritized residents.¹⁴ The purpose of this brief is to examine the current availability of emergency department services across both rural and minoritized areas in the U.S.

METHODS

Defining ZCTAs with a high proportion of minoritized racial/ethnic group (MRG) residents

ZCTAs (n = 32,670) were first classified as rural or urban using Rural Urban Commuting Area (RUCA) definitions with ZCTAs classified as level 1 through 3 defined as urban and those classified as level 4 through 10 defined as rural.¹⁵ Given differences in the demographic profiles of rural and urban places, rural and urban ZCTAs were examined separately.

ZCTAs were classified as being a “top” place for a specific racial/ethnic group if the proportion of persons who identified as that group in the ZCTA met or exceeded the 95th percentile for the proportion of those residents in all rural or all urban ZCTAs respectively (Table 1, at right). With the exception of non-Hispanic white residents, the “top 5%” of all ZCTAs for any one population group was usually less than a majority and for some populations was fairly low. “Hispanic” included all persons of Hispanic ethnicity regardless of race. ZCTAs that fell in the top category for more than one MRG population were grouped separately so that categories do not overlap.

Table 1. Proportion of residents needed to meet or exceed the 95th percentile^a by race/ethnicity and rurality

	Rural	Urban
Non-Hispanic Black	34.4%	49.3%
Hispanic	23.8%	34.1%
Non-Hispanic American Indian/Alaska Native	11.8%	2.2%
Non-Hispanic Asian	2.5%	15.3%
Non-Hispanic White	100.0%	100.0%

^a Percentiles derived from population data obtained from the American Community Survey.

Thus, the final analysis included seven mutually exclusive categories within both rural and urban ZCTAs: top ZCTAs for Non-Hispanic (NH) Black, NH Asian, NH American Indian/Alaska Native, Hispanic, multiple MRG, and NH White populations, and a referent category which included all other ZCTAs (see Table 2) and (Figure 1, next page). Note that MRG ZCTAs are not “majority minoritized” places; rather, they are ZCTAs in which the proportion of each group is at the top of the distribution compared to other ZCTAs. The geographic location of top MRG and NH White ZCTAs is shown in Figure 1 on the next page.

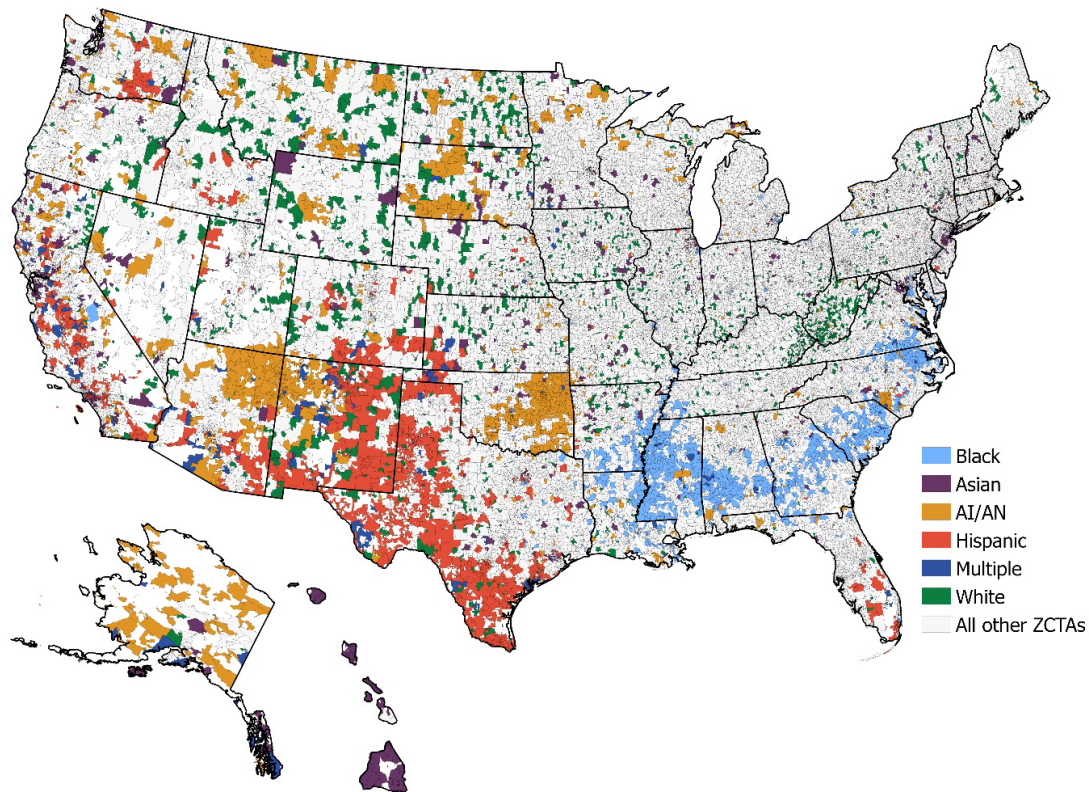
Table 2. Distribution of ZCTAs in the top 5th percentile for minoritized and white racial/ethnic group population by rurality and racial/ethnic group (2015-2019 American Community Survey)

Racial/ethnic group categories:	Urban ZCTAs		Rural ZCTAs		Total, all ZCTAs	
	n	%	n	%	n	%
Minoritized groups						
Hispanic*	755	4.2	594	4.0	1,349	4.1
NH* American Indian/Alaska Native.	825	4.6	668	4.5	1,493	4.6
NH* Asian	851	4.8	622	4.2	1,473	4.5
NH* Black	874	4.9	709	4.8	1,583	4.9
> 1 MRG	127	0.7	156	1.1	283	0.9
Non-minoritized						
NH* White	1,203	6.8	2,177	14.6	3,380	10.3
All other ZCTAs (excludes NH White)	13,160	74.0	9,949	66.9	23,109	70.7
Total	17,795	100.0	14,875	100.0	32,670	100.0

Note: Percentiles derived from population data obtained from the 2015-2019 American Community Survey. More than 5% of ZCTAs in both urban and rural areas had 100% white populations; all such ZCTAs were classified as high NH white ZCTAs.

*Hispanic includes all racial identities. All other racial/ethnic groups classified as “NH” (non-Hispanic).

Figure 1. Locations of top minoritized racial/ethnic group (MRG) and white population ZCTAs, 2015-2019 American Community Survey (ZCTAs meeting the 95th percentile threshold by racial and ethnic group)^a



^aData from the 2015-2019 American Community Survey ^b Map adapted from Eberth et al, 2022.¹⁴

Defining emergency departments and trauma centers

Information on emergency services was drawn from the 2019 American Hospital Association (AHA) survey. For clarity, the AHA definition is provided here:

Emergency services. Health services that are provided after the onset of a medical condition that manifests itself by symptoms of sufficient severity, including severe pain, that the absence of immediate medical attention could reasonably be expected by a prudent layperson, who possesses an average knowledge of health and medicine, to result in placing the patient's health in serious jeopardy.

To capture the geographic locations of emergency departments, we restricted the analysis to on-campus emergency departments defined as: Hospital facilities for the provision of unscheduled outpatient services to patients whose conditions require immediate care.

Trauma centers are defined in the AHA survey as follows:

Trauma center (certified). A facility to provide emergency and specialized intensive care to critically ill and injured patients. For service owned or provided by the hospital, please specify trauma level. Level 1: A regional resource trauma center which is capable of providing total care for every aspect of injury and plays a leadership role in trauma research

and education. Level 2: A community trauma center which is capable of providing trauma care to all but the most severely injured patients who require highly specialized care. Level 3: A rural trauma hospital which is capable of providing care to a large number of injury victims and can resuscitate and stabilize more severely injured patients so that they can be transported to level 1 or 2 facilities.

The analysis examines the presence or absence of a trauma center; it does not distinguish among the differing levels of trauma care. Note that trauma center certification requirements are set at the state level and thus may vary across states.¹⁵

How we measured “spatial availability” of hospital-based emergency department and trauma services

Locations of emergency departments were geocoded using ArcGIS Pro v2.8. We then calculated the straight-line distance from the population-weighted ZCTA centroid, a point marking the ZCTA’s geographic center based on where people live, rather than land area, to the nearest emergency department. Actual driving distances will be longer than this measure, so the information provided here is a conservative estimate of travel distances. Distance calculations were restricted to the contiguous 48 states excluding Alaska and Hawaii. The unusual geography of these two states would distort distance measures. Within the 48 states, we calculated the proportions of top MRG areas within specific distances (≤ 15 , 16-30, and >30 miles) of the nearest emergency services. Details are provided in the Appendix.

Limitations

First, the analysis is limited to hospital-based emergency departments. We excluded freestanding emergency departments as these are generally located in more affluent ZCTAs (i.e., higher incomes and a lower proportion of Medicaid beneficiaries) with fewer minoritized group residents.¹⁶ This makes our estimates of disparities in burden of access to emergency services more conservative. *Second*, we used straight line calculations as the measure of access to emergency and trauma services rather than driving distance or driving time. While straight line distance is highly correlated with travel distance,¹⁷ this measure might overestimate the spatial accessibility of emergency and trauma services in some areas. Finally, the brief uses data from the 2019 AHA survey, a self-reported form. For hospitals that had missing data regarding emergency or trauma in the AHA form, we substituted data from CMS provider files.

In the sections that follow, we document spatial accessibility to trauma and emergency department services across minoritized racial/ethnic groups defined at the ZIP Code Tabulation Area (ZCTA) level. Maps are provided showing the distribution of these facilities across the whole U.S. We then provide distance calculations limited to MRG ZCTAs in the 48 contiguous states. Alaska and Hawaii are excluded because travel patterns and distance considerations in those states differ markedly from those in the contiguous states. Information about the socio-demographic characteristics of MRG ZCTAs, and on the subset included in the 48-state analysis, is provided in the Appendix.

FINDINGS

Access to Hospital-Based Emergency Department and Trauma services

In 2019, there were 3,386 hospitals with on-campus emergency departments: 1,482 (44%) in rural and 1,904 (56%) in urban ZCTAs (Figure 2, next page). There were 1,671 hospitals with trauma services: 713 (43%) in rural and 958 (57%) in urban ZCTAs. (Figure 3, following page). These maps show the national distribution of both services and include the whole U.S.

In subsequent sections, we examine the distance between these services and top MRG ZCTAs in the continental U.S. For convenience, emergency and trauma services are examined separately.

Figure 2. Geocoded locations of hospital-based Emergency Department services showing highly represented minoritized racial/ethnic group ZCTAs, 2019

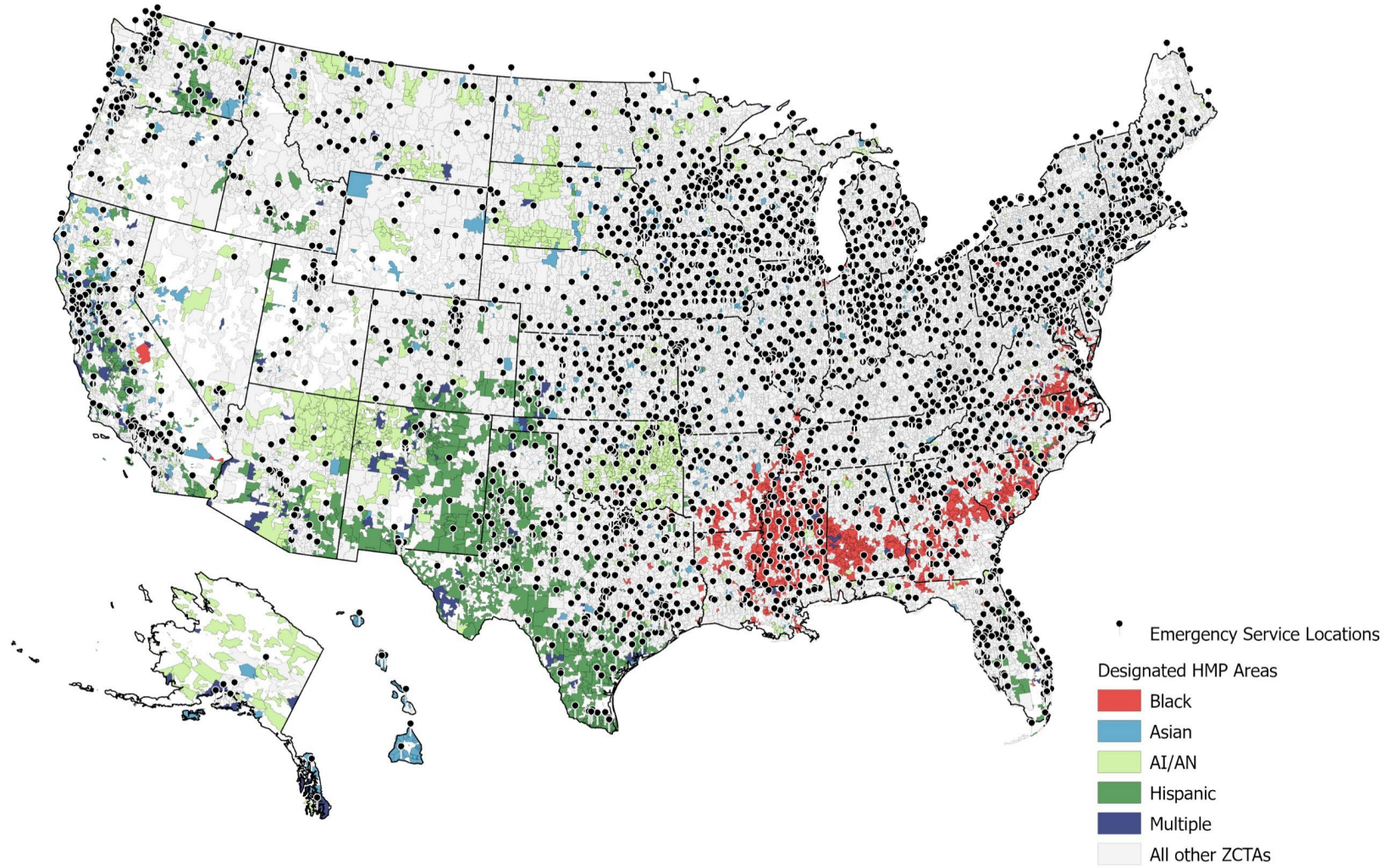
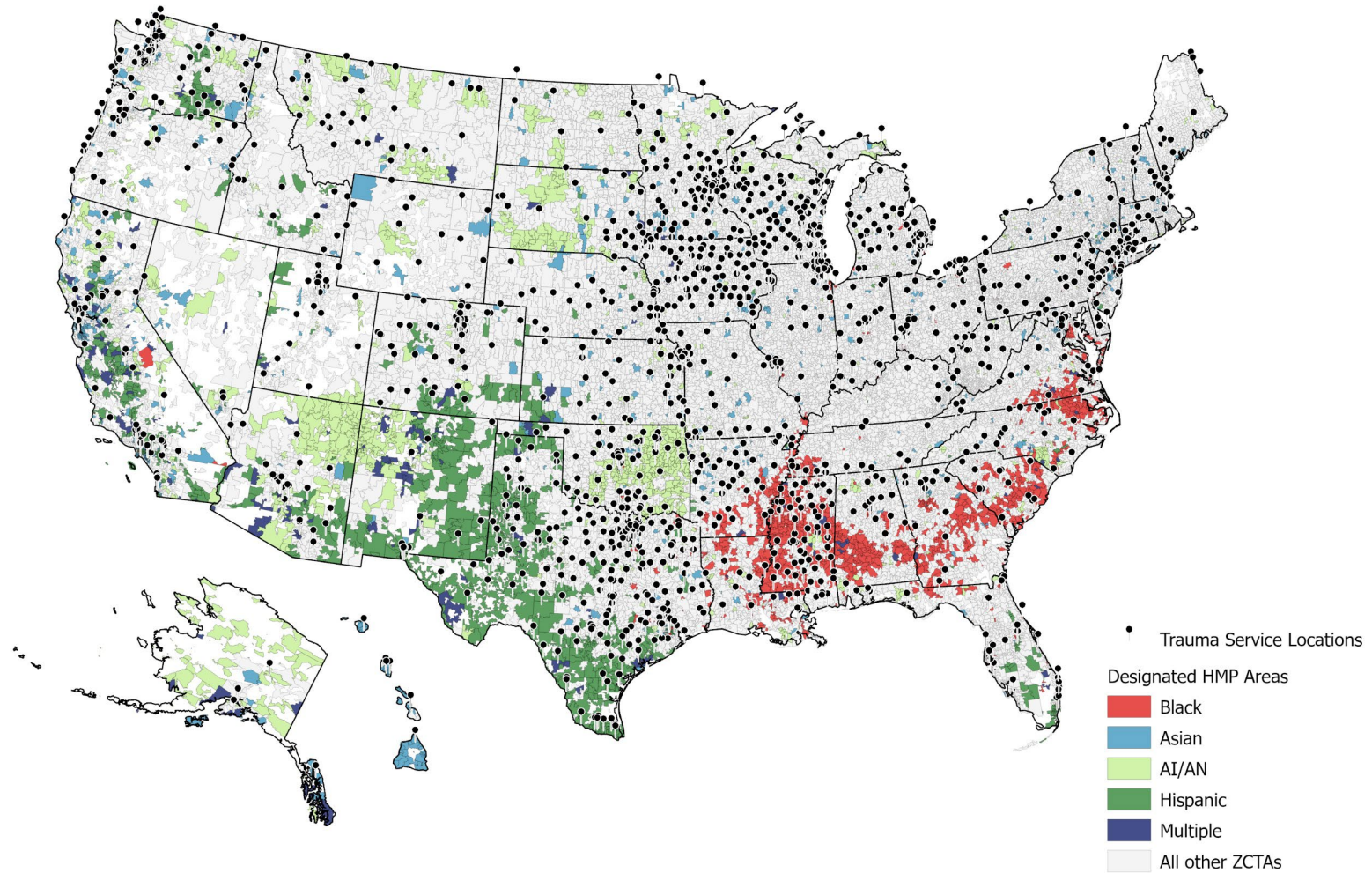


Figure 3. Geocoded locations of hospital-based trauma services showing highly represented minoritized racial/ethnic group ZCTAs, 2019



Distance to emergency department services

Figure 4, below, shows the geographic distribution of access to the nearest hospital-based emergency department by ZCTA population category. The relationship between emergency department proximity and top MRG places varied between urban and rural ZCTAs (Table 3, next page).

In urban areas, emergency department services were closer to top MRG ZCTAs than other ZCTAs in urban areas; the opposite was the case in rural areas. Urban top MRG ZCTAs were half the median distance to the nearest emergency department when compared to other ZCTAs (3.9 miles compared to 7.5 respectively (Table 3, next page). In contrast, the median distance to the nearest emergency department across rural ZCTAs with a top proportion of minoritized groups was 16.2 miles compared to 3.9 miles for urban ZCTAs of the same classification.

Examining rural distances across racial/ethnic categories, ZCTAs in the top 5% for Hispanic and American Indian/Alaska Native residents were both a median of 18 miles or more from the nearest emergency department versus 13.4 miles for non-minoritized ZCTAs.

Figure 4. Distance to the nearest emergency department, 48 contiguous states, by MRG ZCTA status

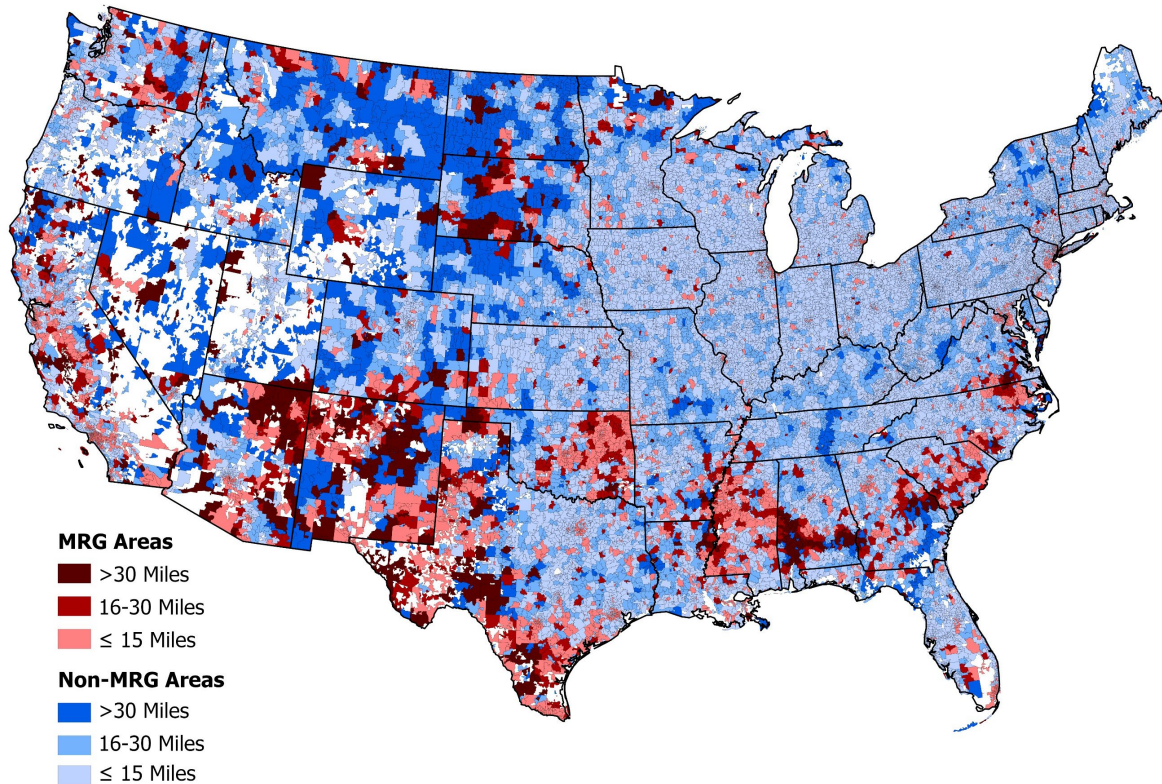


Table 3. Median distance (in miles) to nearest emergency department and trauma service in the U.S. by rurality and 95th percentile MRG population status, 2019

	Emergency Department			Trauma Services		
	Urban	Rural	<i>Rural to Urban Ratio</i>	Urban	Rural	<i>Rural to Urban Ratio</i>
Minoritized ZCTAs	3.9	16.2	4.2	6.4	25.6	4.0
Black/African American	3.6	16.7	4.6	5.5	26.9	4.9
Hispanic	3.7	18.0	4.9	6.0	25.1	4.2
American Indian/Alaska Native	10.1	18.9	1.9	13.3	27.3	2.1
Asian	2.7	12.3	4.6	4.6	22.0	4.8
High for multiple groups	2.8	17.3	6.2	5.3	35.2	6.6
Non-minoritized ZCTAs	7.5	13.4	1.8	11.5	23.6	2.1
White	12.0	15.0	1.3	17.8	26.2	1.5
All other: no group \geq 95 th percentile	7.0	13.2	1.9	10.8	23.2	2.1
<i>Minoritized to non-minoritized Ratio</i>	0.5	1.2		0.6	1.1	

Data Sources: Rural Urban commuting Area Codes (2010), Zip Code Tabulation Area (ZCTA)-level American Community Survey (2015–2019), and the Survey American Hospital Association Annual (2019) **Notes:** Distance was measured from each ZCTA’s geographic centroid to the address of the closest emergency department or trauma center. ZCTAs included in the above analysis met the 95th percentile criteria for each racial/ethnic group.

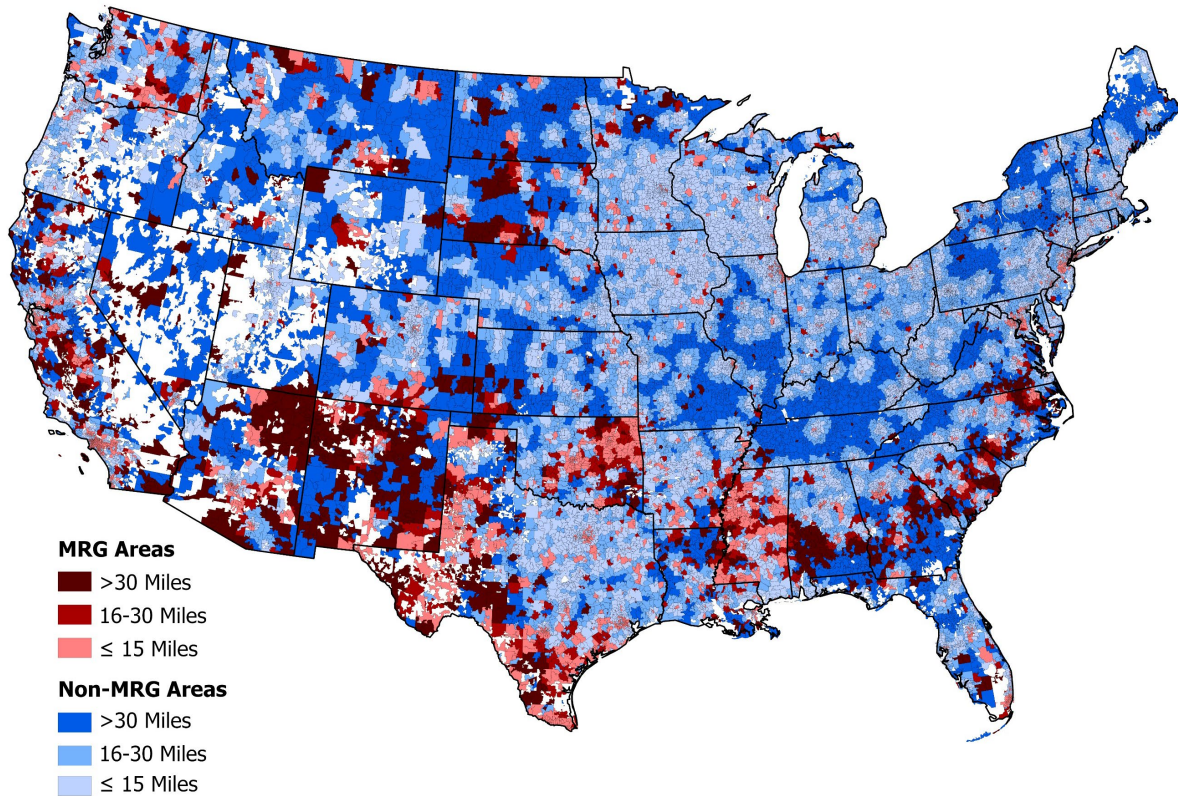
Distance to the nearest trauma center

As with emergency departments, top MRG ZCTAs were located closer to trauma services than were other ZCTAs in urban areas but farther away in rural areas. Across urban MRG ZCTAs, the median distance to a trauma service was 6.4 miles, compared to 11.5 miles across white and other ZCTAs (see Table 3, above). Within rural ZCTAs, top MRG ZCTAs were slightly farther from a trauma center than white/all other ZCTAs, a median of 25.6 miles versus 23.6 miles.

Within rural ZCTAs, those in the top 5% for more than one minoritized group were located farthest from a trauma center at a median of 35.2 miles; this value was 6.6 times higher than the equivalent distance for urban ZCTAs of 5.3 miles (Table 3, above). The smallest median distance for rural MRG groups was found for top Asian MRGs which were located a median of 33.0 miles from trauma services. As noted in the rightmost column in Table 3, the degree by which rural median distances to trauma care exceeded urban distances ranged from 2.1 among American Indian/Alaska Native populations up to the 6.6 times noted for areas with multiple MRG groups. In contrast, the urban/rural differential for top white ZCTAs was only 1.5 times, and the urban/rural differential for all ZCTAs that do not fall in the top 5 percent for any population group was 2.1 times.

The distances to the nearest trauma center for MRG and other ZCTAs within the 48 contiguous states are graphically illustrated in Figure 5 (next page). Darker colors indicate greater distances to trauma services. Large portions of rural America, both with and without minority population presence, are located more than 30 miles from the nearest trauma center.

Figure 5. Distance to the nearest trauma center, 48 contiguous states, by MRG ZCTA status



Note: Areas with high density of minoritized racial and ethnic population (MRG) are colored gradient of garnet. Areas with non-high density of minoritized racial and ethnic population (non-MRG) are colored gradient of blue.

Census regions have differing topography and population density affecting distance to care. Figures 6 and 7 (next page) display the percent of ZCTAs without access to a hospital-based emergency department and trauma services, respectively, within 30 miles across the four U.S. Census regions, and by top MRG status. Overall, rural ZCTAs compared to urban ZCTAs in the same Census region were much more likely to lack a hospital-based emergency department or trauma service within 30 miles. In areas without highly represented minoritized groups, 11.4% of rural ZCTAs lack an emergency department within 30 miles and 35.7% lack a trauma service within 30 miles. The disparity was greater in ZCTAs with highly represented minoritized groups: 24.6% of rural MRG ZCTAs lack an emergency department within 30 miles and 45.8% lack a trauma service within 30 miles.

Specifically, in the West, rural ZCTAs with high representation of minoritized groups have the highest percentage (66.0%) of ZCTAs without access to trauma within 30 miles in the U.S. Similarly, around half (48.0%) of the West rural ZCTAs without high representation of minoritized groups are without access to trauma within 30 miles in the U.S. On the contrary, only 1.6% of urban Midwest ZCTAs with highly represented minoritized groups have no access to a trauma service.

Figure 6. Percent of ZCTAs in the 48 contiguous states *without* access to a hospital-based emergency department within 30 miles by Census region and minoritized racial/ethnic group classification

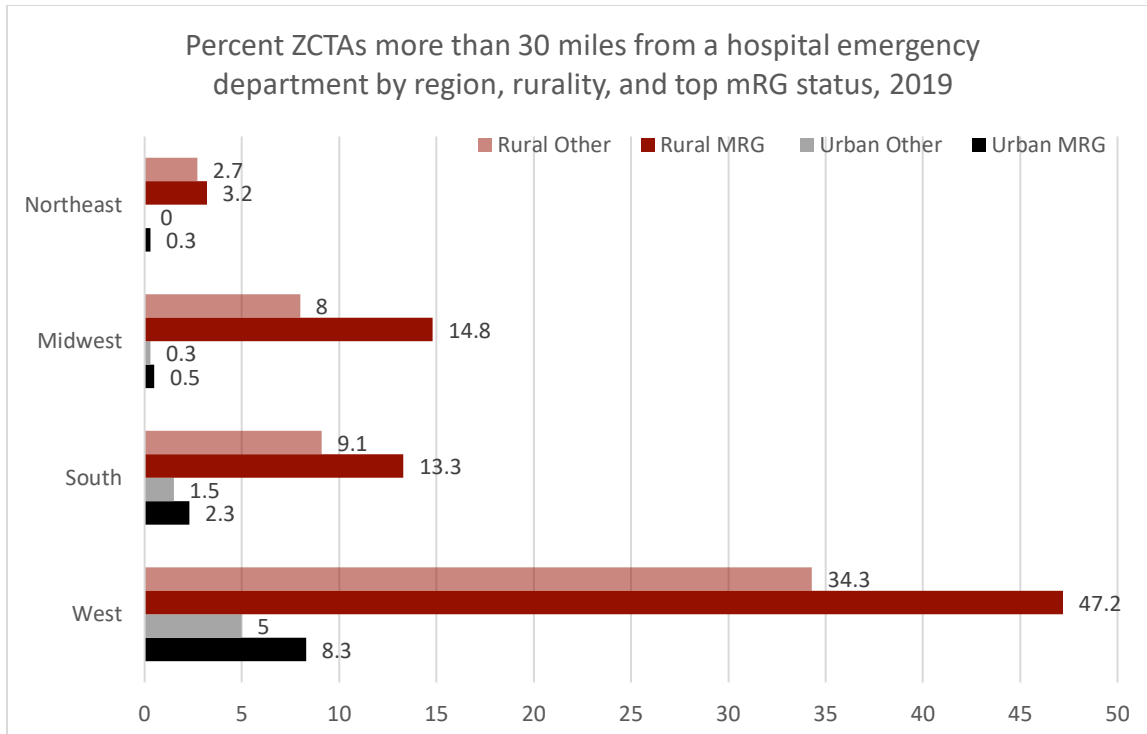
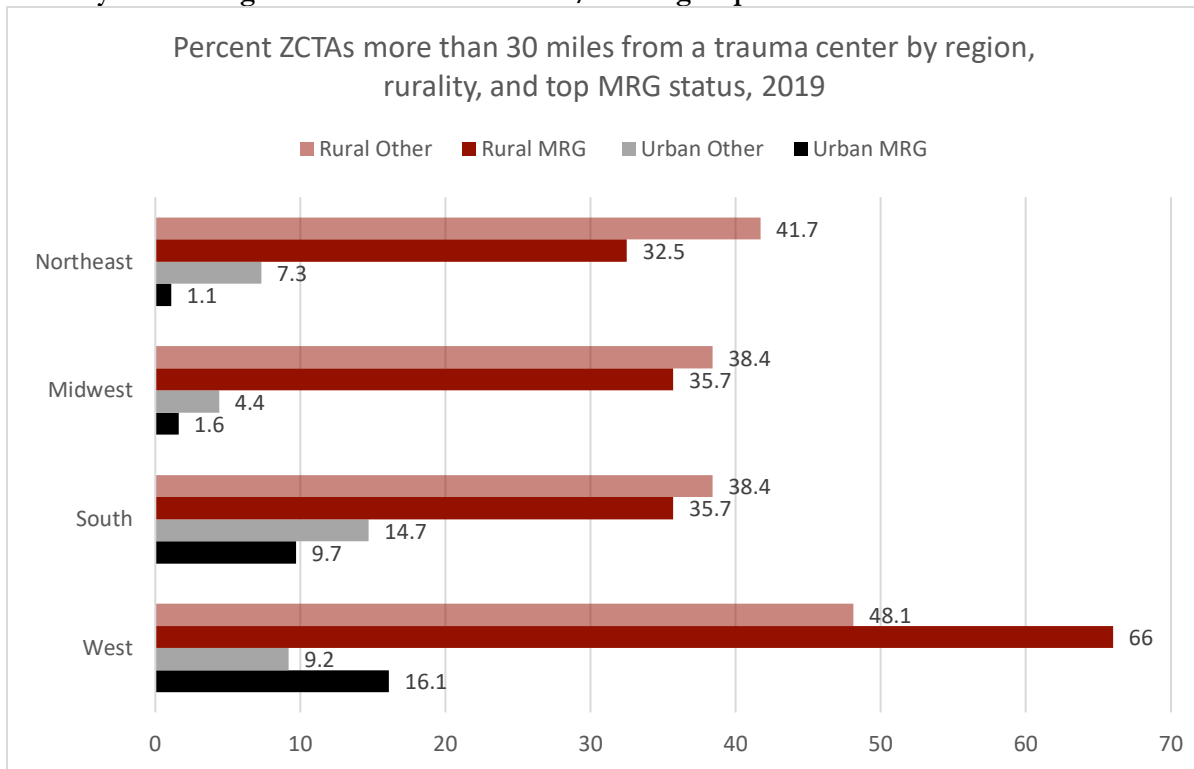


Figure 7. Percent of ZCTAs in the contiguous 48 states *without* access to trauma services within 30 miles by Census region and minoritized racial/ethnic group classification



CONCLUSIONS

There are inequities in access to emergency department and trauma services across racial/ethnic and rural regions of the U.S. Rural ZCTAs were much more likely to lack a hospital-based emergency department or trauma service within 30 miles compared to urban ZCTAs. In addition, the median distance to the nearest emergency department was significantly greater for rural top MRG ZCTAs than other ZCTAs. These findings are in concordance with previous evidence on disparities in terms of distance to care for rural residents in the U.S.^{3, 13, 14, 19}



Our findings may highlight the importance of the new Rural Emergency Hospital (REH) designation established by the Consolidated Appropriations Act.²⁰ This provision would allow small rural hospitals and critical access hospitals to convert from offering a full range of inpatient hospital care to offering only emergency department services with a requirement that the institution have transfer agreements with level I or II trauma centers. Details regarding this new designation are still being developed by the Centers for Medicare & Medicaid Services.²¹ The National Advisory Committee on Health and Human Services has made multiple suggestions for flexibility in the implementation of this new type of facility including a recommendation for formal consultation with tribal authorities.²² Final CMS regulations have not yet been established, so the degree of adoption of this alternative and its effects on population health cannot yet be addressed. However, one analysis of potential adoption, from data on hospital finances, estimated that only 68 eligible hospitals out of a total of 1,673 potential applicants would make the conversion to an REH.²² While the REH program may assist selected communities, possibly in the Midwest and South, these estimates suggest it is not a total solution to the issue of emergency services in rural America.

At the state level, the expansion of Medicaid programs by states that have not done so yet, by reducing the rate of hospital closures in minority counties, may help retain emergency services in rural communities with substantial populations of minoritized persons. In states that have certificate of need laws, state action may also be helpful at ensuring that new facilities are located near at-need populations. An analysis of the increase in trauma centers between 2009 and 2018 in Arizona found no improvement in rural transport times which the investigators attribute to placement of new centers in areas that already were served.²⁴

In the short term, there are steps that existing facilities can take to ensure that they are providing prompt care for rural patients with emergency medical and trauma needs. First, the Rural Trauma Team Development Course (RTTDC) of the American College of Surgeons²⁵ is an educational intervention that has demonstrated both good provider acceptance and reduced time-to-transfer for trauma patients whose needs cannot be met at a rural facility.^{26, 27, 28} Support for offering this training to CAH's and other small rural hospitals that have not yet participated in it may help patient outcomes. Finally, regional agreements can help ensure that patients needing to be transferred to larger hospital are transported quickly.

Second, telehealth, both in the emergency department and linked to emergency medical services (EMS) vehicles, has the potential to reduce the access burden of physical distance to emergency service. For pre-hospital care, tele-linked ambulances can initiate care for time-sensitive conditions such as stroke.^{29, 30} Tele-emergency department support originating in a larger facility can improve the capacity and resources of rural emergency departments to diagnose and manage patients locally reducing unnecessary patient transfer.^{31, 32} In addition, tele-emergency support from a larger facility can support small free-standing emergency departments and minor treatment clinics to address access issues in remote areas and overcrowding of urban emergency departments.

Retaining the COVID-era telemedicine-friendly laws and policies that enhance telemedicine uptake and utilization can support rural emergency departments.³³ Key policy areas include coverage of audio-only services, waiving cost sharing or requiring cost sharing no higher than similar in-person services, reimbursement parity between telemedicine and in-person services, easing prescribing requirements, easing consent requirements, and cross-state licensing.³⁴

 <p>Rural Health Research & Policy Centers Funded by the Federal Office of Rural Health Policy www.ruralhealthresearch.org</p>  <p>RURAL & MINORITY Health Research Center</p>	<p>Funding: This project was supported by the Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (HHS) under grant number U1CRH45498, Rural Health Research Grant Program Cooperative Agreement. The information, conclusions, and opinions expressed in this brief are those of the authors and no endorsement by FORHP, HRSA, or HHS is intended or should be inferred.</p> <p>For more information about the Rural and Minority Health Research Center, contact Director Elizabeth Crouch, PhD (crouchel@mailbox.sc.edu) or Deputy Director Peiyin Hung, PhD (hungp@mailbox.sc.edu).</p>
<p>Suggested citation: Naftagi N, Hung P, Merrell M, Benavidez G, Zahnd W, Oyesode O, Yell N, Babalola O, Crouch E, Probst JC, Eberth J. Availability of hospital-based Emergency Department and trauma services in areas with a high density of residents from minoritized racial and ethnic groups. Rural and Minority Health Research Center Policy Brief. September 2022. Link to Report</p>	

REFERENCES

1. Flanagan A, Frey T, Christiansen SL, AMA Manual of Style Committee. Updated Guidance on the Reporting of Race and Ethnicity in Medical and Science Journals. *JAMA*. 2021;326(7):621–627
2. Rural and Minority Health Research Center, University of South Carolina. The Problem of the Color Line: Place, race, and access to health care in America. *Health Affairs* February 7, 2022. Available at <https://www.healthaffairs.org/racism-and-health/storymap-the-problem-of-the-color-line>.
3. Eberth JM, Hung P, Benavidez GA, Probst JC, Zahnd WE, McNatt MK, Toussaint E, Merrell MA, Crouch E, Oyesode OJ, Yell N. The Problem Of The Color Line: Spatial Access To Hospital Services For Minoritized Racial And Ethnic Groups. *Health Aff (Millwood)*. 2022 Feb;41(2):237-246.
4. Centers for Medicare & Medicaid Services. Emergency Medical Treatment & Labor Act (EMTALA). Centers Medicare Medicaid Serv. Published online 2010:1-2. <https://www.cms.gov/Regulations-and-Guidance/Legislation/EMTALA?redirect=/EMTALA/>
5. Rosenbaum S. The enduring role of the Emergency Medical Treatment and Active Labor Act. *Health Aff (Millwood)*. 2013 Dec;32(12):2075-81.
6. Garcia MC, Rossen LM, Bastian B, Faul M, Dowling NF, Thomas CC, Schieb L, Hong Y, Yoon PW, Iademarco MF. Potentially Excess Deaths from the Five Leading Causes of Death in Metropolitan and Nonmetropolitan Counties - United States, 2010-2017. *MMWR Surveill Summ*. 2019 Nov 8;68(10):1-11.
7. Cairns C, Ashman JJ, Kang K. Emergency department visit rates by selected characteristics: United States, 2019. *NCHS Data Brief*, no 434. Hyattsville, MD: National Center for Health Statistics. 2022.
8. Circo GM. Distance to trauma centres among gunshot wound victims: identifying trauma 'deserts' and 'oases' in Detroit. *Inj Prev*. 2019 Sep;25(Suppl 1):i39-i43.
9. Jarman MP, Hashmi Z, Zerhouni Y, Udyavar R, Newgard C, Salim A, Haider AH. Quantifying geographic barriers to trauma care: Urban-rural variation in prehospital mortality. *J Trauma Acute Care Surg*. 2019 Jul;87(1):173-180.
10. Probst JC, Zahnd WE, Hung P, Eberth JM, Crouch EL, Merrell MA. Rural-Urban Mortality Disparities: Variations Across Causes of Death and Race/Ethnicity, 2013-2017. *Am J Public Health*. 2020 Sep;110(9):1325-1327.
11. Smedley BD, Stith AY, Nelson AR. *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*. Washington (DC): National Academies Press (US); 2003.
12. Gaskin DJ, Dinwiddie GY, Chan KS, Rachael M. Residential Segregation and Disparities in Healthcare Services Utilization. *Med Care Res Review* 2012;69(2):158–175. doi:10.1177/1077558711420263.
13. Carr BG, Branas CC, Metlay, Joshua P. MD P, Sullivan, Ashley F. MS M, Camargo CA. Access to Emergency Care in the United States. *Annu Emerg Med*. 2008;54(2):261-269.
14. Hsia R, Shen YC. Possible geographical barriers to trauma center access for vulnerable patients in the United States: an analysis of urban and rural communities. *Arch Surg*. 2011 Jan;146(1):46-52.
15. Economic Research Service, U.S. Department of Agriculture. Rural-Urban Commuting Area Codes (2010, revised 2019). Available at <https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes/>. Accessed March 12, 2022.
16. American College of Surgeons. Trauma Verification FAQs. Available at <https://www.facs.org/quality-programs/trauma/tcp/center-programs/vrc/faq/standards>. Accessed April 13, 2022.
17. Schuur JD, Baker O, Freshman J, Wilson M, Cutler DM. Where Do Freestanding Emergency Departments Choose to Locate? A National Inventory and Geographic Analysis in Three States. *Ann Emerg Med*. 2017 Apr;69(4):383-392.e5.
18. Boscoe F, Henry K, Zdeb M. A nationwide comparison of driving distance versus straight-line distance to hospitals. 2012;64(2):188–96.
19. Hung P, Casey MM, Kozhimannil KB, Karaca-Mandic P, Moscovice IS. Rural-urban differences in access to hospital obstetric and neonatal care: How far is the closest one? *J Perinatol*. 2018;38(6):645-652.

20. 116th Congress, Public Law 116-260, Consolidated Appropriations Act. Available at <https://www.congress.gov/bill/116th-congress/house-bill/133/text>. Accessed April 24, 2022.
21. Centers for Medicare & Medicaid Services. Conditions of Participation for Rural Emergency Hospitals and Critical Access Hospital COP Updates (CMS-3419-P)
22. National Advisory Committee on Rural Health and Human Services. *Rural Emergency Hospital Policy Brief And Recommendations To The Secretary*. October, 2021.
23. Pink GH, Thompson KW, Howard HA, Holmes GM. *How Many Hospitals Might Convert to a Rural Emergency Hospital (REH)?* NC Rural Health Research Program, UNC Sheps Center. July 2021.
24. Jones MD, Paulus JA, Jacobs JV, Bogert JN, Chapple KM, Soe-Lin H, Weinberg JA. Trauma patient transport times unchanged despite trauma center proliferation: A 10-year review. *J Trauma Acute Care Surg*. 2021 Mar 1;90(3):421-425.
25. American College of Surgeons. Rural Trauma Team Development Course. Available at <https://www.facs.org/quality-programs/trauma/education/rural-trauma-team-development-course/>
26. Zhu TH, Hollister L, Scheumann C, Konger J, Opoku D. Effectiveness of the Rural Trauma Team Development Course for Educating Nurses and Other Health Care Providers at Rural Community Hospitals. *J Trauma Nurs*. 2016 Jan-Feb;23(1):13-22.
27. Bauman ZM, Loftus J, Hodson A, Farrens A, Shostrom V, Summers J, Phillips PE, Evans CH, Schlitzkus LL. Rural Trauma Team Development Course Instills Confidence in Critical Access Hospitals. *World J Surg*. 2020 May;44(5):1478-1484.
28. Dennis BM, Vella MA, Gunter OL, Smith MD, Wilson CS, Patel MB, Nunez TC, Guillaumondegui OD. Rural Trauma Team Development Course decreases time to transfer for trauma patients. *J Trauma Acute Care Surg*. 2016 Oct;81(4):632-7.
29. Mathur S, Walter S, Grunwald IQ, Helwig SA, Lesmeister M, Fassbender K. Improving Prehospital Stroke Services in Rural and Underserved Settings With Mobile Stroke Units. *Front Neurol*. 2019 Mar 1;10:159.
30. Kandimalla J, Vellipuram AR, Rodriguez G, Maud A, Cruz-Flores S, Khatri R. Role of Telemedicine in Prehospital Stroke Care. *Curr Cardiol Rep*. 2021 May 10;23(6):71.
31. Natafqi N, Shane DM, Ullrich F, MacKinney CA, Bell A, Ward MM. Using tele-emergency to avoid patient transfers in rural emergency departments: An assessment of costs and benefits. *J Telemed Telecare*. Published online 2017:2-7. doi:10.1177/1357633X17696585
32. Natafqi N, Mohr NM, Wittrock A, Bell A, Ward MM. The Association Between Telemedicine and Emergency Department (ed) Disposition: A Stepped Wedge Design of an Ed-based Telemedicine Program In Critical Access Hospitals. *J Rural Hlth*. 2020;(36):360-370. doi:10.1111/jrh.12370
33. Pitsor J, Wnlund S. States Turn to Telehealth During the Pandemic. State Legislatures Magazine, October 29, 2020. Available at <https://www.ncsl.org/research/health/states-turn-to-telehealth-during-the-pandemic-magazine2020.aspx>. Accessed June 4, 2022.
34. Volk J, Palanker D, O'Brien M, Goe CL. States ' Actions to Expand Telemedicine Access During COVID-19 and Future Policy Considerations.; 2021. <https://www.commonwealthfund.org/publications/issue-briefs/2021/jun/states-actions-expand-telemedicine-access-covid-19>

APPENDIX

Methodology

Data Sources

Data on the racial/ethnic composition of ZCTAs and their socioeconomic characteristics were obtained from the U.S. Census Bureau's American Community Survey (ACS) 2015-2019 5-year estimates.¹

Key Definitions

Rurality: Rurality was defined using the ZIP approximated Rural Urban Commuting Area (RUCA) codes.² Specifically, ZCTAs were assigned the RUCA code for the matching ZIP even if additional ZIP codes were included in the creation of the ZCTA boundary. Those ZCTAs with a ZIP matched RUCA code of 1-3 were designated as urban while those with a RUCA code of 4-10 were designated as rural. The Uniform Data System (UDS) Mapper was used to identify the corresponding ZCTA for each ZIP code.³ The UDS Mapper is a mapping tool operated primarily by data from the Uniform Data System to analyze service area of health centers. Since the U.S. Census Bureau does not release an official crosswalk between ZIP Codes and ZCTAs, the UDS Mapper was used to identify ZCTAs using patient data that was matched from the Uniform Data System. Each ZCTA code was added to the dataset using a left join via ZIP codes. Since there were multiple ZIP codes for some ZCTA codes, unique CMS Certification Numbers (CCN's) were counted for each ZCTA code. The procedure worked well as there were no ZIP codes used for multiple ZCTA codes.

Minoritized racial and ethnic groups: To classify ZCTAs as high MRG ZCTAs we used the national 95th percentile of each minoritized racial/ethnic groups population proportion stratified by rural/urban status (**See Table 1 for each MRG threshold**). Specifically, we ranked all rural and urban ZCTAs based on the proportions of residents in each of the following MRGs: Black/African American, Hispanic/Latino, American Indian/Alaska Native, Asian and then identified ZCTAs with proportions higher or equal to the national 95th percentile in each racial and ethnic group. For ZCTAs that fell into multiple MRG groups, we categorized them into a separate stratum. In addition, among ZCTAs that are not with high (> 95th percentile) MRG residents, we identified those that had 100% non-Hispanic Whites to distinguish ZCTAs with all Whites from ZCTAs without high representation of any one racial and ethnic group

Characteristics of top MRG ZCTAs

Top MRG ZCTAs could differ from other ZCTAs in the U.S. on characteristics that affect demand for dialysis services. To provide context for our dialysis availability results, we compared MRG ZCTAs, defined as those in the 95th percentile for the proportion of each group, to all other ZCTAs (labeled "all other;" Table A-1, page 19).

- Demographic characteristics:
 - Across both rural and urban ZCTAs, the proportion of the population that is age 65 or older is significantly lower in MRG ZCTAs than in "all other" ZCTAs.
 - Top MRG areas, with the exception of top Asian ZCTAs, generally had higher proportions of the population under age 65 who lacked health insurance.
- Disease prevalence: Hypertension and diabetes are shown as measures of population health. Both could also contribute to the need for ED services through cardiovascular (acute myocardial infarction) or endocrinological (diabetic ketoacidosis) emergencies.

- Although top Hispanic and Asian ZCTAs had lower estimated prevalence of hypertension and diabetes than referent ZCTAs, NH Black and NH American Indian and Alaska Native ZCTAs had disease rates that exceeded the referent category.
- Household characteristics: We examined vehicle availability within the household as an indicator of transportation difficulty, particularly in rural places. Community poverty can make an area unattractive for healthcare providers of all kinds as persons who are uninsured or whose care is funded by lower-paying insurers, such as Medicaid, offer lower payment for the provider.
 - Within rural MRG ZCTAs, ZCTAs in the top group for AI/AN, Black, and multiple MRG populations had higher proportions of households that lacked a vehicle; the Asian ZCTAs did not differ from the “all other” group.
 - The top AI/AN ZCTAs were the only group for which the proportion of households without a vehicle was significantly higher among rural than among urban ZCTAs (rural 19.0%, urban 5.8%).
 - The proportion of households with incomes at or below 200% of the Federal Poverty Level was higher among MRG ZCTAs than the “all other” group for all except top Asian ZCTAs.

Table A-1. Characteristics of top MRG ZCTAs when compared to all other ZCTAs by rurality¹ in percent (population and household data from the 2015-2019 American Community Survey; estimated disease prevalence from CDC Places tool)

	Personal Characteristics				Household Characteristics	
	Demographic		Estimated prevalence of		Lack vehicle	At or Below 200% FPL
	Residents over 65	Lack health insurance	High blood pressure	Diabetes		
Rural ZCTAs (14,875)	%	%	%	%	%	%
>1 MRG (156)	16.6 ***	15.6 ***	34.9 **	13.7 ***	11.6 ***	45.0 ***
Hispanic (594)	17.2 ***	15.1 ***	34.3 ***	13.7 ***	5.2	45.4 ***
NH Am. Ind./AK Nat. (668)	16.6 ***	20.5 ***	37.0 ***	15.0 ***	19.0 ***	49.5 ***
NH Asian (622)	20.5 **	7.4 **	32.6 ***	11.0 ***	4.7	32.8 *
NH Black (709)	19.3 ***	12.6 ***	45.3 ***	17.3 ***	10.5 ***	51.6 ***
NH White (2,177)	26.2 ***	7.5 ***	37.5 ***	12.8 ***	4.2 **	35.2 *
All other ZCTAs (9,949)	21.7	8.4	36.2	12.1	4.8	34.4
Urban ZCTAs (17,795)	%	%	%	%	%	%
>1 MRG (127)	12.3 ***	14.6 ***	30.6 **	13.3 **	11.5 ***	49.3 ***
Hispanic (755)	12.1 ***	17.0 ***	30.7 ***	13.5 ***	10.5 ***	48.1 ***
NH Am. Ind./ AK Nat. (825)	17.4	11.2 ***	34 ***	11.7 ***	5.8	36.7 ***
NH Asian (851)	14.0 ***	5.3 ***	25.3 ***	8.6 ***	12.1 ***	21.6 ***
NH Black (874)	15.0 ***	11.3 ***	42.4 ***	16.5 ***	17.8 ***	49.0 ***
NH White (1,203)	23.9 ***	6.6 **	36.5 ***	12.2 ***	5.1 *	31.8 ***
All other ZCTAs (13,160)	17.7	7.2	32.2	10.4	5.6	27.1

¹With the exception of lack of health insurance, ALL rural values differ significantly from the corresponding urban value. ²NH = Non-Hispanic ³Statistical indicators: Group differs from Referent ZCTA within either all rural or all urban ZCTAs. * = p < .05; ** = p < .01; *** p < .001

While we included all ZCTAs nationally for mapping, analysis of distance was limited to the 48 contiguous states due to the atypical distance situations in Alaska and Hawaii. Overall, 98% of ZCTAs are covered by the distance calculations. The largest rural discrepancies involve the top American Indian/Alaska Native ZCTAs (80% included), many of which are located in Alaska, and NH Asian ZCTAs (89% included) many of which are in Hawaii. While the proportion of rural ZCTAs in the top 5% for more than one minoritized group also dropped (85% of total), this overall category is quite small.

Table A-2: ZCTAs included in distance calculations for the 48 contiguous states

ZCTA Racial/ Ethnic Category	All ZCTAs		Studied ZCTAs		Studied as % of original	
	Urban	Rural	Urban	Rural	Urban	Rural
White	1,203	2,177	1,201	2,171	100%	100%
>1 MRG	127	156	127	132	100%	85%
Hispanic	755	594	755	594	100%	100%
NH AI/AN	825	668	803	536	97%	80%
NH Asian	851	622	824	551	97%	89%
NH Black	874	709	872	709	100%	100%
All other ZCTAs	13,160	9,949	13,145	9,915	100%	100%
Total	17,795	14,875	17,727	14,608	100%	98%

Statistical and Spatial Analysis

We calculated mean values of ACS estimates across rural-urban and MRG ZCTA groupings. Using ArcGIS Pro v2.8, we used the ArcGIS world geocoding service to geocode emergency department and trauma service addresses to obtain XY geographic coordinates of each unique emergency department and trauma service location. Using population weighted ZCTA centroids (an areas geographic center), we calculated the straight-line distance in miles to the nearest emergency department and trauma service.

Appendix References:

¹ U.S. Census Bureau. Explore Census Data. <https://data.census.gov/cedsci/> Accessed August 4, 2021

² United States Department of Agriculture. Rural-Urban Commuting Area Codes. <https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes.aspx> Accessed August 4, 2021

³ American Academy of Family Physicians. ZIP Code to ZCTA Crosswalk. <https://udsmapper.org/zip-code-to-zcta-crosswalk/> Accessed August 4, 2021