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Rural Policy Brief

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COVID-19 Mortality Rates across Noncore, Micropolitan, and Metropolitan Counties by Community Characteristics, December 2020-January 2021

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Purpose

This policy brief examines differences in COVID-19 mortality rates across rural-urban designations and stratifications by geography, county-level sociodemographic factors, and county-level health care factors. Between December 2020 and January 2021, COVID-19 deaths were at their peak, hospital capacity was stretched, and COVID-19 vaccines were not widely available, making this a critical time period to examine. These findings may provide insights to ensure that the health care and social support system can manage the ongoing COVID-19 pandemic and prepare for future health emergencies.

Key Findings

- COVID-19 mortality rates between December 2020 and January 2021 were highest in noncore counties, followed by micropolitan and metropolitan counties.
- The Midwest experienced the highest COVID-19 mortality rates, particularly in noncore counties.
- Compared to more racially and ethnically homogeneous counties, those with at least 20 percent of the population being Hispanic or American Indian/Alaska Native (AI/AN) had higher COVID-19 mortality rates. Micropolitan counties with at least 20 percent AI/AN population reported the highest rates.
- Counties with the highest nursing home bed density (by quartile) reported the highest mortality rates, regardless of rurality. Across all nursing home bed density quartiles, micropolitan and noncore counties had the highest mortality rate.

Background

The COVID-19 pandemic hit nonmetropolitan populations hard. As of August 1, 2022, the cumulative mortality rate among nonmetropolitan counties exceeded that of metropolitan counties by 34 percent despite having lower cumulative case rates.[1] Studies suggest that as many as half of rural residents are at risk for hospitalization or death if infected with COVID-19.[2] At the intersection of race and geography, Cheng et al found that rural counties in the top quartile of Black and Hispanic populations had

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significantly higher than average daily increases in their COVID-19 mortality rates.[3,4] Other studies have shown poverty, uninsured status, and other factors to be significant contributors.[1] However, many of these studies were reflective of the pandemic before the peak of cases and deaths in December 2020 and January 2021. It is important, therefore, to continue to assess the impact of various factors on COVID-19 mortality in rural areas during peak times to fully understand contributing factors.

The first year of the pandemic was marked in rural areas by initial disparities in access to testing and more pronounced geographic hotspots of disease incidence and mortality due to high risk of exposure (e.g., counties with meatpacking plants, or adjacency to such counties) and high risk of severe disease among those living in institutional settings (e.g., nursing homes). [5,6] However, factors related to geographic differences in COVID-19 mortality rates during the period of peak cases and deaths may differ from rates earlier in the pandemic. Further, unique factors that affect COVID-19 mortality rates may also be in play, such as racial/ethnic composition and exposure-related and treatment-related health care access characteristics. Knowing that many hospitals, including those in rural areas, approached or exceeded their maximum capacity during the surge of cases in November-December 2020, we expect that this resource strain may have subsequently further contributed adversely to mortality rates in December 2020 through January 2021, especially as this time period pre-dates the widespread availability of vaccines.

Data and Methods

COVID-19 mortality data were extracted from the Johns Hopkins COVID-19 Data Repository by county for the period December 1, 2020, through January 31, 2021.[7] Urban Influence Codes (UICs) were used to categorize counties as metropolitan, micropolitan, or noncore.[8] Measures of racial/ethnic composition were derived from 2015-2019 American Community Survey (ACS) five-year estimates.[7] Data on county-level health care characteristics most relevant to COVID-19 mortality included ICU bed density as a measure of capacity to care for hospitalized patients with severe complications due to COVID-19, and nursing home bed density as a measure populations at high risk for severe outcomes (i.e., hospitalization and/or death). The number of ICU beds within each county was compiled from the 2019 American Hospital Association Survey, and nursing home bed counts were taken from 2020 CMS Nursing Home Compare Data.[9,10] Densities of both ICU beds and nursing home beds were calculated per 100,000 population within the county.

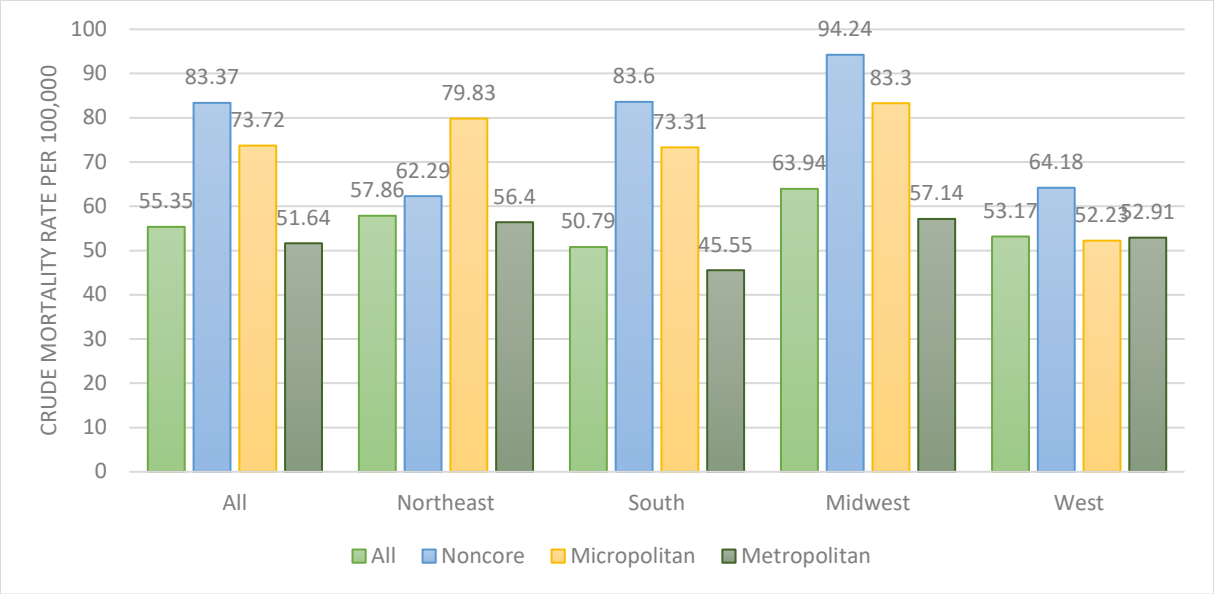
We compiled data from multiple sources to examine crude mortality rates per 100,000 population aggregated across metropolitan, micropolitan, and noncore counties at national and state levels (crude mortality rates are calculated by dividing the number of deaths by the total population within an area of interest). Additionally, we performed stratifications based upon county racial/ethnic composition (using a cut point of 20 percent or higher of Black, Hispanic, or AI/AN populations, U.S. Census Region, and quartile of ICU bed and nursing home bed density.

Results/Findings

During this two-month time period, 178,739 COVID-19 deaths (crude mortality rate of 55.35 per 100,000) occurred in the U.S. Across geographies, 142,950 COVID-19 deaths occurred in metropolitan counties (crude mortality rate of 51.64 per 100,000)

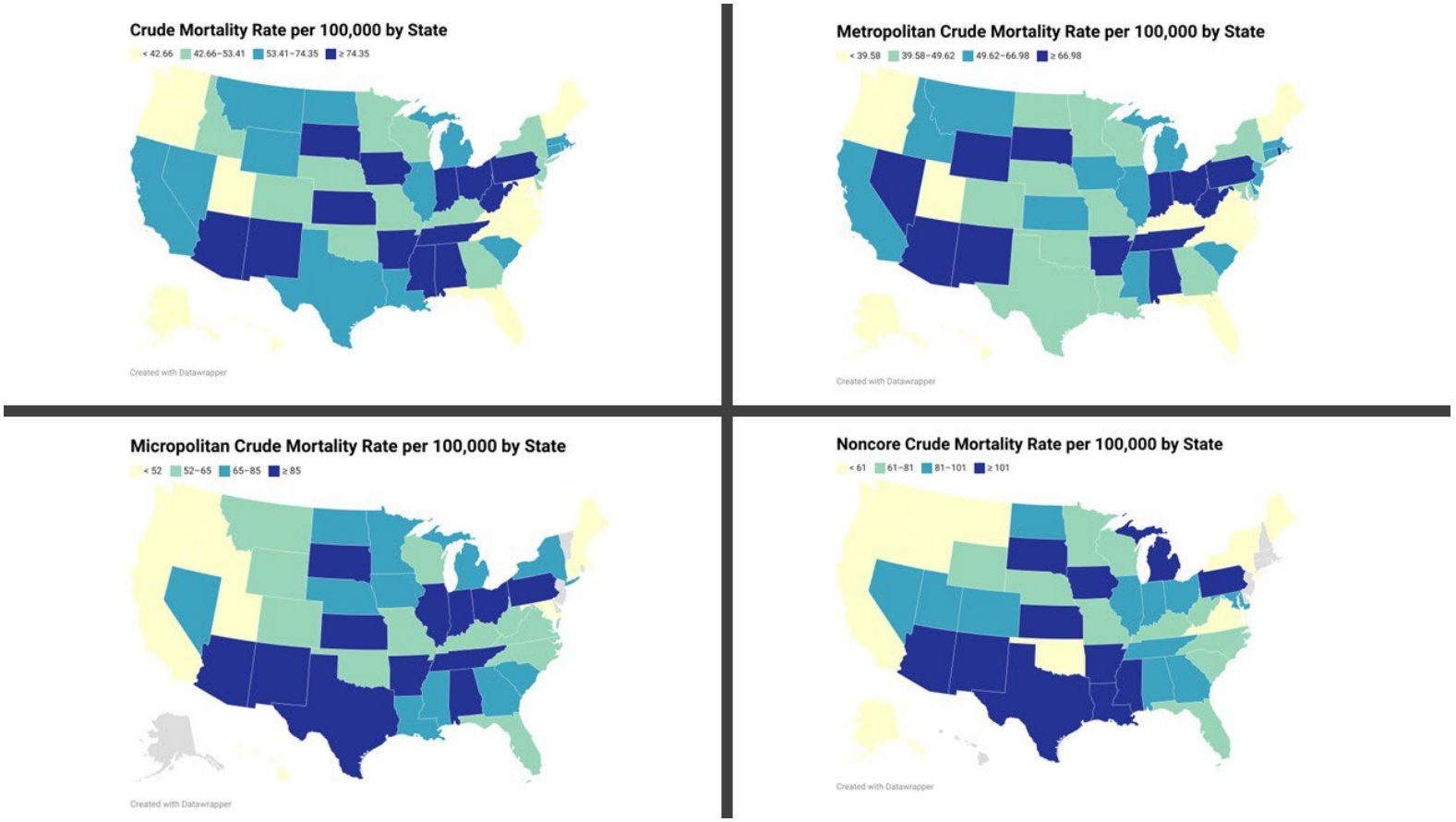
compared to 20,078 deaths in micropolitan (73.72 per 100,000), and 15,711 deaths (83.37 per 100,00) in noncore counties (Figure 1). In other words, if micropolitan and noncore counties had the same mortality rates as metropolitan areas, there would have been 11,992 fewer deaths in nonmetropolitan (micropolitan and noncore combined) counties. Crude mortality rates also varied across levels of rurality and U.S. Census Region. Overall, the Midwest experienced the highest mortality rate during this time (63.94 deaths per 100,000 population). The Midwest also had the highest mortality rates across each level of rurality, 94.24, 83.30, and 57.14 per 100,000 across noncore, micropolitan, and metropolitan counties, respectively. Within each region, noncore mortality rates were highest, except for the Northeast, which had the highest rate in micropolitan counties.

Figure 1: Crude COVID-19 Mortality Rates by Rurality and U.S. Census Region



Across states, the highest mortality rates tended to occur in the Midwest and South (Figure 2; specific rates are reported in Appendix 1). In metropolitan and micropolitan areas, the highest quartiles of mortality rates were scattered throughout the Midwest, South, and West. In noncore areas, the Midwest and South both had four states in the top quartile of deaths. Five states—Arizona, Arkansas, New Mexico, Pennsylvania, and South Dakota—were in the top quartile of overall mortality rates as well as metropolitan, micropolitan, and noncore rates. The Pacific Northwest and northern New England were in the lowest quartile across all maps.

Figure 2: COVID-19 Crude Mortality Rate per 100,000 by State and Rurality, December 2020–January 2021. (NOTE: States in gray either had no counties with the respective designation or had fewer than 16 deaths among that designation and rates were unstable.)



Assessing crude mortality rates at the intersection of rurality and racial/ethnic composition yields mixed findings (Table 1). With one exception (AI/AN populations of 20% or greater), there is a trend of higher crude mortality rates with increasing rurality (i.e., noncore rates are higher than micropolitan, micropolitan are higher than metropolitan. The difference based on percentage of the population is more complicated, with mostly higher mortality rates in areas with a higher percentage of AI/AN and Hispanic populations, but mostly lower mortality rates in areas with a higher percentage of Black population. As such, rates were highest among micropolitan counties with 20 percent or more of the population being AI/AN (103.72 per 100,000) and among noncore counties in which 20 percent or more of the population is Hispanic (99.40 per 100,000).

Table 1: Crude COVID-19 Mortality Rates per 100,000 by Rurality and Racial/Ethnic Composition, December 2020–January 2021				
	All (n=3,142 counties)	**Noncore (n=1,335 counties)**	**Micropolitan (n=641 counties)**	**Metropolitan (n=1,166 counties)**
All	55.35	83.37	73.72	51.64
Counties where 20 percent or more of the population is Black (n=497 counties)	47.25	79.02	69.98	44.34
Counties where less than 20 percent of the population is Black (n=2,645 counties)	57.61	84.42	74.33	53.81
Counties where 20 percent or more of the population is American Indian/Alaska Native (n=63 counties)	83.24	75.05	103.72	72.22
Counties where less than 20 percent of the population is American Indian/Alaska Native (n=3,079 counties)	55.21	83.63	73.14	51.60
Counties where 20 percent or more of the population is Hispanic (n=396 counties)	53.21	99.40	79.86	51.82
Counties where less than 20 percent of the population is Hispanic (n=2,746 counties)	56.52	82.04	72.89	51.53

Counties with no ICU beds had higher mortality rates (70.03) than both the third (52.63) and fourth (55.66) quartiles of ICU bed density (Table 2). However, there was no apparent pattern between the density of ICU beds within the county and the crude mortality rate across rurality groupings. With increasing density of nursing home beds, the crude COVID-19 mortality rate increased overall and within noncore, micropolitan, and metropolitan counties. Noncore counties with the highest density of nursing home beds had the highest mortality rate (106.90 per 100,000).

Table 2: Crude COVID-19 Mortality Rates per 100,000 by Rurality and ICU and Nursing Home Bed Density, December 2020-January 2021				
	All (n=3,142 counties)	**Noncore (n=1,335 counties)**	**Micropolitan (n=641 counties)**	**Metropolitan (n=1,166 counties)**
ICU Bed Density per 100,000				
No Beds* (n=1,590 counties)	70.03	83.08	70.05	57.75
Quartile 3 (>0-18.02 per 100,000) (n=766 counties)	52.63	78.72	71.46	50.74
Quartile 4 (18.03+ per 100,000) (n=786 counties)	55.66	86.62	77.06	52.24
Nursing Home Bed Density per 100,000				
Quartile 1 (<416.38 per 100,000) (n=785 counties)	45.61	58.23	47.09	45.33
Quartile 2 (416.38-697.42 per 100,000) (n=786 counties)	53.69	70.05	68.25	51.92
Quartile 3 (697.43-1097.5 per 100,000) (n=785 counties)	75.98	81.62	87.05	72.42
Quartile 4 (1097.6 per 100,000) (n=786 counties)	94.33	106.90	91.17	82.46
*The median number of ICU beds per 100,000 across counties is 0, and thus quartiles 1 and 2 are represented by the “no beds” category.				

Discussion

We examined COVID-19 mortality between December 2020 and January 2021 across nonmetropolitan (micropolitan and noncore) and metropolitan counties by community characteristics. During this time, the highest COVID-19 crude mortality rates were seen in noncore counties across the U.S. and regionally, except for the Northeast. Regionally, the Midwest experienced the highest mortality rates. At the intersection of race/ethnicity and rurality, the highest rates in micropolitan areas occurred among counties with more than 20 percent AI/AN population, followed by noncore areas with 20 percent or more Hispanic populations. Lastly, crude COVID-19 mortality rates were higher with increases in nursing home bed densities in all three geographies. Overall, we did not observe any pattern between crude COVID-19 mortality rates and ICU bed densities in noncore, micropolitan, and metropolitan counties.

The finding of the highest mortality rates in noncore counties is aligned with earlier studies assessing rates in the spring and early summer of 2020.[12] Despite being more geographically isolated, a potentially protective factor against the spread, most rural counties experienced notable increases in deaths. The higher mortality rates in noncore counties may reflect the limited health care infrastructure, higher proportions of the elderly population, and higher rates of comorbidities.

We found that the Midwest experienced particularly high rates of COVID-19 mortality across county rurality, but especially in micropolitan and noncore counties. Regional differences may, in part, reflect the Northeast experiencing a peak surge early in 2020 and the South experiencing a surge during the summer of 2020. Further, analysis from the Kaiser Family Foundation shows vast swaths of counties in the Upper Midwest lacking ICU beds.[13] However, our analysis did not necessarily show higher COVID-19 mortality rates in noncore or micropolitan counties lacking ICU beds, which may reflect the ability of rural hospitals to be adaptive and collaborative during a crisis.[14]

The highest COVID-19 mortality rates were observed in micropolitan counties with 20 percent or more AI/AN and noncore counties with greater than 20 percent Hispanic population. These results align with a recent study by the Kaiser Family Foundation that evaluated COVID-19 mortality rates by racial and ethnic composition.[13] The increased COVID-19 mortality rates in AI/ANs and Hispanic populations residing in micropolitan and noncore counties could be due to living circumstances such as holding a job that does not allow working from home, or lack of availability of public health services. In particular, many rural Hispanic communities may be more at risk due to holding jobs that put them at high risk for exposure (e.g., meatpacking), which have been shown earlier in the pandemic to be associated with higher rates of COVID-19 cases and deaths. Both Hispanics and American Indian/Alaska Natives also are more likely to live in multigenerational living arrangements which also may contribute to spread of the virus. [16-18]

Areas of higher nursing home bed density also had higher COVID-19 mortality rates during this time period. Although this was true regardless of rurality, noncore areas with the highest quartile of nursing home bed density also reported the highest mortality rates. While we report mortality rates only by county, other research reports that nursing home deaths were also highest in December 2020 and January 2021.[19] Previous work has also shown that staffing shortages in rural nursing homes accelerated COVID-19 deaths.[20]

The particularly high COVID-19 mortality rates in noncore, Midwestern, and nonmetropolitan areas with higher proportions of Hispanic and AI/AN residents are concerning. While some of these mortality disparities may reflect the higher proportions of older adults in rural areas, Hispanic communities tend to be younger, and Hispanic populations are the fastest-growing

populations in rural areas.[21] It is important to ensure that these populations as well as AI/AN populations have adequate access to important acute care services.

Our findings underscore the importance of a well-resourced rural health care infrastructure that can respond to surges in novel viruses and other health care emergencies. Similarly, it is imperative that nursing home settings have the resources to provide adequate infection monitoring, isolation procedures, and staffing policies to protect residents and staff. Future work should continue to monitor inequities in COVID-19 deaths in rural areas, particularly as uptake of vaccines has been lower in rural communities.[22]

References

1. Centers for Disease Control and Prevention. Trends in COVID-19 Cases and Deaths in the United States, by County-level Population Factors. Accessed August 1, 2022. https://covid.cdc.gov/covid-data-tracker/#pop-factors_totaldeaths
2. Kauffman BG, Whitaker R, Pink G, Holmes GM. Half of Rural Residents at High Risk of Serious Illness Due to COVID-19, Creating Stress on Rural Hospitals. *J Rural Health*. 2020; 36 (4):584-590.
3. Cheng KJG, Sun Y, Monnat SM. COVID-19 Death Rates Are Higher in Rural Counties With Larger Shares of Blacks and Hispanics. *Journal of Rural Health*. 2020;36(4):602-608. doi:10.1111/jrh.12511
4. Glance L, Thirukumaran CP DA. The Unequal Burden of COVID-19 Deaths in Counties With High Proportions of Black and Hispanic Residents. *Medical Care*. 2021;59(6):470-476.
5. Yang BK, Carter MW, Nelson HW. Trends in COVID-19 cases, deaths, and staffing shortages in US nursing homes by rural and urban status. *Geriatr Nurs*. 2021;42(6):1356-1361. doi:10.1016/j.gerinurse.2021.08.016
6. Saitone TL, Aleks Schaefer K, Scheitrum DP. COVID-19 morbidity and mortality in U.S. meatpacking counties. *Food Policy*. 2021;101:102072. doi:10.1016/j.foodpol.2021.102072
7. Johns Hopkins Coronavirus Resource Center. COVID-19 Map - Accessed May 12, 2021. https://coronavirus.jhu.edu/map.html
8. United States Department of Agriculture. Urban Influence Codes. Access May 12, 2021. https://www.ers.usda.gov/data-products/urban-influence-codes.aspx
9. U.S. Census Bureau. American Community Survey. Accessed May 12, 2021. https://data.census.gov/cedsci/
10. American Hospital Association. American Hospital Association Annua Survey Database Access May 12, 2021 https://www.ahadata.com/aha-annual-survey-database
11. Centers for Medicare and Medicaid Services. Accessed May 12, 2021. https://www.medicare.gov/care-compare/?providerType=NursingHome&redirect=true
12. Karim SA and Chen HF. Deaths From COVID-19 in Rural, Micropolitan, and Metropolitan Areas: A County-Level Comparison. *Journal of Rural Health*. 2021; 37(1): 124-132.
13. Kaiser Health News. Millions Of Older Americans Live In Counties With No ICU Beds As Pandemic Intensifies. Accessed May 12, 2021. https://khn.org/news/as-coronavirus-spreads-widely-millions-of-older-americans-live-in-counties-with-no-icu-beds/
14. Atkinson MK, Hick JL, Singer SJ, Cagliuso NV, Biddinger PD. Do Rural Hospitals Have An Advantage During A Pandemic? *Health Affairs Forefront*. March 22, 2022. https://www.healthaffairs.org/do/10.1377/forefront.20220321.42134/

15. Ndugga N, Hill L, Artiga S, Haldar S. Latest Data on COVID-19 Vaccinations by Race/Ethnicity. Accessed August 1, 2022. https://www.kff.org/coronavirus-covid-19/issue-brief/latest-data-on-covid-19-vaccinations-by-race-ethnicity/
16. Saitone TL, Aleks Schaefer K, Scheitrum DP. COVID-19 morbidity and mortality in U.S. meatpacking counties. *Food Policy*. 2021 May; 101: 102072.
17. Albrecht DE. Factors Explaining Variations in COVID 19 Deaths in Rural America. *Journal of Rural Social Sciences*.2022; 37(2) Article 2. Available at: https://egrove.olemiss.edu/jrss/vol37/iss2/2
18. Vandenberg A. The Impacts and Implications of COVID-19 on Household Arrangements. October 2021. https://aspe.hhs.gov/sites/default/files/documents/f8348b44ab9008397797e50935ec1688/impacts-and-implications-covid-19-household-arrangements.pdf
19. Chidambaram P and Garfield R. Nursing Homes Experienced Steeper Increase In COVID-19 Cases and Deaths in August 2021 Than the Rest of the Country. Accessed August 1, 2022 https://www.kff.org/coronavirus-covid-19/issue-brief/nursing-homes-experienced-steeper-increase-in-covid-19-cases-and-deaths-in-august-2021-than-the-rest-of-the-country/
20. Yang BK, Carter MW, Nelson HW. Trends in COVID-19 cases, deaths, and staffing shortages in US nursing homes by rural and urban status. *Geriatr Nurs.* 2021 Nov-Dec;42(6):1356-1361. doi: 10.1016/j.gerinurse.2021.08.016
21. Lichter DT and Johnson KM. A Demographic Lifeline? Immigration and Hispanic Population Growth in Rural America. *Population Research and Policy Review*. 2020; 39, 785-803.
22. Ullrich F and Mueller K. COVID-19 Cases and Vaccination Rates. https://rupri.public-health.uiowa.edu/publications/policybriefs/2021/COVID%20Vaccinations%20and%20Cases.pdf

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Appendix Table 1: Crude Rates of COVID-19 Mortality by State and County Rurality, December 2020-January 2021

State	All		Noncore		Micropolitan		Metropolitan	
	Deaths	Crude Mortality Rate per 100,000	Deaths	Crude Mortality Rate per 100,000	Deaths	Crude Mortality Rate per 100,000	Deaths	Crude Mortality Rate per 100,000
Alabama	4200	83.34	602	97.47	574	108.55	3024	81.33
Alaska	144	19.50	40	20.71	**	**	103	20.63
Arizona	6499	93.56	157	154.33	370	150.06	5972	90.51
Arkansas	2378	79.51	611	107.61	481	84.50	1286	69.38
California	21934	56.03	77	28.48	195	34.68	21662	56.54
Colorado	2883	52.12	282	91.80	244	62.17	2357	48.78
Connecticut	2027	56.60			92	50.27	1935	56.94
Delaware	485	51.08					485	51.08
District of Columbia	233	34.04					233	34.04
Florida	8166	39.64	225	64.93	200	55.17	7741	38.92
Georgia	4683	45.48	642	81.37	648	65.44	3393	39.83
Hawaii	165	11.60			19	7.06	146	12.66
Idaho	824	48.82	83	59.48	154	36.73	587	51.99
Illinois	7025	54.79	570	94.60	824	94.54	5631	49.62
Indiana	5026	75.22	401	87.44	1003	99.87	3622	70.00
Iowa	2585	82.52	1070	136.93	404	81.91	1111	59.80
Kansas	2426	83.40	571	146.90	614	112.76	1241	62.82
Kentucky	1919	43.22	654	66.67	477	56.04	788	30.21
Louisiana	2491	53.41	361	100.98	277	68.95	1853	47.46
Maine	398	29.86	122	28.86	27	22.21	249	31.58
Maryland	2527	42.09	75	91.64	34	48.94	2418	41.32
Massachusetts	3827	56.03	**	**	21	23.80	3806	56.55
Michigan	6169	61.95	670	100.96	782	68.96	4717	57.81
Minnesota	2623	47.45	369	64.02	444	67.12	1810	42.20
Mississippi	2250	75.28	668	101.02	756	79.72	826	59.89
Missouri	3077	50.52	547	66.00	438	61.22	2092	46.02
Montana	578	55.48	172	46.89	168	53.08	238	66.40
Nebraska	983	51.61	232	68.48	228	69.59	523	42.24
Nevada	2134	73.01	29	88.69	175	73.01	1930	72.82
New Hampshire	530	39.45			194	42.98	332	39.32
New Jersey	4511	50.79					4511	50.79
New Mexico	1721	82.24	121	131.68	620	103.54	980	69.91
New York	8946	45.60	233	59.54	679	68.7	8034	44.05
North Carolina	4150	40.86	398	62.99	863	54.84	2889	36.34
North Dakota	499	66.34	182	92.23	133	73.99	184	49.05
Ohio	9230	79.28	435	96.73	1814	94.94	6981	75.22
Oklahoma	1804	46.04	280	51.72	416	51.87	1108	43.03
Oregon	1047	25.65	30	30.21	191	33.94	826	24.15

State	All		Noncore		Micropolitan		Metropolitan	
	Deaths	Crude Mortality Rate per 100,000	Deaths	Crude Mortality Rate per 100,000	Deaths	Crude Mortality Rate per 100,000	Deaths	Crude Mortality Rate per 100,000
Pennsylvania	11311	88.43	523	128.31	1472	138.57	9316	82.29
Rhode Island	783	74.10					783	74.10
South Carolina	2685	54.18	205	67.38	300	67.63	2180	51.80
South Dakota	844	97.65	341	156.51	206	89.37	297	71.41
Tennessee	4961	74.59	650	100.42	832	97.43	3479	67.56
Texas	15313	54.91	1519	107.12	1573	96.26	12221	49.21
Utah	788	25.88	121	83.48	37	20.86	630	23.14
Vermont	105	16.80	17	10.45	**	**	67	30.73
Virginia	2498	29.69	459	58.98	172	64.20	1867	25.34
Washington	1596	21.88	32	20.50	120	20.86	1444	22.00
West Virginia	1378	75.18	278	69.54	166	55.24	931	82.48
Wisconsin	3000	51.92	478	66.35	482	62.04	2040	47.66
Wyoming	383	65.83	109	68.19	137	56.221	137	76.84

Cells that have been "grayed out" have no counties of the corresponding type; cells with ** indicate that there were fewer than 16 deaths within this category during this time indicating an unstable rate that is therefore suppressed.