FINDINGS BRIEF
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RURAL & MINORITY Health Research Center

Prevent or Treat: Availability of Diabetes Self-Management Education and Dialysis in High Need Rural Counties

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KEY FINDINGS

Diabetes education:

- Nationally, 41.0% of all counties contained at least one location where diabetes self-management education (DSME) is offered. Rural counties were less likely to have DSME than urban counties (30.1% versus 59.6%; $p < .001$).
- Within rural counties, noncore counties were less likely to have in-county DSME than micropolitan counties (21.3% versus 48.4%; $p < .001$).
- Within high need counties (those in the top quartile for estimated diabetes prevalence), 36.7% of urban counties and 31.3% of micropolitan counties have a DSME site (ns). Among high-need noncore rural counties, however, only 12.8% have this service available.

Dialysis:

- Across the U.S., at least one site for kidney dialysis services is available in 59.2% of all counties. Facilities are present in similar proportions of urban and micropolitan counties (79.5% and 80.5%, respectively) but present in only 31.1% of noncore rural counties.

Both services:

Nationally, more rural counties contained dialysis facilities (931 counties; 47.1%) than contained DSME (594; 30.1%). Across 790 high diabetes need counties, 164 (20.8%) have DSME while 417 (52.8%) had an in-county dialysis facility.

INTRODUCTION

Certain chronic conditions, when inadequately controlled, have consequences that are catastrophic both for the health and well-being of the individual and for the cost of providing health care. Diabetes is a particularly insidious chronic condition: among other outcomes, diabetes is implicated in about 44% of all new cases of end stage kidney disease (ESKD).[1]

ESKD occurs when the kidneys have ceased to function; it is uniformly fatal unless treated. ESKD treatment consists of a kidney transplant or ongoing dialysis.[1] Dialysis is a complex process in which blood is withdrawn from the body, circulated through machines to remove waste that would otherwise have been processed by the kidneys, and returned. In-center hemodialysis, the most common treatment mode, requires that the person living with ESKD travel to a dialysis center 3 times per week for 2 – 3 hours per session to stay alive. As of 2020, there were 807,920 persons living with ESKD in the U.S; the cost of their care exceeded $37B and made up about 6.2% of Medicare expenditures.[2]

Because diabetes and ESKD are closely related, it is beneficial to examine the availability of services for both. In this brief, we address the availability of diabetes self-management education which is an intervention intended to reduce the adverse consequences of diabetes along with the availability of dialysis which treats ESKD.

The adverse effects of diabetes, such as kidney disease, are reduced when patients can successfully manage their condition keeping blood glucose levels within clinical guidelines.[2] Good control requires more than just access to medication. Patients must learn to monitor their blood sugar levels, eat appropriate foods, and incorporate physical activity into their schedule. To address the need to empower patients to control their diabetes, diabetes self-management education (DSME) is a covered service under nearly all forms of health insurance. DSME is a formal educational process that goes beyond simple care instructions provided during a routine office visit. To be reimbursable, DSME programs must be accredited by one of the two major bodies in the field, the American Diabetes Association or the Association of Certified Diabetes Educators. The overall program of instruction must meet quality standards that include an approved curriculum, individualization of delivery to suit patient needs, and assessment of patient progress.[3] DSME programs are available in both in-person learning environments and through approved on-line programs. In-person programs are studied here.

Medicare provides for up to 10 hours of DSME in the first year after diagnosis followed by 2 hours per year thereafter; although, beneficiaries must handle co-pays (20%) if they are in fee-for-service Medicare.[4] Nearly all states (44) require private insurers to cover DSME (2017 data).[5] Similarly, 15 states legally require Medicaid to cover DSME; in 18 other states, Medicaid covers DSME through regulatory action (33 states total; 2017 data).[5]

Diabetes is more prevalent in rural than urban communities in the U.S.[6] Diabetes control, however, as measured by biological metrics such as hemoglobin A1c values[7] and avoidable disease consequences such as emergency department visits[8] and lower extremity amputation[9] is lower in rural than urban areas in the U.S. Diabetes mortality, a final metric for disease burden, has been higher in rural than in urban counties for many years.[10]

Despite the greater prevalence of diabetes in rural counties, as of 2016 only 62% of rural counties (743 counties) had a DSME program accredited by the American Diabetes Association (ADA) or American Association of Diabetes Educators (AADE).[11] Relatedly, research using Medicare billing data found that fee-for-service beneficiaries used DSME services in only 385 rural counties.[12]

The research reported here has multiple goals addressing both diabetes and ESKD.

- First, we assess the availability of in-county DSME across rural and urban counties updating earlier research.[10] To add context, we link the availability of DSME within rural counties to need as measured by the estimated prevalence of diabetes among adults.

- Second, we examine the availability of in-county dialysis across rural and urban counties. Again, we calculate a measure of need to provide context for geographic findings. Assessing dialysis need, we use estimated prevalence of chronic kidney disease (CKD), the immediate predecessor of ESKD.[1,†]

- Third, we compare the relative availability of DSME which has been documented to delay the adverse consequences of diabetes to dialysis, which is an expensive treatment modality for ESKD, a potential consequence of poorly managed diabetes. We use estimated diabetes prevalence to sort counties into high need (top quartile for prevalence) versus other counties.

[†] Note on terminology: in the medical literature, end stage kidney disease (ESKD) has become the preferred term for this condition rather than "end stage renal disease" (ESRD). Note that current Medicare websites still use the term "ESRD" as that was the usage when the enabling legislation was passed.

METHODS

We conducted a cross-sectional analysis of publicly available data regarding the location of DSME programs and ESKD treatment locations linked to estimated disease prevalence information from the Centers for Disease Control and Prevention (CDC).

We obtained the addresses of all accredited DSME providers from the two accrediting organizations, the American Diabetes Association and the Association of Diabetes Care and Education Specialists each of which provided an Excel file of programs and addresses on request. Data represents DSME programs as of December 2022. Addresses were geocoded to the county level using the HUD USPS ZIP-Code – county crosswalk.[13] Several online programs have been accredited by the American Diabetes Association; these programs are not included in the analysis.

Some providers may elect to offer diabetes education informally without seeking certification; this type of care cannot be tracked in our analysis. The certification process has fees ($1,100 for first site and $100 for each additional site) and requires documentation for both the application process and outcome tracking.[14] However, the degree to which providers are offering services that they could not bill to any insurer is likely to be low, and the quality of such education could not be documented. The CDC recommends that DSME providers seek to be certified.[15]

We obtained a list of Medicare-certified dialysis facilities from the Centers for Medicare & Medicaid Services website.[16] Centers were geocoded to the county level. Dialysis units do not fully address the need for kidney care. Chronic kidney disease, before it has progressed to ESKD, requires both primary care providers and nephrologists for adequate disease management. In addition, dialysis is not the only treatment for kidney failure; receipt of a kidney transplant is an alternative approach. However, presence of a dialysis facility in a county implies the availability of some level of knowledgeable practitioners within the county.

Of note, the Indian Health Service promotes diabetes education[17] and supports the Special Diabetes Program for Indians (SDPI).[18] The SDPI reported 302 sites in its 2023 Report to Congress.[19] SDPI sites are not included in our analyses. However, a list of the counties served by SDPI programs is provided in the Appendix (Table A-1).

To identify high-need counties, we obtained county-level estimated crude prevalence of diabetes in adults from the CDC PLACES data portal.[20] The PLACES data estimates for diabetes and chronic kidney disease (excluding ESKD) are based on self-report of a diagnosis in the Behavioral Risk Factor Surveillance System surveys with statistical modeling used to create county-level estimates. We used the PLACES data set for estimating the prevalence of CKD because PLACES provides values for all rural counties and applies to the entire adult population. The Kidney Surveillance System within CDC provides county-level unadjusted estimates only for the proportion of Medicare beneficiaries aged 65 or older who experience CKD, a more restricted population.

The CDC PLACES data set was also used for information regarding population demographics. Of note: the PLACES data set does not include information for two county equivalents in Alaska, the Chugach Census Area and the Copper River Census Area. Thus, our analysis is limited to 3,141 counties.

Information on rurality was drawn from the Economic Research Service, USDA.[21] Rurality was defined at the county level using Urban Influence Codes (UIC). UIC first distinguishes between metropolitan or urban counties, those which contain one or more urbanized areas of 50,000 population, and non-metropolitan counties in which there is no urbanized area that large. Specifically, we grouped counties as urban (UIC 1 & 2), rural micropolitan (UIC 3, 5, 8; non-metropolitan counties containing an urbanized area with a population of 10,000 to 49,999), and rural non-core (UIC 4, 6-7, 9-12; non-metropolitan counties with no urbanized area of 10,000 or more).

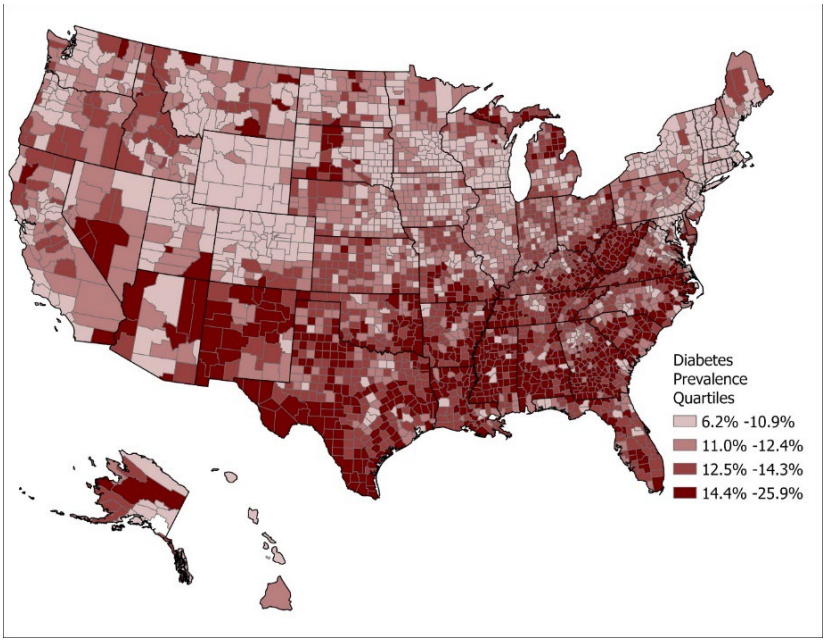
RESULTS

Diabetes Prevalence

The estimated county-level prevalence of diabetes among adults nationally ranges from a low of 6.2% to a high of 25.9%. The mean proportion of adults with diabetes is higher among rural than urban counties (13.3% versus 11.7%, p <0.001); within rural counties, estimated prevalence increases with rurality (12.5% in micropolitan counties, 13.7% in noncore rural counties, p. < 0.001).

As illustrated in Figure 1, diabetes prevalence is regionally concentrated. Counties falling in the highest quartile for diabetes prevalence (14.4% or more of the adult population) are disproportionately located in the South which encompasses 85.4% of top diabetes prevalence counties. Expressed differently, 47.5% of all Southern counties fall into the top quartile. Within rural counties alone, 64.2% of Southern counties fall into the top group for diabetes prevalence accounting for 83.3% of all top-prevalence rural counties (See Appendix, Table A-2).

Figure 1. Estimated proportion of the adult population with diabetes in quartiles.



Availability of DSME

The geographic distribution of DSME programs, by county, is shown in Figure 2. Nationally, 41.0% of all counties contained at least one location where DSME is offered (1,289 counties) leaving 59.0% of counties without this service (1,854 counties). Rural counties were less likely to have DSME than urban counties (30.1% versus 59.6%; p < .001); within rural counties, noncore counties were less likely to have in-county DSME than micropolitan counties (21.3% versus 48.4%; p < .001). An estimated 2.5 million adults with diabetes lived in rural counties that lack DSME. However, the estimated number of diabetic adults in any single rural county varies widely. The median estimated number of persons in a county without DSME was 3,172 in micropolitan counties (range: 49 to 13,792) and 1,079 in noncore counties (range: 12 to 7,955).

Figure 2. Counties with at least one DSME program by rurality.

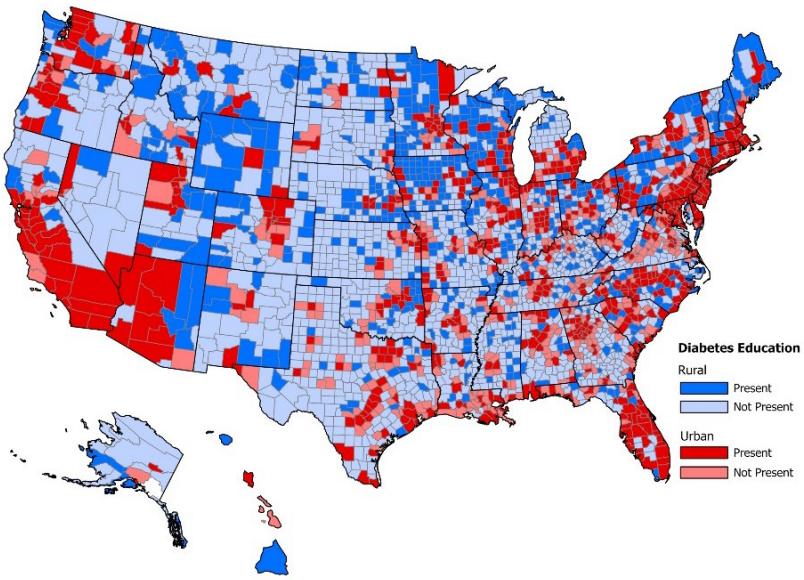
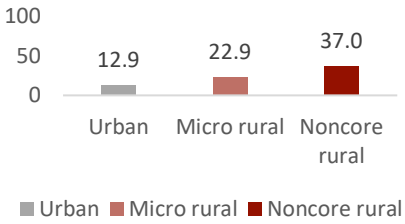


Figure 3. Proportion of counties in which 14.4% or more of adults have diabetes

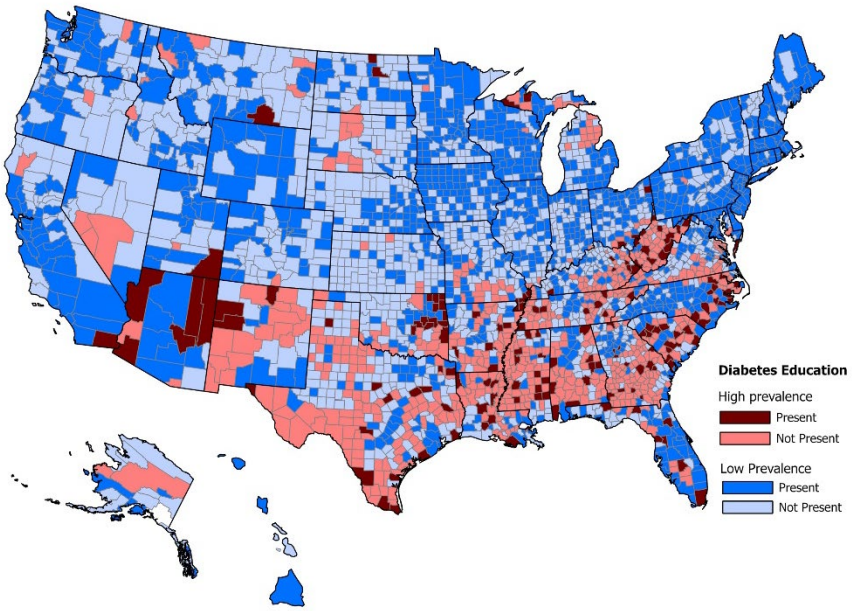


Match between need and DSME availability

To examine the relationship between need and DSME availability, we sorted counties into high need (the top quartile for diabetes prevalence, 14.4% or more; 790 counties) versus other counties (2,351 counties). The average prevalence of diabetes in "high need" counties was 16.2% versus 11.6% in other counties. As indicated in Figure 3, the proportion of counties falling into the "high need" category increased with rurality.

The geographic distribution of high diabetes need counties and the presence or absence of DSME in those counties is illustrated in Figure 4. Of note, of the 641 rural high need counties, 533 (83.2%) were located in the South; the majority of rural counties in the South (64.2%) fell into the high diabetes need category. Urban high need counties were similarly concentrated in the South; 94.7% of high diabetes need urban counties were in Southern states.

Figure 4. DSME availability and county diabetes prevalence (top quartile versus all lower).



Demographic characteristics of high versus low diabetes need counties are provided in the Appendix, Tables A-2 and A-3. High diabetes need counties, both rural and urban, had smaller median populations than other counties. Consistent with disproportionate location in the South, high diabetes need rural counties had a median proportion of non-Hispanic white residents (63.6%), lower than that in low need rural counties (89.4%; p <.001). High-need rural counties were characterized by several measures of health care disadvantage: a greater proportion of the population lacking health insurance (median 17.8% versus 11.9%), less likely to have a hospital in the county (median 66.1% versus 81.5%), and lower broadband access (median 70.7% versus 79.7%; all p < 0.001).

Nationally, only 20.8% of high need counties versus 47.9% of low need counties have a DSME site within the county (Table 1). Within high need counties, 36.7% of urban counties and a similar proportion of micropolitan counties (31.3%, p = .33, ns) have a DSME site. Among high-need noncore rural counties, however, only 12.8% have this service available.

Table 1. Relationship between DSME availability within a county and estimated percent of adults with diabetes by rurality 2022.

High Need Counties (14.4% or more of adults have diabetes)					
High Need Counties	All	Urban	All Rural	Micropolitan rural	Noncore rural
Total high need counties	*790*	*150*	*640*	*147*	*493*
Have DSME	20.8%	36.7%	17.0%	31.3%	12.8%
No DSME	79.2%	63.3%	83.0%	68.7%	87.2%
Low Need Counties (less than 14.4% of adults have diabetes)					
Total low need counties	*2,351*	*1,016*	*1,335*	*494*	*841*
Have DSME	47.9%	63.0%	36.3%	53.4%	26.3%
No DSME	52.2%	37.0%	63.7%	46.6%	73.7%
Total, all counties	*3,141*	*1,166*	*1,975*	*641*	*1,336*
**All urban-rural and all within-rural differences are significant at p < 0.000.					

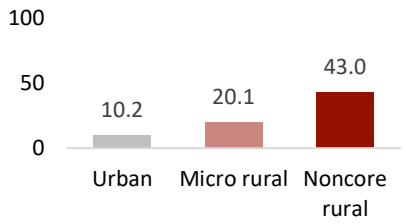
The presence of a DSME program in the county was more common in counties with a hospital. DSME was present in 50.6% of counties that contained at least one hospital but in only 6.2% of counties without a hospital (data not in table). Of the 675 counties across the U.S. that lacked a hospital as of this analysis, only 42 (6.2%) had a location offering DSME. This relationship was found within urban, micropolitan rural, and noncore rural counties.

High diabetes need rural counties were disproportionately counties without a hospital. While 18.5% of low diabetes need rural counties lack a hospital, this increased to 33.9% among high diabetes need counties (p < 0.001). Thus, the likelihood of diabetes education development within these counties is low.

Chronic kidney disease prevalence

The crude county-level estimated prevalence of CKD among adults ranged from 1.9% to 6.5%. As with diabetes, we characterized counties as "high need" if the estimated prevalence of CKD fell in the top quartile across all counties, 3.9% or greater. A higher proportion of rural counties than urban counties, particularly noncore rural counties, were in the highest quartile (Figure 5).

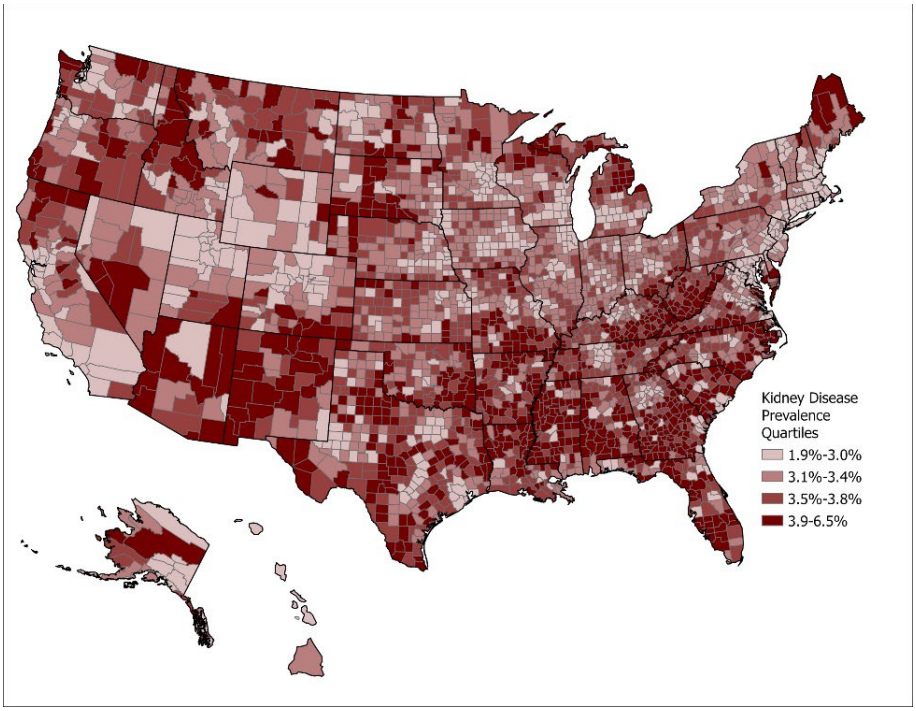
Figure 5. Proportion of counties in which 3.9% or more of adults have CKD.



Counties located in the South were more likely to fall into the top quartile for CKD prevalence (Figure 6). While the South census region accounts for 45.3% of all counties, it holds 71.7% of all counties in the top quartile for CKD prevalence. The concentration of high CKD counties in the South was particularly high among urban counties with 87.4% of all high need urban counties located in Southern states. Among 703 high CKD need rural counties, 69.0% were in Southern states.

Demographic characteristics of high versus low CKD need counties are provided in the Appendix, Tables A-4 and A-5. High CKD need counties differ in racial composition from lower need areas with high need counties having a median non-Hispanic white proportion of 70.6%, versus 85.5% in other rural counties. Measures of disadvantage are higher in high CKD need counties which have a higher proportion of the population that lacks health insurance, have not completed high school, and lack broadband access than do lower prevalence counties.

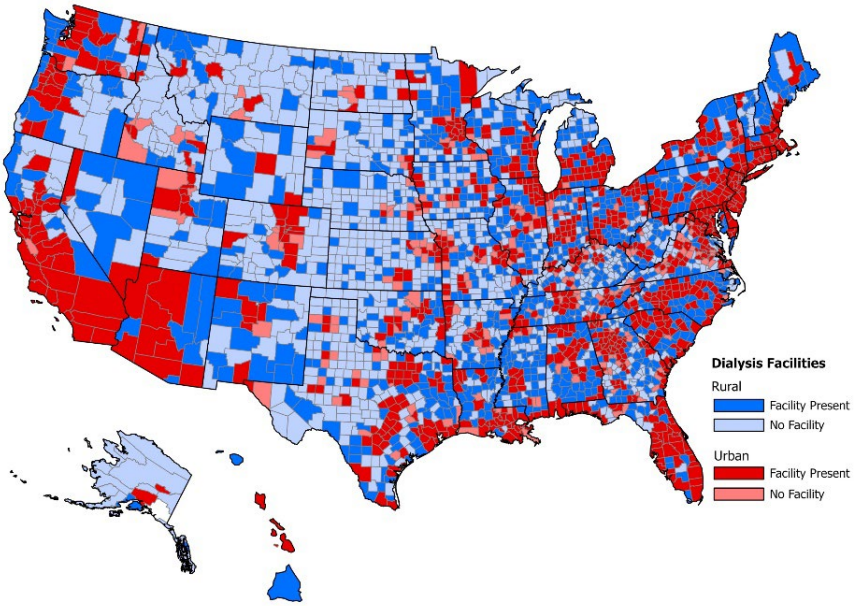
Figure 6. Estimated proportion of the adult population with chronic kidney disease.



Availability of Dialysis

Across the U.S., at least one site for kidney dialysis services is available in 59.2% of all counties (Figure 7). While rural counties overall were less likely than urban counties to have a dialysis facility (47.1% versus 79.7%, $p < 0.000$), this difference is attributable to low facility availability in noncore rural counties. A similar proportion of micropolitan and urban counties contain a dialysis facility (80.5% and 79.7%, respectively), but only 31.1% of noncore rural counties have local dialysis.

Figure 7. Counties with at least one dialysis facility by rurality.



Match between CKD need and dialysis availability

Nationally, 26.5% of all counties have estimated CKD rates of 3.9% or higher (highest quartile) with rural counties being more likely to fall into the high need category than urban counties (35.6% versus 10.2%; $p < 0.001$). Persons with CKD that have not yet advanced to renal failure do not require dialysis making this a less than perfect measure for dialysis need. However, the presence of a dialysis facility may indicate local availability of specialty care, such as nephrology, that might be able to slow the course of CKD and prevent progression to dialysis.[22]

High need counties are not better supplied with local dialysis services. Only 46.8% of all high need counties versus 63.6% of other counties contain at least one dialysis facility (Figure 8). Disparities are more pronounced for noncore rural counties. While high need and other micropolitan rural counties were equally likely to contain a dialysis facility (81.4%), only 35.5% of high need noncore counties contained this service (Table 2.)

Figure 8. Availability of Dialysis in high CKD need and other counties.

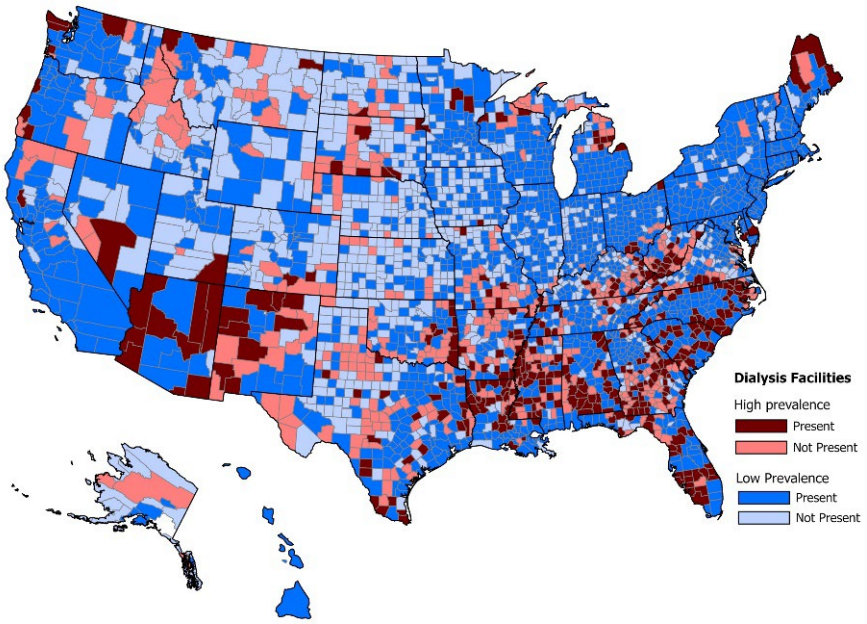


Table 2. Relationship between need for dialysis and dialysis availability

High Need Counties (3.9% or more of adults have chronic kidney disease)					
High Need Counties	All	Urban	All Rural	Micropolitan rural	Noncore rural
Total high need counties	*822*	*119*	*703*	*129*	*574*
Have Dialysis	46.8%	63.9%	44.0%	81.4%	35.5%
No Dialysis	53.8%	31.1%	56.1%	18.6%	64.5%
Low Need Counties (less than 14.4% of adults have diabetes)					
Total low need counties	*2,319*	*1,272*	*1,047*	*512*	*760*
Have Dialysis	63.6%	81.5%	48.9%	80.3%	27.8%
No Dialysis	36.4%	18.5%	51.1%	19.7%	72.2%
Total, all counties	*3,141*	*1,166*	*1,975*	*641*	*1,336*
All urban-rural and all within-rural differences are significant at $p < 0.000$. Note that the CDC Places Data Set only contained estimates for 3,141 counties.					

As was the case for DSME, dialysis availability was linked to the presence of a hospital in the county. Across all counties, only 126 counties that lacked a hospital contained a dialysis facility (18.7% of 675 counties without a hospital). Conversely, only 29.7% of counties that included a hospital lacked a dialysis location (732 out of 2,466 counties). Restricting to rural counties, only 64 (13.8%) of 464 counties without a hospital contained a dialysis facility. However, hospital presence did not guarantee dialysis within the county; 42.6% of rural counties that included a hospital (644/1511) did not have a dialysis facility.

Prevent or Treat: availability of DSME versus dialysis in high-need rural counties

Nationally, more rural counties contained dialysis facilities (931 counties; 47.1%) than contained DSME (594; 30.1%; data not in table). Given that need for DSME may vary, we tightened the analysis by comparing the availability of DSME to the availability of dialysis within counties characterized by need based on estimated proportions of adults with diabetes.

Among the 790 high diabetes need counties, 164 (20.8%) have DSME while 417 (52.8%) have an in-county dialysis facility. Within the 640 rural counties that fall into the high need category, 109 (17.0%) have in-county DSME while 315 (49.2%) have at least one dialysis provider.

Table 3 explores all permutations of need and service availability. Across all high diabetes need counties, 36.5% contain no DSME program but do have at least one dialysis facility. This pattern is most pronounced among micropolitan high diabetes need counties within which 53.7% have in-county dialysis but lack in-county DSME. Among noncore rural counties, 32.1% have dialysis but no DSME; however, the majority of noncore rural counties (55.2%) lack both services.

In both micropolitan and noncore high diabetes need counties, the proportion with in-county dialysis (83.7% and 39.0%, respectively)[‡] exceeds the proportion with DSME in the county (31.3% and 12.8%, respectively).

A pattern of greater availability of dialysis than DSME is also present among low diabetes need rural counties. In low diabetes need micropolitan counties, 79.6% contain at least one dialysis facility; among noncore rural counties, 26.5% have at least one facility. Again, these values are higher than the proportion of counties with any in-county DSME program.

Table 3. Availability of DSME and Dialysis services by diabetes need and rurality 2022**.**
(Note that percentages do not sum to overall DSME availability as categories overlap)

			Rural Counties		
Availability in:	Total	Urban	Total Rural	Micropolitan	Noncore
High diabetes need counties (14.4-25.9% DM prevalence)					
High need counties (n)	*790*	*150*	*640*	*147*	*493*
DSME in county	20.8%	36.7%	17.0%	31.3%	12.8%
Only DSME	4.4%	2.7%	4.8%	1.4%	5.9%
DSME and dialysis	16.3%	34.0%	12.2%	29.9%	6.9%
Dialysis but no DSME	36.5%	34.0%	37.0%	53.7%	32.1%
Neither service	42.8%	29.3%	45.9%	15.0%	55.2%
Low diabetes need counties (7.6 – 14.3% DM prevalence)					
Low need counties	*2,351*	*1,016*	*1,335*	*494*	*841*
DSME in county	47.9%	63.0%	36.3%	53.4%	26.3%
Both services	40.7%	60.2%	25.8%	48.0%	12.7%
Only DSME	7.2%	2.8%	10.6%	5.5%	13.6%
Only dialysis	20.7%	21.2%	20.4%	31.6%	13.8%
Neither service	31.4%	15.9%	43.3%	15.0%	59.9%

[‡] Note dialysis presence is the sum of two lines in the table: DSME and dialysis, plus Dialysis but no DSME.

CONCLUSIONS

Rural counties were less likely than urban counties to contain in-county diabetes self-management education (DSME) which can help patients reduce the likelihood that their diabetes will progress to kidney damage as well as other comorbidities. Rural counties were also less likely than urban counties to contain dialysis facilities which are essential for persons experiencing end stage kidney disease (ESKD). Neither of these findings is surprising given known health care infrastructure deficits in rural areas.[11, 23] Similarly, our finding regarding the mismatch between DSME availability and population diabetes prevalence parallels previous research.[26]

Comparing the availability of DSME and dialysis is instructive. Simply put, more counties had the resources to treat a highly debilitating, extremely expensive condition (ESKD) than to provide relatively low-cost diabetes education which might lower the prevalence of ESKD. A large part of this difference may be due to funding sources and funding amounts. Since 1972, Medicare has been the principal payor for all ESKD care including dialysis. Availability of a guaranteed funder may account for the broad availability of this very specialized form of care. Dialysis generates considerable income for providers: the cost of ESKD care was estimated at approximately $79,000 per patient in 2020. [23] DSME, on the other hand, is billed at roughly $56 per 30-minute individual session and about $16 per person for group educational sessions. Since DSME providers can only bill Medicare for 10 sessions during a patient's first year of a diabetes diagnosis and one hour per year thereafter and the patient must cover any deductible amounts, DSME is not a revenue-generating service.

Expanding the availability of DSME to persons with diabetes who live in rural counties is essential. Options for increasing access include expanded availability of on-line DSME and reducing patient costs associated with this service.

- Online educational programs may offer one means for providing services to rural residents in counties that lack DSME. Links to accredited online programs are provided on the American Diabetes Association and Association of Certified Diabetes Educators websites. At present, lack of broadband access is a barrier to this solution in some areas.[28] The Bipartisan Infrastructure Act, which allocates $65 billion to extending internet access nationally, may help by providing funding both for literal physical access to broadband and for subsidies to allow low-income households to pay for services.[29]

- Even when DSME is locally available, it may not be within financial reach of all patients. While Medicare and Medicaid, as well as private insurers in nearly all states, treat DSME as a reimbursable service, they do not waive patient financial responsibility. Low-income and uninsured persons are less likely to report having had DSME than are their counterparts suggesting that cost of the educational programs may constitute a barrier.[30,31] Future research could examine the degree to which rural residents with diabetes perceive cost to be a barrier to participating in DSME. State policy may be able to address this issue if it is broadly present. As of November 2022, 22 states and the District of Columbia had passed legislation capping patient copayments for insulin.[27] Similar initiatives could address reducing the cost of DSME.

While dialysis is more widely available than DSME, dialysis facilities were present in only 31.1% of noncore rural counties. Research using 2008 data found that patient travel distance increased with rurality from an estimated 13.7 miles in urban counties to 29.3 miles in micropolitan rural counties, 34.4 miles in small adjacent rural counties, and 39.8 miles in remote rural counties.[23] Further research is needed to explore the consequences of this service gap for patient travel and ultimately for mortality. Subsidies for the provision of dialysis in remote rural counties may be appropriate to ensure equitable outcomes for all patients.

APPENDIX

Table A-1. List of Counties containing one or more programs of the Special Diabetes Program for Indians by Indian Health Service Area and State.

County	State	Number of SIP Programs in County
Alaska Service Area		
Yakutat City and Borough	Alaska	1
Dillingham Census Area	Alaska	1
Yukon-Koyukuk Census Area	Alaska	1
North Slope Borough	Alaska	1
Northwest Arctic Borough	Alaska	1
Kodiak Island Borough	Alaska	1
Nome Census Area	Alaska	1
Ketchikan Gateway Borough	Alaska	1
Bethel Census Area	Alaska	1
Juneau City and Borough	Alaska	1
Kenai Peninsula Borough	Alaska	2
Fairbanks North Star Borough	Alaska	1
Anchorage Municipality	Alaska	4
Copper River Census Area	Alaska	2
Chugach Census Area	Alaska	1
Albuquerque Service Area		
Montezuma County	Colorado	1
La Plata County	Colorado	1
Denver County	Colorado	1
Socorro County	New Mexico	1
Cibola County	New Mexico	4
Taos County	New Mexico	2
Rio Arriba County	New Mexico	2
Otero County	New Mexico	1
McKinley County	New Mexico	1
Sandoval County	New Mexico	7
Santa Fe County	New Mexico	4
Bernalillo County	New Mexico	2
El Paso County	Texas	1
Bemidji Service Area		
Cook County	Illinois	1
Keweenaw County	Michigan	1
Baraga County	Michigan	1
Gogebic County	Michigan	2
Leelanau County	Michigan	1
Emmet County	Michigan	1
Chippewa County	Michigan	2

Cass County	Michigan	1
Barry County	Michigan	1
Isabella County	Michigan	1
Wayne County	Michigan	1
Chippewa County	Minnesota	1
Renville County	Minnesota	1
Mille Lacs County	Minnesota	1
Carlton County	Minnesota	1
Cass County	Minnesota	1
Becker County	Minnesota	1
Beltrami County	Minnesota	1
St. Louis County	Minnesota	1
Hennepin County	Minnesota	1
Menominee County	Wisconsin	1
Forest County	Wisconsin	2
Ashland County	Wisconsin	1
Bayfield County	Wisconsin	1
Burnett County	Wisconsin	1
Sawyer County	Wisconsin	1
Jackson County	Wisconsin	1
Vilas County	Wisconsin	1
Oneida County	Wisconsin	1
Shawano County	Wisconsin	1
Milwaukee County	Wisconsin	1
Billings Service Area		
Blaine County	Montana	1
Rosebud County	Montana	1
Roosevelt County	Montana	1
Hill County	Montana	1
Glacier County	Montana	1
Silver Bow County	Montana	1
Lake County	Montana	1
Lewis and Clark County	Montana	1
Cascade County	Montana	2
Missoula County	Montana	1
Yellowstone County	Montana	2
Fremont County	Wyoming	2
California Service Area		
Modoc County	California	2
Inyo County	California	1
Plumas County	California	1
Lassen County	California	1
Glenn County	California	1

Siskiyou County	California	2
Calaveras County	California	1
Lake County	California	1
Mendocino County	California	2
Humboldt County	California	2
Shasta County	California	2
Butte County	California	1
Placer County	California	1
Santa Barbara County	California	2
Sonoma County	California	1
Tulare County	California	1
Kern County	California	1
Fresno County	California	2
Alameda County	California	1
Santa Clara County	California	1
Sacramento County	California	2
San Bernardino County	California	3
San Diego County	California	3
Los Angeles County	California	1
Great Plains Service Area		
Tama County	Iowa	1
Thurston County	Nebraska	2
Knox County	Nebraska	2
Douglas County	Nebraska	1
Sioux County	North Dakota	1
Benson County	North Dakota	1
Mountrail County	North Dakota	1
Rolette County	North Dakota	1
Williams County	North Dakota	1
Buffalo County	South Dakota	1
Ziebach County	South Dakota	1
Lyman County	South Dakota	1
Moody County	South Dakota	1
Charles Mix County	South Dakota	1
Roberts County	South Dakota	1
Todd County	South Dakota	1
Oglala Lakota County	South Dakota	1
Pennington County	South Dakota	1
Minnehaha County	South Dakota	1
Nashville Service Area		
Escambia County	Alabama	1
New London County	Connecticut	2
Broward County	Florida	1

Miami-Dade County	Florida	1
La Salle Parish	Louisiana	1
Jefferson Davis Parish	Louisiana	1
Avoyelles Parish	Louisiana	1
St. Mary Parish	Louisiana	1
Washington County	Maine	2
Aroostook County	Maine	2
Penobscot County	Maine	1
Dukes County	Massachusetts	1
Barnstable County	Massachusetts	1
Choctaw County	Mississippi	1
Franklin County	New York	1
Madison County	New York	1
Chautauqua County	New York	1
Niagara County	New York	1
Onondaga County	New York	1
Suffolk County	New York	1
Swain County	North Carolina	1
Washington County	Rhode Island	1
York County	South Carolina	1
Polk County	Texas	1
King William County	Virginia	1
New Kent County	Virginia	1
Amherst County	Virginia	1
Richmond city	Virginia	1
Navajo Service Area		
Apache County	Arizona	4
San Juan County	Utah	1
Oklahoma Service Area		
Doniphan County	Kansas	1
Brown County	Kansas	2
Jackson County	Kansas	1
Douglas County	Kansas	1
Noble County	Oklahoma	1
Pawnee County	Oklahoma	1
Seminole County	Oklahoma	1
Caddo County	Oklahoma	4
Ottawa County	Oklahoma	2
Pontotoc County	Oklahoma	1
Lincoln County	Oklahoma	1
Okmulgee County	Oklahoma	1
Kay County	Oklahoma	2
Bryan County	Oklahoma	1

Osage County	Oklahoma	1
Cherokee County	Oklahoma	1
Payne County	Oklahoma	1
Pottawatomie County	Oklahoma	3
Comanche County	Oklahoma	2
Canadian County	Oklahoma	1
Tulsa County	Oklahoma	1
Oklahoma County	Oklahoma	1
Maverick County	Texas	1
Dallas County	Texas	1
Phoenix Service Area		
La Paz County	Arizona	1
Gila County	Arizona	2
Coconino County	Arizona	3
Navajo County	Arizona	3
Yuma County	Arizona	2
Mohave County	Arizona	1
Yavapai County	Arizona	2
Pinal County	Arizona	2
Maricopa County	Arizona	5
Mineral County	Nevada	1
White Pine County	Nevada	2
Churchill County	Nevada	1
Elko County	Nevada	1
Douglas County	Nevada	1
Lyon County	Nevada	1
Washoe County	Nevada	3
Clark County	Nevada	2
Uintah County	Utah	1
Iron County	Utah	1
Tooele County	Utah	1
Salt Lake County	Utah	1
Portland Service Area		
Benewah County	Idaho	1
Boundary County	Idaho	1
Nez Perce County	Idaho	1
Bannock County	Idaho	1
Jefferson County	Oregon	1
Lincoln County	Oregon	1
Umatilla County	Oregon	1
Coos County	Oregon	2
Klamath County	Oregon	1
Polk County	Oregon	1

Douglas County	Oregon	1
Multnomah County	Oregon	1
Pend Oreille County	Washington	1
Pacific County	Washington	1
Stevens County	Washington	1
Mason County	Washington	2
Grays Harbor County	Washington	2
Clallam County	Washington	4
Cowlitz County	Washington	1
Skagit County	Washington	3
Whatcom County	Washington	2
Kitsap County	Washington	2
Thurston County	Washington	1
Yakima County	Washington	1
Spokane County	Washington	1
Snohomish County	Washington	1
Pierce County	Washington	1
King County	Washington	2
Tucson Service Area		
Pima County	Arizona	3

Source: Indian Health Service, *Special Diabetes Program for Indians Fiscal Year 2023 Grant Programs*, available at [https://www.ihs.gov/sdpi/], downloaded May 3, 2023.

Table A-2. Characteristics of high versus low diabetes need counties by rural counties.
Note: high need counties have an estimated adult diabetes prevalence of 14.4% or greater.

All Rural Counties	**High DM need** (640 counties)	**Low DM need** (1,335 counties)	**P value**
Geography (Census Region)			<0.0001
Northeast	1.2%	98.9%	
Midwest	8.8%	91.2%	
South	64.2%	35.8%	
West	13.1%	86.9%	
Demographics			
Total population (median)	14,584	17,258	0.0099
Race/ethnicity (median %)			
NH White	63.6%	89.4%	<0.0001
NH Black	7.0%	1.0%	<0.0001
Hispanic	3.6%	4.1%	0.0452
NH American Indian/Alaska Native	0.7%	0.9%	0.0001
Asian/Pacific Islander	0.6%	0.8%	<0.0001
Age distribution (median %)			
Below age 18 years	21.4%	21.9%	0.0056
18 – 64	56.8%	56.7%	0.6197
Age 65 and older	21.1%	21.0%	0.6891
Not English fluent (median %)	0.6%	0.6%	0.9876
Enabling characteristics			
Population <18 years old below Federal Poverty Level (median %)	27.7%	15.7%	<0.0001
Uninsured (median %)	17.8%	11.9%	<0.0001
Unemployed (median %)	7.2%	5.9%	<0.0001
Education High School (median %)	82.3%	90.2%	<0.0001
Facilitating: health care resources			
HPSA status (% yes)	95.2%	83.5%	<0.0001
FQHC in county (% yes)	75.8%	50.0%	<0.0001
RHC in county (% yes)	88.8%	82.6%	0.0004
Hospital in county (% yes)	66.1%	81.5%	<0.0001
Broadband access (median %)	70.8%	79.7%	<0.0001

Table A-3. Characteristics of high versus low diabetes need counties by urban counties.
Note: high need counties have an estimated adult diabetes prevalence of 14.4% or greater.

All Urban Counties	High DM need (150 counties)	Low DM need (1,016 counties)	P value
Geography (Census Region)			<0.0001
Northeast	0.8%	99.2%	
Midwest	1.0%	99.0%	
South	24.0%	76.0%	
West	2.8%	97.2%	
Demographics			
Total population (median)	27,055	111,340	<0.0001
Race/ethnicity (median %)			
NH White	59.2%	78.7%	<0.0001
NH Black	24.8%	5.3%	<0.0001
Hispanic	3.7%	6.3%	<0.0001
NH American Indian/Alaska Native	0.5%	0.6%	0.0544
Asian/Pacific Islander (combined)	0.7%	1.8%	<0.0001
Age distribution (median %)			
Below age 18 years	21.4%	22.1%	0.0359
18 – 64	58.3%	60.0%	<0.0001
Age 65 and older	19.9%	17.6%	<0.0001
Not English fluent (median %)	0.5%	1.1%	<0.0001
Enabling characteristics			
Population <18 years old below Federal Poverty Level (median %)	26.6%	13.8%	<0.0001
Uninsured (median %)	16.3%	10.8%	<0.0001
Unemployed (median %)	7.6%	6.7%	<0.0001
Education High School (median %)	83.8%	90.6%	<0.0001
Facilitating: health care resources			
HPSA status (% yes)	93.3%	78.0%	<0.0001
FQHC in county (% yes)	84.0%	76.7%	0.0445
RHC in county (% yes)	76.7%	53.8%	<0.0001
Hospital in county (% yes)	68.0%	84.0%	<0.0001
Broadband access (median %)	75.0%	84.9%	<0.0001

Table A-4. Characteristics of high versus low chronic kidney disease need counties by rural counties. Note: high need counties have an estimated adult chronic kidney disease prevalence of 3.9%

	High CKD need	Low CKD need	P value
All Rural Counties	703	1,272	
Geography (Census Region)			<0.0001
Northeast	8.1%	92.0%	
Midwest	16.6%	83.4%	
South	58.4%	41.6%	
West	28.2%	71.8%	
Demographics			
Total population (median)	13,482	18,763.5	<0.0001
Race/ethnicity (median %)			
NH White	70.6%	88.5%	<0.0001
NH Black	2.8%	1.1%	<0.0001
Hispanic	3.5%	4.2%	0.0032
NH American Indian/Alaska Native	0.8%	0.8%	0.4914
Asian/Pacific Islander (combined)	0.6%	0.8%	<0.0001
Age distribution (median %)			
Below age 18 years	20.9%	22.1%	<0.0001
18 – 64	56.0%	57.1%	<0.0001
Age 65 and older	22.6%	20.5%	<0.0001
Not English fluent (median %)	0.5%	0.6%	0.1499
Enabling characteristics			
Population <18 years old below Federal Poverty Level (median %)	27.1%	15.5%	<0.0001
Uninsured (median %)	16.9%	11.9%	<0.0001
Unemployed (median %)	7.1%	5.9%	<0.0001
Education High School (median %)	83.2%	89.9%	<0.0001
Facilitating: health care resources			
HPSA status (% yes)	94.6%	83.2%	<0.0001
FQHC in county (% yes)	72.4%	50.6%	<0.0001
RHC in county (% yes)	89.8%	81.7%	<0.0001
Hospital in county (% yes)	66.3%	82.2%	<0.0001
Broadband access (median %)	71.4%	79.7%	<0.0001

Table A-5. Characteristics of high versus low chronic kidney disease need counties by urban counties. Note: high need counties have an estimated adult chronic kidney disease prevalence of 3.9%

	High CKD need	Low CKD need	P value
All Urban Counties	119	1,047	
Geography (Census Region)			<0.0001
Northeast	0.8%	99.2%	
Midwest	1.7%	98.3%	
South	17.6%	82.4%	
West	6.3%	93.7%	
Demographics			
Total population (median)	21,629	108,594	<0.0001
Race/ethnicity (median %)			
NH White	62.6%	78.1%	<0.0001
NH Black	18.6%	5.4%	0.0003
Hispanic	4.3%	6.1%	0.0014
NH American Indian/Alaska Native	0.6%	0.6%	0.4985
Asian/Pacific Islander	0.7%	1.7%	<0.0001
Age distribution (median %)			
Below age 18 years	20.6%	22.2%	<0.0001
18 – 64	57.4%	60.0%	<0.0001
Age 65 and older	21.5%	17.5%	<0.0001
Not English fluent (median %)	0.6%	1.1%	0.0007
Enabling characteristics			
Population <18 years old below Federal Poverty Level (median %)	26.1%	14.0%	<0.0001
Uninsured (median %)	17.5%	10.9%	<0.0001
Unemployed (median %)	7.5%	6.7%	0.0005
Education High School (median %)	84.3%	90.4%	<0.0001
Facilitating: health care resources			
HPSA status (% yes)	94.1%	78.3%	<0.0001
FQHC in county (% yes)	79.8%	77.4%	0.5405
RHC in county (% yes)	79.8%	54.2%	<0.0001
Hospital in county (% yes)	65.6%	83.8%	<0.0001
Broadband access (median %)	73.8%	84.6%	<0.0001

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