P E R S P E C T I V E S

PHOENIX CENTER FOR ADVANCED LEGAL & ECONOMIC PUBLIC POLICY STUDIES

# Broadband, Diabetes and Advocacy: A Review of Recent Claims

**George S. Ford, PhD***

**April 29, 2025**

A recent article published in KFF HEALTH NEWS entitled *Millions in US Live in Places Where Doctors Don't Practice and Telehealth Doesn't Reach* highlights geographic areas termed *dead zones*—*i.e.*, counties lacking both healthcare providers and reliable high-speed internet.[1] The article provides statistics showing that residents in these dead zones have worse health outcomes, particularly regarding diabetes.[2] Through personal stories and county-level data, the narrative suggests that the $65 billion allocated for improved broadband infrastructure and adoption in the 2021 Infrastructure Investment and Jobs Act may, by extension, also improve health outcomes in these counties—labeled *broadband deserts*—through access to telehealth.[3] The article is a thoughtful and interesting piece of advocacy and a timely counter to the Trump Administration's apparent interest in substantially altering BEAD spending levels and technology preferences.[4]

While an appealing narrative, the empirical analysis in the KFF article is minimal and provides no meaningful link between broadband availability and health outcomes. A lack of high-speed broadband services is largely a rural problem and rural areas are known to have worse health outcomes for many reasons.[5] To properly contextualize the relationship between broadband access and health outcomes, it is important to consider the broader social determinants of health ("SDOH") framework.[6] Hill-Briggs, *et al*. (2021) discuss how diabetes can be determined by socioeconomic status (*e.g.*, race, education, income), neighborhood and physical environment, food environment, health care access, and social context.[7] In rural areas obesity is more prevalent and people are older on average, both of which contribute to diabetes.

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The analysis of broadband's impact on health outcomes can be taken up a notch. To do so, in this PERSPECTIVE I use data from the KFF article, augmented with a few other variables, to conduct a more thorough empirical analysis of the KFF article's claim. While the KFF article is vague on causes and effects, a reasonable reading of the KFF article suggests perhaps two possible mechanisms at play: First, telehealth via broadband may reduce the incidence of Type II diabetes (perhaps less so for Type I diabetes, which has a hereditary component) through medical guidance and monitoring. If so, then we should expect lower diabetes rates in areas with good broadband, assuming broadband is widely used for guidance and monitoring. Second, broadband-based telehealth could be a treatment mechanism for the disease and should reduce the health consequences, of which mortality is the most severe.

While the KFF article is a good read—rich with anecdotal and circumstantial evidence—my empirical analysis finds that the few SDOH factors fully explain the differences in diabetes rates and diabetes-related mortality between broadband haves and have-nots; broadband has no effect. It is unclear, therefore, whether expanding broadband access to unserved areas will have much effect, if any, on the treatment of diabetes. Of course, more analysis of this important topic is warranted.

**Empirical Framework**

The KFF article defines a *broadband desert* as a county where less than 70% of homes have access to broadband services (based on the Federal Communications Commission's National Broadband Map). The empirical question is whether broadband, perhaps via telehealth, can affect diabetes prevalence or mortality.

Let the prevalence of diabetes ($D_i$) and diabetes mortality ($M_i$) in a county $i$ be related to underlying SDOH factors ($S_i$), local healthcare availability ($H_i$), broadband access ($B_i$), and random disturbance terms (*e.g.*, hereditary factors). Diabetes prevalence and mortality are from the Center for Disease Control ("CDC") and broadband deserts and healthcare availability and most of the $S_i$ are from the KFF data. Mortality is the average of years 2022 and 2023.

The two equations (a recursive system) to be estimated are,

$$D_i = f_D(S_i, H_i, B_i) + \varepsilon_i^D \ , \qquad (1)$$

$$M_i = f_H(D_i, S_i, H_i, B_i) + \varepsilon_i^H \ . \qquad (2)$$

As Hill-Briggs, *et al.* (2021) note, "life-course exposure based on the length of time one spends living in resource-deprived environments—defined by poverty, lack of quality education, or lack of health care—significantly impacts disparities in diabetes risk, diagnosis, and outcomes." Included in $S_i$ are age variables (diabetes is more prevalent in older adults), race variables (diabetes is more prevalent in the Black population), the poverty rate, the share of people with some college education, the obesity rate (a strong determinant of Type II diabetes).[8] The variable $H_i$ is the (natural log of the) number of Medicaid beneficiaries per primary care provider. $B_i$ is a dichotomous indicator for a broadband desert. The mortality rate $M_i$ is log transformed. All variables except for age and the diabetes-related mortality rate are included in the KFF data.

Accounting for reliable mortality data (2,792 counties) and missing data on $H_i$ (11 observations) renders a final sample of 2,781 counties. In all, 18.6% of counties in the sample are labeled broadband deserts.

*Simple Means Differences*

The simple means-differences of $D_i$ and $M_i$ (ignoring $S_i$ and $H_i$), as in the KFF article, are summarized in Table 1. State cluster robust t-statistics are reported.

**Table 1. Simple Means Differences**

| | Diabetes ($D_i$) | Mortality ($M_i$) |
|---|---|---|
| BB Deserts | 0.150 | 508.9 |
| Others | 0.132 | 429.0 |
| Difference | 0.0188*** | 79.87*** |
| | (6.62) | (6.99) |
| *N* | 2,781 | 2,781 |
| $R^2$ | 0.073 | 0.057 |

Stat Sig. *** 1% ** 5% * 10%

We see that both outcomes are larger in broadband deserts (consistent with the KFF article), with diabetes prevalence being 1.88 percentage points larger (13.6%) and mortality being 79.9 larger (18.6%). These are sizable differences, and while indicating worse health outcomes they do not tell us much about the effect of broadband on those outcomes—only that the two are correlated, perhaps both influenced by confounders.[9]

*Conditional Means Differences*

Equations (1) and (2) are estimated to condition the means-differences on $S_i$, $H_i$, and $D_i$. To account for $D_i$ being on the unit interval, the $D_i$ model is estimated by General Linear Model ("GLM") of the binomial family with a logit link. The average marginal effect (AME) is reported. (Linear regression provides comparable results.) The natural log transformation is applied to mortality ($M_i$). The two equations are recursive (due to $D_i$ being in the $M_i$ model) and are estimated independently; joint estimation provides nearly identical results as the residuals are weakly correlated.[10]

**Table 2. Conditional Means Differences**

| **Outcome** | Diabetes ($D_i$) | Mortality ($\ln(M_i)$) |
|---|---|---|
| $B_i$ | -0.0004<br>(-0.38) | -0.0540***<br>(-4.36) |
| $D_i$ | … | 3.087*** |
| $H_i$ | 0.0024*** | 0.0107*** |
| Obesity | 0.2110*** | 0.7840** |
| White | -0.0358*** | -0.1210 |
| Hispanic | 0.0092 | -0.3800*** |
| Black | 0.0108* | -0.0396*** |
| Poverty | 0.1040*** | 0.7800*** |
| Age 45-64 | 0.1170*** | 0.0431 |
| Age 65+ | 0.2150*** | 2.775*** |
| Some College | -0.0666*** | -0.772*** |
| $N$ | 2,781 | 2,781 |
| (Pseudo) $R^2$ | 0.853 | 0.730 |
| Chi2 | 2747.0*** | … |
| F | … | 157.1*** |

Stat Sig. *** 1% ** 5% * 10%

Including the other covariates ($S_i$, $H_i$), summarized in Table 2, tells an entirely different tale. Both models perform well with many statistically significant coefficients, high $R^2$ values, and high model statistical significance. The signs and sizes of the coefficients are sensible.

Diabetes prevalence is no different in broadband deserts than in other counties; the sign on the coefficient is small, negative and statistically insignificant.[11] Thus, counties with high levels of high-speed broadband are no better off than those with lower levels of broadband availability. Broadband is not an effective treatment mechanism for reducing diabetes prevalence even when the service is available.[12]

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As for mortality, broadband deserts have lower mortality rates of 5.3%. Not only is broadband not an effective treatment to reduce the negative health consequences of diabetes, but these results suggest it worsens them. The effect is statistically different from zero. It's a peculiar result, no doubt, but it is explained later.

In these models, a dichotomous measure of $B_i$ is used—broadband deserts. Results when switching to a continuous measure of broadband availability (higher values imply more broadband, no less as with broadband deserts) are comparable to those in Tables 1 and 2. That is, higher broadband coverage reduces both outcomes unconditionally, but when conditioned on the covariates broadband coverage has no effect on $D_i$ and a positive effect on $M_i$ (mortality and broadband are positively correlated).

**Table 3. Parsimonious Alternative**

| **Outcome** | Diabetes ($D_i$) | Mortality ($\ln(M_i)$) |
|---|---|---|
| $B_i$ | 0.0014<br>(0.91 | 0.0327***<br>(-2.37) |
| $D_i$ | … | 3.475*** |
| Obesity | 0.285*** | 2.484*** |
| Poverty | 0.208*** | 2.304*** |
| Age 45-64 | 0.099*** | 0.8750 |
| Age 65+ | 0.167*** | 3.386*** |
| $N$ | 2,781 | 2,781 |
| (Pseudo) $R^2$ | 0.754 | 0.676 |
| Chi2 | 1264.8*** | … |
| F | … | 301.9*** |

Stat Sig. *** 1% ** 5% * 10%

Table 3 summarizes a more parsimonious model. Even in this scaled-down model, the coefficient on $B_i$ for diabetes prevalence is small and statistically insignificant while its coefficient is negative and statistically significant for mortality.

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*Covariate Differences*

The differences in the means of the covariates between groups are substantial in some cases, and such differences may explain the peculiar result regarding broadband and higher mortality. Table 4 summarizes the Standardized Differences for each covariate where a difference of 0.25 is considered "large" (and some researchers use 0.10). The Standardized Differences for seven of the nine covariates surpass this threshold. Such large differences may cause problems with simple regression analysis as the "control" counties are used to project a counterfactual on the broadband desert counties.

**Table 4. Standardized Differences**

| | **BB Deserts** | **Others** | **St. Diff** |
|---|---|---|---|
| $H_i$ | 350.4 | 249.4 | 0.477 |
| Obesity | 0.393 | 0.374 | 0.409 |
| White | 0.757 | 0.739 | 0.092 |
| Hispanic | 0.062 | 0.105 | 0.359 |
| Black | 0.116 | 0.090 | 0.165 |
| Poverty | 0.168 | 0.139 | 0.494 |
| Age 45-64 | 0.267 | 0.255 | 0.427 |
| Age 65+ | 0.217 | 0.192 | 0.569 |
| Some College | 0.488 | 0.560 | 0.714 |
| $N$ | 2,781 | | |

To address this concern, I use the doubly robust inverse probability weighted regression adjustment ("IPWRA") and compute the average treatment effect on the treated ("ATET"), where the broadband desert indicator is the treatment. All covariates are included as regressors and the share of population classified as rural (from the KFF data) is included in the $B_i$ equation (estimated by Logit). As before, the $D_i$ model is estimated by Fractional Logit. This method uses propensity score weighting to ensure balance in the covariates between the two groups.

**Table 5. IPWRA Estimates**

| | Diabetes ($D_i$) | Mortality ($\ln(M_i)$) |
|---|---|---|
| *All Covariates* | | |
| $B_i$ | -0.0002<br>(-0.20) | -0.0275<br>(-1.87) |
| *Parsimonious Model* | | |
| $B_i$ | 0.0011<br>(0.70) | -0.0222<br>(-1.42) |
| $N$ | 2,781 | 2,781 |

Stat Sig. *** 1% ** 5% * 10%

Results are summarized in Table 5 for models including all covariates and the more parsimonious specification. Now, the effect of broadband is statistically insignificant for both outcomes, though the ATET remains negative and not small (with t-statistics exceeding 1.0) for mortality. Accounting for SDOH factors, even some of them, broadband availability (or the lack thereof) has little-to-no effect on either outcome.

***These findings, though preliminary, suggest that the $65 billion allocated for broadband infrastructure and adoption in the 2021 Infrastructure Investment and Jobs Act may not significantly improve health outcomes in targeted communities unless integrated with broader investments addressing underlying socioeconomic determinants of health.***

**Limitations**

There are several limitations to this analysis. First, the data used are largely from the KFF dataset, which are limited in several respects and restrict the empirical methods. County-level data may not be ideal in analyzing health issues.

Second, the analysis focuses solely on diabetes outcomes, and broadband's impact might differ for other health conditions where telehealth could be more effective.

Third, while the analysis includes several covariates of SDOH factors, there may be other relevant confounders, interaction effects, or non-linearities that are not captured in the models.

Fourth, the analysis does not address the quality of telehealth services when available or patient utilization rates, which could influence effectiveness. A recent review of the research by Dhediya, *et al.* (2022) finds mixed results of telehealth's effectiveness in controlling diabetes.[13]

While my analysis is limited in several respects, it casts doubt on advocacy based on overly simplistic analysis. Certainly, more research on the health disparities and the effectiveness of telehealth in rural areas and/or broadband deserts is warranted.

**Conclusion**

The KFF article's narrative creates an impression that broadband expansion could significantly improve health outcomes in underserved communities. The analysis, however, was more assertion than anything—too simplistic to say much, potentially misdirecting policy attention toward technological solutions when fundamental socioeconomic challenges may require other sorts of intervention.

***This analysis suggests a more nuanced reality: broadband deserts coincide with poor health outcomes not because one causes the other, but because both are symptoms of the same underlying socioeconomic conditions, as is recognized in the healthcare literature.***

The analysis presented here recognizes that health disparities result from complex, interconnected factors that extend far beyond any single determinant. Areas with limited broadband access and healthcare provider shortages often face multiple disadvantages, including lower educational attainment and higher poverty rates, and differ across race and age in ways that affect diabetes. This analysis suggests a more nuanced reality: broadband deserts coincide with poor health outcomes not because one causes the other, but because both are symptoms of the same underlying socioeconomic conditions, as is recognized in the healthcare literature.

In simple analyses, akin to the KFF article, there are differences in both diabetes prevalence and mortality in areas described as broadband deserts. Yet, when accounting for factors that determine both outcomes, there is little-to-no difference in either diabetes prevalence or diabetes-related mortality between the areas. These findings, though preliminary, suggest that the $65 billion allocated for broadband infrastructure and adoption in the 2021 Infrastructure Investment and Jobs Act may not significantly improve health outcomes in targeted communities unless integrated with broader investments addressing underlying socioeconomic determinants of health.

Health disparities in rural areas are a serious issue not to be taken lightly, but broadband expansion is no silver bullet (at least with respect to diabetes). A significant body of research exists on such disparities, perhaps offering a better look at real causes and solutions.

## NOTES:

* **Dr. George S. Ford** ***is the Chief Economist of the Phoenix Center for Advanced Legal and Economic Public Policy Studies. The views expressed in this*** **PERSPECTIVE** ***do not represent the views of the Phoenix Center or its staff. Dr. Ford may be contacted at*** ford@phoenix-center.org.

1 S.J. Tribble and H.K. Hacker, *Dead Zone: Millions in US Live in Places Where Doctors Don't Practice and Telehealth Doesn't Reach*, KFF HEALTH NEWS (March 10, 2025) (available at: https://kffhealthnews.org/news/article/dead-zone-sickest-counties-slow-internet-broadband-desert-health-care-provider-shortage).

2 The Federal Communications Commission, using simple means differences, also considers the relationship between broadband and diabetes. *Studies and Data Analytics on Broadband and Health*, Federal Communications Commission (last visited April 2, 2025) (available at: https://www.fcc.gov/health/sdoh/studies-and-data-analytics#:~:text=There%20is%20a%20significant%20correlation,next%20lower%20quintile%20of%20access).

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5 A. Robeznieks, *Inequitable Rural Health Trends Are Alarming – And Unacceptable*, American Medical Association (December 13, 2024) (available at: https://www.ama-assn.org/delivering-care/population-care/inequitable-rural-health-trends-are-alarming-and-unacceptable#:~:text=People%20who%20live%20in%20rural,their%20urban%20and%20suburban%20counterparts).

6 *Social Determinants of Health*, Center for Disease Control, Public Health Professionals Gateway (May 15, 2023) (available at: https://www.cdc.gov/public-health-gateway/php/about/social-determinants-of-health.html#:~:text=Overview-,Social%20determinants%20of%20health%20(SDOH)%20are%20non%2Dmedical%20factors,that%20shape%20everyday%20life%20conditions.).

7 F. Hill-Briggs, *et al.*, *Social Determinants of Health and Diabetes: A Scientific Review*, 44 DIABETES CARE 258-278 (2021).

8 *National Diabetes Statistics Report*, Center for Disease Control (May 15, 2024) (available at: https://www.cdc.gov/diabetes/php/data-research/index.html).

9 A confounder is a variable that influences both variables and causes a spurious association.

10 An alternative specification of mortality is $M_i/D_i$, which is the mortality rate among diabetics. This, however, imposes a constraint on the $D_i$ coefficient (equal to 1), which need not be true.

11 The statistical significance of $B_i$ vanishes when only including the obesity, poverty, and age variables.

12 Similar results are found in R.W. Grant, et al., *Internet Use Among Primary Care Patients with Type 2 Diabetes*, 20 JOURNAL OF GENERAL INTERNAL MEDICINE 470-473 (2005) (available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC1490127/#sec9).

13 R. Dhediya, *et al*., *Role of Telemedicine in Diabetes Management*, 17 JOURNAL OF DIABETES SCIENCE AND TECHNOLOGY 775-781 (2022) (available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC10210114).