Exploring the Relationship Between Critical Access Hospitals and Rural County Health

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Abstract: Critical Access Hospitals (CAHs) were developed as a model to improve the access and availability of hospital services in rural counties. There has been limited research on clinical outcomes to evaluate the impact of CAHs since they were authorized through the Balanced Budget Act. This study evaluates CAH’s performance on clinical outcomes, and compares health outcomes between rural counties with CAHs and rural counties without established federally supported hospitals. The American Hospital Association’s (AHA) Annual Survey Database was used to identify CAHs within rural counties and their characteristics. The County Health Rankings (CHR) data were used to quantify health outcomes by county. US rural counties with CAHs versus remaining US rural counties without CAHs were correlated with measures of Clinical Care (p < 0.001), US rural counties with CAHs presented greater health status with regard to All Health Outcomes, p < 0.0001; Length of Life, p < 0.0001; Quality of Life, p < 0.0001; All Health Factors, p < 0.0001; Health Behaviors, p < 0.0001; Social and Economic Environment, p < 0.0001 and Physical Environment, p < 0.0001, than compared to US rural counties without CAHs. Rural counties serviced by CAHs demonstrate better overall health status scores, on several CHR metrics, as compared to rural counties without CAHs. The only exception to this conclusion being that rural counties without CAHs performed superiorly in the CHR metrics related to primary care and mental health services, demonstrating capacities in which CAHs could improve the impact on health in the counties they serve.

Keywords: US Hospitals, County Health, Social Determinants, Community Benefit, Critical Access Hospitals

1. Introduction

Critical Access Hospitals (CAHs) were developed as a model to improve the access and availability of hospital services in rural counties. The CAH designation was created by Congress through the Balanced Budget Act of 1997 in response to rural hospital closures during the 1980s and early 1990s. The act aimed to reduce the financial vulnerability of rural hospitals and to improve access to healthcare by keeping essential services in rural communities. [1]

A CAH is defined as a rural hospital with < 25 beds that is located at least 35 miles from another hospital, maintains an average duration of stay < 96 hours, and offers 24-hour emergency services 7 days a week. [2] There are 1341 CAHs distributed broadly throughout the United States (US). Overall, CAHs comprise 24% of American hospitals. Because CAHs provide essential medical services to otherwise underserved communities; they function under financial protection from the Centers for Medicare and Medicaid Services (CMS) and less stringent regulations than larger non-rural hospitals. [2-4]

There has been limited research on clinical outcomes to
evaluate the impact of CAHs since they were authorized through the Balanced Budget Act. On average, the aggregation of these studies on the benefits of CAHs has been equivocal. [5-10] For example, previous research has determined worse outcomes in CAHs compared with non-CAHs specifically in patients with AMI, CHF, and pneumonia based on clinical capabilities, mortality rates, and other measurable processes of care. [6-8] In contrast, Ona and Davis demonstrated an economic benefit to Kansas counties in which hospitals maintain CAH status. [9] Investigators have arrived at contradictory conclusions regarding the impact and quality of CAHs, resulting in an unclear assessment of CAHs’ overall contributions to the health status of the communities and counties they serve. [8-10]

Although research focusing on several specific CAH outcomes exists, no national studies to date have characterized all CAHs or the overall impact they have on rural counties’ health status, compared with similar rural counties that are not serviced by CAHs.[11] Therefore, this evaluation was performed to clearly define operational demographics of CAHs, to analyze these hospitals’ collective performance on universal clinical outcomes, and to compare health outcomes between rural counties with and without CAHs.

2. Methods

2.1. Data Sources: Background Info

Two publicly available data sources, the County Health Rankings (CHR) 2016 National Data file and the Annual Survey Database by the American Hospital Association (AHA), were used to analyze the demographics of CAHs and the quality health metrics of rural counties with and without CAHs. American Hospital Association Annual Survey Database [12]

The AHA Annual Survey Database is a comprehensive census of US hospitals based on the AHA Annual Survey of Hospitals administered annually. The purpose of the Survey is to collect utilization, financial and personnel information on each of the nations’ hospitals. The Survey’s overall response rate averages approximately 80% each year. For hospitals that do not respond or respond incompletely to the survey, a statistical methodology is run against their records to impute missing values.

The Database is a reliable resource for health services research and trend analyses, and it offers a-snapshot of hospital-specific data on approximately 6,500 hospitals and > 400 healthcare systems, including > 1,000 data fields covering organizational structure, personnel, hospital facilities and services, and financial performance. Hospitals submit the survey based on their results from the last twelve-month period. The data from the AHA survey for 2016 were utilized to determine the total number of CAHs in the US, their location, and their proximity to larger hospitals. These data also determined the locations of rural counties that did not have CAHs, allowing for comparison between rural counties with CAHs and those without CAHs.

County Health Rankings [13]

The County Health Rankings (CHR) were developed by the University of Wisconsin Population Health Institute and the Robert Wood Johnson Foundation, to provide quality metrics upon which every county in the US can be evaluated and compared. The CHRs are developed annually based on national health data recorded from counties across the US and compose overall health rankings based upon both “Health Outcomes” and “Health Factors.” The “Health Outcomes” represent the health of a county and the “Health Factors” represent the range of personal, social, economic and environmental factors influencing the health of a county. Each category is then broken into “focus areas,” which receive a weighted score based on that county’s performance on individual health measures. These weighted scores for individual health measures and focus areas are then aggregated into weighted scores for more general “sub-categories” and eventually into an overall score for “Health Outcomes” and “Health Factors.” For this study, CHR data were analyzed from the quality metrics of: “All Health Outcomes,” “Length of Life,” “Quality of Life,” “Health Behaviors,” “Clinical Care,” “Social Economic,” “Physical Environment,” and “All Factors.” These quality metrics were compared between rural counties with CAHs and rural counties without CAHs.

The CHR data measures the health of nearly all counties in the nation and ranks the counties within states. The Rankings are compiled using county-level measures from a variety of national and state data sources. These measures are standardized and combined using scientifically-informed weights. By ranking the health of nearly every county in the nation, the CHR data can help communities understand what influences how healthy residents are and how long they will live.

Further, the CHR data draws upon the most reliable and valid measures available to compile the Rankings. For the measured values, the margins of error are provided with a 95% confidence interval. In many ranked counties, some individual measures do not have a large enough sample size to report data for that measure. In these counties, the state average is assigned for any missing value to be able to calculate a rank for that category.

2.2. Data Sources: Data Inclusion

Community Health Status All measures included in the 2016 CHR National Data file (available at www.countyhealthrankings.org) were used as a representation of “health status” both within the 1,974 U.S. Rural counties and the remaining 1,167 U.S. Non-Rural counties. This included the five measures, which informed the overarching Health Outcomes category and 33 additional measures, spread across the four related sub-categories (i.e., Health Behaviors, Clinical Care, Social and Economic Environment, and Physical Environment) representing Health Factors.

2.3. Statistical Analyses

Statistical and multiple regression analyses were completed in three analytic phases using Statistical Analysis System (SAS, 9.4). As shown in Figure 1, phases 1, 2 & 3, each corresponded
to a separate research question and involved analyses at both the summary composite and individual measure level. Summary composite measure data were generated by aggregating individual CHR measures into z-scores for eight larger CHR categories, which included: Overall Health Outcomes, Length of Life, Quality of Life, Overall Health Factors, Health Behaviors, Clinical Care, Social and Economic Factors, and Physical Environment. The methodology for creating the z-scores can be found via: http://www.countyhealthrankings.org/ranking-methods/calculating-scores-and-ranks. The z-score statistical method was utilized for this study because it normalizes measurements across all of the categories. The individual measure data, on the other hand, included the original CHR measures from the 2016 CHR National Data file. This individual measure data included: Premature Death, Poor or Fair Health, Poor Physical Health Days, Poor Mental Health Days, Low Birthweight, Adult Smoking, Adult Obesity, Food Environment Index, Physical Inactivity, Access to Exercise Opportunity, Excessive Drinking, Alcohol-Impaired Deaths, Sexually Transmitted Infections, Teen Births, Uninsured, Primary Care Physicians, Dentists, Mental Health Providers, Preventable Hospital Stays, Number of Diabetics, Diabetic Monitoring, Mammography Screening, High School Graduation, Some College, Unemployment, Children in Poverty, Income Inequality (80th%), Income Inequality (20th%), Income Inequality (Ratio), Children in Single-Parent, Social Associations, Violent Crime, Injury Deaths, Air Pollution, Drinking Water Violations, Severe Housing Problems, Driving Alone to Work and Long Commute-Alone.

Figure 1. Rural Counties with Critical Access Hospitals: Inclusion Criterion.

* Data source: 2016-2017 US News & World Report Best Hospitals Specialty Rankings.
** Data source: 2016 AHA Guide: Hospital Classification.
Table 1. U.S. rural counties versus non-rural counties.

| CHR Summary Composite | Direction of Health* | Rural Counties | Non-Rural Counties |
|-----------------------|----------------------|----------------|-------------------|
| All Health Outcomes   | -                    | 1823 0.14 0.87 | 1158 -0.21 0.70  | <0.0001* |
| Length of Life        | -                    | 1830 0.19 0.98 | 1159 -0.33 0.79  | <0.0001* |
| Quality of Life       | -                    | 1878 0.37 3.73 | 1163 -0.43 2.92  | <0.0001* |
| All Health Factors    | -                    | 1317 0.63 3.56 | 1053 -1.01 3.27  | <0.0001* |
| Health Behaviors      | -                    | 1753 0.85 4.26 | 1147 -1.61 4.08  | <0.0001* |
| Clinical Care         | -                    | 1588 0.63 3.72 | 1101 -1.69 3.81  | <0.0001* |
| Social and Economic Environment | - | 1438 0.96 5.17 | 1092 -0.52 4.86  | <0.0001* |
| Physical Environment  | -                    | 1948 -0.49 2.03 | 1159 0.90 1.68  | <0.0001* |

| CHR Focus Areas               | Measure                      | Direction of Health | Rural Counties | Non-Rural Counties |
|-------------------------------|------------------------------|----------------------|----------------|-------------------|
| Health Outcomes               |                              |                      |                |                   |
| Length of Life                | Premature Death              | -                    | 1830 8528.1 2508.2 | 1159 7232.1 2002.7 | <0.0001* |
| Poor or Fair Health           |                              | -                    | 1974 17.53 5.32 | 1166 16.02 4.18  | <0.0001* |
| Quality of Life               |                              | -                    | 1974 3.89 0.79 | 1166 3.68 0.63  | <0.0001* |
| Poor Physical Health Days     |                              | -                    | 1974 3.69 0.66 | 1166 3.65 0.53  | 0.0027 |
| Poor Mental Health Days       |                              | -                    | 1878 8.22 2.37 | 1164 8.12 1.69  | 0.2021 |
| Low Birthweight               |                              | -                    |                |                   |
| Health Behavior Health Behaviors |                             |                      |                |                   |
| Tobacco Use                   |                              | -                    | 1974 18.90 3.92 | 1166 17.66 3.44  | <0.0001* |
| Adult Smoking                 |                              | -                    | 1974 31.61 4.32 | 1167 29.97 4.52  | <0.0001* |
| Diet and Exercise             |                              | +                    | 1974 6.76 1.30 | 1167 7.29 1.05  | <0.0001* |
| Physical Inactivity           |                              | -                    | 1974 28.43 5.17 | 1167 25.66 5.37  | <0.0001* |
| Alcohol & Drug Use            |                              | +                    | 1908 52.13 23.02 | 1159 71.12 21.78 | <0.0001* |
| Access to Exercise Opp.       |                              | +                    | 1974 16.25 3.39 | 1167 17.27 3.22  | <0.0001* |
| Alcohol-Impaired Deaths       |                              | -                    | 1954 31.67 18.11 | 1160 30.84 11.27 | <0.0001* |
| Sexual Activity               |                              | -                    | 1804 335.4 260.5 | 1157 372.9 215.2 | <0.0001* |
| Teen Births                   |                              | -                    | 1879 45.32 19.86 | 1163 35.86 15.97 | <0.0001* |
| Clinical Care                 |                              | -                    |                |                   |
| Uninsured                     |                              | -                    | 1974 18.35 5.48 | 1166 15.98 5.08  | <0.0001* |
| Access to Care                |                              | +                    | 1860 51.53 32.16 | 1144 62.58 37.64 | <0.0001* |
| Dentists                      |                              | +                    | 1919 37.85 24.73 | 1144 50.52 30.99 | <0.0001* |
| Mental Health Providers       |                              | +                    | 1724 120.0 144.5 | 1131 150.0 131.5 | <0.0001* |
| Preventable Hospital Stays    |                              | -                    | 1905 68.44 27.64 | 1153 56.44 17.29 | <0.0001* |
| Quality of Care               |                              | +                    | 1936 83.83 7.33 | 1163 85.55 4.34  | <0.0001* |
| Diabetic Screening            |                              | +                    | 1873 59.28 8.92 | 1156 62.29 6.73  | <0.0001* |
| Social and Economic Environment |                              |                      |                |                   |
| Education                     |                              | +                    | 1517 84.44 9.39 | 1120 83.88 8.40  | 0.1062 |
| Employment                    |                              | +                    | 1974 53.73 11.24 | 1166 60.60 11.05 | <0.0001* |
| Unemployment                  |                              | -                    | 1974 6.36 2.56 | 1165 6.10 1.76  | 0.0009* |
| Children in Poverty           |                              | -                    | 1974 25.33 9.05 | 1165 21.01 8.06  | <0.0001* |
| Income                        |                              | +                    | 1974 81839.0 13628.6 | 1166 100737 23054.1 | <0.0001* |
| Income Inequality: 80th%      |                              | +                    | 1974 18635.9 4725.9 | 1166 23039 6745.2 | <0.0001* |
| Income Inequality: 20th%      |                              | -                    | 1974 4526.7 0.2 | 1164 44918 0.70  | 0.1909 |
| Income Inequality: Ratio      |                              | -                    | 1974 45.26 0.72 | 1164 44.918 0.70  | 0.1909 |
| Family & Social Support       |                              | +                    | 1974 32.51 10.99 | 1165 32.42 9.09  | 0.7935 |
| Support                       |                              | +                    | 1974 15.66 7.77 | 1167 10.96 4.28  | <0.0001* |
| Community                     |                              | -                    | 1837 217.6 173.8 | 1137 299 219.5  | <0.0001* |
| Safety                        |                              | -                    | 1864 85.06 25.88 | 1160 65.88 18.45 | <0.0001* |
| Physical Environment          |                              | -                    |                |                   |
| Air & Water                   |                              | -                    | 1948 11.57 1.50 | 1160 11.74 1.56  | 0.003* |
| Drinking Water Violations     |                              | -                    | 940 48.08 657 58.35 | >0.0001* |
| Housing & Transit             |                              | -                    | 1974 13.81 4.86 | 1167 15.63 4.68  | <0.0001* |
| Long Commute- Alone           |                              | -                    | 1974 78.08 7.99 | 1166 80.36 7.01  | <0.0001* |

Bold indicates the +/- direction that is associated with the value depicting health status. When + is presented, greater values indicate greater health status. When - is presented, lower values indicate greater health status. *Indicates significance (p < 0.05).

Phase one of Figure 1, compared the average CHR summary composites and individual measures for U.S. rural and non-rural counties included in the 2016 CHR National Data file. In this analysis, t tests were conducted to compare the community health indicators that served as continuous variables and chi-square tests were used for those that served as categorical variables.

Phase two of Figure 1, compared the average CHR summary composites and individual measures for US rural counties with hospitals versus US rural counties without hospitals. The analysis was done through independent t test for continuous variables and chi-square tests for categorical variables.
hospitals included in the 2016 CHR National Data file. In this analysis, t-tests were conducted to compare the community health indicators that served as continuous variables and chi-square tests were used for those that served as categorical variables.

Phase three of Figure 1, compared the average CHR summary composites and individual measures for US rural counties with CAHs versus rural counties without a CAH included in the 2016 CHR National Data file. In this analysis, t-tests were conducted to compare the community health indicators that served as continuous variables and chi-square tests were used for those that served as categorical variables.

| Table 2. U.S. rural counties with hospitals versus U.S. rural counties without hospitals. |

A

| CHR Summary Composite | Direction of Health | Rural Counties with Hospital | Rural Counties without Hospital | P-Value |
|-----------------------|---------------------|------------------------------|--------------------------------|---------|
| All Health Outcomes   | -                   | 1480 0.09 0.86 343 0.35 0.90 | -                              | <0.0001*|
| Length of Life        | -                   | 1485 0.15 0.96 345 0.37 1.04  | 0.0005*                        |
| Quality of Life       | -                   | 1513 0.16 3.65 365 1.23 3.92  | -                              | <0.0001*|
| All Health Factors    | -                   | 1168 0.50 3.59 149 1.65 3.22   | -                              | <0.0001*|
| Health Behaviors      | -                   | 1443 0.66 4.28 310 1.75 4.05   | -                              | <0.0001*|
| Clinical Care         | -                   | 1374 0.39 3.75 214 2.22 3.05   | -                              | <0.0001*|
| Social and Economic Environment | -              | 1223 0.74 5.14 215 2.20 5.22   | -                              | 0.0002* |
| Physical Environment  | -                   | 1522 -0.53 1.93 426 -0.32 2.32  | -                              | 0.9097  |

B

| CHR Focus Areas | Measure | Direction of Health | Rural Counties with Hospital | Rural Counties without Hospital | P-Value |
|-----------------|---------|---------------------|------------------------------|--------------------------------|---------|
| Health Outcomes | Length of Life | 1485 8418.40 2418.30 345 9000.5 2818.90  | 0.0004*                        |
|                 | Poor Health | 1535 17.33 5.11 439 18.24 5.97   | 0.004*                         |
| Quality of Life | Poor Mental Health | 1535 3.86 0.76 439 3.97 0.87  | 0.0192*                        |
|                 | Low Birthweight | 1535 3.6878 0.65 439 3.6916 0.69  | 0.9174                         |
| Tobacco Use     | Adult Smoking | 1535 18.82 3.74 439 19.18 4.49  | 0.118                          |
| Diet and Exercise | Food Environment Index | 1535 35.67 1.18 439 6.35 1.56  | <0.0001*                      |
|                 | Physical Inactivity | 1535 28.24 5.29 439 29.09 4.68  | 0.0012*                       |
| Alcohol & Drug Use | Access to Exercise Opp. | 1535 55.38 20.73 397 39.77 26.82  | <0.0001*                      |
| Use             | Excessive Drinking | 1535 16.43 3.37 439 15.62 3.36  | <0.0001*                      |
| Sexual Activity  | Sexually Transmitted Inf. | 1535 336.8 255.4 436 329.4 281.3  | 0.6529                        |
| Clinical Care   | Uninsured | 1535 17.86 5.31 439 20.06 5.73   | <0.0001*                      |
| Access to Care  | Primary Care Physicians | 1535 56.59 30.33 439 29.63 30.66  | <0.0001*                      |
|                 | Dentists | 1525 40.35 21.84 394 28.21 31.88  | <0.0001*                      |
| Quality of Care | Number of Diabetics | 1535 74.5 2.76 439 8.24 5.17   | 0.002*                         |
|                 | Diabetic Monitoring | 1531 83.67 7.49 405 84.44 6.64  | 0.0444*                       |
| Social and Economic Environment | Manningm Screening | 1506 59.41 8.80 367 58.77 9.37  | 0.2399                        |
| Education       | High School Graduation | 1283 84.24 9.35 234 85.59 9.53  | 0.0465*                       |
|                 | Some College | 1535 54.29 10.64 439 51.78 12.96  | 0.0002*                       |
| Employment      | Unemployment | 1535 6.26 2.45 439 6.70 2.90   | 0.0043*                       |
|                 | Children in Poverty | 1535 24.86 8.61 439 27.00 10.27  | <0.0001*                      |
| Income          | Income Inequality: 80th% | 1535 82427 12748.30 439 79746.60 1618290  | 0.0015*                       |
|                 | Income Inequality: 20th% | 1535 18710.2 4510.50 439 18375.90 540950  | 0.2375                        |
|                 | Income Inequality: Ratio | 1535 4.53 0.71 439 4.50 0.77  | 0.4356                        |
| Family & Social Support | Children in Single-Parent | 1535 32.65 10.21 439 32.02 13.38  | 0.3586                        |
| Support         | Social Associations | 1535 15.95 7.23 439 14.65 9.35  | 0.0071*                       |
| Community       | Violent Crime | 1449 227.90 171.30 388 179.30 178   | <0.0001*                      |
| Safety          | Injury Deaths | 1506 83.67 24.06 358 90.80 31.81  | <0.0001*                      |
| Physical Environment | Air Pollution | 1522 11.56 1.49 426 11.59 1.54  | 0.7543                        |
| Safety          | Drinking Water Violations | 1528 51.18 427 48.82 84.82  | 0.0037*                       |
|                | Severe Housing Problems | 1535 13.93 4.60 439 13.36 5.66  | 0.0514                        |
|                | Driving Alone to Work | 1535 78.78 6.64 439 75.62 11.20  | <0.0001*                      |
|                | Long Commute- Alone | 1535 25.75 7.82 439 32.70 11.89  | <0.0001*                      |

Bold indicates the +/- direction that is associated with the value depicting health status. When + is presented, greater values indicate greater health status. When - is presented, lower values indicate greater health status. *Indicates significance (p < 0.05).
3. Results

3.1. Phase One: U.S. Rural Counties Versus Non-rural Counties

Summary Composite Table 1A provides an overview of results comparing the average CHR summary composites of rural and non-rural counties (N=3,141). As shown in Figure 2, panel a, phase 1 considered 1,974 rural counties and 1,167 non-rural counties within the analysis. All eight of the summary composite measures were significantly different between rural and non-rural counties: All Health Outcomes, p < 0.001; Length of Life, p < 0.001; Quality of Life, p < 0.001; All Health Factors, p < 0.001; Health Behaviors, p < 0.001; Clinical Care, p < 0.001; Social and Economic Environment, p < 0.001 and Physical Environment, p < 0.001). In addition, the direction of the health indicator favored improved health in non-rural counties on 7 of the 8 measures except for physical environment, which favored the rural counties (Table 1A).

Individual Measures Table 1B provides a summary of the results on individual CHR measures for the 3,141 counties comparing rural and non-rural counties. Thirty-two of the 38 measures demonstrated significance (p ≤ 0.05) with 22 (72.7%) indicating greater health status in non-rural counties (Table 1B).
### Table 3. U.S. rural counties with critical access hospital versus remaining U.S. rural counties without critical access hospital.

| CHR Summary Composite | Rural Counties with CAH | Rural Counties with Non-CAH | P-Value |
|------------------------|-------------------------|-----------------------------|---------|
| **A**                   |                         |                             |         |
| All Health Outcomes    | -                       | 735                         | -0.13   | 0.79 | 619 | 0.38 | 0.85 | <0.0001* |
| Length of Life         | -                       | 740                         | -0.03   | 0.91 | 619 | 0.37 | 0.96 | <0.0001* |
| Quality of Life        | -                       | 767                         | -0.09   | 3.38 | 620 | 1.66 | 3.50 | <0.0001* |
| All Health Factors     | -                       | 472                         | -0.38   | 3.26 | 578 | 1.28 | 3.60 | <0.0001* |
| Health Behaviors       | -                       | 701                         | -0.10   | 3.99 | 616 | 1.52 | 4.28 | <0.0001* |
| Clinical Care          | -                       | 646                         | 0.55    | 3.55 | 602 | 0.38 | 3.85 | 0.4252 |
| Social and Economic Environment | -               | 512                         | -0.62   | 4.88 | 591 | 1.98 | 5.06 | <0.0001* |
| Physical Environment   | -                       | 780                         | -1.06   | 1.98 | 619 | 0.13 | 1.73 | <0.0001* |

| CHR Focus Areas        | Measure                          | Rural Counties with CAH | Rural Counties with Non-CAH | P-Value |
|------------------------|----------------------------------|-------------------------|-----------------------------|---------|
| **B**                   |                                  |                         |                             |         |
| Health Outcomes        |                                  |                         |                             |         |
| Length of Life         | Premature Death                  | 740                     | 7962.90                     | 2198.10 | 619 | 8958.3 | 2508 | <0.0001* |
| Quality of Life        | Poor Physical Health Days        | 788                     | 15.88                        | 4.56 | 621 | 19.29 | 5.20 | <0.0001* |
| Health Behaviors       | Poor Mental Health Days          | 788                     | 3.64                          | 0.72 | 621 | 4.15 | 0.74 | <0.0001* |
| Tobacco Use            | Adult Smoking                    | 788                     | 17.88                        | 3.34 | 621 | 19.95 | 3.83 | <0.0001* |
| Diet and Exercise      | Food Environment Index           | 788                     | 7.02                          | 1.18 | 621 | 6.66 | 1.17 | <0.0001* |
| Alcohol & Drug Use     | Access to Exercise Opp.          | 767                     | 52.23                        | 21.58 | 618 | 58.49 | 19.22 | <0.0001* |
| Sexual Activity        | Sexually Transmitted Inf.        | 712                     | 271.12                       | 227.9 | 620 | 406   | 269  | <0.0001* |
| Clinical Care          | Uninsured                        | 788                     | 17.76                        | 5.54 | 621 | 18.16 | 4.98 | 0.1467 |
| Access to Care         | Primary Care Physicians          | 765                     | 54.39                        | 32.87 | 620 | 58.02 | 27.21 | 0.0284* |
| Mental Health Providers| Preventable Hospital Stays       | 781                     | 38.03                        | 23.29 | 618 | 41.75 | 20.27 | 0.0014* |
| Quality of Care        | Number of Diabetics              | 788                     | 33.43                        | 20.14 | 620 | 29.92 | 12.67 | <0.0001* |
| Social and Economic Environment |                    | 716                     | 40.71                        | 18.92 | 621 | 50.59 | 19.54 | <0.0001* |
| Education              | High School Graduation           | 550                     | 84.90                        | 9.66 | 609 | 83.63 | 9.26 | 0.023* |
| Employment             | Some College                     | 788                     | 55.72                        | 11.19 | 621 | 52.31 | 9.83 | <0.0001* |
| Income                 | Children in Poverty              | 788                     | 22.95                        | 8.12 | 621 | 27.41 | 8.72 | <0.0001* |
| Income                 | Income Inequality: 80th%         | 788                     | 82316.3                      | 12047.3 | 621 | 80840.7 | 13697 | 0.0007* |
| Income                 | Income Inequality: 20th%         | 788                     | 19502.5                      | 4153.00 | 621 | 17596.6 | 4805.60 | 0.0001* |
| Family & Social Support| Children in Single-Parent        | 788                     | 29.82                        | 9.90 | 621 | 35.92 | 9.91 | <0.0001* |
| Community              | Violent Crime                    | 726                     | 176.10                       | 136.60 | 602 | 286.3 | 189  | <0.0001* |
| Physical Environment   | Injury Deaths                    | 761                     | 86.11                        | 24.81 | 619 | 81.21 | 23.09 | 0.0002* |

Bold indicates the +/- direction that is associated with the value depicting health status. When + is presented, greater values indicate greater health status. When - is presented, lower values indicate greater health status. *Signifies significance (p < 0.05).

### 3.2. Phase Two: U.S. Rural Counties with Hospitals Versus U.S. Rural Counties Without Hospitals

Summary Composite: Table 2A provides an overview of results comparing the average CHR summary composites of rural counties with hospitals versus rural counties without hospitals. As shown in Figure 2, phase 2 considered 1,535 rural counties with hospitals and 439 rural counties without hospitals within the analysis. Seven of the eight summary composite measures demonstrated a significant relationship: All Health Outcomes, p < 0.0001; Length of...
Individual Measures Table 2B provides a summary of the results comparing individual CHR measures for rural counties with hospitals versus rural counties without hospitals. Twenty-three of the 38 measures demonstrated significance (p ≤ 0.05) with 19 (50.0%) indicating greater health status in rural counties with hospitals (Table 2B).

3.3. Phase Three: U.S. Rural Counties with CAH Versus Rural Counties Without CAH

Summary Composite Table 3A provides an overview of the results comparing the average CHR summary composites of rural counties with CAH versus rural counties without CAH. As shown in Figure 2, panel c, phase 3 considered 788 rural counties with CAH and 621 rural counties without CAH within the analysis. Significance was found in seven of the eight summary composite relationships: All Health Outcomes, p < 0.0001; Length of Life, p < 0.0001; Quality of Life, p < 0.0001; All Health Factors, p < 0.0001; Health Behaviors, p < 0.0001; Social and Economic Environment, p < 0.0001 and Physical Environment, p < 0.0001. In addition, the direction of the health indicator favored improved health in the rural counties with CAH on 7 of the 8 measures (Table 3A).

Individual Measures Table 3B provides a summary of the results comparing individual CHR measures for rural counties with CAH versus rural counties without CAH. Thirty-four of the 38 measures demonstrated significance (p ≤ 0.05) with 25 (65.8%) indicating greater health status in rural counties with CAHs.

4. Discussion

This study utilized data available through the CHRs and the AHA’s Annual Survey Database to evaluate CAH’s performance on clinical outcomes, and compare health outcomes between rural counties with CAHs and rural counties without CAHs. There were three important findings from the study. First, we found significantly better health outcomes in non-rural counties as compared to rural counties on the majority of health measures. Second, the presence of a hospital demonstrates a positive correlation in rural healthcare and improves the measured health outcomes at the level of the counties. Finally, as a corollary of hospital presence, we found significantly preferable scores on health metrics in rural counties served by CAHs compared with rural counties without CAHs in nearly all of the categories evaluated. These improved scores were most evident in focus areas of health outcomes and health behaviors, but interestingly less so in the focus area of clinical care. In aggregate, we found for the majority of health measures (1) better health outcomes in non-rural counties, (2) better health outcomes in rural counties with hospitals than counties without any hospitals, and (3) higher quality health metrics in rural counties with CAHs than rural counties without CAHs.

A primary aim of this study involved the evaluation of rural county health measures as a composite and to compare outcomes to those measured in non-rural counties. In this analysis, we found better health outcomes overall in non-rural counties. Due to closer proximity to healthcare centers and increased availability of resources, we expected non-rural counties to perform better on the health outcomes. For the most part, this held true, but interestingly, rural counties demonstrated preferable values in 27.3% of health outcomes evaluated when compared with urban counties. Several of the health behavior outcomes in which rural counties excelled include excessive drinking and sexually transmitted infections (STI), which are both lower in rural counties according to CHR data (Table 1B). In regard to excessive drinking, the results mirror the outcomes by Warren et al. who also demonstrated higher levels of access to legal substances by rural students, thereby indicating a direct relationship between the ease of access to substances and substance use.[14] Further, Tzilos et al. demonstrated that women who reside in rural areas of the United States in comparison to women living in urban areas faced multiple health concerns, including substance use disparities, and often at greater rates. [15] The literature for alcohol use in the rural US is equivocal with some reports highlighting the independent contribution of rurality. [16-19] In contrast, other reports demonstrate the lack of an increased risk. [20] Similarly, outcomes for STI incidence in the rural environment highlight the important influence in context to both risk for disease and diagnosis of disease. [21]

Rural counties also demonstrated positive upstream factors of county health seen in their physical environment, with fewer drinking water violations, severe housing problems, driving alone to work, and long solitary commutes to work. Though not directly regulated by healthcare availability, these environmental aspects greatly impact health in a community. This evaluation demonstrates that although urban counties performed better in metrics related to healthcare, there are certain measures of health that are superior in rural counties.

Next, in the analysis of rural counties with hospitals and rural counties without hospitals, we found that the presence of a hospital matters in rural healthcare and improves the measured health outcomes at the level of the counties. These results reflect the outcomes by Chan et al. who also demonstrated residents of rural areas have increased travel distance and time compared to their urban counterparts, thereby suggesting that most rural residents do not rely on urban areas for much of their care. [22] Significant data demonstrated that rural counties with hospitals boasted higher quality health metrics than counties without any hospitals in all areas except for excessive drinking, alcohol related deaths, and sexually transmitted infections (Table 2B). Although these are important factors in a county’s health, these are likely not directly within the hospital’s scope of
control in the counties they treat; therefore, this is not a reflection on the efficacy of hospitals in rural counties, but a reflection of unevulated contributors to county health.

Finally, in the analysis of rural counties with CAHs versus those without, counties served by CAHs resulted in better scores on the majority of health metrics, significantly demonstrating the benefits that these hospitals provide to the counties they serve. In the analysis of rural counties with and without CAHs, we found significantly preferable scores on health metrics in rural counties served by CAHs. Several items in our evaluation stood out in contrast, specifically the higher number of primary care physicians and mental health providers in rural counties without CAHs. As preventative medicine has a major impact on public health, the availability of primary care and mental health physicians may contribute to the preferable scores we observed on outcomes such as excessive drinking and alcohol-impaired deaths seen in rural counties without CAHs. Though some may consider access to primary care antithetical to the evaluation of hospital efficacy, it is certainly important to maintaining quality health in a community. Counties with CAHs may benefit from establishing primary care clinics in association with CAHs to increase the availability of primary care and mental health services [23-25].

Several limitations within this study exist and should be addressed. First, while we used standardized definitions to identify CAHs and validated their categorization as CAHs, there may be elements of categorial bias due to miscategorization of some hospital types. We believe that while this is a potential limitation, the standardized approach and validation in two datasets, along with the analysis of rurality using multiple methods, mitigates this limitation. Second, while we considered all counties in the study, incomplete data from the two available databases were completed by imputing for missing values and may have an impact on the results. We expect that using two datasets with high reliability and standardized methods year over year would mitigate this problem. Third, many counties had multiple CAHs and, aggregating their individual data into overall county data, may have affected the evaluation of individual hospital impact. However, despite averaging the health scores for these counties, this study does provide evidence that these counties performed better with the presence of a CAH. Future studies at the level of the hospital and not the county may provide additional insights into the independent contributions of CAHs on the clinical care that they provide. Finally, there may be elements of assignment bias that led to miscategorization of diagnoses. For example, the lower rate of excessive drinking and STIs seen in this study may, in part, be due to a lack of screening and therefore diagnosis of these conditions in the datasets.

Despite these limitations, this study offers an important evaluation of the efficacy of CAHs and the benefits they provide to the counties they serve. In addition, further study into specific differences in healthcare that improve health outcomes in these counties should be encouraged.

5. Conclusion

The main finding of this study is that rural counties serviced by CAHs demonstrate better overall health status scores, on several CHR metrics, as compared to rural counties without CAHs. The only exception to this conclusion being that rural counties without CAHs performed superiorly in the CHR metrics related to primary care and mental health services, demonstrating capacities in which CAHs could improve the impact on health in the counties they serve.

Since the Balanced Budget Act of 1997 designated “CAH”, there have been no broad scale, national studies evaluating these hospitals on their impact for the communities they serve. This study opens the door for further evaluations of CAHs and demonstrates certain areas in which these hospitals could improve health outcomes. By broadening the spectrum of care provided by CAHs and developing partnerships to offer outpatient care as well, the CAH could evolve into a more efficacious entity, improving rural county performance on metrics evaluating both health and healthcare. Our results demonstrate that these hospitals offer a unique opportunity to improve healthcare availability to rural counties and to reduce potential healthcare disparities between rural and non-rural counties across the US.

Conflict of Interest

All the authors do not have any possible conflicts of interest

Disclaimer

The opinions expressed in this document are those of the authors and do not reflect the official position of their current affiliations.

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