



H·CUP

HEALTHCARE COST AND UTILIZATION PROJECT

HCUP Method Series

**Conducting County-Level Analyses With HCUP Data:
Approaches and Methodological Considerations.**

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1. INTRODUCTION

Users of the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project (HCUP) State databases—the State Inpatient Databases (SID), the State Emergency Department Databases (SEDD), and the State Ambulatory Surgery and Services Databases (SASD)—may be interested in conducting county-level analyses. These analyses can be conducted using either the county in which the patient resides (*patient county*) or the county of the hospital at which services are administered (*hospital county*). This report provides users with information on the availability of county information in the HCUP State databases, as well as guidance on how to use county information for analyses while protecting patient and hospital confidentiality.

HCUP State databases include the Federal Information Processing Standards (FIPS) county codes to identify the county associated with the patient’s residence. Information on patient county varies across States and years but often is assigned from the ZIP Code of the patient’s residence. Only a few HCUP Partners geocode the county from an actual street address or census tract or have patients self-identify their county of residence.¹ Assignment of county from the ZIP Code is problematic because a ZIP Code may span more than one county.

If the HCUP Partner organization permits the release of hospital identifiers, information on the hospital county is obtained from the American Hospital Association (AHA) Annual Survey of Hospitals and is available through the HCUP AHA Linkage Files.² For the AHA Annual Survey, county is assigned on the basis of hospital ZIP Code. When a ZIP Code is in multiple counties, the ZIP Code is assigned to the county in which most of the population of the ZIP Code resides.³

There are several methodological issues to consider in choosing how to assign and use patient or hospital county. This report presents options for addressing these issues. Although it focuses on county-level analyses, similar and additional considerations would apply to more granular analyses (e.g., ZIP Code-level analyses).

2. APPROACHES TO ASSIGNING COUNTY FROM ZIP CODE

The source of patient county information provided in the HCUP State databases varies across States and data years (see Section 3.1 for additional details). To ensure consistent county assignment when using HCUP data for multiple States, years, or both, researchers may choose to assign patient county to HCUP records using the patient ZIP Code (data element ZIP). A challenge associated with this approach is that nearly 25 percent of U.S. ZIP Codes cross

¹ In data year 2017, two Partners determined the county based on the complete patient address (Georgia and Louisiana) and another Partner used the census tract to identify county (Texas).

² Agency for Healthcare Research and Quality. American Hospital Association Linkage Files. Healthcare Cost and Utilization Project (HCUP). Last modified November 14, 2019. www.hcup-us.ahrq.gov/db/state/ahalinkage/aha_linkage.jsp. Accessed December 10, 2019.

³ This information was determined via correspondence with the AHA Resource Center on November 7, 2019.

county lines. One way to handle these cases is to assign county on the basis of the centroid of the ZIP Code—either the geographic centroid or the population centroid. The county of geographic centroid of the ZIP Code can be identified using the SASHELP.ZIPCODE lookup file from SAS[®].⁴ The population centroid is the geographical point that describes the center point of the ZIP Code’s population.⁵

To assess the differences between these two approaches, we conducted an analysis of all 2017 SID combined, comparing county assignment using the two types of centroids. We limited the analysis to records from community hospitals, excluding rehabilitation and long-term acute care facilities. Pooling the SID across 48 HCUP Partner States (Appendix A) resulted in more than 44,000 unique ZIP Codes with at least one record in 2017. The ZIP Codes spanned all HCUP States in addition to non-HCUP States and U.S. territories. We then assigned the county using the geographic centroid versus the population centroid. Table 1 shows the congruence between the assignments. Appendix B provides counts by patient State for each of the comparison categories. Identification of the population centroid is possible only for ZIP Codes with an associated population. Some ZIP Codes are specific to a Post Office (P.O.) Box or a business or government building that has no associated population.

Table 1. Assignment of County for Combined 2017 SID Records Using Geographic Centroid (from SAS) Versus Population Centroid (from Claritas)

Assignment	Records, N	Records, %
Same county assigned	33,722,926	97.7
Different counties assigned	213,904	0.6
Only assigned by geographic centroid	406,638	1.2
Only assigned by population centroid	116	0.0
No county assigned by either approach	12,592	0.0
County cannot be assigned	155,947	0.5
Missing ZIP Code	29,902	0.1
Foreign ZIP Code	43,303	0.1
Homeless ZIP Code	80,622	0.2
Nonnumeric ZIP Code	2,120	0.0
Total records in combined 2017 SID	34,512,123	100.0

Abbreviation: SID, State Inpatient Databases.

Note: Counts are limited to community hospitals, excluding rehabilitation and long-term acute care facilities.

Source: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, State Inpatient Databases, 47 States and the District of Columbia, 2017.

⁴ Additional information from SAS on the geocode procedure is available at SAS. Geocode Procedure. support.sas.com/documentation/cdl/en/graphref/65389/HTML/default/viewer.htm#n1cqwrpowwd416n1lmw39ughjpuh.htm.

⁵ For this analysis, population centroid was based on data from Claritas. For more information, visit www.claritas.com/.

We examined the ZIP Code assignments by type:

- *Same county assigned.* Almost all inpatient stays (97.7 percent) were assigned to the same county using the two approaches. This included ZIP Codes that crossed county borders but for which the geographic and population centroids were in the same county. We examined these assignments and found that they included universities, military bases, and Indian reservations.
- *Different counties assigned.* A small percentage of records (0.6 percent) were assigned different counties by the two approaches. This included ZIP Codes that crossed county borders and for which the geographic centroid was in a different county from the population centroid. For example, the ZIP Code 23223 in Richmond, Virginia, crosses the counties Richmond City (assigned by geographic centroid) and Henrico (assigned by population centroid). Different county assignments occurred for ZIP Codes in all but four States (Delaware, Hawaii, Maine, and Wyoming; see Appendix B). The three States with the most affected ZIP Codes were Texas (30 ZIP Codes), North Carolina (21 ZIP Codes), and Virginia (19 ZIP Codes).
- *County assigned only by geographic centroid.* A small percentage of records (1.2 percent) were assigned a county by geographic centroid but not by population centroid. The ZIP Codes assigned only by geographic centroid were spread across all States (see Appendix B). A review of these ZIP Codes found them to be designated⁶ as either a “P.O. Box ZIP Code” or a ZIP Code specific to a business or government building. The county of the P.O. Box was specific to the location of the P.O. Box. It is possible that residents using that P.O. Box for mail service live in a different county. An example of a ZIP Code specific to a business is ZIP Code 84143, which is a large hospital in Salt Lake City. ZIP Codes with no population reported in the 2010 census would not have a population centroid.
- *County assigned only by population centroid.* A total of 116 records were assigned a county by population centroid but not by geographic centroid. These 12 ZIP Codes were boroughs in Alaska or national forest/wilderness areas.
- *No county assigned by either approach.* About 12,600 records did not have the county assigned by either approach. These ZIP Codes were invalid.
- *County could not be assigned.* For a small percentage of records (0.5 percent), county could not be assigned for one of several reasons: the record was missing the ZIP Code, the ZIP Code indicated that the patient was foreign, the ZIP Code indicated that the patient was homeless, or the ZIP Code was nonnumeric (see Table 1 and Appendix B for details).

3. PATIENT COUNTY

3.1 HCUP Data Elements

HCUP State databases contain several data elements related to patient county.

PSTCO: Patient State/county FIPS code. The data element PSTCO retains the county code provided by the HCUP Partner organization regardless of how the information is collected. In data year 2017, three Partners (Colorado, Montana, and New Mexico) provide the county of residence reported by the patient, two Partners (Georgia and Louisiana) determine the county

⁶ We used www.zip-codes.com to determine ZIP Code designations.

on the basis of the complete patient address, and one Partner (Texas) uses the census tract to identify county. All other Partner organizations either do not provide information on the patient's county (and the data element PSTCO is not in the State database) or assign the county on the basis of the patient's ZIP Code. For some Partners, the approach to patient county assignment has changed over time.⁷

PSTCO2: Patient State/county FIPS code, possibly derived from ZIP Code. The data element PSTCO2 retains patient county information provided by the HCUP Partner (i.e., the information provided in the data element PSTCO) when available and assigns patient county on the basis of ZIP Code for all other records.

- If the Partner organization provides information on the patient State/county, it is retained in two HCUP data elements: PSTCO with the original information and PSTCO2 with the original and augmented information. Any records with a missing or invalid county code in PSTCO have the county code in PSTCO2 assigned from the patient's ZIP Code (first on the basis of the geographic centroid and then, if still missing, by the population centroid).
- If the Partner organization does not provide information on patient State/county, PSTCO2 is assigned solely from the patient's ZIP Code. The county is first assigned based on the geographic centroid (from SAS), and if still missing from the population centroid (from Claritas).

ZIP: Patient ZIP Code. The data element ZIP retains the patient's ZIP Code as provided by the HCUP Partner, with a few exceptions.⁸ The availability of this data element varies by State (see "Availability of Data Elements by Year" on the [SID](#), [SEDD](#), or [SASD](#) Database Documentation pages on the HCUP User Support [HCUP-US] website for more information).

The data element ZIP is missing for a small percentage of records in the HCUP State databases. Tables 2 and 3 summarize the missingness of this data element in the 2017 SID and 2017 SEDD, respectively. Appendix C provides the number and percentage of records missing ZIP by hospital State.

Table 2. Missingness of ZIP Data Element in 2017 SID

Missingness	Total Records	Missing ZIP	
		No.	%
Total (all SID)	34,512,123	29,902	0.1
Minimum	41,837	0	0.0
Average	719,003	623	0.1
Maximum	3,698,493	6,319	0.3

⁷ For State-specific notes regarding PSTCO, visit HCUP-US: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project. Central Distributor SID: Description of Data Elements. www.hcup-us.ahrq.gov/db/vars/siddistnote.jsp?var=pstco.

⁸ Foreign ZIP Codes are recoded to indicate Canadian, Mexican, and other or unspecified foreign ZIP Codes. Invalid ZIP Codes are identified (ZIP = "A"). The ZIP Code for homeless patients is set to missing (ZIP = " ") in the 1988–1999 HCUP databases and to "H" beginning in the 2000 HCUP databases.

Abbreviation: SID, State Inpatient Databases.

Notes: This analysis was limited to community hospitals, excluding rehabilitation and long-term acute care facilities.

Source: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, State Inpatient Databases, 47 States and the District of Columbia, 2017.

Table 3. Missingness of ZIP in 2017 SEDD

Missingness	Total Records	Missing ZIP	
		No.	%
Total (all SEDD)	98,154,465	374,442	0.4
Minimum	181,290	0	0.0
Average	2,583,012	9,854	0.2
Maximum	12,868,014	211,447	2.6

Abbreviation: SEDD, State Emergency Department Databases.

Notes: This analysis was limited to community hospitals, excluding rehabilitation and long-term acute care facilities.

Source: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, State Emergency Department Databases, 37 States and the District of Columbia, 2017.

3.2 Analytic Considerations When Reporting by Patient County

There are several analytic considerations when reporting HCUP data by patient county. First, the HCUP Data Use Agreement does not allow the identification of hospitals. When aggregating data by county, users must ensure that the data do not represent records from only one hospital, which could be indirectly identified. The number of hospitals that are included in the aggregation by patient county will vary depending on the analysis. If using only one HCUP State database, researchers should consider that patients residing in one county may be treated in a hospital in their county of residence or in another county in the State. If combining data across HCUP State databases, researchers should consider that patients residing in one county may be treated at a hospital in their State or in the other included States. Depending on the parameters and goals of a particular analysis, a researcher may or may not want to capture the records of patients who traveled long distances for care (e.g., outside of their county, State, or region of residence).

Second, the extent to which an analysis of patient county may encompass a relatively large number of hospitals varies across the number of included States, the patient condition, and the hospital setting. For example, in the case of emergency department (ED) visits for diabetes, people traveling away from home would likely need immediate care at a nearby hospital. As such, we would expect these ED visits to be dispersed across a greater distance and across a greater number of hospitals compared with inpatient stays for childbirth/delivery. In the latter case, expectant mothers would be less likely to travel and more likely to go to a hospital near home for their delivery. Therefore, we would expect inpatient stays for delivery to be less dispersed geographically.

For the purpose of this analysis, we combined 2017 SEDD from 37 States and the District of Columbia to examine ED visits related to diabetes. We also combined 2017 SID from 48 States and the District of Columbia to examine inpatient deliveries (see Appendix D for definition of *deliveries*). We then summarized counts for ED visits, inpatient stays, and hospitals by patient and hospital county. Table 4 presents information on diabetes-related ED visits in 2017, by patient county and hospital county, for five example counties. Table 5 presents the same information for inpatient stays for delivery in 2017. These example counties were typical of the patterns exhibited in other counties but were chosen because they are geographically dispersed and had a sizable number of encounters and hospitals.

In the case of County A in Kentucky, Table 4 demonstrates that there were more ED visits involving diabetes when counts were aggregated by hospital county rather than by patient county (3,993 vs. 2,607 visits). However, the ED visits for residents of the county were dispersed across 48 hospitals overall—only 4 of which were located in the same county. Table 5 demonstrates that for this same county, there were more than twice the number of inpatient stays for delivery when record counts were aggregated by hospital county compared with patient county (7,848 vs. 3,788 stays). In this case, the inpatient stays for residents of the county were dispersed across only 22 hospitals, 3 of which were located in the same county. It should be noted that not all hospitals provide ED or maternal services. The general pattern of greater dispersion across hospitals for ED visits involving diabetes compared with inpatient stays for delivery held true for all example counties.

Across all example counties, for both scenarios (ED visits involving diabetes and inpatient stays for delivery) the number of hospitals was substantially higher when record counts were aggregated by patient county compared with hospital county—at least 11 times higher for the ED visits and at least 7 times higher for the inpatient stays. This was true whether the number of visits or stays was higher, lower, or similar for patient county compared with hospital county.

Researchers who wish to limit the scope of hospitals included in county-level analyses that use patient county have several potential options. For example, they may choose to limit the analysis to records for which patient county is equivalent to hospital county, to hospitals in the patient State of residence, or, additionally, to hospitals in a different State but within a certain radius of the patient county. In the latter case, HCUP State databases would need to be combined for the analysis.

Tables 4 and 5 also show the extent to which the number of hospitals decreases when these various limitations are applied. (For the purposes of these examples, a radius of 250 miles was used.) Additionally, these tables demonstrate that, at least for the example conditions, patients almost always are treated at hospitals in their State of residence and, in the vast majority of cases, in their county of residence. Thus, applying limits to hospital location did not dramatically affect the record counts.

Looking at County E in Arizona as an example, we see a decrease of 83.8 percent (from 427 to 69) in the number of hospitals with ED visits involving diabetes when limiting to within the State or within 250 miles of the patient county, of 87.8 percent (from 427 to 52 hospitals) when limiting to within the State, and of 93.9 percent (from 427 to 26) when limiting to hospitals in the patient

county. However, these limitations resulted in ED visit decreases of only 1.2 percent (from 41,091 to 40,600 visits), 1.3 percent (from 41,091 to 40,573), and 2.4 percent (from 41,091 to 40,091), respectively. Similar decreases were observed for this county when applying the limits to inpatient stays for delivery: hospital count decreases of 77.3 percent, 79.8 percent, and 88.3 percent, respectively, and inpatient stay count decreases of 0.3 percent, 0.3 percent, and 0.9 percent, respectively.

Table 4. Hospitals With Diabetes-Related ED Visits in 2017, Aggregated by Patient County Versus Hospital County (Selected County Examples)

Type of Aggregation	County A, Kentucky	County B, New Jersey	County C, Wisconsin	County D, Florida	County E, Arizona
Counts by patient county					
Hospitals any distance					
No. of ED visits	2,607	3,927	14,702	17,770	41,091
No. of hospitals	48	85	125	233	427
Hospitals in State or within 250 miles					
No. of ED visits	2,593	3,886	14,636	17,610	40,600
No. of hospitals	34	53	70	103	69
Hospitals in State					
No. of ED visits	2,583	3,844	14,619	17,610	40,573
No. of hospitals	27	37	54	103	52
Hospitals in same county					
No. of ED visits	2,515	3,415	13,681	14,462	40,091
No. of hospitals	4	6	9	19	26
Counts by hospital county					
No. of ED visits	3,993	3,686	14,722	16,173	43,893
No. of hospitals	4	6	9	19	26
Counts in SEDD					
No. of hospitals	4	6	11	21	35

Abbreviations: ED, emergency department; SEDD, State Emergency Department Databases.

Notes: All hospital counts are limited to community hospitals, excluding rehabilitation and long-term acute care facilities. The analysis included records with any diagnosis of diabetes mellitus with complication (Clinical Classifications Software Refined category END003).

Source: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, State Emergency Department Databases, 5 States, selected example counties, 2017.

Table 5. Number of Hospitals With Inpatient Stays for Childbirth/Delivery in 2017, Aggregated by Patient County Versus Hospital County (Selected County Examples)

Type of Aggregation	County A, Kentucky	County B, New Jersey	County C, Wisconsin	County D, Florida	County E, Arizona
Counts by patient county					
Hospitals any distance					
No. of inpatient stays	3,788	9,851	12,901	30,348	48,406
No. of hospitals	22	90	60	120	163
Hospitals in State or within 250 miles					
No. of inpatient stays	3,784	9,840	12,886	30,257	48,255
No. of hospitals	18	79	45	50	37
Hospitals in State					
No. of inpatient stays	3,775	8,195	12,872	30,257	48,248
No. of hospitals	15	36	32	50	33
Hospitals in same county					
No. of inpatient stays	3,700	4,654	11,768	24,302	47,948
No. of hospitals	3	5	7	10	19
Counts by hospital county					
No. of inpatient stays	7,848	5,165	14,037	25,967	51,012
No. of hospitals	3	5	7	10	19
Counts in SID					
No. of hospitals	4	6	11	21	35

Abbreviation: SID, State Inpatient Databases.

Note: All hospital counts are limited to community hospitals, excluding rehabilitation and long-term acute care facilities. See Appendix D for codes used to define delivery.

Source: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, State Inpatient Databases, 5 States, selected example counties, 2017.

4. HOSPITAL COUNTY

4.1 HCUP Data Elements

Hospital county is available in a separate file from HCUP State database files. For the HCUP Central Distributor State databases, hospital county can be obtained from the AHA Linkage File, if the HCUP Partner organization permits the release of hospital identifiers. There is one file per year and State. The level of observation in the AHA Linkage File is the Partner-provided hospital identifier (DSHOSPID). Merge the HCUP State database to the AHA Linkage File by year, hospital State (HOSPST), and DSHOSPID. In some States, DSHOSPID is one-to-one mapping to the AHA hospital identifier (AHAID). In other States, multiple DSHOSPIDs map to a single AHAID because the AHA considers facilities under the same ownership as one hospital.

HFIPSSTCO: Hospital FIPS State/county code. The data element HFIPSSTCO indicates the five-digit state and county FIPS code listed for a hospital in the AHA Annual Survey. Each hospital has only one unique State/county code. If multiple hospital units are in different counties, HFIPSSTCO is the county code of the primary facility. As noted above, for the AHA Annual Survey, county is assigned on the basis of hospital ZIP Code. When a ZIP Code is in multiple counties, the ZIP Code is assigned to the county in which most of the population of the

multiple counties, the ZIP Code is assigned to the county in which most of the population of the ZIP Code resides.⁹ HFIPSSTCO is available for all States starting in 2012. It should be noted that HFIPSSTCO includes *unmodified* FIPS county codes, which include unique values for independent cities, such as Baltimore City and St. Louis City. This also includes FIPS codes for outlying areas of the United States and freely associated States (i.e., American Samoa, Federated States of Micronesia, Guam, Marshall Islands, Commonwealth of the Northern Mariana Islands, Palau, Puerto Rico, U.S. minor outlying islands, and the U.S. Virgin Islands).

HOSPSTCO: Hospital modified FIPS State/county code. The data element HOSPSTCO indicates the five-digit state and county modified FIPS code listed for a hospital in the AHA Annual Survey. The modified FIPS county code uses one county code for independent cities and the surrounding county. For example, Baltimore City is included in Baltimore County, and St. Louis City is included in St. Louis County. Similar to HFIPSSTCO, each hospital has only one unique State/county code. If multiple hospital units are in different counties, HOSPSTCO is the county code of the primary facility. HOSPSTCO is available for all States prior to 2012.

4.2 Analytic Considerations When Reporting by Hospital County

There are several analytic considerations when reporting HCUP data by hospital county, especially because the HCUP Data Use Agreement (DUA) **prohibits reporting data that could identify individual establishments directly or by inference.**¹⁰

One analytic challenge is that some counties have no hospital. As such, a county-level analysis would have no hospital utilization data for these counties. Figure 1 shows the percentage of counties in each HCUP State with no hospitals, one hospital, and two or more hospitals (see Appendix E for more detailed counts.) Whereas 1 State and the District of Columbia (both with fewer than 20 counties total) have hospitals in all counties, in 12 States, at least 20 percent of counties do not have a hospital. For Georgia, Kentucky, and South Dakota more than one-third of the counties in the State do not have a hospital. Potential approaches to addressing this challenge include excluding counties without hospitals from the analysis or combining data across adjacent counties until there are data from at least two hospitals.

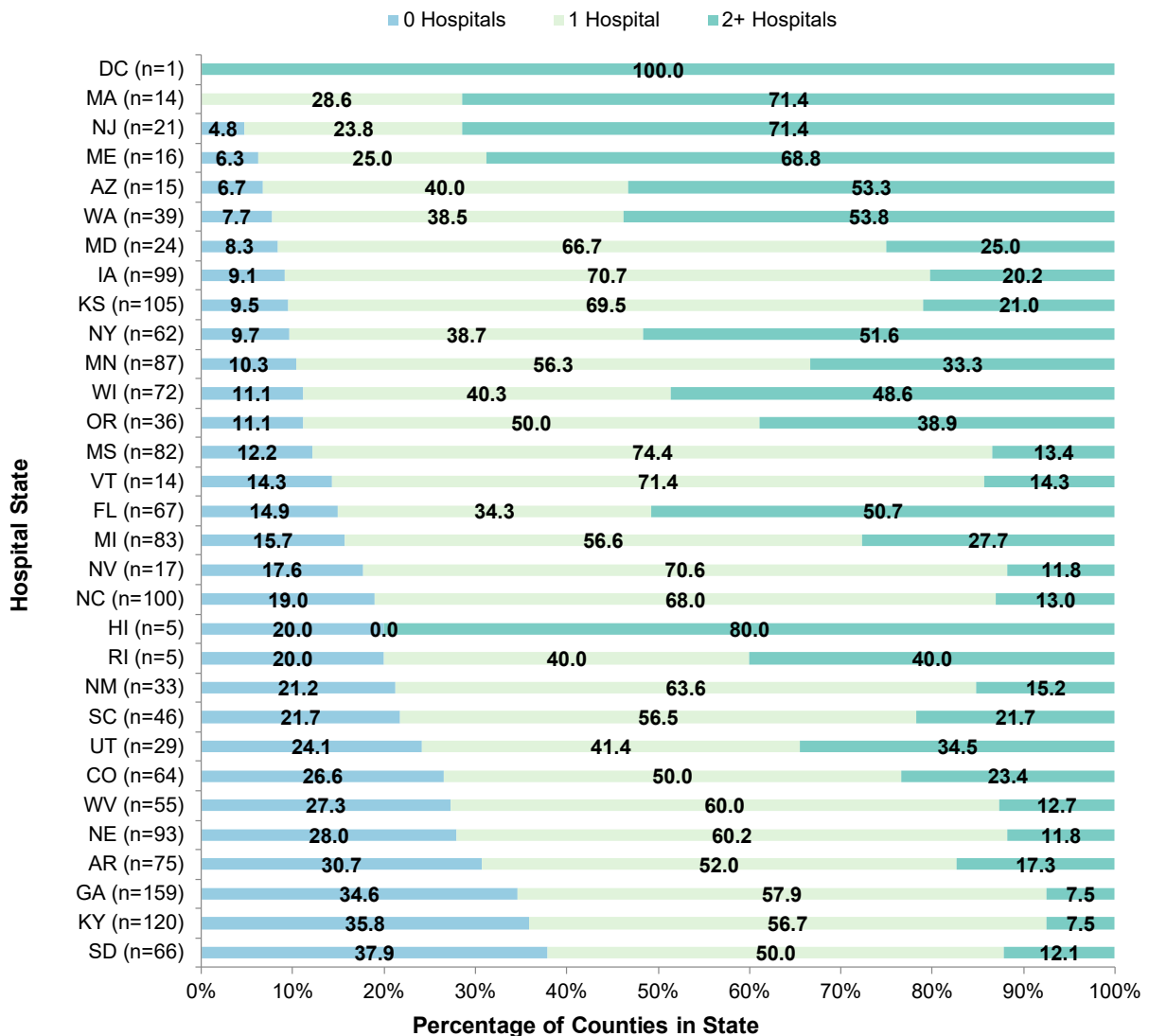
One data usage issue associated with analyses conducted using hospital county is that many counties have only one hospital. As such, reporting by hospital county would identify an individual hospital. As demonstrated in Figure 1, for all but 1 State and the District of Columbia, more than 20 percent of counties have only one hospital. For 19 States, 50 percent or more of counties have only one hospital. To maintain hospital confidentiality, values based on fewer than two hospitals must be suppressed. Alternatively, users may choose to combine counties for the purposes of reporting or to report values at the level of substate region.¹¹

⁹ This information was determined via correspondence with the AHA Resource Center on November 7, 2019.

¹⁰ For more information, visit HCUP-US: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project. HCUP Data Use Agreement Training. www.hcup-us.ahrq.gov/tech_assist/dua.jsp.

¹¹ See the substate region definitions provided by the Substance Abuse and Mental Health Services Administration (SAMHSA) National Survey on Drug Use and Health (NSDUH) for an example: <https://www.samhsa.gov/data/report/2014-2016-nsduh-substate-region-definitions>.

Figure 1. Percentage of Counties With No Hospitals, One Hospital, and Two or More Hospitals, by Hospital State, 2017



Source: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, State Inpatient Databases, 30 States and the District of Columbia, 2017.

5. OTHER CONSIDERATIONS FOR COUNTY-LEVEL ANALYSES

5.1 Partner-Specific Requirements for County-Level Aggregation

HCUP Partners have varying requirements for county-level aggregation as reported in Community-Level Statistics (CLS). For example, some Partners allow the reporting of their data in CLS at only the state and subregion level, not at the county level. For the most current information, reference the restrictions detailed in the Partner-Specific Requirements for Use of HCUP Data Documentation available on HCUP-US.¹²

¹² Partner-Specific Requirements are available under HCUP Partner Agreements on the HCUP-US website: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project. HCUP

5.2 Merging HCUP Data With Other County-Level Data

When merging HCUP data with other data sources at the county level, users should be aware that some data sources use modified FIPS county codes—or codes that aggregate information for certain sets of counties. For example, the AHA Annual Survey combines independent cities with the surrounding county (e.g., Baltimore City would be included in Baltimore county instead of identified with a separate FIPS county code). Another example is the Bureau of Economic Analysis (BEA), which uses unique modification codes to represent combined areas (i.e., multiple counties or counties and independent cities).¹³ In these cases, aggregation of HCUP data may be required prior to merging.

5.3 Longitudinal Analyses

HCUP users conducting longitudinal analyses at the county level should be aware of changes to FIPS codes for counties or county-equivalent entities (e.g., independent cities) over time. These changes are made for several reasons, including the renaming of an existing county, a status change for an existing county (e.g., change to town status), or the creation of a new county. Table 6 summarizes FIPS county code changes that apply to HCUP data (i.e., at least one HCUP database included data for the county's State at the time of the code change).¹⁴ If a code change occurred during the study period, it is recommended that researchers check the relevant FIPS codes within all datasets to ascertain whether any recoding is needed to maintain consistent county coding across data years.

Partner Agreements. www.hcup-us.ahrq.gov/team/recruit/moas_duas.jsp. Reference the Partner-Specific Requirements by Requirements and the requirement subcategory of Community-Level Statistics. Login is required.

¹³ See the following for a detailed list of BEA modifications: Bureau of Economic Analysis. Component Counties by State. apps.bea.gov/regional/docs/statelist.cfm.

¹⁴ For a comprehensive review of all changes to counties or county-equivalent entities, see the following: U.S. Census Bureau. Substantial Changes to Counties and County Equivalent Entities: 1970-Present. www.census.gov/programs-surveys/geography/technical-documentation/county-changes.html.

Table 6. FIPS County Code Changes Applicable to HCUP Databases

State	Date of Change	Name Prior to Change	FIPS Code Prior to Change	New County Name	New County FIPS Code	Additional Information
Alaska	July 1, 2015	Wade Hampton Census Area	02270	Kusilvak Census Area	02158	Wade Hampton Census Area, Alaska, was renamed as Kusilvak Census Area, and the county code changed.
Colorado	November 15, 2001	Adams, Boulder, Jefferson, and Weld Counties	08001, 08013, 08059, 08123	Broomfield County	08014	Broomfield County was created out of parts of Adams, Boulder, Jefferson, and Weld Counties. ^a
Florida	November 13, 1997	Dade County	12025	Miami-Dade County	12086	Dade county was renamed as Miami-Dade County.
South Dakota	May 1, 2015	Shannon County	46113	Oglala Lakota County	46102	Shannon County was renamed to Oglala Lakota County.
Virginia	July 1, 2001	Clifton Forge City	51560	Alleghany County	51005	The independent city of Clifton Forge changed to town status and was merged into Alleghany County.
Virginia	July 1, 2013	Bedford City	51515	Bedford County	51019	Bedford (independent) City was changed to town status and added to Bedford County.

Abbreviation: FIPS, Federal Information Processing Standards.

^a The prior counties and their respective FIPS county codes still existed after the creation of Broomfield County. According to Wikipedia, Boulder County lost about 40,000 residents to Broomfield County in 2001 (https://en.wikipedia.org/wiki/Boulder_County,_Colorado). The estimated 2002 population for Broomfield County was about 42,000 (<https://www.area-codes.com/county/co-broomfield.asp>). This suggests that most of Broomfield's population came from Boulder County. Depending on the goals of a given analysis, researchers may consider combining Broomfield and Boulder Counties for analyses that include data years before and after this change.

Source: U.S. Census Bureau. Substantial Changes to Counties and County Equivalent Entities: 1970-Present. <https://www.census.gov/programs-surveys/geography/technical-documentation/county-changes.html>. Accessed December 9, 2019.

6. CONCLUSIONS

HCUP State databases provide researchers with the necessary information to conduct county-level analyses using either patient county or hospital county. County-level analyses can be very

informative, but understanding the source of this information and the methods used to assign the information, as well as the associated limitations, is important. For example, counties assigned using the ZIP Code may not always be a patient's true county of residence. Researchers also should consider several methodological and data usage issues when conducting county-level analyses. For analyses using data aggregated by patient county, a single patient county may include many hospitals where patients are treated. For analyses using data aggregated by hospital county, some counties do not have any hospitals. Additionally, county-level information from HCUP and county-level information from other sources may use different coding schemes (i.e., FIPS vs. modified FIPS), and some FIPS county codes have changed over time. Finally, county-level results based on HCUP data must not inadvertently identify a single hospital.

APPENDIX A. HCUP PARTNERS

HCUP would not be possible without the contributions of the following data collection Partners from across the United States.

Alaska Department of Health and Social Services
Alaska State Hospital and Nursing Home Association
Arizona Department of Health Services
Arkansas Department of Health
California Office of Statewide Health Planning and Development
Colorado Hospital Association
Connecticut Hospital Association
Delaware Division of Public Health
District of Columbia Hospital Association
Florida Agency for Health Care Administration
Georgia Hospital Association
Hawaii Health Information Corporation
Illinois Department of Public Health
Indiana Hospital Association
Iowa Hospital Association
Kansas Hospital Association
Kentucky Cabinet for Health and Family Services
Louisiana Department of Health
Maine Health Data Organization
Maryland Health Services Cost Review Commission
Massachusetts Center for Health Information and Analysis
Michigan Health & Hospital Association
Minnesota Hospital Association
Mississippi State Department of Health
Missouri Hospital Industry Data Institute
Montana Hospital Association
Nebraska Hospital Association
Nevada Department of Health and Human Services
New Hampshire Department of Health & Human Services
New Jersey Department of Health
New Mexico Department of Health
New York State Department of Health
North Carolina Department of Health and Human Services
North Dakota (data provided by the Minnesota Hospital Association)
Ohio Hospital Association
Oklahoma State Department of Health
Oregon Association of Hospitals and Health Systems
Oregon Office of Health Analytics
Pennsylvania Health Care Cost Containment Council
Rhode Island Department of Health
South Carolina Revenue and Fiscal Affairs Office
South Dakota Association of Healthcare Organizations
Tennessee Hospital Association
Texas Department of State Health Services
Utah Department of Health
Vermont Association of Hospitals and Health Systems

Virginia Health Information
Washington State Department of Health
West Virginia Department of Health and Human Resources, West Virginia Health Care Authority
Wisconsin Department of Health Services
Wyoming Hospital Association

APPENDIX B. ASSIGNMENT OF COUNTY FOR COMBINED 2017 STATE INPATIENT DATABASES RECORDS USING GEOGRAPHIC CENTROID (FROM SAS) VERSUS POPULATION CENTROID (FROM CLARITAS), BY PATIENT STATE

Patient State Assigned From ZIP After Pooling 2017 SID	Same County Assigned			Different Counties Assigned			Only Assigned by Geographic Centroid (from SAS)			Only Assigned by Population Centroid (from Claritas)			No County Assigned by Either Approach			Grand Total
	No.	Row %	Col. %	No.	Row %	Col. %	No.	Row %	Col. %	No.	Row %	Col. %	No.	Row %	Col. %	
Overall	33,722,926	97.7	100.0	213,904	0.6	100.0	406,638	1.2	100.0	116	0.0	100.0	12,592	0.0	100.0	34,512,123
None	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	12,592	7.5	100.0	168,539
HCUP State																
Arizona	631,326	97.0	1.9	3,184	0.5	1.5	16,084	2.5	4.0	0	0.0	0.0	0	0.0	0.0	650,594
Arkansas	374,991	97.8	1.1	1,333	0.3	0.6	6,928	1.8	1.7	0	0.0	0.0	0	0.0	0.0	383,252
Colorado	443,000	96.2	1.3	10,955	2.4	5.1	6,675	1.4	1.6	0	0.0	0.0	0	0.0	0.0	460,630
DC	78,828	99.6	0.2	*	*	*	339	0.4	0.1	0	0.0	0.0	0	0.0	0.0	79,171
Florida	2,624,813	98.7	7.8	4,864	0.2	2.3	30,772	1.2	7.6	0	0.0	0.0	0	0.0	0.0	2,660,449
Georgia	1,034,753	98.2	3.1	9,916	0.9	4.6	9,449	0.9	2.3	0	0.0	0.0	0	0.0	0.0	1,054,118
Hawaii	108,947	97.9	0.3	0	0.0	0.0	2,340	2.1	0.6	*	*	*	0	0.0	0.0	111,288
Iowa	345,990	98.2	1.0	3,931	1.1	1.8	2,575	0.7	0.6	0	0.0	0.0	0	0.0	0.0	352,496
Kansas	315,412	99.3	0.9	731	0.2	0.3	1,542	0.5	0.4	0	0.0	0.0	0	0.0	0.0	317,685
Kentucky	568,069	98.3	1.7	1,924	0.3	0.9	7,938	1.4	2.0	0	0.0	0.0	0	0.0	0.0	577,931
Maine	138,067	98.3	0.4	0	0.0	0.0	2,454	1.7	0.6	*	*	*	0	0.0	0.0	140,522
Maryland	624,533	98.7	1.9	4,995	0.8	2.3	2,995	0.5	0.7	0	0.0	0.0	0	0.0	0.0	632,523
Massachusetts	757,831	98.8	2.2	1,392	0.2	0.7	7,606	1.0	1.9	0	0.0	0.0	0	0.0	0.0	766,829
Michigan	1,227,793	98.8	3.6	8,962	0.7	4.2	5,558	0.4	1.4	0	0.0	0.0	0	0.0	0.0	1,242,313
Minnesota	584,644	99.0	1.7	2,959	0.5	1.4	2,804	0.5	0.7	0	0.0	0.0	0	0.0	0.0	590,407
Mississippi	368,809	95.8	1.1	9,597	2.5	4.5	6,542	1.7	1.6	0	0.0	0.0	0	0.0	0.0	384,948
Nebraska	198,815	99.3	0.6	64	0.0	0.0	1,372	0.7	0.3	0	0.0	0.0	0	0.0	0.0	200,251
Nevada	305,522	98.0	0.9	385	0.1	0.2	5,746	1.8	1.4	0	0.0	0.0	0	0.0	0.0	311,653
New Jersey	980,807	99.2	2.9	1,930	0.2	0.9	5,949	0.6	1.5	0	0.0	0.0	0	0.0	0.0	988,686
New Mexico	190,498	93.0	0.6	2,365	1.2	1.1	12,044	5.9	3.0	0	0.0	0.0	0	0.0	0.0	204,907
New York	2,317,494	99.1	6.9	6,574	0.3	3.1	13,589	0.6	3.3	0	0.0	0.0	0	0.0	0.0	2,337,657
North Carolina	1,044,746	97.2	3.1	13,873	1.3	6.5	16,213	1.5	4.0	0	0.0	0.0	0	0.0	0.0	1,074,832
Oregon	361,688	99.1	1.1	65	0.0	0.0	3,364	0.9	0.8	*	*	*	0	0.0	0.0	365,118

Patient State Assigned From ZIP After Pooling 2017 SID	Same County Assigned			Different Counties Assigned			Only Assigned by Geographic Centroid (from SAS)			Only Assigned by Population Centroid (from Claritas)			No County Assigned by Either Approach			Grand Total
	No.	Row %	Col. %	No.			No.	Row %	Col. %	No.	Row %	Col. %	No.	Row %	Col. %	
Rhode Island	122,260	99.5	0.4	34	0.0	0.0	538	0.4	0.1	0	0.0	0.0	0	0.0	0.0	122,832
South Carolina	550,810	97.5	1.6	6,658	1.2	3.1	7,475	1.3	1.8	0	0.0	0.0	0	0.0	0.0	564,943
South Dakota	96,383	97.9	0.3	233	0.2	0.1	1,793	1.8	0.4	0	0.0	0.0	0	0.0	0.0	98,409
Utah	253,002	97.7	0.8	*	*	*	6,082	2.3	1.5	*	*	*	0	0.0	0.0	259,090
Vermont	48,060	96.5	0.1	517	1.0	0.2	1,222	2.5	0.3	0	0.0	0.0	0	0.0	0.0	49,799
Washington	633,806	98.3	1.9	767	0.1	0.4	9,900	1.5	2.4	0	0.0	0.0	0	0.0	0.0	644,473
West Virginia	241,261	93.2	0.7	3,426	1.3	1.6	14,305	5.5	3.5	0	0.0	0.0	0	0.0	0.0	258,992
Wisconsin	572,201	98.4	1.7	5,926	1.0	2.8	3,502	0.6	0.9	0	0.0	0.0	0	0.0	0.0	581,629

Abbreviation: SID, State Inpatient Databases.

Note: An additional 155,947 records (0.5% of records overall and 92.5% of records not assigned to a State), county could not be assigned for one of several reasons: the record was missing ZIP Code (29,902 records), the ZIP Code indicated that the patient was foreign (43,303), the ZIP Code indicated that the patient was homeless (80,622 records), or the ZIP Code was nonnumeric (2,120 records). These counts are factored into the grand total for the "overall" and "none" rows in the table.

* Cell counts less than 11 are suppressed.

Source: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, State Inpatient Databases, 47 States and the District of Columbia, 2017.

APPENDIX C. MISSINGNESS OF ZIP DATA ELEMENT IN 2017 STATE INPATIENT DATABASES, BY HOSPITAL STATE

Hospital State	2017 SID			2017 SEDD		
	Total Records	No. Missing ZIP	% Missing ZIP	Total Records	No. Missing ZIP	% Missing ZIP
Total	34,512,123	29,870	0.1	98,154,465	374,437	0.4
Minimum	41,837	0	0.0	181,290	0	0.0
Average	719,003	679	0.1	2,583,012	10,120	0.2
Maximum	3,698,493	6,319	0.3	12,868,014	211,447	2.6
Arizona	654,479	2,160	0.3	2,128,694	9,317	0.4
Arkansas	367,936	47	0.0	1,234,046	169	0.0
Colorado	476,054	1,122	0.2	n/a	n/a	n/a
DC	129,346	125	0.1	n/a	n/a	n/a
Florida	2,734,194	6,319	0.2	8,882,417	25,479	0.3
Georgia	1,056,464	797	0.1	4,259,266	3,957	0.1
Hawaii	113,012	205	0.2	n/a	n/a	n/a
Iowa	340,611	21	0.0	1,160,766	187	0.0
Kansas	320,595	193	0.1	980,593	1,148	0.1
Kentucky	567,160	154	0.0	2,108,888	934	0.0
Maine	139,031	14	0.0	579,327	329	0.1
Maryland	601,202	487	0.1	2,057,899	2,216	0.1
Massachusetts	804,148	529	0.1	2,451,337	63,057	2.6
Michigan	1,217,423	521	0.0	n/a	n/a	n/a
Minnesota	603,471	0	0.0	1,721,431	0	0.0
Mississippi	371,467	70	0.0	n/a	n/a	n/a
Nebraska	206,174	0	0.0	500,652	0	0.0
Nevada	321,015	242	0.1	1,072,015	2,323	0.2
New Jersey	935,695	*	*	3,111,755	137	0.0
New Mexico	187,077	34	0.0	n/a	n/a	n/a
New York	2,347,150	2,072	0.1	6,927,258	16,804	0.2
North Carolina	1,091,234	96	0.0	4,308,935	1,180	0.0
Oregon	375,941	98	0.0	1,359,932	536	0.0
Rhode Island	124,174	47	0.0	409,021	409	0.1
South Carolina	532,729	61	0.0	2,250,942	599	0.0
South Dakota	105,924	*	*	n/a	n/a	n/a
Utah	275,720	340	0.1	741,540	1,352	0.2
Vermont	53,630	*	*	234,893	39	0.0
Washington	642,603	128	0.0	n/a	n/a	n/a
West Virginia	248,091	0	0.0	n/a	n/a	n/a
Wisconsin	571,189	213	0.0	1,953,339	1,061	0.1

Abbreviations: n/a, not applicable; SEDD, State Emergency Department Databases; SID, State Inpatient Databases.

Note: The analysis was limited to community hospitals, excluding rehabilitation and long-term acute care facilities. As indicated by "n/a", 2017 SEDD are not available for all HCUP States.

Sources: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, State Inpatient Databases, 47 States and the District of Columbia, 2017; Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, State Emergency Department Databases, 37 States and the District of Columbia, 2017.

APPENDIX D. DIAGNOSIS CODES DEFINING DELIVERIES

Type of Code	Code	Description
Indicators of Delivery		
ICD-10-CM	Z37	Outcome of delivery
ICD-10-CM	O80	Encounter for full-term uncomplicated delivery
ICD-10-CM	O82	Encounter for cesarean delivery without indication
DRG	765	Cesarean section with complicating conditions/major complicating conditions
DRG	766	Cesarean section without complicating conditions/major complicating conditions
DRG	767	Vaginal delivery with sterilization and/or dilation and curettage
DRG	768	Vaginal delivery with operating room procedure except for sterilization and/or dilation and curettage
DRG	774	Vaginal delivery with complicating diagnoses
DRG	775	Vaginal delivery without complicating diagnoses
ICD-10-PCS	10D00Z	Extraction of products of conception, open approach
ICD-10-PCS	10D07Z	Extraction of products of conception, via natural or artificial opening
ICD-10-PCS	10E0XZZ	Extraction of products of conception, external approach
Excluded: Abortive Outcomes		
ICD-10-CM	O00	Ectopic pregnancy
ICD-10-CM	O01	Hydatidiform mole
ICD-10-CM	O02	Other abnormal products of conception
ICD-10-CM	O03	Spontaneous abortion
ICD-10-CM	O04	Complications following (induced) termination of pregnancy
ICD-10-CM	O07	Failed attempted termination of pregnancy
ICD-10-CM	O08	Complications following ectopic and molar pregnancy
ICD-10-PCS	10A0	Abortion of products of conception
ICD-10-PCS	10D17ZZ	Extraction of products of conception, retained, via natural or artificial opening
ICD-10-PCS	10D18ZZ	Extraction of products of conception, retained, via natural or artificial opening endoscopic

Abbreviations: DRG, diagnosis-related groups; ICD-10-CM/PCS, International Classification of Diseases, Tenth Revision, Clinical Modification/Procedure Coding System

Note: Records with any abortion codes were excluded.

APPENDIX E. FREQUENCIES OF COUNTIES WITH NO HOSPITALS, ONE HOSPITAL, AND TWO OR MORE HOSPITALS, BY HOSPITAL STATE, 2017

Hospital State	2017 State Inpatient Databases: Number of Counties						
	Total	With No Hospitals	With 1 Hospital	With 2 Hospitals	With 3–5 Hospitals	With 6–10 Hospitals	With 11+ Hospitals
Arizona	15	1	6	3	3	1	1
Arkansas	75	23	39	10	2	1	0
Colorado	64	17	32	6	9	0	0
DC	1	0	0	0	0	1	0
Florida	67	10	23	14	12	3	5
Georgia	159	55	92	6	5	1	0
Hawaii	5	1	0	1	1	2	0
Iowa	99	9	70	16	4	0	0
Kansas	105	10	73	18	3	1	0
Kentucky	120	43	68	6	2	1	0
Maine	16	1	4	7	4	0	0
Maryland	24	2	16	2	2	1	1
Massachusetts	14	0	4	2	4	2	2
Michigan	83	13	47	13	8	1	1
Minnesota	87	9	49	23	4	2	0
Mississippi	82	10	61	7	4	0	0
Nebraska	93	26	56	7	3	1	0
Nevada	17	3	12	0	1	0	1
New Jersey	21	1	5	4	9	2	0
New Mexico	33	7	21	4	0	1	0
New York	62	6	24	11	13	5	3
North Carolina	100	19	68	8	4	1	0
Oregon	36	4	18	7	6	1	0
Rhode Island	5	1	2	1	0	1	0
South Carolina	46	10	26	5	3	2	0
South Dakota	66	25	33	7	1	0	0
Utah	29	7	12	8	1	0	1
Vermont	14	2	10	2	0	0	0
Washington	39	3	15	11	8	1	1
West Virginia	55	15	33	6	1	0	0
Wisconsin	72	8	29	20	14	0	1

Source: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project, State Inpatient Databases, 30 States and the District of Columbia, 2017.