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PROJECT TITLE:
Hospital Beds in Colorado



Description of Review

Team Health reviewed online resources to inform the data mining and visualization project. The resources are evaluated from the lenses of the hypothesis that there are not enough hospitals and hospital beds in the state of Colorado. Colorado ranks comparably lower in hospital bed count to other states in the country (Hospital, 2020). The research related to this topic aims at defining the current issue of hospital bed shortage in the state, during times where hospitals are in greater need, as well as preparing for future needs of the state's population. A portion of the research related to this topic focuses on the idea that Colorado has a growing senior population. In 2020, about 18% of the Colorado population is represented by seniors (Age 65+) (Colorado, 2020). As a result, the likelihood of hospitalizations per 1000 people increases with an aging population. In addition to an aging population, there are many rural counties in the state that, while are small in population, have a high number of senior citizens and no hospitals (The, 2016). Finally, in light of the Covid-19 pandemic, there is concern that Colorado does not have a sufficient number of hospital beds (specifically ICU beds) to handle an outbreak (Vaughan, 2020).

Research

According to data from the Kaiser Family Foundation (1999-2018), Colorado has 1.9 hospital beds per 1000. This is lower than the national average of 2.4. The variation from the national mean is explained by the difference in non-profit hospital ownership. The state has the same number of private hospitals per 1000 people at .4 and .1 more in government owned hospitals, but lags in non-profit hospitals by a significant .6 per 1000 people (Hospital, 2020).

Colorado is comprised of 64 counties, 24 of which are considered rural and 23 are considered frontier (The, 2019). Rural counties are defined as counties that do not have any cities over 50,000 people and frontier counties are defined as counties that have a population density of 6 or fewer residents per square mile (Snapshot, 2019). In Colorado all frontier counties are also rural. Colorado Rural Health Center's most recent report found that 13 of Colorado's 47 rural counties do not have hospitals (Snapshot, 2019). Because of this, and the average EMS transport time for dispatch calls from scene to hospital arrival time is 34.1 minutes in rural Colorado compared to 23.3 in urban (Snapshot, 2019). Another concern for rural counties is the growing population of seniors. The report found that while only 13% of Colorado's population live in rural counties, 17% of Colorado's population aged 65-84 and 40% of the population over 80 live in rural areas (The, 2016). This information is important to consider because as a person ages, their chances of needing hospitalization at some point also increases. The Healthcare Cost and Utilization Project performed an analysis on the rate of inpatient stays per 100,000 by age group from 2000-2015. The data revealed that individuals ages 65 and older have the highest rate of inpatient stays in comparison to all other age groups. Ages 45-64 had approximately 11,000 inpatient stays per 100,000 through the 16 years, while ages 65 and older had approximately 30,000 inpatient stays per 100,000, which is over double. Age ranges 18-44 and under 18 were significantly lower in inpatient stays compared to the older age groups (Sun, Karaca, & Wong, 2018).

In light of the Corona Virus Pandemic, there is growing concern for the number of hospital beds (specifically ICU beds) in Colorado. Journalist Kevin Vaughan of 9NEWS interviewed health professionals and looked at an analysis of Colorado Hospital Association data from 2018. His findings were that "Nearly 300,000 Coloradans live in counties with no intensive

care hospital beds” (Vaughan, 2020). The author writes, “A 2019 analysis published by CHI showed only one Colorado county – San Miguel in the southwest corner of the state – with none of its land within a 45-minute drive of a hospital”. He continues, “Even so, vast sections of many rural counties are a farther drive” (Vaughan, 2020). Twenty counties in Colorado have hospitals but no ICU bed. Vaughan says, “Combined those 37 counties had a population of 299,883 in 2018 – roughly 5% of the state’s population that year of 5.6 million” (Vaughan, 2020). Not only does the lack of hospital beds in rural counties bring down the state average of hospital beds, but also rural communities are at risk of not having proper intensive care.

KUNC reports that the infection rate of COVID-19 is going to lead to a lack of hospital beds and other medical supplies in parts of Colorado. The data, from the Colorado Department of Public Health and Education (CDPHE), shows that the most infections and therefore the highest need for hospitals beds are generally correlated with the highest population counties. Based on population and hospital bed estimates, if 20% of the population were to contract the disease, the hospitals would have to run at 120% capacity, overwhelming hospital resources. (Yoanna, 2020)

Methods

Data for “Colorado County Population” was sourced from the United States Census Bureau. They are estimates based on population growth from 2010 to 2018, projecting the county level population of Colorado for 2019. The data that was used was cleansed for use by Cubit. The data was trimmed to be just the county level data for 2017 instead of the full dataset for a nine-year span.

Data for “US Population and Beds” and “Colorado Population and Beds” was retrieved from a 1999 - 2018 AHA Annual Survey performed by Health Forum, LLC, an affiliate of the American Hospital Association. The beds per 1000 people ratios found in this data set are based on annual population estimates made by the United States Census Bureau. The average beds per 1000 people metric found in “US Population and Beds” represents an average of all 50 states. This was found by computing the mean of all 50 states for each year displayed.

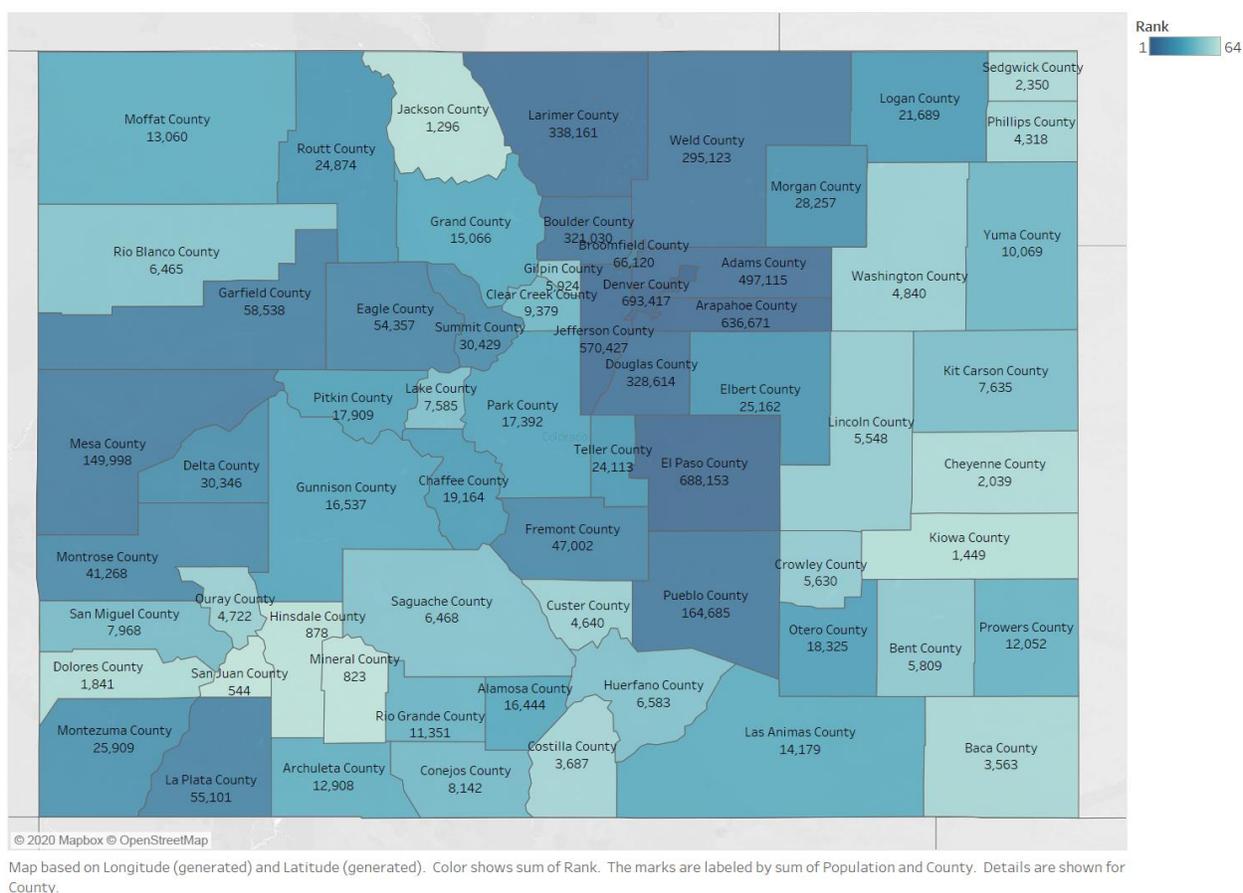
After comparing the hospital count per county population, the team narrowed down the analysis to the hospital bed count by county to more accurately assess the state’s need for additional beds. A data set was obtained from the Colorado Hospital Association that included all Colorado hospitals from 2017 and their licensed bed count. Then, each hospital address was searched to find its corresponding county, which was entered manually into the spreadsheet. A few hospital bed counts were 0, which caused room for concern. For any hospital bed counts at 0, additional research was performed to obtain the correct bed count for the most accurate results. This comparison gives a more detailed analysis of the hospital bed count shortage in the state because the number of hospitals is not a direct indicator of the number of beds since all hospitals in the state vary in size (1999-2018).

The team then compared Colorado county population in 2017 to the hospital bed count in 2017. First, the data set was retrieved from the Colorado Data Marketplace that projected Colorado county populations from 1990-2040. The data was filtered to only include population projections for 2017. Then, the total population column for each county was added together to get the total overall population for each county. An additional column was added into the spreadsheet to include total hospital bed count. To calculate the ratio, total hospital bed count was divided by total population per county (Dola, 2019).

Visualizations and Explanations

In the “Colorado County Population” choropleth, the population by county in 2017 is shown. As expected, the Denver Metro Area is the more densely populated part of the choropleth. 2017 was chosen so that a relevant comparison could be made to other data sets from 2017.

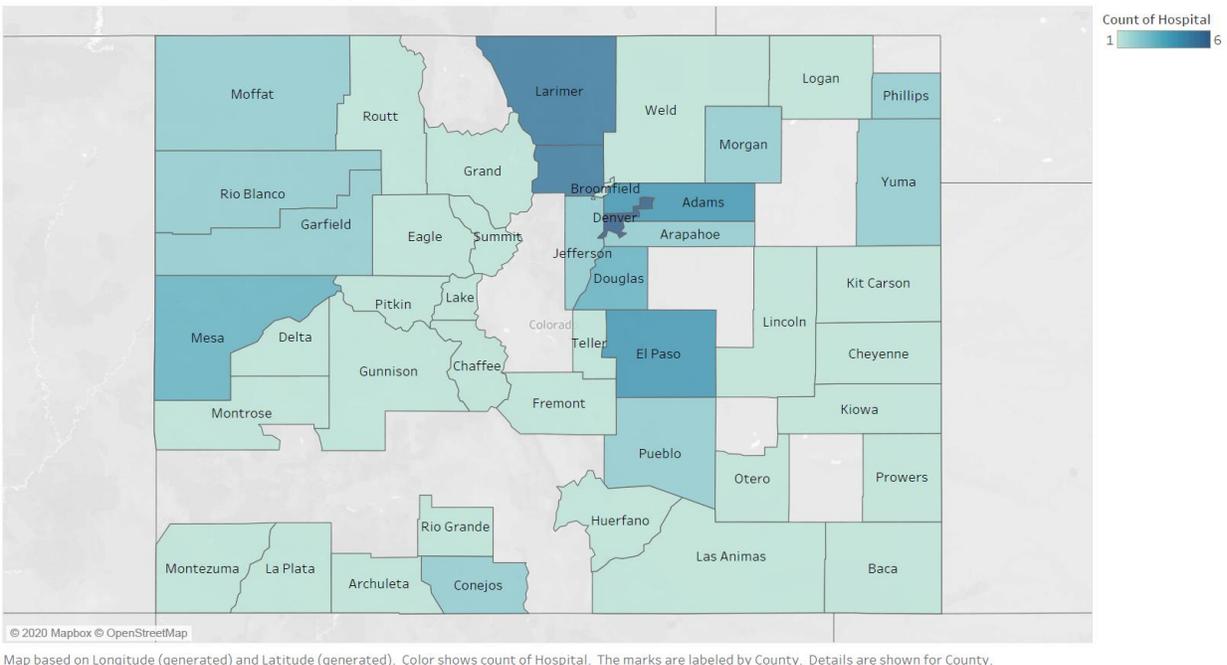
Colorado County Population



This is to be used in conjunction with the “Hospitals Per County” choropleth to analyze where more hospitals are needed. The need for hospital beds is shown in the graph “Hospital Beds per 1000 People by County”. These choropleths show that frequency of people and hospital beds are correlated and give a good basis to understand the other graphs.

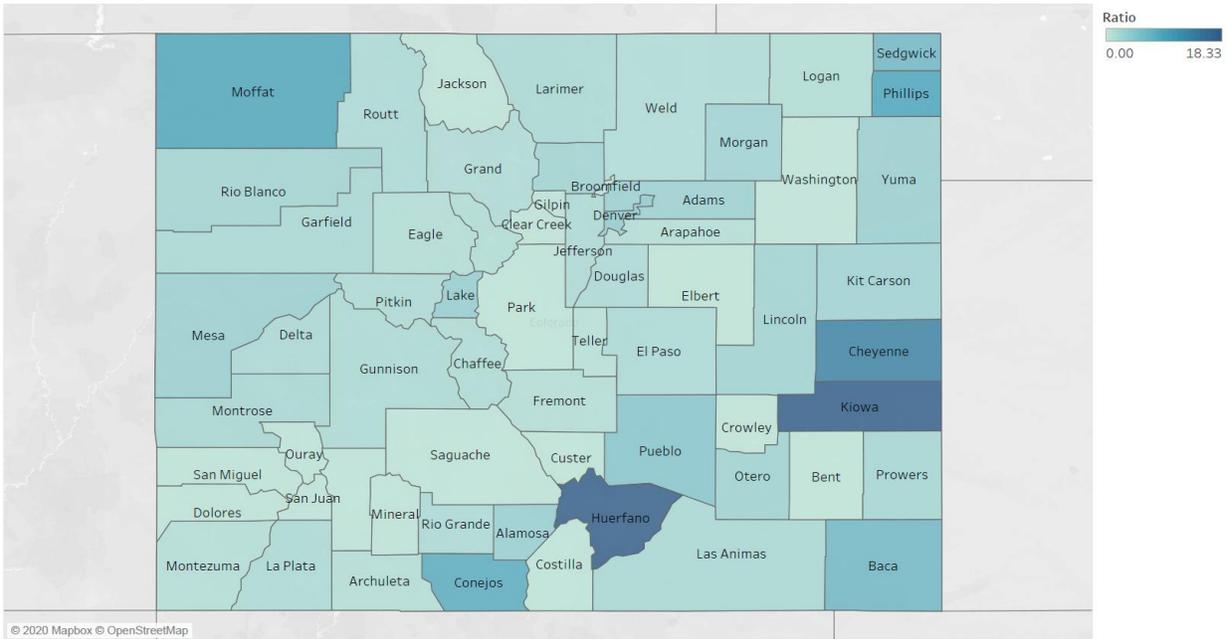
The hospital bed count per county reveals that as of 2017, there are 16 counties in the state of Colorado that do not have hospitals. In rural areas of the state, this makes it increasingly difficult for individuals to seek hospitalization when necessary due to its distance. However, it is important to consider factors such as population count and proximity to other counties with hospitals when analyzing whether the resources to build a hospital are necessary.

Number of Hospitals Per County (2017)



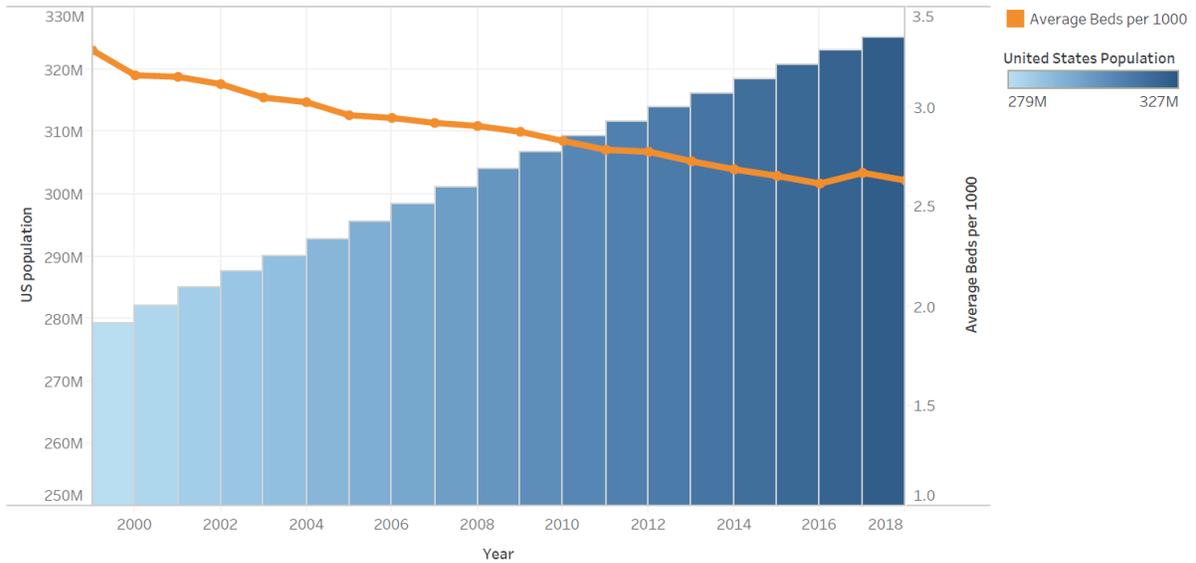
A combination of county population and hospital bed count data from the year 2017 were used to determine the ratio of hospital beds per 1,000 people per county. The visualization shows that most counties in the state of Colorado have under 2.4 beds per 1,000 people per county (1999-2018). Specifically, large counties such as Arapahoe county has a population of roughly 700,000 people and a ratio of .9 beds per 1000. This becomes an issue when analyzing surrounding counties who also have lower ratios because these counties don't have the capacity to manage those from surrounding counties in addition to their own population (Colorado, 2020).

Hospital Bed Count per 1,000



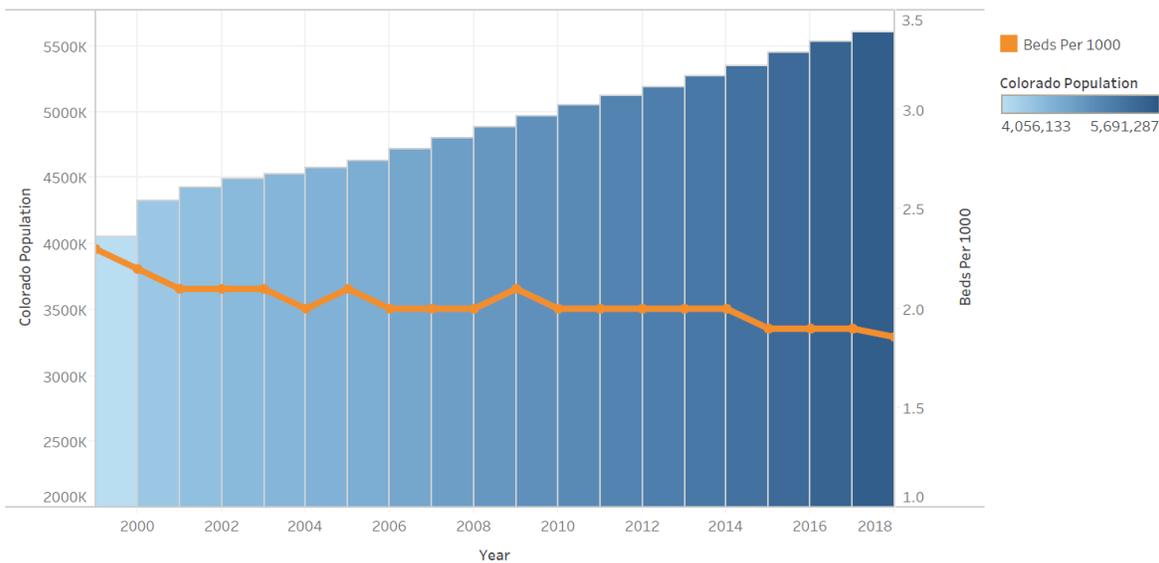
Both graphs, “US Population and Beds” and “Colorado Population and Beds”, give a 19-year historical timeline of the amount of hospital beds per thousand people. “US Population and Beds” compares the increase in total US population with the change in the 50-state average (sum of “number of beds per thousand” for each state divided by 50) number of beds per thousand people. “Colorado Population and Beds” compares the increase in Colorado’s population with the change in number of beds per thousand people. The purpose of these graphs is to analyze the trend in Colorado’s hospital bed ratio and compare it to the national average (Hospital, 2020). Although Colorado does have a hospital bed ratio that is historically 30% less than the national average, the trend line appears to be flatter than the national average. This means that the national average hospital beds per 1000 ratio is falling faster than Colorado’s.

United States Population and Average Hospital Beds per 1000 people



The trends of sum of US population and Average Beds per 1000 for Year. For pane Sum of US population: Color shows sum of US population. For pane Sum of Average Beds per 1000: Color shows details about Average Beds per 1000.

Colorado Population and Hospital Beds per 1000 People



The trends of sum of Colorado Population and Beds Per 1000 for Year. For pane Sum of Colorado Population: Color shows sum of Colorado Population. For pane Sum of Beds Per 1000: Color shows details about Beds Per 1000.

In conclusion, the data supports the claim that Colorado indeed does have a much lower hospital bed per 1000 people ratio than the national average. The analysis confirms that 16 counties do not have hospitals with licensed hospital beds and vast majority of these are rural counties. The following counties are large in population and have significantly lower bed ratios

than the state average: Arapahoe County, Broomfield County, and Fremont County.

Additionally, these large counties are surrounded by others with a hospital bed ratio per 1,000 people per county that is less than 1.5, which is much lower than the national average. This raises concern for the state of Colorado as a whole and its ability to provide an optimal amount of hospital beds for its residents. However, there are many other factors that need to be taken into consideration before determining where hospitals are needed in the state such as age of county population, proximity to surrounding counties with excess hospital beds, and other socioeconomic factors.

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