

Nonprofit Hospitals and Climate-Sensitive Hazards: A Content Analysis of Community Health
Needs Assessments in High-Risk United States Counties

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Abstract

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Aim: This study aims to examine the extent to which nonprofit hospitals describe climate-sensitive hazards in their community health needs assessments (CHNAs).

Background: Climate change is a pressing public health problem that calls for supportive programming tailored to communities. Nonprofit hospitals are uniquely positioned as medical anchor institutions to support their communities as climate-sensitive hazard risk increases through federally mandated CHNAs and community benefit investments.

Design: We performed a content analysis of nonprofit hospital CHNAs in United States counties determined to have Very High Risk of natural hazard impacts, as determined by the National Risk Index (NRI). We assessed what climate-sensitive hazards are included in CHNAs and how

they are described, including whether they are identified as a priority health need, which has been shown to indicate greater hospital investment in implementations to address the health need. Following content analysis, hospital and community characteristics were compared to assess for differences between hospitals that did and did not include climate-sensitive hazards as a priority health need.

Results: In a sample of 168 hospitals, the majority (85.1%) describe at least one climate-sensitive hazard in their CHNA. However, few (11.9%) consider these climate-sensitive hazards a priority health need of their community. Air pollution is the most commonly described climate-sensitive hazard (61.3%). Hospital and community characteristics did not differ between hospitals that did and did not indicate climate-sensitive hazards as a priority health need, with one exception: hospitals that included climate-sensitive hazards as a priority health need were located in counties with lower poverty rates.

Conclusion: In conclusion, our study suggests that while most hospitals in counties with Very High Risk of natural hazards mention at least one climate-sensitive hazard in their CHNAs, few consider them a priority health need of their community. Further research is needed to examine the national distribution of nonprofit hospitals' inclusion of climate-sensitive hazards in CHNAs and implementation strategies, as well as to understand the barriers and facilitators for hospital leadership in describing climate-sensitive hazards as priority health needs in their communities.

Background

Climate change is a public health crisis

Climate change is a pressing public health crisis.^{1,2} In the United States, climate-sensitive hazards are predicted to increase in frequency and severity, with major implications for human health, including higher rates of pulmonary, cardiovascular, renal, and neurological disease.²⁻⁴ A hazard is defined as “the potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.”² Changes in climate impact the frequency and severity of climate-sensitive hazards, which include hydrometeorological hazards and infectious, chemical, and other hazards whose frequency, severity, and exposure likelihood are substantially affected by climate. Heat waves are an example of a climate-sensitive hazard. Due to changes in climate, heat waves in the United States are rising significantly in number, length, and intensity.^{5,6} Wildfires are another example of a climate-sensitive hazard as they are influenced by the hydrologic cycle and temperature.⁷ Climate change has contributed to increased wildfire season length and additional burned area in the United States.^{8,9}

The Intergovernmental Panel on Climate Change’s (IPCC) conceptual framework provides a basis for describing risk of adverse impacts from climate-sensitive hazards.² Risk is composed of a population’s vulnerability factors, hazards, and exposure to those hazards (Fig. 1). Just as the hazard component is influenced by anthropogenic climate change, the vulnerability and exposure components are influenced by socioeconomic processes like adaptation and mitigation efforts. Every community experiences different levels of risk based on its unique combination of climate-sensitive hazards, vulnerability, and exposure.¹⁰ Thus, climate resilience strategies tailored to each community and iteratively evaluated and adjusted are needed.^{10,11}

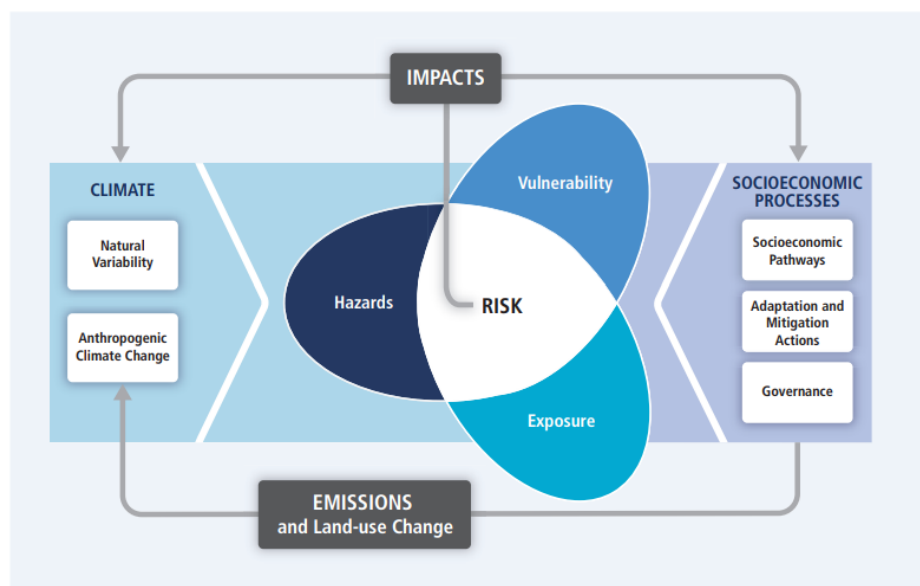


Figure 1. Intergovernmental Panel on Climate Change’s conceptual model defining risk as a function of vulnerability, hazards, and exposure influenced by climate change and adaptation and mitigation activities

Nonprofits as anchor institutions and community benefit

Nonprofit hospitals are uniquely positioned to support climate resilience efforts through community benefit work.^{12–14} Hospitals are often considered anchor institutions: large, place-based organizations with significant economic and cultural impacts on their communities and “a commitment to consciously apply their resources to better the long-term welfare of the communities in which the institution is anchored.”^{12–}

14

Between their role as anchor institutions and the benefits of a federal tax-exempt status, nonprofit hospitals (hereafter referred to as hospitals) have layers of responsibility to provide community benefits outside clinical care. However, they have historically shown very little community-building investment.^{15,16} Following scrutiny of community benefit spending, the Internal Revenue Service (IRS) implemented additional requirements for hospitals as part of the Affordable Care Act (ACA).^{17,18} Hospitals must complete a community health needs assessment (CHNA) every three years and make it

widely available to maintain their tax-exempt status. In the CHNA, the hospital must describe the community it serves, the process and methods used for the assessment, data sources, a prioritized list of significant health needs affecting that community, and existing resources available to meet health needs.¹⁸ The IRS specifies that hospitals must also engage the community in the process and consider “environmental factors that influence health.”¹⁸ Following the CHNA, hospitals then choose actions to address priority health needs as an Implementation Strategy document.¹⁹

CHNAs have the potential to identify key community health priorities.²⁰ The Fourth National Climate Assessment urges climate action through existing policies like CHNA, claiming that a significant portion of climate risk can be addressed by integrating environmental health into established practices.⁷

Literature review: CHNA analyses

Hospitals employ a variety of methods to conduct and report their CHNAs and produce documents that vary widely in quality as a result.²¹ Hospitals generally use both primary and secondary data to support CHNA writing.²² However, data collection is not always inclusive, with a distinct lack of age representation.²²

Hospitals collaborate to write CHNAs at multiple organizational levels, including municipality and system-level collaborations.²³ Hospitals may also collaborate with local health departments to conduct CHNAs. Santos and colleagues found that nationally, 34% of hospitals collaborated on first-cycle CHNAs with local health departments.²⁴ Likewise, Beatty et al. found a first-cycle collaboration rate with local health departments in Missouri of 18%.²⁵

There is evidence of more effective community improvement investment when hospitals and local health departments collaborate. Hospitals that collaborated with local health departments had higher odds of including behavioral health needs in their CHNAs.²⁴ State laws requiring local health department collaboration on CHNAs were associated with increased community benefit spending.²⁶ Where local health departments and hospitals collaborated on implementation strategies with a priority on substance

use, there was a deceleration in the rate of drug-induced mortality of 8 deaths per 100,000 people.²⁷

Isehunwa and colleagues found that high levels of collaboration between local health departments and hospitals were associated with reduced age-adjusted years of potential life lost rates and reduced premature age-adjusted mortality rates.²⁸

The views of community members are an important contribution to CHNAs. Community responses can surface health needs that hospital leadership may not otherwise consider.²⁹ Most hospitals (89%) meet the ACA requirement that community input is included in the CHNA process.³⁰ However, they may not fully utilize it. While most hospitals met with community stakeholders, few engaged general community members.³¹ It has been shown that hospitals solicit community input in certain aspects of CHNAs, but the community is not meaningfully engaged throughout the process.³¹ One study found that community members identified substance use as a critical health need, but hospitals rarely included it in implementation plans.³² The disparity between the community identification of substance use as a health need and the lack of hospital investment to address it was attributed to a lack of resources, risk aversion, concern about hospital expertise, and stigma by hospital leadership.³²

Despite the requirement for evaluation in the community benefit improvement process, hospitals do not consistently evaluate their community benefit implementations. Yeager et al. report that evaluation measures were used in only half of a national sample of hospitals, even when a majority mentioned some type of evaluation process.³³ Where hospitals do evaluate their implementations, they most commonly report system use and rarely include social or health outcomes.^{30,33} Even so, the use of outcome indicators in CHNAs and implementation strategy evaluation increased over successive reporting cycles.³⁴

The alignment between identified significant health needs and hospitals' implementation strategies to address them varies across samples. In the first cycle of the community benefit process, many health needs that appeared frequently in CHNAs, like behavioral health, substance abuse, and social factors, were not addressed in implementation plans.³⁵ However, Franz and colleagues found that the inclusion of implementation strategies that targeted significant community health needs was higher over

successive cycles.³⁶ Santos et al. (2020) report that in a national sample, implementation strategies were well aligned with the top 10 most commonly identified priority health needs.²⁴

Several factors increase the alignment between identified significant health needs and chosen implementation strategies. Hospitals are more likely to invest in a health need if it is identified as the number one health priority.³⁶ Similarly, whether a social need was top-ranked is associated with inclusion in implementation strategy plans.³⁶ For example, Lindenfeld et al. found that implementation strategies targeting substance use disorder were associated with whether a hospital identified substance use disorder as a top three priority health need.³⁷ Additionally, greater alignment was seen when equity was used as a guiding theme for CHNAs.³⁸

Previous qualitative analyses of CHNAs have been conducted to assess awareness and response to select public health concerns. One study used content analysis to look for inclusion of health equity as a significant health need and found that all CHNAs included at least one equity term.³⁹ Another investigated the inclusion of people with disabilities and found that most hospitals generally reference disability, though without specific information.⁴⁰ Fischer et al. found that in the United States' most violent cities, 74% of CHNAs include violence-related terms and 32% identified violence as a priority health need.⁴¹

Substance use disorder (SUD) is a commonly investigated health concern in CHNAs. Singh et al. found that 70% of hospitals in urban areas with high opioid death rates included opioid use as a community health need.⁴² Across the United States, one-third of hospitals that identified opioid use as a priority health need did not take measures to address it in their community.⁴³ However, an analysis of the next cycle of CHNA found that a majority of hospitals observed included SUD in their implementation strategies.⁴⁴ Lindenfeld et al. similarly found that, while implementation strategies to address substance use disorder were found in only 44.7% of observed hospitals, this was an improved rate from the previous cycle of CHNA.³⁷

Analysis of CHNAs from children's hospitals is occasionally considered separately from adult-focused institutions. Children's hospitals are more likely to identify social needs than adult-serving

hospitals.^{45,46} Three-quarters of children's hospitals' implementation strategies target the broader community and not just pediatric patients.⁴⁶

Environmental health has been largely absent from prior studies of hospital community benefit investment. While not the focus of analysis, Bias et al. reported that air pollution was included as a community-identified health need but was not highlighted as a priority by hospital leadership.²⁹ Pennel et al. reported that priority health needs in CHNAs rarely include community conditions, including environmental conditions.⁴⁷ Finally, analysis of the first CHNAs published in Philadelphia after the implementation of the ACA reported that no hospital in the sample included air or water quality.⁴⁸ No prior study has evaluated the inclusion of climate-sensitive hazards in CHNAs.

Hospitals in the United States are required to conduct CHNAs every three years and outline implementation plans for priority health needs. There is evidence that many community needs, including environmental concerns, are not systematically addressed in the process but the extent to which these hospitals address climate-sensitive hazards is unknown. There is also evidence that prevalent concerns in a given community are often included, suggesting that climate-sensitive hazards might be addressed in the CHNAs of hospitals in areas with high exposure to climate-sensitive hazards.^{41,42}

Aims

This study has three aims:

1. Examine the extent to which hospitals in United States counties with Very High Risk for natural hazard impacts, as defined by the NRI, identify climate-sensitive hazards as a significant health need in their communities.
2. Describe how climate-sensitive hazards are characterized in CHNAs, including whether they are identified as priority health needs.
3. Compare hospital and community characteristics between hospitals that do and do not include climate-sensitive hazards as a priority health need.

- a. Hypothesis 1: The total hospital revenue, bed count, teaching hospital status, church affiliation status, and rate of community benefit spending between hospitals that do and do not include climate-sensitive hazards in their CHNA will be the same.^{21,37,42,44,49}
- b. Hypothesis 2: There will be a significant difference in county unemployment rate, county poverty rate, and Medicaid expansion state status between hospitals that do and do not include climate-sensitive hazards in their CHNA.^{38,42,42,43}

Methods

Study Design Description

We examined how hospitals describe climate-sensitive hazards as a community health need through content analysis of publicly available CHNA documents. A sample of United States hospitals in counties with high risk of climate-sensitive hazard impact was created using the Community Benefit Insight Database and the National Risk Index and compared to the national population of hospitals.^{50,51} Following a qualitative content analysis of CHNAs described below, hospital and community demographic metrics were compared to assess for differences between hospitals that did and did not include climate-sensitive hazards as a priority health need in their CHNAs (Fig. 2).

Data Sources and Collection Processes

The Community Benefit Insight Database (CBI) was created and maintained by Research Triangle Institute International (RTI International) and the Milken Institute School of Public Health at The George Washington University.⁵² It is an aggregation of publicly available data submitted by tax-exempt hospitals from all 50 states and the District of Columbia to the IRS, U.S. Census Bureau data, and Centers for Medicare and Medicaid Services data.⁵² This study uses the 2021 and 2022 CBI data. Fields used for sample determination include hospital ID number, name, street address, city, state, ZIP code, and

county. Fields used for statistical analysis include hospital bed count (n), total hospital revenue (dollars), community benefit spending rate as a percentage of total expenses (percent), teaching hospital status (yes/no), and church affiliation status (yes/no). Community variables of interest include poverty rate, defined as the percentage of persons in poverty at the county level; unemployment rate, defined as the percentage of individuals aged 16 years and older who are unemployed at the county level; and Medicaid expansion state status (yes/no), defined as whether a hospital is located in a state that has implemented the ACA Medicaid expansion, which covers adults with incomes up to 138% of the Federal Poverty Level.

The National Risk Index (NRI) is a dataset compiled and maintained by the United States Federal Emergency Management Agency (FEMA) which quantifies the risk of 18 natural hazards per county including: avalanche, coastal flooding, cold wave, drought, earthquake, hail, heat wave, hurricane, ice storm, landslide, lightning, riverine flooding, strong wind, tornado, tsunami, volcanic activity, wildfire, and winter weather.⁵⁰ This study utilizes the NRI Composite Score and county borders. The NRI Composite Score is a numeric indicator that quantifies risk of adverse impact based on geographic, natural hazard, and community characteristics.⁵⁰ A score over 99 is designated the highest tier of risk and termed “Very High Risk.” For this study, the NRI was accessed through ArcGIS Living Atlas. County borders for the NRI are based on 2021 U.S. Census data.⁵⁰

A list of all hospitals in the United States from the CBI database was geocoded using ArcGIS Pro version 3.30 and OpenStreetMap.⁵³ Duplicates and locations not geocoded were excluded from further analysis. Hospitals located within counties with an NRI “Very High Risk” Composite Score were selected to form the hospital sample group (n=200).

An internet search was conducted to collect the most recent CHNA for each sample hospital from January 2025 to March 2025. Hospitals for which a CHNA could not be found in PDF format were excluded from the sample (n=31). Hospitals were also excluded if their most recent CHNA publication date was earlier than 2019 (n=1). To confirm preliminary matches between CHNA document and hospital, multiple features, including the hospital name and address, were checked before data were extracted from CHNA.

Assessing the sample hospitals

In order to compare the sample hospitals in counties of Very High Risk to the national population of hospitals, counts, percentages, and bar charts of the categorical variables teaching hospital status, church affiliation status, and Medicaid expansion state status were calculated for the sample hospitals and the national population of hospitals. Likewise, the mean, standard deviation, median, interquartile range, and skewness of the continuous variables bed count, total hospital revenue, community benefit spending rate, poverty rate, and unemployment rate were calculated for both groups. Continuous variables with skewness >1 were transformed using natural logarithm to better approximate a normal distribution and meet the assumptions of the following statistical tests. Table of descriptive statistics, bar charts, and boxplots used to illustrate variable distribution can be found in the appendix.

We conducted one sample t-tests for the continuous variables unemployment rate and poverty rate to determine whether the mean of each variable for hospitals in Very High Risk counties was significantly different from the mean of the national hospital population assuming equal variance and normal distribution. Similarly, we conducted one sample t-tests for the transformed continuous variables total hospital revenue, bed count, and community benefit spending rate. We used chi-squared tests to determine if the frequency of the categorical variables Medicaid expansion state status, church affiliation status, and teaching hospital status was the same between hospitals in Very High Risk counties and the national population of hospitals. We used an alpha level of 0.05 for all statistical tests.

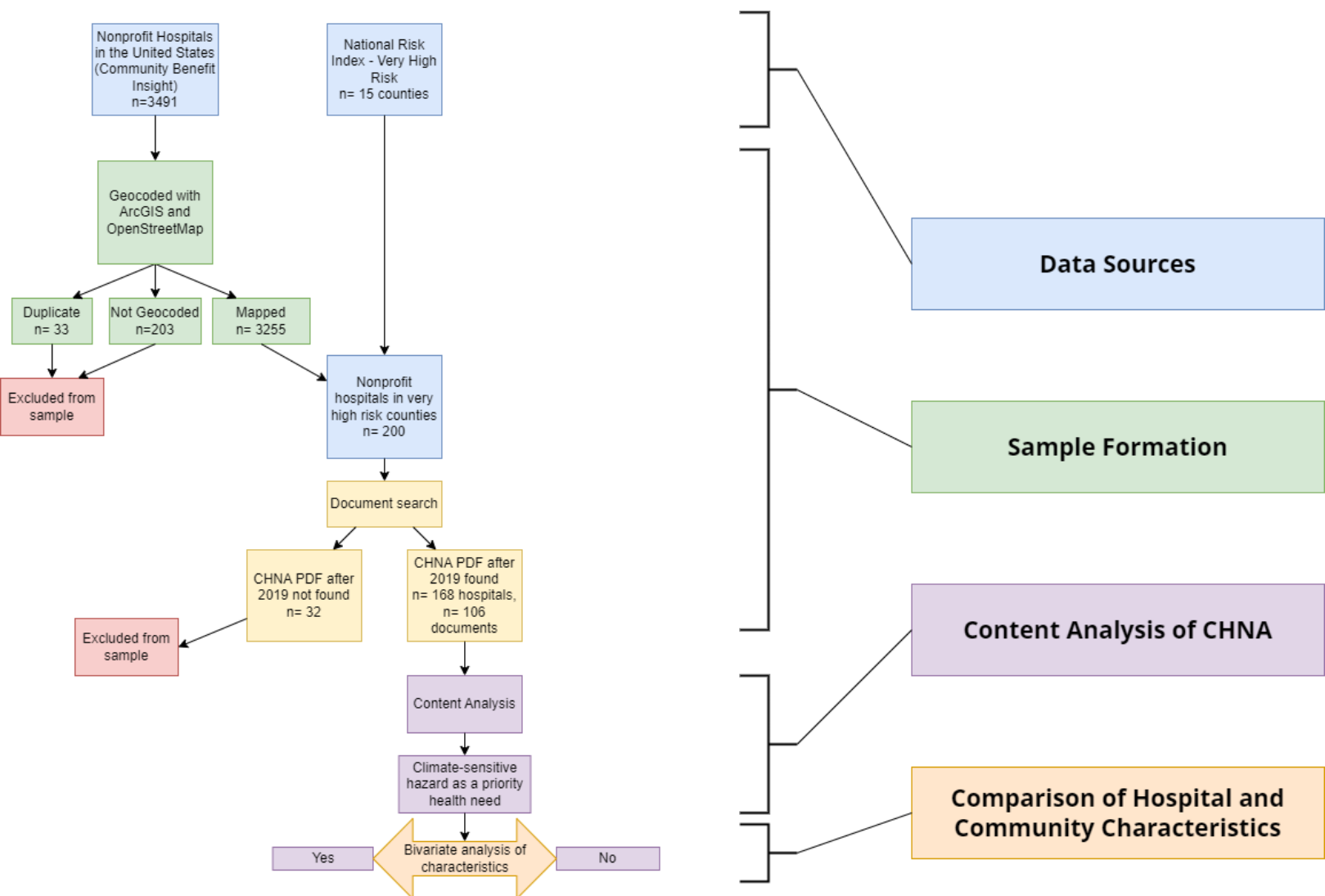


Figure 2. Approach showing data sources, sample formation, content analysis, and comparison of hospital and community characteristics.

Content Analysis

We utilized a combination of summative content analysis and policy document surveillance methods to extract data from CHNAs.^{54–56} Due to the length of the documents, we reviewed and coded select sections of each CHNA. A table of sections that were selected for review and coding can be found in the Appendix. For all CHNAs, we reviewed the section or sections that included a list of prioritized health needs. Additionally, we reviewed all sections titled “Environment,” “Climate,” “Air Pollution,” or “Air Quality.” To determine additional sections for review not titled as above, CHNAs were searched for 48 climate-sensitive hazard terms. The section of each instance of a climate-sensitive hazard term was also reviewed. A list of terms used for the document search can be found in the Appendix.

Codebook development included both deductive and inductive approaches. Deductive codes and code definitions were developed using the NRI. Then, 30 randomly selected CHNAs from the sample were read in their entirety. Information relevant to the research aims identified through this data familiarization process was used to develop additional inductive codes and code definitions. The codebook can be found in the supplementary materials.

Selected sections of each CHNA were read, and codes systematically applied using ATLAS.ti (Version 25.0.1.32924). Approximately ten percent of CHNAs were coded by one investigator (R.C) and coded material reviewed by a second investigator (J.H.) (2). The remainder of the CHNAs were coded by R.C. Any disagreements or uncertainty in coding were addressed through discussion, with consensus decisions recorded in ATLAS.ti memos and updates to code definitions reflected in the codebook.

Coding questions with binary or categorical answers based on coded text were developed to translate qualitative data to continuous data for analysis (Fig. 3).^{55,56} Where CHNAs included more than one hospital, answers to coding questions were applied to each hospital covered by the CHNA, given that the document serves to meet a legal compliance requirement for each. Answers to coding questions were kept in a Microsoft Excel Spreadsheet Version 2504.

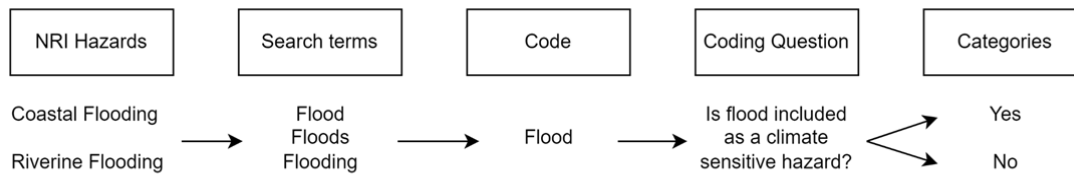


Figure 3. Example of code and coding question development

Statistical Analysis

Descriptive statistics were calculated for answers to coding questions. We calculated the count and percent of hospitals that included any description of a climate-sensitive hazard, and whether climate-sensitive hazards are included as a priority health need. We also determined count and percent of each climate-sensitive hazard and related term individually included by hospitals in their CHNA, stratified by whether climate-sensitive hazards were included as a priority health need.

Counts, percentages, and bar charts of the categorical variables teaching hospital status, church affiliation status, and Medicaid expansion status were calculated overall and stratified by whether a climate-sensitive hazard was identified as a priority health need. The mean, standard deviation, median, IQR, range, and skewness of the continuous variables bed count, total hospital revenue, community benefit spending rate, poverty rate, and unemployment rate were calculated overall and stratified by whether a climate-sensitive hazard was identified as a priority health need. Continuous variables with skewness >1 were transformed using natural logarithm to better approximate a normal distribution and meet assumptions of the following statistical tests. Boxplots were used to illustrate continuous variables and can be found in the appendix.

We conducted 2-sample t-tests for the continuous variables poverty rate and unemployment rate by whether a climate-sensitive hazard was identified as a priority health need assuming equal variance and normal distribution. We conducted two sample t-tests for transformed variables total hospital revenue, bed count, and community benefit spending rate by whether a climate-sensitive hazard was identified as a priority health need. A Mann-Whitney test was conducted for church affiliation status,

teaching hospital status, and Medicaid expansion state status stratified by whether a climate-sensitive hazard was identified as a priority health need. An alpha level of 0.05 was used for all statistical tests. Descriptive and inferential statistics were calculated in R (Version 2024.12.0+467).

Human Subjects Protection

This study utilized publicly available documents and did not include human participants. Accordingly, institutional review board approval was not sought or obtained.

Results

Two hundred hospitals were identified in 15 Very High Risk counties as determined by the NRI (Fig. 4). Of these, 32 hospitals did not meet inclusion criteria (31 no PDF found, 1 older than 2019), resulting in a sample of 168 hospitals and 106 CHNAs. Fifteen CHNAs were in support of more than one hospital.

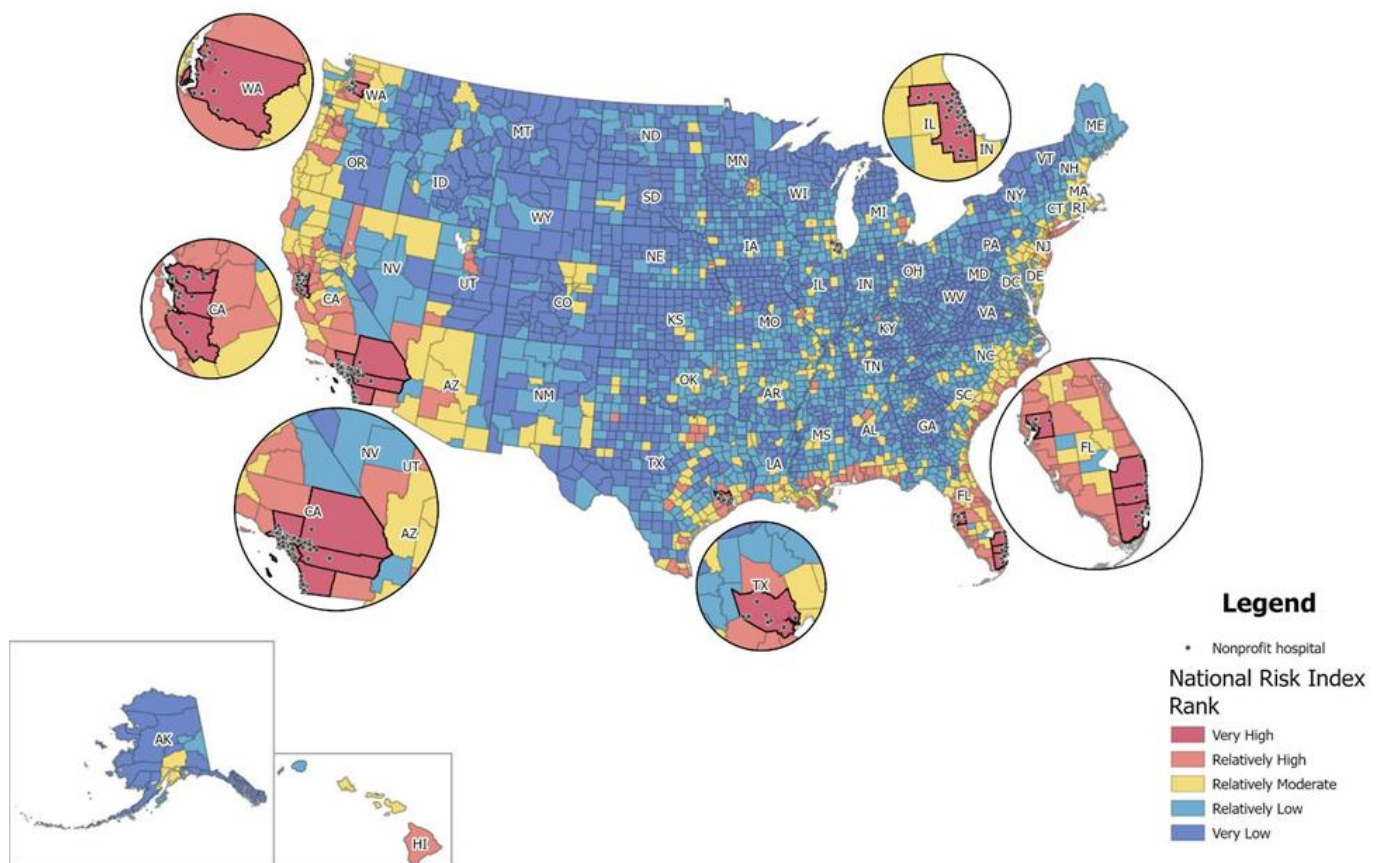


Figure 4. United States counties' risk of natural hazards, as determined by the NRI, and location of hospitals. Highlighted sections show a sample of hospitals in counties determined to be of highest risk, termed “Very High.”

Hospitals in counties of Very High Risk report higher total hospital revenue ($mean=4,989,160,037$, $SD=8,866,466,229$) than United States hospitals in general ($mean=211634,348$, $SD=4612419374$, $p<0.001$, Table 1). They also have higher bed count ($mean=343$, $SD=238$) than United States hospitals in general ($mean=203$, $SD=241$, $p<0.001$, Table 1). Hospitals in counties of Very High Risk do not differ from the national population of hospitals in community benefit spending rate ($p=0.11$, Table 1). Hospitals in counties of Very High Risk ($n=168$) had a higher proportion of church affiliated hospitals than the national population ($n=3,177$, $p=0.002$, Table 1). Similarly, sample hospitals had a higher proportion of Medicaid expansion state status ($p<0.001$, Table 1). Hospitals in counties of Very High Risk do not differ from the national population of hospitals in proportion of teaching hospitals ($p=0.15$, Table 1). Hospitals in counties of Very High Risk report higher unemployment rates ($mean=4.11$, $SD=0.93$) than United States hospitals in general ($mean=3.63$, $SD=1.04$, $p=0.002$, Table 1). Hospitals in counties of Very High Risk report lower poverty rates ($mean=12.28$, $SD=2.56$) than United States hospitals in general ($mean=13.3$, $SD=4.6$, $p<0.001$, Table 1).

Table 1. Characteristics of hospitals in United States counties with Very High Risk of climate-sensitive hazard impacts. Bolded characteristics indicate significant differences at the 95% confidence level.

Hospital Characteristic	Sample hospitals n=168	All hospitals n=3,177	p-value
Total Hospital Revenue, mean (SD)¹	\$4,989,160,037 (\$8,866,466,229)	2,116,342,348 (4,612,419,374)	<0.001
Bed Count, mean (SD)¹	343 (238)	203 (241)	<0.001
Total Community Benefit Spending Rate (as % of total revenue), mean (SD) ¹	9.2 (7.5)	9.5 (25.6)	0.11

Church Affiliation Status, n (%)²	26 (15.8%)	282 (8.9%)	0.002
Teaching Hospital, n (%) ²	61 (37.0%)	1,009 (31.8%)	0.15
Community Characteristic			
Medicaid Expansion State Status, n (%)²	136 (82.4%)	2,017 (63.5%)	<0.001
Unemployment Rate, mean (SD)¹	4.11 (0.93)	3.63 (1.04)	0.002
Poverty Rate, mean (SD)¹	12.28 (2.56)	13.3 (4.6)	<0.001
Location by County, n (%)			
Alameda, CA	10 (6.1%)		
Contra County CA	5 (3.0%)		
Los Angeles, CA	42 (25.4%)		
Orange, CA	11 (6.7%)		
Riverside, CA	4 (2.4%)		
San Bernardino, CA	7 (4.2%)		

San Diego, CA	11 (6.7%)
Santa Clara, CA	2 (1.2%)
Broward, FL	2 (1.2%)
Hillsborough, FL	5 (3.0%)
Miami-Dade, FL	8 (4.8%)
Palm Beach, FL	3 (1.8%)
Cook, IL	31 (18.8%)
Harris, TX	11 (6.7%)
King, WA	13 (7.9%)

¹ T-test

² Chi-squared test

Of the 168 hospitals, 85.1% include a description of climate-sensitive hazards. Eighty percent of hospitals specifically name at least one climate-sensitive hazard. The number of specific climate-sensitive hazards included in each CHNA ranged from zero (n=32, 19.0%) to six (n=16, 9.5%).

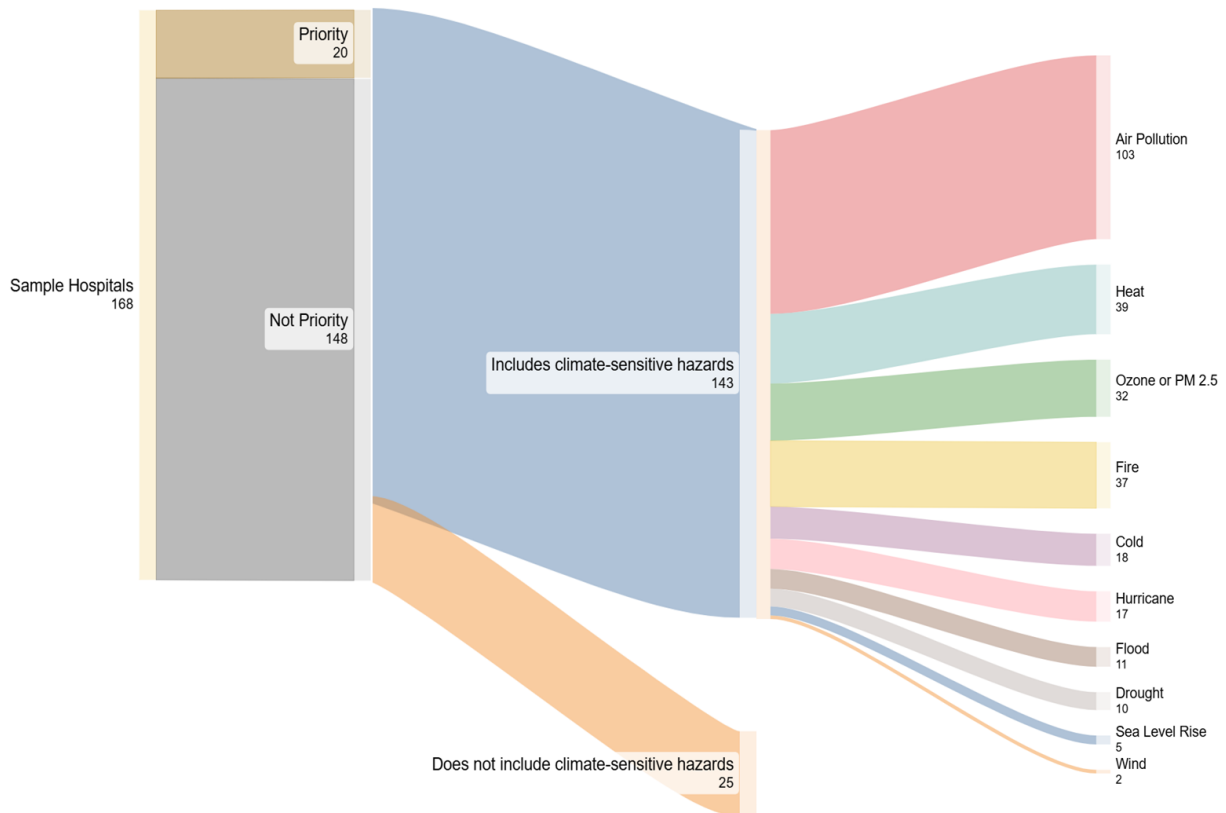


Figure 5. Hospitals that include climate-sensitive hazards as a priority health need, include descriptions of climate sensitive hazards, and specific hazards.

The most frequently described climate-sensitive hazard by hospitals was air pollution (61.3%)(Table 2, Fig. 6). However, only 13.1% of hospitals mentioning air pollution explicitly linked air pollution to the climate (Table 2). The second most frequently cited specific hazard was heat (23.2%), followed by wildfire (22.0%). Twenty-seven hospitals (43.5%) included ozone or particulate matter 2.5 (PM 2.5) measures. Infrequently described climate-sensitive hazards were cold (10.7%), hurricane (10.1%), flood (6.5%), drought (7.8%), sea level rise (3.0%), and wind (1%). Hail, cyclone, typhoon, ice, landslide, lightning, tornado, tsunami, and pollen were not included in any CHNA.

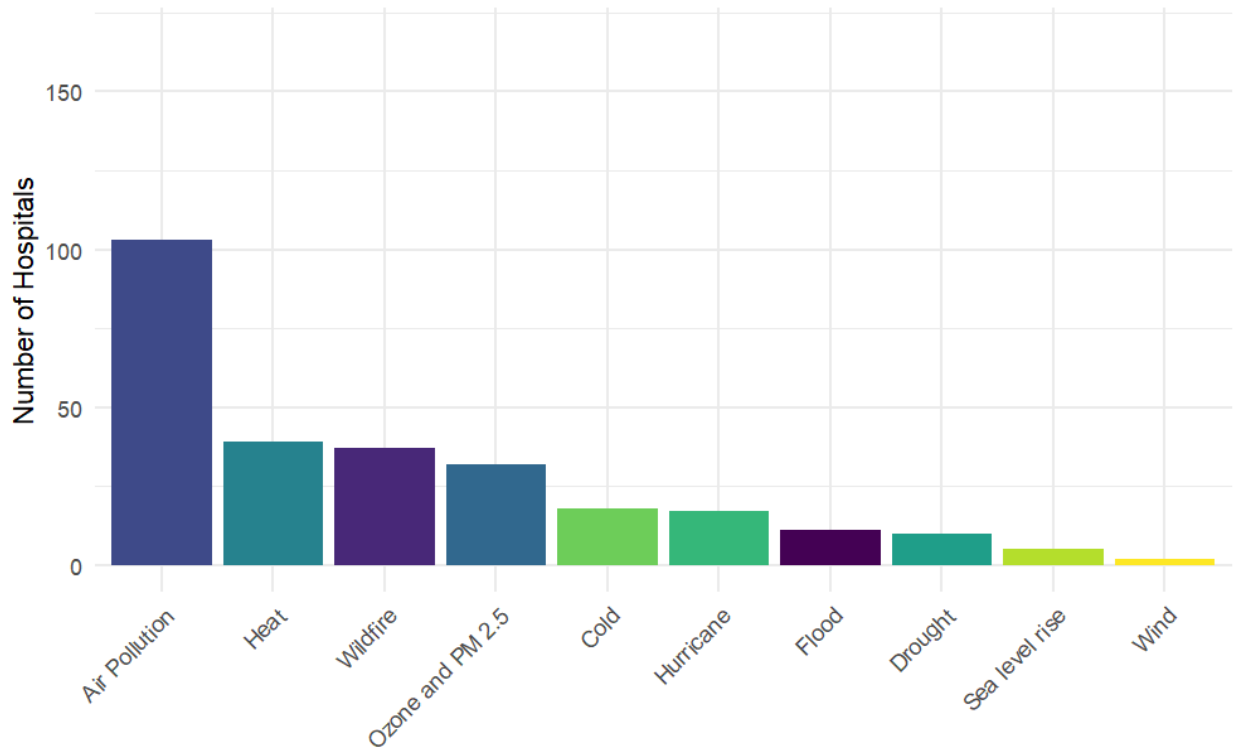


Figure 6. Frequency of specific climate-sensitive hazards included in hospital CHNAs.

Twenty (11.9%) of hospitals included climate-sensitive hazards as a priority health need. Among hospitals that identified climate-sensitive hazards as a priority health need, all (100%) included descriptions of air pollution, 19 included heat (95.0%), 13 included wildfire (65%), 11 included hurricane (55%) 10 included cold (50.0%), three included drought (15%), and two included wind (10%)(Table 2). The average number of specific hazards among hospitals that included a climate-sensitive hazard as a priority health need was 5. Among hospitals that did not prioritize climate-sensitive hazards, the average number of specific climate-sensitive hazards included was 1.

Table 2. Frequency of specific climate-sensitive hazards in hospital CNHAs stratified by whether a climate-sensitive hazard is identified as a priority health need.

Climate-sensitive hazard included as a priority health need			
Variable	Overall N = 168 ¹	No N = 148 ²	Yes N = 20 ²
Air Pollution	103 (61.3%)	83 (80.6%)	20 (19.4%)
Included, not explicitly climate-related	81 (48.2%)	73 (90.1%)	8 (9.9%)
Included, explicitly climate-related	22 (13.1%)	10 (45.4%)	12 (54.5%)
Heat	39 (23.2%)	20 (51.3%)	19 (49.7%)
Ozone or PM 2.5	32 (19.0%)	29 (90.6%)	3 (9.4%)
Wildfire	37 (22.0%)	24 (16.2%)	13 (65.0%)
Cold	18 (10.7%)	8 (44.4%)	10 (55.6%)
Hurricane	17 (10.1%)	6 (35.3%)	11 (64.7%)
Flood	11 (6.5%)	11 (100.0%)	0 (0.0%)
Drought	10 (6.0%)	7 (70.0%)	3 (30.0%)
Sea Level Rise	5 (3.0%)	5 (100.0%)	0 (0.0%)
Wind	2 (1.2%)	0 (0.0%)	2 (100.0%)

Hail	0 (0.0%)	0 (0.0%)	0 (0.0%)
Cyclone	0 (0.0%)	0 (0.0%)	0 (0.0%)
Typhoon	0 (0.0%)	0 (0.0%)	0 (0.0%)
Ice	0 (0.0%)	0 (0.0%)	0 (0.0%)
Landslide	0 (0.0%)	0 (0.0%)	0 (0.0%)
Lightning	0 (0.0%)	0 (0.0%)	0 (0.0%)
Tornado	0 (0.0%)	0 (0.0%)	0 (0.0%)
Tsunami	0 (0.0%)	0 (0.0%)	0 (0.0%)
Pollen	0 (0.0%)	0 (0.0%)	0 (0.0%)

¹ n (% of column)

² n (% of row)

The most frequently used climate-sensitive hazard-related terms were “disaster” (37.5%) and “climate” (35.7%)(Table 3, Fig. 7). Thirty-one percent of hospitals include “extreme” as applied to climate, 23.3% include “environmental justice,” and 1.8% include “storm.”

Among hospitals that identified climate-sensitive hazards as a priority health need, “climate” is included in 15 (75.0%), “extreme” in 15 (75.0%), “disaster” in 11 (55.0%), and “environmental justice” is included in 8 (40.0%) (Table 3).

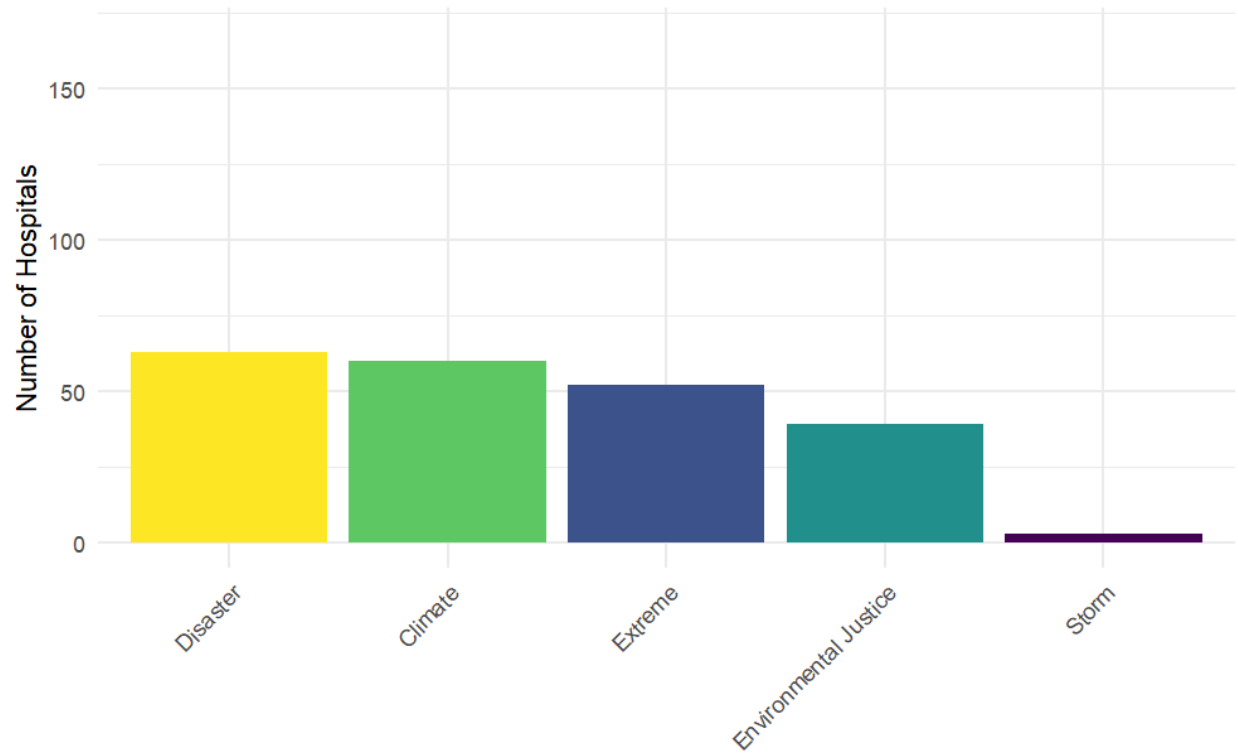


Figure 7. Frequency of climate-sensitive hazard-related terms included in hospitals' CHNAs.

Table 3. Frequency of climate-sensitive hazard-related terms included by hospitals in CHNAs stratified by whether climate-sensitive hazards are identified as a priority health need.

Variable	Climate-sensitive hazard included as a priority health need		
	Overall N = 168 ¹	No N = 148 ²	Yes N = 20 ³
Climate	60 (35.7%)	45 (75.0%)	15 (25.0%)
Disaster	63 (37.5%)	52 (82.5%)	11 (17.5%)

Environmental Justice	39 (23.2%)	31 (79.5%)	8 (20.5%)
Extreme	52 (31.0%)	37 (71.1%)	15 (28.8%)
Storm	3 (1.8%)	3 (100.0%)	0 (0.0%)
¹ n (% of column)			
² n (% of row)			

Climate-sensitive hazards were described in CHNAs in four main ways: narratively, using qualitative data; statistically, using quantitative data; as a description of an existing resource in the community that addresses climate-sensitive hazards; and as a quote or summary of a community member from hospital-solicited community input (Table 4).

Table 4. Description types used by hospitals to describe a climate-sensitive hazard in CHNAs.

Description Type	Example
Narrative	“Black, Indigenous, and people of color living in cities and rural communities and on tribal lands experience greater exposure to air pollution, extreme heat, and flooding.”
Statistic	“With changes to weather patterns, the threat of wildfires also increases. In Orange County, in 2023, there are 102,029 acres categorized as “Very High” fire hazard severity”
Community Resource Description	“Chief Heat Officer Expands, accelerates and coordinates efforts to protect people from heat; carves out strategies to address natural disasters and climate change issues such as sea-level rise in Miami-Dade County”
Community Member Input	“A participant from Snoqualmie Valley reported that during the June 2021 heat wave, the power went down in a major grocery store of their small town, and refrigerators stopped working.”

Hospitals that included a climate-sensitive hazard as a priority health need (n=20) were located in counties with lower poverty rates than those that did not (n=148, $p<0.05$, Table 5, Fig 8)). Hospitals that included a climate-sensitive hazard as a priority health need did not differ significantly in total hospital revenue ($p=0.08$), community benefit spending rate ($p=0.85$), bed count ($p=0.89$), church affiliation status ($p=0.50$), Medicaid expansion status ($p=0.13$), teaching hospital status ($p=0.62$), or unemployment rate ($p=12$) from hospitals that did not (Table 5, Appendix Fig. 8-11).

Table 5. Comparison of hospital and community characteristics between hospitals that did and did not include a climate-sensitive hazard as a priority health need. Bold indicates significance at the 95% confidence level.

Hospital Characteristic	Climate-sensitive hazard included as a priority health need		p-value
	No (n = 148)	Yes (n = 20)	
In Total Hospital Revenue, mean (SD)	21.01 (1.66)	21.80 (1.78)	0.081 ¹
In Bed Count mean (SD)	5.58 (0.80)	5.60 (0.86)	0.89 ¹
In Community Benefit Spending Rate (as % of total revenue) mean (SD)	2.89 (0.97)	2.86 (0.79)	0.85 ¹
Church Affiliation Status n (%)	22 (15.4%)	4 (18.2%)	0.50 ²
Teaching Hospital Status n (%)	53 (36.3%)	8 (42.1%)	0.62 ²

Community
characteristic

Medicaid Expansion State

Status	118 (80.8%)	18 (94.7%)	0.13 ²
n (%)			

Unemployment Rate	4.15 (0.92)	3.78 (0.94)	0.12 ¹
mean (SD)			

Poverty Rate	12.54 (2.47)	10.32 (2.44)	0.001 ¹
mean (SD)			

¹ Welch Two Sample t-test

² Mann-Whitney test

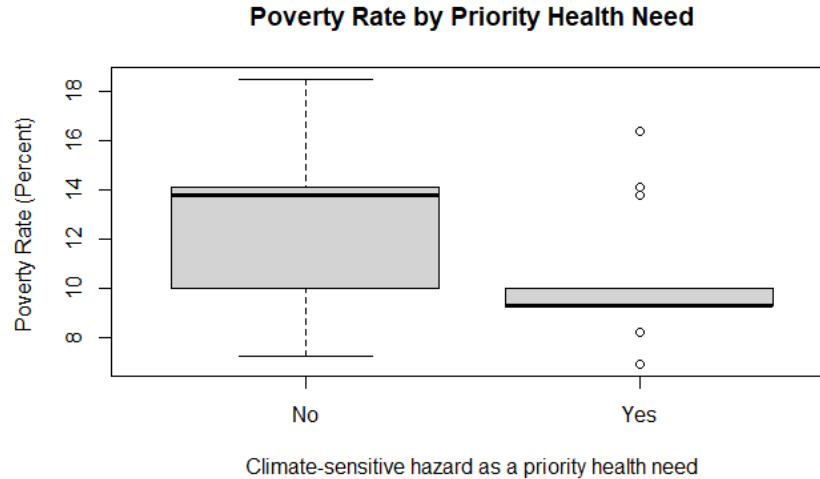


Figure 8. Poverty rate in percent stratified by whether a hospital included a climate-sensitive hazard as a priority health need.

Discussion

Climate-sensitive hazards pose an accelerating risk to human health, and there is a clear rationale for health systems to recognize this risk and consider risk management strategies as part of their broader community benefit activity. Prior work has found that community concerns prevalent in hospital service areas are frequently included in their CHNAs.^{24,39–42} However, our analysis of CHNAs done by hospitals in regions with high hazard exposure reveals that many climate-sensitive hazards are not included, except for air pollution.

The majority of hospitals include at least one instance of a climate-sensitive hazard. However, only about 12% of hospitals include climate-sensitive hazards as a priority health need. Whether a health need is identified as a priority is an indication of whether a hospital will invest in implementation strategies to address that health need in its community.^{36,37} Because few hospitals have indicated that climate-sensitive hazards are a priority health need for their community, the likelihood that hospitals will initiate implementation strategies to invest in them is also low. However, prior studies show that CHNA depth and quality improve over successive cycles.^{34,37} Further investigation into the barriers and enablers of hospital leadership in considering climate-sensitive hazards as a community health need is needed so that guidelines can be constructed to support inclusion.

The disparity between the rate of inclusion (85.1%) and the rate of prioritization (11.9%) of climate-sensitive hazards as a community health need may indicate a gap in the prioritization process. Powell et al. similarly found that few hospitals identified implementation strategies to address frequently identified community health needs, including behavioral health and social factors.³⁵ While a data-based approach to prioritization has been proposed, there is no standard for how hospital leadership assigns priority after identifying significant community health needs.⁵⁷ Standardization may assist hospitals in achieving greater alignment between the critical health needs of their community and those they choose to prioritize and subsequently invest in addressing.

Notably, approximately 30% of hospitals in our sample of hospitals with high hazard exposure do not contain any description of climate-sensitive hazards, and half of the specific hazards were absent from all CHNAs. This is of particular concern as our sample of hospitals are located in counties with the highest risk of natural hazards according to the NRI. Further research at the national level is needed to examine the inclusion of climate-sensitive hazards in CHNAs across the United States.

It should be noted that CHNAs are one of many hospital policy documents and cannot capture the full awareness and action of hospitals regarding the risk of climate-sensitive hazards. For example, hospitals are required to engage in preparedness activities under the Centers for Medicare & Medicaid Services (CMS) Emergency Preparedness Rule and the Joint Commission accreditation requirements.^{58,59} Hospitals may also adjust operations to promote sustainable health care practices in order to mitigate climate change impacts.^{60,61} However, given the nature of community benefit, nonprofit hospitals must also consider community-level health, in addition to sustainable operations or hospital emergency planning.

Air pollution is the most frequently included climate-sensitive hazard. This is likely due to two factors. First, air quality is the example given by the IRS when explaining that CHNAs must include descriptions of the environment.⁶² Second, data for air pollution, particularly monitoring for P.M. 2.5, is readily available for 98% of the United States population due to the Environmental Protection Agency's regulatory requirements.^{63,64} Where air pollution is described, it is infrequently explicitly linked to climate. This may be influenced by political stigma around using terms related to climate change in public policy documents or a lack of knowledge around the connection between air pollution and climate.

Characteristics of hospitals that do and do not identify climate-sensitive hazards as a priority health need do not differ, with one exception. Hospitals that include climate-sensitive hazards as a priority health need are located in counties with lower poverty rates. This finding is consistent with prior studies examining how hospitals report on their ability to conduct CHNAs and address specific health needs.^{43,65} Hospitals in counties with higher poverty rates more frequently reported being unable to address substance use as a community health need due to a lack of resources.^{43,65} Hospitals in communities with

higher rates of poverty may lack the resources to invest in the community benefit process, limiting their capacity to invest in examining the impact of climate-sensitive hazards in their communities. Hospitals may benefit from further guidelines and resources on quantifying and describing climate-sensitive hazards.

Limitations

This study has several limitations. The use of binary coding questions for the inclusion of each hazard means that we do not discriminate between hospitals that discuss a climate-sensitive hazard in depth and those that briefly mention it. This study describes the attention of hospitals to climate-sensitive hazards as a community health need, as captured in CHNAs. Hospitals may use other policies, like CMS required emergency preparedness plans, to describe their interface with climate-sensitive hazards.⁵⁸ There are no non-coastal counties in the sample due to the structure of the NRI composite indicator and the selection of a relatively high NRI score threshold for inclusion in the sample. This weights the inclusion of specific hazards observed in this study towards those frequently encountered in coastal counties.

Next Steps

This work prompts several questions that could be investigated through future work. Future investigations could evaluate a representative sample of all hospitals across the United States, including assessment of inclusion of implementation strategies, to describe awareness of and actions invested in addressing climate-sensitive hazards through community benefit work. Additionally, interviews could provide insight into the awareness, barriers, and enablers experienced by hospital leadership that influence the inclusion of climate-sensitive hazards or climate resilience in CHNAs and hospital-based community improvement programming.

Conclusion

In conclusion, our study suggests that while most hospitals in counties with Very High Risk of natural hazards mention at least one climate-sensitive hazard in their CHNAs, few consider them a priority health need of their community. We observed that 85.1% of hospitals included in our sample include climate-sensitive hazards in some capacity in their CHNAs. Air pollution was the most frequently included climate-sensitive hazard, although it was explicitly linked to climate in only 13.1% of hospitals. Few (11.9%) hospitals identified climate-sensitive hazards as a priority health need. Hospitals that included climate-sensitive hazards as a priority health need were located in counties with lower poverty rates. Further research is needed to examine the national distribution of hospitals' inclusion of climate-sensitive hazards in CHNAs, implementation strategies, and to understand the barriers and facilitators for hospital leadership in describing climate-sensitive hazards as priority health needs in their communities.

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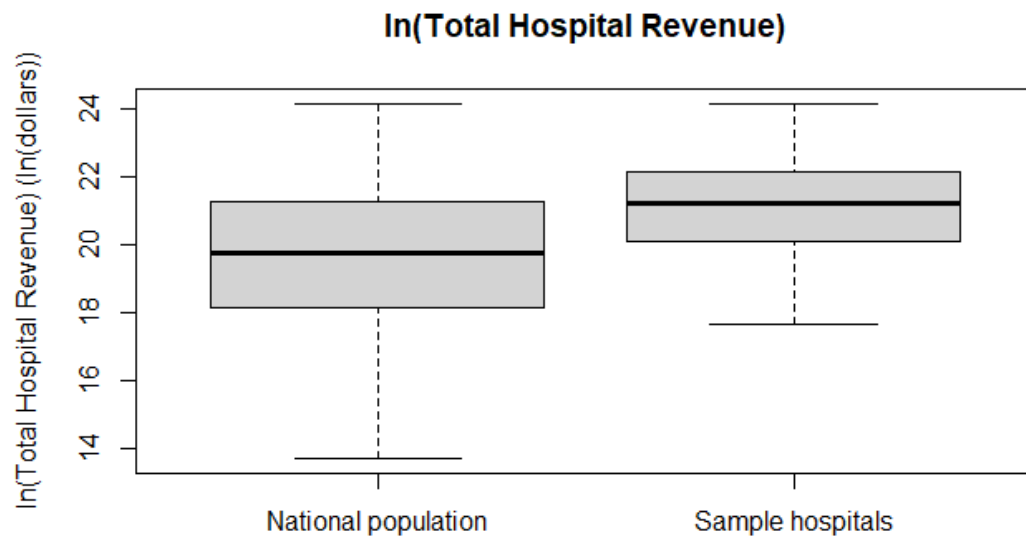
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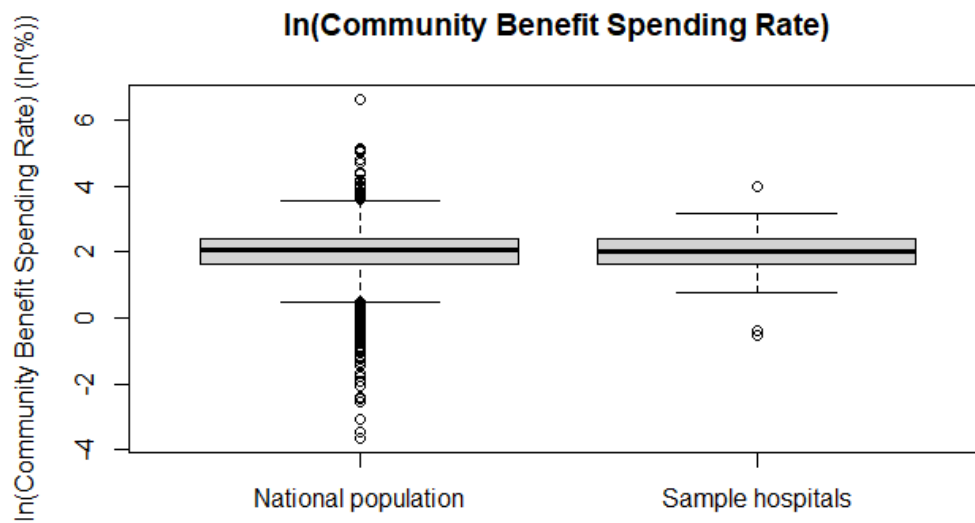
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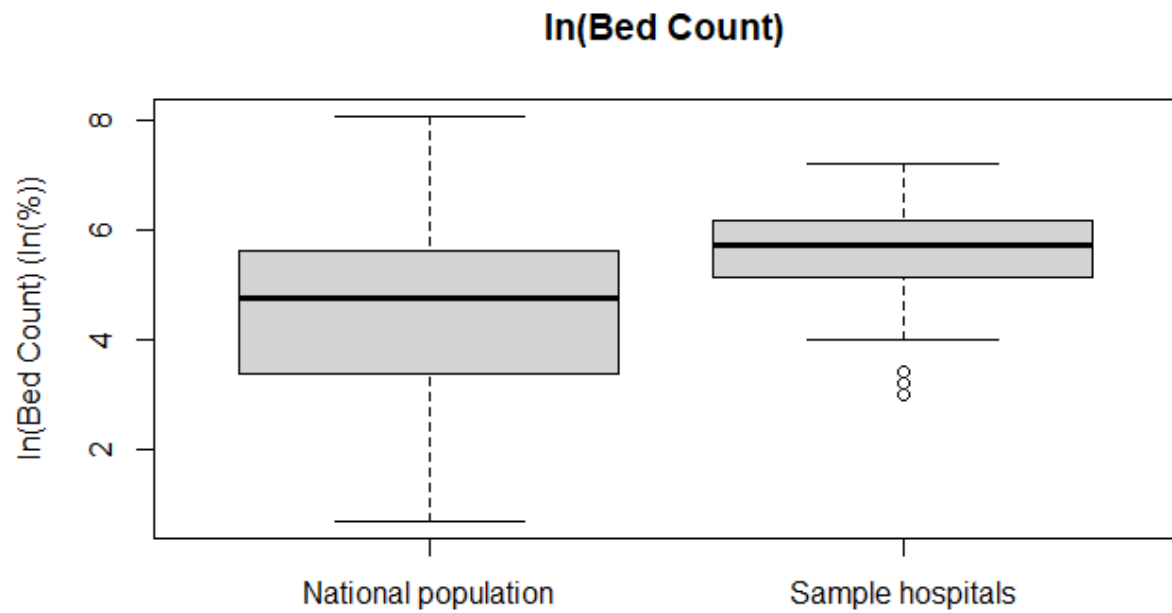
Appendix



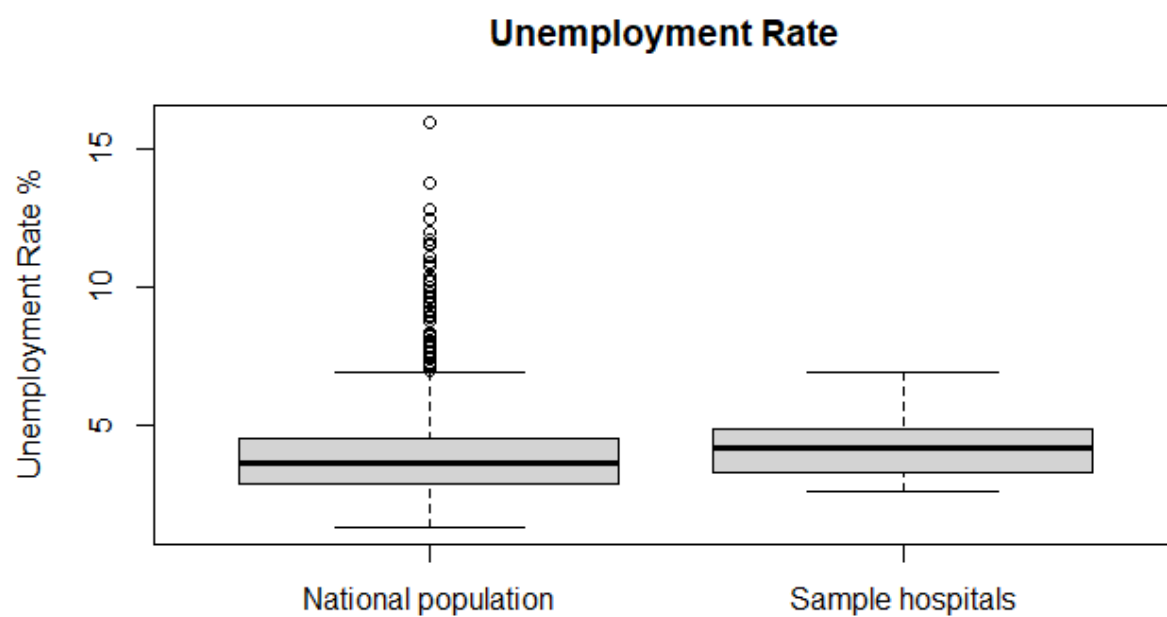
Appendix Figure 1. Natural log of total hospital revenue for national population of hospitals and sample hospitals



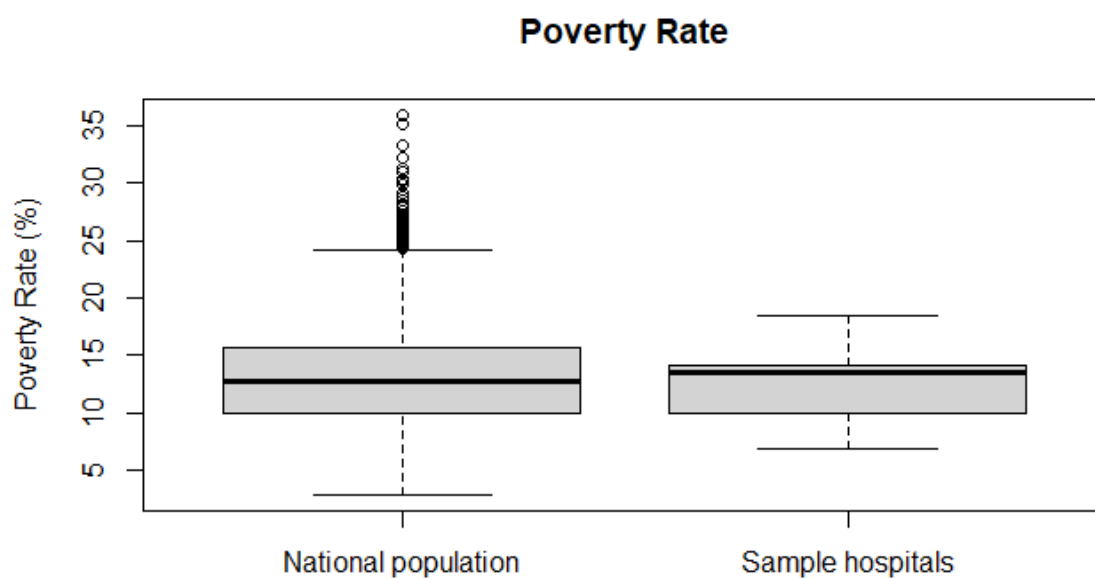
Appendix Figure 2. Natural log of community benefit spending rate for national population of hospitals and sample hospitals



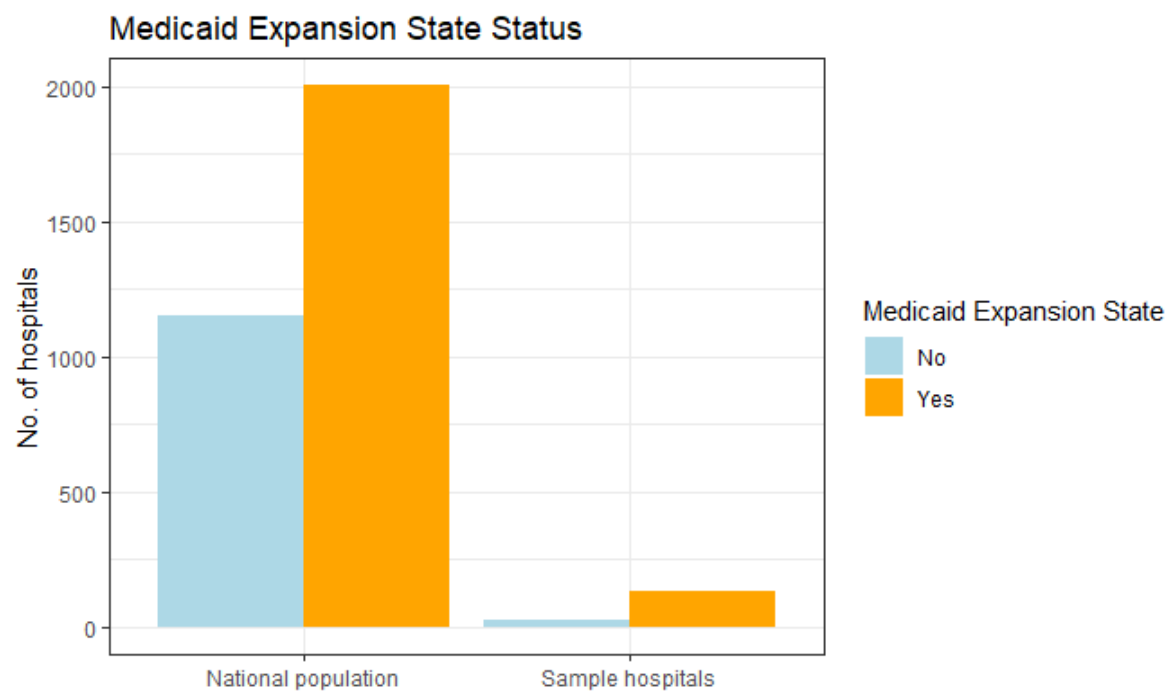
Appendix Figure 3. Natural log of bed count for national population of hospitals and sample hospitals



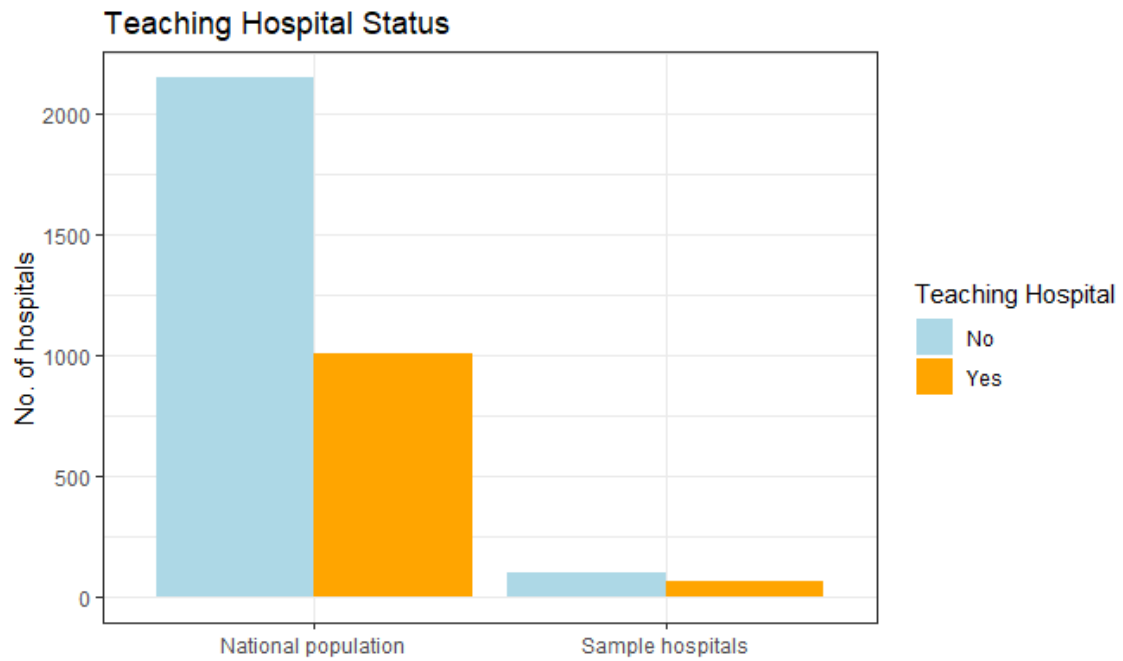
Appendix Figure 4. Unemployment rate for national population of hospitals and sample hospitals



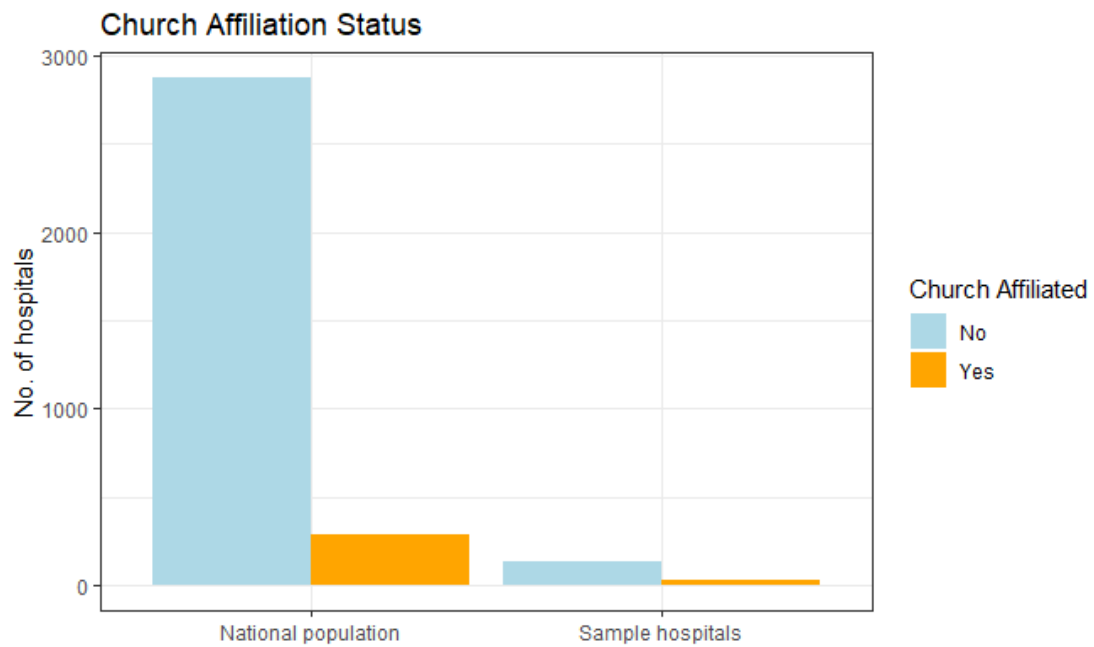
Appendix Figure 5. Poverty rate for national population of hospitals and sample hospitals



Appendix Figure 6. Medicaid expansion state status for national population of hospitals and sample hospitals



Appendix Figure 7. Teaching hospital status for national population of hospitals and sample hospitals



Appendix Figure 8. Church affiliation status for national population of hospitals and sample hospitals.

Appendix Table 1. Descriptive statisticss for sample hospital and the national population of hospital characteristics including transformed variables

	Sample Population	National population
Variable	N=168	N = 3,177
Total Hospital Revenue (dollars)		
Mean (SD)	4,989,160,037 (8,866,466,229)	2,052,010,932, (4,533,939,251)
Median (IQR)	1,582,242,737 (485,414,131, 4,140,209,334)	366,352,130 (75,723,042, 1,660,298,499)
Skewness	2	4
lnTotal Hospital Revenue (ln(dollars))		
Mean (SD)	21.18 (1.56)	19.75 (2.00)
Median (IQR)	21.18 (20.11, 22.14)	19.73 (18.16, 21.25)
Skewness	0.13	0.08

Community Benefit rate		
($\%$)		
Mean (SD)	9.2 (7.5)	9.9 (18.1)
Median (IQR)	7.6 (4.9, 10.8)	7.8 (5.1, 10.9)
Skewness	4.3	25.5
ln Community Benefit		
rate ($\ln(\%)$)		
Mean (SD)	2.05 (0.60)	1.97 (0.80)
Median (IQR)	2.04 (1.63, 2.38)	2.06 (1.63, 2.39)
Skewness	-0.33	-0.93
Bed Count		
Mean (SD)	4.11 (0.93)	195, (233)
Median (IQR)	309 (173, 475)	114 (29, 273)
Skewness	0.07	3
ln Bed Count		
Mean (SD)	5.61 (0.75)	4.63 (1.21)

Median (IQR)	5.74 (5.15, 6.16)	4.74 (3.37, 5.62)
Skewness	-0.69	-0.09
Unemployment Rate (%)		
Mean (SD)	12.28 (2.56)	3.87, (1.43)
Median (IQR)	13.80 (10.00, 14.10)	3.60 (2.90, 4.50)
Skewness	0.07	1.95
Poverty Rate (%)		
Mean (SD)	12.28 (2.56)	13.3, (4.6)
Median (IQR)	13.80 (10.00, 14.10)	12.8 (10.0, 15.7)
Skewness	-0.23	0.8

Appendix Table 2. Document metadata including hospitals included in each CHNA, year CHNA was published, and sections included in content analysis

Document ID	Hospital IDs	Sections coded	Document Year
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1	168 182 194 200 264 315 259 272 308 373 374 399	Prioritization pg 19 - 25	2022
2	3211 3213 3217 3214 3222 3224 3246 3250 3251 3257	Climate Change 113-117, Executive summary 9-10, Community Identified Priorities 18-40,	2024
3	177	Prioritization of Identified Health Needs page 12, page 114. page 154, 553 page 173,	2022
4	185 203 261	Environmental and community themes 14, Appendix M 76, Executive Summary 6,	2022

	364		
5	187	Prioritized Description of Significant Health Needs 121-124	2022
6	189	Executive Summary 5-7, Projected Impact of Climate Change in Orange County 18-20, Table 6 26,	2023
7	192	Identification and prioritization of the community's health needs 9-12, 16, 18	2022
8	196 275 295 313 260	Service offerings 12, Executive Summary 27, 2022 Top community needs 59-160, Resources and assets to meet community needs 162,	2022
9	201	Prioritized Description of Significant Health Needs 112-114, Air pollution 46,	2022
10	216	Prioritization of Significant Health Needs 10-13	2021
11	218	Air Quality 11, Prioritized Description of Significant Health Needs 112-114	2022
12	228	Air Quality 59, Prioritized Description of Significant Health Needs, 150-152, Community Input 107	2022
13	232	PRIMARY DATA KEY FINDINGS	2022

		97-103, Asthma 23	
14	822 828 836 839 886 789 808 769 841 745 843 821 783 768 829 809 765 784 810 847 773 780 838 760	Key Takeaways from Community Input about Current Needs and Assets 22, Priority Community Health Issues, 2022 CHNA 27, 31, Inequities in Environment 37, 52, 62, 85,	2022
15	239	Ozone Levels 43, Prioritized Description of Significant Health Needs	2022

		121,	
16	253	Significant health needs 28-32	2022
17	266	Significant health needs 30 - 32	2022
18	276	Physical Environment pages 35 - 37, Prioritization of needs page 68	2022
19	279	Prioritization of Significant Needs 14, Air Quality 37	2022
20	288	Prioritization of Significant Needs 17, Air Quality 49	2022
21	292	Page 20, Prioritization of needs page 10,	2022
22	306	Prioritization of Significant Needs 17, Air Quality 55	2022
23	307	Prioritization of Significant Needs 16, Air Quality 48	2022
24	329	Identification and Prioritization of Significant Health Needs 14-16, Air Quality 35,	2019
25	338	Identification and prioritization of the community's health needs 9,	2022
26	342 360	Significant Community Needs 15, Prioritization of Significant Needs 17-18, Attachment 3 123 Air Quality 54	2022
27	356	Identification and prioritization of the community's health needs 9-10	2022

28	365	Identification and prioritization of the community's health needs 9-11	2022
29	367	Identification and prioritization of the community's health needs 9-111, Health Need Profile structural racism 19	2022
31	513	Key Findings 5-7, Summary of Most Significant Health Needs from all Sources 43, Results of the CHNA: Prioritized Health Needs 44-46, Focus Group Results 68	2023
32	522	Whole Document	2020
33	538	Priority Selection 27, Priority Issues to be Addressed 33, Priority Issues that will not be Addressed 33,	2019
34	540	Significant Community Health Needs 48-50	2022
35	569	Priorities addressed 30, Priorities not addressed 31-32	2022
36	573	Physical Environment 18, Prioritized health needs 25-28	2022
37	578	Executive Summary, 9-15, Community Health Indexes 21-25, Pollution and Environmental Risk Factors Appendix 64	2024
38	212	Introduction 4-15, Respiratory disease 67	2022
39	224	Identification and prioritization of the community's health needs 9-10, Health Needs Profiles 11-25	2022

40	247	Executive Summary 1, Appendix A 162, Appendix O 553, Appendix B 181,	2022
41	250	Highlights of findings II-III, Prioritized Health Needs IV, Evaluation of Impact 100-150	2021
42	255	"Priority community Health Needs 11-1"	2019
43	320	Key Findings 11, Results of CHNA: Community Health Summit Prioritized Needs 37, Results of Focus groups 18-20, Physical Environment 35,	2021
44	332	Prioritization of Significant Needs 14-24	2022
45	2992	Prioritized Needs of the Houston Methodist Baytown Hospital Community 37-87, Social Determinants of Health 87-95, 32	2022
46	3451 3471	Community Input 10, Prioritized Significant Health Needs	2019
47	2936	Social and Economic Determinants of Health 32, Prioritized Significant Health Needs 55-80	2022
48	3039	Introduction 7, Increase access to mental health care services including treatment for substance use disorder 64	2022
49	204	Executive Summary 1-19, Appendix A 162, Appendix O 553, Appendix B 181,	2022
50	222	Identification and prioritization of the community's health needs 9-10	2022
51	252	Executive Summary 1-19, Appendix A 162, Appendix O 553, Appendix B 181,	2022

52	262 366	Significant Health Needs 28-30	2022
53	282	Prioritization of needs page 6	2022
54	298	Executive Summary iii-iv, Air Pollution 28,	2022
55	310 237	IDENTIFICATION AND PRIORITIZATION OF THE COMMUNITY'S HEALTH NEEDS 12-20, Appendix D, Appendix E.	2022
56	316		2022
57	326	Identification and prioritization of the community's health needs 9-10, Structural racism health profile 20, 27	2022
58	327	Executive Summary 5, Physical Environment of the community 19, Health Issues of Vulnerable Populations 53, Prioritization of Identified Health Needs 53-58, Appendix C	2024
59	331	Executive Summary 5, Physical Environment of the community 19, Health Issues of Vulnerable Populations 53, Prioritization of Identified Health Needs 53-58, Appendix C	2024
60	335	Prioritization of Significant Needs 13-15	2022
61	336	Identification and prioritization of the community's health needs 9-10	2022
62	343	Air Quality 27-28, Executive Summary 5, Prioritization of Significant Needs 13-14,	2022
63	341	Page 81, Prioritization of needs page 11	2022

64	345	Page 31, Prioritization page 9	2022
65	346	Community Input 49, Executive Summary 4, Prioritization of Significant Needs 12-13,	2022
66	358	Executive Summary 6, Prioritization of Significant Needs 16-18, Air Quality 48, Attachment 4 130, Attachment 5 133,	2022
67	363	23, 44, Executive Summary 8, Primary Data Findings 96-101	2022
69	401	102, 96, PRIORITIZATION OF SIGNIFICANT HEALTH NEEDS 13-16	2022
70	400	Appendix B Characteristics of health 101-123, Prioritized Health Needs 75, Executive Summary 1-6	2022
71	404 402	Critical Health concerns 56-57, survey Findings 61-63, Prioritized health needs 5,	2019
72	406	Significant Needs the Hospital Intends to Address 26	2024
73	407	Key Findings 26	2022
74	541 558	Identifying Priorities 5-7	2023
75	598	Executive Summary 4-9, Findings 16, Perceptions of community and vision for the future 62-66, Key Themes and Conclusions 66, Priorities Identified 68	2022

76	405	Environment page 30- 31, Summary of findings page 46	2022
77	740	Prioritized Health Needs 28, Physical Environment 19,	2022
78	755	About Endeavor Health 3, 2024 CHNA Key Priority Areas 42	2024
79	774	Identifying significant health needs 3-6	2022
80	888	Whole Document	2021
81	776	Executive Summary 4, Priority Health Needs 32-46, Physical Environment 48, 52, Appendix A	2024
82	781	Respiratory disease 78, Summary of Findings 16-17	2022
83	2963	Executive Summary 5, Asthma 46, Attachment 3 71, Prioritized Description of Significant Health Needs 64	2022
84	2983	Prioritized Health Needs 37-87, Introduction 6	2022
85	3042	3Social and Economic Determinants of Health 32, Prioritized Significant Health Needs 53-68, Non-Prioritized Significant Health Needs 68-72	2022
86	3094	Key findings 17-35	2022
87	3088	Prioritized Community Health Needs and Potential Resources 48-65, Recao if 2019 CHNA and 2020-2022 Implementation Strategy 11,	2022

88	299	Prioritization page 8, climate and natural environment page 40	2022
89	3473	Prioritized Health Needs 37-87, Introduction 6	2022
90	576		2022
91	280	Community Input- Chronic Disease 71, PRIORITIZATION OF SIGNIFICANT NEEDS 17-18, Executive Summary 6-8	2022
92	215	Prioritization of Significant Needs 10-12, Air and Water Quality 30. Introduction 5-7,	2022
93	227	Executive Summary 6-8, Significant Health Needs 13-15, Priority Health Needs 15,	2022
94	319	Executive Summary I, Identification and Prioritization of the Community's Health Needs 17-47, Appendix E, Appendix F, Appendix D,	2022
95	509	Prioritization 33-54	2024
96	512 564 581 585	Executive Summary 2-5, Input from Persons who represent the broad interest of the community 31, Prioritization of Health Needs and Available Resources 37-54	2022
97	207	Prioritization page 4	2022
98	225	Identification and prioritization of the community's health needs 9-10	2022
99	286 287 334	Executive Summary 4, Asthma 65, Methods to Identify Community Health Needs 18-20	2022

100	351	Prioritization of Significant Needs 14, Air Quality 27	2022
101	376	Prioritization of Significant Needs 20, 38,	2023
102	555	Prioritization of Health Needs and Available Resources: 29-42	2022
103	557	Prioritized Significant Health Needs 35-50	2022
104	567	Prioritization 35 - 53, Appendix A, Appendix C	2024
105	887	Whole report	2022
106	348	Identification and prioritization of the community's health needs 9-10, 19	2022
107	3235	Executive summary, Prioritization of significant health needs 7-8	2021
108	3236	Whole report	2022
109	3260 3244	Mission and Values 3-7, Data Sources 11-12, Catchment Area Profile 12-19, Lung cancer 24, Priorities 44, Conversations with community organizations providing health and social services across Washington State 46	2023

Appendix Table 7. Search terms used in content analysis of CHNA.

Search Terms			
pollen	cyclone	fire	coastal inundations
pollens	cyclones	wildfire	inundated coastline
flood	typhoon	fires	inundating

floods	typhoons	wildfires	climate
flooding	ice	air pollution	extreme
drought	lightning	air quality	disaster
droughts	lightnings	ozone	disasters
hail	wind	pm 2.5	storm
hails	winds	p.m. 2.5	storms
hailing	tornado	sea level rise	environmental justice
hurricane	tornadoes	sea-level rise	precipitation
hurricanes	tornados	coastal inundation	

Appendix Table 3. Codebook used for content analysis

Category	Code	Definition	Inclusion criteria	Exclusion criteria
Hazard	Pollen	Discussion of pollen as an environmental health hazard	Word is used in relation to human health and the environment	
Hazard	flood	Discussion of flood as an environmental health hazard	Word is used to describe an environmental event	Word is used in a metaphorical way. ex: a flood of emotion
Hazard	cold	Discussion of cold as an environmental health hazard	Word is used to describe low	Word is used to describe

			temperature as it impacts human health	bacterial or viral illness
Hazard	drought	Discussion of drought as an environmental health hazard		
Hazard	hail	Discussion of hail as an environmental health hazard		
Hazard	heat	Discussion of heat as an environmental health hazard	Used to describe heat as an external temperature which poses a health hazard	Heat in reference to artificial heating bills
Hazard	hurricane	Discussion of hurricane as an environmental health hazard	Can be used for general events or named events like Hurricane Katrina	
Hazard	cyclone	Discussion of cyclone as an environmental health hazard	Used to describe cyclone as an environmental event. Includes both cyclone and cyclones	
Hazard	typhoon	Discussion of typhoon as an environmental health hazard		
Hazard	ice	Discussion of ice as an environmental health hazard		
Hazard	landslide	Discussion of landslide as an environmental health hazard		

Hazard	lightning	Discussion of lightning as an environmental health hazard		
Hazard	wind	Discussion of wind as an environmental health hazard		
Hazard	tornado	Discussion of tornado as an environmental health hazard		
Hazard	tsunami	Discussion of tsunami as an environmental health hazard		
Hazard	wildfire	Discussion of wildfire as an environmental health hazard	Includes named and unnamed wildfires, includes discussion of smoke that originates from a wildfire	Excludes discussion of Fire Departments and Fire Department personnel, Excludes arson
Hazard	air pollution	Discussion of air pollution an environmental health hazard		
Hazard	Ozone or pm 2.5	Discussion of ozone or air pollution as an environmental health hazard		
Hazard	sea level rise	Discussion of sea level rise as an environmental health hazard	also includes coastal inundation, inundated	

			coastline,	
Related term	storm	Discussion of storm as an environmental health hazard	Includes precipitation	
Related term	Climate	Discussion of climate as it pertains to the physical environment		Excludes discussion of political environment, or friendliness of hospital staff to patients
Related term	disaster	Discussion of natural disasters in the community as an environmental hazard		Excludes reviews of individual patient interactions where negative encounters are described as disasters
Related term	extreme	Discussion of extreme as it applies to weather, climate, disasters, temperature, weather or any of the other climate-sensitive hazards		

Related term	environmental justice	Discussion of environmental justice that includes climate-sensitive hazards including any of the other codes or terms	Includes environmental injustice, must include an aspect of climate, a specific hazard, or related terms to climate-sensitive hazards	Environmental justice where it is described only in terms of industrial pollution
Air pollution	is climate related	Intended for use as co-code of Hazard:air pollution. Includes discussions of air pollution as an environmental health hazard that is explicitly linked to climate	includes if air pollution is discussed under the heading of climate or climate change, is described using the words climate, or is directly described as being influenced by climate	Excludes discussions of traffic related air pollution
Air pollution	is not climate related	Intended for use as co-code of Hazard:air pollution. Includes discussions of air pollution as an environmental health hazard that is not explicitly linked to climate	includes discussions of air pollution as exclusively traffic related pollutants or industrial releases of toxins. Includes air pollution descriptions where there is no connection to climate in section heading or in surrounding text	Excludes descriptions of air pollution listed under climate headings or where surrounding text includes discussion of

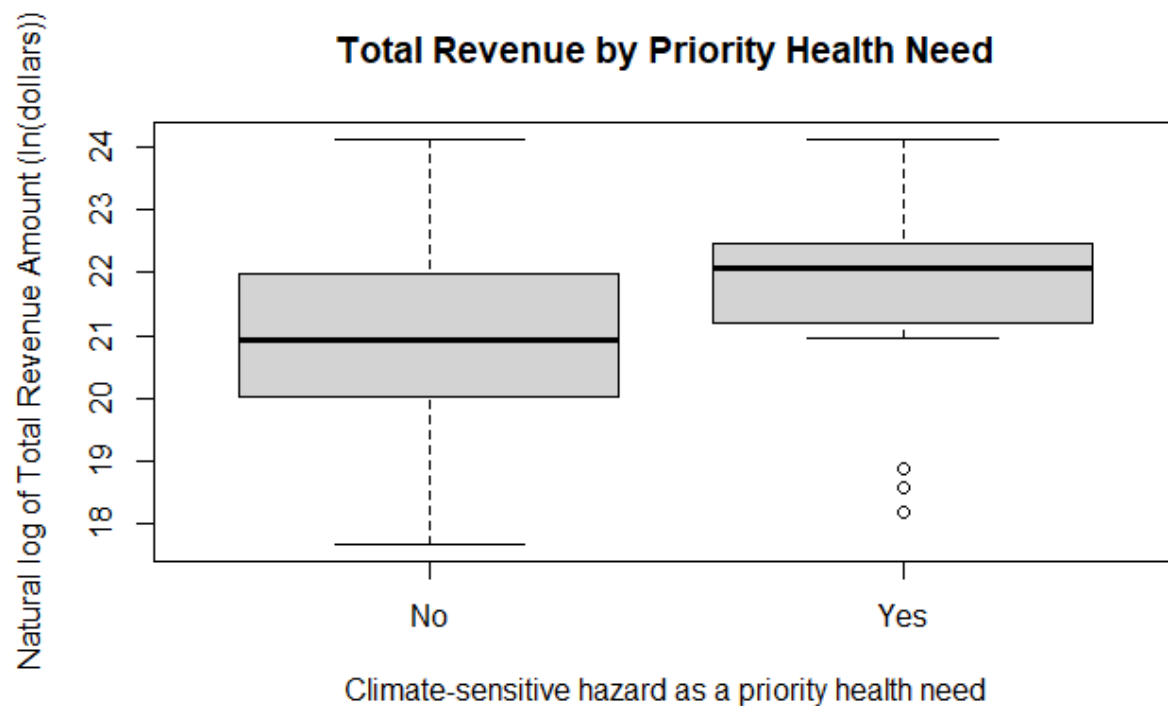
				climate
Admin	Good quote	Used to mark a quote with potential to show example of other codes		
Admin	conflict	Used to mark conflict or uncertainty in coding		
Description	Data	Describes the hazard using quantitative data. intended to use as a co-code for the General and Hazard categories	includes statistics, heat maps, vulnerability indexes, proportions, frequencies,	
Description	Community Resource	Describes a person or an organization and their roles in the community, intended to use as a co-code for the General and Hazard word match categories		
Description	Community Input	Hazard or related term is described in a quote from a community member or is part of a description of community member responses, intended to use as a co-code for the General and Hazard word match categories		
Description	Narrative	Hazard or related term is described quantitatively using text		excludes the other

				descriptpion categories
Priority	Climate sensitive hazard/s is listed as a priority	The CHNA lists a climate sensitive hazard, climate change, or environmental justice as a priority for the CHNA cycle.	Includes if a climate- sensitive hazard is the title/specifically named priority health need or if the description of a priority health need includes a climate- sensitive hazard or related term	

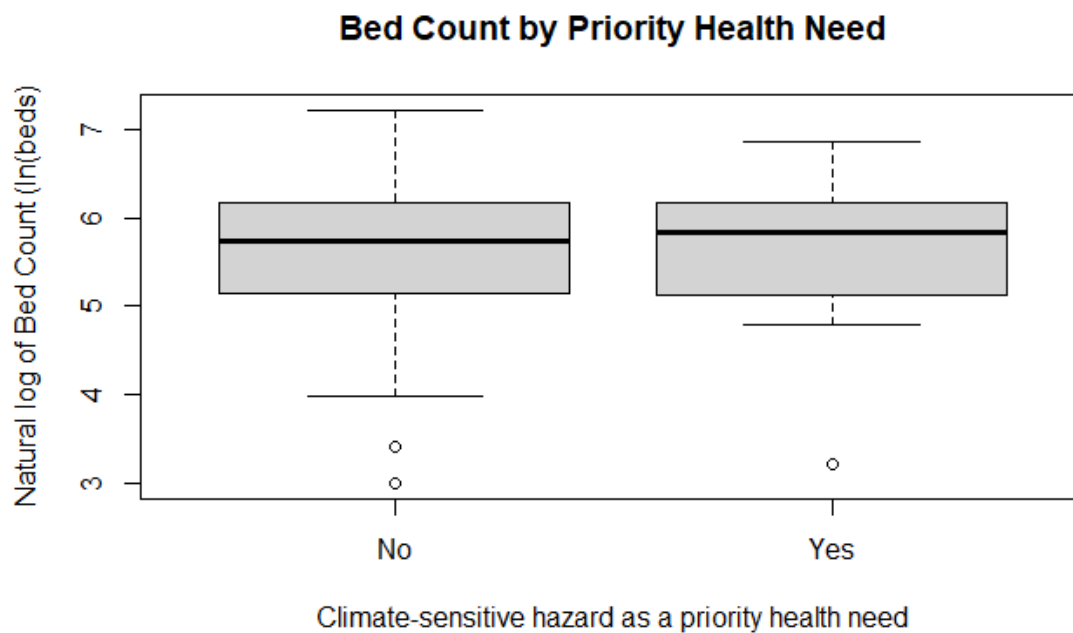
Appendix Table 4. Binary and categorical coding questions with answer categories.

Coding Questions	Answer Categories
Is Pollen included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is flood included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is cold included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is drought included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is hail included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is heat included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is hurricane included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is cyclone included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is typhoon included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is ice included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is landslide included as a climate sensitive hazard in this hospital's CHNA?	Yes/No

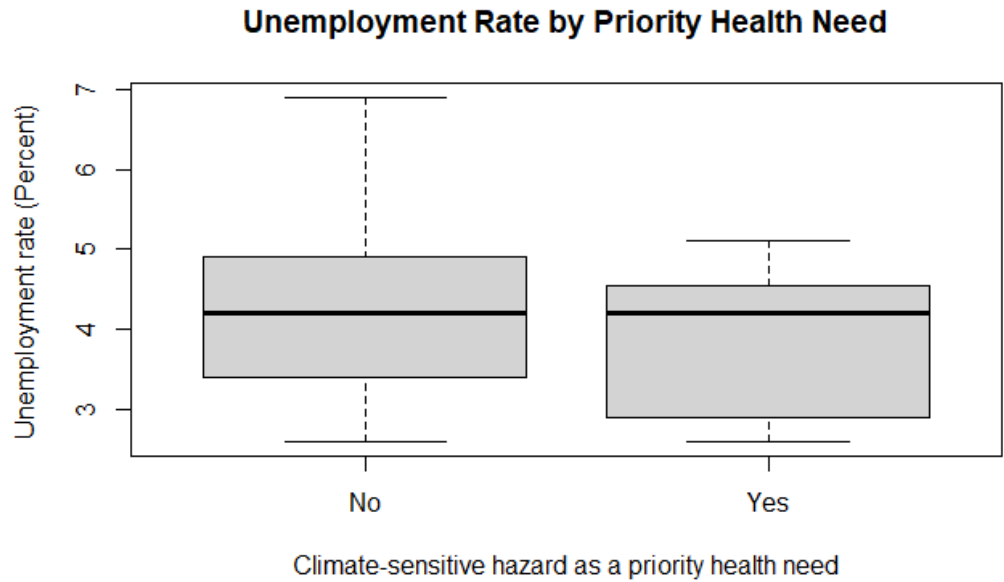
Is lightning included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is wind included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is tornado included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is tsunami included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is wildfire included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is air pollution included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is ozone or pm 2.5 included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is sea level rise included as a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is storm included to describe a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is climate included to describe a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is disaster included to describe a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is extreme included to describe a climate sensitive hazard in this hospital's CHNA?	Yes/No
Is environmental justice included to describe a climate sensitive hazard in this hospital's CHNA?	Yes/No
How is air pollution described	included, climate related/included, not climate related/excluded
How is the climate-sensitive hazard or related term described?	Narratively/statistically/community input/community resource
Is a climate-sensitive hazard indicated as a priority health need?	Yes/No



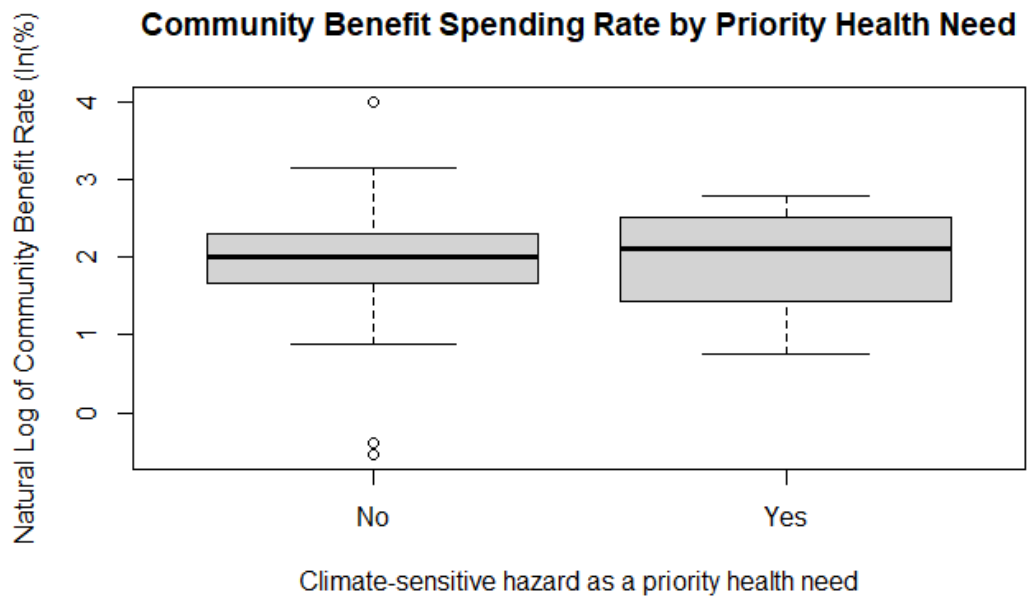
Appendix Figure 8. Transformed hospital total hospital revenue stratified by whether a climate-sensitive hazard is identified as a priority health need.



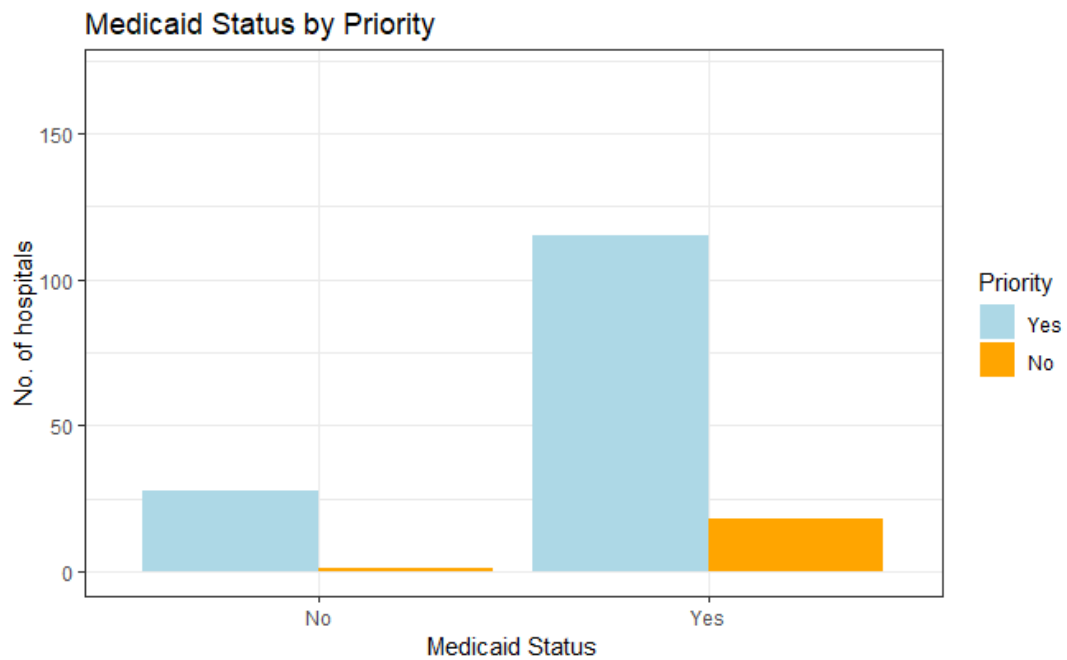
Appendix Figure 9. Transformed hospital bed count stratified by whether a climate-sensitive hazard is identified as a priority health need.



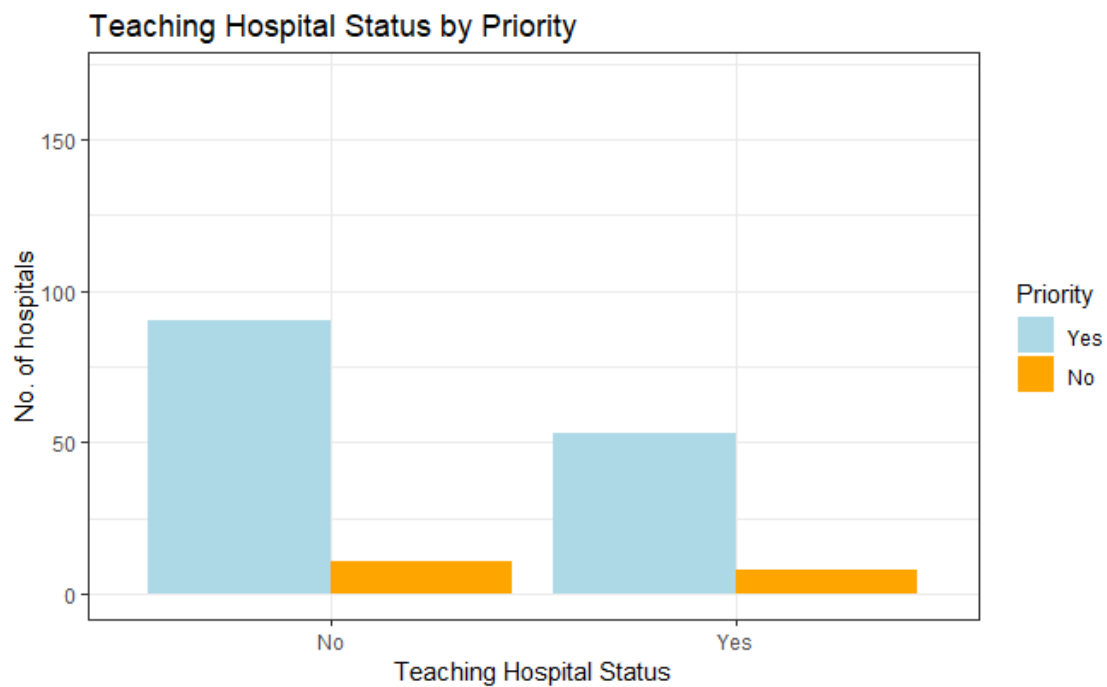
Appendix Figure 10. Hospital community unemployment rate stratified by whether a climate-sensitive hazard is identified as a priority health need.



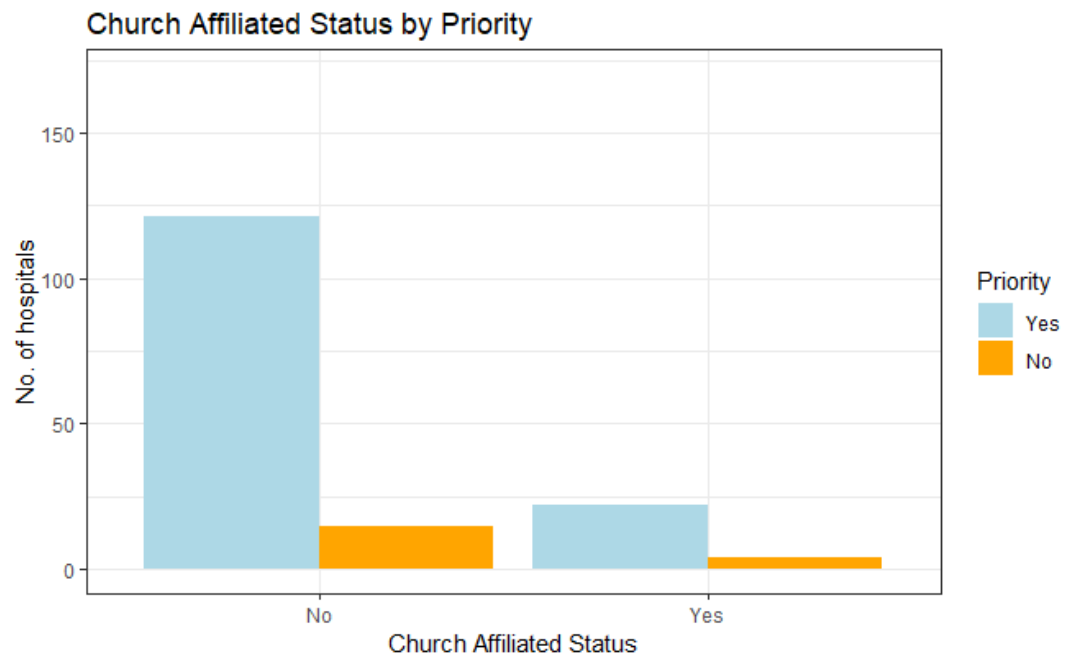
Appendix Figure 11. Transformed hospital community benefit spending rate stratified by whether a climate-sensitive hazard is identified as a priority health need.



Appendix Figure 12. Number of hospitals located in Medicaid expansion states stratified by whether a climate-sensitive hazard is identified as a priority health need



Appendix Figure 13. Number of hospitals that are teaching hospitals stratified by whether a climate-sensitive hazard is identified as a priority health need.



Appendix Figure 14. Number of hospitals that are church affiliated stratified by whether a climate-sensitive hazard is identified as a priority health need.