The Design Utility of Rural Hospital Community Health Needs Assessments

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Introduction

Rural communities across the United States continue to face barriers accessing quality healthcare (Coughlin et al., 2019; Douthit et al., 2015). Limitations including inadequate or no insurance coverage (Bolin et al., 2015; Day, 2019; Goldfield & Fuller, 2019), lack of community resources, training, transportation (Iglehart, 2018), and types of services offered are frequent and continued barriers to receiving quality care in rural environments (Bolin et al., 2015; Brems et al., 2006). The rate of providers in rural populations continues to fall leaving communities underserved and with limited access to basic, preventative care (Yates et al., 2023). As communities in rural areas continue to age, we face the ever-growing challenge of providing care to a population that has increased medical care needs and complexity (Cohen & Greaney, 2023; Wu et al., 2022). Older adults in rural communities are often socioeconomically disadvantaged and face increased barriers to receiving primary healthcare (Ford et al., 2016). While most rural communities have family practice physicians, it is rare to have geriatricians, internists, pediatricians or obstetricians/gynecologists except, possibly, as a traveling/mobile clinic typically only in the immediate area once a month or via scheduled telehealth visit. This lack of access and use of primary care can be a significant reducer in the use of emergency and urgent care services (Timmins et al., 2020). Keeping an aging population healthy through preventative care and consistent primary care allows emergency departments to remain clear for more emergent cases.

In addition to the lack of resources causing inadequate care, rural communities are at risk of receiving reduced access to care due to hospital closures (Kaufman et al., 2016). Hospital closures between 2010-2019 left up to 0.97% of the population without hospital access within 15

minutes driving time (McCarthy et al., 2021). Hospital closures in rural settings can leave many without life-saving care access for hundreds of miles. Vehicle-based ground transportation time to access care increases in rural areas of the country often leading to delayed medical care (Wolfe et al., 2020). According to the Center for Healthcare Quality and Payment Reform, as of July 2024, 25% of hospitals in the state of Montana are at risk of closure (*Rural hospitals at risk of closing*, 2024). Especially in remote or isolated locations, rural hospital closures are associated with long-term decreases in the supply of physicians in multiple specialties, nurses and allied health personnel (Germack et al., 2019). The overall lack of resources available within and external to critical access hospitals (CAHs) can be a contributing factor in closures as the facility does not have the means to remain agile and respond to the needs of an evolving population.

Many critical access facilities run at a financial deficit which can mean that prior to closing altogether, certain branches of care are shut down or mergers take place to conserve budget (Carroll et al., 2023). As of July 2024, 64% of rural hospitals in Montana suffered a loss of services, such as not having any obstetrical care or an optometrist local to the region (*Rural hospitals at risk of closing*, 2024). Rural facilities often have low patient volume, which can lead to reduced income as compared to more urban hospital settings (Levinson et al., 2023). Low patient volume (e.g., patient census) may be due to smaller population size and the necessary travel to seek care in more developed facilities or those with strong resource networks to urban or academic medical centers. In particular, the loss of local obstetrical care impacts both maternal-fetal mortality and the local community's population, which further exacerbates low patient census and smaller population size (Kozhimannil et al., 2018; Kozhimannil et al., 2019). While the financial deficit was somewhat lessened during COVID-19 by federal relief funds

(Levinson et al., 2023), those funds were limited. The underlying challenges facing rural facilities were only temporarily alleviated by the relief funds, not solved.

Background

Critical Access Hospital (CAH) is a designation given to certain hospitals in rural communities that meet a set of criteria as defined by the Centers for Medicare & Medicaid Services (Schoenbaum, 2011). Criteria to meet CAH designation includes: 25 or fewer acute care beds, located further than 35 miles from another hospital, provides 24/7 emergency care, and maintains an average length of stay for acute care patients of 96 hours or less (*Critical Access Hospitals (CAHs)*, 2024). CAHs are critical for providing care in rural settings where access to larger hospitals is costly or transportation prohibitive. Additionally, CAHs provide life-saving emergent care to stabilize patients and transfer, when needed, to larger care facilities (Seright & Winters, 2015).

A majority of Montana's rural hospitals were constructed between the 1950s and 1970s with federal funds appropriated by the Hill-Burton Hospital Survey and Construction Act, Pub. L. 79–725, 60 Stat. 1040, enacted July 13, 1946. Few communities have invested in renovations and updates, resulting in these facilities aging faster than other hospitals nationwide. **The extensive changes to equipment, technologies, service lines and care complexity have led most facilities to a point where new construction is more cost-efficient to revitalize the built environment to better meet community needs for both outpatient and inpatient services.** The United States Department of Agriculture (USDA) Rural Development fund includes direct loans (7 CFR Part 1942, Subpart A) and grants (7 CFR Part 3570, Subpart A) to help finance construction costs and upgrades in furniture, fixtures, and equipment, but generally only funds a

portion of the costs. The remaining cost burden most often depends on bonds or other means of local fundraising.

Of the 67 hospitals established in Montana, 55 are considered critical access (*Rural hospitals at risk of closing*, 2024; *Top hospitals in Montana by net patient revenue*, 2024). Closures for CAHs in Montana can leave communities without access to care for hundreds of miles. A closure for the rural CAH used for the present analysis would leave the residents of the primary service area without access to care for over 200 miles.

With a population of just 1.1 million, Montana is one of the least populated and most rural states. An estimated 44% of the Montana population lives in rural communities (*Montana Census 2020: Make it Count*, 2020), defined as having a population of less than 2,500. Of the 453 statistical areas in Montana, there was just an average population of 1,781 persons in 2024 including all cities (54), villages (74) and census-designated places (325) (United States Census Bureau, 2024). The 2024 census determined a slight increase from the average in 2020 of 1,672 persons (United States Census Bureau, 2024). Nearly 40% of these 453 statistical areas decreased population, many decreasing by -20% or more (United States Census Bureau, 2024). Since a large portion of Montana's geographic area is considered rural, similar challenges that the studied CAH and other surrounding areas face are not unique.

A CHNA is a tool used to gather information on the self-reported health and health-related goals of a specific population, understand the resources available to meet these goals, and describe the community's needs to achieve the quality of life associated with their meaning of health as a construct (Ravaghi et al., 2023). CHNAs have historically been used to help guide and create community health improvement (CHI) plans by healthcare facilities to be responsive

to community changes and adapt to evolving care delivery considerations, ranging from local policy to federal mandates (Stoto et al., 2019). However, CHNAs are largely static reports which minimizes the ability to exchange knowledge of the changing health needs in rural communities. When resources are limited, it becomes critical to allocate according to the stated needs of the community. Community Health Needs Assessments (CHNAs) support the collective healthcare and design industry understanding of needs in siloed, rural communities by giving community members a voice in the steering of larger initiatives and establishing mutual goals between the healthcare facility and community.

Rural Community Participatory Design Framework

The Rural Community Participatory Design Framework (RCPDF) is a design framework by which active community members participate in informing design choices in the healthcare-built environment (Johnson & Hellem, 2024). The RCPDF overlaps common phases of a design project – Ideation+Alignment; Planning; Construction; Occupancy; Evaluation; and Mutual Goal-Setting – with known contextual cultural considerations during these phases. An example is the need to establish *familiarity* (perceptions of being welcomed or unwelcomed) during the Occupancy project phase, which can be supported through culturally responsive transition and activation planning (Johnson & Hellem, 2024). Another example in this cyclical framework is the appraisal of *health behaviors* and *health beliefs* during the Mutual Goal-Setting phase to segue into Ideation+Alignment canvassing of *resources* and *networks* associated with the behaviors and beliefs (Johnson & Hellem, 2024).

This type of design framework goes beyond community participatory research and involves the community in the actual design process. CHNAs provide data that can be used in

RCPDF without overburdening the community and spending precious financial resources. By using existing resources gathered by community members, the design team can get a head start in creating community context. During the Ideation+Alignment phase, secondary analysis of CHNA data can be used within the RCPDF to appraise existing and identify non-existing resources or networks that will help or hinder project progression (Johnson & Hellem, 2024). This allows for alignment of costs, materials, labor, and other core components of project management. The CHNA is an investment of time and financial resources for the healthcare facility to maintain its tax status, thus significant to leverage during project management as common ground of community voices and an additional lens of healthcare utilization patterns. **Viewing the community as the client, the design team delivers meaningful outcomes through the RCPDF while being stewards of the cultural concepts which are foundational to the rural way of life and pervade the meaning of health and healthcare.** The framework is cyclical in nature, meaning that once the design process is complete, the evaluation process begins again. Continuous evaluation of data is necessary to allow the system to be adaptive to the community's changing needs.

Purpose

For participatory design to be effective, understanding the broader health needs driving the design change is necessary. The main objective is to understand the community perceptions of health and their experience related to accessing healthcare needs. Perceptions of health often drive the decision to access care. Analysis of the CHNA provides a picture of the experience of healthcare in the studied service area and its surrounding areas. CHNAs are required by law for healthcare facilities to remain designated as a CAH and retain their respective tax status, making their availability as a source of data to inform design decision-making predictable. This study’s

short-term goal was to describe the infrastructure needs and community healthcare services necessary to sustain care delivery at this CAH such that informed decision-making may occur related to plans for renovation of the hospital and/or plans for lines of services congruent to resources available. The long-term goal is to leverage identified areas of opportunity for heightened efficiency and revenue to support a profitable, sustainable healthcare system for the residents of the CAH's service area and its surrounding areas. **This longer-term initiative includes updated infrastructure, comprehensive personnel recruitment and retainment plans, and deepened partnership with community leaders to empower the CAH to be a responsive, adaptable system of care.**

Methods

Project Design

This study is a retrospective quantitative, descriptive, secondary analysis of a CHNA dataset for a CAH to identify areas of community perspective convergence and divergence from the observed findings in the hospital environment which may affect healthcare access and utilization of local services. The Office of Rural Health for Montana conducted a CHNA based on pre-determined lines of questioning and survey structure, which was mailed to residents in the service county and adjacent areas that are included in the catchment zone of the CAH. The initial analysis performed by the Office of Rural Health primarily included descriptive statistics and qualitative interpretation, with an ultimate deliverable to the CAH leadership of an executive summary of the findings and recommendations based on the results. The Office of Rural Health completed a comparison between the most recent two CHNA datasets (2021 and 2024) to

determine patterns of differing responses among community members completing the surveys. The present secondary analysis was driven by the pre-established comparison.

Ethical Considerations

This study was approved through the Montana State University Institutional Review Board (# 2023-851-Expedited). As part of the regulatory review, initial permission was obtained by the CAH leadership to request access to the raw data and collaborate with the Office of Rural Health to glean additional potential insights that otherwise may be not readily visible in the traditional CHNA report. In alignment with federal reporting guidelines related to low census populations, generalized categories were established a priori to support anonymity of residents, particularly with survey items that had low response (i.e., less than or equal to 10 responses). Given the methodological focus on this analysis, proper nouns and identifying information within the survey questions and responses were removed given heightened familiarity among the population. Once the CHNA dataset was prepared by the Office of Rural Health, it was transferred by secure, encrypted file management within the University system to a shared repository only accessible by personnel identified in the Institutional Review Board protocol.

Setting

The surveyed CAH is a 6-bed Critical Access Hospital with an attached Rural Health Clinic (RHC) located in the northeastern plains of Montana. The CAH has a service area of 5,100 square miles and provides medical services to the immediate communities' residents totaling 4,192 people and the adjacent three counties. The CAH's county is designated by the US Department of Health and Human Services as a health professional shortage area due to the low ratio of primary care and specialty providers per resident, which also qualifies this region as a

frontier county (i.e., low density of persons per square mile as well as distance and travel time to service/market). The CAH's primary service area includes its located city, two villages, and four population centers as designated by the United States Census Bureau. The CAH's key services include emergency medical services, inpatient and outpatient care, skilled nursing and swing bed capabilities, laboratory, radiology, physical therapy/occupational therapy, and a durable medical equipment supplier. The family health clinic includes services such as primary care, telehealth, and outreach clinic providers in the area (e.g., ophthalmology) once or twice monthly. Currently, the CAH has an estimated 300 total patient days per year and a revenue of nearly $11 million. There is another CAH within 70 miles to the West and a slightly larger CAH within 90 miles to the South. The closest Level I facility (highest level of trauma care) is 210 miles, which under ideal conditions via ground transport is over three hours of transit time across rural, two-lane highways or roadways, with limited or extremely limited services between townships and small municipalities.

Sample and Recruitment

The CAH provided an aggregated list of outpatient and inpatient admissions and information regarding service area zip codes. The included zip codes with the greatest number of admissions were selected to be included in the survey. A random list of 800 residents was then selected with the assistance of the Social Data Collection and Analysis Services (i.e., a fee-for-service core facility at Montana State University Bozeman). This core facility enables the collection, cleaning, and presentation of high-quality data for researchers using a variety of social and behavioral methods. Residence was stratified in the initial sample selection so that each area would be represented in proportion to the overall served population and the proportion of past admissions. This stratification enabled a balance of both populations concentrated in

clustered towns and those in more frontier settings, such as ranches or farms with fewer than six persons per square mile. Additionally, survey completion was targeted for even distribution as possible to male and female representing populations given the disproportional response rate among females traditional to both rural setting and survey distribution method given their high involvement in healthcare behaviors in family structures (Koolwal, 2021; Wu, Zhao, & Fils-Aime, 2022). Surveys were mailed to participants and could be returned via mail or completed online via a provided web link. Proportional representation of the geographic areas was the most important factor considered in distribution. As such, age was not considered when proportionally sampling.

Measures

Forty-two questions were included, of which four questions were demographic measures. Items of measurement included questions such as perceptions of personal health (11 questions), perceptions of community health (9 questions), barriers to receiving care (8 questions), and quality of care (1 question) (Table 1). Question response items were asked on a binary, Likert scale, all that apply, single select, or to select the top three.

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Focus area

For this secondary analysis, primary items of interest included: perceptions of health, both personal and community, insurance coverage, and barriers to care. Information relating to knowledge of services available was also of interest. With an aging population, knowledge of services available can also be a barrier due to communication channels. Rural communities will

sometimes receive specialists that come for single or multi-day clinic appointments. These appointments can happen once a month, once a quarter, or even more infrequently. Alerting the community of availability to see traveling specialists can present a unique challenge in knowing which medium to communicate through (e.g., magazine ads vs. Facebook ads).

Data Analysis

Data were de-identified and stored in password protected digital storage. Due to the data coding of the initial analysis, some items had to be recoded to fit a binary coding, such as 1 for "yes" and 0 for "no." Secondary descriptive, inferential and predictive analysis were performed using Minitab statistical software (V22, Minitab LLC, State College, PA). Descriptive analyses were used to understand respondent's characteristics and perceptions of aspects of care including access and barriers. Chi-square association tests were performed to identify univariate trends amongst perceptions and respondent characteristics.

Leveraging a community-based participatory design framework, the Rural Community Participatory Design Framework, stakeholder interviews and observational assessments of the CAH built environment were conducted prior to analyses of the CHNA data (Johnson & Hellem, 2024) This exploratory, contextual inquiry approach identified key areas of interest among community members and hospital leadership to isolate in the CHNA data for comparative analysis and determination of clinical utility of CHNA responses towards physical infrastructure decision-making. Based on these *a priori* indicators with that highest degree of clinical utility that influenced design of the healthcare-built environment, binary logistic regression models were constructed to determine the relationship between accessing primary, hospital, and specialty healthcare in the last three years and eight predictors. For each of the three binary

responses (yes accessed care in the last 3 years), four predictors were included that were Likert-rating of respondent's perception of community health, personal health, health insurance coverage, and knowledge of health services available. Four additional demographic predictors were included to explain any differences in accessing care based on residence, gender, age and employment.

An exploratory Classification and Regression Trees (CART® Classification, V22, Minitab, LLC, State College, PA) was used to model the same three binary responses with respect to the eight predictors. CART prediction was used to illustrate the patterns and relationships with the binomial responses and specified predictors (Breiman et al., 1984). As an alternative to standard parametric methods, these three CART classification models were primarily used to gain insight into relative variable importance and identify groups in the data with desirable characteristics. Each CART classification model's nodes, misclassification cost, relative variable importance, confusion matrix, receiver operating characteristic (ROC) curve, gain chart, and lift chart were reviewed prior to acceptance (Breiman et al., 1984; Gordon, 1984). Given the small sample sizes, CART was used as a proof-of-concept to analyze CHNA data for future more robust analyses across multiple CAHs. Given the imbalanced relative frequencies for the binary response, all binary logistic regression and CART classification models used "Yes accessed care within the last three years" (1) as the event of interest. The significance level was set at $\alpha=0.05$ for all statistical analyses. All analyses were reviewed for practical and clinical significance with rural healthcare experts to maximize interpretability for community stakeholders.

Results

2024 CHNA Response Rate and Respondent Demographics

One hundred and seventy-five surveys were returned out of 800. Of those 800 surveys, 50 were returned undeliverable resulting in a 23.3% response rate (175/800). Over half of the responses were received from the primary city (58.8%, Table 2), which is the main geographic area served by the CAH. The remaining responses were from smaller surrounding communities (35.1%). While age was not a consideration when sampling, the results of the age categories of respondents are consistent with the aging population of other rural communities (Cohen & Greaney, 2023). The Office of Rural Health performed a similar CHNA in 2021. The present research team did not analyze the data; however, access was provided to the final report to compare descriptive statistics of the sample. The largest category of respondents were ages 66-75 in the 2021 and 2024 CHNA. In 2021, respondents ages 66-75 made up 27.1% of all responses. This percentage increased to 32.9% (*n*=57) in 2024.

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Of the respondents that chose to identify their gender (*n*=171), 34.5% were male (*n*=59), and 65.5% were female (*n*=112). Non-binary and other were additional options for gender identification. No respondents identified with these categories. The high response rate of females as compared to males is not surprising as women tend to be the primary healthcare decision makers of their household (Matoff-Stepp et al., 2014). Respondents were also asked to indicate their employment status. Unsurprisingly, given the age of the population, the majority of respondents indicated they were retired (*n*=67). If employed, most respondents indicated they worked full time (*n*=64).

Several of the respondents reported not accessing any type of care in the last 3 years. Specifically, 6% had not accessed any type of primary care, 37% hospital-based, and 22%

specialty care in 36 months. As this survey was conducted in 2024, there is an overlap with the COVID-19 pandemic of 2021. For those that only accessed primary care services, most were older between 56 and 75 years old (55%), were retired and had good insurance coverage. For those that did not access any primary care services (6%), most had fair to poor insurance coverage, tended to be younger (18-35 years old) and had another type of employment. For those that did access primary care and at least one other service, most accessed hospital-based care (78% vs. 22%, respectively). While there were respondents who did not access care, a vast majority reported accessing one to multiple healthcare services in the last three years. General perceptions of those that did access care thought their personal and community health was at least somewhat healthy, had good to excellent health insurance coverage, and felt their knowledge of health services in the community was at least fair to good. Over half of the respondents lived locally to the CAH, were female and worked full-time.

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Accessed Primary Care in the Last Three Years

Nearly all respondents accessed primary healthcare services in the last three years (94.12%), but only 11.8% were seen in the CAH's attached rural health clinic (RHC) or local provider. Most reported their primary care services were in cities located 130+ miles (30.4%) and 200+ miles (16.2%) from the CAH's located city. Both alternate facilities have ground transportation times greater than 2 hours one-way under optimal conditions. Most selected their primary care services to be closest to home (38.5%) and prior experience with the selected clinic (39.1%). Nearly 40% of respondents reported a delay in seeking healthcare. Respondents most often delayed care because they could not get an appointment (26%), felt it cost too much (26%), concerned about the quality of medical providers (26%), or took too long to wait for an

appointment (24%). There were additional delays due to concerns over provider choice, respect and when offices were open (>10% each). Transportation, distance, childcare, and employment were not cited as primary sources for delays in care (<10% each). Interestingly, only 13.5% reported missing any type of medical appointment due to transportation issues or delays.

Using forward selection, binary logistic regression determined that insurance coverage and age were significantly associated with being seen by a primary care provider (Table 4). Compared with a perception of poor insurance coverage, both perceived good (p=0.018) and excellent (p=0.036) coverage were significantly associated with a higher odd of accessing primary care in the last 3 years. A majority of respondents stated they had government-sponsored insurance (41.5%, Medicare/Medicaid/Veteran Affairs) followed by employer-sponsored insurance (23%). Less than 5% of respondents stated not having insurance of any kind primarily due to the cost of medical insurance (63%). Similarly, those 36-55 years old (p=0.025) and 56-75 years old (p=0.003) were significantly more likely to access primary care services compared to their younger counterparts (18-35 years old).

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Accessed Hospital Care in the Last 3 years

Most respondents accessed hospital services in the last three years (63.4%) with 26.9% being seen in the local CAH. However, hospital-based services were also accessed at the closest two CAHs requiring one-way commutes of 90 miles (18.5%) and 71 miles (23.2%), respectively. Most sought care at alternate facilities due to privacy/confidentiality concerns (49%), closer to their residence (35%), emergent situation (31.5%), and the hospital's reputation for quality care (31.5%). Using binary logistic regression, personal health, community health, age and

employment status were forward selected into the model for hospital-based care (Supplemental Table 1). The factors of personal health, community health, age and employment status, while included at an alpha of 0.25, failed to reach the level of significance. Those who perceived the community as somewhat healthy, retired, or worked part-time were slightly less likely to access hospital-based care (p = 0.087, 0.104, 0.095, respectively). Conversely, those aged between 36-55 years old were slightly more likely to access hospital care (p=0.100, Odds Ratio = 3.79). The large service area and the adjacent available two CAHs in nearby counties resulted in increased variability for usage at the studied CAH.

Accessed Specialist Care in the Last 3 years

Most respondents accessed specialty care services in the last three years (77.7%) with only 16.0% being seen in the local CAH. A majority accessed specialty services at the closest Level I facility, which has the largest number of specialties in the state. Some specialists were accessed at the closest two CAHs (29.8% and 22.1%, respectively). Respondents most frequently reported being seen by a dentist (28.5%), orthopedic surgeon (26.2%) optometrist (23.85%), and cardiologist (21.5%). None (0%) of the respondents indicated that that had been seen in the last 3 years by a dietician, geriatrician, psychiatrist, social worker or substance abuse counselor. An additional 13 specialties were seen by 10 or more respondents. Only 21% combined accessed any type of therapy service (physical and occupational) and audiology, which occupy a significant portion of the outpatient clinic and inpatient services.

Personal health, community health, insurance coverage and gender were forward selected into the binary logistic regression model for specialty care (Table 7). Those who perceived their personal health as healthy to very healthy were significantly more likely to access specialty care

(p=0.049). Conversely, those who perceived the community as healthy to very healthy, were significantly less likely to access specialty care (p=0.046). Of note, both groups are contrasted with those that perceived their own health and the community's health as unhealthy. Those with excellent insurance coverage were significantly more likely to access specialists for their care (p=0.094). Males were slightly more likely to access specialty care than females (p=0.14).

Exploratory Predictive CART Analysis

While all eight predictors were included in the forward selection process, knowledge of health services and zip code of residence both failed to meet the selection alpha of 0.25 for all three response models. Moreover, gender and employment status were only marginally significant for a single model. Despite the relatively low sample sizes, CART models were used to identify classifications among the categorical predictors and binary responses which otherwise did not emerge using regression approaches (Table 5). **Perceptions of community health, employment status, insurance coverage and age were the top three predictors amongst the three CART models for accessing primary, hospital and specialty care.** These strong relationships identified in the CART model were likely not identified using the regression models due to the complexity and underlying patterns difficult for standard statistical techniques to identify. Those accessing specialty care showed a diverse range of perceptions and groupings, which led to the most complex 9-node decision tree heavily branched towards excellent insurance coverage and perceptions of their community's and personal health. Uniquely, employment status, residence, and gender provided no relative importance in accessing specialty care in Montana, likely due to the lack of specialty care within the state. While an exploratory predictive analyses, the relatively simple 4-node models for accessing primary and hospital-based care provide an excellent decision tree for education to the community and reducing

barriers by healthcare providers in the area. A strong focus on communication and educating personal and community health with access to at least good health insurance coverage may enable better usage of local resources for primary and hospital care.

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Discussion

The present analysis is consistent with similar research on seeking medical care in rural and urban communities (Harju et al., 2006). As shown in this study as with others in both rural and urban settings, ability to pay for services is a major determinant to seek care (Cyr et al., 2019). As both rural and urban settings seek to leverage telehealth to reduce costs and travel burden, there is still disparity in home digital access, Internet, and insurance coverage. Among residents most vulnerable to increased morbidity and mortality, such as shown in one study with American Indians, Alaska Natives, Hispanics, and non-Hispanic Blacks (Curtis et al., 2021). Compoundingly, both rural and urban communities have noted challenges with shared information exchange and communication across clustered healthcare facilities or practices that may be frequented by a local population. Ineffective communication leads to redundancy in diagnostics and delays in care plan harmonization across primary and specialty providers, which allocates time away from value-added patient care and moreso on coordination that burdens both rural and urban residents (Cyr et al., 2019). As shown in this study, specialty visits are accessed either via rotational clinics or in separate facilities external to the local CAH, which may affect CAH utilization and perception of its role in community healthcare delivery.

Knowledge of local CAH services did not prove to be a significant factor in healthcare access behaviors across any of the models. Based on this analysis, a respondent's insurance

coverage status and type may drive decision-making particularly when seeking primary and preventative care. However, insurance coverage and type of insurance was not significantly related to being hospitalized in the last three years, which may be in part given the emergent or urgent situation where care is necessitated regardless of insurance status. As the question did not specify the reason for a hospital visit (emergent vs. non-emergent), a visit to the hospital could also be indicative of the upward trend in rural communities of using emergency services for primary care reasons (Baskin et al., 2015).

As is the case across the United States, rural residents are aging at a faster rate than urban centers (Cohen & Greaney, 2023). Aging populations, such as the population identified in this study, require anticipatory considerations to healthcare and general services offered in order to '*age in place*.'(Cohen & Greaney, 2023). *Aging in place* largely rests on cultural and environmental factors that promote wellness and decrease isolation among older adults, thus affording improved health monitoring and resource allocation to support food security, social involvement in the community, and safety (Cohen & Greaney, 2023). However, older adults have experienced constrained services in their rural communities that leave gaps in necessary care attributable to changes in local economies as young adults depart from low-resource (rural, frontier) settings to metropolitan and micropolitan centers (Thiede et al., 2017). **Environments conducive to healthy aging extend beyond the hospital walls, as evidenced by this secondary analysis, to perceptual implications of the community at-large being 'healthy' or 'unhealthy' if key adjacencies are not available.** Common adjacent resource examples include grocery stores, areas for physical exercise, community centers, and public transportation (Klann et al., 2019).

A secondary analysis of CHNAs can provide additional feedback to CAHs on questions that are more relevant to the needs of the community and perceptions of quality that inform future design choices while acknowledging the differing degrees of adaptability with local resources. While the traditional approach of descriptive statistical CHNA reports provide useful information, diving deeper into data analysis and looking at the associative results between questions allows for a more robust interpretation of the data with a higher degree of clinical utility. For example, an association between insurance status and access to primary care services may indicate absence of local facilities or differences in respondent behaviors, norms, or values associated with primary or preventative care.

A key finding of this study was the low or unreportable resident response rate of accessing physical/occupational therapy or audiology, yet these two specialty offerings comprise a significant footprint (of the approximately 30,000 combined square footage of outpatient clinic and hospital these services occupy over 6,000 square feet ~20%) of the CAH. At the time of initial contextual observation by the study team, the healthcare leadership had discussed expanding the physical/occupational therapy space, which is contradictory to the reported utilization by this study sample.

Implications and Recommendations for Rural Healthcare Design

While contextual observation and qualitative interviews are the ultimate standard for community participatory design, the expense of gathering enough data in interviews can be cost prohibitive (Rupert et al., 2017). As CHNAs are a fixed requirement, they can be an anticipatory bridging tool and resource between design team and the rural community to rapidly assess the fit of a project's scope and budget. **CHNAs, as demonstrated through the RCPDF, can also act**

as a catalyst in starting conversations with the community through their own words and perceptions. Ultimately, the early integration of community voice can shorten the overall timeline of projects while still achieving more meaningfulness to a resource –sustainable design approach.

CHNA data analysis findings should not act as a complete substitute for qualitative interviews. Rather, synergistic interpretation of focus group data collection should be used to either validate convergence or divergence from CHNA analysis findings. Divergence from CHNA findings should be further investigated before design changes are finalized. This may be indicative of inadequate population sampling in the CHNA process, or imbalanced focus group composition of stakeholders. An example is the heavy emphasis on expanding physical/occupational therapy, which is gaining attention as a shortfall in reimbursement for rural areas compounded by absence of trained providers (*Small Rural Hospital and Clinic Finance 101 Guide*, 2021). However, the CHNA does not depict sufficient attention to this service line in comparison to absent service lines which would meet other meaningful design goals, such as inclusion of obstetrical care and veteran's health, which are both known healthcare access shortages in this region of Montana, particularly among American Indian communities which border the CAH (Charlton et al., 2016). Design teams may then be responsive to these identified service lines that are under-developed or not yet included in the operational planning of the proposed space in the CAH, demonstrating the importance of leveraging the CHNA as a tool to promote conversation with the client and evidence in the design process.

CHNAs are helpful in that the data is widely available and gives community voice perspective through utilization of retrospective data acquisition. In its current format, however, CHNAs are isolated by system or state, with little affordance to readily collate data for large

representations of geographical regions. Future recommendations include collation of CHNA data among design firms to understand regional and state-wide patterns of healthcare utilization, which in turn permits anticipatory prospective patterns over time. This would allow for more collaboration amongst healthcare facilities that are responsive in their decision-making related to service line inclusions and the implications for built environment evaluations and engagement with community leaders.

As other research has reported, useful indicators of community health and wellbeing are subjectively selected and often lack evidence-base to adequately inform materials selection, construction schedule, and thematic architectural elements crucial for community representation (Lach et al., 2022). Globally, this study and the included framework validated global appraisals of community assessments in that the approach here was grounded in the community's capabilities and their knowledge base related to design and definition of health (Ravaghi et al., 2023). Capabilities in operational planning of a healthcare project may include level of technological integration, ability to communicate via phone/computer service, and the presence of local economy which substantiates the value proposition for a service line or facility (Ravaghi et al., 2023).

Limitations

Rural populations are known to be quantitatively small, racially/ethnically homogeneous, and geographically distanced. Given these established characteristics of rurality, the effect size in this study was small though many of the associations and models were significant. As this study utilized an exploratory CHNA, collation of additional years of CHNA data may allow for more robust data interpretation. Questions included on the CHNA were not augmented for this study

and lacked validated measures for certain inquiries, such as asking respondents about their level of depression. Questions permitted openness with interpretability by respondents, which in turn widened the response variability and reduced the generalizability afforded from narrowing response options. This widened response potential created many categories of responses that were too few to report.

To address limitations noted here in future research, the investigators will collaborate with the Office of Rural Health and partnering CAHs to determine changes in approach with survey lines of questioning to optimize use of results across different design projects. As the response rate was 25.6% (188 residents) for the 2021 CHNA, there is opportunity to reimagine the sampling approach and methods to expand the inclusion of additional voices from the surrounding communities to increase the response rate. This has included raising the CHNA as an important instrument of change management and utility for design teams with the state healthcare association stakeholdership. Additionally, the predictive modeling was exploratory and having yielded positive results can now be applied to a much larger sample size to understand regional healthcare paradigms using CART and other more advanced artificial intelligence modeling. Future work will include a larger sample size of CHNA data across all MT CAHs to predict response values for new observations. RCPDF is an iterative process, requiring a constant feedback loop between CAHs and the communities of interest during renovations, rehabilitations of care delivery spaces, and complete redesign projects. Through analysis of CHNAs, interpretation of findings, focus groups, and improvement of survey design, CAHs can utilize community voice to improve project design and execution.

Conclusions

This project, which consisted of a secondary data analysis of a community health needs assessment for a small CAH in rural Montana, was conducted to expand our understanding alignment between observable built environment findings which may affect care access, and behaviors compared to resident survey responses. Through this study, it is suggested that visits to a primary care facility, specialty clinic, or the hospital have certain associated predictors, such as insurance, perceptions of personal health, or perceptions of community health. Novel to this analysis is the finding that respondent knowledge of service offerings in the area was not a significant predictor of engaging with CAH services.

As CHNAs are consistently conducted and public sources of information, there is a high degree of utility for design teams during ideation and project conceptualization to gain insights from a larger sample of a geographically expansive population outside stakeholders immediately local to a facility or those identifying as employees. CHNAs may also be used to guide healthcare facilities and systems in low-resource settings to develop post-occupancy evaluations and performance metrics which are congruent to the built environment in which care is delivered. The RCPDF was validated in its adaptability to incorporate retrospective sources of information to guide phases of a design project and integrate external sources of community data to lend additional insights, which may guide client decision-making. Future research will be pursued to include longitudinal review of CHNAs compared to augmentations in the built environment and healthcare service lines of CAHs to understand regional patterns of resident healthcare seeking and access behaviors.

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