Environmental Health in Rural Alaskan Health Clinics: A 5-Year Review

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Abstract **Small health clinics often are the sole source of healthcare for communities in Alaska's rural interior. Ensuring that these facilities maintain a safe and functional condition, therefore, is essential to ensure both access and continuity of care. The study described here analyzed 78 environmental health surveys conducted by the Tanana Chiefs Conference in 26 clinics over a 5-year period. These surveys aim to help clinics identify and address issues that could compromise patient safety or the clinic's ability to provide patient care. The large variation in clinic size and service demand is addressed by expressing data as rates per 1,000 annual residents. Of the 1,315 observations recorded, the most common observations were related to building condition and design (34.2%), safety and health (25.1%), and fire safety (15.8%). Although these clinics fulfill a much-needed niche, clinic location and lack of resources can lead to poor environmental health conditions. Failure to remedy these issues can lead to less comprehensive patient care, reduced safety for staff, and an unsanitary clinic environment.**

Keywords: rural health, tribal communities, health disparities, public and environmental health surveillance

Introduction

Environmental health conditions are critical to patient and staff safety in healthcare settings. Without these conditions, patients and staff can experience adverse health effects from a lack of proper sanitation, air quality, and inadequate waste disposal, for example. Thus, violations of these environmental health standards can lead to issues such as contamination, infection, and disruption of healthcare services (Brender et al., 2011). Severe enough violations could lead to closure of the clinic by the Accreditation Association for Ambulatory Health Care (AAAHC).

It is important to note that Community Health Aide Program clinics often are the only source of healthcare in rural Alaskan communities. There might be physician assistants or nurse practitioners at a clinic in a nearby village; rural areas lack major hospitals that are found in cities such as Fairbanks and Anchorage. Thus, closure of a rural clinic could leave hundreds of residents without healthcare (Chernoff & Cueva, 2017).

The Tanana Chiefs Conference (TCC), founded in 1962, became the provider of many Bureau of Indian Affairs programs, including environmental health, starting in 1974 for several predominantly Indigenous villages (Tanana Chiefs Conference, 2025). Being the sole provider of these services in such a rural location means finding solutions to a variety of unique challenges (e.g., isolation, limited resources, extreme winter weather conditions). Due to the location, many of these communities can be accessed only by air or water, severely limiting the sustainability of these clinics (Storey, 2010). This situation leads to disparities in healthcare access and quality of care for communities that are predominantly Indigenous (Ehrenpreis & Ehrenpreis, 2022).

Although rural healthcare access has received some attention, environmental health compliance rarely is looked at in depth (Dash & Rath, 2021). Sparse data exist detailing how often different violations occur in these settings, as well as what the most common violations are. For the TCC region of Alaska Native communities, it was virtually impossible to find any public data, which leads to a gap in understanding the risk factors and long-term trends of environmental health in Alaska's Interior.

To address this gap, 5 years of environmental health inspection data from TCC records were analyzed. The goals for this study were to see 1) if there was an overall improvement in the number of observations seen in studies over the past 5 years, 2) what findings were the most common, and 3) how many of these observations were repeated across years.

Methods

This project was a retrospective, descriptive analysis of environmental surveys that were collected during 2020–2024 via annual, nonregulatory surveys conducted in clinics. Of note, these inspection surveys are observational and serve as evaluations to guide corrective actions before regulatory inspec-

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TABLE **1**

Frequency of Survey Administration Across Communities

# of Years Survey Was Conducted	# of Communities
1	2
2	8
3	7
4	5
5	4
Total	26

tions by AAAHC. Thus, these surveys do not depict formal violations and are instead preventive measures. This data set applies to 26 villages across Alaska's Interior, comprising a population of 5,682 people. All clinics were rural health clinics, some of which were tribal facilities owned by TCC.

The surveys were conducted by TCC staff, all of whom were environmental health specialists who hold at least a bachelor's degree in environmental health. The main tool used was the Village Health Clinic Survey checklist from the TCC Office of Environmental Health (OEH). Additionally, most observations were photographically documented. Each of the observations was grouped into categories: building condition and design, environmental services, fire safety, furnishings, infection prevention and control, safety and health, and refuse. Each category consisted of several subcategories (e.g., plumbing, electrical, and lighting for the category of building condition and design).

Data were documented electronically in the TCC OEH records. Each observation was categorized by location, the finding, corrective action needed, and any photographic documentation of the observation. A total of 78 surveys during 2020–2024 were reviewed and analyzed.

To standardize comparisons across diverse clinic sizes and service demands, findings were normalized per 1,000 annual residents. Some variation in the data is because not every clinic conducts surveys annually. Additionally, the clinics varied widely in size and frequency of use. The smallest villages had only a few dozen residents, whereas the largest villages had >600 residents. Consequently, some clinics had a far lower caseload and were not staffed at times, leading to a wide variation in the number of findings across clinics.

Population data were obtained from internal TCC data from census estimates. Descriptive statistics were calculated using Microsoft Excel, and annual trends were established by comparing the average observations per 1,000 annual residents across the study period.

This study was conducted using anonymous compiled data. Because our agency has no regulatory authority, and no identifying information was used, institutional review board approval was not needed for this study. All clinic names from which the data were pulled have been excluded from our analysis to preserve confidentiality.

FIGURE **1**

Percentage of Observations by Category

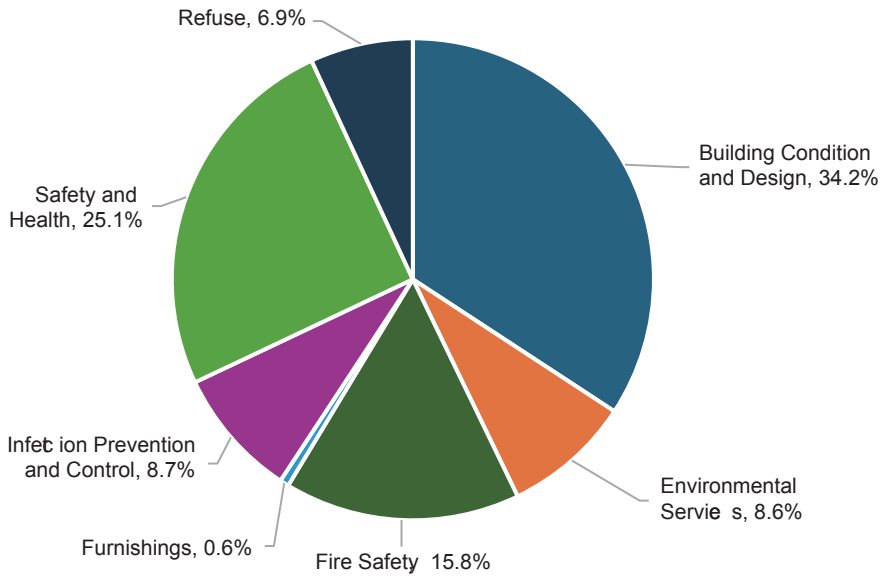


TABLE **2**

Observations by Category

Category	# of Observations	% of Observations	Per 1,000 Annual Residents
Building condition and design	450	34.2	27.1
Environmental services	113	8.6	6.8
Fire safety	208	15.8	12.5
Furnishings	8	0.6	0.5
Infection prevention and control	115	8.7	6.9
Safety and health	330	25.1	19.9
Refuse	91	6.9	5.5
Total	1,315	100	79.3

TABLE **3**

Results by Year

Year	Population of Surveyed Towns	Total Observations	Total Observations Per 1,000 Population	Repeat Observations	Repeat Observations Per 1,000 Annual Residents
2020	1,866	180	96.5	42	22.5
2021	4,561	326	71.5	50	11.0
2022	4,978	365	73.3	89	17.9
2023	2,953	262	88.7	68	23.0
2024	2,220	182	82.0	32	14.4
Total	16,578	1,315	411.7	281	88.8

TABLE **4**

Observation Results by Region

Region	# of Observations	% of Observations	Per 1,000 Annual Residents
Yukon–Tanana	459	34.9	88.4
Yukon–Kuyokuk	454	34.5	85.6
Yukon Flats	225	17.1	134.6
Upper Tanana	177	13.5	39.5
Total	1,315	100	348.1

Results

Overall, 26 clinics were surveyed, which led to a total of 78 surveys analyzed. The timeframe of this study was 2020–2024. On average, each clinic had 3 years of data to study; only 4 communities had a survey from all 5 years (Table 1). Across all surveys, 1,315 observations were recorded.

The most frequent types of observations were building condition and design (34.2%), safety and health (25.1%), and fire safety (15.8%). The least common types of observations were furnishings (0.6%) and refuse (6.9%) (Figure 1). After being standardized per 1,000 annual residents, there were 27.1 observations for building condition and design, 19.9 observations for safety and health, and 12.5 observations for fire safety (Table 2).

The number of observations varied considerably over the years surveyed. The total number of observations per 1,000 annual residents was the highest in 2020 (96.5), dropped significantly in 2021 (71.5), rose until 2023 (88.7), and then dropped slightly in 2024 (82.0) (Table 3). The repeated observations followed a similar trend.

The clinics in the Yukon–Tanana region had the most observations (459), comprising 34.9% of all observations. The Upper Tanana clinics had the least observations (177), comprising 13.5% of observations. When controlled per 1,000 annual residents, the Yukon Flats region had the most observations (134.6) and the Upper Tanana region had the least (39.5) (Table 4).

Discussion

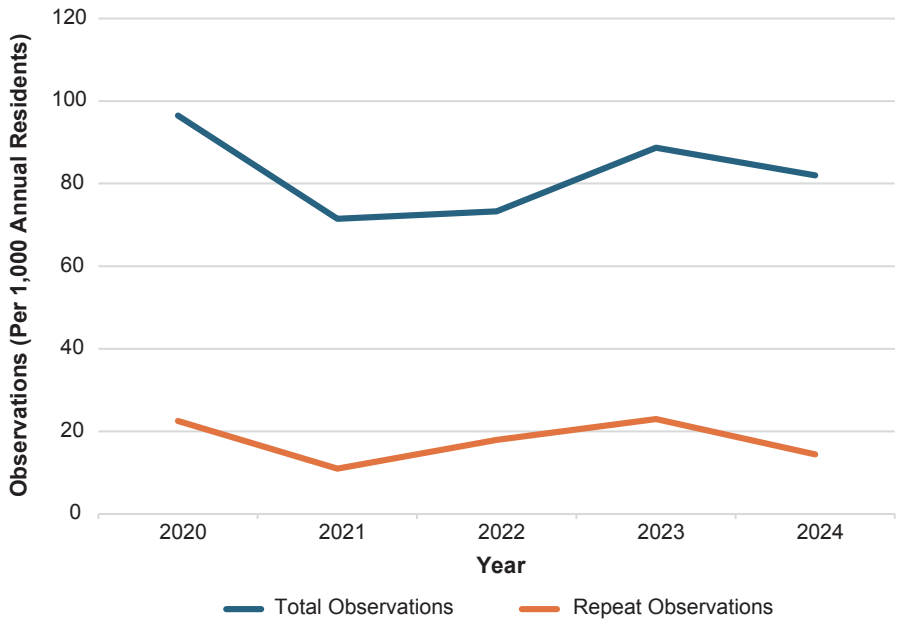
This analysis found that building condition and design observations were the most common, while furnishing observations were by far the least common. A yearly trend showed an overall decrease from 2020 through 2024, but fluctuations occurred between years and the number of observations varied greatly between regions.

One possible explanation for frequent building condition findings could be the persistent infrastructure challenges that are often documented in rural communities (Qin et al., 2022). Due to the harsh climate, particularly in winter, pipes often back up or freeze due to seasonal changes (Smith et al., 2008). Water expands when freezing and can cause cracks in the flooring, walls, and ceilings of a building. Due to the rural nature of these clinics, maintenance can be delayed indefinitely or performed by personnel without formal training. This situation could explain the relatively large number of fire safety observations, which were often due to a lack of annual fire extinguisher inspections (which must be conducted by an accredited fire and safety retailer) and faulty fire safety systems that needed maintenance.

This structural and systemic damage (e.g., cracked walls, ceiling leaks, faulty fire safety infrastructure) can compromise typical public health prevention measures including infection control (e.g., mold growth from poor ventilation), injury control (e.g., injuries from collapsing ceilings), and basic sanitation (e.g., contamination from faulty water supply). These issues are not minor—they often reduce the efficiency and overall operability of the clinic, especially in the case of emergencies. In particular, lapses in fire safety increase the risk of a clinic burning down (Agus Salim et al., 2021), which would leave the community without healthcare access and, more importantly, could result in the injury or death of residents. Together, these conditions create a hazardous environment, which increases the high barrier that Native populations deal with when accessing health services.

Another common type of finding was observations in the category of safety and health, which includes issues of compressed gases, medicine control, and hazard communication. One issue found in most clinics was expired medical equipment. From a public health perspective, expired medication and patient care materials pose a large risk to patient safety, such

FIGURE **2**



as reduced treatment efficacy and increased infection risk (Sivasankaran et al., 2019).

Furthermore, some clinics do not have a large enough population to support various types of interventions. For example, a particular community without a large amount of trauma injuries was found to have expired surgical tape from 2017 due to a lack of need. Additionally, clinics typically have only a few employees at any given time and sometimes are not staffed year-round. Thus, it can be difficult to regularly check and pull expired items from inventory (Bashatah & Wajid, 2020).

Annual Trends

One especially interesting result was the fluctuation in the number of observations between years. It is no surprise that 2020, the year of the COVID-19 pandemic, had the highest number of observations per 1,000 annual residents, because most clinics were struggling to find staff and stay afloat amid high patient volume. The high observations in 2020, though, contrasted with a sharp decrease in observations in 2021. One potential reason for this drastic reduction in observations could be that TCC travel was limited in 2021 to more essential visits, and environmental health surveys for clinics were not prioritized. This situation could have led to a less strict inspection of a clinic, and also a reduction in the most remote clinics being inspected, which together could result in a lower number of findings. Overall, 2022 remained largely unchanged from 2021, other than a moderate uptick in repeat issues (Figure 2).

The largest increase in observations occurred in 2023, with 88.7 observations per 1,000 annual residents (Table 2). This finding can be attributed to multiple factors. For one, travel within TCC was becoming less strict after the pandemic, allowing travel to all villages rather than only to the villages deemed necessary. There was also some staff turnover within the TCC OEH. Additionally, different inspectors make different observations, which leads to variations in findings. Furthermore, clinics that had been inspected for the first time in years in 2023 had a better understanding of what was needed to improve their environmental health, explaining why the number of repeat observations was low in 2024 (Figure 2).

Regional Trends

Contextualizing results by region is more complex due to variations in size and population. This variation, though, likely explains the somewhat inconsistent data. The Yukon–Tanana and Yukon–Koyukuk regions have more consistent data, which can be attributed to a larger population being served, larger clinics, and more surveys from which to pull data from. Of note, though, the Upper Tanana and Yukon Flats both have lower populations, fewer clinics, and fewer surveys to pull data from, which led to a wide variation in observations per 1,000 annual residents (39.5 versus 134.6), as shown in Table 4.

Similar Research

These findings can be further contextualized with published research. For example, there are repeated issues in accessing healthcare as a rural Alaskan, particularly for Alaska Natives (Cromer et al., 2019). Public health, and in particular environmental health, are already neglected fields. More immediately pressing issues (e.g., healthcare) exist, however, which will necessarily divert much of the attention. Additionally, the lack of health support in rural communities is leading some individuals—especially young people—to leave their communities (Driscoll et al., 2010). Alaska Natives leave their communities for other reasons, such as opportunities elsewhere for work. For this reason, many of the communities that TCC serves are shrinking, and this reality has been made worse by the fact that very few children are being raised in the villages due to limited opportunities (Blue Bird Jernigan et al., 2020).

Policy and Public Health Implications

One of the goals of this study was to bring attention to the challenges that these rural communities face, which can be attributed at least partially to a lack of resources. Although the Community Health Aides/Practitioners Program has helped expand access to the most remote areas (Golnick et al., 2012), many rural communities remain vulnerable to basic infrastructure issues. For example, multiple clinics were found with system failures, leading to issues such as a lack of running water in the clinics.

Moreover, the surveys examined in this study help the clinics self-evaluate their standings, allowing them to maintain accreditation. Without intervention, unresolved problems could lead to clinic closure, leaving hundreds of people without access to care. Thus, more funding is needed for not only

healthcare delivery in these areas but also the infrastructure and environmental health resources that support healthcare.

Limitations and Strengths

It is important to acknowledge the limitations of this study. There was incomplete survey coverage for most clinics across all years, both due to the pandemic and to logistical limitations. Furthermore, the data are observational, and TCC OEH is not the regulatory agency for these facilities. Additionally, there were variations in how observations were documented because there were three main inspectors, each of whom had slightly different viewpoints on how to inspect clinics. There is also a notable lack of published data specifically addressing the environmental health conditions of clinics in rural Alaska. This study aimed to help fill that gap by analyzing environmental health survey data from clinics within the region. Due to a lack of comparable research, it is difficult to contextualize findings from similar populations.

This study has several strengths. The longitudinal scope of the surveys over 5 years gives weight to the research findings, as the surveys cover some data before the pandemic as well as the entirety of the pandemic and its consequential effects. These data are from an underrepresented region with many underserved people, leading to previously unpublished insights due to a lack of study. Additionally, these data are based on an internal perspective of a tribal agency and focused on prevention rather than punitive findings. This approach and emphasis ensure that minor mistakes are corrected before major ones could lead to a clinic being closed.

Future Studies

Follow-up studies are needed on environmental health in clinics in rural Alaska to help support and further contextualize the findings from this study. Possible future research directions include research on the link between environmental health and patient outcomes, as well as a study on the new software being used by TCC to track environmental health observations. Additionally, it would be interesting to see the perspective of the clinic staff, as inspectors typically only see the clinics once per year.

Conclusion

This study analyzed persistent environmental health challenges that clinics in rural Alaska face, particularly challenges related to infrastructure, medicine control, and fire safety. While there was an overall decrease in the number of environmental health observations since 2020, substantial fluctuation occurred between years. Targeted maintenance and increased staffing could potentially help remedy some of these issues.

In a practical sense, this study provides administrators, tribal leaders, and policymakers with data-driven insights and conclusions to help prioritize resources such as funding. Academically, this study brings attention to environmental health issues in an underrepresented setting. This study underscores the need for improved monitoring systems, increased funding for fields such as environmental health that support healthcare, and stronger infrastructure investment to ensure quality healthcare is delivered in underserved and rural areas. Assistance from advocates and policymakers is still needed to facilitate positive change.

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