

ORIGINAL ARTICLE

Climate change health assessment: a novel approach for Alaska Native communities

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ABSTRACT

Objectives. Develop a process for assessing climate change impacts on public health that identifies climate-health vulnerabilities and mechanisms and encourages adaptation.

Study design. Multi-stakeholder, participatory, qualitative research.

Methods. A Climate Change Health Assessment (CCHA) was developed that involved 4 steps: (1) *scoping* to describe local conditions and engage stakeholders; (2) *surveying* to collect descriptive and quantitative data; (3) *analysis* to evaluate the data; and (4) *planning* to communicate findings and explore appropriate actions with community members. The health effects related to extreme weather, thinning ice, erosion, flooding, thawing permafrost and changing conditions of water and food resources were considered.

Results. The CCHA process was developed and performed in north-west Arctic villages. Refinement of the process took place in Point Hope, a coastal Inupiat village that practices whaling and a variety of other traditional subsistence harvest practices. Local observers identified climate change impacts that resulted in damaged health infrastructure, compromised food and water security and increased risk of injury. Priority health issues included thawing traditional ice cellars, diminished quality of the community water source and increased safety issues related to sea ice change. The CCHA increased awareness about health vulnerability and encouraged informed planning and decision-making.

Conclusion. A community-scale assessment process guided by observation-based data can identify climate health impacts, raise awareness and encourage adaptive actions, thereby improving the response capacity of communities vulnerable to climate change.

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Keywords: Indigenous, Arctic, climate change, Alaska Natives, health assessment

INTRODUCTION

Around the world, communities seek local scale information so they can mitigate negative climate effects and develop healthy methods for adaptation (1). In Alaska, the effects of climate change vary by region and by community, but across the state residents are concerned about threats to food and water resources, public safety and infrastructure. In response, the Alaska Native Tribal Health Consortium (ANTHC)¹ developed a Climate Change Health Assessment (CCHA) process that identifies vulnerability and develops response capacity at the local and regional level.

Indigenous populations are vulnerable to climate change because of their close relationship to the environment, subsistence lifestyle and prevalence of impoverishment, marginalization and disparities in their disease burden (2,3). Rural Alaska Natives are highly dependent on traditional subsistence plant and wildlife species, experience high rates of unemployment and poverty and have a well-described set of health disparities (4). Alaska Natives number approximately 135,000 and comprise 19% of the state's population, the largest percentage of Native Americans of any state in the country. Approximately 65% live in isolated rural areas off the road system and 58% reside in villages of 300 or fewer residents (5).

The climate in Alaska has changed rapidly during the past 50 years, with warming occurring at twice the rate as the rest of the United States. During this time, the average mean annual temperature has warmed by 1.6°C (6). This has resulted in changes to the ecosystem, including thawing permafrost, melting glaciers, increasing

incidence of extreme weather, drought and erosion, and changes in the range and distribution of plants and wildlife (7).

These impacts are changing the lives of Alaska Natives. A variety of health effects, both positive and negative, have been described by residents. Examples of positive effects include the emergence of new food resources and lengthening of the seasons for water treatment. Examples of negative health effects include morbidity and mortality caused by unpredictable and extreme weather, changes to lifestyle or diet, potential changes in infectious diseases and damage or disruption to water and sanitation infrastructure.

Warming of the North Pacific and Bering Sea has been accompanied by the emergence of new zoonotic diseases and is increasing the prevalence of existing zoonotic diseases (8). In addition, warming is thawing ice and permafrost and melting glaciers, increasing the outflow from some Arctic rivers and increasing industrial contaminants to sea water (9,10). Mental health has also been affected causing fear, anxiety or depression, as extreme weather threatens human life or property or as rapid environmental change alters valued landscapes, resources, cultural elements or revered places (11).

The public health field has been increasingly challenged to address multifaceted climate health risks at the community level. Generally, the traditional environmental health exposure/response methodology strains under the complexity of climate change health risk assessment (12). Global, regional and national climate change assessments have generally aggregated information above the level of resolution required for effective community policy (13,14)

¹ANTHC is a statewide organization consisting of all the Alaska Native regional health corporations. ANTHC provides centralized community health services, village sewer and water construction, and operates a multi-specialty, tertiary care hospital.

and have often incompletely considered health impacts (15).

The limitations of applying large geospatial analyses to local climate impacts are known, as landscape change can outweigh the influence of longer-term climate change and as local land cover can influence micro-climate conditions in temperature, evapo-transpiration and run-off (16). Experience with community-level health assessments therefore remains largely undeveloped as climate change complexities interact with standing limitations of epidemiology.

These research challenges complicate assessment of adaptation options (12). However, a public health approach is in practice that focuses on (1) understanding climate change impacts over both temporal and spatial scales; (2) understanding the multifactorial influences to climate-sensitive health outcomes; and (3) developing a working understanding of the exposure-response relationships between environmental impacts and health outcomes (17). The successful navigation of these 3 areas requires interdisciplinary coordination on

climate change research, training and policy decision-making (16,18).

The objective of a CCHA is to provide a useful public health assessment, followed by appropriate intervention and monitoring. Interventions for health risks include limiting climate change through mitigation of greenhouse gases, or responding to climate change impacts (1) through adaptive engineering, education, prevention, surveillance, health care, disaster preparedness and public policy (19,20). Applicable assessment work has been undertaken in Canadian Aboriginal communities, with a focus on multi-stakeholder, participatory community dialogue (21). Our work follows and further develops and adapts this work to Alaska Native communities.

MATERIALS AND METHODS

Development of the CCHA

ANTHC developed a comprehensive process for evaluating health effects on orders of time, space and population (17) and on adaptation options

Table I. Epidemiological limitations in assessing climate change risk.

Limitation areas*	
Climate characteristics	
	<ul style="list-style-type: none"> • Global scale of risk • Complex vulnerabilities • Non-linear risk (occurs continuously through evolving pathways)
Baseline assessment	
	<ul style="list-style-type: none"> • Baseline variability difficult to differentiate from seasonal variability and existing climate disease dynamics (24) • Small population size undermines statistical evaluation
Effect confounders	
	<ul style="list-style-type: none"> • Health outcomes have diverse exposure modifiers and complex causal chains
Bias in exposure assessment	
	<ul style="list-style-type: none"> • Populations affected differentially, spatially and temporally, may receive selection bias
Future uncertainties	
	<ul style="list-style-type: none"> • Evolving characteristics of climate change • Populations will have uncertain societal, technological, behavioural and demographic characteristics (25)
Impact quantification	
	<ul style="list-style-type: none"> • Non-linear exposure and vulnerability make population comparisons difficult • Alternative metrics may be necessary to improve population comparisons

*Adapted from (13,17).

(12). The process had to be flexible for application across diverse environmental regions and populations of Alaska. ANTHC has performed health impact assessments (HIA) on large-scale natural resource development projects and a wide spectrum of experts also consulted in developing the CCHA, integrating methods from both environmental audit processes and HIA.

The CCHA was devised over 24 months and centred on a provisional 4-step process: (1) *scoping* to describe local conditions and engage stakeholders; (2) *surveying* to collect descriptive and quantitative data; (3) *analysis* to evaluate the data; and (4) *planning* to communicate findings and explore appropriate actions with community members. These steps were refined during the process by utilizing recommendations from climate and health experts and community members.

CCHA focuses on local observations and traditional seasonal time scales, on synthesizing climate and health causal chains, and on a broadly participatory framework, which combines Indigenous and Western knowledge systems and which was applied initially in Northwest Alaska in 2009. During 4 site visits, 29 community members were interviewed. As indicated, there are 4 steps in the CCHA process:

1. *Scoping* – This step developed a profile of general climate and health conditions, as well as demographics, geography, cultural distinctions and social and economic conditions. Effective partnering was essential for the success of the process and scoping was only initiated upon receiving a written request from local governance. Additionally, partnerships were initiated with state and federal agencies, academic institutions and researchers. General understanding

of the potential climate-sensitive disease burden was achieved through descriptions of the historical exposure–response relationships alongside environmental setting and etiological pathway (17,22). By synthesizing climate and disease data, preliminary climate change health effect pathways were identified.

2. *Surveying* – This step involved collection of observational data at the community level and allowed comparison of the regional profile developed during scoping, with local knowledge. Unique seasonal calendars were developed based on traditional subsistence seasons. This allowed the collection of observational data based on culturally appropriate and relevant timeframes. A survey tool, the Climate and Health Measure (CAHM), was developed and used for recording observations, assessing potential health effects, identifying data gaps and exploring adaptation pathways. Although too large to be included here, the CAHM is a data management spreadsheet with impact categories such as extreme weather, permafrost, erosion, ice and snow conditions, water and sanitation, food safety and security, and flora and fauna. The CAHM was modified using findings from the scoping process, thereby tailoring observational categories to the regional environment.

Participants were informed about climate change impacts within the region (e.g., warming), potential intermediate impact mechanisms (e.g., thawing permafrost) and human health effects (e.g., food spoiling in underground ice cellars). The community was not subjected to random sampling. Instead, there was a survey that focused on local key-informants whose knowledge contributed to the community climate-health profile. Inspections were performed of infrastructure, facilities and climate impact areas (often thaw, flood and erosion zones).

3. *Analysis* – This step examined the data on relationships between climate impact and health outcomes and established a baseline against which seasonal changes for subsistence and other activities were measured. Environmental epidemiology methods were applied, including analysis of environmental variables and health threats for correlation of discrete event trends or application of modelling of specific climate change variables (e.g., global sea level projections applied at local resolution). Descriptive information was identified and submitted to experts and stakeholders for criticism and input. If relationships were established, then impact categories were established to provide qualitative evidence for development of adaptation strategies.

4. *Planning* – This step involved returning draft findings to the community and initiation of response planning. Priority health issues were published in bulletins to expedite reporting and development of capacity for community response. Findings were presented and adaptation options explored in planning meetings with local leadership and, in return, interviews were held with key informants. Priorities were identified and directives were made for actions within local decision-making frameworks. This encouraged development of an action plan for monitoring and evaluating outcomes, a critical process in the adaptation response (12).

The CCHA report includes descriptions of climate-health mechanisms, vulnerability by health category, measures of health risks and benefits, principles for adaptation planning and specific public health recommendations. Recommendations may include building local response capacity, raising awareness, addressing data gaps, developing community plans and implementing and evaluating adaptation actions.

RESULTS

The first CCHA was performed in Point Hope in the spring and summer of 2009. A traditional Inupiat community of about 700 residents, Point Hope is located on the coast of the Chukchi Sea, in north-west Alaska. It is a region of rapid permafrost thaw and is vulnerable to coastal erosion, storm surge and flooding. The population is reliant on tundra lakes for water, on sea mammals for food and on the sea ice for hunting. Emphasis was placed on addressing impacts that were currently occurring, rather than those projected for the future. Priorities focused on previously undescribed vulnerability of the food and water supply. A brief summary of the CCHA results are provided as follows:

Scoping – The regional health authority expressed concern about climate change impacts. Requests for an assessment were made by the city and tribal government, and supporting resolutions were received from the health authority and borough. Scoping characterized the cultural, social, economic, environmental and health status of the population. Regional temperature data indicated that from 1949 to 2005 the average annual temperature increased by 1.8°C (6), with a significantly greater increase occurring in winter than in other seasons. Potential impacts include diminished sea ice, thawing permafrost and reduced access to subsistence resources.

Surveying – Twenty-nine individuals were interviewed, including local leaders, teachers, water plant operators, health aides, environmental managers, behavioural health workers, subsistence harvesters and public safety officers. Inspections were performed of the infrastructure, cultural sites, subsistence harvest and other areas vulnerable to thaw, flood and erosion. The CAHM survey tool was utilized by the assess-

ment team to categorize raw data into 6 categories: impact type, season, health effect, key observer, data gap and potential adaptation.

Analysis – Priority health issues included food insecurity from thawing traditional underground food cellars, reduction in source water quality due to warming and algae blooms, and an increased risk of injury from travelling on thin sea ice. Local temperature trend data and records from water treatment operations were analysed for climate-impact mechanisms. Draft reports were prepared and reviewed extensively with community members and health and borough authorities. (The final report can be found at www.anthc.org/chs/ces/climate/climateandhealthreports.cfm.) Feedback was provided at local and regional government council meetings and in a public forum in Point Hope. A regional climate change summit was held in the Kotzebue in September 2010 that included tribal representatives from across the Northwest Arctic Region.

Planning – Bulletins were published on priority health issues (food and water security). Planning sessions were initiated to develop strategic approaches to address these priorities. Special considerations in selecting adaptation options included funding resources, local capacity, available partnerships and whether the current state of knowledge would allow for the development of effective measures. Actions have included ground temperature monitoring of permafrost and source water physical conditions, and adaptive engineering designs to

improve food cellar performance. Regional and state governments have initiated programs to assess the vulnerability of other communities to similar water and food security problems.

As there are limitations to confirming conclusive climate-health relationships in short time period surveys, the CCHA only describes potential health risks and benefits. The resulting health effects are placed into a modified risk table to consider the probability of an effect and the severity of consequences, an accepted method for climate change impact planning (23). Such a risk table is detailed below (Table II), providing selected findings from Point Hope.

DISCUSSION

Climate change is having a dramatic impact on the Arctic environment, changing weather, the landscape, flora and fauna and the lives and health of Arctic peoples. Preventing negative health outcomes requires a local scale understanding of the type, timing and rate of change, as well as the direct and indirect health effects. In Point Hope, the CCHA was driven by local observation, then synthesized with available climate, environment and health data. Priorities were identified and stakeholders were empowered to address specific problems, consider strategies, develop partnerships and implement adaptive measures. By applying a process that relies upon local observations, the Alaska Tribal Health System has been able to

Table II. Climate impacts and health effects risk table, Point Hope, Alaska.

Impacts and effects	Thawing food cellars	Delayed shore ice	Warming lake water
Known negative	food insecurity	erosion, flooding	water insecurity
Known positive	none	none	none
Potential negative	foodborne illness	increased injury	waterborne illness
Potential positive	none	none	longer water treatment season

act quickly and support local efforts to develop appropriate responses.

This process is benefiting other communities by describing climate-health connections within the Alaska Native context. Since the Point Hope assessment was finished, 3 other communities have performed a CCHA. It is proving to be a model that delivers direct utility for the public health sector in Alaska, and it will continue to improve as relevant epidemiological methodologies evolve. Public health has been challenged to assess diverse health determinant factors in the context of climate change. The CCHA succeeds in identifying community vulnerability, engaging community members and facilitating adaptation planning. Given the rate of change that is occurring globally, there will be a growing need for community assessment processes that describe impacts to public health. CCHA provides a ready method for use in rural communities across the Arctic, one that could be adapted anywhere.

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