CLUSTER: VULNERABLE POPULATIONS IN THE ARCTIC

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Climate change and health effects in Northwest Alaska

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This article provides examples of adverse health effects, including weather-related injury, food insecurity, mental health issues, and water infrastructure damage, and the responses to these effects that are currently being applied in two Northwest Alaska communities.

Background: In Northwest Alaska, warming is resulting in a broad range of unusual weather and environmental conditions, including delayed freeze-up, earlier breakup, storm surge, coastal erosion, and thawing permafrost. These are just some of the climate impacts that are driving concerns about weather-related injury, the spread of disease, mental health issues, infrastructure damage, and food and water security. Local leaders are challenged to identify appropriate adaptation strategies to address climate impacts and related health effects.

Implementation process: The tribal health system is combining local observations, traditional knowledge, and western science to perform community-specific climate change health impact assessments. Local leaders are applying this information to develop adaptation responses.

Objective: The Alaska Native Tribal Health Consortium will describe relationships between climate impacts and health effects and provide examples of community-scaled adaptation actions currently being applied in Northwest Alaska.

Findings: Climate change is increasing vulnerability to injury, disease, mental stress, food insecurity, and water insecurity. Northwest communities are applying adaptation approaches that are both specific and appropriate.

Conclusion: The health impact assessment process is effective in raising awareness, encouraging discussion, engaging partners, and implementing adaptation planning. With community-specific information, local leaders are applying health protective adaptation measures.

Keywords: *climate change*; *health impact assessment*; *health effects*; *Arctic health*

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Arctic populations are vulnerable to climate change and seek adaptive strategies that will protect health and health infrastructure (1). Little has been done to assess climate change impacts at the community level, and knowledge to guide local adaptation efforts is limited. Northwest Alaska is experiencing a broad range of climate-related impacts with positive and (predominately) negative effects on health and well-being. Risks of injury, mental stress, and chronic and acute disease are increasing in an already vulnerable population (2). New risks related to food and water security are emerging along with damage and disruption to water and sanitation infrastructure. Participatory health impact assessments are being used to record local observations, describe vulnerability, and to develop appropriate responses.

The public health sector is challenged to assess community vulnerability to climate change and to develop capacity for appropriate health protective actions. These can include limiting climate impacts by reducing greenhouse gases, or responding to climate impacts through adaptation (3). Examples of adaptation include adaptive engineering strategies, public education, disease surveillance, health forecasting, extreme weather early warning systems, health work force training, disaster preparedness, and health consideration in public policy (4). In rural Alaska, there is a need for a comprehensive and multidisciplinary approach that identifies climate change's range of health-impact manifestations in time, space, and by population (5).

The Alaska Native Tribal Health Consortium has developed a process driven by local and regional

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observation that synthesizes complex climate and health causal chains, and combines both indigenous and western knowledge systems (6). Development of the process and the implementation was funded by the US Indian Health Service and the US Environmental Protection Agency. This article provides examples of climate health effects related to injury, infectious disease, food security, mental health, and sanitation infrastructure. It also provides examples of adaptive strategies that are being applied in two communities: Point Hope and Kivalina.

Present investigation

Regional characteristics

The Northwest Arctic region crosses the Arctic Circle and covers an area of about 63,000 square kilometers. Bordered by the Brooks Mountain Range to the north and the Chukchi Sea to the west, the area is underlain by ice-rich permafrost and is in the transition zone between taiga forest in the south and tundra in the north. It is also a transition zone between Arctic, maritime, and continental climate regions. In the hub community of Kotzebue, temperatures range from −46°C to +29°C. Total annual precipitation averages 23 cm with an average annual snowfall of about 101 cm (7). Between 1949 and 2006, the average annual temperature increased by 1.8°C (8), with the greatest increase occurring during the winter months. A comparison of monthly average air temperatures suggests a trend of increasing temperature in every month of the year (9).

About the people

There are a total of 12 communities in the Northwest Arctic region, the largest of which is Kotzebue with a population of about 8,000 residents. The region is remote and isolated with no connecting roads between communities or with the rest of the state. Eighty-five percent of residents are Inupiat Eskimos and many are engaged throughout the year harvesting caribou, seal, fish, whale, moose, berries, birds, and edible plants. Employment related to education, health, government, mining, transportation, fishing, and construction contribute to the economy. Unemployment is about 15.6%. The median household income is $45,976.00 and about 17.4% of the population is below the poverty level.

In 1950, the average life expectancy for Alaska Natives was 46.6 years. By 2001, life expectancy at birth for both sexes had risen to 70.3 years, largely due to decreases in mortality from infectious disease and unintentional injuries (10). Still, mortality rates for Alaska Natives exceed that of 'all races' in the USA, for all causes except heart disease. Rates for most chronic diseases are increasing. Age-standardized rates of cancer are up by 12%, chronic obstructive pulmonary disease up by 191%, and diabetes is up by 262%. These general trends also apply in the Northwest Arctic where the leading causes of death – cancer, heart disease, unintentional injuries, cerebrovascular diseases, and suicide – are all increasing (11).

Climate impacts, health effects, and adaptation

Injury

Extreme and unpredictable weather, altered seasons, and poor water, snow, and ice conditions are climate impacts that can cause injury. A leading concern in the Northwest is falls through ice. During the past two decades, thick multiyear sea ice has been replaced by thinner first-year ice over large areas of the Arctic (12). There is anecdotal evidence that sea ice conditions are increasing the risk of injury.

> *"The ice is no good for hauling out bowhead. Too thin. This spring it was so bad people were falling through the ice all over the place. It was very dangerous." (Ray Koonuk Sr., Environmental Program Director)*

On May 8, 2008, three Point Hope whaling crews were cast adrift when shore-fast ice broke free, resulting in helicopter rescues. Diminishing river ice is also a concern for many communities. Northwest Arctic residents rely on river ice roads to hunt, travel between communities, and transport fuel and supplies. But many rivers now have a shorter ice travel season. The Kobuk River is breaking up more than a week earlier than when records began in the early 1900s resulting in ice conditions that are more unpredictable and unsafe, even in mid-winter (13). Concerns about ice safety were expressed by residents in all of the communities surveyed.

> *"A few years ago freeze-up was late. We had three or four snow machines go through the ice. Two machines were lost." (Andrew Baldwin Jr., Public Safety Officer)*

Adaptation responses are merging traditional knowledge with modern technology. In Point Hope, emergency response time has been improving with the distribution and broader use of personal emergency locator beacons. The beacons are provided on loan to hunters and travelers by the local fire department. These are tracking transmitters that aid in the detection and location of people in distress.

> *"The storms have been very bad. Lots of wind and blowing snow. Hunters are using locator beacons that are tracked by Search and Rescue in Barrow. These result in rescues and saved lives." (Willard Hunnicutt, Fire Chief)*

Infectious diseases

The Northwest Arctic region has high rates of respiratory infection. In 2005, pneumonia was the leading cause of hospitalization, accounting for over 55% of hospital discharges. Poor sanitation is an important causal factor.

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Alaska Native homes without running water experience far higher rates of respiratory and skin infections (14). Climate change can indirectly increase the risk of infectious disease by damaging and disrupting water and sanitation infrastructure.

> *"When the washeteria freezes up, the number of people visiting the clinic with infections goes up." (Isabelle Booth, Community Health Aide)*

In October 2004, the development of shore ice in the village of Kivalina was delayed because of unusually mild temperatures. Shore ice is important as it provides a buffer between powerful storm waves and the fragile Arctic coastline. Storm surge that month (see photo 1) caused extensive erosion and damaged the sewage drain field at the washeteria, the only facility in Kivalina that provides public toilet, laundry, and shower facilities. The damage closed the washeteria for five consecutive months in 2005 and continued to contribute to declining days of washeteria operation over the next few years. Extended periods of closure raised concerns about the potential for increased rates of skin and respiratory infection.

A preliminary review of clinical patient visit codes by the Alaska Native Tribal Health Consortium suggests that increasing washeteria closure days correspond with increasing rates of skin infection. Between 2004 and 2007, the total number of skin disease-related clinical visits to the Kivalina Clinic more than tripled: from 44 visits per year in 2004 to 140 per year in 2007. An epidemiological evaluation has been initiated by the US Centers for Disease Control and Prevention to evaluate the potential relationship between washeteria closure and incidence of infectious disease. Adaptation activities in Kivalina include the construction of a new washeteria waste water system and an engineering feasibility study to look at other possible water and sanitation improvements.

Photo 1. Kivalina residents build an emergency sea wall. Photo courtesy of Millie Hawley

Food insecurity

A traditional lifestyle and diet helps to prevent many chronic diseases, but climate change is decreasing access to some healthy traditional foods. In Point Hope and Kivalina, thawing of the permafrost in traditional underground ice cellars is decreasing food security (15). Harvested bowhead and beluga whale is stored in underground food cellars, (see photo 2). The cellars until recently were frozen year round. Today, they typically thaw in the summer, resulting in meat and blubber that can be unsafe or inedible.

> *"We used to have frozen whale meat and maktak all year round, winter and summertime too. But it is not frozen anymore." (Joe Towksjhea, Retired Whaling Captain)*

Warming temperatures may also be increasing risk of food-borne, gastrointestinal diseases. Adaptation responses have included monitoring the cellar temperatures and humidity. A review of traditional *siġl·uaqs* design, construction, and methods of use is also being performed. Interdisciplinary teams, including traditional users, permafrost scientists, and engineers are meeting to identify potential adaptation options for these coastal communities.

Photo 2. Kivalina resident Millie Hawley inspects a traditional ice cellar. M. Brubaker

Mental health

Alaska Natives are experiencing stress related to rapid cultural change and the loss of social, cultural, and environmental conditions. Climate change can also generate stress and fear related to safety and security. Flooding in the fall of 2007 resulted in evacuation of the entire village of Kivalina. On-going vulnerability to storm events puts residents at higher risk for behavioral health problems. Local health workers report heightened stress, fear, and anxiety among residents during the storm season.

> *"Every time the waves get high, people get anxious. Some people walk all night. My ten year old son was worried the house would blow away." (Alice Adams, Community Counselor)*

A preliminary review of selected clinical patient visit codes suggests that increased behavioral health visits occur during the storm season (2). Adaptation has included the construction by the Army Corps of Engineers of 1,000 m rock revetment wall. Residents reported feeling 'safer' and 'happier' as a result (16).

Community water infrastructure

Climate change is a new challenge for water utilities already struggling with high operating costs. Warming and permafrost thaw is impacting water availability and water quality, and causing some surface water systems to operate outside their design parameters. The active thaw layer of the permafrost is increasing, and even the deep permafrost is warming, as much as 2°C over the past 20 years (17). A review of satellite imagery by the US Geologic Survey suggests that the size of the lakes in the vicinity of Point Hope is undergoing rapid change. Point Hope acquires water from a small tundra lake situated on top of permafrost. From late June until early September operators work 24-hour shifts to have enough stored water to last through the winter. But high summer temperatures in recent years has increased algae and other biological growth in the lake, decreasing water quality and fouling filters at the water plant.

> *"There have been lots of mosquitoes and mosquito larvae. They plug up the bag filters and we have to change them every five minutes." (Andrew Frankson, Water Operator)*

Typically, water plant operators clean water system prefilters four times per day. In 2008, the number of required cleaning events rose to as much as 50 times per day, significantly decreasing productivity. Periods of increased filter change correspond with periods of high air temperature. Adaptation responses have included baseline testing of water quality and active monitoring of lake water conditions.

Conclusion

In Northwestern Alaska, climate change is increasing vulnerability to injury, disease, mental stress, food insecurity, and water insecurity. Northwest communities are applying adaptation approaches that are specific and appropriate. Satellite technology is helping to reduce risk of injury by quickly locating hunters in distress. Improved shore revetment walls not only prevent erosion and protect infrastructure but also help reduce mental stress. In communities concerned with changes to source water quality, improved monitoring is helping engineers to design more resilient and condition appropriate water systems. Community-scale health impact assessment is an approach that is helping communities in Northwestern Alaska identify and address their local climate challenges. Understanding the connections between climate change and human health is the first step toward effective adaptation planning.

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