Framework document

Climate Change and Infectious Diseases in the Arctic: A "White Paper" from the International Circumpolar Surveillance Climate Change and Infectious Disease Working Group

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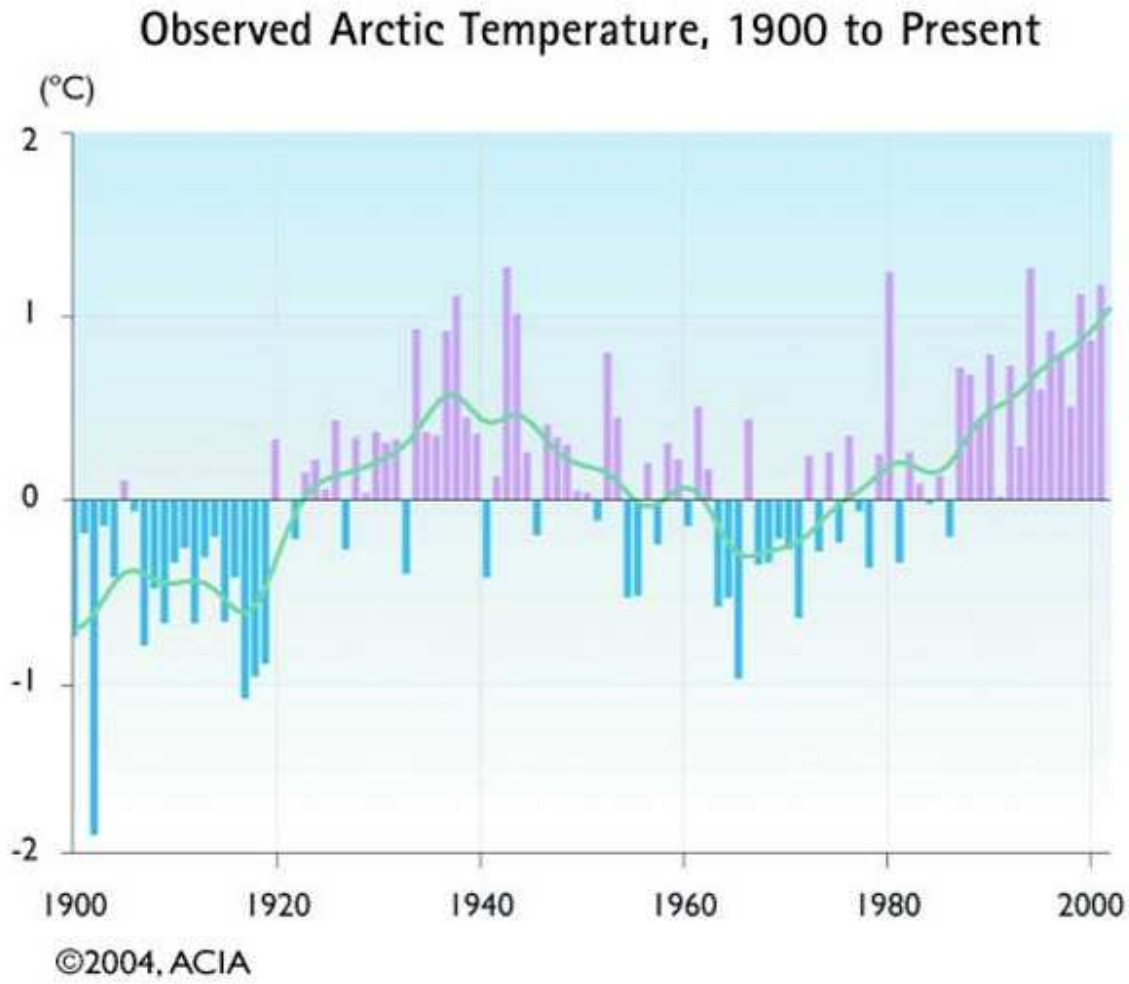
A. Background

The Arctic, like most other parts of the world, warmed substantially over the twentieth century, principally in recent decades (Figure 1). Arctic climate models project continued warming with a 3-5°C mean increase by 2100. The winters will warm more than summers, the mean annual precipitation is projected to increase, and continued melting of land and sea ice is expected to increase river discharge and contribute to rising sea levels. These changes will be accompanied by greater overall climate variability and an increase in extreme weather events (Arctic Council, 2005).

The rapid warming in the Arctic is already bringing about substantial ecological and socioeconomic impacts, many of which result from the thawing of permafrost, flooding, and shoreline erosion resulting from storm surges and loss of protective sea ice. In many communities, the built infrastructure is supported by permafrost. Loss of this permafrost foundation will result in damage to water intake systems and pipes, and may result in contamination of the community water supply. In addition, loss of foundation support for access roads, boardwalks, water storage tanks, and wastewater treatment facilities will render water distribution and wastewater treatment systems inoperable. Several villages already face relocation because village housing, water system, and infrastructure are being undermined (Warren et al., 2005).

Figure 1: Observed Arctic Temperature, 1900 to Present

Observed Arctic Temperature, 1900 to Present: Annual average change in near surface air temperature from stations on land relative to the average for 1961-1990, for the region from 60 to 90°N. (Arctic Council 2005)



It is well known that climate and weather affect the distribution and risk of many vector-borne diseases, such as malaria, RVF, plague, and dengue fever in tropical regions of the globe. Weather also affects the distribution of food- and water-borne diseases and emerging infectious

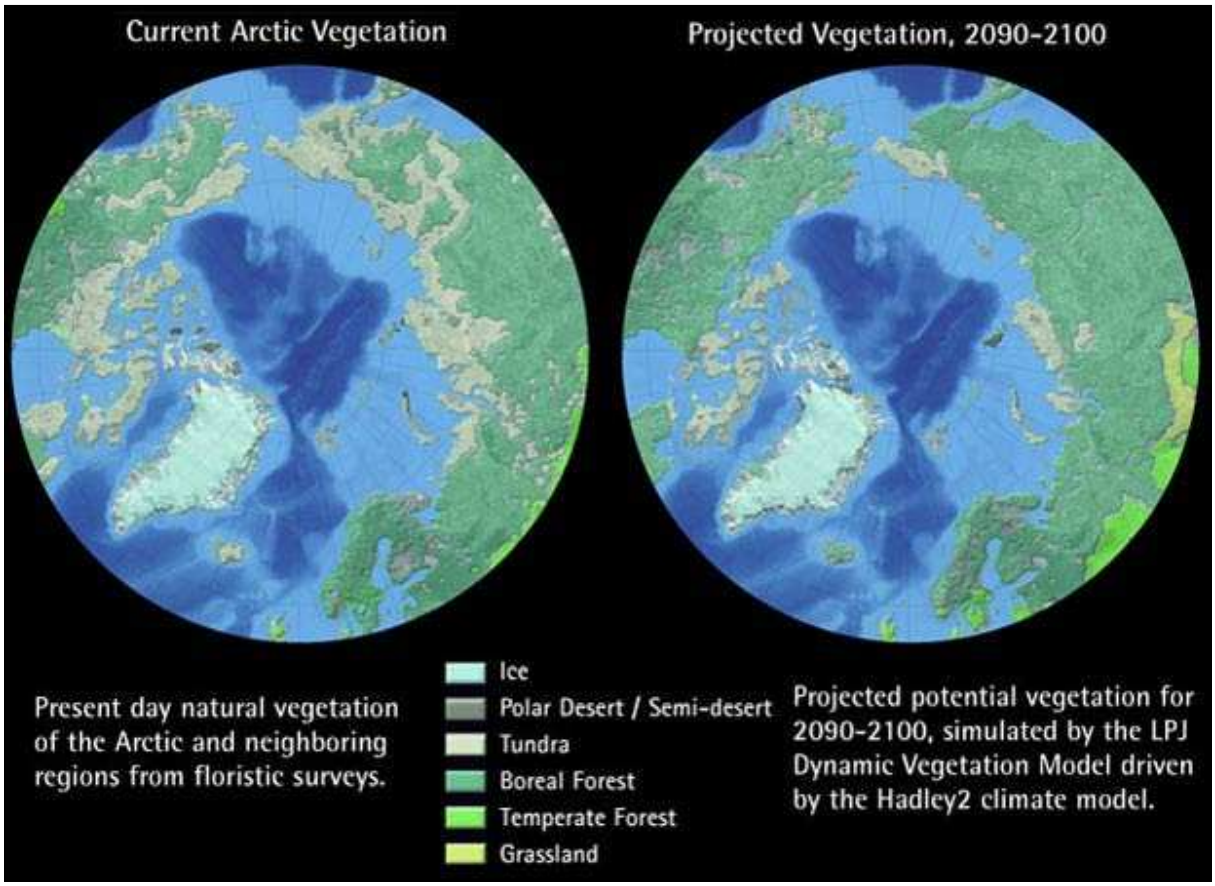
diseases, such as West Nile virus, hantavirus, and Ebola hemorrhagic fever (Haines et al., 2006). Less is known about the impact of climate change and the risk and distribution of infectious diseases in Arctic regions.

There is the potential for infectious diseases to emerge as a result of climate change related damage to the water and sanitation infrastructure or water sources by melting permafrost, storm surge or flooding which affects water quantity and quality (increased rates of respiratory and skin infections, and diarrheal diseases caused by bacterial, viral, and parasitic agents).

Infectious diseases relating to food safety and security. Many Arctic residents depend on subsistence hunting, fishing and gathering for food and a predictable climate for food storage. Food storage methods often include above ground air-drying and or smoking of fish and meat at ambient temperature, below ground cold storage on or near the permafrost, and fermentation. Changes in climate may prevent the proper drying of fish or meat, resulting in spoilage (botulism). Similarly loss of the permafrost may result in spoilage of food stored below ground. In addition warmer temperatures may allow an infected host animal species to survive winters in larger numbers, increase in population and expand their range of habitation and thus increase the opportunity to pass infections to humans (toxoplasma, trichinella, brucellosis). (Parkinson 2008; Parkinson, AJ., B Evengard 2009)

Rising temperatures are expected to favor a northward expansion of boreal forest into the tundra, and of tundra into the polar desert (Figure 2) (Arctic Council 2005). Infectious diseases transmitted by insect or animal vectors. Climate change may influence the density and distribution of animal hosts and mosquito vectors which could result in an increase in human illness or a shift in the geographical range of disease caused by these agents (echinococcus, tularemia, puumalavirus, tick-borne encephalitis, borrelliosis, West Nile virus) (Revich B, et al 2012; Hueffer K, et al 2013)

Figure 2: Arctic vegetation zones are likely to shift, causing wide-ranging impacts. (Arctic Council 2005).



Rural communities harvest thousands of marine and terrestrial animals each year. Wildlife managers in every northern jurisdiction also sample smaller numbers of animals. These animals could serve as a key sentinel population to allow assessment of trend in prevalence of known zoonotic pathogens as well as the detection of newly emerging infections. This information could enable coordinated international response and better analysis of efficiency of mitigation and adaption measures.

The Arctic Council has recognized Food and Water Security as a critical human health issue in the circumpolar north, especially in rural communities. Throughout the world the close link between ecosystem health and health of food species and humans has been recognized

and is the foundation of the "one health concept". This concept is nowhere more apparent than in the Arctic. The human wildlife interaction in the context of a changing Arctic environment, rapid resource development, new shipping routes, all make the circumpolar north the place where "one health' will need to be the organizing concept for approaching future population health for both humans and wildlife.

B. Overview of the Organization

The International Circumpolar Surveillance of Emerging Infectious Diseases is an Arctic Council, Sustainable Development Working Group Human Health Experts Group project that aims to link public health laboratories, institutes and academic centers across the circumpolar north for the purpose of monitoring and sharing information on infectious diseases of concern, collaborating on research and prevention and control activities. Working groups have been established for surveillance of invasive bacterial diseases, and tuberculosis and research working groups have been formed for diseases caused by helicobacter pylori, and viral hepatitis (Figure 3).

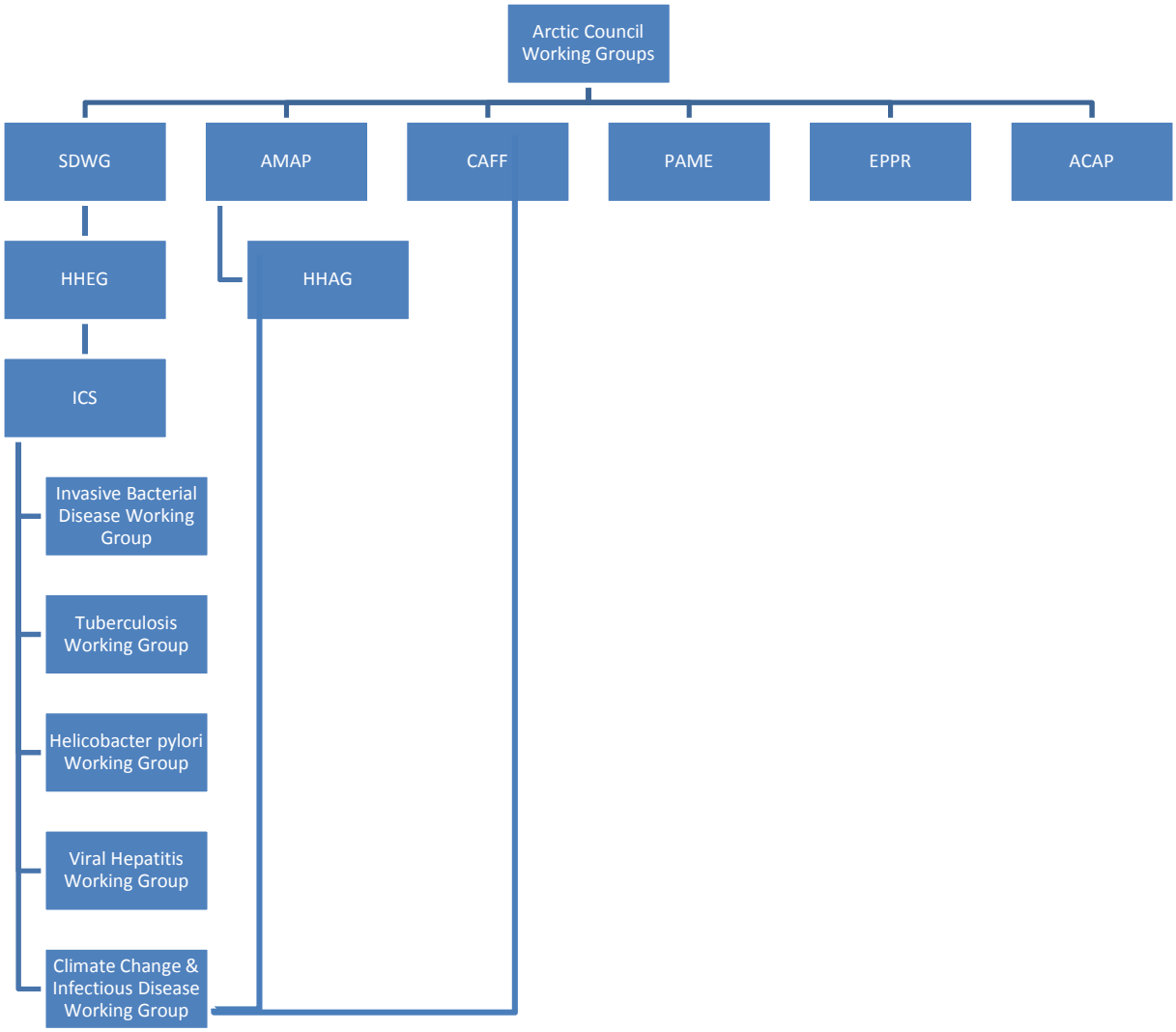
An ICS Climate Change and Infectious Diseases working group was formed at a meeting at the Danish Polar Centre, Copenhagen September 19, 2011.

The Mission of the ICS Climate Change Working Group will be to share information on climate sensitive infectious diseases in the North and to identify potential cross border collaborative surveillance or research activities that would allow the monitoring of climate sensitive diseases of concern that have the potential to spread, and to work towards established a formal quantitative link between weather, climate and infectious disease prevalence and geographic distribution.

Membership is comprised of international subject matter experts with circumpolar in-country knowledge of climate change and infectious disease surveillance and research activities, including members of the Arctic Council's, Sustainable Development Working Group(SDWG) Human Health Experts Group (HHEG), the Arctic Monitoring and Assessment Program (AMAP), Human Health Assessment Group (HHAG), Conservation of Flora and Fauna Working Group (CAFF) and subject matter experts from WHO, ECDC, the US CDC, the Alaska Native Tribal Health Consortium, and Arctic Council Permanent Participant organizations.

The overall purpose of the group will be to conduct surveillance and research for targeted public health actions including the development of adaptation strategies to minimize or eliminate the impact of climate sensitive infectious diseases on northern populations and to evaluate climate influences on infectious disease occurrence or emergence.

Figure 3: Arctic Council Organizational Chart showing ICS working groups



C. Overview of Proposed Projects

Conduct surveillance evaluations of climate sensitive zoonotic infectious diseases.

For diseases of concern, create schematics which illustrate interactions between pathogens, vectors, reservoirs, pathways and related weather and climate variability and potential impact on infectious disease prevalence and distribution.

Prepare a comprehensive survey/review of health data resources in a particular region that could be paired with environmental data for quantitative estimation of the links between climate and disease.

Conduct a pilot seroprevalence study to determine the prevalence of zoonotic infections in rural Alaska subsistence bird hunters their families, Alaska sport hunters, non hunters and Alaska wildlife biologists/researchers/professionals.

Conduct a larger Alaska statewide serosurvey using of stored sera collected from this population between 1980-1986. Samples will be stratified by region of residence, gender, and age. Results will establish a baseline of zoonotic disease prevalent in the US Arctic and could be expanded to include other circumpolar countries. Results from this serosurvey will be used to target communities, or regions for specific prospective serosurveys, risk factor analysis, testing of key marine and terrestrial wildlife and lead to the implementation of prevention and control outreach, education, and communication activities.

Conduct serosurveys of at risk human residents who handle butcher and prepare food made from substance animal species, as well as those who consume, smoke, or dry tissue from those animals. Many specimen banks exist that could be used for this purpose (ie AMAP Maternal Monitoring Programs).

Conduct a survey of available human specimen banks in the circumpolar north

Conduct serologic sampling of as many subsistence harvested animals, targeting those that are most often consumed. Local knowledge of important ecological connections may determine that other species be examined, as well as the ecology of many zoonotic pathogens is incompletely understood. Wildlife agencies may have old banked blood

from species important as food sources and these may augment current collection efforts and give important historic perspectives as to any association with temperature trends over time.

Evaluate, and deploy, field detection systems for climate sensitive infectious agents and environmental contaminants in hunter killed wildlife.

Establish quality assurance programs in antibody detection to allow sharing of standardized data between countries (ie SDWG ICS QC program).

Establish quality assurance programs for toxic metals and organic contaminants to allow sharing of standardized data between countries (ie AMAP HHAG ring test).

Establish regional blood sampling programs using hunter killed wildlife. These can be established by developing local capacity using filter paper collection of blood and can be used to determine antibodies to a wide variety of zoonotic pathogens, as well as toxic metals and persistent organic contaminants.

Establish a communication strategy for data sharing with communities, circumpolar countries and other organizations and agencies with wildlife and human health responsibilities. The development of consumption advisories should be done in consultation with affected communities as practiced by AMAP HHAG.

Assemble web-based resources that will include diseases that are climate sensitive, together with known spatial distribution, prevalence rates, the climate linkage framework for each, links to research papers and data sets focusing on each, geographical data on known outbreaks, case studies, agencies, research teams conducting studies and responding to health concerns.

D. Project Activities and Timeline

E. Outcomes

1. What immediate and long-range results are expected? Will these results help the institution and others? Change children's lives, the educational community and the world?
2. How will the results impact your constituents or community?
3. How serious are the need and necessity for immediate action?

F. Evaluation

1. By what criteria will the success or failure of this project be measured?
2. What techniques or tools will be used to evaluate?
3. Who will do the evaluation? When and how often will they do it?
4. How will evaluation results be used? Who will see evaluations?

G. Funding

1. What is the anticipated total budget for this project? Give a complete budget breakdown.
2. Where will the funding come from?

H. Implementation Plan

Projects will be undertaken and monitored by sub groups that will report updates and progress to the International Circumpolar Surveillance Climate Change and Infectious Disease Working Group.

E. References

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