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Review Paper

Surveillance of infectious diseases in the Arctic

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ABSTRACT

Objectives: This study reviews how social and environmental issues affect health in Arctic populations and describes infectious disease surveillance in Arctic Nations with a special focus on the activities of the International Circumpolar Surveillance (ICS) project.

Methods: We reviewed the literature over the past 2 decades looking at Arctic living conditions and their effects on health and Arctic surveillance for infectious diseases.

Results: In regards to other regions worldwide, the Arctic climate and environment are extreme. Arctic and sub-Arctic populations live in markedly different social and physical environments compared to those of their more southern dwelling counterparts. A cold northern climate means people spending more time indoors, amplifying the effects of household crowding, smoking and inadequate ventilation on the person-to-person spread of infectious diseases. The spread of zoonotic infections north as the climate warms, emergence of antibiotic resistance among bacterial pathogens, the re-emergence of tuberculosis, the entrance of HIV into Arctic communities, the specter of pandemic influenza or the sudden emergence and introduction of new viral pathogens pose new challenges to residents, governments and public health authorities of all Arctic countries. ICS is a network of hospitals, public health agencies, and reference laboratories throughout the Arctic working together for the purposes of collecting, comparing and sharing of uniform laboratory and epidemiological data on infectious diseases of concern and assisting in the formulation of prevention and control strategies (Fig. 1). In addition, circumpolar infectious disease research workgroups and sentinel surveillance systems for bacterial and viral pathogens exist.

Conclusions: The ICS system is a successful example of collaborative surveillance and research in an extreme environment.

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Introduction

The Arctic region extends north of 60° north latitude, borders the Arctic Ocean and includes all or northern parts of eight nations. Endemic and epidemic infectious diseases have been documented across Arctic populations.^{1,2} The introduction of antibiotics and vaccines and the establishment of robust public health systems targeting multiple diseases including tuberculosis (TB) and sexually transmitted infections (STIs) have greatly reduced the morbidity and mortality of infectious disease problems in many Arctic countries. Despite these interventions, high rates of invasive diseases are caused by bacterial pathogens such as *Streptococcus pneumoniae*,^{3,4} *Haemophilus influenzae*,^{5–7} *Helicobacter pylori*,^{8–11} and group A streptococcus.^{12,13}

Skin and soft-tissue infections^{14,15} and TB^{1,2,16} continue to persist. In addition, the emergence of antibiotic resistance among bacterial pathogens once easily treated with commonly used antibiotics,^{14,17–19} the specter of pandemic influenza^{20–22} or the sudden emergence and introduction of new viral pathogens^{23,24} are of increasing concern to residents, governments and public health authorities of all Arctic countries.

A small group of infectious disease epidemiologists and international health experts who have worked together collaboratively in the field of International Circumpolar Surveillance (ICS) for greater than a decade reviewed the literature over the past 2 decades looking at Arctic living conditions, antibiotic use and Arctic surveillance for infectious diseases. This review will describe pertinent issues in the social and physical environment. It will also review how crowded living conditions and overuse of antibiotics can affect the health of Arctic populations. Finally, it will look at the important role that surveillance plays in preventing and controlling infectious diseases in this region.

International circumpolar surveillance

The role of surveillance in prevention and control of infectious diseases in the Arctic

As in other parts of the world, a key component of prevention and control of infectious diseases in Arctic regions is surveillance. Basic surveillance functions include detecting and reporting cases of disease. Other functions include analyzing and confirming information received to identify disease outbreaks or longer term trends and applying this information to implement prevention and control strategies. Effective surveillance can facilitate timely control of outbreaks, inform public health officials' decisions on resource allocation, and provide data to adjust prevention and control strategies to maximize their impact.²⁵

Active population-based surveillance and the use of surveillance to monitor implemented vaccination programmes in reducing the burden of invasive disease caused by bacterial pathogens is feasible and population-based surveillance of diseases of concern including invasive bacterial diseases is conducted by public health agencies in the USA (Alaska),

Canada, Greenland, Iceland, Norway, Sweden, and Finland.²⁶ A realization of common health issues among Arctic countries due in part to sparse populations living in remote settlements where household crowding is often an issue led to the formation in 1999 of ICS, a circumpolar network of hospital, public health agencies, and reference laboratories throughout the Arctic.^{26,27}

The ICS project

The ICS project was established in 1999 to create an infectious disease surveillance network of hospital and public health laboratories and institutions throughout the Arctic countries and territories. The project initially focused on invasive bacterial diseases caused by the following organisms: *S. pneumoniae*, *H. influenzae*, *Neisseria meningitidis*, and groups A and B streptococcus. In 1999, the project integrated prospective population-based surveillance data for invasive pneumococcal disease (IPD) from the US Arctic (Alaska) and Northern (N.) Canada. In subsequent years, the ICS network expanded to include the following: Greenland in 2000; Iceland, Norway and Finland in 2001; and Northern (N.) Sweden in 2003.^{26,27} All the circumpolar countries of the north (territory north of 60° latitude) with the exception of Russia now participate in ICS for invasive bacterial diseases (Fig. 1). A separate ICS surveillance system for TB has recently been developed.²⁸

An ICS quality-control programme was instituted in 1999 among the three reference laboratories in Alaska (USA) and Northern Canada (the Arctic Investigations Program laboratory in Anchorage, Alaska, the National Center for Streptococcus laboratory in Edmonton, Canada, and the Public Health laboratory in Quebec, Canada) for serotyping and antimicrobial susceptibility testing of *S. pneumoniae*. Each year, participating laboratories exchanged panels of pneumococcal isolates for serotyping and susceptibility testing using methods routinely used in each laboratory. Results obtained between each laboratory were compared, discrepancies between results were identified and potential factors contributing to the discrepancies were identified. The programme was extended to include the Statens Serum Institute (SSI) in Copenhagen, Denmark in 2004.²⁹ In 2005, an ICS quality control exchange programme for serotyping of isolates of *H. influenzae* and *N. meningitidis* was implemented by the National Microbiology Laboratory, Public Health Agency of Canada, in Winnipeg, Manitoba.³⁰ In 2011, a programme that monitors laboratory proficiency in the *emm* typing of GAS was co-developed by the Centers for Disease Control and Prevention's Arctic Investigation Program (CDC, AIP) and the Public Health Agency of Canada's National Microbiology Laboratory (NML) which includes laboratories within the ICS network that routinely type GAS isolates (AIP, NML and Provincial Laboratory for Public Health, Edmonton, Alberta, Canada (ProvLab)).³¹

The priorities and overall direction of ICS are governed by a Steering Committee consisting of two representatives from each participating country, representation from WHO European regional office (Copenhagen), the Arctic Council Indigenous People Secretariat, and the Russian Association of Indigenous People of the North (RAIPON). Other infectious

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