

International Circumpolar Surveillance (ICS)
Prevention and Control of Emerging Infectious Disease in the Arctic

A Sustainable Development Working Group Project
Endorsed and approved by the Arctic Council,
Barrow, Alaska, November 2000

Report of Activities 1999-2002

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Abstract

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Arctic Council Participation: United States, Canada, Denmark/Greenland, Iceland, Norway, Sweden, Finland, Russian Federation.Implementing Agency: US Centers for Disease Control and Prevention, Atlanta, GeorgiaThe goal of this project is to establish an integrated International Circumpolar Surveillance (ICS) network linking hospitals and public health laboratories throughout the Arctic for the purpose of monitoring emerging and reemerging infectious disease problems within Arctic communities, and assist in the formulation of preventive strategies. The plan is to establish population based surveillance of diseases of most concern to residents of Arctic countries, to determine the rates of disease, populations at greatest risk, and the most effective preventive strategies. ICS was established for invasive pneumococcal disease in the US Arctic (Alaska) and northern Canada (1999), Greenland, Iceland, Norway, and Finland (2000), and Sweden (2001). Surveillance for other invasive bacterial diseases (i.e., those caused by *Haemophilus influenzae*, *Neisseria meningitidis*, Groups A & B streptococcus) was initiated for the North American Arctic in 2000, and will be implemented in other Arctic countries in subsequent years. The surveillance of other diseases such as tuberculosis, HIV/AIDS, and hepatitis C can be added to ICS as the need and support arise.

Contents

Executive Summary

- I. Project goals**
- II. Issues to be addressed**
- III. Project structure**
- IV. Results 1999-2000**
- V. Work-Plan**
- VI. Relationship to other Arctic Council programs**
- VII. Anticipated outcomes**
- VIII. Further Issues for Consideration**
- IX. Financial and other resources**
- X. References**
- XI. Web sites**
- XII. Reports and Presentations**
- XIII. Contacts**

Executive Summary:

International Circumpolar Surveillance (ICS): Prevention and Control of Emerging Infectious Disease in the Arctic

Project Initiation:

Communities throughout the world are being threatened by an array of newly emerging infectious agents, a resurgence of old, once preventable infectious diseases and now the intentional release of infectious agents. Infectious diseases impact human development and sustainable economic development. With increased rates in air travel and international trade Arctic communities are no longer isolated from such threats. International surveillance of infectious diseases may serve as an early warning system of emerging threats and provide increased capacity to monitor the effectiveness of public health control measures.

The feasibility of establishing an integrated international population based surveillance for invasive pneumococcal diseases was accomplished during the US tenure as chair of the Arctic Council (1999-2000) by linking laboratories and public health authorities in the North American Arctic (US/Alaska, and northern Canada). Greenland, Finland and Norway joined ICS in 2000. The ICS project was officially endorsed as an Arctic Council Project at the Ministerial meeting held in Barrow, Alaska, October 2000.

Project Description:

The aim of this project is to establish an integrated International Circumpolar Surveillance (ICS) system for infectious diseases through a network of hospital and public health laboratories and authorities located throughout the Arctic. Linking public health facilities within the Arctic states will allow for the collection and sharing of uniform laboratory and epidemiological data that will describe the prevalence of infectious diseases of concern in Arctic populations, and assist in the formulation of prevention and control strategies. The plan is to establish population based surveillance of diseases of most concern to residents of Arctic countries, to determine the rates of disease, populations at greatest risk, and the most effective prevention strategies. ICS was established for invasive pneumococcal disease in the US Arctic (Alaska) northern Canada, (1999), Greenland, Iceland, Norway, and Finland (2000), and Sweden (2001). Surveillance for other invasive bacterial diseases (i.e., those caused by *Haemophilus influenzae*, *Neisseria meningitidis*, Groups A & B streptococcus) was initiated for the North American Arctic in 2000, and will be implemented in other in the Arctic countries in subsequent years. The surveillance of other diseases such as tuberculosis, HIV/AIDS, and hepatitis C can be added to ICS as the need and support arise.

Progress to date:

Surveillance of invasive pneumococcal disease from 25 hospital laboratories in the US Arctic and 14 hospital laboratories in northern Canada was established in 1999. A pneumococcal quality control program was established between reference laboratories in the US Arctic and Canada to monitor testing accuracy and precision. In 2000, cases of invasive pneumococcal disease were reported from Greenland, Iceland, Norway and Finland. Also in 2000, laboratories

in the US Arctic and northern Canada began reporting invasive diseases caused by *Haemophilus influenzae*, *Neisseria meningitidis*, and Groups A and B streptococcus. An ICS steering committee was established in September 2000 to guide and review activities of ICS as well as to identify, prioritize and initiate the development of new surveillance activities. The steering committee consists of two experts in Arctic human health from each country including representation from indigenous peoples organizations (permanent participants). Working Groups have been established to coordinate surveillance activities for invasive bacterial diseases and tuberculosis. Comprehensive reports for the surveillance of invasive bacterial diseases have been generated for 1999 and 2000.

Future Work Plan 2002-2004:

Continue circumpolar surveillance of invasive bacterial diseases (lead country US).
Develop a circumpolar laboratory quality control program for pathogens under surveillance.
Initiate circumpolar surveillance of tuberculosis (lead country Canada)
Consider circumpolar surveillance of infectious agents causing chronic diseases (HIV/AIDS, hepatitis C, *Helicobacter pylori*).
Explore options for extending ICS activities into Arctic regions of the Russian Federation (Barents Sea region and Russian Far East).
Explore options for linkage of ICS with the Arctic Council's AMAP Human Health Working Group and other international surveillance networks (WHO, EU).

**International Circumpolar Surveillance (ICS)
Prevention and Control of Emerging Infectious Disease in the Arctic**

I. Project goal

Establish an integrated International Circumpolar Surveillance (ICS) system through a network of hospital and public health authorities throughout the Arctic.

II. Issues to be addressed

A. Relevance and Importance

Arctic populations have long endured the debilitating effects of both endemic and epidemic infectious diseases, the effects of which have impacted social and economic development in circumpolar regions of the globe. With the advent of antibiotics, tuberculosis and other life threatening infections seemed conquerable. The incidence of childhood diseases such as diphtheria, whooping cough, and meningitis were reduced dramatically through the use of vaccines. These advances, together with improvements in sanitation and water quality, dramatically lowered the incidence of infectious diseases in many peoples throughout the developing world including those of the Arctic. However, as we enter the 21st Century, the specter of antibiotic-resistant forms of old diseases such as tuberculosis, measles, diphtheria, and meningitis once again is threatening circumpolar communities. Our communities are also threatened by a number of newly emerging diseases, such as HIV, hepatitis C, and a host of food and waterborne illnesses. Moreover several infectious agents have now been commonly associated with the development of malignancies in Arctic peoples: hepatitis B virus and, hepatitis C virus (liver cancer), *Helicobacter pylori* (gastric cancer), human papilloma virus (cervical cancer), Epstein-Barr virus (nasopharyngeal cancer).

B. Significance to Arctic Residents

The goal of the sustainable development program of the Arctic Council is to *propose and adopt steps to be taken by Arctic States to advance sustainable development in the Arctic, including opportunities to protect and enhance the environment, the economies, cultures and health of indigenous communities and other inhabitants of the Arctic, as well as to improve the environmental economic and social conditions of Arctic communities as a whole*. Human health is a critical component of any sustainable development program. Sustainable economic development is frequently accompanied by changes in a number of factors which impact human health and the emergence of infectious disease problems. These include rapid population growth; depopulation of small arctic communities; urbanization of arctic peoples and ensuing social and economic difficulties; changes in governments, self-governance, and fiscal policies; increased regional and global travel; changes in the food supply; changes in human behaviors such as increased substance abuse, intravenous drug use and risky sexual behavior; the use of more antibiotics in remote arctic communities, hastening the development of antimicrobial resistance; and contamination of the subsistence food supply with heavy metals and pesticide residues with deleterious effects on the developing immune system. Infectious disease incidence is an important indicator of human health. Establishment of a surveillance system to monitor changes

in infectious diseases is critical to maintenance of sustainable development in the Arctic, and to disease prevention and control activities.

C. Related International Activities Underway

The US Centers for Disease Control and Prevention's Arctic Investigations Program together with the Indian Health Service, the State of Alaska's Division of Public Health, and Alaska Native Health corporations and organizations have a long history of initiating and maintaining infectious disease surveillance and prevention and control activities among Native and non-Native residents of the US Arctic¹. In 1994 the US Centers for Disease Control and Prevention developed a plan to address the threat of emerging infectious diseases in the United States². The plan, updated in 1999³, calls for revitalizing critical public health functions such as surveillance, applied research, infrastructure and training and prevention and control capabilities not only in the US but world wide. In addition, the Committee on International Science Engineering and Technology Policy (CISET), recommended that the U.S. government develop partnerships with other countries, with World Health Organization (WHO), and with other international organizations to improve worldwide disease surveillance, reporting and response⁴, resulting in the development and publication in 2002 of the CDC's Global Infectious Disease Strategy⁵. A number of alliances have now been created within Europe and between the US and European Countries to promote international emerging infectious disease surveillance and response networks. In addition Health Canada through its Laboratory Centre for Disease Control and Bureau of Infectious Diseases maintains national surveillance for emerging infectious diseases. The national health surveillance infrastructure initiative of Health Canada also contributes to the enhancement of surveillance through the development of Internet based tools such as the Spatial Public Health Information Exchange (SPHINX). The Nordic countries, (Denmark, Iceland, Norway, Sweden and Finland), have well established infectious disease surveillance systems in place and have a long standing tradition in the field of international cooperation in infectious disease prevention and control initiatives. A recent collaborative project funded by the Nordic Council of ministers is focused on strengthening infectious disease prevention and control in the adjacent Baltic and Barents sea regions of the Russian Federation. These international activities together with the formation of a number of international economic alliances (European Union, Asia Pacific Economic Cooperative) provide the opportunity for increased global communication and collaboration between countries to address human health issues of common concern. The establishment of an infectious disease surveillance system within Arctic Council countries will allow linkage and standardization of surveillance information to other established systems thereby contributing to the global surveillance and prevention and control of emerging infectious disease problems.

III. Project Structure

The project initially focused on establishing an international circumpolar surveillance (ICS) system for diseases caused by *Streptococcus pneumoniae*. This bacterium causes pneumonia, meningitis and bacteremia in both the very young and the elderly. Once easily treated with antibiotics, this bacterium is now becoming resistant to commonly used antibiotics. This is of great concern to the public health community and is increasingly a target for surveillance by many countries world wide. A vaccine is available for use in persons 2 years of age and older. In the US Arctic this vaccine is recommended for all those over 55 years of age. A new vaccine for infants has been developed and is licenced for use in the US, Canada, and the European Union. The fact that diseases caused by *Streptococcus pneumoniae* are already being monitored by many public health authorities within the Arctic Council countries make establishing a circumpolar surveillance system for this infection feasible. In addition the availability of a vaccines for adults and infants makes much illness caused by *Streptococcus pneumoniae* preventable.

Key components of ICS includes:

- i. Identifying key public health contacts within Arctic Council countries. These persons should be familiar with infectious disease surveillance systems in place (particularly surveillance systems for diseases caused by *Streptococcus pneumoniae*) in the member country. Through correspondence, individual or working group meetings, the scope and gaps of individual surveillance systems will be determined.
- ii. Determining the comparability of laboratory and data collection methods, and negotiating standard protocols, quality control programs (which will define comparable laboratory and data collection methods).
- iii. Sharing and reporting data in agreed formats.
- iv. The formation of a working group of key laboratory and public health contacts to coordinate pneumococcal surveillance within their respective jurisdictions. This group will meet on an annual or biannual basis to review problems, progress, compliance, report generation, and future plans.
- v. The formation of a steering committee of national Arctic Health experts to coordinate new objectives and initiatives within ICS.

Once established this program will form a framework through which surveillance of other infectious diseases as well as prevention and control programs can be added. Other infectious diseases of circumpolar community concern include; other invasive bacterial diseases (caused by *Haemophilus influenzae*, *Neisseria meningitidis*, Group A and B streptococcus), tuberculosis, HIV, hepatitis, food (botulism, brucellosis), waterborne diseases, respiratory diseases of children such as those caused by respiratory syncytial virus, and chronic conditions related to infectious agents (hepatitis B virus and liver cancer, human papilloma virus and cervical cancer). In

addition the surveillance model developed by this program for infectious disease may be adapted to monitor other non infectious human health priorities of community concern.

IV: Results 1999-2000

In January 1999, the US CDC's Arctic Investigations Program, representatives from Health Canada, Canada's Northern Territories, the National Centre for Streptococcus in Alberta and Laboratoire de Sante Publique de Quebec in Montreal began an international cooperative initiative of population-based surveillance for invasive *Streptococcus pneumoniae* utilizing 25 hospital laboratories in the US Arctic (Alaska), and 14 laboratories serving residents of the northern Canada (Yukon Territory, Northwest territories, Nunavut, Northern Quebec, and Northern Labrador). In 1999 and 2000 any isolate of *Streptococcus pneumoniae* recovered from a patient at a hospital in the US or Canadian Arctic were sent to one of three reference laboratories for characterization, serotyping and antimicrobial susceptibility testing. Patient demographics and clinical information were collected and sent to the CDC's Arctic Investigations Program for storage and analysis.

In 1999 a laboratory based quality control program was established between the three reference laboratories (the CDC's Arctic Investigations Program, Canada's National Center for Streptococcus, and the Laboratoire de Sante Publique de Quebec) to ensure comparability of serotyping and antimicrobial susceptibility testing methods.

In 2000 the US and Canadian Arctic surveillance system was expanded to include the reporting of invasive diseases caused by *Haemophilus influenzae*, *Neisseria meningitidis*, Group A and B streptococcus.

Greenland joined ICS in 2000, annually reporting invasive pneumococcal disease from 15 district hospitals utilizing reference laboratories in Nuuk, Greenland and the Statens Serum Institute in Copenhagen.

Iceland also provided data on invasive pneumococcal disease for 2000 as reported from 10 district hospitals which provide diagnostic microbiology services to the residents of this country. Pneumococcal isolates are sent to the reference hospital in Reykjavik for serotyping and susceptibility testing .

Norway contributed data to ICS on invasive pneumococcal disease as reported from 33 district hospitals in 2000. Pneumococcal isolates recovered from patients are sent to one or two reference laboratories in Oslo or Tromso for serotyping and susceptibility testing.

Finland provided data on invasive pneumococcal disease as reported from 23 district hospitals that provide diagnostic microbiology. All isolates recovered are submitted to the National Public Health Institute Laboratory in Oulu for serotyping and susceptibility testing.

Sweden joined ICS in 2002 and will provide data on invasive pneumococcal disease in Sweden for 2001.

While only two years of surveillance data (1999-2000) are currently available for the US Arctic and northern Canada, and data for only one year (2000) has been collected for Greenland, Iceland, Norway and Finland the following preliminary observations can be made.

Indigenous peoples, young children (<2 years of age) and elderly persons (>65 years of age) residing in the north American Arctic (Alaska, northern Canada) have high rates of invasive pneumococcal disease.

In the US Arctic 11% of pneumococcal isolates were resistant to penicillin (serotypes 6B, 9V, 14, 19F, 23F) and in northern Canada 8% were resistant to penicillin, and all were serotype 9V

The case fatality rate in the US Arctic is over three times the case fatality rate in northern Canada or Iceland.

Overall, pneumococcal serotypes 1 and 14 are the most prevalent serotypes in the North American Arctic. Both serotypes are contained in the 23 valent pneumococcal polysaccharide vaccine recommended for adults, but serotype 1 is not included in the 7 valent conjugate vaccine for children < 2 years of age.

For the north American Arctic 76% of deaths were potentially preventable with the use of the 23 valent polysaccharide vaccines.

Further evaluations of vaccine use and efforts to improve vaccine coverage are needed.

In 2000 invasive disease caused by *Haemophilus influenzae* type b persisted among children in the US Arctic possibly due to incomplete or late vaccination and persistence of oropharyngeal carriage.

Standardized international surveillance of infectious diseases is feasible and allows for the direct comparison of disease rates, pathogen characteristics and evaluation of intervention effectiveness between participating countries.

2001 data on invasive diseases caused by *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Neisseria meningitidis*, Groups A and B streptococcus are currently being collected from laboratories in the US Arctic and northern Canada. Greenland, Iceland, Norway, Sweden and Finland will provide 2001 data for invasive pneumococcal disease.

V. Work Plan 2002-2004:

Surveillance of invasive pneumococcal disease occurring in the US Arctic, northern Canada, Greenland, Iceland, Norway, Finland, and Sweden will continue.

An international quality control program already established in the US Arctic and Canada to monitor the accuracy and precision of laboratory methods for serotyping and antibiotic susceptibility measurement will be expanded to link other reference laboratories used by participating countries.

Surveillance of invasive diseases caused by *Haemophilus influenzae*, *Neisseria meningitidis*, Groups A and B streptococcus occurring in the US Arctic and northern Canada will continue.

Circumpolar surveillance of tuberculosis will be initiated and the establishment of surveillance of infectious diseases causing chronic diseases (HIV/AIDS, hepatitis C, *Helicobacter pylori*) will be explored.

Preliminary discussions with public health officials in Arctic regions of the Russian Federation have raised the possibility of expanding ICS activities to include the Barents Sea Region, Kamchatka, Chukotka, and the Republic of Sakha.

VI. Relationship to other Arctic Council Programs:

A. Arctic Monitoring and Assessment Program(AMAP) activities and priorities.

Exposure to persistent organic pollutants (POP=s) and heavy metals are of primary concern because of their accumulation in the marine food chain and ultimately in the subsistence food sources of many Arctic residents. The potential effects of these pollutants on human fetal, infant and child development are of concern and are now priority areas of investigation by both the AMAP and Sustainable Development human health working groups or the Arctic Council countries. Studies have also shown that both POP=s and certain heavy metals impact key elements of the immune system thereby compromising the human primary defense against bacterial, viral, and parasitic infections. The surveillance of infectious diseases in Arctic populations will allow measurement of baseline rates of disease, comparisons of disease rates between Arctic regions, and evaluation of environmental pollution as risk factors for increased rates of infectious diseases.

B. Sustainable Development Project: Future of Children and Youth of the North.

This project draws attention to a broad range of factors that affect health of children and youth of the Arctic. These range from socioeconomic (social status, poverty or income), to availability of health services, biophysical factors (bacterial water quality, chemical contaminants in water, air, or food), and to psychosocial factors (such as family violence, social support networks, substance abuse and physical activity levels). The biophysical health component examines the

effects of contaminants in the water, air and food of norther children and youth, and the biomedical conditions affecting the health of children and youth of the Arctic. Contaminants of concern include; microbial agents, persistent organic pollutants (POP=s), toxic metals, radio nuclides. The impact of these contaminants on human health can be measured using a variety of indicators including an assessment of rates of childhood and adolescent infectious diseases. The surveillance of infectious diseases in Arctic populations will allow measurement of rates of disease in this target population.

C. Arctic Climate Impact Assessment (ACIA)

The goal of ACIA is to provide information on the consequences of climate variability and change to the governments, organizations and peoples of the Arctic region. The assessment will collect scientific information predict environmental, human health and socio-economic impacts and recommend actions. Global warming and other extreme climate events directly and indirectly threaten human health and may act as catalysts for outbreaks of infectious diseases. The establishment of a circumpolar surveillance system for infectious diseases should also allow the monitoring of diseases potentially sensitive to both long and short term changes in climate.

VII. Anticipated Outcomes of ICS

Significant outcomes of this project include the linkage of clinical laboratories, public health facilities, and reference laboratories within the Arctic states to allow the collection of standardized laboratory and epidemiological data on diseases of concern.

Initially the prevalence, characteristics, age group and geographic distribution of invasive pneumococcal disease in the Arctic will be described. This information will allow targeting of populations for pneumococcal disease prevention and control activities, which may include the use of available vaccines, or educational programs aimed at controlling the spread of drug resistant infections.

This project will allow international standardization of laboratory methods to ensure laboratory method comparability between countries. Similarly epidemiologic data collection and reporting methods will be standardized, allowing comparison of information not only between Arctic countries but also between other countries with comparable surveillance systems.

Communication between clinical, reference laboratories and public health facilities within and between Arctic countries will be enhanced. The formation of an ICS steering committee consisting of experts in Arctic Health issues from each participating Arctic country will allow continued discussion of other public health problems and development of additional collaborative surveillance systems to include other infectious, non infectious diseases of concern. Relatively little is known about infectious disease problems in Arctic regions of the Russian Federation. The inclusion of public health representatives from these regions in ICS will enhance knowledge of infectious diseases of concern in these isolated regions of the Arctic.

Surveillance information of other invasive bacterial diseases such as those caused by *Haemophilus influenzae*, *Neisseria meningitidis*, Group A and Group B streptococcus now being shared between laboratories in the US Arctic (Alaska) and Northern Canada, could be expanded to include other participating countries. Similar surveillance systems could be established for tuberculosis, or infectious agents responsible for chronic diseases (HIV/AIDS, hepatitis B, hepatitis C, *Helicobacter pylori*).

As ICS expands to develop an infectious disease surveillance network of clinical, reference laboratories and public health authorities to all major Arctic regions of the globe, interaction and linkage with other established or developing surveillance networks (WHO, and EU surveillance initiatives) is anticipated which will provide information about emerging infectious disease problems and public health control measures on a global scale.

VIII. Further issues for consideration:

While infectious disease are only one area of concern, other health hazards impacting sustainable development in the Arctic include 1) injuries, both occupational and personal; 2) premature death/shortening of life-span; 3) industrial pollutants; 4) alcoholism, depression, suicide; 5) global warming/climatic changes and impacts on subsistence food sources and nutrition; 6) water quality and availability, human and animal waste disposal and solid waste management. The establishment of an integrated circumpolar surveillance for infectious diseases through collaboration, communication, development of standard protocols for methods, data and data sharing, creates a model by which other integrated surveillance systems for other human health problems facing Arctic communities can be addressed.

IX. Financial and Other Resources

A. Budget

Funding for the establishment and maintenance ICS has been provided by the US Centers for

Disease Control and Prevention's National Center for Infectious Disease, and Health Canada's Division of Respiratory Disease Prevention and Control.

Year	CDC	Health Canada	Total
1999	159,000	18,000	177,000
2000	159,000	18,000	177,000
2001	175,000	24,000	199,000
2002	175,000	24,000	199,000

Funds have been used for project travel, meeting support, personnel costs including a full time ICS coordinator and part-time data manager for maintenance of the international data base, and preparation and dissemination of data .

B. Commitment by Country

Countries participating in the surveillance system generally bear the cost of travel and accommodation for key personnel to work group meetings to be held annually or biannually. Such meetings often have been planned to coincide with scheduled national or international meetings of interest to, and usually attended to by the key public health contacts.

Costs laboratory associated with the isolation, identification, serotyping, antimicrobial susceptibility testing, shipping, handling and long term storage of bacterial isolates, collection analysis, and reporting of case data are born by each participating country since these activities are generally part of ongoing surveillance activities.

Further cooperative activities (ie collaborative research activities) may require additional resources which may require cost sharing.

C. Sustainability:

Each participating country recognizes the importance of human health as a critical part of any sustainable development program. All Arctic Council countries have public health surveillance systems in place and already carry the costs for surveillance of infectious diseases of community concern. Sustainability of the proposed surveillance system will depend on collaboration and enhanced communication between key public health contacts within each participating country, rapid dissemination of information collected accomplished by current Internet technology and report publication. Presenting human health proposals to ministerial representatives of each country raises awareness of the importance of human health issues facing Arctic communities, and consequently may influence additional support for human health projects brought before the Arctic Council by member countries.

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