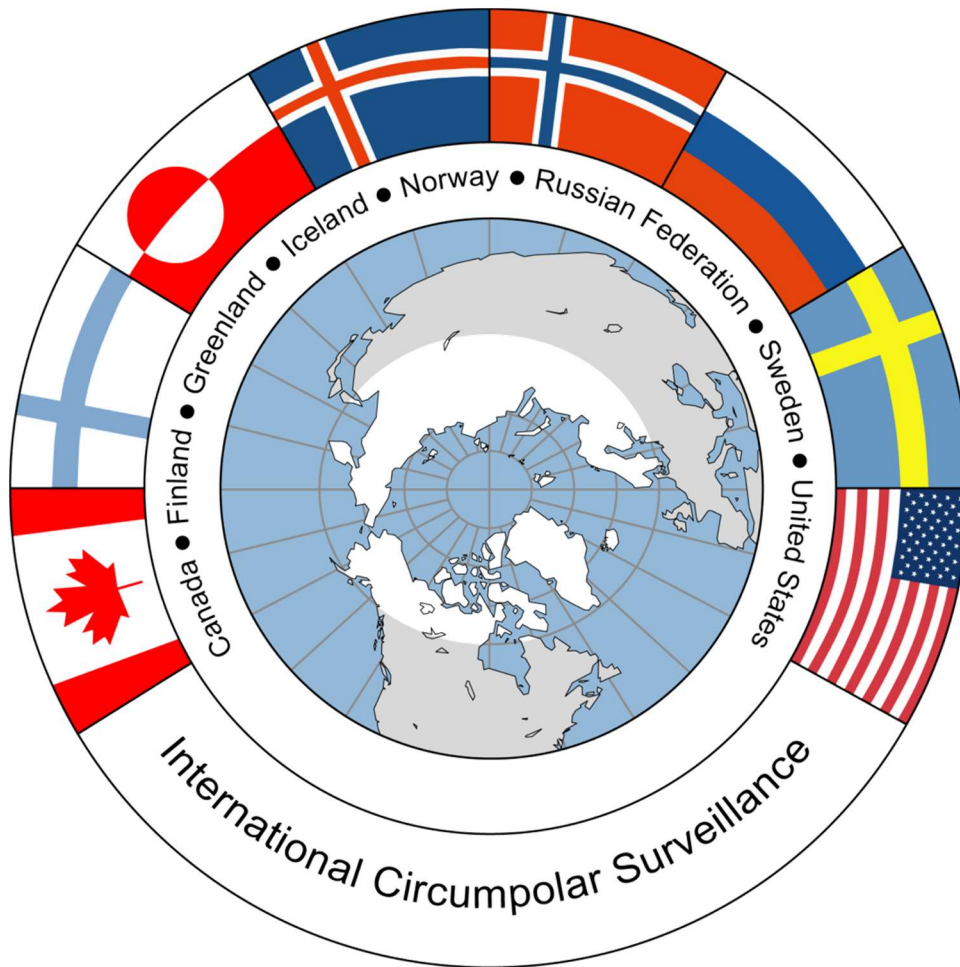


# INTERNATIONAL CIRCUMPOLAR SURVEILLANCE (ICS) SUMMARY REPORT



**YEAR 2008 DATA**



## TABLE OF CONTENTS

	<u>Page</u>
<b>Summary</b>	<b>1</b>
<b>Introduction</b>	<b>2</b>
<b>Goals</b>	<b>2</b>
<b>Methods</b>	<b>3</b>
<b>Results</b>	
<i>Streptococcus pneumoniae</i>	<b>8</b>
<i>Haemophilus influenzae</i>	<b>16</b>
<i>Neisseria meningitidis</i>	<b>19</b>
Group A <i>Streptococcus</i>	<b>21</b>
Group B <i>Streptococcus</i>	<b>24</b>
<b>Conclusions</b>	<b>27</b>
<b>Acknowledgements</b>	<b>27</b>
<b>Source</b>	<b>27</b>
<b>Participants</b>	<b>28</b>

## SUMMARY

International Circumpolar Surveillance (ICS) is a population-based surveillance system for invasive bacterial diseases established in the U.S. Arctic, Northern Canada, Greenland, Iceland, Norway, Finland, and Northern Sweden. Data collection began in 1999 and includes information on disease caused by *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Neisseria meningitidis*, and groups A and B *Streptococcus* (GAS, GBS). This report reviews the data collected for the year 2008.

Data on invasive disease with the organism *S. pneumoniae* are collected from all participating countries. A total of 2,089 cases of invasive pneumococcal disease were identified in 2008. Overall, rates of invasive *S. pneumoniae* were highest in individuals less than 2 years of age except in Greenland and Norway where rates were highest in persons 65 years and older. Case fatality ratios ranged from 9-14%. Race and ethnicity data are collected only in N. Canada and the U.S. Arctic; rates of invasive pneumococcal disease in Northern Canadian Aboriginals and U.S. Arctic Native populations were 29 and 56 cases per 100,000 population, respectively, which represents a decrease in disease from 2007. Pneumonia and bacteremia were the most common clinical presentations; cigarette smoking and alcohol abuse were the most common risk factors. The most common *S. pneumoniae* serotype in Iceland was 14; in Greenland and N. Sweden the most common serotype was 1; in the U.S. Arctic the most common serotype was 7F; and in N. Canada the most common serotype was 8.

Data on invasive disease due to *H. influenzae*, *N. meningitidis*, and groups A and B *Streptococcus* are currently collected in Greenland, Northern Canada, Northern Sweden and the U.S. Arctic; Norway also contributes data on cases of *N. meningitidis* and *H. influenzae*. A total of 108 *H. influenzae* cases, 42 *N. meningitidis* cases, 75 GAS cases, and 42 GBS cases were reported in 2008. In general, the highest rates of disease as a result of all organisms occurred in N. Canada Aboriginal or Alaska Native persons less than two years of age and persons 65 years and older.

### Surveillance Organisms Reported by Country, ICS 2008 Data

Country	<i>S. pneumoniae</i> n (rate*)	<i>H. influenzae</i> n (rate*)	<i>N. meningitidis</i> n (rate*)	GAS n (rate*)	GBS n (rate*)
Finland	910 (17.1)	N/A	N/A	N/A	N/A
Greenland	7 (12.4)	0 (0)	0 (0)	0 (0)	2 (3.5)
Iceland	46 (14.6)	N/A	N/A	N/A	N/A
N. Canada	33 (22.7)	8 (5.5)	1 (0.7)	25 (17.2)	1 (0.7)
N. Sweden	92 (18.1)†	3 (1.2)‡	0 (0)‡	12 (4.8)‡	11 (4.4)‡
Norway	853 (18)	76 (1.6)	36 (0.8)	N/A	N/A
U.S. Arctic	148 (21.8)	21 (3.1)	5 (0.7)	38 (5.6)	28 (4.1)
<b>Total</b>	<b>2,089 (17.8)</b>	<b>108 (1.8)</b>	<b>42 (0.7)</b>	<b>75 (6.6)</b>	<b>42 (3.7)</b>

\*Cases per 100,000

† Norbotten & Vasterbotten

‡ Norbotten

## INTRODUCTION

In January, 1999, the United States and Canada began international cooperative population-based surveillance for invasive *S. pneumoniae* by all laboratories serving residents of the North American Arctic. In January, 2000, this surveillance system expanded to include invasive diseases with the following organisms: *H. influenzae* (all types), *N. meningitidis*, GAS, and GBS. These pathogens were selected for ICS because rates of these diseases are elevated in indigenous peoples of the north, strains demonstrate resistance to commonly used antibiotics, they are routinely cultured in clinical laboratories, and clinically important serotypes of *S. pneumoniae*, *H. influenzae*, and *N. meningitidis* are vaccine preventable in infants and adults.

Denmark's autonomous region of Greenland joined ICS in 2000; Iceland, Norway (including Svalbard), and Finland joined in 2001; the Northern Sweden regions of Norbotten and Vasterbotten joined in 2003 and 2006, respectively.

## GOALS

The goal of ICS is to establish an integrated network of hospital and public health facilities throughout the Arctic countries to monitor infectious diseases of concern. Linking public health facilities within Arctic nations will allow for the collection and sharing of uniform laboratory and epidemiological data that will describe the prevalence of infectious diseases in Arctic populations and assist in the formulation of prevention and control strategies.

The project, initiated in 1998, focused on establishing an ICS system for diseases caused by *S. pneumoniae*. This bacterium causes pneumonia, meningitis, and bacteremia in both the very young and the elderly. Once easily treated with antibiotics, this bacterium has become 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 worldwide. A polysaccharide vaccine is available for use in persons two years of age and older. A conjugate vaccine for infants has been developed and is licensed for use in the U.S., Canada, and the European Union. The fact that diseases caused by *S. pneumoniae* were already being monitored by many public health authorities within the Arctic states made establishing a circumpolar surveillance system for this infection feasible. In addition, due to the availability of polysaccharide and conjugate vaccines, much of the morbidity and mortality caused by *S. pneumoniae* is currently preventable.

ICS objectives include:

- Identify key public health contacts within Arctic countries. These persons should be familiar with infectious disease surveillance systems in place (particularly surveillance systems for diseases caused by *S. pneumoniae*) in the member country. Through correspondence and working group meetings, the scope and gaps of the surveillance systems are determined.
- Determine the comparability of laboratory and data collection methods, and negotiate standard protocols and quality control programs.
- Share and report data in agreed upon formats.
- Form a working group of key laboratory and public health contacts to coordinate pneumococcal surveillance within their respective jurisdictions. This group meets on a regular basis to review problems, progress, compliance, report generation, and future plans.

- Form a steering committee of national Arctic health experts to coordinate new objectives and initiatives within ICS.

This program forms 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 *H. influenzae*, *N. meningitidis*, GAS, and GBS), tuberculosis, HIV, hepatitis, foodborne diseases (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.

## METHODS

ICS is coordinated by personnel at the Arctic Investigations Program, Centers for Disease Control and Prevention, in Anchorage, Alaska.

A case of invasive *S. pneumoniae*, *H. influenzae*, *N. meningitidis*, GAS or GBS is defined by the isolation of the bacteria from a normally sterile site, (including blood, cerebrospinal fluid, pleural fluid, peritoneal fluid or joint fluid) that has been taken from a resident of the surveillance area.

In the U.S. Arctic and Northern Canada, laboratory, demographic and clinical data are collected continually by ICS, while in Greenland, Iceland, Northern Sweden, Norway, and Finland, summary data are submitted to ICS in aggregate at the end of the year.

### Surveillance System Description by Country/Region

The following table outlines the organisms reported and data provided by each country or region.

#### **Data Provided by Country/Region, ICS 2008**

<b>Country</b>	<b><i>S. pneumoniae</i></b>	<b><i>H. influenzae</i></b>	<b><i>N. meningitidis</i></b>	<b>GAS</b>	<b>GBS</b>	<b>Serotype</b>	<b>Demographics</b>	<b>Race/Ethnicity</b>	<b>Risk Factors</b>	<b>Outcome</b>
<b>Finland</b>	X						X			
<b>Greenland</b>	X	X	X	X	X	X	X			X
<b>Iceland</b>	X					X	X			X
<b>N. Canada</b>	X	X	X	X	X	X	X	X	X	X
<b>N. Sweden</b>	X	X	X	X	X		X			
<b>Norway</b>	X	X	X				X			X
<b>U.S. Arctic</b>	X	X	X	X	X	X	X	X	X	X

## Finland

- 23 district hospital laboratories participate in ICS.
  - Provide diagnostic microbiology services for all residents of Finland.
  - All invasive isolates of *S. pneumoniae* submitted to the National Public Health Institute (KTL) laboratory in Oulu.
- Antimicrobial susceptibility testing of *S. pneumoniae* isolates was performed by agar dilution method at district hospital laboratories as well as the KTL laboratory.
- Population estimates for 2008 were obtained from the website <http://www.stat.fi>

## Greenland

- 15 district hospital laboratories participate in ICS.
  - Provide diagnostic microbiology services for all residents of Greenland.
  - All invasive isolates of *S. pneumoniae*, *H. influenzae*, *N. meningitidis*, GAS, and GBS submitted to reference laboratories in Nuuk and Copenhagen.
- Antimicrobial susceptibility testing of *S. pneumoniae* isolates was performed by agar dilution at the central laboratory at Queen Ingrid's Hospital in Nuuk.
- Serotyping was performed at the Statens Serum Institute in Copenhagen, Denmark, by the Quellung method.
- Clinical and demographic data for every case of invasive *S. pneumoniae*, *H. influenzae*, *N. meningitidis*, GAS, and GBS was collected by public health authorities at the end of the year and entered onto a standardized collection tool, the Bacterial Diseases Surveillance Form (BDSF), which is also used in Iceland, Northern Canada, and the U.S. Arctic.
- Population estimates for 2008 were obtained from the website <http://www.stat.gl>

## Iceland

- 10 district hospital laboratories and one regional laboratory participate in ICS.
  - Provide diagnostic microbiology services for all residents of Iceland.
  - All invasive isolates of *S. pneumoniae* submitted to the reference hospital in Reykjavik.
- Antimicrobial susceptibility testing of *S. pneumoniae* isolates is performed by disc diffusion method at the Landspítali University Hospital (LUH) in Reykjavik and the laboratory at the regional hospital in Akureyri. All oxacillin resistant isolates are then analyzed by E test.
- Serotyping is performed at the LUH by coagglutination using antisera from Statens Serum Institute.
- Clinical and demographic data for every case of invasive *S. pneumoniae* was collected by public health authorities at the end of the year and entered onto the same collection form (BDSF) used in Greenland, Northern Canada, and the U.S. Arctic.
- Population estimates for 2008 were obtained from the website <http://www.statice.is>

## Northern Canada

- 14 Canadian laboratories participate in ICS.
  - Provide diagnostic microbiology services for all residents of the Yukon Territory, Northwest Territories, Nunavut, Northern Quebec, and Northern Labrador.
  - Submit all invasive isolates of *S. pneumoniae*, *H. influenzae*, *N. meningitidis*, GAS, and GBS to one of two reference laboratories in Canada.
  - *S. pneumoniae*, *H. influenzae*, GAS, and GBS isolates are serotyped by the Quellung method using Statens Serum Institute antisera.
- Antimicrobial susceptibility of *S. pneumoniae*, GAS, and GBS isolates was tested by micro-broth dilution (according to NCCLS recommendations).
- Communicable disease consultants located within one of the five regions of Northern Canada provided clinical and demographic information on the same collection form (BDSF) used in Greenland, Iceland, and the U.S. Arctic.
- Laboratory and clinical data are forwarded to the ICS coordinator at AIP in Anchorage.
- Population estimates for 2008 were obtained from the website <http://www.statcan.ca>

## Northern Sweden

- 1 district laboratory participates in ICS.
  - Provides diagnostic microbiology services for all residents of Norrbotten and Vasterbotten counties.
  - The main reference laboratory is at the Swedish Institute for Infectious Disease Control in Stockholm.
  - Isolates are serotyped by the Quellung method.
- Antimicrobial susceptibility testing was by disc diffusion at the University Hospital in Umea and Sunderby Hospital in Lulea.
- Population estimates for 2008 were obtained from the website [http://www.scb.se/default\\_2154.asp](http://www.scb.se/default_2154.asp)

## Norway

- 33 district hospital laboratories participate in ICS.
  - Provide diagnostic microbiology services for all residents of Norway.
  - All invasive isolates of *S. pneumoniae* submitted to one of two reference laboratories in Oslo or Tromso.
- Antimicrobial susceptibility testing of *S. pneumoniae* isolates is performed using the disc diffusion method at district hospital laboratories, the reference laboratory in Tromso or the main national laboratory in Oslo.
- Serotyping is performed at the Statens Serum Institute in Denmark by the Quellung method.
- Population estimates for 2008 were obtained from the website <http://www.ssb.no>



## U.S. Arctic

- 23 laboratories providing diagnostic services to residents of Alaska submitted to AIP isolates of *S. pneumoniae*, *H. influenzae*, *N. meningitidis*, GAS, and GBS cultured in blood, cerebrospinal fluid, or from other sterile sites.
  - *S. pneumoniae* and *H. influenzae* isolates are serotyped by the Quellung method using Statens Serum Institute antisera.
  - Serogroup testing of *N. meningitidis* was done using real-time PCR to detect the *ctaA* gene (capsule transport), as well as the genes required for serogroup-specific capsule biosynthesis.
- Antimicrobial susceptibility testing of *S. pneumoniae* isolates is performed at AIP by micro-broth dilution (according to NCCLS recommendations).
- Clinical and demographic information on each case-patient is recorded by AIP research nurses onto the same collection form (BDSF) used in Greenland, Iceland, and Northern Canada.
- Population estimates for 2008 were obtained from the website <http://www.labor.state.ak.us>

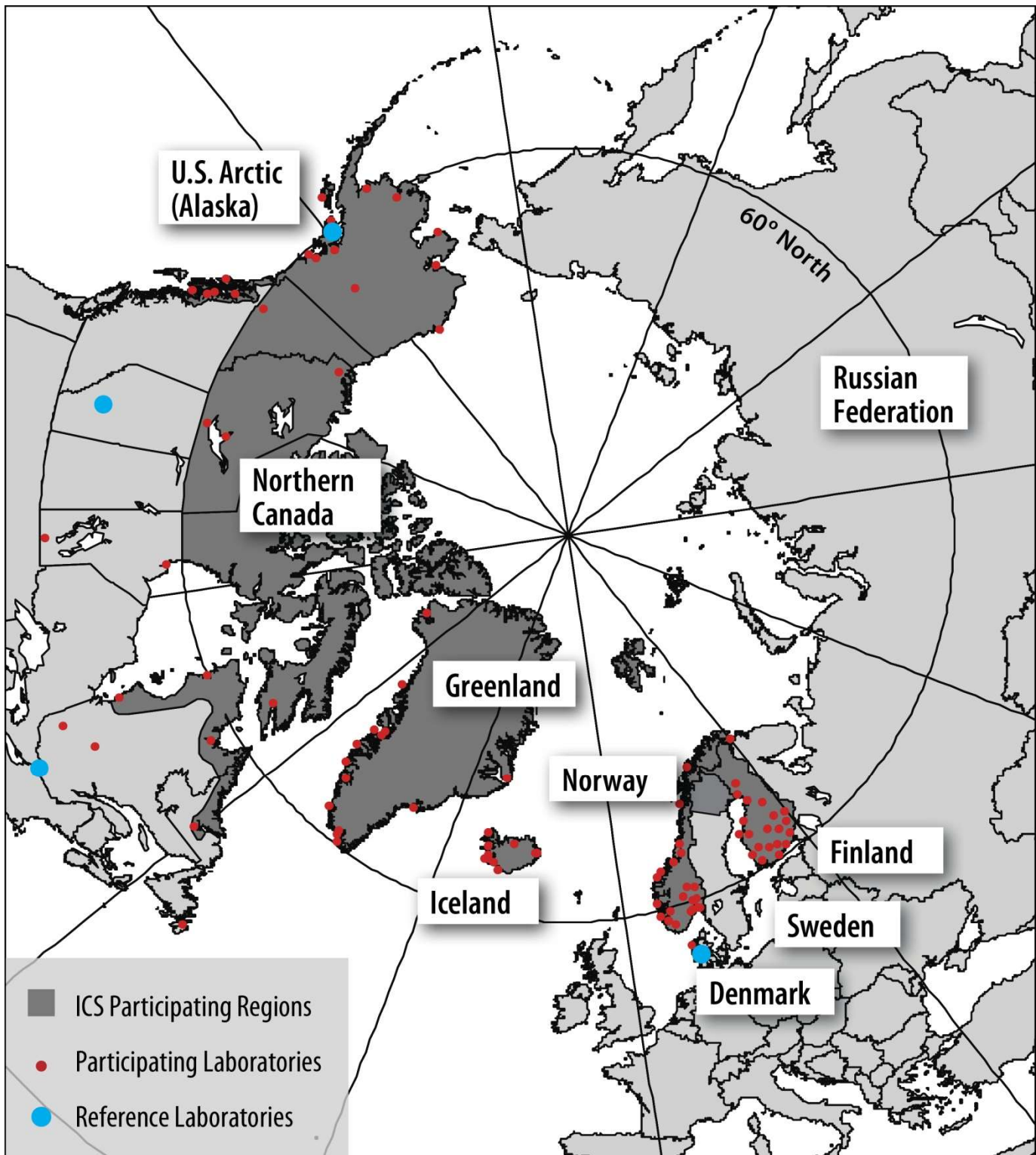
## Quality Control

*Streptococcus pneumoniae*: Currently 37 clinical laboratories in the U.S. Arctic and N. Canada forward isolates from patients with invasive pneumococcal disease to reference laboratories in Alaska and Canada respectively. To ensure inter-laboratory comparability of *S. pneumoniae* serotyping and antimicrobial susceptibility testing between two reference laboratories in Canada (Alberta and Quebec) and one in the U.S. (Alaska), the ICS *S. pneumoniae* inter-laboratory quality control (QC) program was established in 1999. Statens Serum Institute, Copenhagen, Denmark, joined the program in 2004.

Each reference laboratory is responsible for exporting one QC panel of seven *S. pneumoniae* isolates every other year to each of the other laboratories using a transportation medium of their choice for a total of 14 *Strep pneumoniae* isolates in 2008. Serotyping was performed by Quellung reaction. Minimum inhibitory concentration (MIC) is determined for each QC isolate and for ATCC strain 49619 for those antibiotics which are routinely tested in each laboratory. MIC results for each laboratory are expected to be within one log<sub>2</sub> dilution of each other regardless of testing method. Discrepancies of results are documented and examined to determine causes and solutions [1].

*Neisseria meningitidis*/*Haemophilus influenzae*: An interlaboratory quality control program for *Neisseria meningitidis* and *Haemophilus influenzae* was established in 2005. Participating laboratories include the National Microbiology Laboratory, Winnipeg, Manitoba, Canada; Arctic Investigations Program, Anchorage, Alaska, USA; Laboratoire Santé Publique du Québec, Sainte-Anne-de-Bellevue, Québec, Canada; National Centre for Streptococcus, Edmonton, Alberta, Canada; and Statens Serum Institut, Copenhagen, Denmark. Strain panels are distributed twice a year from the National Microbiology Laboratory or Arctic Investigations Program [2].

# Participating Countries, ICS 2008



## RESULTS

### *Streptococcus pneumoniae*

#### Case Demographics

A total of 2,089 cases of invasive disease caused by *S. pneumoniae* were reported to ICS during 2008 by Finland, Greenland, Iceland, N. Canada, N. Sweden, Norway, and the U.S. Arctic. The highest rates of disease (22.7 per 100,000) occurred in N. Canada and the lowest in Greenland (12.4 per 100,000) with an overall rate for the ICS circumpolar region of 17.8 per 100,000; 53% of all cases occurred in males. The median age of cases overall was 60.4 years with the lowest median age in N. Canada (28 years) and the highest in Norway (65.8 years). Case fatality ratios ranged from 8.7% in Iceland to 14.3% in Greenland; the overall case fatality ratio was 12.9%.

#### ***Streptococcus pneumoniae* Case Demographics, ICS 2008 Data**

Country	Population	# Cases	Rate*	Sex M (%)	Median Age (min-max) yrs	Deaths n (CFR†)
<b>Finland</b>	5,326,314	910	17.1	516 (57)	58 (0-97)	‡
<b>Greenland</b>	56,462	7	12.4	5 (71)	52.3 (41.2-67.7)	1 (14.3%)
<b>Iceland</b>	315,459	46	14.6	25 (54)	48.3 (0.5-83.6)	4 (8.7%)
<b>N. Canada</b>	145,493	33	22.7	17 (52)	28 (0-79.1)	3 (10.3%) <sup>b</sup>
<b>N. Sweden</b>	507,489 <sup>a</sup>	92	18.1	51 (55)	61 (0.3-93)	‡
<b>Norway</b>	4,737,171	853	18	424 (50)	65.8 (0.1-98.8)	52 (13.7%) <sup>b</sup>
<b>U.S. Arctic</b>	679,720	148	21.8	74 (50)	46 (0.4-101)	13 (8.8%)
<b>Total</b>	11,768,108	2,089	17.8	1,112 (53)	60 (0-101)	73 (12.9%)

\*Number of cases per 100,000 per year

†Case fatality ratio

‡Case outcomes not reported from Finland, N. Sweden

<sup>a</sup> Population for Norbotten and Vasterbotten

<sup>b</sup> Case outcomes unknown in 4 cases from N. Canada, 473 cases from Norway

#### ***Streptococcus pneumoniae* by Age Category, ICS 2008 Data**

Age	Finland	Greenland	Iceland	N. Canada	N. Sweden	Norway	U.S. Arctic
<2 yrs	Pop	118,672	1,642	9,090	5,327	10,399	118,166
	N (%)	63 (7)	0 (0)	11 (24)	12 (36)	5 (6)	18 (2)
	Rate*	53.1	0	121	225.3	48.1	15.2
2-19 yrs	Pop	1,104,780	16,518	80,574	44,556	104,996	1,104,780
	N (%)	63 (7)	0 (0)	4 (9)	3 (9)	4 (4)	28 (3)
	Rate*	5.7	0	5	6.7	3.8	2.5
20-64 yrs	Pop	3,209,907	34,738	189,386	90,576	294,507	2,820,917
	N (%)	460 (50)	6 (86)	17 (37)	13 (39)	44 (48)	363 (43)
	Rate*	14.3	17.3	9	14.4	14.9	12.9
65+ yrs	Pop	892,068	3,564	36,409	7,481	97,587	693,308
	N (%)	324 (36)	1 (14)	14 (30)	5 (15)	39 (42)	444 (52)
	Rate*	36.3	28.1	38.5	66.8	40	64
All ages	Pop	5,326,314	56,462	315,459	145,493	507,489	4,737,171
	N	910	7	46	33	92	853
	Rate*	17.1	12.4	14.6	22.7	18.1	18

\*Number of cases per 100,000 per year

When stratified by age, the highest rates of disease in all countries occurred in those cases less than two years of age and in cases 65+ years of age.

### Seasonality

*S. pneumoniae* was diagnosed throughout the year in 2008 in each country. No distinct patterns in seasonality occurred, however, the lowest proportion of cases tended to occur in the third quarter of the year.

### Race

Race and ethnicity data were collected in N. Canada and the U.S. Arctic. Rates of invasive pneumococcal disease were higher in Aboriginal and Native populations than in non-Aboriginal and non-Native populations with the exception of non-Aboriginals 2-19 years old in N. Canada. The highest rates of disease occurred in children less than 2 years of age and adults 65+ in both countries.

### ***Streptococcus pneumoniae* by Race and Age Categories, ICS 2008 Data**

Age (yrs)	N. Canada*		U.S. Arctic		
	Aboriginal	Non-Aboriginal	Native	Non-Native	
<2	Population	3,680	1,647	6,645	16,213
	Cases (rate‡)	10 (271.7)	2 (121.4)	14 (210.7)	1 (6.2)
2-19	Population	33,205	11,351	48,927	146,306
	Cases (rate‡)	2 (6)	1 (8.8)	12 (24.5)	7 (4.8)
20-64	Population	42,435	48,141	71,091	341,083
	Cases (rate‡)	8 (18.9)	1 (2.1)	42 (59.1)	44 (12.9)
65+	Population	3,385	4,096	7,970	41,483
	Cases (rate‡)	4 (118.2)	0 (0)	7 (87.8)	21 (50.6)
All	Population	82,705	62,788	134,633	545,087
Ages	Cases (rate‡)	24 (29)	4 (6.4)	75 (55.7)	73 (13.4)

\*Race unknown in 4 cases 20-64 years, 1 case 65+ years

‡Number of cases per 100,000 per year

### Clinical Presentation

The most common clinical presentations associated with *S. pneumoniae* were pneumonia, bacteremia, and meningitis. Clinical diagnoses other than bacteremia and meningitis were not reported in the Iceland, Finland and N. Sweden *S. pneumoniae* data. In N. Canada, Norway, and the U.S. Arctic the clinical presentation reported most often was pneumonia (61%, 54% and 70%, respectively); in Finland, Iceland and N. Sweden it was bacteremia (96%, 91% and 97%, respectively) and in Greenland both pneumonia and meningitis were reported in 43% of cases.

### Clinical Presentation of Reported *Streptococcus pneumoniae* Cases, ICS 2008 Data

	Finland n (%)	Greenland n (%)	Iceland n (%)	N Canada n (%)	N Sweden n (%)	Norway n (%)	US Arctic n (%)
<b>Pneumonia*</b>	0 (0)	3 (43)	0 (0)	20 (61)	0 (0)	459 (54)	103 (70)
<b>Bacteremia</b>	872 (96)	1 (14)	42 (91)	5 (15)	89 (97)	291 (34)	21 (14)
<b>Meningitis</b>	38 (4)	3 (43)	4 (9)	5 (15)	3 (3)	67 (8)	7 (5)
<b>Empyema</b>	0 (0)	0 (0)	0 (0)	1 (3)	0 (0)	0 (0)	8 (5)
<b>Septic arthritis</b>	0 (0)	0 (0)	0 (0)	1 (3)	0 (0)	1 (<1)	2 (1)
<b>Endocarditis</b>	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)
<b>Cellulitis</b>	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)
<b>Peritonitis</b>	0 (0)	0 (0)	0 (0)	1 (3)	0 (0)	0 (0)	1 (1)
<b>Amnionitis</b>	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (<1)	0 (0)
<b>Other</b>	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	34 (4)	1 (1)
<b>Total Cases</b>	910	7	46	33	92	853	148

\*with bacteremia

### Risk Factors

Greenland, N. Canada and the U.S. Arctic reported medical conditions or risk factors associated with *S. pneumoniae*. In adults 18 years and older, cigarette smoking and alcohol abuse were the most common associated conditions occurring in 14 to 47% of patients.

### *Streptococcus pneumoniae* Risk Factor/Medical Conditions in Adults\*, ICS 2008 Data

	Greenland n (%)	N. Canada n (%)	U.S. Arctic n (%)
<b>Cigarette Smoking</b>	1 (14)	3 (16)	53 (47)
<b>Alcohol Abuse</b>	1 (14)	7 (37)	40 (35)
<b>Chronic Lung Disease and/or Asthma</b>	0 (0)	3 (16)	29 (25)
<b>Immunosuppressive Therapy</b>	0 (0)	1 (5)	5 (4)
<b>Diabetes</b>	0 (0)	3 (16)	17 (15)
<b>Injection Drug Use</b>	0 (0)	0 (0)	0 (0)
<b>Asplenia</b>	0 (0)	1 (5)	0 (0)
<b>Total Adult* Cases</b>	7	19	114

\*≥ 18 years

### Vaccination Policy

In Finland, Iceland, N. Canada, Norway, and the U.S. Arctic, 23-valent pneumococcal polysaccharide vaccine (PS23) is recommended for persons 55 years and older (U.S. Arctic), over 60 years (Iceland) or over 65 years of age (Finland, N. Canada, Norway), and to persons greater than two years of age (Finland, Iceland, Norway, U.S. Arctic) or greater than five years of age (N. Canada) with specific medical problems. The vaccine is only recommended for certain risk groups in N. Sweden. The pneumococcal 7-valent conjugate vaccine (PCV7) was introduced into the infant immunization schedule in the U.S. Arctic in January, 2001, and in Norway in July, 2006. In N. Canada, PCV7 was introduced in northern Quebec and Nunavut in 2002, Newfoundland and Yukon in 2005 and Northwest Territory in 2006.

## Vaccination Status

Twenty-two and 93 percent of *S. pneumoniae* cases in children less than 2 years of age with known vaccination status were vaccinated with PCV7 in N. Canada and the U.S. Arctic, respectively. None of the cases in Norway eligible for PCV7 or PS23 were vaccinated indicating much less frequent use of these vaccines than in N. Canada and the U.S. Arctic. Vaccine coverage data were not reported from Finland and Iceland.

### *Streptococcus pneumoniae* Case Vaccination Status for Pneumococcal Vaccine, ICS 2008 Data

	N. Canada	Norway	U.S. Arctic
<b>Total cases eligible for PCV7 vaccine*</b>	12	18	15
<b>Vaccine status known in cases eligible for PCV7</b>	9	4	15
<b>Cases eligible for PCV7 vaccinated (%)†</b>	2 (22%)	0 (0%)	14 (93%)
<b>Total cases eligible for PS23 vaccine‡</b>	5	444	47
<b>Vaccine status known in cases eligible for PS23</b>	4	123	28
<b>Cases eligible for PS23 vaccinated (%)†</b>	3 (75%)	0 (0%)	23 (82%)

\*Children less than 2 years of age

†Percent of vaccine status known cases

‡Adults 55 years and older in the U.S. Arctic, 65 years and older in N. Canada and Norway

## Serotypes

The *S. pneumoniae* serotypes reported by ICS regions in 2008 are listed in the following table; yellow highlights the most common serotypes in each country. Serotypes included in the 7-valent conjugate vaccine are the most prevalent in the countries that did not include the vaccine in their universal vaccine programs in 2008 (Greenland, Iceland).

### *Streptococcus pneumoniae* Serotypes by Country, ICS 2008 Data

Serotype	Greenland n (%)	Iceland n (%)	N. Canada† (%)	N. Sweden* n (%)	U.S. Arctic† n (%)
<b>1</b>	2 (29)	3 (7)	0 (0)	0 (0)	0 (0)
<b>3</b>	0 (0)	1 (2)	0 (0)	8 (17)	3 (2)
<b>4‡</b>	0 (0)	3 (7)	1 (3)	3 (6)	0 (0)
<b>6</b>	0 (0)	0 (0)	1 (3)	2 (4)	0 (0)
<b>6A</b>	0 (0)	2 (4)	0 (0)	0 (0)	2 (1)
<b>6B‡</b>	1 (14)	1 (2)	1 (3)	1 (2)	0 (0)
<b>6C</b>	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)
<b>7</b>	0 (0)	0 (0)	0 (0)	7 (15)	0 (0)
<b>7C</b>	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)
<b>7F</b>	1 (14)	3 (7)	0 (0)	0 (0)	29 (22)
<b>8</b>	0 (0)	0 (0)	5 (16)	0 (0)	7 (5)
<b>9</b>	0 (0)	0 (0)	0 (0)	4 (9)	0 (0)
<b>9N</b>	0 (0)	0 (0)	3 (10)	0 (0)	1 (1)
<b>9V‡</b>	0 (0)	4 (9)	0 (0)	0 (0)	1 (1)
<b>10A</b>	0 (0)	0 (0)	1 (3)	0 (0)	3 (2)
<b>10F</b>	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)
<b>11A</b>	0 (0)	0 (0)	0 (0)	0 (0)	2 (1)
<b>12</b>	0 (0)	1 (2)	0 (0)	0 (0)	0 (0)
<b>12F</b>	0 (0)	0 (0)	1 (3)	0 (0)	11 (8)

Serotype	Greenland n (%)	Iceland n (%)	N. Canada† (%)	N. Sweden* n (%)	U.S. Arctic† n (%)
14‡	0 (0)	9 (20)	3 (10)	7 (15)	0 (0)
15	0 (0)	0 (0)	0 (0)	2 (4)	0 (0)
15A	0 (0)	0 (0)	3 (10)	0 (0)	4 (3)
15B	0 (0)	0 (0)	1 (3)	0 (0)	2 (1)
16F	0 (0)	0 (0)	1 (3)	0 (0)	4 (3)
17F	0 (0)	0 (0)	1 (3)	0 (0)	0 (0)
18	0 (0)	0 (0)	0 (0)	3 (6)	0 (0)
18C‡	1 (14)	2 (4)	1 (3)	0 (0)	0 (0)
19	0 (0)	0 (0)	0 (0)	4 (9)	0 (0)
19A	0 (0)	5 (11)	4 (13)	0 (0)	28 (21)
19F‡	1 (14)	2 (4)	1 (3)	0 (0)	2 (1)
20	0 (0)	0 (0)	0 (0)	0 (0)	8 (6)
22	0 (0)	2 (4)	0 (0)	1 (2)	0 (0)
22A	0 (0)	0 (0)	1 (3)	0 (0)	0 (0)
22F	0 (0)	0 (0)	1 (3)	0 (0)	11 (8)
23	0 (0)	0 (0)	0 (0)	4 (9)	0 (0)
23A	0 (0)	2 (4)	0 (0)	0 (0)	1 (1)
23B	0 (0)	0 (0)	0 (0)	0 (0)	4 (3)
23F‡	1 (14)	2 (4)	0 (0)	0 (0)	0 (0)
29	0 (0)	2 (4)	0 (0)	0 (0)	0 (0)
31	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)
33	0 (0)	2 (4)	0 (0)	0 (0)	0 (0)
33F	0 (0)	0 (0)	1 (3)	0 (0)	3 (2)
35	0 (0)	0 (0)	0 (0)	1 (2)	0 (0)
35B	0 (0)	0 (0)	0 (0)	0 (0)	3 (2)

\*Serogroup level data from Vasterbotten

†PCV7 included in universal vaccine program

‡Serotype included in PCV7 vaccine

### Vaccine-Preventable Cases and Deaths

For the countries reporting serotype data, more than 81% of *S. pneumoniae* cases in persons  $\geq 2$  years of age were preventable with use of the 23-valent polysaccharide vaccine. Use of the 7-valent conjugate vaccine would have potentially prevented 60% of *Strep pneumoniae* cases in children  $< 2$  years of age in Iceland. There was only one case of disease caused by a serotype contained in the 7-valent vaccine in N. Canada and U.S. Arctic children less than 2 reflecting widespread introduction of this vaccine and the near elimination of vaccine preventable disease in this population. The proportion of deaths potentially preventable with use of the 23-valent polysaccharide vaccine related to *S. pneumoniae* ranged from 91% to 100%.

## Proportion of Vaccine Preventable Cases/Deaths from Invasive Pneumococcal Disease, ICS 2008 Data

	Greenland n/Denom* (%)	Iceland n/Denom* (%)	N. Canada n/Denom* (%)	U.S. Arctic n/Denom* (%)
Cases ≥ 2 years old with serotype in the 23-valent pneumococcal polysaccharide vaccine	7/7 (100)	25/31 (81)	17/19 (89)	99/120 (82.5)
Cases < 2 years old with serotype in the 7-valent pneumococcal conjugate vaccine	0/0 (0)	6/10 (60)	1/11 (9)	1/15 (7)
Deaths (all ages) for which the serotype was contained in the 23-valent pneumococcal vaccine	1 (100‡)	4 (100‡)	3 (100‡)	10 (91‡)

\*Number of isolates serotyped by country by age group

‡Percentage of total death

### Outcome

A total of 73 deaths associated with *S. pneumoniae* were reported to ICS in 2008. Overall, the highest case fatality ratio (CFR) occurred in persons 65+ years of age (17%). Finland and N. Sweden did not report outcome data.

## *Streptococcus pneumoniae* Age-Specific Case-Fatality Ratios (CFR), ICS 2008 Data

		<2 years	2-19 years	20-64 years	65+ years	All Ages
<b>Greenland</b>	Deaths/Cases*	0/0	0/0	1/6	0/1	1/7
	(CFR)	(0%)	(0%)	(17%)	(0%)	(14%)
<b>Iceland</b>	Deaths/Cases*	0/11	0/4	1/17	3/14	4/46
	(CFR)	(0%)	(0%)	(6%)	(21%)	(9%)
<b>N. Canada</b>	Deaths/Cases*	0/9†	0/3	2/13	1/4†	3/29
	(CFR)	(0%)	(0%)	(15%)	(25%)	(10%)
<b>Norway</b>	Deaths/Cases*	1/10†	0/17†	16/157†	35/196†	52/379
	(CFR)	(0%)	(0%)	(10%)	(18%)	(13%)
<b>U.S. Arctic</b>	Deaths/Cases*	0/15	1/19	9/86	3/28	13/148
	(CFR)	(0%)	(5%)	(11%)	(11%)	(9%)
<b>Total</b>	Deaths/Cases*	1/45	1/43	29/279	42/243	73/568
	(CFR)	(2%)	(2%)	(10%)	(17%)	(13%)

\*Cases with known outcome.

†Outcome unknown in (3) N. Canada, (8) Norway cases < 2 years; (11) Norway cases 2-19 years; (206) Norway cases 20-64 years; (1) N. Canada, (248) Norway cases 65+ years

### Antimicrobial Susceptibility

In 2008, antimicrobial susceptibility results were reported to ICS from Finland, Greenland, Iceland, N. Canada, N. Sweden and the U.S. Arctic. The following table outlines for each country the antibiotics tested, the number of isolates reported tested for each antibiotic and the proportion (NS%) of isolates tested that showed any level of non-susceptibility.



***Streptococcus pneumoniae* Antibiotic Susceptibility Testing, ICS 2008 Data**

Antibiotic	Finland n (NS%)	Greenland n (NS%)	Iceland n (NS%)	N. Canada (NS%)	N. Sweden n (NS%)	U.S. Arctic n (NS%)
Ceftriaxone	0	0	46 (0%)	19 (0%)	4 (0%)	135 (4%)
Chloramphenicol	0	0	46 (2%)	23 (0%)	0	135 (2%)
Clindamycin	0	0	0	21 (5%)	45 (0%)	135 (3%)
Erythromycin	0	7 (0%)	46 (17%)	22 (23%)	92 (0%)	135 (16%)
Levofloxacin	0	0	0	22 (0%)	0	135 (1%)
Penicillin	910 (2%)	7 (0%)	46 (9%)	24 (0%)	90 (3%)	135 (21%)
Rifampin	0	0	0	0	0	135 (2%)
TMP Sulfa*	0	0	46 (15%)	23 (9%)	54 (19%)	135 (26%)
Vancomycin	0	0	0	24 (0%)	0	135 (0%)

\*Trimethoprim-sulfamethoxazole

Of the antibiotics tested, the largest numbers of isolates were resistant to penicillin, TMP-Sulfa and erythromycin. Results by country for each of these antibiotics are shown in the tables below. In the U.S. Arctic, 44 isolates comprised of 11 serotypes (6A, 6C, 7F, 8, 9V, 15B, 16F, 19A, 23B, 33F, 35B) showed multi-drug resistance. The largest proportion (n = 25, 57%) of the multi-drug resistant isolates was serotype 19A and isolates with this serotype were the only ones that were resistant to more than three antibiotics. In N. Canada, one of five serotype 8 isolates and the single serotype 6B isolate were resistant to two antibiotics. In Iceland, 3 of 5 serotype 14 isolates were antibiotic resistant; three were resistant to one antibiotic, one showed resistance to two antibiotics and one showed resistance to three antibiotics. The one 6B and two 19F isolates were all resistant to three antibiotics. Finland and N. Sweden did not report serotypes.

***Streptococcus pneumoniae* Penicillin Susceptibility Results, ICS 2008 Data**

	# Tested	I* (%)	I* Serotypes (n)	R* (%)	R* Serotypes (n)
Finland	910	13 (1%) †		3 (<1%) †	
Greenland	7	0 (0%)		0 (0%)	
Iceland	46	4 (9%)	19F (2), 14 (1), 6B (1)	0 (0%)	
N. Canada	24	0 (0%)		0 (0%)	
N. Sweden	90	3 (3%) †		0 (0%)	
U.S. Arctic	135	25 (19%)	19A (17), 6A (2), 35B (2), 6C (1), 9V (1), 23A (1), 23B (1)	4 (3%)	19A (3), 35B (1)

\*I=Intermediate resistance, R=Fully resistant

†Serotypes not provided

***Streptococcus pneumoniae* TMP-Sulfa Susceptibility Results, ICS 2008 Data**

	# Tested	I* (%)	I* Serotypes (n)	R* (%)	R* Serotypes (n)
Iceland	46	1 (2%)	33	6 (13%)	19F (2), 6B (1), 14 (1), 19A (1), 23F (1)
N. Canada	23	2 (9%)	6B, 9N	0 (0%)	
N. Sweden	54	6 (11%) †		4 (7%) †	
U.S. Arctic	135	9 (7%)	12F (2), 19A (2), 33F (2), 10A (1), 15B (1), 23B (1)	26 (19%)	19A (22), 6C (1), 9V (1), 10A (1), 33F (1)

\*I=Intermediate resistance, R=Fully resistant

†Serotypes not provided

***Streptococcus pneumoniae* Erythromycin Susceptibility Results, ICS 2008 Data**

	# Tested	I* (%)	I* Serotypes	R* (%)	R* Serotypes (n)
<b>Greenland</b>	7	0 (0%)		0 (0%)	
<b>Iceland</b>	46	0 (0%)		8 (17%)	14 (5), 19F (2), 6B (1)
<b>N. Canada</b>	22	0 (0%)		5 (23%)	14 (3), 8 (1), 6B (1)
<b>N. Sweden</b>	92	0 (0%)		0 (0%)	†
<b>U.S. Arctic</b>	135	0 (0%)		21 (16%)	19A (12), 6A (2), 7F (1), 8 (1), 9V (1), 15B (1), 16F (1), 23B (1), 33F (1)

\*I=Intermediate resistance, R=Fully resistant

†Serotypes not provided

Quality Control

In 2008, two QC panels of seven *S. pneumoniae* isolates plus a control strain each were shipped and tested. Beginning in 2005, the MIC data was analyzed in two ways. The first comparison is based on MIC data provided by the distributing laboratory and is the method used historically in the QC program. The new methodology provides an analysis of MIC data for all the participating laboratories by using the modal MIC for each antibiotic-organism combination as the value to which the other data are compared. The modal MIC is the MIC most frequently reported. When two MIC values were reported with equal frequency, both were accepted as a modal value. Antibiotic-organism combinations for which there was no consensus on a modal MIC were excluded from the analysis. The rationale for initiating the second analysis recognizes that there is an allowable variation of one log<sub>2</sub> dilution inherent for any MIC testing system. This means that there is no one absolutely correct MIC value to which all others can be compared. The modal MIC may be a better representation of this ‘true’ value than any one laboratory can provide. For Panel 2008-A, overall serotyping performance was 100%. The modal MIC comparison resulted in an overall correlation of 97.4% with individual participant correlation ranging from 78%-100%. Overall category agreement was 97.1% with individual participant agreement ranging from 94.3%-100%. For Panel 2008-B, overall serotyping correlation was 97.5%. The overall modal MIC correlation was 91.5% [1].

Conclusions

*Streptococcus pneumoniae* remains a major cause of invasive bacterial disease in circumpolar regions. Disease rates are highest in indigenous populations. The impact of the conjugate vaccine is clear in the U.S. Arctic and is beginning to be seen in N. Canada. Surveillance for evidence of impact in other circumpolar countries will be important to confirm effectiveness and provide support for continuing immunization programs.

## *Haemophilus influenzae*

### Case Demographics

Greenland, N. Canada, N. Sweden (Norrbotten), Norway and the U.S. Arctic reported the occurrence of *H. influenzae* in each country during 2008. Greenland reported no cases. A total of 107 cases of invasive disease caused by *H. influenzae* were reported to ICS during 2008 by N. Canada, N. Sweden (Norrbotten), Norway and the U.S. Arctic. The highest rate of disease in the regions reporting cases was in N. Canada (4.8 per 100,000) and the lowest in N. Sweden (1.2/100,000). Median age of cases was highest in Norway (66.3 years) and lowest in N. Canada (0.8 years).

### *Haemophilus influenzae* Case Demographics, ICS 2008 Data

Country	Population	# Cases	Rate*	Sex M (%)	Median Age (min-max) yrs	Deaths n (CFR†)
Greenland	56,462	0	0	No cases	No cases	No cases
N. Canada	145,493	7	4.8	5 (71)	0.8 (0-44)	0 (0%)
N. Sweden	249,677	3	1.2	1 (33)	59 (6-97)	‡
Norway	4,737,171	76	1.6	36 (47)	66.3 (0.3-93.2)	4 (9%)‡
U.S. Arctic	679,720	21	3.1	13 (62)	54.4 (0-92.7)	3 (14%)
<b>Total</b>	<b>5,868,523</b>	<b>107</b>	<b>1.8</b>	<b>55 (51)</b>	<b>62.3 (0-97)</b>	<b>7 (7%)</b>

\*Number of cases per 100,000 per year

†Case fatality ratio

‡ Case outcome unknown in (31) Norway cases; N. Sweden did not report case outcomes

When stratified by age, the highest rates of disease for both N. Canada and the U.S. Arctic was in the <2 years age category; no disease was reported in the <2 years age category in N. Sweden. The highest rate of disease in Norway was in the 65+ years of age category.

### *Haemophilus influenzae* by Age Category, ICS 2008 Data

Age		N. Canada	N. Sweden	Norway	U.S. Arctic
<2 yrs	Population	5,327	4,800	118,166	22,858
	Cases (%)	5 (71)	0 (0)	2 (3)	7 (33)
	Rate*	93.9	0	1.7	30.6
2-19 yrs	Population	44,556	51,055	1,104,780	412,174
	Cases (%)	1 (14)	1 (33)	5 (7)	1 (5)
	Rate*	2.2	2	0.5	0.5
20-64 yrs	Population	90,576	143,703	2,820,917	412,174
	Cases (%)	1 (14)	1 (33)	29 (38)	7 (33)
	Rate*	1.1	0.7	1	1.7
65+ yrs	Population	7,481	50,119	693,308	49,455
	Cases (%)	0 (0)	1 (33)	40 (53)	6 (29)
	Rate*	0	2	5.8	12.1
<b>All ages</b>	Population	145,493	249,677	4,737,171	679,720
	Cases	7	3	76	21
	Rate*	4.8	1.2	1.6	3.1

\*Number of cases per 100,000 per year

## Race

Rates of disease were highest (135.9 per 100,000) in N. Canada Aboriginal cases less than two years of age. In the U.S. Arctic, rates of disease were higher in Native populations than in non-Native populations in all age categories.

### ***Haemophilus influenzae* by Race and Age Categories, ICS 2008 Data**

Age (yrs)	N. Canada		U.S. Arctic		
	Aboriginal	Non-Aboriginal	Native	Non-Native	
<2	Population	3,680	1,647	6,645	16,213
	Cases (rate†)	5 (135.9)	0 (0)	3 (45.2)	4 (24.7)
2-19	Population	33,205	11,351	48,927	146,306
	Cases (rate†)	1 (3)	0 (0)	1 (2)	0 (0)
20-64	Population	42,435	48,141	71,091	341,083
	Cases (rate†)	1 (2.4)	0 (0)	4 (5.6)	3 (0.9)
65+	Population	3,385	4,096	7,970	41,483
	Cases (rate†)	0 (0)	0 (0)	2 (25.1)	4 (9.6)
All	Population	82,705	62,788	134,633	545,087
Ages	Cases (rate†)	7 (8.5)	0 (0)	10 (7.4)	11 (2)

†Number of cases per 100,000 per year

## Clinical Presentation

In N. Canada and the U.S. Arctic, the most common clinical presentation associated with *H. influenzae* was pneumonia (43% in both regions). Bacteremia was the most common clinical presentation in N. Sweden (100%) and Norway (45%).

### **Clinical Presentation of Reported *Haemophilus influenzae* Cases, ICS 2008 Data**

	N. Canada n (%)	N. Sweden n (%)	Norway n (%)	U.S. Arctic n (%)
<b>Pneumonia*</b>	3 (43)	0 (0)	20 (26)	9 (43)
<b>Bacteremia</b>	1 (14)	3 (100)	34 (45)	7 (33)
<b>Meningitis</b>	3 (43)	0 (0)	8 (11)	2 (9.5)
<b>Empyema</b>	0 (0)	0 (0)	0 (0)	1 (5)
<b>Septic arthritis</b>	0 (0)	0 (0)	1 (1)	2 (9.5)
<b>Other/Unknown</b>	0 (0)	0 (0)	13 (17)	0 (0)
<b>Total</b>	7	3	76	21

\*with bacteremia

## Risk Factors

Thirty-one percent of adult ( $\geq 18$  years) cases of *H. influenzae* reported in the U.S. Arctic indicated smoking as an associated risk factor; 23% indicated chronic lung disease or diabetes as an associated risk factor. None of the adult N. Canadian *H. influenzae* cases any risk factors. N. Sweden and Norway did not report risk factor data.

## Vaccination Status

The *H. influenzae* type b (Hib) conjugate vaccine is required as part of routine childhood vaccination in N. Canada, N. Sweden, Norway and the U.S. Arctic. Three cases of Hib were reported in N. Canada and two cases in the U.S. Arctic in children less than five years. One Hib case in N. Canada and neither case in the U.S. Arctic had received Hib vaccine. Data on vaccine status were not provided by N. Sweden and Norway.

### **Haemophilus influenzae Case Vaccination Status for Hib Vaccine, ICS 2008 Data**

	<b>N. Canada</b>	<b>U.S. Arctic</b>
<b>Total cases* eligible for Hib vaccine†</b>	4	8
<b>Vaccine status known in cases* eligible for Hib vaccine</b>	4	7
<b>Cases* eligible for Hib vaccine vaccinated (%)‡</b>	3 (75%)	3 (43%)

\*All serotypes

†Children less than 5 years of age

‡Percent of vaccine status known cases

## Serotypes

### **Haemophilus influenzae Serotypes by Country, ICS 2008 Data**

<b>Serotype</b>	<b>N. Canada n (%)</b>	<b>Norway n (%)</b>	<b>U.S. Arctic n (%)</b>
<b>a</b>	2 (29)	1 (1.5)	2 (10)
<b>b</b>	3 (42)	1 (1.5)	3 (15)
<b>c</b>	0 (0)	0 (0)	0 (0)
<b>d</b>	0 (0)	0 (0)	0 (0)
<b>e</b>	0 (0)	1 (1.5)	1 (5)
<b>f</b>	0 (0)	16 (23)	1 (5)
<b>Non-typeable</b>	2 (29)	50 (72.5)	13 (65)
<b>Total*</b>	7	69	20

\*Number of cases serotyped

The most common *H. influenzae* serotype in N. Canada and the U.S. Arctic was type b (42% and 15% of cases, respectively) and in Norway it was type f (23% of cases. Non-typeable cases also made up a large proportion of cases in each country; 29% in N. Canada, 72.5% in Norway and 65% in the U.S. Arctic. N. Sweden did not provide serotype data.

## Outcome

Seven deaths were associated with *H. influenzae* cases reported to ICS in 2008; three from the U.S. Arctic and four from Norway. No deaths were reported in N. Canada and N. Sweden did not provide outcome data.

### ***Haemophilus influenzae* Deaths by Country, ICS 2008 Data**

	<b>Norway</b>	<b>U.S. Arctic</b>
<b>No. Deaths</b>	4	3
<b>Case Fatality Ratio</b>	9%*	14%
<b>Age Range (yrs)</b>	73.2-93.2	63.5-92.4
<b>Serotypes (n)</b>	NT (3), unknown (1)	NT (3)
<b>Clinical Presentations (n)</b>	Pneumonia (2), other (2)	Empyema (1), pneumonia (1), bacteremia (1)

\*Case outcome unknown in (31) Norway cases

#### Quality Control

Two QC panels of five *H. influenzae* and *N. meningitidis* isolates were shipped and serogrouped or serotyped. Discrepant results were due to the primer set available that did not include all possible serogroups [2].

#### Conclusions

Widespread use of Hib conjugate vaccines has led to the virtual disappearance of Hib disease in these populations. Substantial replacement with other serotypes has not occurred. The proportion of disease caused by non-typeable organisms is increasing and severity is similar to Hib disease.

## *Neisseria meningitidis*

### Case Demographics

Greenland, N. Canada, N. Sweden (Norbotten), Norway and the U.S. Arctic reported the occurrence of *N. meningitidis* during 2008. A total of 42 cases of invasive disease caused by *N. meningitidis* were reported to ICS; no cases occurred in Greenland or N. Sweden in 2008. Rates were similar in all three regions where disease occurred. Three deaths associated with *N. meningitidis* were reported from Norway.

### *Neisseria meningitidis* Case Demographics, ICS 2008 Data

Country	Population	# Cases	Rate*	Sex M (%)	Median Age (min-max) yrs	Deaths n (CFR†)
<b>Greenland</b>	56,462	0	0	0 (0)	No cases	0 (0%)
<b>N. Canada</b>	145,493	1	0.7	0 (0)	1 case – 2.3 years	0 (0%)
<b>N. Sweden</b>	249,677	0	0	0 (0)	No cases	0 (0%)
<b>Norway</b>	4,737,171	36	0.8	15 (42)	18.3 (0.1-92.8)	3 (10%)‡
<b>U.S. Arctic</b>	679,720	5	0.7	4 (80)	0.6 (0.2-20.6)	0 (0%)
<b>Total</b>	5,868,523	42	0.7	19 (45)	17.7 (0.1-92.8)	3 (8%)

\*Number of cases per 100,000 per year

†Case fatality ratio

‡Outcome unknown in 5 cases

When stratified by age, the highest rates of disease in Norway and the U.S. Arctic occurred in the less than 2 years old age category; in N. Canada, the highest rate of disease occurred in the 2-19 years age category.

### *Neisseria meningitidis* by Age Category, ICS 2008 Data

Age		N. Canada	Norway	U.S. Arctic
<2 yrs	Pop	5,327	118,166	22,858
	N (%)	0 (0)	7(19)	4 (80)
	Rate*	0	5.9	17.5
2-19 yrs	Pop	44,556	1,104,780	195,233
	N (%)	1 (100)	14 (39)	0 (0)
	Rate*	2.2	1.3	0
20-64 yrs	Pop	90,576	2,820,917	412,174
	N (%)	0 (0)	8 (22)	1 (20)
	Rate*	0	0.3	0.2
65+ yrs	Pop	7,481	693,308	49,455
	N (%)	0 (0)	7 (19)	0 (0)
	Rate*	0	1	0
All ages	Pop	145,493	4,737,171	679,720
	N	1	36	5
	Rate*	0.7	0.8	0.7

\*Number of cases per 100,000 per year

## Race

In the U.S. Arctic, one case of *N. meningitidis* occurred in AK Native people (rate 0.7/100,000) and four in non-Native persons (rate 0.7/100,000). In N. Canada, the single NM case occurred in an Aboriginal person (rate 1.2/100,000).

## Clinical Presentation

The most common clinical presentation in all countries reporting invasive *N. meningitidis* in 2008 was meningitis ranging from 53% to 100% of cases.

### **Clinical Presentation of Reported *Neisseria meningitidis* Cases, ICS 2008 Data**

	<b>N. Canada</b>	<b>Norway</b>	<b>U.S. Arctic</b>
	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>
<b>Pneumonia*</b>	0 (0)	2 (6)	0 (0)
<b>Bacteremia</b>	0 (0)	9 (25)	1 (20)
<b>Meningitis</b>	1 (100)	19 (53)	4 (80)
<b>Septic arthritis</b>	0 (0)	1 (3)	0 (0)
<b>Other</b>	0 (0)	5 (12)	0 (0)
<b>Total</b>	1	36	5

\*with bacteremia

## Risk Factors

Risk factor data was reported by N. Canada and the U.S. Arctic; no risk factors were associated with cases in 2008.

## Serogroups

Forty of 42 cases of invasive *N. meningitidis* reported to ICS in 2008 included serogroup data. The most common serogroup in all countries was B which occurred in 53% to 100% of cases.

### ***Neisseria meningitidis* Serogroups by Country, ICS 2008 Data**

<b>Serogroup</b>	<b>N. Canada</b>	<b>Norway</b>	<b>U.S. Arctic</b>
	<b>n (%)</b>	<b>n (%)</b>	<b>n (%)</b>
<b>B</b>	1 (100)	19 (53)	3 (60)
<b>C</b>	0 (0)	8 (22)	0 (0)
<b>W135</b>	0 (0)	1 (3)	0 (0)
<b>Y</b>	0 (0)	6 (16.5)	2 (40)
<b>Unknown</b>	0 (0)	2 (5.5)	0 (0)
<b>Total</b>	1	36	5

## Conclusions

*Neisseria meningitidis* is a relatively uncommon cause of invasive bacterial disease in the circumpolar area under surveillance, however, continued surveillance is warranted due to high morbidity and mortality associated with outbreaks.



## Group A *Streptococcus*

### Case Demographics

Greenland, N. Canada, N. Sweden (Norrbotten) and the U.S. Arctic each reported the occurrence of GAS during 2008. A total of 75 cases of invasive disease caused by GAS were reported to ICS; no cases occurred in Greenland in 2008. The rate of disease in the regions reporting cases was highest in N. Canada (17.2 per 100,000) compared to the lowest in N. Sweden (4.8 per 100,000). Six deaths were associated with GAS, one in N. Canada and five in the U.S. Arctic.

### Group A *Streptococcus* Case Demographics, ICS 2008 Data

Country	Population	# Cases	Rate*	Sex M (%)	Median Age (min-max) yrs	Deaths n (CFR†)
Greenland	56,462	0	0	No cases	No cases	No cases
N. Canada	145,493	25	17.2	7 (28)	39.7 (1-81.7)	1 (5%) <sup>a</sup>
N. Sweden	249,677	12	4.8	7 (58)	60.5 (17-88)	‡
U.S. Arctic	679,720	38	5.6	26 (68)	51.6 (0.2-87.2)	5 (13%)
<b>Total</b>	<b>1,131,352</b>	<b>75</b>	<b>6.6</b>	<b>40 (53)</b>	<b>50 (0.2-88)</b>	<b>6 (10%)</b>

\*Number of cases per 100,000 per year

†Case fatality ratio

‡Outcomes not reported from N. Sweden

<sup>a</sup>Outcome unknown in 3 cases from N. Canada

When stratified by age, the highest rates of disease occurred in individuals 65+ years of age in N. Canada and the U.S. Arctic (93.6 per 100,000 and 22.2 per 100,000, respectively).

### Group A *Streptococcus* by Age Category, ICS 2008 Data

Age		N. Canada	N. Sweden	U.S. Arctic
<2 yrs	Population	5,327	4,800	22,858
	Cases (%)	1 (4)	0 (0)	3 (8)
	Rate*	18.8	0	13.1
2-19 yrs	Population	44,556	51,055	195,233
	Cases (%)	7 (28)	1 (8)	2 (5)
	Rate*	15.7	2	1
20-64 yrs	Population	90,576	143,703	412,174
	Cases (%)	10 (40)	5 (42)	22 (58)
	Rate*	11	3.5	5.3
65+ yrs	Population	7,481	50,119	49,455
	Cases (%)	7 (28)	6 (50)	11 (29)
	Rate*	93.6	12	22.2
All ages	Population	145,493	249,677	679,720
	Total Cases	25	12	38
	Rate*	17.2	4.8	5.6

\*Number of cases per 100,000 per year

## Race

Race and ethnicity data were collected by N. Canada and the U.S. Arctic. Higher rates of disease occurred in all age categories in N. Canada Aboriginal people and U.S. Arctic Native people than in non-Aboriginal and non-Native people.

### **Group A *Streptococcus* by Race and Age Categories, ICS 2008 Data**

Age (yrs)	N. Canada*		U.S. Arctic		
	Aboriginal	Non-Aboriginal	Native	Non-Native	
<2	Population	3,680	1,647	6,645	16,213
	Cases (rate†)	1 (27.2)	0 (0)	2 (30.1)	1 (6.2)
2-19	Population	33,205	11,351	48,927	146,306
	Cases (rate†)	7 (21.1)	0 (0)	2 (4.1)	0 (0)
20-64	Population	42,435	48,141	71,091	341,083
	Cases (rate†)	5 (11.8)	3 (6.2)	7 (9.9)	15 (4.4)
65+	Population	3,385	4,096	7,970	41,483
	Cases (rate†)*	5 (147.7)	1 (24.4)	6 (75.3)	5 (12.1)
All	Population	82,705	62,788	134,633	545,087
Ages	Cases (rate†)	18 (21.8)	4 (6.4)	17 (12.6)	21 (3.9)

†Number of cases per 100,000 per year

\*Race unknown in (2) N. Canada cases 20-64, (1) N. Canada case  $\geq$  65

## Clinical Presentation

The most common clinical presentation for GAS cases in N. Canada (36%) and N. Sweden (100%) was bacteremia, in the U.S. Arctic it was cellulitis (39%).

### **Clinical Presentation of Reported group A *Streptococcus* Cases, ICS 2008 Data**

	N. Canada n (%)	N. Sweden n (%)	U.S. Arctic n (%)
<b>Bacteremia</b>	9 (36)	12 (100)	7 (18)
<b>Pneumonia*</b>	1 (4)	0 (0)	8 (21)
<b>Meningitis</b>	1 (4)	0 (0)	1 (3)
<b>Empyema</b>	1 (4)	0 (0)	0 (0)
<b>Cellulitis*</b>	3 (12)	0 (0)	15 (39)
<b>Necrotizing fasciitis</b>	2 (8)	0 (0)	2 (5)
<b>Septic arthritis</b>	4 (16)	0 (0)	3 (8)
<b>Osteomyelitis</b>	2 (8)	0 (0)	0 (0)
<b>Other</b>	2 (8)	0 (0)	2 (5)
<b>Total</b>	25	12	38

\*with bacteremia

## Risk Factors

Cigarette smoking was the most common risk factor associated with adult ( $\geq 18$  years) GAS cases in the U.S. Arctic; it was reported in 41% of cases. In N. Canada, the most common risk factor was diabetes which was reported in 29% of cases. N. Sweden did not report risk factor data.

### **Group A *Streptococcus* Risk Factor/Medical Conditions in Adults\*, ICS 2008 Data**

	<b>N. Canada n (%)</b>	<b>U.S. Arctic n (%)</b>
<b>Cigarette Smoking</b>	0 (0)	14 (41)
<b>Alcohol Abuse</b>	2 (12)	11 (32)
<b>Chronic Lung Disease and/or Asthma</b>	0 (0)	9 (26)
<b>Immunosuppressive Therapy</b>	0 (0)	1 (3)
<b>Diabetes</b>	5 (29)	11 (32)
<b>Injection Drug Use</b>	0 (0)	1 (3)
<b>Asplenia</b>	0 (0)	1 (3)
<b>Total Adult* Cases</b>	17	34

\* $\geq 18$  years

## Outcome

Five deaths in cases with GAS were reported from the U.S. Arctic (CFR 13%); four occurred in the 20-64 years old age category and one in a person  $\geq 65$ . One death was reported in N. Canada (CFR 5%); the death occurred in the 65+ year old age category. N. Sweden did not report case outcome data.

## Conclusions

These data suggest markedly higher rates in indigenous populations. Increased awareness of risk may help target improved treatment responses.

## Group B *Streptococcus*

### Case Demographics

Greenland, N. Canada, N. Sweden and the U.S. Arctic each reported the occurrence of GBS during 2008. A total of 42 cases of invasive disease caused by GBS were reported to ICS. The rate of disease was highest in N. Sweden (4.4 per 100,000) compared to N. Canada (0.7 per 100,000). Three deaths were associated with GBS in 2008.

### Group B *Streptococcus* Case Demographics, ICS 2008 Data

Country	Population	# Cases	Rate*	Sex M (%)	Median Age (min-max) yrs	Deaths n (CFR†)
Greenland	56,462	2	3.5	2 (100)	58 (53.6-62.5)	2 (100%)
N. Canada	145,493	1	0.7	0 (0)	1 case – 63.3	0 (0%)
N. Sweden	249,677	11	4.4	5 (45)	68 (0-84)	‡
U.S. Arctic	679,720	28	4.1	19 (68)	60.3 (0-104.6)	1 (3.6%)
<b>Total</b>	<b>1,131,352</b>	<b>42</b>	<b>3.7</b>	<b>26 (62)</b>	<b>62.4 (0-104.6)</b>	<b>3 (9.7%)</b>

\*Number of cases per 100,000 per year

†Case fatality ratio

‡No outcomes reported from N. Sweden

When stratified by age, the highest rates of disease occurred in cases less than two years of age in N. Sweden (20.8/100,000) and cases 65 and older in the U.S. Arctic (24.3 per 100,000).

### Group B *Streptococcus* by Age Category, ICS 2008 Data

Age		Greenland	N. Canada	N. Sweden	U.S. Arctic
<2 yrs	Population	1,642	5,327	4,800	22,858
	Cases (%)	0 (0)	0 (0)	1 (9)	4 (14)
	Rate*	0	0	20.8	17.5
2-19 yrs	Population	16,518	44,556	51,055	195,233
	Cases (%)	0 (0)	0 (0)	0 (0)	0 (0)
	Rate*	0	0	0	0
20-64 yrs	Population	34,738	90,576	143,703	412,174
	Cases (%)	2 (100)	1 (100)	3 (27)	12 (43)
	Rate*	5.8	1.1	2.1	2.9
65+ yrs	Population	3,564	7,481	50,119	49,455
	Cases (%)	0 (0)	0 (0)	7 (64)	12 (43)
	Rate*	0	0	14	24.3
All ages	Population	56,462	145,493	249,677	679,720
	Total Cases	2	1	11	28
	Rate*	3.5	0.7	4.4	4.1

\*Number of cases per 100,000 per year

There were two cases of early-onset disease (cases less than 7 days old); one in N. Sweden (0.3 cases per 1,000 births) and one in the U.S. Arctic (0.1 cases per 1,000 births).

## Race

Race and ethnicity data were collected in N. Canada and the U.S. Arctic. The highest rates of disease caused by GBS in the U.S. Arctic occurred in AK Native children less than 2 and AK Native persons 65 and older. The single case of GBS reported in N. Canada occurred in a non-Aboriginal person.

### **Group B *Streptococcus* by Race and Age Categories, ICS 2008 Data**

Age (yrs)	N. Canada		U.S. Arctic		
	Aboriginal	Non-Aboriginal	Native	Non-Native	
<2	Population	3,680	1,647	6,645	16,213
	Cases (rate*)	0 (0)	0 (0)	2 (30.1)	2 (12.3)
2-19	Population	33,205	11,351	48,927	146,306
	Cases (rate*)	0 (0)	0 (0)	0 (0)	0 (0)
20-64	Population	42,435	48,141	71,091	341,083
	Cases (rate*)	0 (0)	1 (2.1)	3 (4.2)	9 (2.6)
65+	Population	3,385	4,096	7,970	41,483
	Cases (rate*)	0 (0)	0 (0)	3 (37.6)	9 (21.7)
All	Population	82,705	62,799	134,633	545,087
Ages	Cases (rate*)	0 (0)	1 (1.6)	8 (5.9)	20 (3.7)

\*Number of cases per 100,000 per year

## Clinical Presentation

In the U.S. Arctic, bacteremia (50%) was the most common clinical presentation reported for cases of GBS in 2008 followed by septic arthritis (18%) and cellulitis (11%). The single case in N. Canada presented with bacteremia; in Greenland, one case presented with pneumonia and the second with endocarditis. All of the GAS cases in N. Sweden were reported as bacteremia which may reflect a difference in reporting practices.

### **Clinical Presentation of Reported group B *Streptococcus* Cases, ICS 2008 Data**

	Greenland	N. Canada	N. Sweden	U.S. Arctic
	n (%)	n (%)	n (%)	n (%)
<b>Bacteremia</b>	0 (0)	1 (100)	11 (100)	14 (50)
<b>Pneumonia*</b>	1 (50)	0 (0)	0 (0)	2 (7)
<b>Meningitis</b>	0 (0)	0 (0)	0 (0)	1 (3.5)
<b>Septic arthritis</b>	0 (0)	0 (0)	0 (0)	5 (18)
<b>Cellulitis*</b>	0 (0)	0 (0)	0 (0)	3 (11)
<b>Osteomyelitis</b>	0 (0)	0 (0)	0 (0)	1 (3.5)
<b>Peritonitis</b>	0 (0)	0 (0)	0 (0)	1 (3.5)
<b>Endocarditis</b>	1 (50)	0 (0)	0 (0)	0 (0)
<b>Other</b>	0 (0)	0 (0)	0 (0)	1 (3.5)
<b>Total</b>	2	1	11	28

\*with bacteremia

## Risk Factors

Thirty-three percent of GBS adult ( $\geq 18$  years) cases reviewed in the U.S. Arctic indicated diabetes as a risk factor in 2006; 25% had chronic lung disease and 8% smoked, abused alcohol or were receiving immune suppressive treatment. Risk factors were not reported for the one N. Canada case. N. Sweden does not report risk factor data.

## Outcome

One death in cases with GBS was reported in the U.S. Arctic (CFR 3.6%); the death occurred in the 65+ age category. Two deaths were reported in Greenland (CFR 100%); both cases occurred in the 20-64 year old age category. No deaths were reported in Canada and N. Sweden did not report case outcome data.

## Conclusions

Guidelines for universal screening of pregnant women for GBS carriage were established in 2002 which have resulted in decreases in early onset disease. Cases continue to occur in older age groups which warrants continued surveillance.

## **CONCLUSIONS**

The ICS program continued to expand in 2006. Monitoring rates of disease and levels of antimicrobial resistance in *S. pneumoniae*, *H. influenzae*, *N. meningitidis*, GAS and GBS via use of the ICS system is important in providing data on groups at risk for disease, measurement of effectiveness of prevention measures, and emerging challenges in serotype distribution and antimicrobial resistance. Efforts to expand ICS to include all circumpolar nations will continue.

## **ACKNOWLEDGMENTS**

ICS is a cooperative project funded by the Office of Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia, and by the Public Health Agency of Canada in Ottawa, Canada.

We would like to thank all individuals involved in ICS at participating laboratories and public health departments.

## **SOURCE**

This report was prepared by:

Tammy Zulz, MPH  
Surveillance Coordinator

Michael Bruce, MD MPH  
Epidemiology Team Leader

Alan Parkinson, PhD  
Deputy Director

Arctic Investigations Program  
OID/NCEZID/DPEI  
Centers for Disease Control and Prevention  
Phone: (907) 729-3400  
Fax: (907) 729-3429

## REFERENCES

- [1] Reasonover A, Zulz T, Bruce MG, Bruden D, Jetté L, Kaltoft M, Lambertsen L, Parkinson A, Rudolph K, Lovgren M. The International Circumpolar Surveillance interlaboratory quality control program for *Streptococcus pneumoniae*, 1999 to 2008. *J Clin Microbiol.* 2011 Jan;49(1):138-43
- [2] Tsang RS, Rudolph K, Lovgren M, Bekal S, Lefebvre B, Lambertsen L, Zulz T, Bruce M. International circumpolar surveillance interlaboratory quality control program for serotyping *Haemophilus influenzae* and serogrouping *Neisseria meningitidis*, 2005 to 2009. *J Clin Microbiol.* 2012 Mar;50(3):651-6



## PARTICIPANTS

### International Circumpolar Surveillance (ICS) Participants, 2008

#### FINLAND

<b>Reference Laboratory</b>	National Public Health Institute (KTL) Laboratory, Oulu
<b>Laboratories</b>	Et.-Pohjanmaan sh-piiri, Seinäjoen sairaalan mikrobiol. lab. Etelä-Karjalan keskussairaalan kl.mikrobiologian laboratorio HY – Serobakteriologian laitos Jorvin sairaala, kliinisen mikrobiologian laboratorio KYS – Mikrobiologian laboratorio Kainuun keskussairaalan mikrobiologian laboratorio Kanta-Hämeen keskussairaalan mikrobiologian laboratorio Keski-Pohjanmaan keskussairaalan mikrobiologian laboratorio Keski-Suomen keskussairaalan mikrobiologian laboratorio Kymenlaakson keskussairaalan mikrobiologian laboratorio Lapin keskussairaalan mikrobiologian laboratorio Länsi-Pohjan keskussairaalan laboratorio Mikkelin keskussairaalan mikrobiologian laboratorio OYKS – Mikrobiologian laboratorio Oulun kiakonissalairoksen laboratorio Pohjois-Karjalan keskussairaalan mikrobiologian laboratorio Päijät-Hämeen keskussairaalan mikrobiologian laboratorio Rauman aluesairaalan laboratorio Satakunnan keskussairaalan mikrobiologian laboratorio Savonlinnan keskussairaalan laboratorio TAYS – Mikrobiologian laboratorio TYKS – Mikrobiologian laboratorio Vaasan keskussairaalan mikrobiologian laboratorio

#### GREENLAND

<b>Reference Laboratories</b>	Statens Serum Institute, Copenhagen, Denmark Centralab at Queen Ingrid's Hospital, Nuuk, Greenland
<b>Laboratories</b>	Nanortalik Hospital Qaqortoq Hospital Narsaq Hospital Paamiut Hospital Maniitsoq Hospital Sisimut Hospital Aasiaat Hospital Qasigiannuguit Hospital Ilulissat Hospital Qeqertarsuaq Hospital Uummannaq Hospital Upernavik Hospital Qaanaaq Hospital Ammassalik Hospital Ittoqqortoormiit Hospital

### ICELAND

<b>Reference Laboratory</b>	Department of Microbiology, Landspítali University Hospital, Reykjavik
<b>Laboratories</b>	Akranes Hospital Isafjordur District Hospital Stykkisholmur Local Health Center St. Joseph's Hospital Hafnarfjorour Municipal Hospital of Vestmannaeyjar Akureyri Egilstadir Health Center Selfoss Health Center Sudurnes Health Center (Keflavik) Regional Hospital Neskaupstadur

### NORTHERN CANADA

<b>Laboratory Centre for Disease Control</b>	Respiratory Division, Bureau of Infectious Diseases, Laboratory Centre for Disease Control, Ottawa
<b>Reference Laboratories</b>	National Centre for Streptococcus, Provincial Laboratory of Public Health, Edmonton, AB Laboratoire de Santé Publique du Québec, Montréal, QC National Centre for Meningococcus, Provincial Laboratory of Public Health, Winnipeg, MB
<b>Laboratories</b>	Whitehorse General Hospital, Whitehorse, YK Stanton Regional Health Board, Yellowknife, NT H.H. Williams Memorial Hospital, Hay River, NT Inuvik Regional Hospital, Inuvik, NT Baffin Regional Hospital, Iqaluit, NU Churchill Regional Health Authority, Churchill, MB Cadham Provincial Laboratory, Winnipeg, MB Ungava Tulattavik Health Centre, Kuujuaq, QC Inulitsavik Hospital, Puvirnituq, QC Cree Health Board, Chisasibi, QC CSSSR, Chibougamou, QC Val d'Or Hospital, Val d'Or, QC Melville Hospital, Goose Bay, NL Newfoundland Public Health Laboratory, St. John's, NL
<b>Public Health</b>	Yukon Communicable Disease Control, Whitehorse, YK Health Protection Unit, Government of NWT, Yellowknife, NT JA Hildes Northern Medical Unit, Winnipeg, MB Régie Régionale de la Santé et des Services Sociaux, Kuujuaq, QC Région Cri de la Baie James, Module de Santé Publique, Montreal, QC Communicable Disease Control, Health Laborador Corporation, Goose Bay, NL IMPAct Coordinator, Vaccine Evaluation Centre, Vancouver, BC

### NORTHERN SWEDEN

<b>Reference Laboratory</b>	Department of Bacteriology, Swedish Institute for Infectious Disease Control, Stockholm
<b>Laboratories</b>	Department of Microbiology, Sunderby Hospital, Lulea

### NORWAY

<b>Reference Laboratory</b>	Oslo/Tromso
<b>Laboratories</b>	<p>Frederikstad, Østf. SSH  Sarpsborg SH  Akershus SSH, SiA  Bærum SH  Aker SH  Fürsts laborat, Oslo  Dr. Willes med.lab.  Radiumhospitalet  Folkehelsa, vir.lab.  Folkehelsa, bakt.lab.  Forsv.mik.lab.Folk.h.  Rikshospitalet, mik.lab.  Ullevål SH, mik.lab.  Lab. klin. mikrob. Oslo  Lillehammer mik.lab  Elverum mik.lab.  Buskerud SSH, mik.lab.  Vestfold SSH, mik.lab.  Telelab  Vest-Agder SSH, mik.lab.  Rogaland SSH, mik.lab.  Haukeland SH, mik.lab.  Sogn-Fk. SSH, mik.lab.  Ålesund FSH, mik.lab.  Molde FSH, mik.lab.  Trondheim RSH, mik.lab.  Innherred SH, mik.lab.  Namdal SH, mik.lab.  Nordland SSH, mik.lab.  Tromsø RSH, mik.lab.  Kirkenes SH, mik.lab.  Laboratorium INA/div.  Haugesund, mik.lab.</p>

### U.S. ARCTIC

<b>Reference Laboratory</b>	Arctic Investigations Program, National Center for Infectious Diseases, Centers for Disease Control and Prevention, Anchorage, AK
<b>Laboratories</b>	<p>Alaska Native Medical Center, Anchorage, AK          Alaska Regional Hospital, Anchorage, AK          Bartlett Regional Hospital, Juneau, AK          Bassett Army Hospital, Fort Wainwright, AK          Central Peninsula General Hospital, Soldotna, AK          Cordova Community Medical Center, Cordova, AK          Elmendorf Air Force Base Hospital, Anchorage, AK          Fairbanks Memorial Hospital, Fairbanks, AK          Kakanak Hospital, Dillingham, AK          Ketchikan Regional Hospital, Ketchikan, AK          Manilaq Medical Center, Kotzebue, AK          Norton Sound Regional Hospital, Nome, AK          Petersburg Medical Center, Petersburg, AK          Providence Alaska Medical Center, Anchorage, AK          Providence Island Medical Center, Kodiak, AK          Samuel Simmonds Memorial Hospital, Barrow, AK          Sitka Community Hospital, Sitka, AK          South Peninsula Hospital, Homer, AK          Southeast Area Regional Health Corporation, Sitka, AK          State Public Health Laboratory, Division of Public Health, Department of Health and Social Services, Anchorage, AK          Valdez Community Hospital, Valdez, AK          Valley Hospital, Palmer, AK          Wrangell General Hospital, Wrangell, AK          Yukon-Kuskokwim Delta Regional Hospital, Bethel, AK</p>