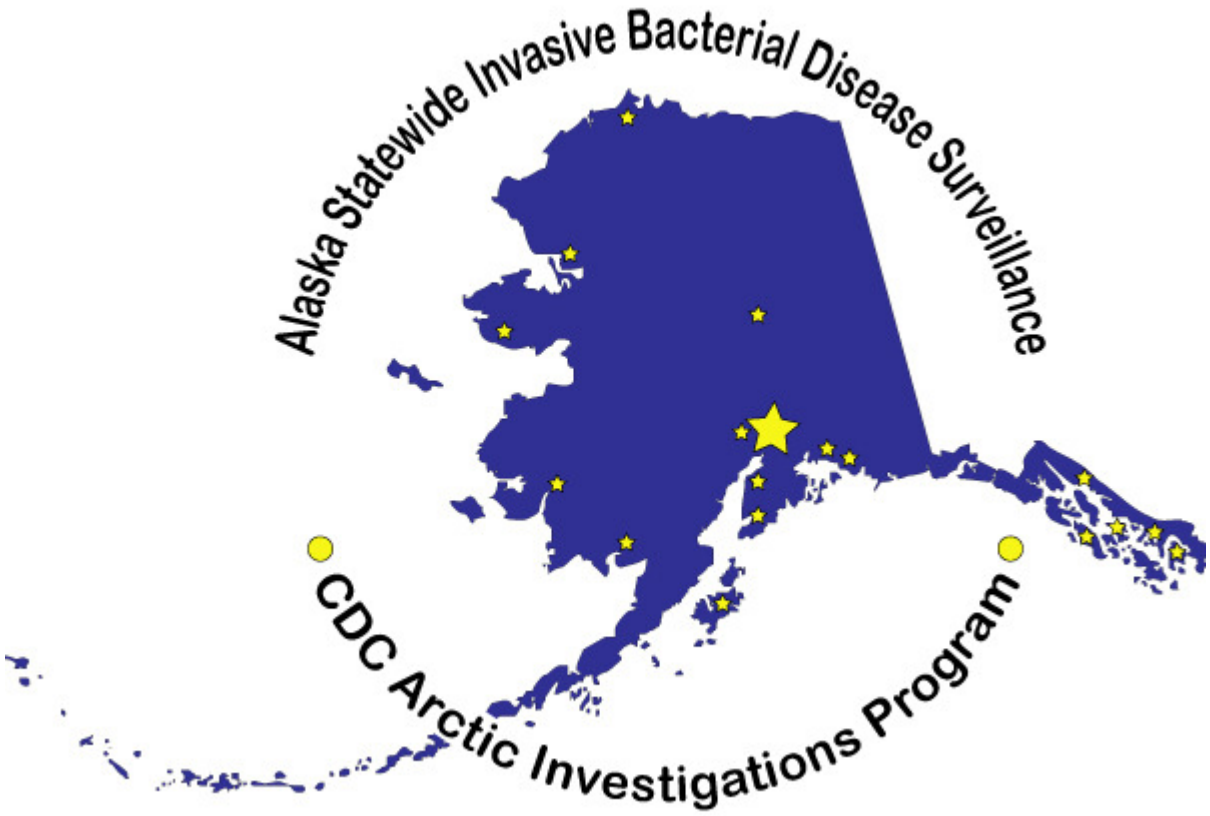

Surveillance of Invasive Bacterial Disease in Alaska, 2007

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Alaska Statewide Invasive Bacterial Disease

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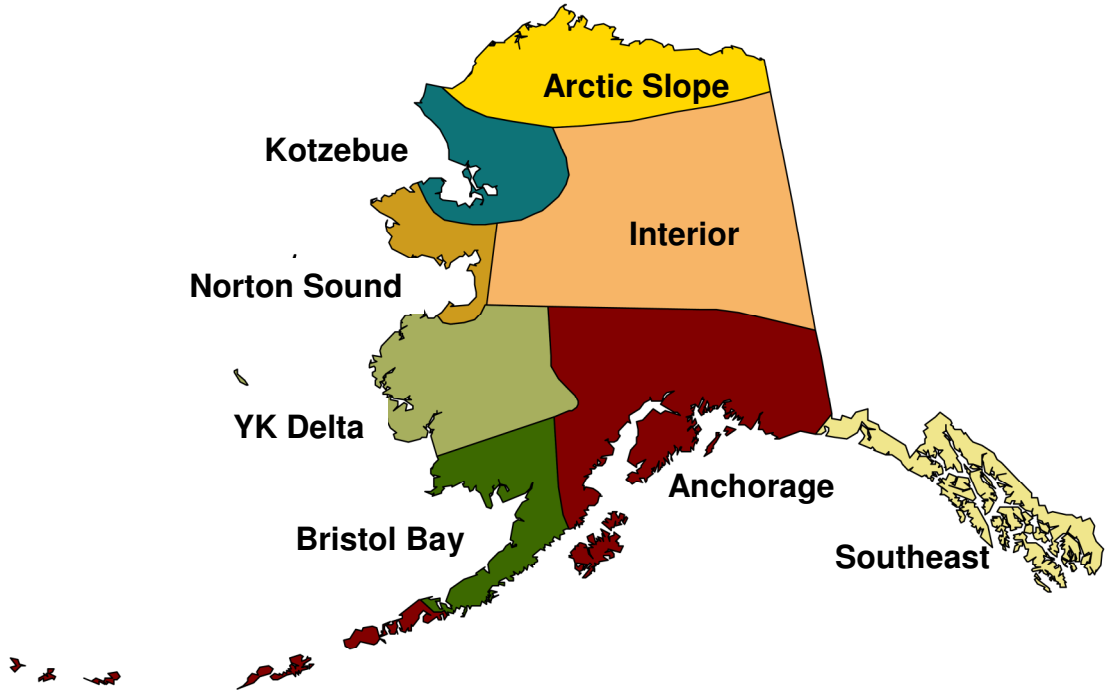
Summary

The Centers for Disease Control and Prevention's Arctic Investigations Program (AIP) in Anchorage, Alaska, maintains a statewide surveillance system for invasive diseases caused by *Streptococcus pneumoniae*, *Haemophilus influenzae, Neisseria meningitidis,* and groups A and B streptococci. Laboratories throughout the state are requested to send to AIP any isolates of these organisms recovered from a blood culture, CSF, or other normally sterile site in an Alaska resident. Isolate identification is confirmed and, when appropriate, serotyped and tested for antimicrobial susceptibility. The objectives of this system are to provide information on disease rates within the state, monitor the emergence of antimicrobial resistance, and to monitor the effectiveness of implemented vaccine programs, such as the 23-valent pneumococcal polysaccharide vaccine, the pneumococcal conjugate vaccine and *Haemophilus influenzae* type b vaccines.

Figure 1: Invasive Bacterial Disease Surveillance Regions – Alaska, 2007



In 2007, the total numbers of cases of invasive disease caused by these organisms reported to AIP were 149 *S. pneumoniae*, 15 *H. influenzae*, 5 *N. meningitidis*, 32 group A *Streptococci* (GAS) and 38 group B *Streptococci* (GBS). Alaska Native people had higher rates of disease than non-Native people for all surveillance organisms. Rates of invasive pneumococcal disease were highest in the YK Delta. Rates for each organism by region are presented in the following table.

Table 1: Surveillance Organisms Reported by Region – Alaska, 2007

Region	*S. pneumoniae* n (rate*)	*H. influenzae* n (rate*)	*N. meningitidis* n (rate*)	GAS n (rate*)	GBS n (rate*)
Anchorage	83 (18.5)	10 (2.2)	1 (0.2)	19 (4.2)	25 (5.6)
Arctic Slope	2 (34.7)	0 (0)	0 (0)	1 (17.3)	1 (17.3)
Bristol Bay	5 (71.2)	1 (14.2)	0 (0)	0 (0)	0 (0)
Interior	19 (18.2)	2 (2.9)	2 (2.9)	7 (6.7)	8 (7.7)
Kotzebue	1 (12.3)	0 (0)	0 (0)	0 (0)	1 (12.3)
Norton Sound	4 (42.1)	1 (10.5)	0 (0)	2 (21)	0 (0)
Southeast	5 (7.2)	0 (0)	0 (0)	3 (4.3)	2 (2.9)
YK Delta	30 (121.2)	0 (0)	2 (8.1)	0 (0)	1 (4)
Total	149 (22)	15 (2.2)	5 (0.7)	32 (4.7)	38 (5.6)

*Cases per 100,000 population

Introduction

AIP conducts statewide surveillance of invasive *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Neisseria meningitidis*, and groups A and B *Streptococcus*. This program is part of a passive, laboratory-based surveillance system in which laboratories from all hospitals throughout the state are encouraged to participate. The population included in the AIP surveillance is the State of Alaska, which totaled 676,987 persons in 2007 [1]. Case detection occurs year-round as participating laboratories send isolates recovered from sterile sites to the AIP laboratory in Anchorage, accompanied by basic demographic and clinical information on the cases. Materials and forms for isolate shipment and data collection are provided to each laboratory by AIP. At year-end, AIP asks that each laboratory review their records and provide information on any cases that may have been overlooked. In 2007, 23 laboratories in Alaska participated in the invasive disease surveillance system, either by sending isolates to the AIP laboratory throughout the year, conducting year-end record reviews, or both. Beginning in January, 2007, invasive *S. pneumoniae*, GAS and GBS became reportable conditions to the State of Alaska Division of Public Health (DPH). Reports of cases of disease caused by these organisms, along with cases of invasive *H. influenzae* and *N. meningitidis* which were previously reportable, are shared between AIP and DPH.

AIP defines a case of invasive *S. pneumoniae, H. influenzae*, *N. meningitidis*, GAS or GBS as an isolate 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 Alaska. In addition, for GAS, isolates are requested from deep tissue infections such as might be collected from surgical debridement of cases of necrotizing fasciitis.

Invasive Pneumococcal Disease

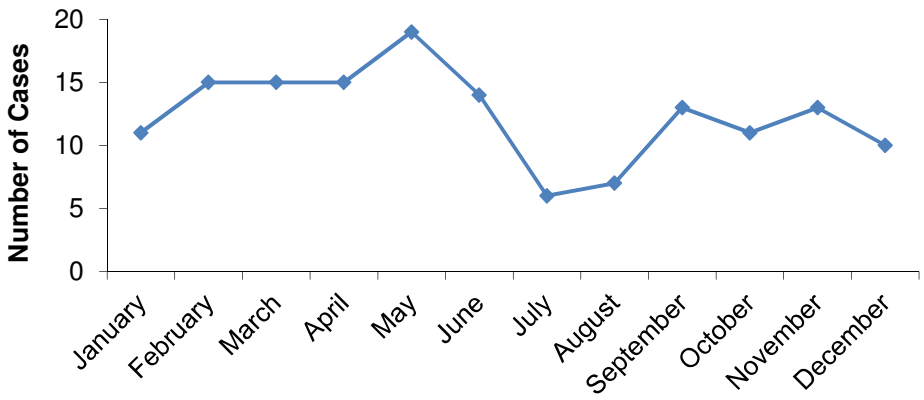
Overall Incidence

A total of 141 pneumococcal isolates were received at AIP in 2007. An additional 5 cases were detected through year-end follow up with participating laboratories, 4 cases through shared surveillance with the State DPH and one case through on-site personnel review of medical records for a total of 149 cases of invasive pneumococcal disease. The overall rate for invasive pneumococcal disease in 2007 was 22 cases per 100,000 persons per year. Alaska rates for 2007 were higher than the Active Bacterial Core Surveillance (ABCs) 2007 national projected rate of 13.9/100,000 [2]. ABCs is a surveillance system operated in 10 states which covers a population of over 39 million persons.

Seasonality

Invasive *Streptococcus pneumoniae* cases were identified in each month of 2007. The largest number of cases was reported in May.

Figure 2: Invasive Pneumococcal Disease, by Month of Culture - Alaska, 2007



Race

In 2007, the state population was comprised of 19.9% Alaska Native people *(Alaska Natives 134,881, non-Natives 542,106)* [1]. The percentage of all reported *S. pneumoniae* cases that occurred in 2007 among Alaska Native people was 52%; for a total of 77 cases resulting in an age-adjusted rate of 54.4/100,000 persons per year. Seventy-two cases occurred among the non-Native population for an age-adjusted rate of 12.2/100,000 persons per year. The rate ratio of age-adjusted rates of *S. pneumoniae* disease for the Alaska Native population compared with the non-Native population in 2007 is 4.5.

Table 2: Invasive *Streptococcus pneumoniae* Cases by Race – Alaska, 2007

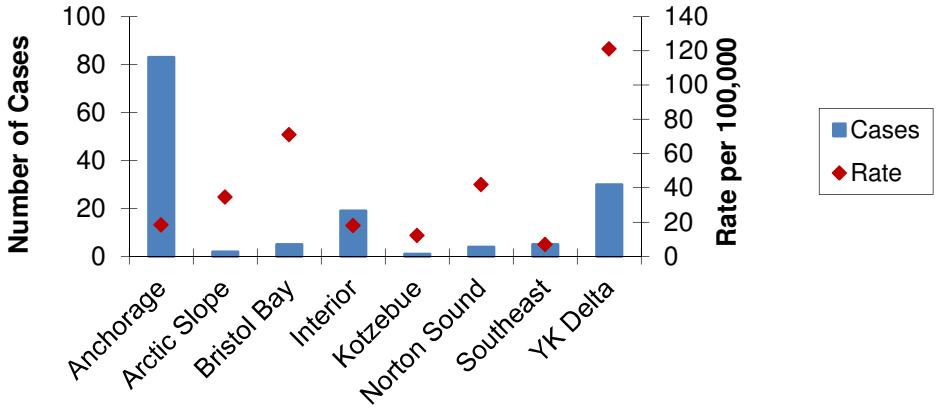
Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native	77 (52)	54.4	60	5 (6.5)
Non-Native†	72 (48)	12.2	61	7 (9.7)
Total	149		60	12 (8.1)

*Cases per 100,000 per percent distribution of Alaska 2000 population
†Includes 4 cases for which race was unknown

Region

The highest percentage (56%) of invasive pneumococcal disease cases occurred in the Anchorage area in 2007. Rates of disease, however, were highest in the YK Delta (121.2/100,000 persons per year).

Figure 3: Invasive Pneumococcal Disease, Cases & Rates by Region - Alaska, 2007

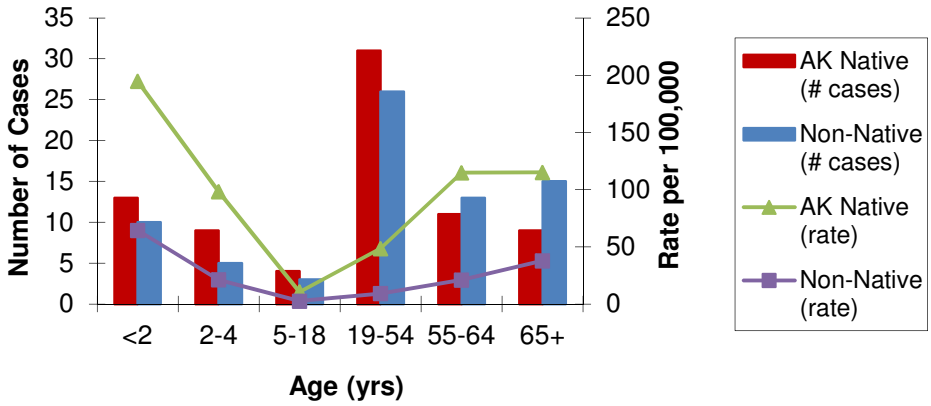


Age

Cases occurred in all age groups in 2007 ranging from 2 months to 94.1 years with a median age of 46 years. Overall, the highest rates of disease occurred in children less than 2 years old.

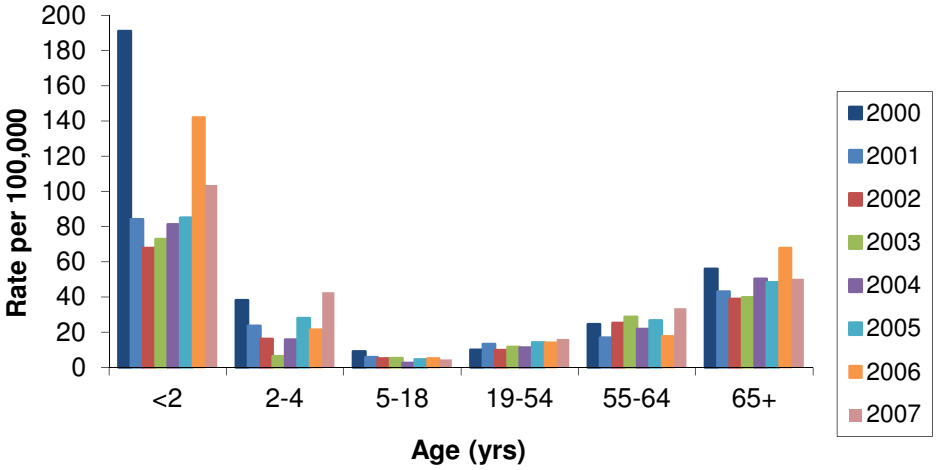
When stratified by age and race, the highest rates of disease in 2007 occurred in Alaska Native children less than 2 years old (194.7/100,000 persons per year).

Figure 4: Invasive Pneumococcal Disease, Cases & Rates by Age Group & Race - Alaska, 2007



Since the initiation of a pneumococcal conjugate vaccine program in 2001, overall rates of invasive disease have declined dramatically in children less than 2 years of age [3]. In 2000, overall yearly rates of pneumococcal disease in children less than 2 years were 191.2/100,000, dropping to a low of 67.9/100,000 in 2002 and then increasing to 142.2/100,000 in 2006. In 2007, the rate of invasive pneumococcal disease in children less than 2 years declined to 103.6/100,000 which continues to be well above the lowest rate observed since vaccine introduction.

Figure 5: Invasive Pneumococcal Disease by Age Group - Alaska, 2000-2007



Although pneumococcal disease rates dropped initially in AK Native and non-Native children less than 2 years of age after 2000, the rates of disease in AK Native children less than 2 years have been trending upward from a low of 93.6/100,000 in 2001 to 335.9/100,000 in 2006. This increase in rates is due primarily to disease caused by serotypes not contained in the pneumococcal conjugate vaccine [4]. Although the rate of invasive pneumococcal disease in AK Native children less than 2 years declined in 2007 to 194.7/100,000, this is three times the rate of disease seen in non-Native children. Rates of invasive disease in non-Native children less than 2 years declined during the same time period reaching a low of 26.8 in 2005 and increasing to 64.4/100,000 in 2007.

Figure 6: Invasive Pneumococcal Disease in Alaska Natives, by Age Group - Alaska, 2000-2007

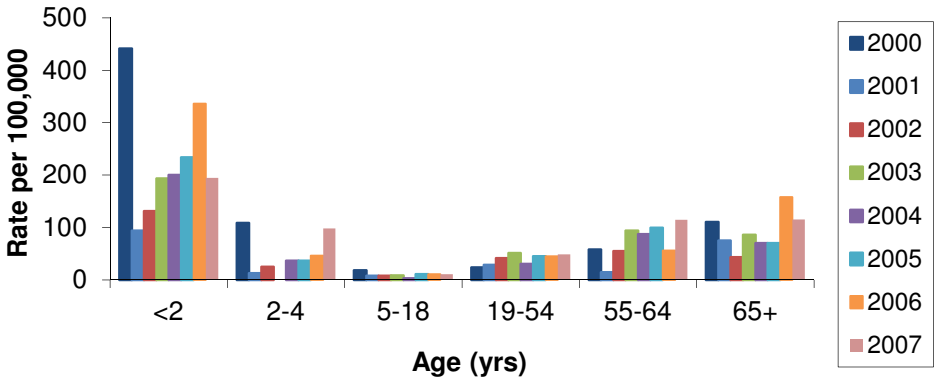
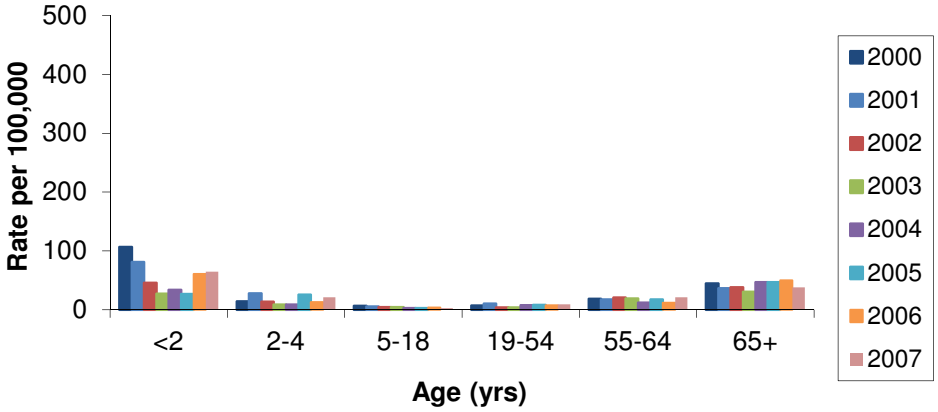


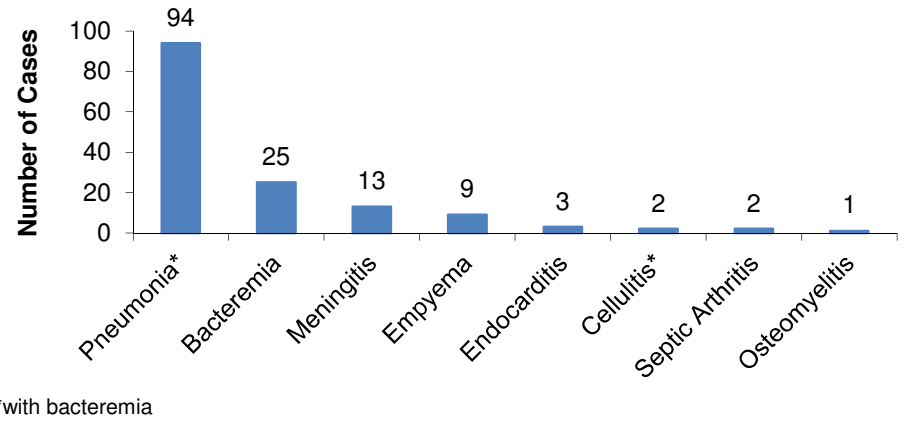
Figure 7: Invasive Pneumococcal Disease in Non-Natives, by Age Group - Alaska, 2000-2007



Clinical Presentation

The primary clinical presentation was determined by a review of the discharge diagnoses in each patient's individual medical record associated with the invasive bacterial illness. In cases with multiple discharge diagnoses, the most serious diagnosis related to the pneumococcal infection was recorded as the primary clinical presentation. Pneumonia with bacteremia was the most common primary clinical presentation in 2007 (63%) followed by bacteremia (17%). Fourteen cases had a secondary pneumococcal-related diagnosis in 2007 - 11 pneumonia, 1 pericarditis, 1 endocarditis, and 1 cellulitis.

Figure 8: Primary Clinical Presentations of Invasive Pneumococcal Disease - Alaska, 2007



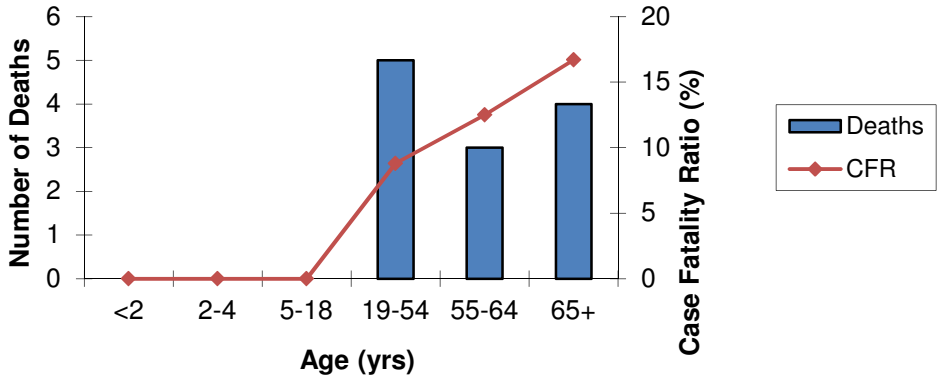
*with bacteremia

In 2007, blood was the most common source of a positive culture which was used to identify 134 (90%) of 149 cases. Cerebrospinal fluid was the positive site for 7% of cases, 3 cases were identified from pleural fluid and 1 case from joint fluid.

Mortality

In 2007, the overall case fatality ratio for *S. pneumoniae* in Alaska was 8.1% (12 deaths out of 149 cases for which outcome was known). The case fatality ratio for non-Natives was higher than Natives; 9.7% (7 deaths) and 6.5% (5 deaths), respectively. Although the majority of deaths occurred in the 19-54 age category (5 deaths), the highest case fatality ratio occurred in the 65+ age category; 16.7% (4 deaths).

Figure 9: Invasive Pneumococcal Deaths & Case Fatality Ratios by Age Group - Alaska, 2007



Serotype

Serotyping of invasive pneumococcal isolates is performed at AIP using internationally standardized methods. Serotype identification is based on the organism's polysaccharide capsule which is a principal virulence factor for pneumococci. This information provides a way to categorize organisms and to determine if the infection was due to a type that could be prevented by use of one of the available pneumococcal vaccines. Serotyping was performed on all of the *S. pneumoniae* cases for which an isolate was available.

Table 3: Invasive Pneumococcal Serotype Distribution by Race and Age Group – Alaska, 2007

		Alaska Native				Non-Native				Unknown
Serotype	Total n (%)	<2	2-18	19-64	65+	<2	2-18	19-64	65+	All Ages
01	1 (<1)	-	1	-	-	-	-	-	-	-
03	10 (7)	-	-	2	-	-	1	6	1	-
04	1 (<1)	-	-	-	-	-	-	1	-	-
05	1 (<1)	-	-	1	-	-	-	-	-	-
06A	4 (3)	-	-	1	-	-	-	1	1	1
06C	4 (3)	-	-	1	1	1	-	1	-	-
07F	23 (16)	4	2	3	1	2	-	10	1	-
08	3 (2)	-	-	-	1	-	-	1	1	-
09N	2 (1)	-	-	1	-	-	-	1	-	-
10A	2 (1)	-	1	-	1	-	-	-	-	-
11A	1 (<1)	-	-	-	-	-	-	-	1	-
12F	16 (11)	1	3	10	1	-	-	1	-	-
13	1 (<1)	-	-	1	-	-	-	-	-	-
15A	5 (4)	-	1	2	-	-	-	1	1	-
15C	1 (<1)	-	-	-	-	-	1	-	-	-
16F	5 (4)	-	1	-	-	-	-	1	3	-
17F	1 (<1)	-	-	-	-	-	-	1	-	-
19A	24 (17)	5	1	2	3	2	5	3	1	2
19A/12F	1 (<1)	-	-	1	-	-	-	-	-	-
20	6 (4)	-	-	5	-	-	-	1	-	-
22A	3 (2)	1	-	2	-	-	-	-	-	-
22F	7 (5)	-	2	2	-	-	-	3	-	-
23A	1 (<1)	-	-	-	-	-	-	-	1	-
23B	2 (1)	-	-	1	-	1	-	-	-	-
31	8 (6)	-	-	2	1	-	-	3	2	-
33F	3 (2)	-	-	1	-	1	-	1	-	-
35B	1 (<1)	-	-	1	-	-	-	-	-	-
35F	2 (1)	-	1	-	-	-	-	-	1	-
38	1 (<1)	-	-	-	-	-	-	-	-	1
Total	140	11	13	39	9	7	7	36	14	4

In 2007, the most common pneumococcal serotypes were 19A (24 isolates, 17%) and 7F (23 isolates, 16%). From 1986 through 2001, serotype 14 was the most common invasive pneumococcal serotype ranging from 7.4% to 23.5% of isolates. Following introduction in 2001 of the pneumococcal conjugate vaccine which includes serotype 14, the proportion of serotype 14 isolates dropped to 1.5% of serotyped isolates in 2006 and did not cause any invasive pneumococcal disease in 2007. However, disease caused by serotypes 7F and 19A, which are not included in the conjugate vaccine, has increased. Prior to 2005, yearly numbers of cases of serotype 7F disease and the proportion of total isolates have ranged from 1 to 10 and 0.9% to 9.3%, respectively. Although the majority (62.5%) of serotype 7F disease occurred in AK Natives during 2005, it was more evenly distributed between AK Native people (48%) and non-Natives (52%) in 2006. In 2007, the proportion of serotype 7F disease that occurred in non-Natives (57%) versus AK Natives (43%) continued to increase. The majority (65%) of serotype 7F cases

occurred in the Anchorage area in 2006; in 2007, they were more widely distributed, however, the highest proportion of cases (58%) occurred again in Anchorage.

Table 4: Invasive Pneumococcal Serotype Distribution by Region – Alaska, 2007

Serotype	Anchorage	Arctic Slope	Bristol Bay	Interior	Kotzebue	Norton Sound	Southeast	YK Delta
01	1	-	-	-	-	-	-	-
03	8	-	-	1	-	1	-	-
04	1	-	-	-	-	-	-	-
05	1	-	-	-	-	-	-	-
06A	3	-	-	-	1	-	-	-
06C	2	-	-	1	-	-	1	-
07F	14	-	1	2	-	-	1	5
08	2	-	-	-	-	1	-	-
09N	1	-	1	-	-	-	-	-
10A	-	-	-	-	-	-	1	1
11A	1	-	-	-	-	-	-	-
12F	3	-	-	-	-	-	-	13
13	1	-	-	-	-	-	-	-
15A	2	1	-	-	-	-	-	2
15C	-	-	-	1	-	-	-	-
16F	4	-	-	1	-	-	-	-
17F	1	-	-	-	-	-	-	-
19A	13	-	-	3	-	2	2	4
19A/12F	-	-	-	-	-	-	-	1
20	2	-	1	3	-	-	-	-
22A	2	-	-	-	-	-	-	1
22F	5	-	1	1	-	-	-	-
23A	1	-	-	-	-	-	-	-
23B	1	-	-	1	-	-	-	-
31	6	1	-	1	-	-	-	-
33F	-	-	-	1	-	-	-	2
35B	1	-	-	-	-	-	-	-
35F	1	-	-	1	-	-	-	-
38	-	-	-	1	-	-	-	-
Total	77	2	4	18	1	4	5	29

Vaccine Serotypes

Two vaccine types were licensed for prevention of pneumococcal disease in 2007. In 2001, the pneumococcal conjugate vaccine (PCV7) was included in the Alaska childhood vaccination schedule. This vaccine provides protection against the 7 most common pneumococcal serotypes causing invasive disease among children (types 4, 6B, 9V, 14, 18C, 19F, 23F). The table below shows the proportion of invasive infections from 2007 that were due to serotypes found in the PCV7 vaccine. There were no cases of pneumococcal disease caused by serotypes contained in the PCV7 vaccine in children less than 5 years of age, the age group for which the vaccine is recommended.

Table 5: Proportion of Invasive Isolates Contained in the PCV7 Vaccine by Age Group and Race – Alaska, 2007

Age (yrs)	Alaska Native (%)	Non-Native (%)	Total (%)
<2	0 (0%) of 11	0 (0%) of 10	0 (0%) of 21
2-4	0 (0%) of 9	0 (0%) of 5	0 (0%) of 14
5+	0 (0%) of 51	1 (2%) of 53	1 (1%) of 104
Total	0 (0%) of 71	1 (1.5%) of 68	1 (<1%) of 139

For the year covered by this report, the 23-valent polysaccharide vaccine (Ps23V) was recommended in Alaska for all persons 55 years and older, and for persons over age 2 who are at higher risk for pneumococcal disease. Revaccination was recommended after 6 years [5]. In 2007, for persons 55 years and older, 26 (58%) of 45 cases serotyped were potentially vaccine preventable invasive pneumococcal illnesses.

Vaccine Failures

A PCV7 vaccine failure is defined as invasive pneumococcal disease caused by a serotype contained in the PCV7 vaccine in a child less than five years old who has had at least two doses of vaccine. There were no vaccine failures in 2007.

Potentially Preventable Deaths

In 2007, pneumococcal vaccine status was known for 111 (74%) of the 149 cases; 76 cases (51%) did receive a pneumococcal vaccine prior to illness and 35 cases (23%) had no record of a pneumococcal vaccine.

Table 6: Potentially Vaccine Preventable Invasive Pneumococcal Deaths – Alaska, 2007

Serotypes	< 2 years	2-4	5-18	19-54	55-64	65+	Total
PCV7	0	0	0	0	0	0	0
Ps23V	0	0	0	4 (80%)	2 (67%)	2 (50%)	8 (67%)
Non-Vaccine	0	0	0	1 (20%)	1 (33%)	2 (50%)	4 (23%)
Total	0	0	0	5	3	4	12

Overall, 67% of all pneumococcal-related mortality in 2007 was potentially preventable with the use of the 23-valent polysaccharide vaccine in persons over 2 years old; 23% of deaths were due to disease caused by serotypes not contained in the 23-valent vaccine. No deaths were caused by serotypes contained in the PCV7 vaccine.

Eight of the 12 deaths in 2007 from invasive *S. pneumoniae* occurred from serotypes contained within the Ps23V vaccine; 4 of the deaths were in individuals eligible for the vaccine. Of those four deaths, two occurred in vaccinated individuals; time since vaccination for each was 1 year and 3 years.

Table 7: Invasive Pneumococcal Disease, Serotypes of Fatal Cases – Alaska, 2007

Serotype	Deaths n (%)	Serotype Frequency (n)
03*	3 (30%)	10
07F*	1 (4%)	23
12F*	1 (6%)	16
15A	1 (25%)	4
19A*	2 (8%)	24
22F*	1 (14%)	7
23A	1 (100%)	1
23B	1 (50%)	2
35F	1 (50%)	2

*Serotypes contained in the 23-valent polysaccharide vaccine

Associated Medical Conditions

The presence of one or more associated medical conditions was reported in 83% of invasive pneumococcal cases in 2007. Cigarette smoking was the most prevalent risk factor observed in adults followed by alcohol abuse and chronic lung disease.

Table 8: Associated Medical Conditions Identified in Invasive Pneumococcal Cases – Alaska, 2007*

Medical Condition/Risk Factor	Adult Cases (≥ 18 years) n=105, Cases (%)
Cigarette smoking	52 (50)
Alcohol abuse	34 (32)
Chronic lung disease	31 (30)
Diabetes	24 (23)
Immunosuppressive treatment	5 (5)
Injection drug use	1 (1)
Asplenia	0 (0)

*More than one risk factor was identified in several cases

Antibiotic Resistance

Susceptibility testing was performed on all isolates received in 2007. Results of the testing are presented in the following table.

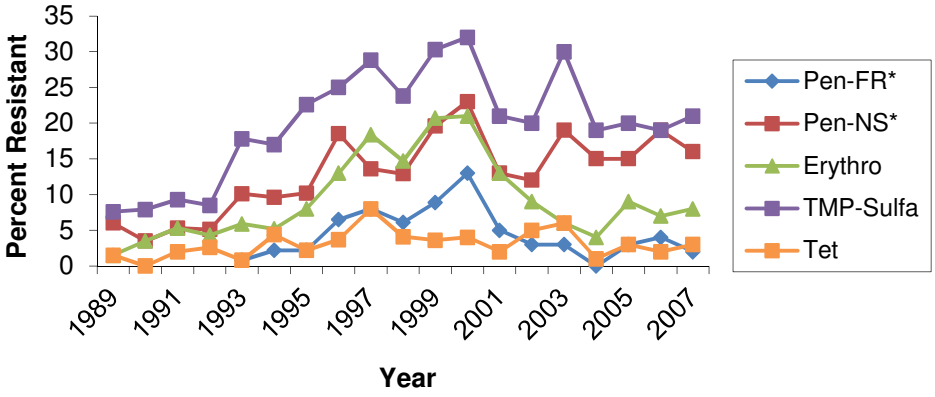
Table 9: Antibiotic Resistance in Invasive *Streptococcus pneumoniae* Isolates – Alaska, 2007

Antibiotic	Susceptible	Intermediate	Resistant	I + R	Total Tested
Penicillin	118 (84%)	19 (14%)	3 (2%)	22 (16%)	140
TMP-sulfa	110 (79%)	6 (4%)	24 (17%)	30 (21%)	140
Erythromycin	129 (92%)	0 (0%)	11 (8%)	11 (8%)	140
Ceftriaxone	137 (98%)	3 (2%)	0 (0%)	3 (2%)	140
Tetracycline	136 (97%)	0 (0%)	4 (3%)	4 (3%)	140
Chloramphenicol	140 (100%)	0 (0%)	0 (0%)	0 (0%)	140
Rifampin	138 (99%)	0 (0%)	1 (1%)	1 (1%)	139
Vancomycin	140 (100%)	0 (0%)	0 (0%)	0 (0%)	140
Levofloxacin	140 (100%)	0 (0%)	0 (0%)	0 (0%)	140
Clindamycin	137 (98%)	0 (0%)	3 (2%)	3 (2%)	140

Cut points from the Minimum Inhibitory Concentration (MIC) Interpretive Standards were used to determine if an isolate was 'susceptible', 'intermediate', or 'resistant' to the antibiotic being tested [6]. The MIC Interpretive Standards definitions of 'susceptible', 'intermediate', and 'resistant' can be found in the Appendix.

Serotypes found in the PCV7 vaccine are more likely to be non-susceptible to penicillin and erythromycin than non-vaccine serotypes. One potential benefit of the use of this vaccine was an anticipated decline in antibiotic resistance among circulating pneumococci. The data in the following graph support this assumption; since the initiation of the PCV7 vaccine in 2001, antibiotic resistance among invasive pneumococci has dropped. During 2003, TMP-sulfa and penicillin resistance increased, however, both decreased in 2004 to similar levels of resistance seen in 2002 and have remained at those levels in 2007. After steadily declining since 2000 to a low of 4% in 2004, erythromycin resistance increased to 9% of tested isolates in 2005 and is similar (8%) in 2007.

Figure 10: Trends in Antibiotic Resistance Among Invasive Pneumococcal Isolates - Alaska, 1989 - 2007



*Pen-FR = fully resistant, Pen-NS = non-susceptible

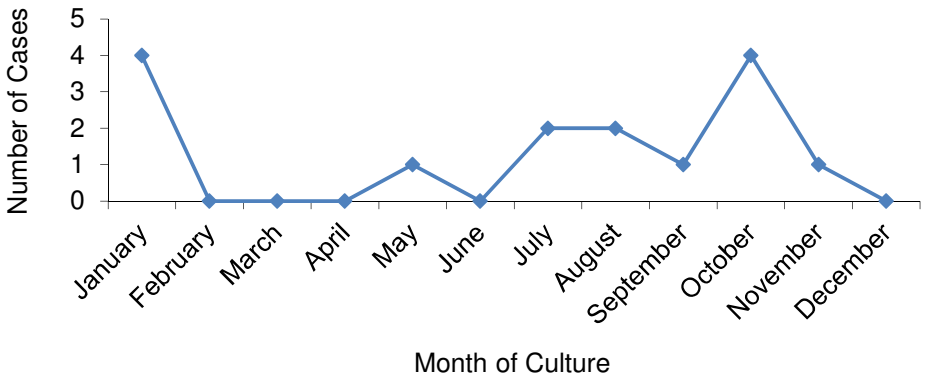
Invasive *Haemophilus influenzae*

Overall Incidence

In 2007, there were 15 cases of invasive *Haemophilus influenzae* in Alaska, for a statewide rate of 2.2/100,000 persons per year. This rate is higher than the national projected rate of 1.6/100,000 persons per year [7]. There were three deaths caused by *H. influenzae* in 2007 for a case fatality ratio of 20%.

Seasonality

Figure 11: *Haemophilus influenzae* Disease by Month of Culture - Alaska, 2007

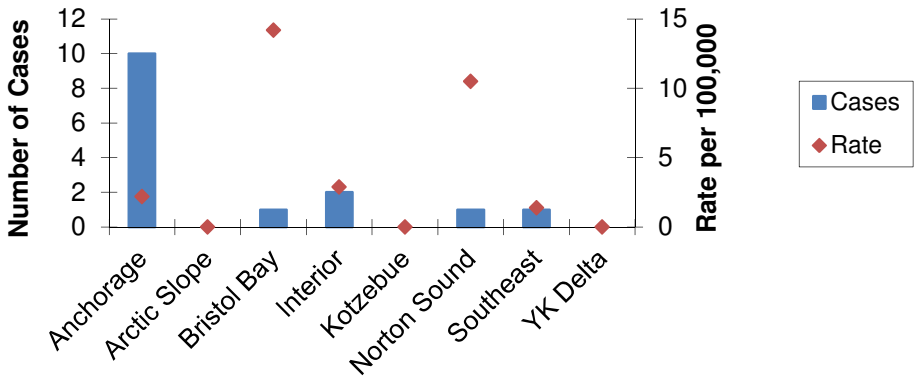


Cases of invasive *H. influenzae* occurred throughout 2007, however, due to the small number of cases, trends in seasonality cannot be determined.

Region

The highest rates of disease caused by invasive *H. influenzae* cases in 2007 were in Bristol Bay (14.2/100,000) and Norton Sound (10.5/100,000) although there was only one case in each region. The largest number of cases occurred in the Anchorage area (10 cases), but the rate was much lower (2.2/100,000).

Figure 12: Invasive *Haemophilus influenzae*, Cases & Rates by Region - Alaska, 2007



Race

Table 10: Invasive *Haemophilus influenzae* Cases by Race – Alaska, 2007

Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native	4 (27)	2.3	75	0 (0)
Non-Native	11 (73)	1.9	64	3 (25)
Total	15		67	3 (20)

*Cases per 100,000 per percent distribution of Alaska 2000 population

In 2007, 73% of the cases occurred in non-Natives. Age-adjusted rates were calculated for Alaska Natives and non-Natives. The age-adjusted rate ratio of *H. influenzae* disease for the Alaska Native population compared with the non-Native population in 2007 was 1.2.

Age

H. influenzae cases ranged in age from newborn to 91 years of age in 2007 (median 29.7 years). Overall, the highest rates of disease occurred in children less than 2 years old and adults 65 and older.

Rates of disease in Alaska Native versus non-Native populations by age group were variable; overall numbers of cases and rates by race and age group are presented in Figure 14. The highest rates of disease occurred in Alaska Native and non-Native children less than two years of age, 30/100,000 persons per year and 12.9/100,000 persons per year, respectively. In adults, the highest rates of disease were in Alaska Native people 65 years and older (12.8/100,000 persons per year).

Figure 13: Invasive *Haemophilus influenzae* by Age Group - Alaska, 2007

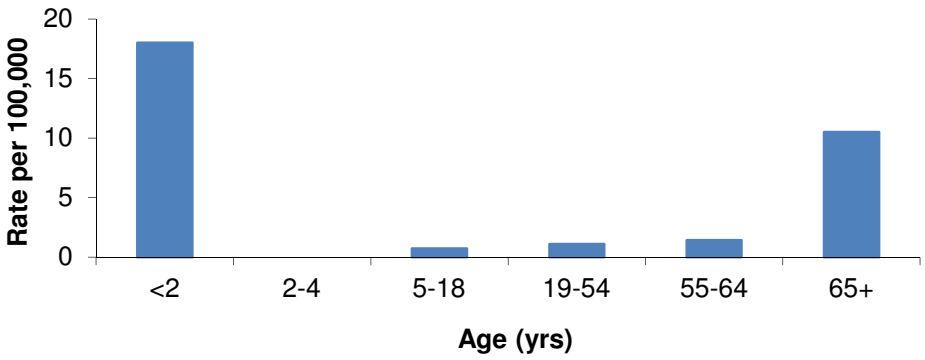
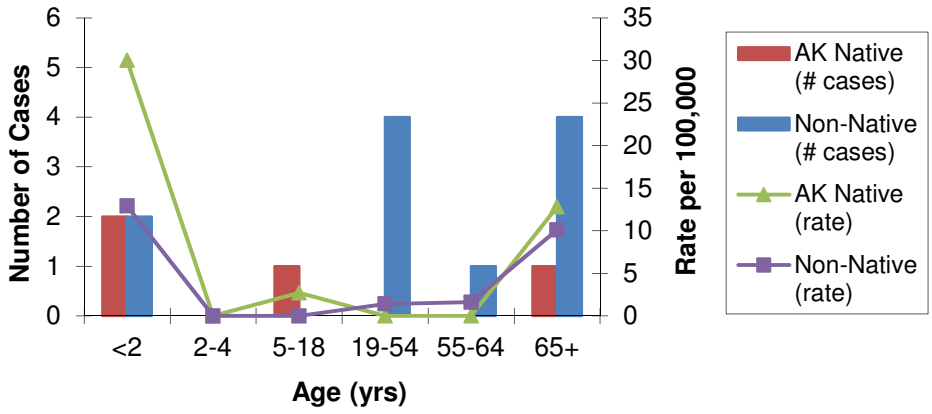


Figure 14: Invasive *Haemophilus influenzae*, Cases & Rates by Age Group & Race - Alaska, 2007



Clinical Presentation

The primary clinical presentation was determined by a review of the discharge diagnoses in each patient's individual medical record associated with the invasive bacterial illness. For cases with more than one diagnosis, the most serious *H. influenzae*-related diagnosis was recorded as the primary clinical presentation. In 2007, bacteremia was the most common presentation (40% of cases).

H. influenzae was isolated from 12 (80%) blood samples, 2 (13%) cerebrospinal fluid samples and 1 (7%) other sterile site.

Table 11: Primary Clinical Presentation of Invasive *Haemophilus influenzae* - Alaska, 2007

Primary Presentation	n (%)
Bacteremia	6 (40)
Pneumonia*	4 (27)
Meningitis	3 (20)
Cellulitis	1 (7)
Other	1 (7)
Total	15

*with bacteremia

Serotypes

All isolates received at AIP are serotyped; 13 of the 15 cases in 2007 had isolates and were serotyped. The bacterial capsule is the basis for serotyping and is the primary virulence factor. Serotype b has been the most common serotype in the past, but its prevalence has decreased with use of the childhood Hib vaccine. Surveillance of serotypes is important for monitoring vaccine effectiveness and emergence of non-vaccine serotypes.

Table 12: Serotypes of Invasive *Haemophilus influenzae* Cases by Race – Alaska, 2007

		Alaska Native				Non-Native			
Serotype	Total n (%)	<2	2-18	19-64	65+	<2	2-18	19-64	65+
a	2	1	0	0	0	1	0	0	0
e	1	0	0	0	1	0	0	0	0
NT*	10	1	0	0	0	1	0	4	4
Total	13	2	0	0	1	2	0	4	4

*Non-typable

Hib

In recent years, the prevalence of *H. influenzae* type b has declined due to increased use of a childhood vaccine against this serotype. No cases of Hib occurred in 2007.

Antibiotic Resistance

Thirteen *Haemophilus influenzae* isolates received at AIP were tested for susceptibility to chloramphenicol, ceftriaxone and TMP/sulfa. All 13 isolates were susceptible to chloramphenicol and ceftriaxone; one isolate was fully resistant to TMP/sulfa, 3 had intermediate resistance and 9 were susceptible.

Table 13: Summary of Invasive *Haemophilus influenzae* Case Characteristics, Alaska, 2007

Sex	Age (Yrs)	Race	Residence	Site of Isolation	Clinical Presentation(s)	Serotype*	Associated Medical Conditions	Survived
F	Newborn	AK Native	Anchorage	Blood	Bacteremia	NT	None	Yes
M	0.4	AK Native	Other	CSF	Meningitis	a	None	Yes
M	0.8	Non-Native	Anchorage	Blood	Meningitis	a	None	Yes
M	1.4	Non-Native	Anchorage	Blood	Pneumonia	NT	Chronic lung disease	Yes
M	12.8	AK Native	Other	Other	Other	Unknown	None	Yes
M	22.1	Non-Native	Anchorage	Blood	Cellulitis	NT	Smoking	No
F	22.3	Non-Native	Anchorage	Blood	Bacteremia	Unknown	Smoking	Yes
M	29.7	Non-Native	Anchorage	Blood	Bacteremia	NT	Alcohol abuse	Yes
F	49.4	Non-Native	Anchorage	CSF	Meningitis	NT	None	Yes
M	60.2	Non-Native	Other	Blood	Pneumonia	NT	Immunosuppressive treatement, diabetes	No
M	66.3	AK Native	Other	Blood	Bacterema	e	Chronic lung disease, alcohol abuse	Yes
F	71.7	Non-Native	Anchorage	Blood	Pneumonia	NT	Chronic lung disease, diabetes	Yes
M	73.4	Non-Native	Anchorage	Blood	Pneumonia	NT	None	Yes
F	82.5	Non-Native	Anchorage	Blood	Bacteremia	NT	None	Yes
M	90.6	Non-Native	Other	Blood	Bacteremia	NT	Diabetes	No

*NT = non-typeable

Invasive *Neisseria meningitidis*

Overall Incidence

A total of 5 cases of invasive *Neisseria meningitidis* were reported to AIP in 2007 for an overall rate of 0.7/100,000. The Alaska rates are slightly higher than the ABCs 2007 national projected rate of 0.3/100,000 [8]. There were no invasive *N. meningitidis*-related deaths in Alaska in 2007.

Seasonality

One *N. meningitidis* case occurred in January and two cases occurred each in February and December; no clusters of related cases were reported.

Race

In 2007, 60% of the cases occurred in non-Natives. Age-adjusted rates were calculated for Alaska Natives and non-Natives. The age-adjusted rate ratio of *N. meningitidis* disease for the Alaska Native population compared with the non-Native population in 2007 was 3.

Table 14: Invasive *Neisseria meningitidis* Cases by Race – Alaska, 2007

Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native	2 (40)	1.2	100	0 (0)
Non-Native	3 (60)	0.4	33	0 (0)
Total	5		60	0 (0)

*Cases per 100,000 per percent distribution of Alaska 2000 population

Region

One case of invasive *N. meningitidis* occurred in Anchorage and two cases occurred in both the Interior and the YK Delta.

Age

Invasive *N. meningitidis* cases reported in 2007 ranged in age from 3.6 to 61.9 years old; the median age was 23.3 years.

Clinical Presentation

The primary clinical presentation was determined by a review of the discharge diagnoses in each patient's individual medical record associated with the invasive bacterial illness. In cases with multiple discharge diagnoses, the most serious diagnosis related to the *N. meningitidis* infection was recorded as the primary clinical presentation. Four cases presented with meningitis and one with pneumonia; one case had a secondary clinical presentation of osteomyelitis.

N. meningitidis was isolated from cerebrospinal fluid in three of five (60%) cases in 2007. Two cases were isolated from blood.

Mortality

There were no *N. meningitidis*-related deaths reported in Alaska in 2007.

Serogroup

Four invasive *N. meningitidis* cases in 2007 were serogrouped; all four were serogroup B.

Table 15: Summary of Invasive *Neisseria Meningitidis* Cases Characteristics, Alaska, 2007

Sex	Age (yrs)	Race	Residence	Site of Isolation	Clinical Presentation(s)	Serogroup	Associated Medical Conditions	Survived
M	3.6	AK Native	Other	CSF	Meningitis, osteomyelitis	B	None	Yes
M	8.9	AK Native	Other	CSF	Meningitis	B	None	Yes
F	23.3	Non-Native	Other	Blood	Meningitis	B	None	Yes
F	57.4	Non-Native	Other	Blood	Pneumonia	Unknown	Chronic lung disease, immune suppressive treatment	Yes
M	61.9	Non-Native	Anchorage	CSF	Meningitis	B	None	Yes

Invasive group A *Streptococcus*

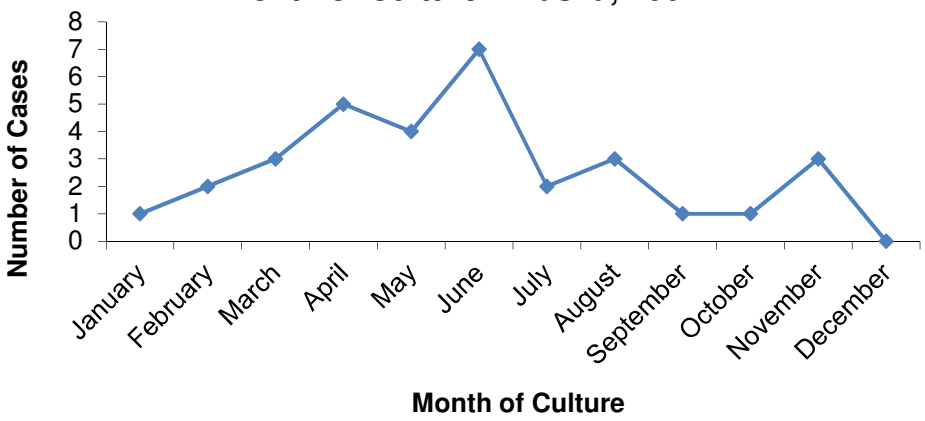
Overall Incidence

A total of 32 cases of invasive group A *Streptococcus* (GAS) were reported to AIP in 2007. The overall rate of invasive GAS disease in the state of Alaska was 4.7/100,000 persons per year. The Alaska rate is higher than the ABCs 2007 national projected rate of 3.8/100,000 [9]. In 2007, there were 4 GAS-related deaths (*emm* types 1, 12 and two unknown) for a case fatality ratio of 12.5%.

Seasonality

Cases of group A *Streptococcus* occurred throughout the year in 2007 with no apparent trends in seasonality.

Figure 15: Invasive group A *Streptococcus*, by Month of Culture - Alaska, 2007



Race

In 2007, 47% of invasive GAS cases in Alaska occurred in the Alaska Native population for an age-adjusted rate of 11.5/100,000 persons per year which was over four times higher than the non-Native age-adjusted rate of 2.8/100,000 persons per year.

Table 16: Invasive group A *Streptococcus* Cases by Race – Alaska, 2007

Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native	15 (47)	11.5	80	2 (13.3)
Non-Native	17 (53)	2.8	65	2 (11.8)
Total	32		72	4 (12.5)

*Cases per 100,000 per percent distribution of Alaska 2000 population

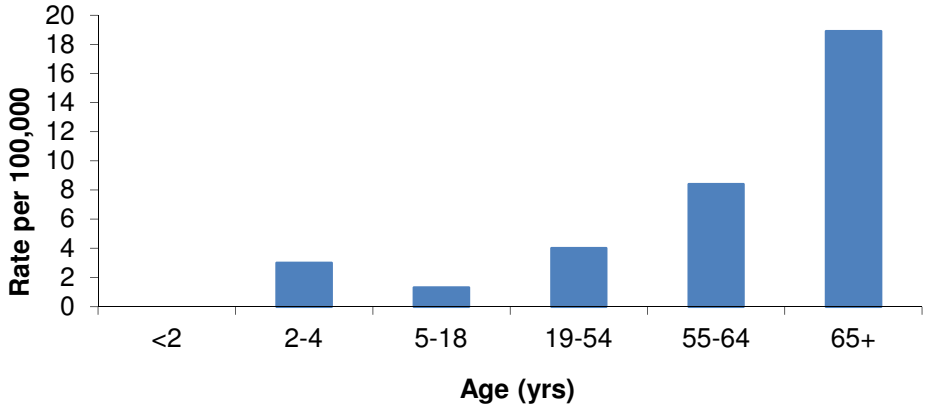
Region

Nineteen (59.4%) of the 32 invasive group A *Streptococcus* cases in 2007 were reported in the Anchorage area, 7 cases in the Interior, 3 cases in Southeast, 2 cases in Norton Sound and one case in the Arctic Slope.

Age

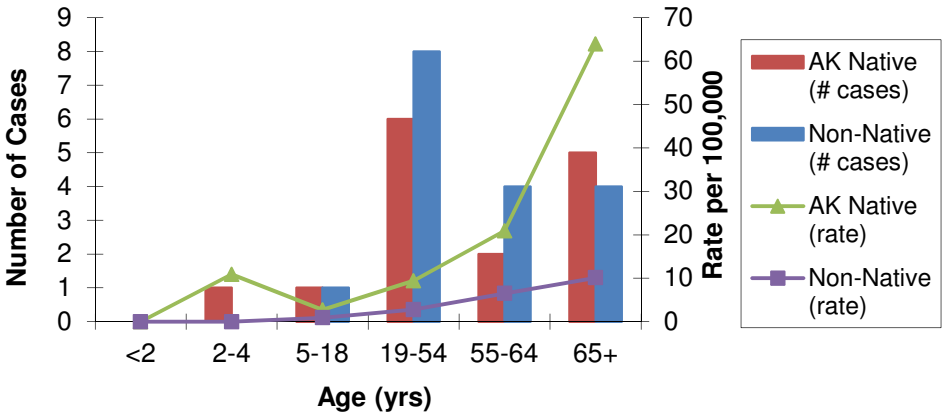
Invasive group A *Streptococcus* cases reported in 2007 ranged in age from 2 to 88.3 years old; the median age was 53.2 years. Highest rates of disease occurred in adults 65 and older (18.9/100,000).

Figure 16: Invasive group A *Streptococcus* by Age Group - Alaska, 2007



When stratified by race, the highest rates of invasive group A streptococcal disease occurred in Alaska Native adults 65 and older (63.9/100,000 persons per year). The highest GAS disease rate in the non-Native population occurred in adults 65 and older (10.1/100,000 persons per year).

Figure 17: Invasive group A *Streptococcus*, Cases & Rates by Age Group & Race - Alaska, 2007



Clinical Presentation

The primary clinical presentation was determined by a review of the discharge diagnoses in each patient's individual medical record associated with the invasive bacterial illness. In cases with multiple discharge diagnoses, the most serious diagnosis related to the GAS infection was recorded as the primary clinical presentation. Table 17 shows the primary clinical presentations of invasive group A *Streptococcus* in Alaska for 2007. Eleven cases also presented with secondary diagnoses including streptococcal toxic shock syndrome, cellulitis and pneumonia.

Group A *Streptococcus* was isolated from blood samples in 25 (78%) of 32 cases, three from joint fluid, two from surgical specimens, and one each from joint fluid and pleural fluid.

Table 17: Primary Clinical Presentations of Invasive group A *Streptococcus* – Alaska, 2007

Primary Presentation	n (%)
Cellulitis*	8 (25)
Bacteremia	6 (19)
Septic arthritis	5 (16)
Pneumonia*	4 (13)
Empyema	2 (6)
Necrotizing fasciitis	1 (3)
Meningitis	1 (3)
Peritonitis	1 (3)
Endocarditis	1 (3)
Epiglottitis	1 (3)
Osteomyelitis	1 (3)
Other	1 (3)
Total	32

*with bacteremia

Table 18: Summary of Invasive group A *Streptococcus* Case Characteristics, Alaska, 2007

Sex	Age (yrs)	Race	Residence	Site of Isolation	Clinical Presentation(s)	*emm* Type	Associated Medical Conditions	Survived
M	2	AK Native	Other	Blood	Bacteremia		None	Yes
F	14.5	Non-Native	Anchorage	Blood	Meningitis, pneumonia	1	None	No
M	15.8	AK Native	Other	Joint fluid	Septic arthritis, cellulitis		None	Yes
M	19.5	Non-Native	Anchorage	Blood	Pneumonia	73	None	Yes
M	22.9	AK Native	Anchorage	Joint fluid	Septic arthritis, cellulitis		Alcohol abuse	Yes
M	24.7	Non-Native	Anchorage	Blood	Cellulitis		Immune suppressive treatment	Yes
M	27.7	AK Native	Other	Blood	Empyema, pneumonia	6	Smoking, alcohol abuse	Yes
F	35.7	AK Native	Anchorage	Blood	Pneumonia	94	Smoking, alcohol abuse	Yes
M	46.5	Non-Native	Anchorage	Blood	Pneumonia	1	Diabetes	Yes
M	46.6	Non-Native	Other	Joint fluid	Septic arthritis	58	Smoking	Yes
M	47.7	AK Native	Anchorage	Blood	Pneumonia, cellulitis	108.1	Alcohol abuse	Yes
F	49	AK Native	Other	Surgical specimen	Other		None	Yes
F	49.6	Non-Native	Anchorage	Blood	Septic arthritis, cellulitis	108	Smoking	Yes
M	50.4	Non-Native	Other	Blood	Bacteremia		Diabetes	Yes
M	52	AK Native	Other	Blood	Cellulitis	92	Chronic lung disease, injection drug use	Yes
F	52.7	Non-Native	Anchorage	Blood	Bacteremia	28	None	Yes
M	53.7	Non-Native	Anchorage	Blood	Necrotizing fasciitis, cellulitis	101	Immune suppressive treatment	Yes
F	55.8	Non-Native	Anchorage	Blood	Endocarditis, streptococcal toxic shock syndrome		None	Yes
M	59.3	AK Native	Other	Blood	Bacteremia		Alcohol abuse	Yes
M	61.8	Non-Native	Anchorage	Blood	Osteomyelitis, cellulitis	1	Diabetes	Yes
M	62.3	Non-Native	Anchorage	Blood	Cellulitis	82	Smoking, chronic lung disease	Yes
F	63.7	AK Native	Anchorage	Blood	Cellulitis	41.2	Chronic lung disease, diabetes	Yes
M	63.9	Non-Native	Other	Blood	Bacteremia	89	None	Yes
F	65.8	Non-Native	Other	Pleural fluid	Empyema	12	Chronic lung disease	Yes
M	66.2	AK Native	Anchorage	Blood	Epiglottitis, pneumonia	1	Immune suppressive treatment	Yes
M	66.9	AK Native	Anchorage	Blood	Cellulitis	58	Alcohol abuse	Yes
M	72.4	Non-Native	Other	Surgical specimen	Septic arthritis, cellulitis		None	Yes
M	73.4	Non-Native	Anchorage	Peritoneal fluid	Peritonitis		None	Yes
M	75.8	AK Native	Other	Blood	Cellulitis	12	None	No
M	75.9	AK Native	Anchorage	Blood	Cellulitis	108	Smoking, chronic lung disease, alcohol abuse, diabetes	Yes
F	84.9	Non-Native	Anchorage	Blood	Cellulitis		Chronic lung disease	No
M	88.3	AK Native	Other	Blood	Bacteremia		None	No

Invasive group B *Streptococcus*

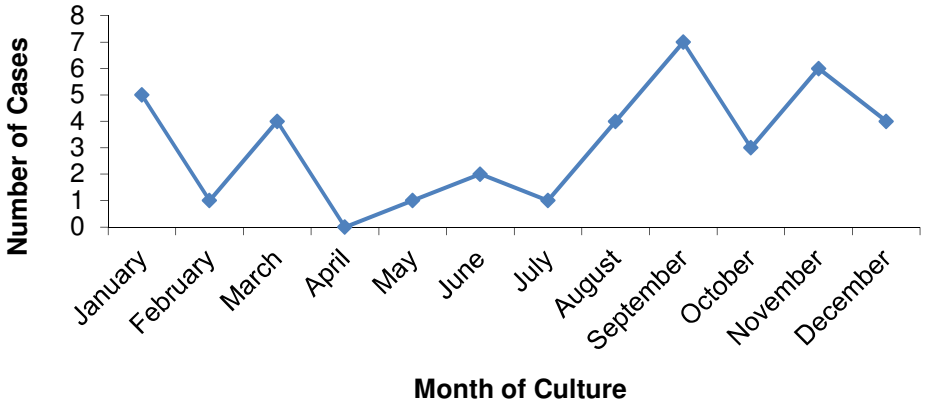
Overall Incidence

A total of 38 cases of invasive group B *Streptococcus* (GBS) were reported to AIP in 2007. The overall rate of invasive GBS disease in the state of Alaska was 5.6/100,000 persons per year. The Alaska rate is lower than the ABCs 2007 national projected rate of 6.6/100,000 [10]. In 2007, there were two GBS-related deaths for a case fatality ratio of 5.4% (outcome was unknown in 1 case).

Seasonality

Cases of group B *Streptococcus* occurred throughout the year with no apparent trends in seasonality.

Figure 18: Invasive group B *Streptococcus*, by Month of Culture - Alaska, 2007



Race

In 2007, 37% of invasive group B *Streptococcus* cases in Alaska occurred in the Alaska Native population for an age-adjusted rate of 10.5/100,000 persons per year which is more than twice the non-Native rate of 3.7/100,000 persons per year.

Table 19: Invasive group B *Streptococcus* Cases by Race – Alaska, 2007

Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native	14 (10.4)	10.5	43	1 (7.1)
Non-Native	24 (4.4)‡	3.7	63	1 (4.4)†
Total	38 (5.6)		55	2 (5.4)†

*Cases per 100,000 per percent distribution of Alaska 2000 population
‡Includes one case for which race was unknown
†Outcome unknown in one case

Region

In 2007, 25 (66%) of the 38 reported GBS cases occurred in Anchorage; eight cases were reported in the Interior, two cases in Southeast Alaska, and one each in Kotzebue, YK Delta and the Arctic Slope.

Age

Invasive group B *Streptococcus* cases reported in 2007 ranged in age from newborn to 87.9 years old; the median age was 55.5 years. Highest rates of disease occurred in children less than two years old (18/100,000 persons per year).

Figure 19: Invasive group B *Streptococcus* by Age Group - Alaska, 2007

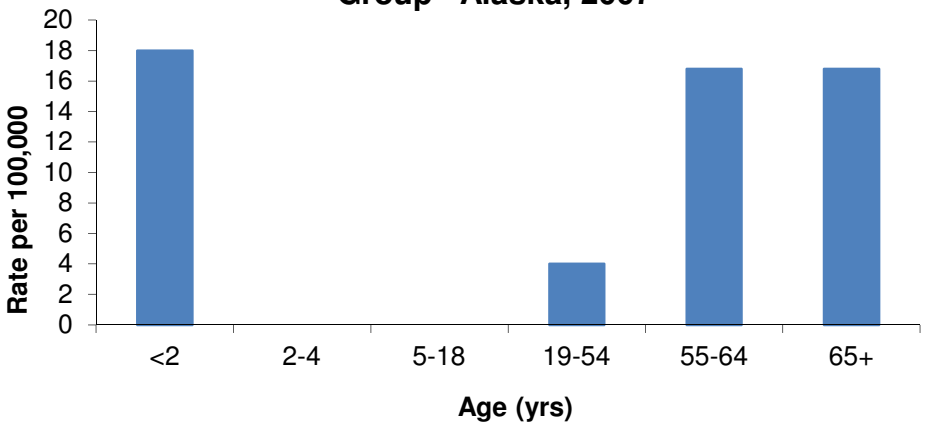
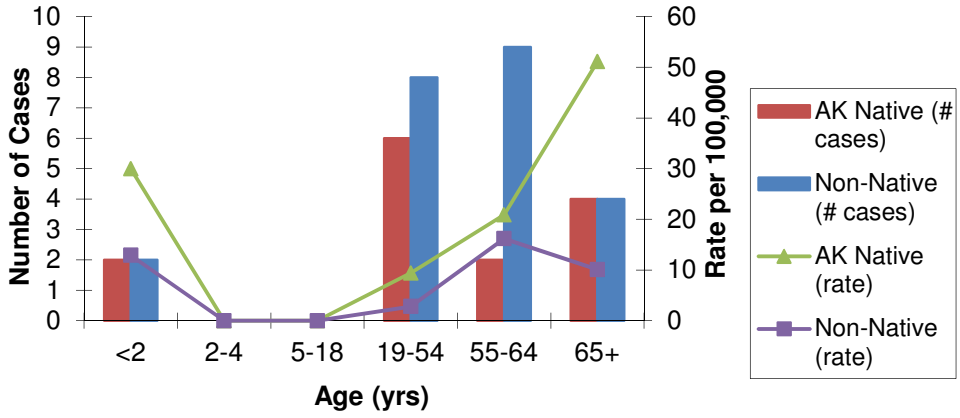


Figure 20: Invasive group B S*treptococcus*, Cases & Rates by Age Group & Race - Alaska, 2007



When stratified by race, the highest rates of disease occurred in AK Native adults 65 years of age and older (51.1/100,000 persons per year). There were two cases of early-onset disease (less than 7 days old) for a rate of 0.2/1,000 births.

Clinical Presentation

The primary clinical presentation was determined by a review of the discharge diagnoses in each patient's individual medical record associated with the invasive bacterial illness. In cases with multiple discharge diagnoses, the most serious diagnosis related to the GBS infection was recorded as the primary clinical presentation. In 2007, the most common clinical presentation was bacteremia which occurred in 11 cases (29%).

Group B *Streptococcus* was isolated from blood in 31 (82%) of 38 cases in 2006; three cases were isolated from joint fluid and one case each was isolated from peritoneal fluid, cerebrospinal fluid, a surgical specimen and an unspecified sterile site.

Table 20: Primary Clinical Presentations of Invasive group B *Streptococcus* – Alaska, 2007

Primary Presentation	n (%)
Bacteremia	11 (29)
Cellulitis*	6 (16)
Pneumonia*	5 (13)
Septic arthritis	4 (10)
Osteomyelitis	4 (10)
Endocarditis	4 (10)
Meningitis	1 (3)
Pericarditis	1 (3)
Peritonitis	1 (3)
Amnionitis	1 (3)
Total	38

*with bacteremia

Antibiotic Resistance

Susceptibility testing was performed on 30 GBS isolates received in 2007. Results of the testing are presented in the following table.

Table 21: Antibiotic Resistance in Invasive group B *Streptococcus* Isolates – Alaska, 2007

Antibiotic	Susceptible	Intermediate	Resistant	I + R	Total Tested
Penicillin	30 (100%)	0 (0%)	0 (0%)	0 (0%)	30
Cefotaxime	30 (100%)	0 (0%)	0 (0%)	0 (0%)	30
Erythromycin	16 (53%)	0 (0%)	14 (47%)	14 (47%)	30
Tetracycline	6 (20%)	0 (0%)	24 (80%)	24 (80%)	30
Levofloxacin	30 (100%)	0 (0%)	0 (0%)	0 (0%)	30
Clindamycin	22 (73%)	0 (0%)	8 (27%)	8 (27%)	30

All isolates tested were susceptible to penicillin, cefotaxime and levofloxacin. Resistance to tetracycline, erythromycin and clindamycin was seen in 80%, 47% and 27%, respectively, of isolates tested. Isolates from the two early onset cases were both resistant to tetracycline and erythromycin; one of the isolates was also resistant to clindamycin.

Table 21: Summary of Invasive group B *Streptococcus* Case Characteristics, Alaska, 2007

Sex	Age (yrs)	Race	Residence	Site of Isolation	Clinical Presentation(s)	Associated Medical Conditions	Survived
F	Newborn	AK Native	Other	Blood	Bacteremia	None	Yes
M	Newborn	Non-Native	Other	Blood	Bacteremia	None	Yes
F	18 days	Non-Native	Other	Blood	Bacteremia	None	Yes
F	25 days	AK Native	Anchorage	Blood	Bacteremia	None	Yes
M	23.4	Non-Native	Other	Blood	Bacteremia	None	Unknown
F	23.4	Non-Native	Anchorage	Other	Amnionitis	None	Yes
M	28.7	AK Native	Other	Blood	Cellulitis	None	Yes
F	35.7	AK Native	Anchorage	Blood	Pneumonia	Smoking, alcohol abuse	Yes
M	36.7	AK Native	Other	Joint fluid	Septic arthritis	None	Yes
M	37.3	AK Native	Anchorage	Joint fluid	Septic arthritis	Smoking, alcohol abuse	Yes
M	37.8	Non-Native	Anchorage	Blood	Bacteremia	Smoking, chronic lung disease, diabetes	Yes
F	40	Non-Native	Anchorage	Blood	Pneumonia	Smoking	Yes
F	40.8	Non-Native	Anchorage	Blood	Bacteremia	None	Yes
M	46.3	AK Native	Other	Peritoneal fluid	Peritonitis	Smoking, alcohol abuse	Yes
F	46.6	AK Native	Anchorage	Surgical specimen	Cellulitis	Smoking, alcohol abuse	Yes
F	46.9	Non-Native	Anchorage	Blood	Cellulitis	Diabetes	Yes
M	49.8	Non-Native	Anchorage	CSF	Meningitis	Smoking, alcohol abuse, diabetes	Yes
M	51.8	Non-Native	Anchorage	Blood	Septic arthritis	Diabetes	Yes
M	55.3	Non-Native	Other	Blood	Cellulitis	Smoking, chronic lung disease, diabetes	Yes
F	55.6	Non-Native	Other	Blood	Bacteremia	Diabetes	Yes
M	56.6	Non-Native	Anchorage	Blood	Osteomyelitis, cellulits	Immune suppressive treatment, diabetes	Yes
F	56.9	Non-Native	Anchorage	Blood	Osteomyelitis, cellulitis	Diabetes	Yes
M	57.7	Non-Native	Anchorage	Blood	Endocarditis	Diabetes	Yes
F	60.3	Non-Native	Other	Blood	Endocarditis	None	No
M	60.9	Non-Native	Anchorage	Blood	Osteomyelitis, cellulitis	Chronic lung disease, diabetes	Yes
F	61.7	Non-Native	Anchorage	Blood	Bacteremia	Chronic lung disease, diabetes	Yes
M	62	Unknown	Anchorage	Joint fluid	Osteomyelitis, septic arthritis	None	Yes
F	62.8	AK Native	Other	Blood	Endocarditis, pericarditis	Smoking, alcohol abuse	Yes
M	63	Non-Native	Anchorage	Blood	Pneumonia	None	Yes
F	63.1	AK Native	Other	Blood	Septic arthritis, cellulitis	None	No
F	66.4	AK Native	Anchorage	Blood	Cellulitis	None	Yes
M	72.8	AK Native	Anchorage	Blood	Pericarditis, empyema	None	Yes
M	74.5	AK Native	Anchorage	Blood	Pneumonia, cellulitis	Diabetes	Yes
M	74.9	Non-Native	Anchorage	Blood	Cellulitis	Diabetes	Yes
M	75.4	Non-Native	Anchorage	Blood	Pneumonia	Diabetes	Yes
M	82.8	Non-Native	Other	Blood	Bacteremia, other	Chronic lung disease	Yes
M	87.6	Non-Native	Anchorage	Blood	Bacteremia	None	Yes
F	87.9	AK Native	Anchorage	Blood	Endocarditis	Chronic lung disease	Yes

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Appendix

MIC Interpretive Standards Definitions:

CLSI [5] provides recommended interpretive categories for various Minimum Inhibitory Concentration values (cut points) for each organism/antibiotic combination which are defined as follows:

1. Susceptible (S):

The "susceptible" category implies that isolates are inhibited by the usually achievable concentrations of antimicrobial agent when the recommended dosage is used for the site of infection.

2. Intermediate (I):

The "intermediate" category includes isolates with antimicrobial agent MICs that approach usually attainable blood and tissue levels and for which response rates may be lower than for susceptible isolates. The "intermediate" category implies clinical efficacy applicability in body sites where the drugs are physiologically concentrated (e.g., quinolones and β-lactams in urine) or when a higher dosage of a drug can be used (e.g., β-lactams). The "intermediate" category also includes a buffer zone which should prevent small, uncontrolled technical factors from causing major discrepancies in interpretations, especially for drugs with narrow pharmacotoxicity margins.

3. Resistant (R):

Resistant strains are not inhibited by the usually achievable concentrations of the agent with normal dosage schedules, and/or that demonstrate MICs or zone diameters that fall in the range where specific microbial resistance mechanisms are likely (e.g., β-lactamases) are likely, and clinical efficacy of the agent against the isolate has not been reliably shown in treatment studies.