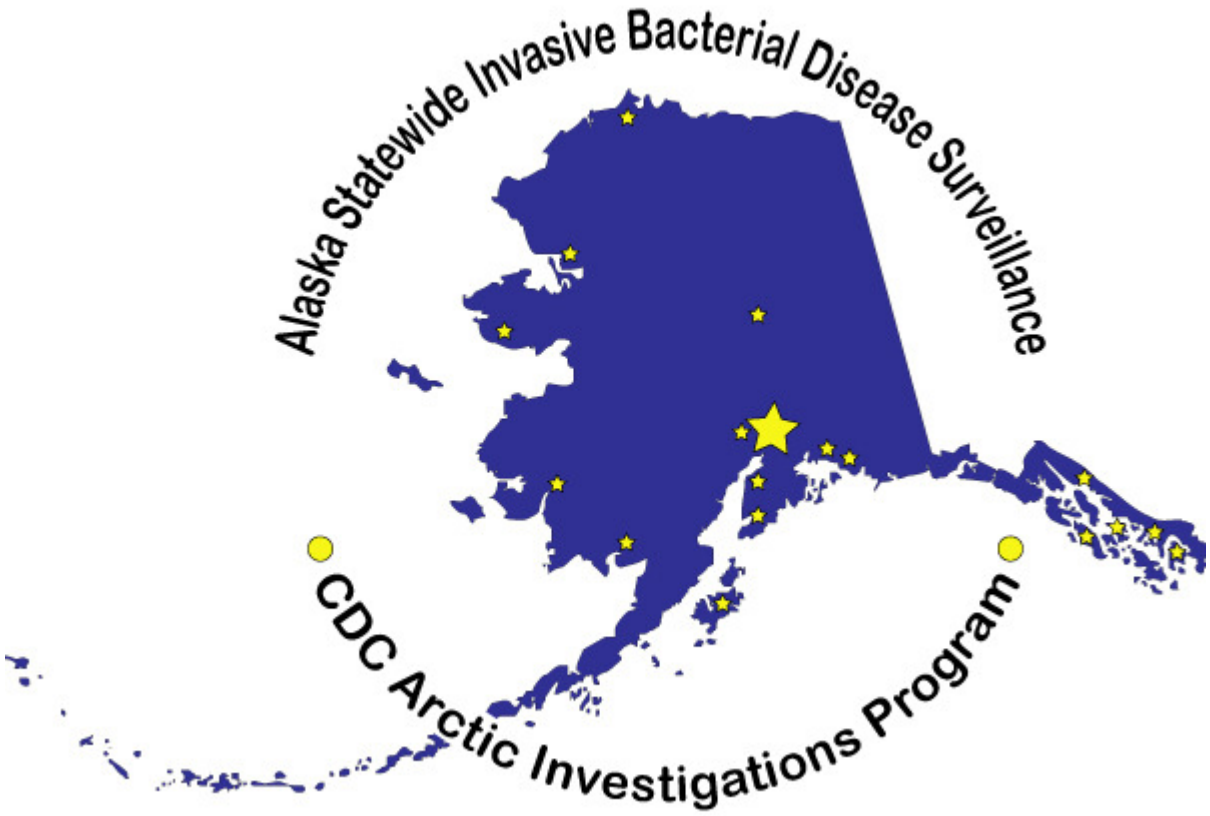

Surveillance of Invasive Bacterial Disease in Alaska, 2013

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Alaska Statewide Invasive Bacterial Disease

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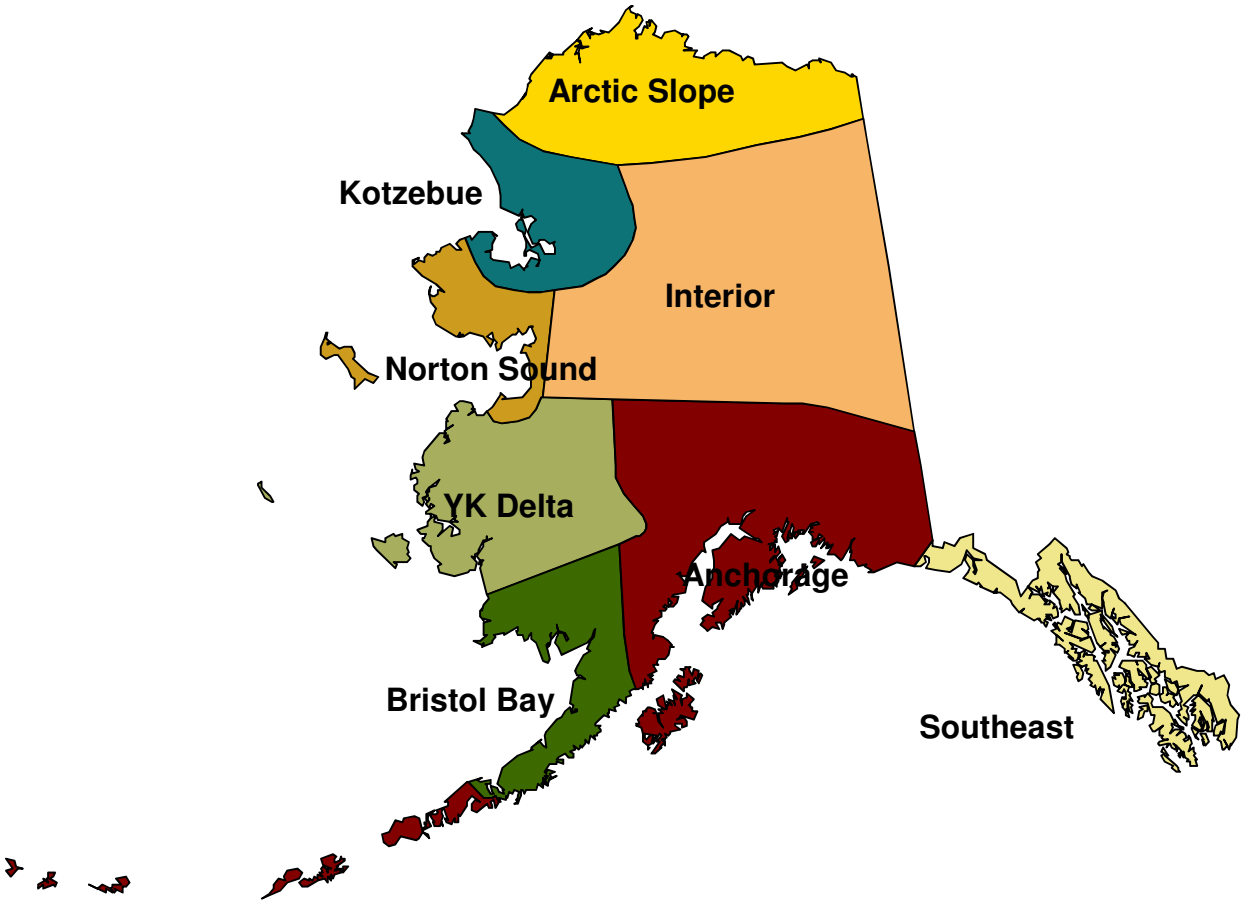
Summary

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, 2013



In 2013, the total numbers of cases of invasive disease caused by these organisms reported to AIP were 106 *S. pneumoniae*, 21 *H. influenzae*, 0 *N. meningitidis*, 52 group A *Streptococci* (GAS) and 37 group B *Streptococci* (GBS). Alaska Native people had higher rates of disease overall than non-Native people

for all surveillance organisms. Rates of invasive pneumococcal disease were highest in the YK Delta and Kotzebue regions. Rates for each organism by region are presented in the following table.

Table 1: Surveillance Organisms Reported by Region – Alaska, 2013

Region	*S. pneumoniae* n (rate*)	*H. influenzae* n (rate*)	*N. meningitidis* n (rate*)	GAS n (rate*)	GBS n (rate*)
Anchorage	61 (12.5)	9 (1.8)	0 (0)	34 (7)	25 (5.1)
Arctic Slope	3 (34)	0 (0)	0 (0)	0 (0)	0 (0)
Bristol Bay	1 (13.7)	0 (0)	0 (0)	0 (0)	0 (0)
Interior	14 (12.4)	1 (0.9)	0 (0)	5 (4.4)	5 (4.4)
Kotzebue	3 (35.4)	1 (11.8)	0 (0)	4 (47.2)	0 (0)
Norton Sound	1 (10.1)	0 (0)	0 (0)	0 (0)	0 (0)
Southeast	8 (10.8)	2 (2.7)	0 (0)	3 (4)	6 (8.1)
YK Delta	15 (57.7)	8 (30.8)	0 (0)	6 (23.1)	1 (3.8)
Total	106 (14.4)	21 (2.9)	0 (0)	52 (7.1)	37 (5)

*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 736,399 persons in 2013 [1]. Case detection occurs year-round as participating laboratories send isolates recovered from sterile sites to the AIP laboratory in Anchorage; materials and forms for isolate shipment and data collection are provided to each laboratory by AIP. Demographic and clinical information on the cases are collected from a review of medical records. At year-end, AIP asks that each laboratory review their records and provide information on any cases that may have been overlooked. In 2013, 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

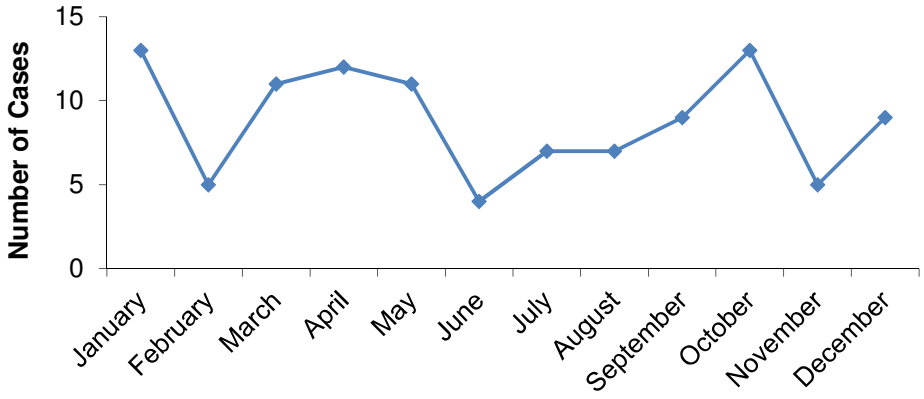
Overall Incidence

A total of 100 pneumococcal isolates were received at AIP in 2013. An additional 6 cases were detected through shared surveillance with the State DPH for a total of 106 cases of invasive pneumococcal disease. The overall rate for invasive pneumococcal disease in 2013 was 14.4 cases per 100,000 persons per year. Alaska rates for 2013 were higher than the Active Bacterial Core Surveillance (ABCs) 2013 national projected rate of 10.7/100,000 [2]. ABCs is a surveillance system operated in 10 states which covers a population of up to 42 million persons.

Seasonality

Invasive *Streptococcus pneumoniae* cases were identified in each month of 2013. The largest number of cases (n=13) was reported both in January and October.

Figure 2: Invasive Pneumococcal Disease, by Month of Culture - Alaska, 2013



Race

In 2013, the state population was comprised of 19% Alaska Native people *(Alaska Natives 142,898, non-Natives 593,501)* [1]. Of all reported *S. pneumoniae* cases in 2013, 47% occurred among Alaska Native people for a total of 50 cases; the age-adjusted rate was 36.9/100,000 persons per year. Fifty-six cases occurred among the non-Native population for an age-adjusted rate of 8.7/100,000 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 2013 was 4.2.

Table 2: Invasive *Streptococcus pneumoniae* Cases by Race – Alaska, 2013

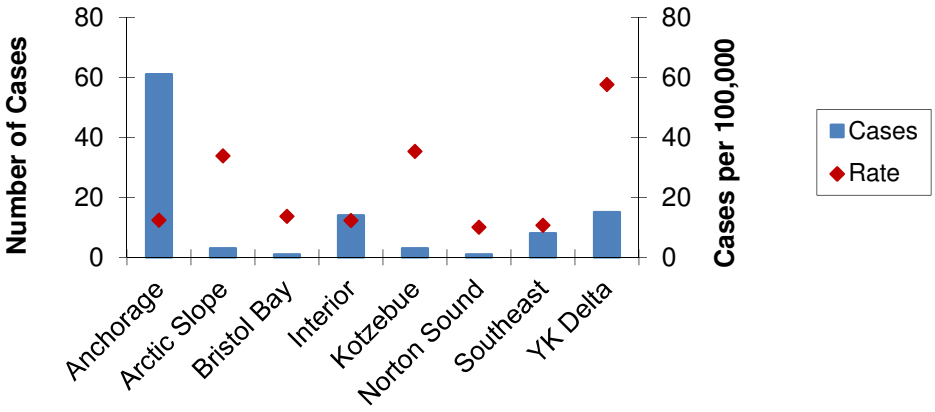
Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native	50 (47)	36.9	62%	12 (24)
Non-Native†	56 (53)†	8.7	63%	5 (9)
Total	106		62%	17 (16)

*Cases per 100,000 per percent distribution of Alaska 2010 population
†Includes 10 cases for which race was unknown

Region

The highest percentage (58%) of invasive pneumococcal disease cases occurred in the Anchorage area in 2013. Rates of disease, however, were highest in the Kotzebue region (35.4/100,000 persons per year) and the YK Delta (57.7/100,000 persons per year).

Figure 3: Invasive Pneumococcal Disease, Cases & Rates by Region - Alaska, 2013

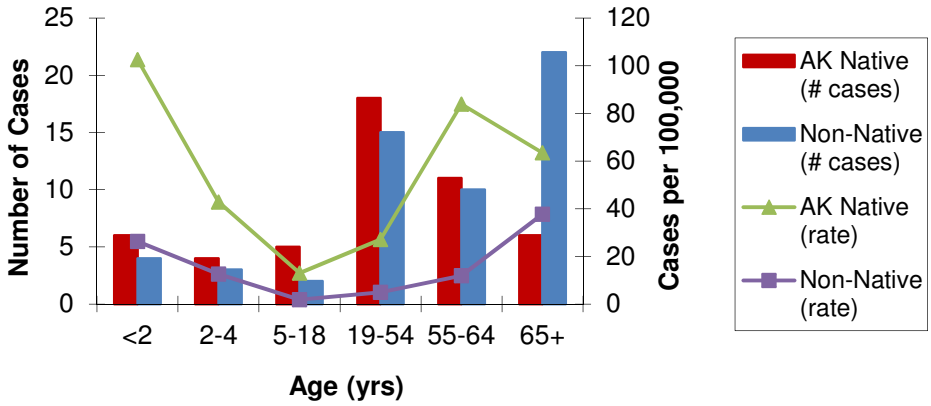


Age

Cases occurred in all age groups in 2013 ranging from 1 day to 97 years with a median age of 54 years. Overall, the highest rates of disease occurred in children less than two years old.

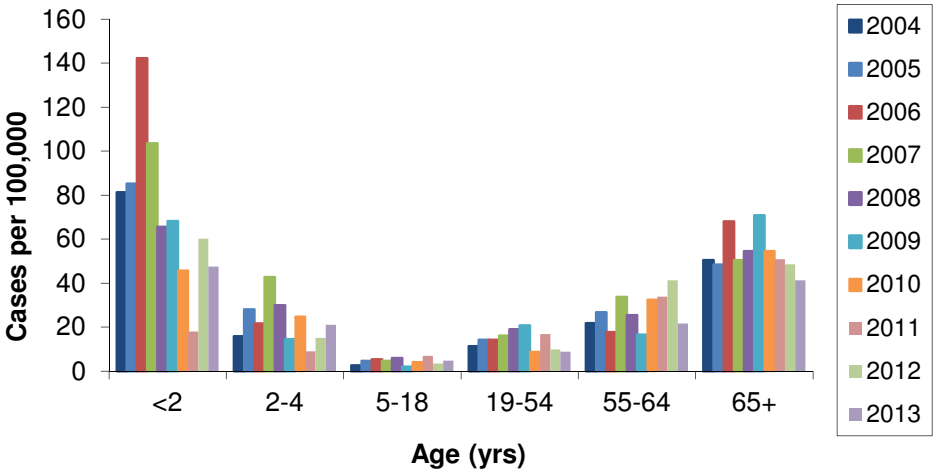
When stratified by age and race, the highest rates of disease in 2013 occurred in Alaska Native children less than two years old (102.5/100,000 persons per year).

Figure 4: Invasive Pneumococcal Disease, Cases & Rates by Age Group & Race - Alaska, 2013



Since the initiation of a pneumococcal 7-valent conjugate vaccine program in 2001, overall rates of invasive disease declined dramatically in children less than 2 years of age [3]. In 2008, the rate of invasive pneumococcal disease in children less than 2 years declined to 65.6/100,000 which was the lowest rate observed in this age group since introduction of the 7-valent vaccine. Following introduction of a 13-valent conjugate vaccine in 2010, rates of disease observed in children less than 2 years old declined to 18/100,000 in 2011. In 2012, however, disease rates in this age group increased to 60.3/100,000 due to disease caused by serotypes not included in the current vaccine. In 2013, rates have declined to 47.5/100,000.

Figure 5: Invasive Pneumococcal Disease by Age Group - Alaska, 2004-2013



Although pneumococcal disease rates dropped initially in AK Native and non-Native children less than 2 years of age after introduction of the 7-valent vaccine, the rates of disease in AK Native children less than 2 years trended upward from a low of 93.6/100,000 in 2001 to 335.9/100,000 in 2006. This increase in rates was due primarily to disease caused by serotypes not contained in the pneumococcal conjugate vaccine [4,5]. In 2009, rates of disease in AK Native children less than 2 years declined to 87.1/100,000 which was the lowest rate since the introduction of the seven-valent pneumococcal vaccine. After introduction of the 13-valent vaccine in 2010, rates declined to 30.7/100,000 in 2011,

however, increased to 177.5/100,000 in 2012 and declined to 102.5/100,000 in 2013. Five (83%) of the 6 cases in 2013 were caused by serotypes not contained in the 13-valent vaccine. Rates of invasive disease in non-Native children less than 2 years declined during the same time period reaching 26.8/100,000 in 2005, and following an increase to 64.4/100,000 in 2007, declined in 2008 to 6.2/100,000. In 2009, the rate of disease in non-Native children less than 2 years increased to 60.3/100,000, but declined to 13/100,000 in 2012 with use of the 13-valent vaccine. In 2013, rates have increased in non-Native children less than 2 years to 26.3/100,000; three (75%) of four cases were caused by non-vaccine serotypes.

Figure 6: Invasive Pneumococcal Disease in Alaska Natives, by Age Group - Alaska, 2004-2013

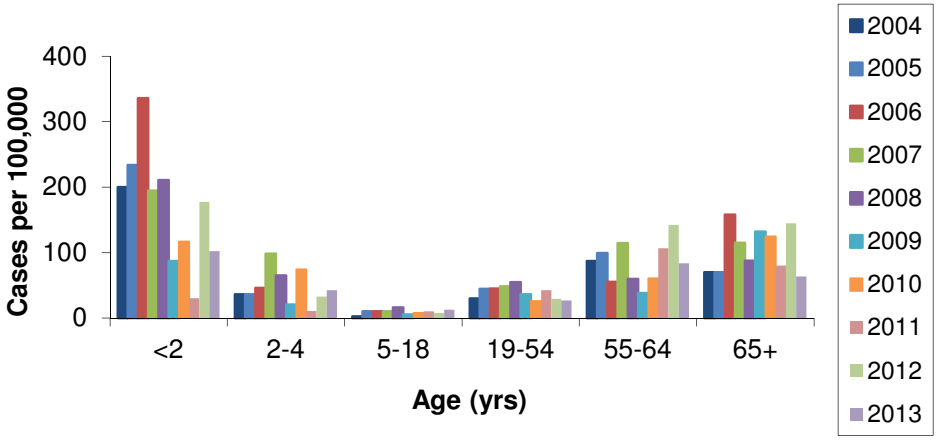
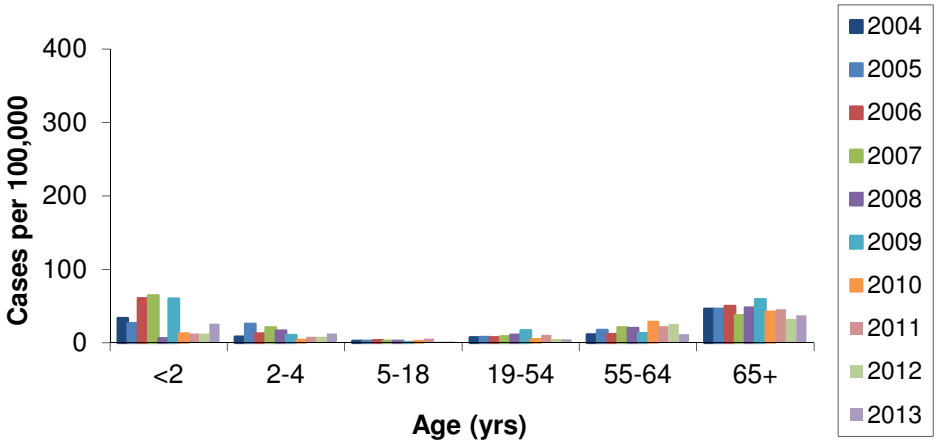


Figure 7: Invasive Pneumococcal Disease in Non-Natives, by Age Group - Alaska, 2004-2013

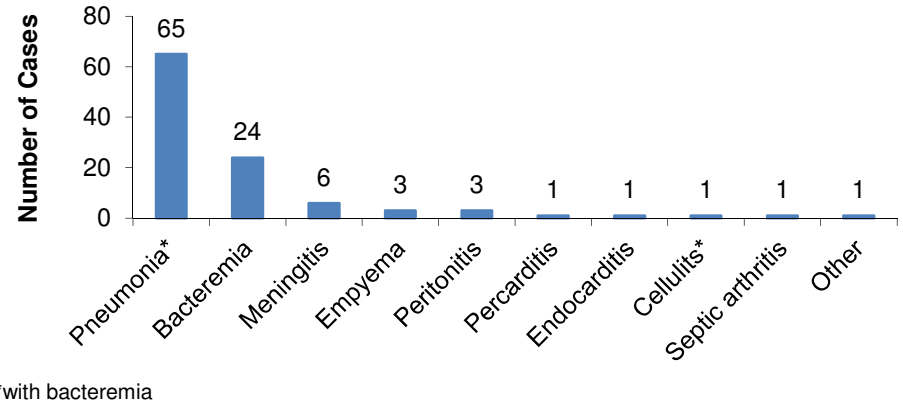


Clinical Presentation

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 2013 (61%) followed by bacteremia (23%). Seventeen cases had a secondary pneumococcal-related diagnosis in 2012 - 9 pneumonia, 3, empyema, 2 meningitis, 1 cellulitis, 1 osteomyelitis and 1 septic arthritis.

Figure 8: Primary Clinical Presentations of Invasive Pneumococcal Disease - Alaska, 2013



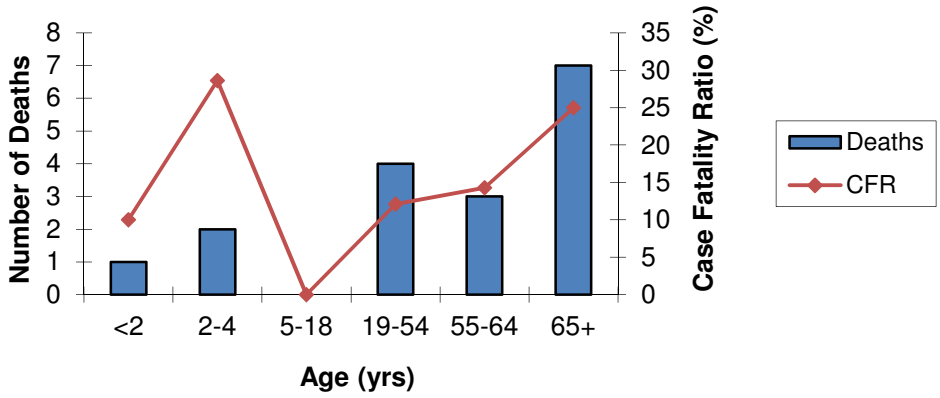
*with bacteremia

In 2013, blood was the most common source of a positive culture which was used to identify 102 (96%) of 106 cases. Two cases were identified from pleural fluid and one each from a pericardial aspirate and surgical specimen.

Mortality

In 2013, the overall case fatality ratio for *S. pneumoniae* in Alaska was 16% (17 deaths out of 106 cases). The case fatality ratio for AK Natives was slightly higher (24%, 12 deaths) than non-Natives (9%, 5 deaths). The largest number of deaths occurred in the 65 and older age category (7 deaths), however, the highest case fatality ratio occurred in the 2-4 age category (2 deaths) 28.6%.

Figure 9: Invasive Pneumococcal Deaths & Case Fatality Ratios by Age Group - Alaska, 2013



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, 2013

		Alaska Native				Non-Native			
Serotype	Total n (%)	<2	2-18	19-64	65+	<2	2-18	19-64	65+
03	4 (4)	-	-	-	-	-	-	3	1
04	1 (1)	-	-	1	-	-	-	-	-
06C	7 (7)	-	-	1	1	-	-	2	3
07C	2 (2)	-	-	1	-	-	-	-	1
07F	5 (5)	-	-	3	-	-	-	-	2
08	4 (4)	-	2	1	-	-	-	1	-
09N	3 (3)	-	-	2	-	-	-	1	-
10A	4 (4)	-	-	1	-	2	-	1	-
11A	3 (3)	-	-	-	-	-	1	1	1
12F	6 (6)	1	1	3	-	-	-	-	1
14	1 (1)	-	-	-	-	-	-	1	-
15A	3 (3)	-	-	1	-	-	-	2	-
15B	3 (3)	-	1	-	-	1	-	1	-
15C	3 (3)	1	-	1	-	-	-	1	-
16F	10 (10)	-	1	3	1	-	1	2	2
17F	3 (3)	-	-	1	2	-	-	-	-
19A	3 (3)	1	-	1	-	-	-	1	-
19F	1 (1)	-	-	-	-	1	-	-	-
22F	13 (13)	-	3	2	2	-	-	1	5
23A	4 (4)	-	-	3	-	-	-	1	-
23B	4 (4)	-	1	-	-	-	1	1	1
31	3 (3)	-	-	2	-	-	1	-	-
33F	3 (3)	1	-	1	-	-	-	1	-
34	3 (3)	-	-	-	-	-	-	3	-
35B	3 (3)	2	-	-	-	-	-	-	1
NT	1 (1)	-	-	-	-	-	1	-	-
Total	100	6	9	28	6	4	5	24	18

In 2013, the most common pneumococcal serotypes were 22F, (13 isolates, 13%), 16F (10 isolates, 10%) and 6C (7 isolates, 7%). 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. Disease caused by serotypes 7F and 19A, which are not included in the 7-valent conjugate vaccine, continually increased until the introduction of the 13-valent vaccine in 2010 which does include these two serotypes. Although cases caused by 7F and 19A continue to occur, they are no longer the most common serotypes and it is anticipated that the number of cases will continue to decline with the use of the vaccine. The majority (46%) of serotype 22F cases and serotype 16F cases (70%) occurred in the Anchorage area in 2013.

Table 4: Invasive Pneumococcal Serotype Distribution by Region – Alaska, 2013

Serotype	Anchorage	Arctic Slope	Bristol Bay	Interior	Kotzebue	Norton Sound	Southeast	YK Delta
03	3	-	-	1	-	-	-	-
04	1	-	-	-	-	-	-	-
06C	2	-	-	2	-	-	3	-
07C	2	-	-	-	-	-	-	-
07F	4	-	-	1	-	-	-	-
08	1	-	1	-	-	-	-	2
09N	1	1	-	1	-	-	-	-
10A	3	-	-	1	-	-	-	-
11A	3	-	-	-	-	-	-	-
12F	2	-	-	1	1	-	-	2
14	1	-	-	-	-	-	-	-
15A	3	-	-	-	-	-	-	-
15B	2	-	-	-	-	-	-	1
15C	1	-	-	-	-	1	1	-
16F	7	-	-	-	-	-	1	2
17F	1	-	-	2	-	-	-	-
19A	-	-	-	1	-	-	1	1
19F	1	-	-	-	-	-	-	-
22F	6	1	-	3	2	-	-	1
23A	2	-	-	1	-	-	-	1
23B	3	-	-	-	-	-	-	1
31	1	1	-	-	-	-	-	1
33F	2	-	-	-	-	-	-	1
34	2	-	-	-	-	-	1	-
35B	2	-	-	-	-	-	-	1
NT	1	-	-	-	-	-	-	-
Unknown	4	-	-	-	-	-	1	1
Total	61	3	1	14	3	1	8	15

Vaccine Serotypes

In 2001, the pneumococcal conjugate vaccine (PCV7) was included in the Alaska childhood vaccination schedule. This vaccine provided protection against the 7 most common pneumococcal serotypes causing invasive disease among children (types 4, 6B, 9V, 14, 18C, 19F, 23F). In early 2010, a new pneumococcal conjugate vaccine (PCV13) was introduced into the Alaska childhood vaccination schedule. This vaccine provided protection against the 7 pneumococcal serotypes contained in the PCV7 vaccine plus six additional serotypes (1, 3, 5, 6A, 7F, 19A) that have caused invasive disease since the introduction of the PCV7 vaccine. The table below shows the proportion of invasive infections from 2013 that were due to serotypes found in the PCV13 vaccine. There were two cases of pneumococcal disease caused by serotypes contained in the PCV13 vaccine in children less than 5 years of age, the age group for which the vaccine is recommended. It is anticipated that the number of cases caused by these serotypes will decrease over time.

Table 5: Proportion of Invasive Isolates Contained in the PCV13 Vaccine by Age Group and Race – Alaska, 2013

Age (yrs)	Alaska Native (%)	Non-Native (%)	Total (%)
<2	1 (17%) of 6	1 (25%) of 4	2 (20%) of 10
2-4	0 (0%) of 4	0 (0%) of 3	0 (0%) of 7
5+	5 (13%) of 39	8 (18%) of 44	13 (16%) of 83
Total	6 (12%) of 49	9 (18%) of 51	15 (15%) of 100

For the year covered by this report, the 23-valent polysaccharide vaccine (Ps23V) was recommended in Alaska for all persons 65 years and older, and for persons over age 2 who are at higher risk for pneumococcal disease [5]. In 2013, for persons 65 years and older, 12 (50%) of 24 cases serotyped were potentially vaccine preventable invasive pneumococcal illnesses.

Vaccine Failures

In 2013, pneumococcal vaccine status was known for 101 (95%) of the 106 cases; 46 cases (46%) of cases with known vaccine status did receive a pneumococcal vaccine prior to illness and 55 cases (54%) had no record of a pneumococcal vaccine.

A PCV13 vaccine failure is defined as invasive pneumococcal disease caused by a serotype contained in the PCV13 vaccine in a child less than five years old who has had at least two doses of vaccine. There was one vaccine failure in 2013. The child had received 3 doses of PCV13 and had no underlying conditions; serotype of the case was 19A.

Potentially Preventable Deaths

Overall, 35% of all pneumococcal-related mortality in 2013 was potentially preventable with the use of the 23-valent polysaccharide vaccine in persons over 2 years old; 47% of deaths were due to disease caused by serotypes not contained in the 23-valent vaccine.

Table 6: Potentially Vaccine Preventable Invasive Pneumococcal Deaths – Alaska, 2013

Serotypes	< 2 years	2-4	5-18	19-54	55-64	65+	Total
PCV13	0	0	0	0	0	0	0
Ps23V	1 (100%)	1 (50%)	0	1 (25%)	1 (33%)	3 (43%)	7 (41%)
Non-Vaccine	0	1 (50%)	0	3 (75%)	1 (33%)	3 (43%)	8 (47%)
Unknown	0	0	0	0	1 (33%)	1 (14%)	2 (12%)
Total	1	2	0	4	3	7	17

Seven of the 17 deaths in 2013 from invasive *S. pneumoniae* occurred from serotypes contained within the Ps23V vaccine; three of the deaths were in individuals eligible for the vaccine. Two deaths occurred in vaccinated individuals; time since vaccination was 11 and 8 years.

Table 7: Invasive Pneumococcal Disease, Serotypes of Fatal Cases – Alaska, 2013

Serotype	Deaths n (%)	Serotype Frequency (n)
04†*	1 (100%)	1
06C	1 (14%)	7
12F*	2 (33%)	6
15C	1 (33%)	3
16F	4 (40%)	10
17F*	1 (33%)	3
22F*	3 (23%)	13
23A	2 (50%)	4

† Serotypes contained in the 13-valent conjugate vaccine
*Serotypes contained in the 23-valent polysaccharide vaccine

Associated Risk Factors

The presence of one or more associated risk factors was reported in 75% of invasive pneumococcal cases in 2013. Cigarette smoking was the most prevalent risk factor observed in adults followed by alcohol abuse and chronic lung disease.

Table 8: Associated Risk Factors Identified in Invasive Pneumococcal Cases – Alaska, 2013*

Risk Factor	Adult Cases (≥ 18 years) n=82, Cases (%)
Cigarette smoking	27 (33%)
Alcohol abuse	25 (31%)
Chronic lung disease	24 (29%)
Diabetes	10 (12%)
Immunosuppressive treatment	3 (4%)
Injection drug use	3 (4%)
Asplenia	0 (0%)

*More than one risk factor was identified in several cases

Antibiotic Resistance

Susceptibility testing was performed on 100 isolates received in 2013. Results of the testing are presented in the following table.

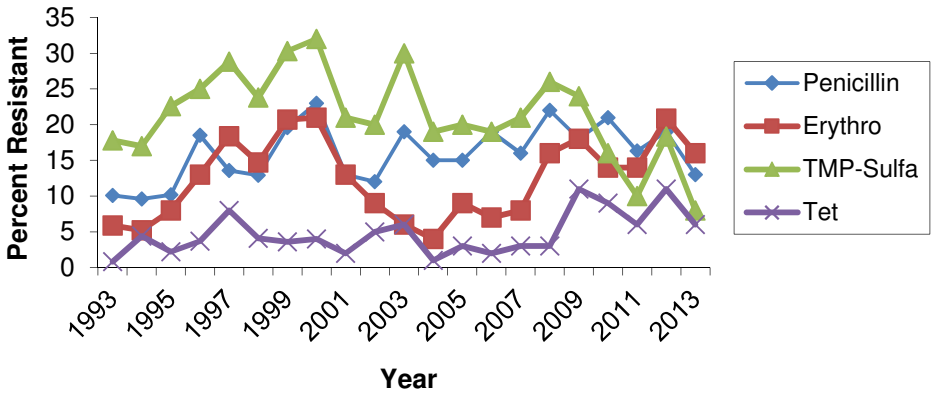
Table 9: Antibiotic Resistance in Invasive *Streptococcus pneumoniae* Isolates – Alaska, 2013

Antibiotic	Susceptible	Intermediate	Resistant	I + R	Total Tested
Penicillin	87 (87%)	0 (0%)	13 (13%)	13 (13%)	100
TMP-sulfa	92 (92%)	3 (3%)	5 (5%)	8 (8%)	100
Erythromycin	84 (84%)	0 (0%)	16 (16%)	16 (16%)	100
Ceftriaxone	97 (97%)	3 (3%)	0 (0%)	3 (3%)	100
Tetracycline	94 (94%)	0 (0%)	6 (6%)	6 (6%)	100
Chloramphenicol	98 (98%)	0 (0%)	2 (2%)	2 (2%)	100
Vancomycin	100 (100%)	0 (0%)	0 (0%)	0 (0%)	100
Levofloxacin	100 (100%)	0 (0%)	0 (0%)	0 (0%)	100
Clindamycin	96 (96%)	0 (0%)	4 (4%)	4 (4%)	100

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 [7]. The MIC Interpretive Standards definitions of 'susceptible', 'intermediate', and 'resistant' can be found in the Appendix.

Serotypes found in the PCV7 and PCV13 vaccines are more likely to be non-susceptible to penicillin and erythromycin than non-vaccine serotypes. One potential benefit of the use of these vaccines was an anticipated decline in antibiotic resistance among circulating pneumococci. Following the initiation of the PCV7 vaccine in 2001, antibiotic resistance among invasive pneumococci dropped. During 2003, TMP-sulfa and penicillin resistance increased, however, following an increase in disease caused by serotype 19A. This serotype is included in the PCV13 vaccine; decreasing proportions of resistant isolates tested may be due to the introduction of the vaccine.

Figure 10: Trends in Antibiotic Resistance Among Invasive Pneumococcal Isolates - Alaska, 1993 - 2013



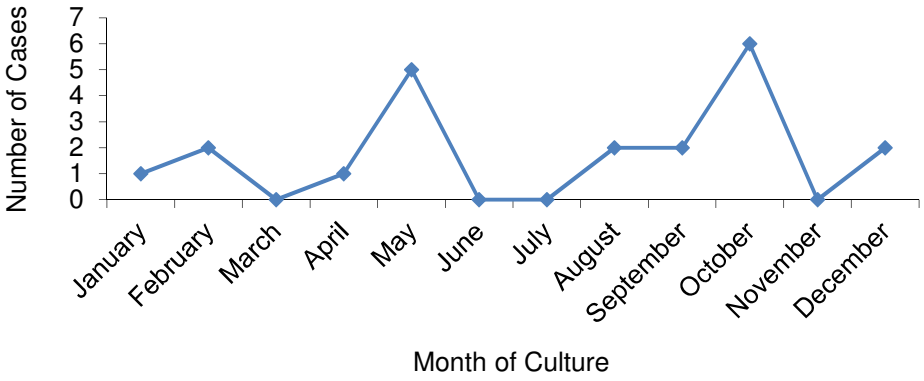
Invasive *Haemophilus influenzae*

Overall Incidence

In 2013, there were 21 cases of invasive *Haemophilus influenzae* in Alaska, for a statewide rate of 2.9/100,000 persons per year. This rate is higher than the national projected rate of 1.77/100,000 persons per year [8]. There were two deaths associated with *H. influenzae* in 2013 for a case fatality ratio of 9.5%.

Seasonality

Figure 11: *Haemophilus influenzae* Disease by Month of Culture - Alaska, 2013

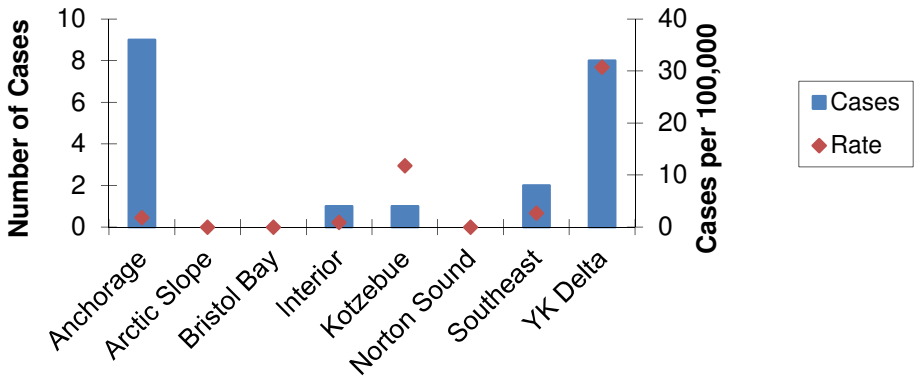


Cases of invasive *H. influenzae* occurred throughout 2013; however, due to the small number of cases, trends in seasonality cannot be determined. The largest number of cases (n=6) occurred in October.

Region

The highest rates of disease caused by invasive *H. influenzae* cases in 2013 were in the regions of the YK Delta, 30.8/100,000 (8 cases), and Kotzebue, 11.8/100,000 (1 case). Although a large number of cases occurred in the Anchorage area (9 cases), the rate was much lower (1.8/100,000).

Figure 12: Invasive *Haemophilus influenzae*, Cases & Rates by Region - Alaska, 2013



Race

Table 10: Invasive *Haemophilus influenzae* Cases by Race – Alaska, 2013

Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native	12 (57%)	7.4	50%	2 (17%)
Non-Native	9† (43%)	1.3	56%	0 (0%)
Total	21		52%	2 (9.5%)

*Cases per 100,000 per percent distribution of Alaska 2010 population
†Includes one case for which race is unknown

In 2013, 57% of the cases occurred in Alaska 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 2013 was 5.7.

Age

H. influenzae cases ranged in age from newborn to 86 years of age in 2013 (median 34 years). Overall, the highest rates of disease occurred in children less than 2 years old (42.7/100,000).

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 children less than two years of age, 136.7/100,000 persons per year and Alaska Native adults 65 years and older, 21.2/100,000 persons per year.

Figure 13: Invasive *Haemophilus influenzae* by Age Group - Alaska, 2013

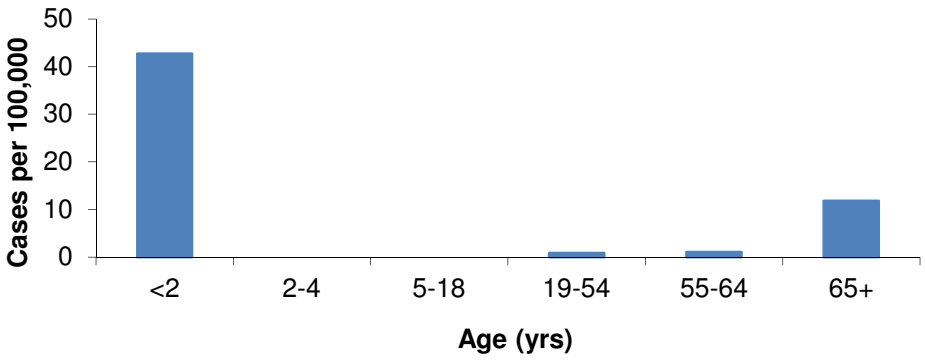
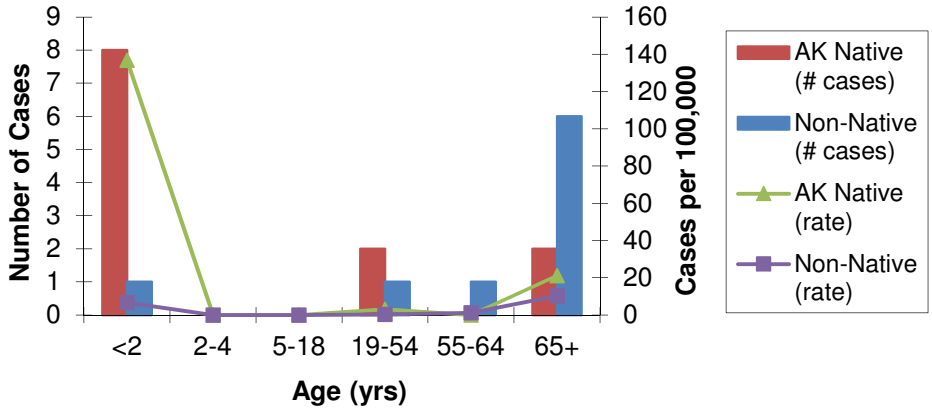


Figure 14: Invasive *Haemophilus influenzae*, Cases & Rates by Age Group & Race - Alaska, 2013



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 2013, pneumonia with bacteremia and bacteremia alone were the most common presentation (38% of cases each).

Seventeen (81%) *H. influenzae* isolates were from blood samples in 2013, and four were from cerebrospinal fluid.

Table 11: Primary Clinical Presentation of Invasive *Haemophilus influenzae* - Alaska, 2013

Primary Presentation	n (%)
Pneumonia*	8 (38%)
Bacteremia	8 (38%)
Meningitis	4 (19%)
Amnionitis	1 (5%)
Total	21

*with bacteremia

Serotypes

All isolates received at AIP are serotyped; all 21 cases in 2013 had isolates and were serotyped. The bacterial capsule is the basis for serotyping and is the primary virulence factor. Serotype b was 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, 2013

		Alaska Native				Non-Native			
Serotype	Total n (%)	<2	2-18	19-64	65+	<2	2-18	19-64	65+
a	5 (24%)	5	0	0	0	0	0	0	0
b	2 (10%)	2	0	0	0	0	0	0	0
f	3 (14%)	0	0	0	1	0	0	1	1
NT*	11 (52%)	1	0	2	1	1	0	1	5
Total	21	8	0	2	2	1	0	2	6

*Non-typeable

Hib

In recent years, the prevalence of *H. influenzae* type b has declined due to increased use of a childhood vaccine against this serotype. Two cases of Hib occurred in 2013 in children less than 1 year old. One child had received one dose of Hib vaccine; vaccine status for the second child was unknown.

Hia

Prior to 2002, *H. influenzae* type a (Hia) had not been detected in Alaska. Following an outbreak in 2003 [9], cases have occurred sporadically until 2010 when an outbreak began in the YK Delta and continued through 2011 [10]. Five cases of Hia were detected in 2013; all occurred in AK Native children less than 2 years old. The rate of invasive disease caused by Hia in AK Native children less than 2 years old for 2013 was 85.4/100,000.

Antibiotic Resistance

Twenty-one *H. influenzae* isolates received at AIP were tested for susceptibility to ampicillin, chloramphenicol and TMP/sulfa; 19 isolates were tested for susceptibility to ceftriaxone. All isolates tested were susceptible to ceftriaxone, one isolate had intermediate resistance to chloramphenicol, 6 isolates were resistant to ampicillin (2 intermediate, 4 fully resistant) and 15 isolates were resistant to TMP/sulfa (5 intermediate and 10 fully resistant).

Table 13: Summary of Invasive *Haemophilus influenzae* Case Characteristics, Alaska, 2013

Sex	Age (Yrs)	Race	Residence	Site of Isolation	Clinical Presentation(s)	Serotype*	Associated Risk Factors	Survived
M	Newborn	Non-Native	Anchorage	Blood	Amnionitis	NT	None	Yes
F	Newborn	AK Native	Other	Blood	Bacteremia	NT	None	Yes
M	0.4	AK Native	Other	CSF	Meningitis	a	None	Yes
M	0.5	AK Native	Other	CSF	Meningitis	a	None	Yes
M	0.5	AK Native	Other	CSF	Meningitis	b	Diabetes	No
F	0.6	AK Native	Other	Blood	Bacteremia	b	None	Yes
M	0.6	AK Native	Other	Blood	Pneumonia	a	None	Yes
F	0.9	AK Native	Other	CSF	Meningitis	a	None	Yes
F	1	AK Native	Other	Blood	Bacteremia	a	None	Yes
F	22.3	Non-Native	Anchorage	Blood	Bacteremia	NT	None	Yes
M	34.2	AK Native	Anchorage	Blood	Pneumonia	NT	None	Yes
F	48.6	AK Native	Anchorage	Blood	Pneumonia	NT	Smoking, chronic lung disease, alcohol abuse	Yes
F	63.4	Non-Native	Anchorage	Blood	Bacteremia	f	Diabetes	Yes
F	68.9	AK Native	Other	Blood	Pneumonia	f	None	Yes
M	69.3	Non-Native	Other	Blood	Pneumonia	NT	Smoking, chronic lung disease	Yes
M	72.7	AK Native	Anchorage	Blood	Pneumonia	NT	Smoking, chronic lung disease	No
F	74.8	Non-Native	Other	Blood	Pneumonia	NT	None	Yes
M	81	Non-Native	Anchorage	Blood	Bacteremia	NT	None	Yes
M	81.6	Non-Native	Anchorage	Blood	Bacteremia	NT	None	Yes
M	85.3	Non-Native	Anchorage	Blood	Pneumonia	f	Chronic lung disease	Yes
F	86.3	Unknown	Other	Blood	Bacteremia	NT	Chronic lung disease	Yes

*NT = non-typeable

Invasive *Neisseria meningitidis*

Overall Incidence

No cases of invasive *Neisseria meningitidis* were reported to AIP in 2013. The ABCs national projected rate for *N. meningitidis* in 2013 was 0.14/100,000 [9].

Invasive group A *Streptococcus*

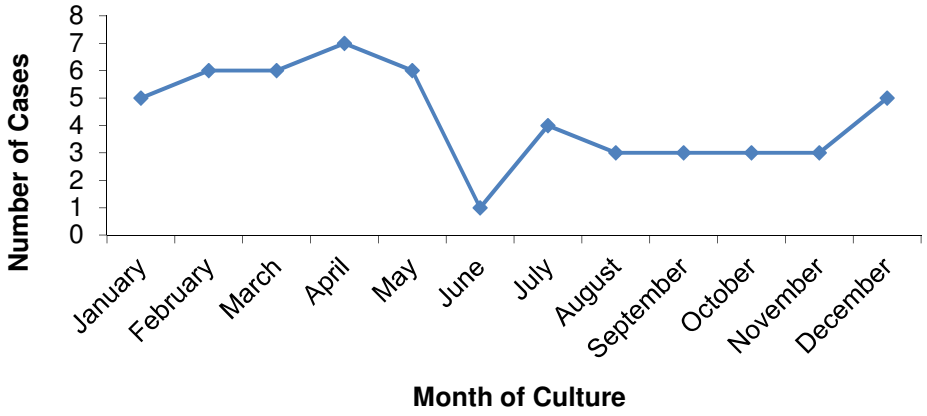
Overall Incidence

A total of 52 cases of invasive group A *Streptococcus* (GAS) were reported to AIP in 2013. The overall rate of invasive GAS disease in the state of Alaska was 7.1/100,000 persons per year. The Alaska rate is higher than the ABCs 2013 national projected rate of 3.7/100,000 [12]. In 2013, there were 7 GAS-related deaths for a case fatality ratio of 14%.

Seasonality

Cases of group A *Streptococcus* occurred throughout the year in 2013 with no apparent trends in seasonality. The largest number of cases (n=7) occurred in April.

Figure 15: Invasive group A *Streptococcus*, by Month of Culture - Alaska, 2013



Race

In 2012, 40% of invasive GAS cases in Alaska occurred in the Alaska Native population. The age-adjusted rate ratio of invasive GAS disease for the Alaska Native population compared with the non-Native population in 2013 was 3.3.

Table 14: Invasive group A *Streptococcus* Cases by Race – Alaska, 2013

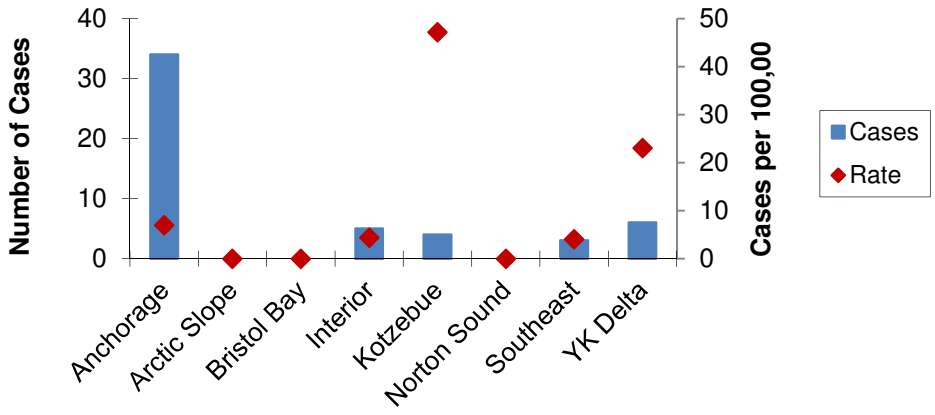
Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native	23 (44%)	16.1	52%	2 (9%)
Non-Native	29† (56%)	4.9	69%	5 (21%)‡
Total	52		62%	7 (14%)

*Cases per 100,000 per percent distribution of Alaska 2010 population
†Includes four cases for which race is unknown
‡Outcome unknown in one case

Region

Thirty-four (65%) of the 52 invasive group A *Streptococcus* cases in 2013 were reported in the Anchorage area, 6 cases in the YK Delta, 5 cases in the Interior, 4 cases in Kotzebue and 3 cases in Southeast. The highest rates of disease occurred in the Kotzebue region (47.2/100,000) and the YK Delta (23.1/100,000).

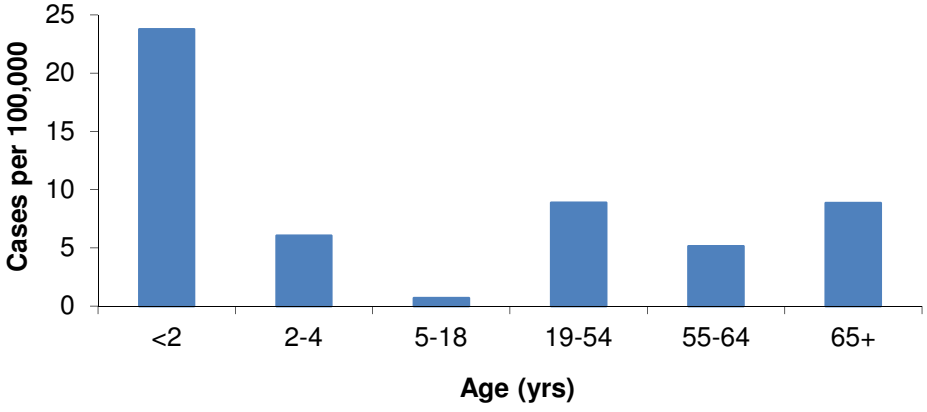
Figure 16: Invasive GAS Disease, Cases & Rates by Region - Alaska, 2013



Age

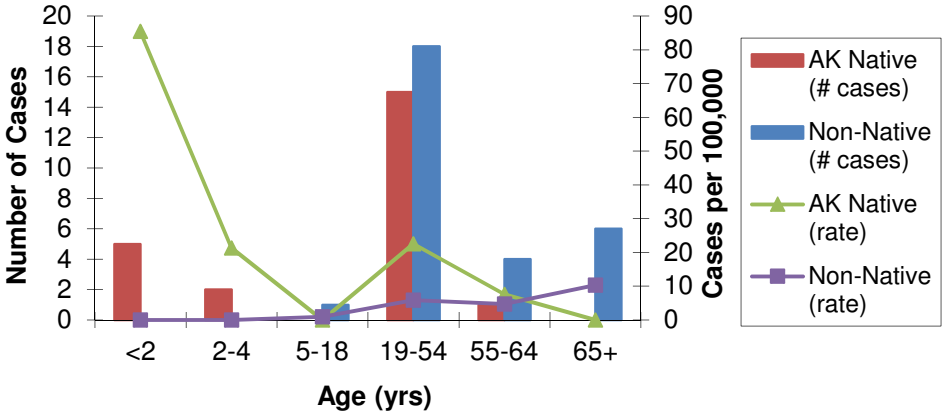
Invasive group A *Streptococcus* cases reported in 2013 ranged in age from 2 months to 84 years old; the median age was 43 years. Highest rates of disease occurred in children less than 2 years old (23.7/100,000).

Figure 17: Invasive group A *Streptococcus* by Age Group - Alaska, 2013



When stratified by race, the highest rates of invasive group A streptococcal disease occurred in Alaska Native children less than two years old (85.4/100,000 persons per year). The highest GAS disease rate in the non-Native population occurred in adults 65 and older (10.3/100,000 persons per year).

Figure 18: Invasive group A *Streptococcus*, Cases & Rates by Age Group & Race - Alaska, 2013



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 15 shows the primary clinical presentations of invasive group A *Streptococcus* in Alaska for 2013. Eight cases also presented with secondary diagnoses including pneumonia, septic arthritis and cellulitis.

Group A *Streptococcus* was isolated from blood samples in 49 (94%) of 52 cases, two from a surgical specimen and one from joint fluid.

Table 15: Primary Clinical Presentations of Invasive group A *Streptococcus* – Alaska, 2013

Primary Presentation	n (%)
Bacteremia	17 (33%)
Cellulitis*	10 (19%)
Pneumonia*	9 (17%)
Necrotizing fasciitis	6 (12%)
Septic arthritis	3 (6%)
Empyema	2 (4%)
Endocarditis	1 (2%)
Peritonitis	1 (2%)
Endometritis	1 (2%)
Other	1 (2%)
Unknown	1 (2%)
Total	52

*with bacteremia

Associated Risk Factors

The presence of one or more associated risk factors was reported in 79% of invasive GAS cases in 2013. Cigarette smoking was the most prevalent risk factor observed in adults followed by diabetes and alcohol abuse.

Table 16: Associated Risk Factors Identified in Invasive GAS Cases – Alaska, 2013*

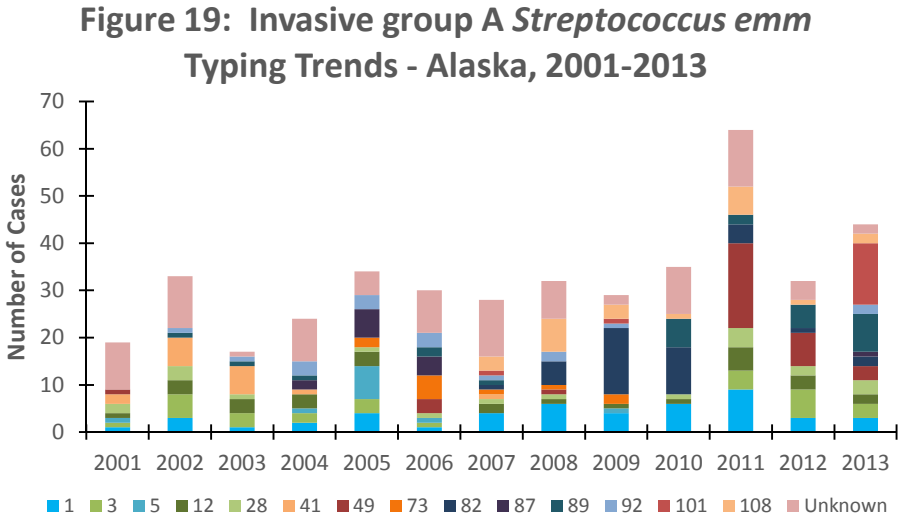
Medical Condition/Risk Factor	Adult Cases (≥ 18 years) n=44, Cases (%)
Cigarette smoking	13 (30%)
Diabetes	11 (25%)
Alcohol abuse	9 (20%)
Chronic lung disease	7 (16%)
Injection drug use	4 (9%)
Immunosuppressive treatment	0 (0%)
Asplenia	0 (0%)

*More than one risk factor was identified in several cases

Molecular Typing

Strain characterization of GAS has traditionally been based on serological identification of the M protein which is a major surface protein and an important GAS virulence factor. In the mid-1990s, many reference labs started using a molecular approach based on sequencing of the N-terminal region of the M protein gene (*emm* gene). To date, more than 200 different *emm* types have been reported. While there are currently no vaccines available to protect against invasive GAS disease, several M protein-based vaccines are in development. Therefore, baseline data on the burden of GAS disease to include *emm* typing are critical to evaluate the potential utility of these candidate vaccines.

In 2013, 50 invasive GAS isolates were *emm* typed at AIP. The most common *emm* types were *emm* 101 (26%) and *emm* 89 (16%). The following graph shows *emm* typing trends over time. Strains that totaled ≤ 10 over the time period were not included.



Antibiotic Resistance

Forty-nine GAS isolates received at AIP were tested for susceptibility to penicillin, ceftriaxone, erythromycin, vancomycin, levofloxacin and clindamycin. All isolates tested were susceptible to penicillin, ceftriaxone, vancomycin and levofloxacin. Two isolates were resistant to both erythromycin and clindamycin; both isolates were *emm* type 11.

Table 17: Summary of Invasive group A *Streptococcus* Case Characteristics, Alaska, 2013

Sex	Age (yrs)	Race	Residence	Site of Isolation	Clinical Presentation(s)	*emm* Type	Associated Risk Factors	Survived
F	0.2	AK Native	Other	Blood	Bacteremia	49	None	Yes
M	0.2	AK Native	Anchorage	Blood	Bacteremia	108	None	Yes
M	0.2	AK Native	Other	Blood	Bacteremia	49	None	Yes
M	0.6	AK Native	Other	Blood	Empyema, pneumonia	108	None	Yes
F	1.5	AK Native	Other	Blood	Septic arthritis	238	None	Yes
M	3.2	AK Native	Other	Blood	Bacteremia	49	None	Yes
M	3.6	AK Native	Other	Blood	Bacteremia	1	None	No
M	12.7	Non-Native	Other	Blood	Bacteremia	3	Chronic lung disease	Yes
M	22.1	Non-Native	Anchorage	Blood	Cellulitis	52	Diabetes	Yes
M	25.5	AK Native	Other	Blood	Other	ND	Chronic lung disease	Yes
F	26.6	Non-Native	Anchorage	Blood	Empyema, pneumonia	82	Smoking, injection drug use	Yes
F	30.5	AK Native	Other	Blood	Bacteremia	12	None	Yes
F	32.5	AK Native	Other	Surgical specimen	Cellulitis	101	Smoking	Yes
F	33.1	AK Native	Anchorage	Blood	Cellulitis	101	Smoking	Yes
M	33.2	Non-Native	Anchorage	Blood	Cellulitis	87	Smoking, injection drug use	Yes
F	35	Non-Native	Other	Blood	Endometritis	28	None	Yes
M	35.3	Non-Native	Anchorage	Blood	Pneumonia, cellulitis	ND	Injection drug use	Yes
M	37.3	Non-Native	Anchorage	Blood	Cellulitis	101	Smoking, diabetes	Yes
M	37.4	Non-Native	Anchorage	Blood	Cellulitis	85	Smoking, chronic lung disease	Yes
F	37.6	Non-Native	Anchorage	Blood	Bacteremia	89	Diabetes	Yes
F	39.9	Non-Native	Anchorage	Blood	Necrotizing fasciitis	238	Injection drug use	Yes
M	40.1	AK Native	Other	Blood	Bacteremia	89	Alcohol abuse	Yes
M	41	AK Native	Anchorage	Blood	Bacteremia	101	Smoking, alcohol abuse, diabetes	Yes
F	41.6	AK Native	Other	Blood	Cellulitis	11	None	Yes
F	41.7	Non-Native	Other	Blood	Bacteremia	1	Diabetes	No
M	43	Non-Native	Anchorage	Blood	Necrotizing fasciitis	92	None	Yes
M	43.1	Unknown	Anchorage	Blood	Cellulitis, necrotizing fasciitis	92	None	Yes
M	43.5	AK Native	Anchorage	Blood	Septic arthritis, osteomyelitis	101	None	Yes
M	44.5	AK Native	Anchorage	Blood	Bacteremia	101	None	No
F	44.8	AK Native	Anchorage	Joint fluid	Septic arthritis	101	Smoking, alcohol abuse	Yes
M	46	AK Native	Anchorage	Blood	Pneumonia	101	Smoking, alcohol abuse	Yes
M	47.1	AK Native	Anchorage	Blood	Pneumonia	101	Alcohol abuse	Yes
M	47.5	Non-Native	Other	Blood	Cellulitis, necrotizing fasciitis	1	Diabetes	Yes
F	47.7	AK Native	Anchorage	Blood	Cellulitis	11	Chronic lung disease	Yes
M	50.2	Non-Native	Anchorage	Surgical specimen	Cellulitis, osteomyelitis, necrotizing fasciitis	89	Smoking, alcohol abuse	Yes
F	51.7	AK Native	Other	Blood	Bacteremia	89	Chronic lung disease	Yes
F	52	Non-Native	Anchorage	Surgical specimen	Necrotizing fasciitis	89	Smoking, chronic lung disease	Yes
F	52.5	Non-Native	Anchorage	Blood	Pneumonia	89	Smoking	Yes
M	52.6	Non-Native	Anchorage	Blood	Bacteremia	101	Smoking, alcohol abuse	No
M	53.3	Non-Native	Anchorage	Blood	Bacteremia	44	None	Yes
F	53.5	AK Native	Other	Blood	Bacteremia	27	Chronic lung disease	Yes
M	56.7	Non-Native	Anchorage	Blood	Pneumonia	101	Diabetes	Yes
F	60	AK Native	Anchorage	Blood	Cellulitis	101	Smoking, alcohol abuse	Yes
F	60.3	Non-Native	Anchorage	Blood	Peritonitis	28	Diabetes	Yes
M	61.1	Non-Native	Anchorage	Blood	Cellulitis	28	Alcohol abuse	Yes
M	62.1	Non-Native	Other	Blood	Bacteremia	3	Diabetes	Yes
M	74	Unknown	Anchorage	Blood	Pneumonia, cellulitis	82	Diabetes	Yes
M	74.1	Unknown	Anchorage	Blood	Pneumonia	3	None	Yes
M	76.6	Unknown	Anchorage	Blood	Endocarditis, pneumonia	101	Chronic lung disease, diabetes	Yes

Sex	Age (yrs)	Race	Residence	Site of Isolation	Clinical Presentation(s)	*emm* Type	Associated Risk Factors	Survived
F	82.1	Non-Native	Anchorage	Blood	Pneumonia	12	None	No
M	82.4	Non-Native	Anchorage	Blood	Cellulitis	89	Chronic lung disease	No
M	84.2	Non-Native	Anchorage	Blood	Pneumonia	89	None	No

ND = typing not done

Invasive group B *Streptococcus*

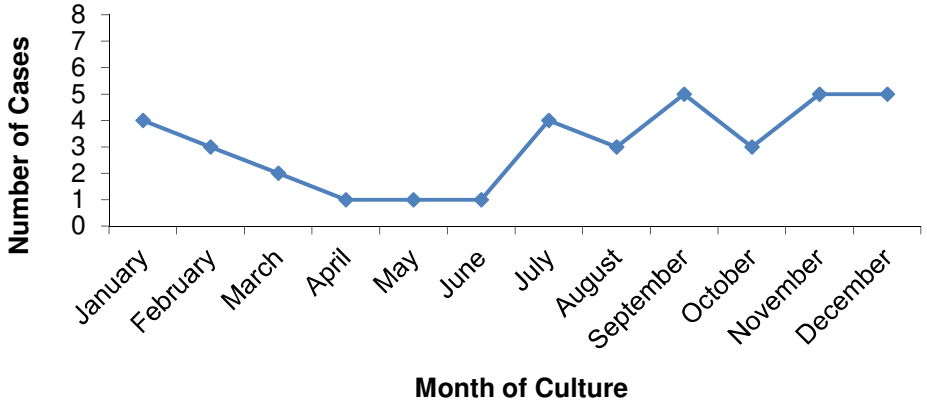
Overall Incidence

A total of 37 cases of invasive group B *Streptococcus* (GBS) were reported to AIP in 2013. The overall rate of invasive GBS disease in the state of Alaska was 5.2/100,000 persons per year. The Alaska rate is lower than the ABCs 2013 national projected rate of 9.2/100,000 [13]. In 2013, there was one GBS-related death for a case fatality ratio of 2.7%.

Seasonality

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

Figure 20: Invasive group B *Streptococcus*, by Month of Culture - Alaska, 2013



Race

In 2013, 22% of invasive group B *Streptococcus* cases in Alaska occurred in the Alaska Native population; the age-adjusted rate was 6.5/100,000 persons per year which is higher than the non-Native rate of 4.5/100,000 persons per year.

Table 18: Invasive group B *Streptococcus* Cases by Race – Alaska, 2013

Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native	8 (22)	6.5	38	0 (0)
Non-Native	29 (78)‡	4.5	41	1 (2.7)
Total	37		40	1 (2.7)

*Cases per 100,000 per percent distribution of Alaska 2010 population
‡Includes one case for which race was unknown

Region

In 2013, 25 (68%) of the 37 reported GBS cases occurred in Anchorage; six cases were reported in Southeast Alaska, five cases in the Interior, and one case in the YK Delta. The highest rates of disease occurred in Southeast Alaska (8.1/100,000) and Anchorage (5.1/100,000).

Age

Invasive group B *Streptococcus* cases reported in 2013 ranged in age from newborn to 84.9 years old; the median age was 59.6 years. Highest rates of disease overall occurred in children less than two years old (28.5/100,000 persons per year).

Figure 21: Invasive group B *Streptococcus* by Age Group - Alaska, 2013

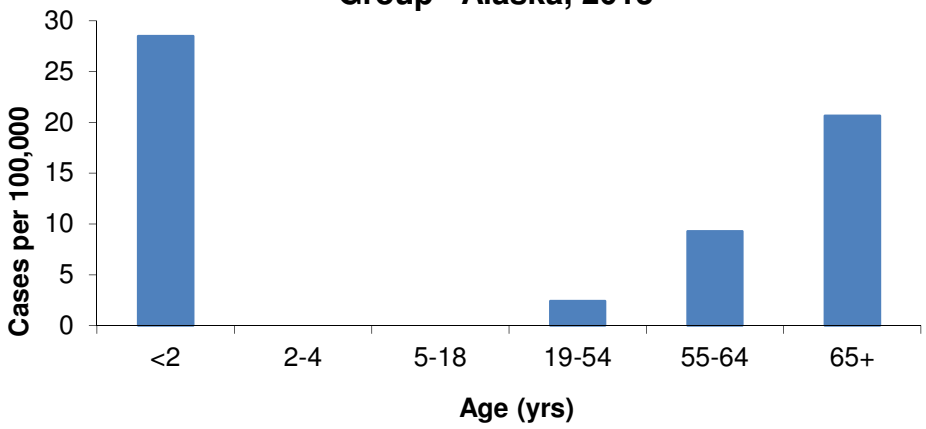
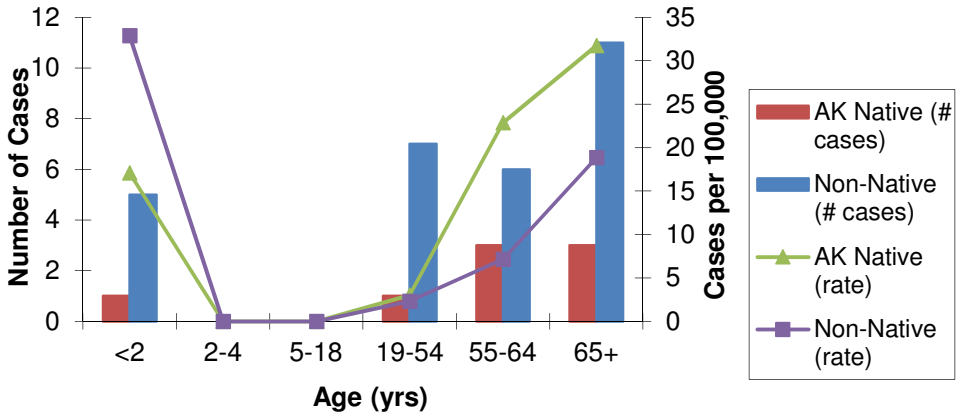


Figure 22: Invasive group B S*treptococcus*, Cases & Rates by Age Group & Race - Alaska, 2013



When stratified by race, the highest rates of disease occurred in non-Native children less than 2 years of age (32.9/100,000 persons per year). There were three cases of early-onset disease (less than 7 days old) for a rate of 0.3/1,000 live 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 2013, the most common clinical presentation was bacteremia which occurred in 16 cases (43%).

Group B *Streptococcus* was isolated from blood in 33 (89%) of 37 cases in 2013; one case was isolated from joint fluid, one case from synovial fluid, one from peritoneal fluid and one case from another sterile site.

Table 19: Primary Clinical Presentations of Invasive group B *Streptococcus* – Alaska, 2013

Primary Presentation	n (%)
Bacteremia	16 (43)
Cellulitis*	8 (22)
Pneumonia*	3 (8)
Endocarditis	2 (5)
Septic arthritis	1 (3)
Amnionitis	1 (3)
Meningitis	1 (3)
Necrotizing fasciitis	1 (3)
Osteomyelitis	1 (3)
Peritonitis	1 (3)
Other	2 (5)
Total	37

*with bacteremia

Antibiotic Resistance

Susceptibility testing was performed on 35 GBS isolates received in 2013. Results of the testing are presented in the following table.

Table 20: Antibiotic Resistance in Invasive group B *Streptococcus* Isolates – Alaska, 2013

Antibiotic	Susceptible	Intermediate	Resistant	I + R	Total Tested
Penicillin	35 (100%)	0 (0%)	0 (0%)	0 (0%)	35
Ceftriaxone	35 (100%)	0 (0%)	0 (0%)	0 (0%)	35
Erythromycin	11 (30%)	0 (0%)	24 (70%)	24 (70%)	35
Tetracycline	5 (14%)	0 (0%)	30 (86%)	30 (86%)	35
Levofloxacin	35 (100%)	0 (0%)	0 (0%)	0 (0%)	35
Clindamycin	23 (66%)	0 (0%)	12 (34%)	12 (34%)	35
Vancomycin	35 (100%)	0 (0%)	0 (0%)	0 (0%)	35

All isolates tested were susceptible to penicillin, ceftriaxone, levofloxacin and vancomycin. Resistance to tetracycline, erythromycin, and clindamycin was seen in 86%, 70%, and 34%,

respectively, of isolates tested. Of the three early onset cases, all isolates were available for susceptibility testing. All three isolates showed resistance to at least two antibiotics. All three isolates tested were resistant to erythromycin and tetracycline; one isolate was also resistant to clindamycin.

Table 21: Summary of Invasive group B *Streptococcus* Case Characteristics, Alaska, 2013

Sex	Age (yrs)	Race	Residence	Site of Isolation	Clinical Presentation(s)	Associated Risk Factors	Survived
F	Newborn	Non-Native	Anchorage	Blood	Bacteremia	None	Yes
F	Newborn	Non-Native	Anchorage	Blood	Amnionitis	None	Yes
M	Newborn	Non-Native	Other	Blood	Bacteremia	None	Yes
M	0.1	Non-Native	Anchorage	Blood	Bacteremia	None	Yes
F	0.1	AK Native	Other	Blood	Bacteremia	None	Yes
F	0.1	Non-Native	Anchorage	Blood	Meningitis	None	Yes
F	24	Non-Native	Other	Other	Necrotizing fasciitis	None	Yes
F	32.7	Non-Native	Anchorage	Blood	Endocarditis	Smoking, injection drug use	Yes
M	40.6	Non-Native	Anchorage	Blood	Bacteremia	Alcohol abuse	Yes
M	45.1	Non-Native	Anchorage	Blood	Bacteremia	Diabetes	Yes
M	46.1	AK Native	Other	Synovial fluid	Septic arthritis	Smoking, alcohol abuse	Yes
F	49.3	Non-Native	Anchorage	Blood	Bacteremia	Diabetes	Yes
M	49.6	Non-Native	Other	Blood	Bacteremia	Alcohol abuse	Yes
F	51	Non-Native	Anchorage	Blood	Cellulitis	None	Yes
F	55.3	Non-Native	Anchorage	Joint fluid	Other	Chronic lung disease, diabetes	Yes
F	55.4	Non-Native	Anchorage	Blood	Cellulitis	Smoking, diabetes	Yes
M	58.1	AK Native	Other	Blood	Other	Diabetes	Yes
F	59.2	Non-Native	Anchorage	Blood	Cellulitis	Immune suppressive therapy	Yes
F	59.6	AK Native	Anchorage	Peritoneal fluid	Peritonitis, pneumonia	Chronic lung disease, alcohol abuse	Yes
F	62.1	AK Native	Other	Blood	Bacteremia	Diabetes	Yes
M	62.4	Non-Native	Other	Blood	Bacteremia	Diabetes	Yes
F	62.5	Non-Native	Anchorage	Blood	Cellulitis	None	Yes
F	63.7	Non-Native	Anchorage	Blood	Bacteremia	None	Yes
M	66.4	Non-Native	Anchorage	Blood	Bacteremia	None	Yes
F	68.5	Non-Native	Anchorage	Blood	Cellulitis	None	Yes
M	69.8	Non-Native	Anchorage	Blood	Cellulitis	None	Yes
M	70	Non-Native	Anchorage	Blood	Bacteremia	Diabetes	Yes
F	73.1	Non-Native	Other	Blood	Bacteremia	Unknown	Yes
F	73..4	Non-Native	Anchorage	Blood	Pneumonia	Chronic lung disease	No
F	76.3	Non-Native	Anchorage	Blood	Cellulitis	Chronic lung disease, diabetes	Yes
M	76.6	Non-Native	Anchorage	Blood	Endocarditis	None	Yes
M	76.9	Non-Native	Other	Blood	Cellulitis, osteomyelitis	Diabetes	Yes
F	80.1	Unknown	Anchorage	Blood	Bacteremia	Diabetes	Yes
F	81.9	AK Native	Anchorage	Blood	Pneumonia	Chronic lung disease, diabetes	Yes
M	82.7	AK Native	Anchorage	Blood	Bacteremia	None	Yes
M	83.2	Non-Native	Other	Blood	Pneumonia	None	Yes
F	84.9	AK Native	Other	Blood	Cellulitis	None	Yes

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Appendix

MIC Interpretive Standards Definitions:

CLSI [7] 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.