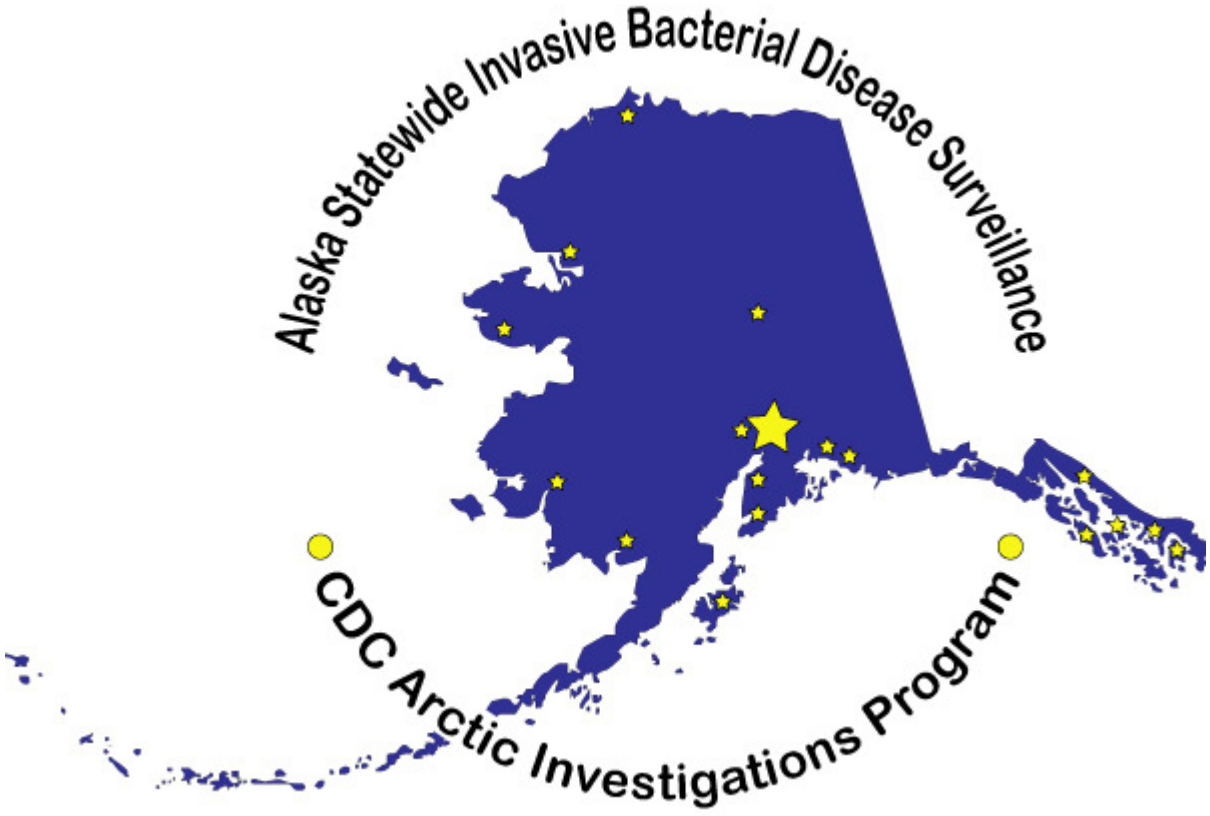

Surveillance of Invasive Bacterial Disease in Alaska, 2017

Arctic Investigations Program
Division of Preparedness and Emerging Infections
National Center for Emerging & Zoonotic Infectious Diseases
Centers for Disease Control and Prevention
4055 Tudor Centre Dr.
Anchorage, AK 99508
(907) 729-3400
ncidaip@cdc.gov

Alaska Statewide Invasive Bacterial Disease

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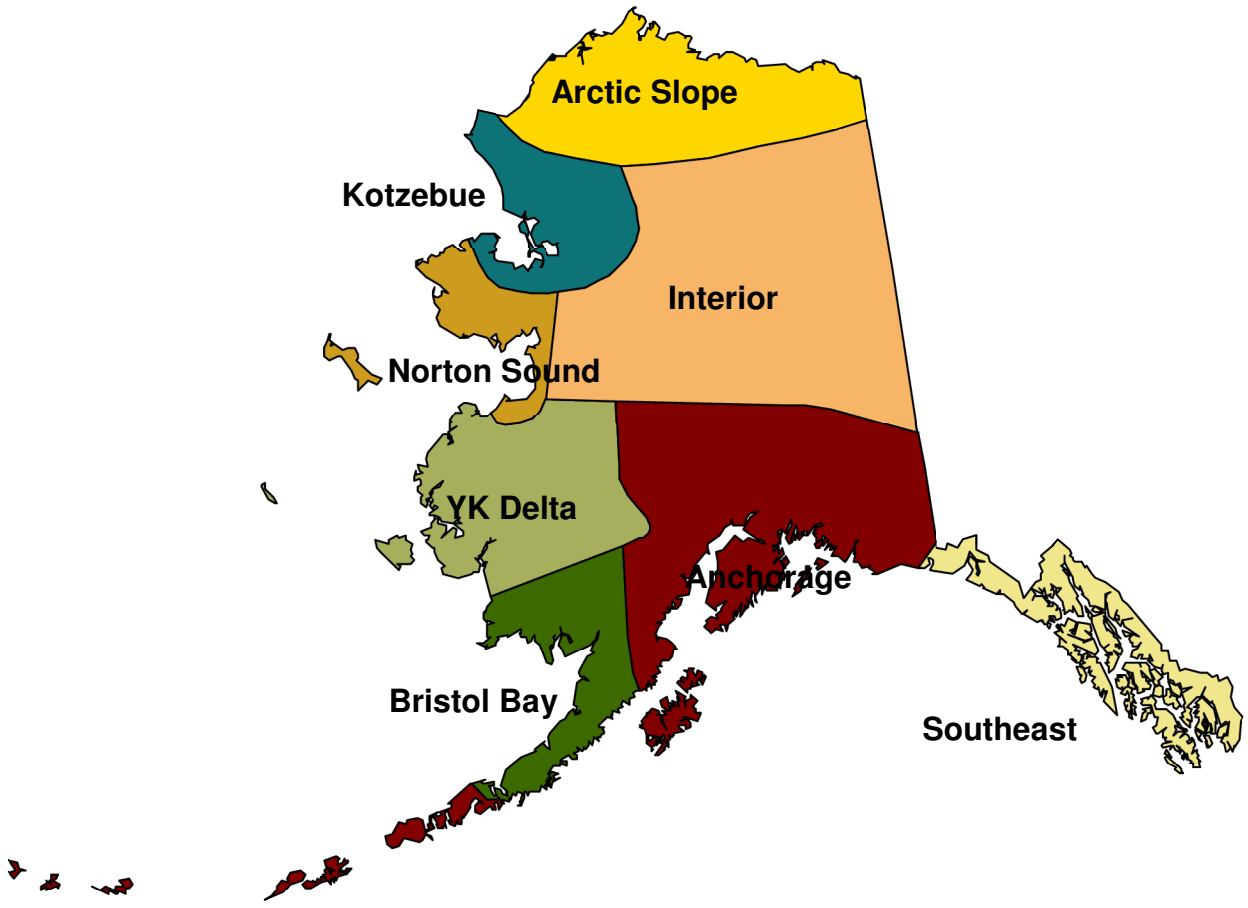
Summary

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, cerebrospinal fluid (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, 2017



In 2017, the total numbers of cases of invasive disease caused by these organisms reported to AIP were 125 *S. pneumoniae*, 23 *H. influenzae*, 2 *N. meningitidis*, 127 group A *Streptococci* (GAS) and 61 group B *Streptococci* (GBS). Alaska Native people had higher rates of disease overall than non-Native people for all surveillance organisms except *N. meningitidis*. Rates of disease were highest in the Anchorage region for *N. meningitidis*, Bristol Bay for *S. pneumoniae*, Kotzebue for groups A and B *Streptococci* and the YK Delta for *H. influenzae*. Rates for each organism by region are presented in the following table.

Table 1: Surveillance Organisms Reported by Region – Alaska, 2017

Region	*S. pneumoniae* n (rate*)	*H. influenzae* n (rate*)	*N. meningitidis* n (rate*)	GAS n (rate*)	GBS n (rate*)
Anchorage	64 (13)	10 (2)	2 (0.4)	93 (18.9)	45 (9.1)
Arctic Slope	2 (22.6)	0 (0)	0 (0)	2 (22.6)	0 (0)
Bristol Bay	5 (70.3)	0 (0)	0 (0)	0 (0)	0 (0)
Interior	19 (17.1)	1 (0.9)	0 (0)	5 (4.5)	3 (2.7)
Kotzebue	4 (46.9)	2 (23.4)	0 (0)	5 (58.6)	2 (23.4)
Norton Sound	1 (10)	1 (10)	0 (0)	4 (40)	2 (20)
Southeast	12 (16.5)	2 (2.7)	0 (0)	5 (6.9)	6 (8.2)
YK Delta	18 (67.8)	7 (26.4)	0 (0)	13 (49)	3 (11.3)
Total	125 (16.9)	23 (3.1)	2 (0.3)	127 (17.2)	61 (8.3)

*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 737,847 persons in 2017 [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 2017, 22 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 isolation of the bacteria from a normally sterile site, including blood, cerebrospinal fluid, pleural fluid, peritoneal fluid or joint fluid collected from a resident of Alaska. In addition, for GAS, isolates are requested from deep tissue infection specimens, such as might be collected from surgical debridement of cases of necrotizing fasciitis.

Invasive Pneumococcal Disease (IPD)

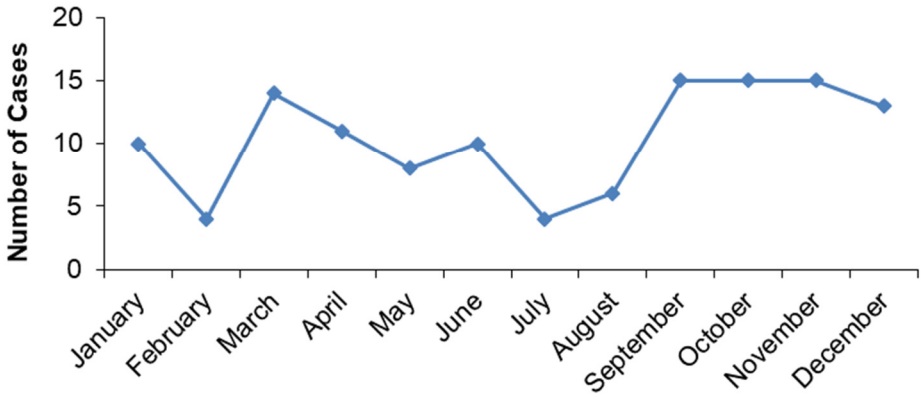
Overall Incidence

A total of 118 pneumococcal isolates were received at AIP in 2017. An additional 7 cases were detected through shared surveillance with the State DPH for a total of 125 cases of invasive pneumococcal disease. The overall rate for invasive pneumococcal disease in 2017 was 16.9 cases per 100,000 persons per year. Alaska rates for 2017 were higher than the Active Bacterial Core Surveillance (ABCs) 2017 national projected rate of 9.5/100,000 [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 2017. The largest number of cases (n=15) was reported in September, October and November.

Figure 2: Invasive Pneumococcal Disease, by Month of Culture - Alaska, 2017



Race

In 2017, the state population was comprised of 20% Alaska Native (AN) people *(Alaska Native persons alone or in combination 147,752 non-Native persons 590,095)* [1]. Of all reported *S. pneumoniae* cases in 2017, 51% occurred among Alaska Native people for a total of 64 cases; the age-adjusted rate was 44.5/100,000 persons per year. Sixty-one cases occurred among the non-Native (NN) population for an age-adjusted rate of 9.2/100,000 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 2017 was 4.8.

Table 2: IPD Cases by Race – Alaska, 2017

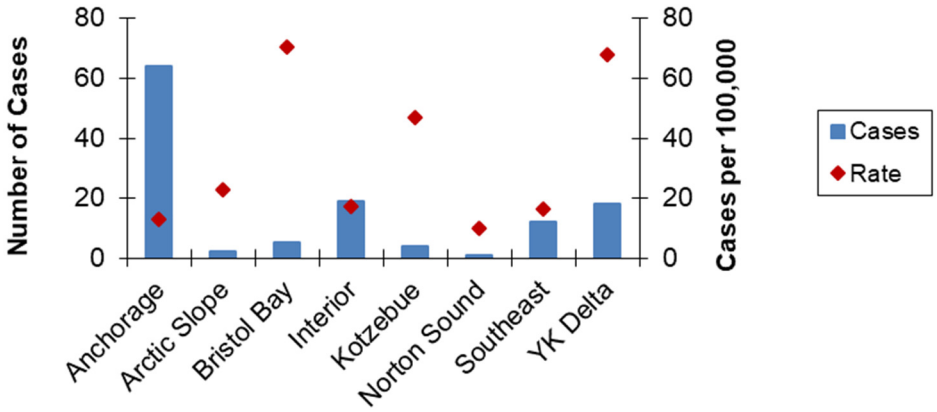
Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native Persons	64 (51)	44.5	63%	5 (8)
Non-Native Persons†	61 (49)†	9.2	64%	7 (11.5)
Total	125		63%	12 (10)

*Cases per 100,000 per percent distribution of Alaska 2010 population
†Includes 6 cases for which race was unknown

Region

The highest percentage (73%) of IPD cases occurred in the Anchorage area in 2017. Rates of disease, however, were highest in Bristol Bay (70.3/100,000 persons per year) and the YK Delta (46.9/100,000 persons per year).

Figure 3: Invasive Pneumococcal Disease, Cases & Rates by Region - Alaska, 2017

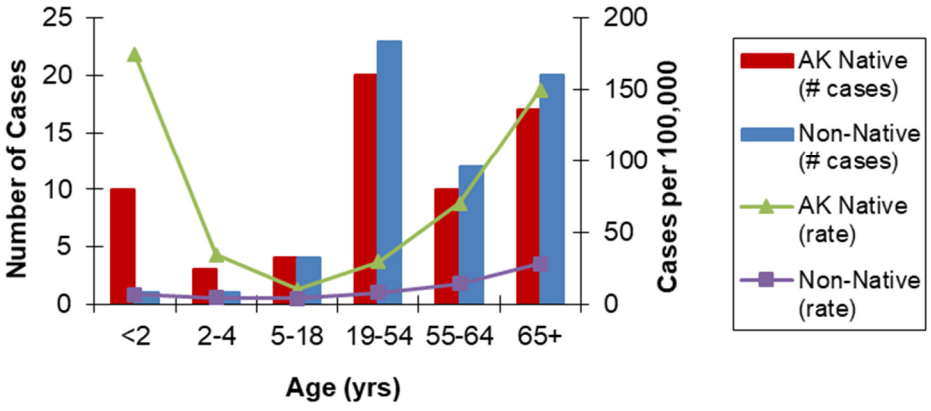


Age

Cases occurred in all age groups in 2017, with patient ages ranging from 2 months to 83 years, with a median age of 53.6 years. Overall, the highest rates of disease occurred in children < 2 years old and adults 65 years and older.

When stratified by age and race, the highest rates of disease in 2017 occurred in Alaska Native children < 2 years old (174.4/100,000 persons per year) and adults 65 years and older (149.8/100,000 persons per year).

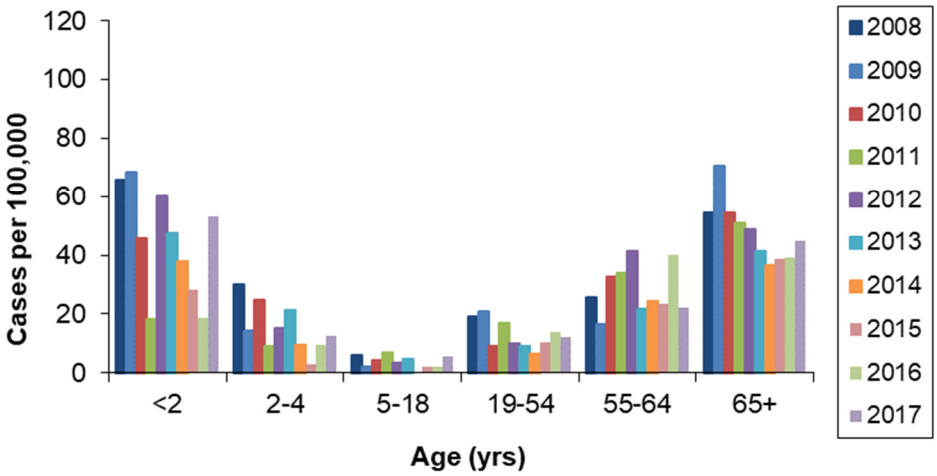
Figure 4: Invasive Pneumococcal Disease, Cases & Rates by Age Group & Race - Alaska, 2017



Trends over Time

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 IPD in children less than 2 years declined to 65.6/100,000; following introduction of a 13-valent conjugate vaccine in 2010, rates declined further to 18/100,000 in 2011. The annualized rate from 2012 to 2017 in this age group is 40.9/100,000 and ranged from 18.8/100,000 to 60.3/100,000.

Figure 5: Invasive Pneumococcal Disease by Age Group - Alaska, 2008-2017



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 (data not shown, historical trend). This rate increase 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 aged less than 2 years declined to 87.1/100,000 and, after introduction of the 13-valent vaccine in 2010, rates declined to 30.7/100,000 in 2011. The annualized rate from 2012 to 2017 in this age group was 105.3/100,000 and ranged from 35.1/100,000 to 177.5/100,000. Rates of invasive disease in non-Native children aged 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 aged less than 2 years increased to 60.3/100,000 but declined to 13/100,000 in 2012 following introduction of the 13-valent vaccine. The annualized rate from 2012 to 2017 in this age group was 16.2/100,000 and ranged from 6.7/100,000 to 26.3/100,000.

Figure 6: Invasive Pneumococcal Disease in Alaska Natives, by Age Group - Alaska, 2008-2017

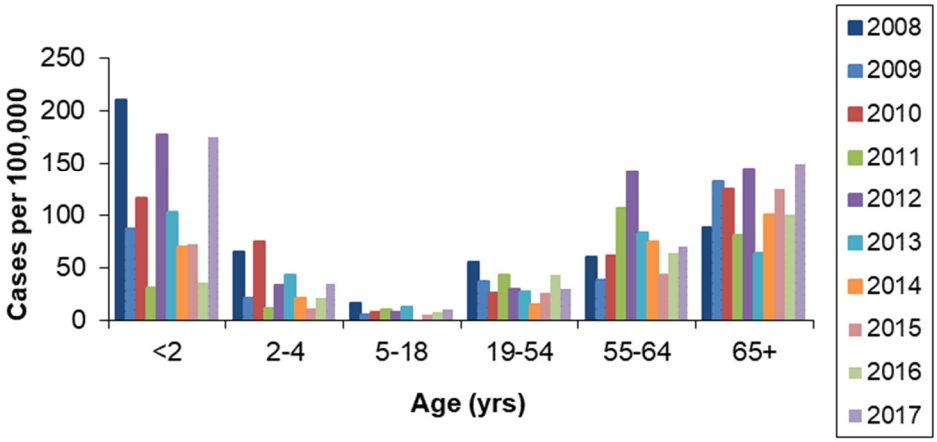
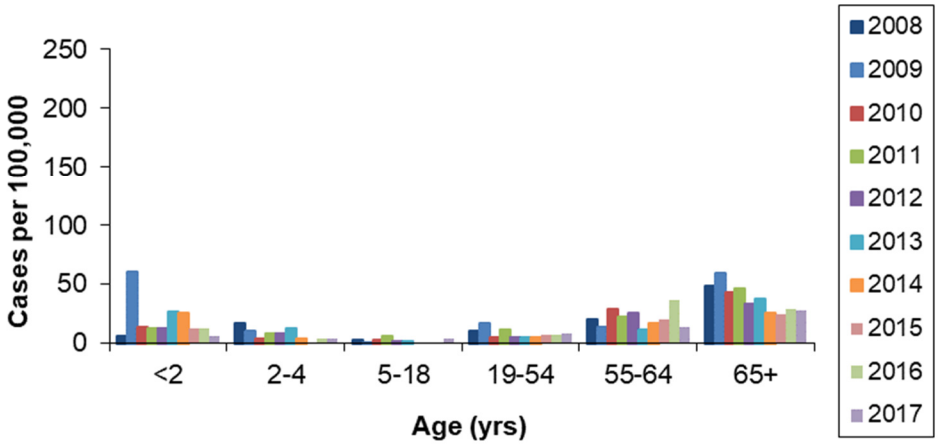


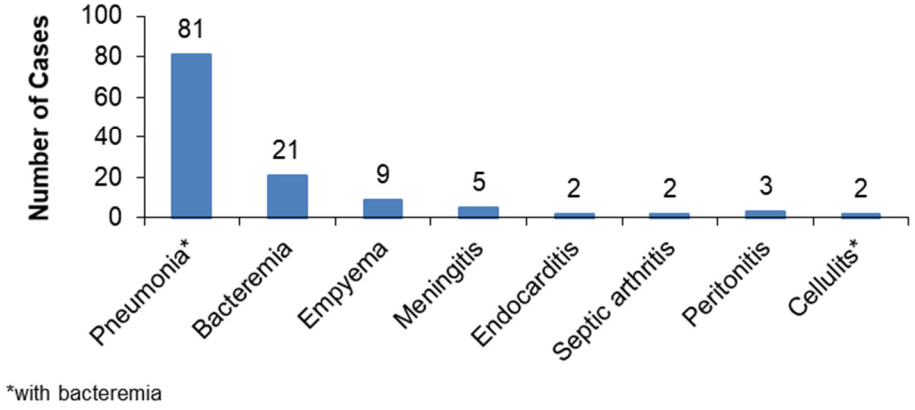
Figure 7: Invasive Pneumococcal Disease in Non-Natives, by Age Group - Alaska, 2008-2017



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 2017 (65%) followed by bacteremia (17%). Ten cases had a secondary pneumococcal-related diagnosis in 2017; seven were pneumonia with bacteremia, two were cellulitis, and one was septic arthritis.

Figure 8: Primary Clinical Presentations of Invasive Pneumococcal Disease - Alaska, 2017



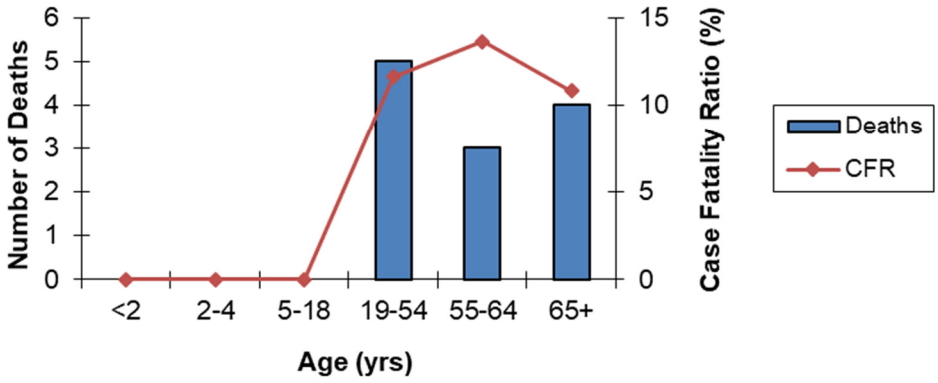
*with bacteremia

In 2017, blood was the most common source of a positive culture which was used to identify 113 (92%) of 125 cases. Five cases were identified from pleural fluid, two cases each were identified from CSF or peritoneal fluid, and one case each was identified from joint fluid or a surgical specimen.

Mortality

In 2017, the overall case fatality ratio for *S. pneumoniae* in Alaska was 10% (12 deaths out of 125 cases). The case fatality ratio for non-Natives was higher (11.5%, 7 deaths) than that for AK Natives (8%, 5 deaths). The highest case fatality ratio occurred in the 55-64 years of age category: 3 deaths, CFR 13.6%.

Figure 9: Invasive Pneumococcal Deaths & Case Fatality Ratios by Age Group - Alaska, 2017



Serotype

Serotyping of IPD 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. AIP received and serotyped 117 isolates in 2017.

Table 3: IPD Serotype Distribution by Race and Age Group – Alaska, 2017

		Alaska Native					Non-Native				
Serotype	Total n (%)	<2	2-4	5-18	19-64	65+	<2	2-4	5-18	19-64	65+
03	9 (8)	-	-	1	2	2	-	-	-	2	2
06C	5 (4)	-	-	1	2	-	-	-	-	2	-
07C	2 (2)	-	-	-	1	-	-	-	1	1	-
07F	9 (8)	-	-	-	1	1	-	-	-	6	-
08	5 (4)	-	-	-	2	1	-	-	-	2	-
09N	11 (9)	2	1	-	1	4	1	-	-	1	1
10A	3 (3)	-	-	-	1	-	-	-	-	1	1
11A	3 (3)	-	-	-	-	-	-	-	-	1	2
12F	5 (4)	-	-	-	1	-	-	-	-	3	1
15A	5 (4)	1	-	-	1	2	-	-	-	-	1
15B	2 (2)	-	-	-	1	1	-	-	-	-	-
15C	1 (<1)	-	-	-	1	-	-	-	-	-	-
16F	4 (3)	-	-	-	2	1	-	-	-	-	1
17F	2 (2)	-	-	-	-	-	-	-	-	1	1
19A	3 (3)	-	-	-	-	-	-	1	1	1	-
19F	6 (5)	-	1	-	2	-	-	-	-	2	1
20	10 (9)	2	-	-	6	-	-	-	-	2	-
22F	8 (7)	-	-	-	1	1	-	-	1	2	3
23A	5 (4)	-	1	-	1	1	-	-	-	1	1
23B	5 (4)	-	-	-	1	-	-	-	-	2	2
24	1 (<1)	-	-	-	1	-	-	-	-	-	-
28A	1 (<1)	-	-	-	-	-	-	-	-	1	-
31	1 (<1)	-	-	-	-	-	-	-	-	1	-
33F	6 (5)	3	-	-	-	-	-	-	1	2	-
34	1 (<1)	-	-	-	-	-	-	-	-	-	1
35B	1 (<1)	-	-	-	-	-	-	-	-	-	1
35F	1 (<1)	-	-	-	-	1	-	-	-	-	-
38	2 (2)	1	-	1	-	-	-	-	-	-	-

		Alaska Native					Non-Native				
Serotype	Total n (%)	<2	2-4	5-18	19-64	65+	<2	2-4	5-18	19-64	65+
Total	117	9	3	3	28	15	1	1	4	34	19

In 2017, the most common pneumococcal serotypes were 9N, (11 isolates, 9%), 20 (10 isolates, 9%), 3 (9 isolates 8%) and 7F (9 isolates, 8%). The majority (50%) of serotype 9N cases, serotype 20 cases (70%), and serotype 7F cases (56%) occurred in the Anchorage area in 2017.

Table 4: IPD Serotype Distribution by Region – Alaska, 2017

Serotype	Anchorage	Arctic Slope	Bristol Bay	Interior	Kotzebue	Norton Sound	Southeast	YK Delta
03	2	1	-	3	-	-	1	2
06C	1	-	-	2	-	-	-	2
07C	1	-	-	1	-	-	-	-
07F	5	-	-	1	1	-	2	-
08	3	-	-	-	-	-	-	2
09N	5	-	-	1	-	-	2	3
10A	2	-	-	1	-	-	-	-
11A	3	-	-	-	-	-	-	-
12F	4	-	-	-	-	-	1	-
15A	4	-	-	-	-	-	-	1
15B	-	1	-	1	-	-	-	-
15C	-	-	-	1	-	-	-	-
16F	3	-	-	1	-	-	-	-
17F	1	-	-	1	-	-	-	-
19A	3	-	-	-	-	-	-	-
19F	4	-	-	1	-	-	1	-
20	7	-	-	1	1	-	-	1
22F	3	-	-	2	-	-	2	1
23A	1	-	-	1	1	-	1	1
23B	4	-	-	-	-	-	-	1
24	-	-	1	-	-	-	-	-
28A	1	-	-	-	-	-	-	-
31	1	-	-	-	-	-	-	-
33F	2	-	-	-	-	-	1	3
34	1	-	-	-	-	-	-	-
35B	1	-	-	-	-	-	-	-
35F	1	-	-	-	-	-	-	-
38	-	-	1	-	1	-	-	-
Unknown	1	-	3	1	-	1	1	1
Total	64	2	5	19	4	1	12	18

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 caused most invasive disease since the introduction of the PCV7 vaccine. The table below shows the proportion of invasive infections from 2017 that were due to serotypes found in the PCV13 vaccine. There were two cases (1 each 19A, 19F) of pneumococcal disease caused by serotypes contained in the PCV13 vaccine in children less than 5 years of age.

Table 5: Proportion of Invasive Isolates with Serotypes Contained in the PCV13 Vaccine by Age Group and Race – Alaska, 2017

Age (yrs)	Alaska Native (%)	Non-Native (%)	Total (%)
<2	0 (0%) of 10	0 (0%) of 1	0 (0%) of 11
2-4	1 (33%) of 3	1 (100%) of 1	2 (50%) of 4
5+	9 (18%) of 51	16 (27%) of 59	25 (23%) of 110
Total	10 (16%) of 64	17 (28%) of 61	27 (22%) of 125

For the year covered by this report, the 23-valent polysaccharide vaccine (PPSV23) 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 addition, one dose of PCV13 was also recommended for persons 65 years and older. In 2017, for persons 65 years and older, 22 (65%) of 34 cases serotyped were potentially vaccine preventable invasive pneumococcal illnesses.

Vaccine Failures

In 2017, pneumococcal vaccine status was known for 125 (100%) of the 125 cases; 54% (n=68) of cases with known vaccine status did receive a pneumococcal vaccine prior to illness; for 57 (46%) cases, there was no record of the patient having previously been vaccinated with a pneumococcal vaccine.

A PCV13 vaccine failure is defined as IPD caused by a serotype contained in PCV13 in a child less than five years old who has had at least two doses of vaccine. There were two PCV13 vaccine failures in 2017.

Potentially Preventable Deaths

Overall, 25% of all pneumococcal-related mortality in 2017 was potentially preventable with the use of the 23-valent polysaccharide vaccine in persons over 5 years old; 50% of deaths were due to disease caused by serotypes not contained in pneumococcal vaccines.

Table 6: IPD Deaths by Vaccine Serotype – Alaska, 2017

Serotypes	< 2 years	2-4	5-18	19-54	55-64	65+	Total
PCV13	0	0	0	0	1 (33%)	1 (25%)	2 (17%)
PPSV23	0	0	0	1 (20%)	0	2 (50%)	3 (25%)
Non-Vaccine	0	0	0	4 (80%)	1 (33%)	1 (25%)	6 (50%)
Unknown	0	0	0	0	1 (33%)	0	1 (8%)
Total	0	0	0	5	3	4	12

Three of the 12 IPD deaths in 2017 were caused by serotypes contained in the PPSV23 vaccine; three of the deaths were in individuals eligible for the vaccine. All deaths occurred in unvaccinated individuals.

Table 7: IPD, Serotypes of Fatal Cases – Alaska, 2017

Serotype	Deaths n (%)	Serotype Frequency (n)
07C	1 (50)	2
11A*	1 (33)	3
16F	2 (50)	4
19F†*	2 (33)	6
22F*	2 (25)	8
23A	1 (20)	5
23B	1 (20)	5
24	1 (100)	1

†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 IPD cases in 2017. Cigarette smoking was the most prevalent risk factor observed in adults, followed by chronic lung disease and alcohol abuse.

Table 8: Associated Risk Factors* Identified in IPD Cases – Alaska, 2017

Risk Factor	Adult Cases (≥ 18 years) n=102, Cases (%)
Cigarette smoking	42 (41)
Chronic lung disease	35 (34)
Alcohol abuse	23 (23)
Diabetes	17 (17)
Immunosuppressive treatment	10 (10)
Injection drug use	7 (7)
Asplenia	0 (0)

*Multiple risk factors may be reported for a given case

Antibiotic Resistance

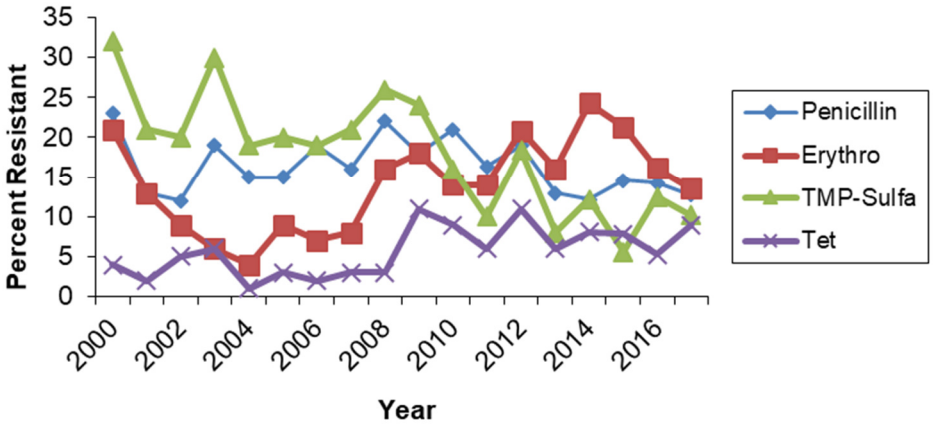
Number of isolates tested for antibiotic resistance varied by the antibiotic tested, ranging from 64 to 117 isolates. Cut points from the Minimum Inhibitory Concentration (MIC) Interpretive Standards were used to determine if an isolate was 'susceptible', 'intermediate', or 'resistant' to the antibiotic being tested [7]. The MIC Interpretive Standards definitions of 'susceptible', 'intermediate', and 'resistant' can be found in the Appendix. Results of the testing are presented in the following table.

Table 9: Antibiotic Resistance in Invasive *Streptococcus pneumoniae* Isolates – Alaska, 2017

Antibiotic	Susceptible	Intermediate	Resistant	I + R	Total Tested
Penicillin	102 (87%)	13 (11%)	2 (2%)	15 (13%)	117
TMP-sulfa	105 (90%)	8 (7%)	4 (3%)	12 (10%)	117
Erythromycin	101 (86%)	0 (0%)	16 (14%)	16 (14%)	117
Ceftriaxone	115 (98%)	0 (0%)	2 (2%)	2 (2%)	117
Tetracycline	58 (91%)	0 (0%)	6 (9%)	6 (9%)	64
Chloramphenicol	117 (100%)	0 (0%)	0 (0%)	0 (0%)	117
Vancomycin	116 (99%)	0 (0%)	1 (1%)	1 (1%)	117
Levofloxacin	117 (100%)	0 (0%)	0 (0%)	0 (0%)	117
Clindamycin	107 (95%)	0 (0%)	6 (5%)	6 (5%)	113

Isolates with serotypes found in PCV7 and PCV13 are more likely to be non-susceptible to penicillin and erythromycin than non-vaccine serotype isolates. One potential benefit of the use of these vaccines was an anticipated decline in antibiotic resistance among circulating pneumococci. Following introduction of PCV7 in 2001, antibiotic resistance among invasive pneumococci dropped. However, during 2003, TMP-sulfa and penicillin resistance increased, associated with an increase in disease caused by serotype 19A. This serotype is included in PCV13; decreasing proportions of isolates resistant to most antibiotics tested are most likely due to the introduction of PCV13 [8].

Figure 10: Trends in Antibiotic Non-Susceptibility Among Invasive Pneumococcal Isolates - Alaska, 2000 - 2017



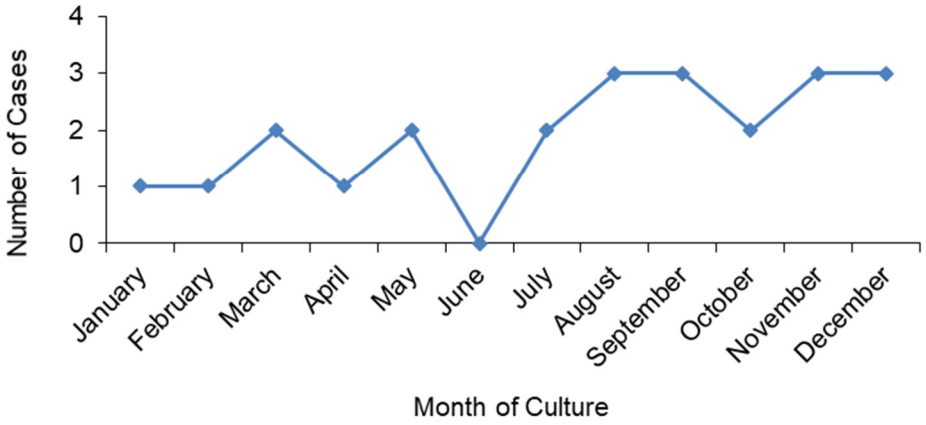
Invasive *Haemophilus influenzae*

Overall Incidence

In 2017, there were 23 cases of invasive *Haemophilus influenzae* in Alaska, for a statewide rate of 3.1/100,000 persons per year. This rate is higher than the ABCs 2017 national projected rate of 2.32/100,000 persons per year [9]. There were 5 deaths associated with *H. influenzae* in 2017 for a case fatality ratio of 22%.

Seasonality

Figure 11: *Haemophilus influenzae* Disease by Month of Culture - Alaska, 2017

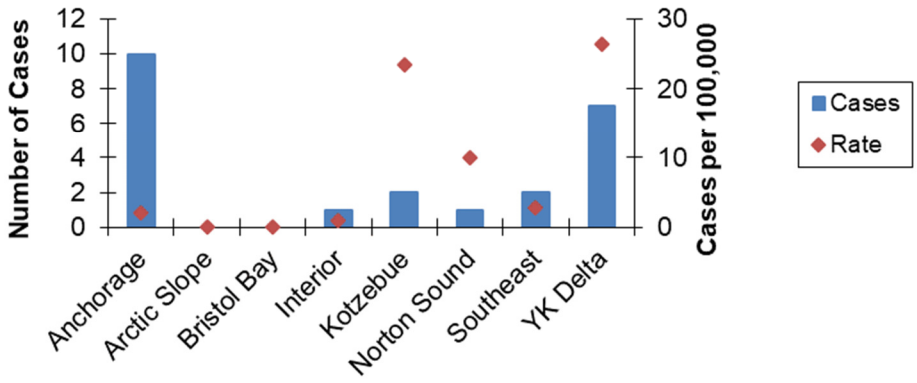


Cases of invasive *H. influenzae* occurred throughout 2017; however, the small number of cases precludes describing seasonality. The majority of cases (n=16) occurred during the 3rd and 4th quarters of the year.

Region

The highest rates of disease caused by invasive *H. influenzae* cases in 2017 were in the YK Delta region, 26.4/100,000 (7 cases), and the Kotzebue region, 23.4/100,000 (2 cases). Although a large number of cases occurred in the Anchorage area (10 cases), the rate was much lower (2/100,000).

Figure 12: Invasive *Haemophilus influenzae*, Cases & Rates by Region - Alaska, 2017



Race

Table 10: Invasive *Haemophilus influenzae* Cases by Race – Alaska, 2017

Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native Persons	14 (61%)	8.2	43%	2 (14%)
Non-Native Persons	9 (39%)	1.4	56%	3 (33%)
Total	23		48%	5 (22%)

*Cases per 100,000 per percent distribution of Alaska 2010 population

In 2017, 61% of the cases occurred in Alaska Native persons. Age-adjusted rates were calculated for Alaska Native and non-Native persons. The age-adjusted rate ratio of *H. influenzae* disease for the Alaska Native population compared with the non-Native population in 2017 was 5.9.

Age

H. influenzae cases ranged in age from 1.5 months to 78.7 years in 2017 (median 2.9 years). Overall, the highest rates of disease occurred in children less than 2 years old (48.2/100,000). 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 and 65+ years of age, 139.5/100,000 persons per year and 26.4/100,000 persons per year, respectively.

Figure 13: Invasive *Haemophilus influenzae* by Age Group - Alaska, 2017

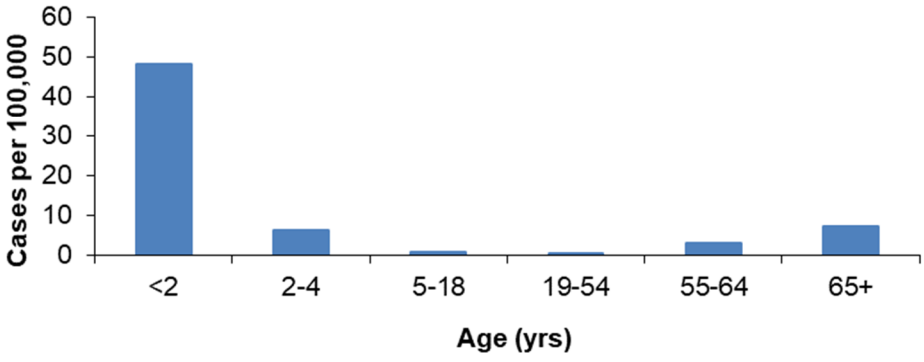
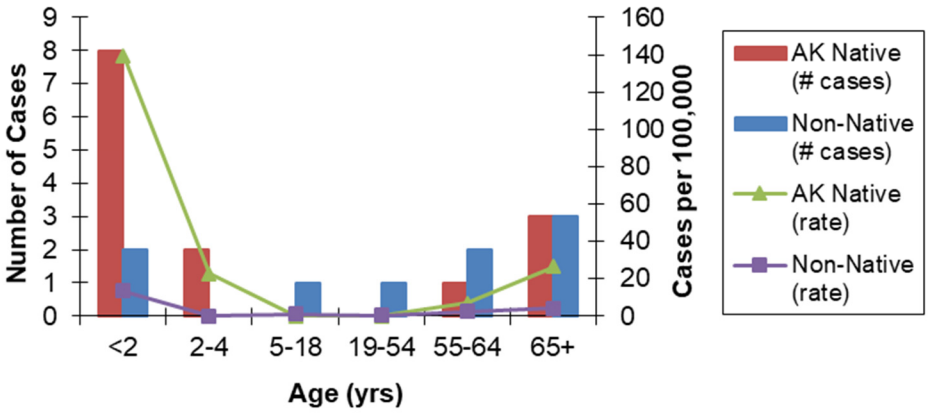


Figure 14: Invasive *Haemophilus influenzae*, Cases & Rates by Age Group & Race - Alaska, 2017



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 2017, pneumonia with bacteremia was the most common presentation (43% of cases).

Fifteen (65%) *H. influenzae* isolates were from blood samples in 2017, six were from CSF and one each was from pleural fluid and joint fluid.

Table 11: Primary Clinical Presentation of Invasive *Haemophilus influenzae* - Alaska, 2017

Primary Presentation	n (%)
Pneumonia*	10 (43%)
Meningitis	6 (26%)
Bacteremia	3 (13%)
Empyema	2 (9%)
Osteomyelitis	1 (4%)
Septic arthritis	1 (4%)
Total	23

*with bacteremia

Serotypes

All isolates received at AIP are serotyped; 22 cases in 2017 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, 2017

		Alaska Native Persons				Non-Native Persons			
Serotype	Total n (%)	<2	2-18	19-64	65+	<2	2-18	19-64	65+
a	7 (30)	7	-	-	-	-	-	-	-
b	2 (9)	-	1	-	-	1	-	-	-
f	2 (9)	-	1	-	-	1	-	-	-
NT*	11 (47)	1	-	1	3	-	1	3	2
Unknown	1 (4)	-	-	-	-	-	-	-	1
Total	23	8	2	1	3	2	1	3	3

*Non-typeable

Hib

In recent decades, the prevalence of *H. influenzae* type b has declined following introduction of universal infant vaccination in 1991. There were two cases of Hib in a child less than 5 years old in 2017; one child was fully vaccinated, and one child was less than 2 months old and had not yet received any vaccine.

Hia

Prior to 2002, *H. influenzae* type a (Hia) had not been detected in Alaska. Following an outbreak in 2003 [10], cases have occurred sporadically until 2010 when an outbreak began in the YK Delta and continued through 2011 [11]. Seven cases of Hia were detected in 2017; 100% 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 2017 was 122.1/100,000.

Antibiotic Resistance

Nineteen *H. influenzae* isolates received at AIP were tested for susceptibility to ampicillin, chloramphenicol, ceftriaxone and TMP/sulfa. All isolates tested were susceptible to ceftriaxone and chloramphenicol, 5 isolates were resistant to ampicillin (1 intermediate, 4 fully resistant), and 14 isolates were resistant to TMP/sulfa (1 intermediate and 13 fully resistant).

Invasive *Neisseria meningitidis*

Overall Incidence

Two cases of invasive *Neisseria meningitidis* were reported to AIP in 2017 for an overall rate of 0.3/100,000. The Alaska rate is higher than the Enhanced Meningococcal Disease Surveillance 2017 national rate of 0.11/100,000 [12]. There were no invasive *N. meningitidis*-related deaths in Alaska in 2017.

Table 13: Invasive *Neisseria meningitidis* Cases by Race – Alaska, 2017

Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native Persons	0 (0)	0.0	0	0 (0)
Non-Native Persons	2 (100)	0.3	50	0 (0)
Total	2		50	0 (0)

*Cases per 100,000 per percent distribution of Alaska 2010 population

Both invasive *N. meningitidis* cases reported in 2017 occurred in non-Native persons aged ≥50 years, one patient presented with meningitis and the other with pneumonia. Isolates from both patients were obtained from blood, and both were serogroup C.

Invasive group A *Streptococcus*

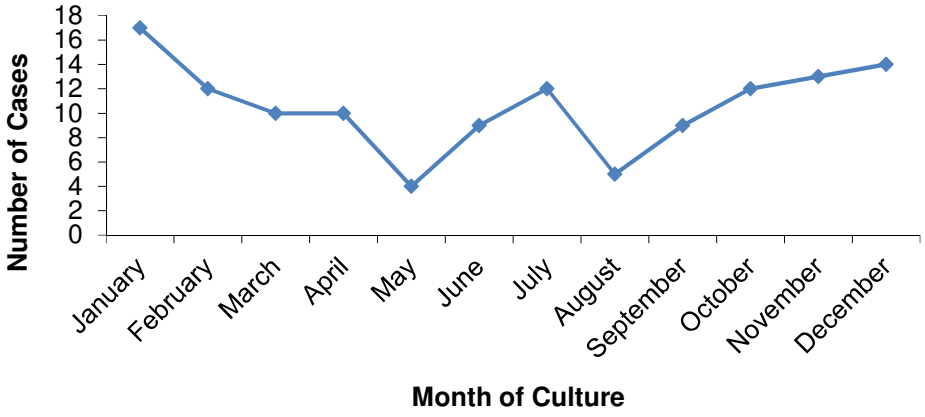
Overall Incidence

A total of 127 cases of invasive group A *Streptococcus* (GAS) were reported to AIP in 2017. The overall rate of invasive GAS disease in the state of Alaska was 17.2/100,000 persons per year. The Alaska rate is higher than the ABCs 2017 national projected rate of 7.26/100,000 [13]. In 2017, there were 8 GAS-related deaths for a case fatality ratio of 6%.

Seasonality

Cases of group A *Streptococcus* occurred throughout the year in 2017 with no apparent trends in seasonality. The largest number of cases (n=17) occurred in January.

Figure 15: Invasive group A *Streptococcus*, by Month of Culture - Alaska, 2017



Race

In 2017, 55% 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 2017 was 6.0.

Table 14: Invasive group A *Streptococcus* Cases by Race – Alaska, 2017

Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native Persons	70 (55%)	52.5	60%	4 (6%)
Non-Native Persons	57† (45%)	8.7	56%	4 (7%)
Total	127		58%	8 (6%)

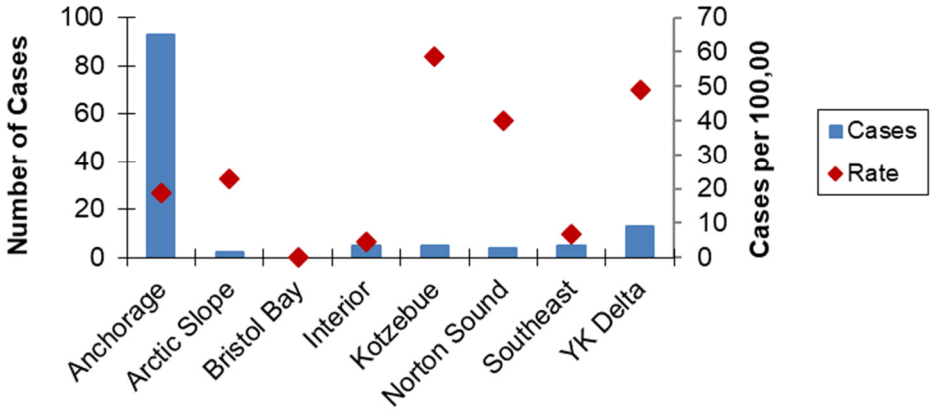
*Cases per 100,000 per percent distribution of Alaska 2010 population
†Includes 4 cases for which race is unknown

Region

Ninety-three (73%) of the 127 invasive group A *Streptococcus* cases in 2017 were reported in the Anchorage area, 13 cases in the YK Delta, 5 cases each in the Interior, Southeast, and Kotzebue regions, 4 cases in Norton

Sound, and 2 cases in the Arctic Slope. The highest rates of disease occurred in the Kotzebue region (58.6/100,000) and the YK Delta (49/100,000).

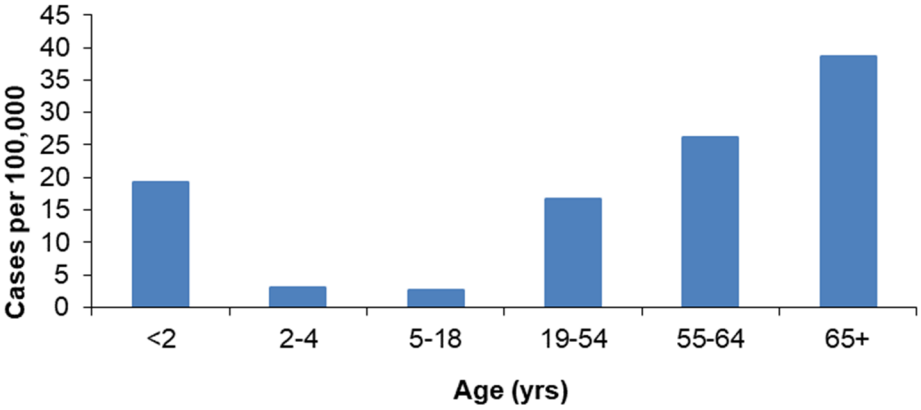
Figure 16: Invasive GAS Disease, Cases & Rates by Region - Alaska, 2017



Age

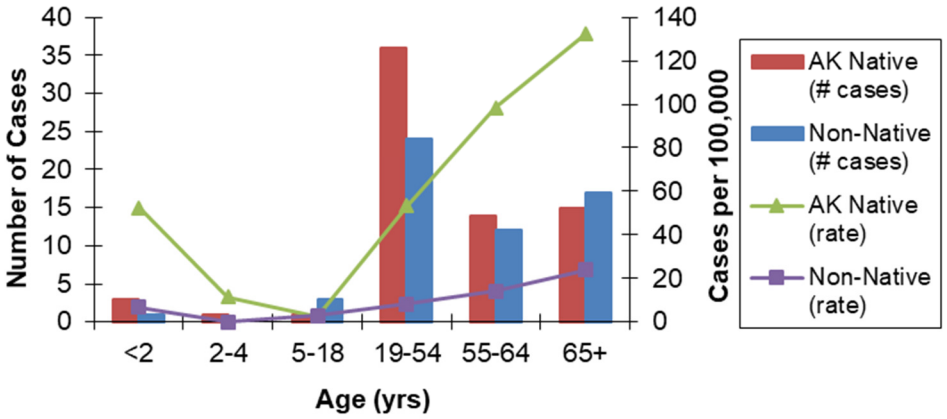
Invasive group A *Streptococcus* cases reported in 2017 ranged in age from 1 month to 93 years old; the median age was 53 years. Highest rates of disease occurred in adults 65 years and older (38.6/100,000).

Figure 17: Invasive group A *Streptococcus* by Age Group - Alaska, 2017



When stratified by race, the highest rates of invasive group A streptococcal disease occurred in Alaska Native adults 65+ years old (132.2/100,000 persons per year). The highest GAS disease rate in the non-Native population also occurred in adults 65 years and older (23.8/100,000 persons per year).

Figure 18: Invasive group A *Streptococcus*, Cases & Rates by Age Group & Race - Alaska, 2017



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 18 shows the primary clinical presentations of invasive group A *Streptococcus* in Alaska for 2017.

Group A *Streptococcus* was isolated from blood samples in 77 (61%) of 127 cases, 36 (28%) from surgical specimens, 6 from wounds, 4 from joint fluid, 3 from pleural fluid, and one from CSF.

Table 15: Primary Clinical Presentations of Invasive group A *Streptococcus* – Alaska, 2017

Primary Presentation	n (%)
Cellulitis*	34 (27%)
Bacteremia	32 (25%)
Necrotizing fasciitis	20 (16%)
Pneumonia*	12 (9%)
Septic arthritis	8 (6%)
Osteomyelitis	4 (3%)
Strep toxic shock	3 (2%)
Empyema	3 (2%)
Meningitis	2 (2%)
Endocarditis	2 (2%)
Bursitis	2 (2%)
Peritonitis	1 (1%)
Amnionitis	1 (1%)
Other	3 (2%)
Total	127

*with bacteremia

Associated Risk Factors

The presence of one or more associated risk factors was reported in 83% of invasive GAS cases in 2017. Cigarette smoking was the most prevalent risk factor reported in adults, followed by alcohol abuse and chronic lung disease.

Table 16: Associated Risk Factors Identified in Invasive GAS Cases – Alaska, 2017*

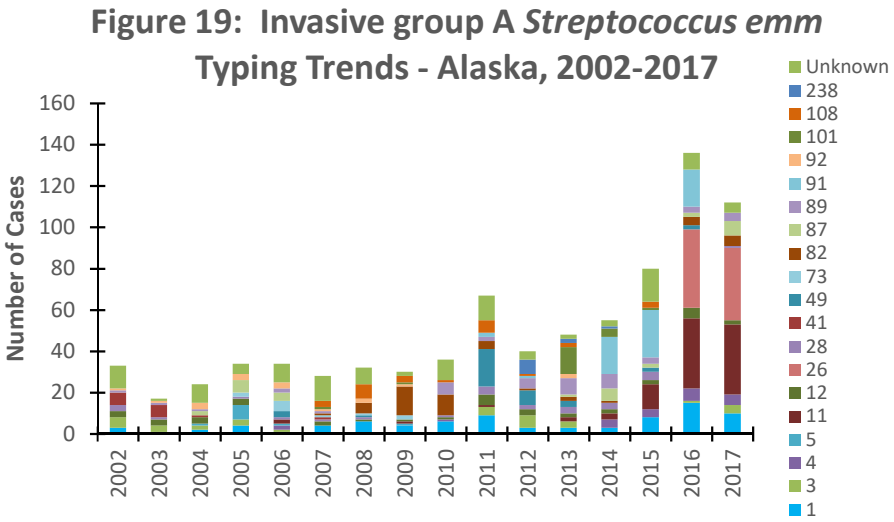
Medical Condition/Risk Factor	Adult Cases (≥ 18 years) n=118, Cases (%)
Cigarette smoking	47 (39%)
Alcohol abuse	37 (31%)
Chronic lung disease	27 (23%)
Diabetes	20 (17%)
Injection drug use	11 (9%)
Immunosuppressive treatment	8 (7%)
Asplenia	0 (0%)

*Multiple risk factors may be reported for a given case

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, baseline data on the burden of GAS disease to include *emm* typing are critical to evaluate the potential utility of any candidate vaccines.

In 2017, 122 invasive GAS isolates were *emm* typed at AIP. The most common *emm* types were *emm* 26 (29%) and *emm* 11 (28%). The following graph shows *emm* typing trends over time. Strains that totaled ≤ 10 over the time period were not included.



Antibiotic Resistance

One hundred twenty-two 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, and vancomycin and levofloxacin. Thirty-eight isolates were resistant to erythromycin; 35 of those were *emm* type 11, two were *emm* type 26.3 and one was *emm* type 4. One erythromycin-resistant *emm* type 11 isolate was also resistant to clindamycin.

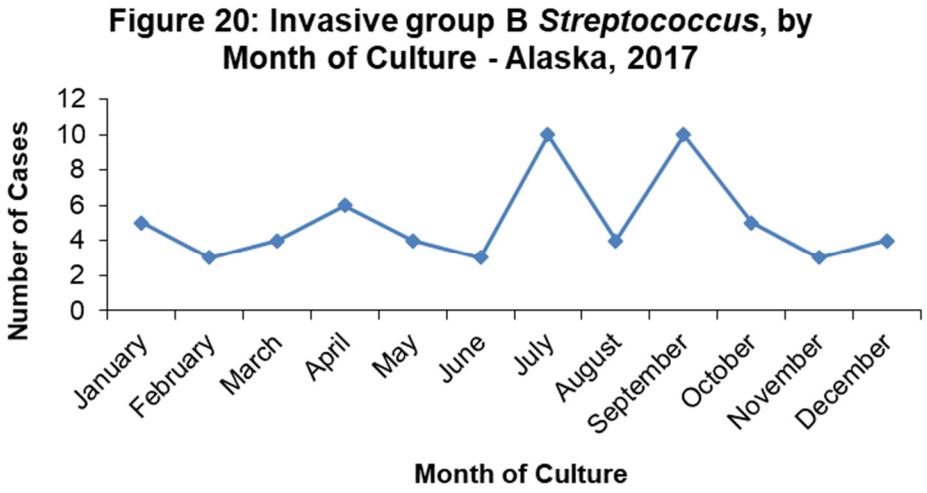
Invasive group B *Streptococcus*

Overall Incidence

A total of 61 cases of invasive group B *Streptococcus* (GBS) were reported to AIP in 2017. The overall rate of invasive GBS disease in the state of Alaska was 8.3/100,000 persons per year. The Alaska rate is less than the ABCs 2017 national projected rate of 9.8/100,000 [14]. In 2017, there were four GBS-related deaths for a case fatality ratio of 6.6%.

Seasonality

Cases of GBS occurred throughout the year with no apparent trends in seasonality.



Race

In 2017, 21% of invasive GBS cases in Alaska occurred in the Alaska Native population. The age-adjusted rate ratio of invasive GBS disease for the Alaska Native population compared with the non-Native population in 2017 was 1.4.

Table 17: Invasive group B *Streptococcus* Cases by Race – Alaska, 2017

Race	Cases n (%)	Age Adjusted Rate*	% Male	Deaths n (%)
Alaska Native Persons	13 (21)	9.9	77	1 (8)
Non-Native Persons	48 (79)†	7.0	67	3 (6)
Total	61		69	4 (7)

*Cases per 100,000 per percent distribution of Alaska 2010 population
†Includes 6 cases for which race was unknown

Region

In 2017, 45 (74%) of the 61 reported GBS cases occurred in Anchorage; 6 cases were reported in the Southeast, three cases each in the Interior and the YK Delta and two cases each in the Kotzebue and Norton Sound regions. The highest rates of disease occurred in the Kotzebue region (23.4/100,000) and Norton Sound (20/100,000).

Age

Invasive GBS cases reported in 2017 ranged in age from newborn to 93 years old; the median age was 53 years. Highest rates of disease overall occurred in persons 65 years and older (32.6/100,000 persons per year).

Figure 21: Invasive group B *Streptococcus* by Age Group - Alaska, 2017

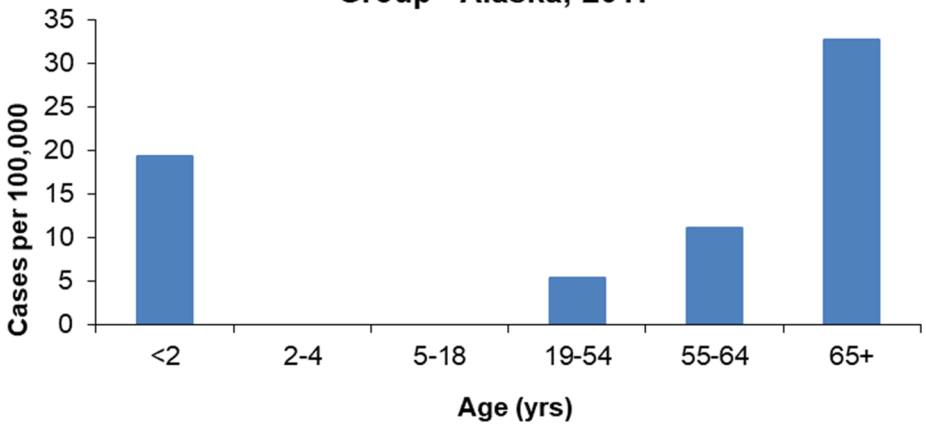
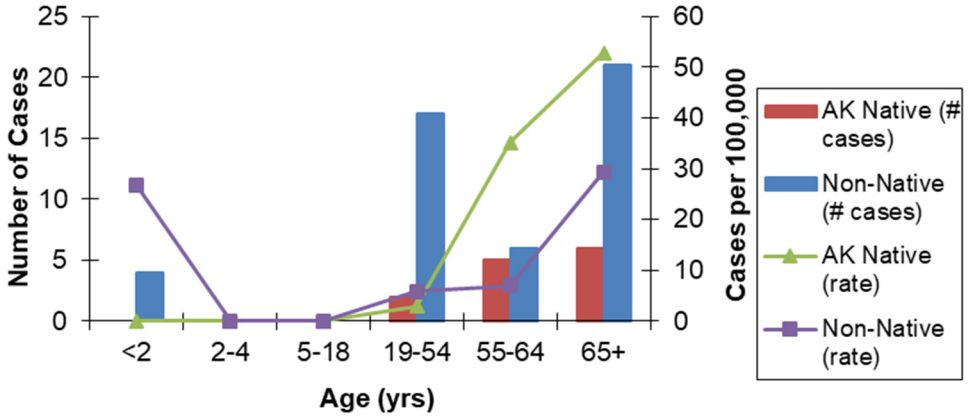


Figure 22: Invasive group B *Streptococcus*, Cases & Rates by Age Group & Race - Alaska, 2017



When stratified by race, the highest rates of disease occurred in AK Native persons 55-64 years old and 65 years and older, 35.2/100,000 persons per year and 52.9/100,000 persons per year, respectively. There were two cases of early-onset disease (disease in infants less than 7 days old) for a rate of 0.2 cases per 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 2017, the most common clinical presentations were cellulitis and osteomyelitis, which occurred in 19 (31%) and 12 (20%) cases, respectively.

Group B *Streptococcus* was isolated from blood in 46 (75%) of 61 cases in 2017; 10 isolates were obtained from surgical specimens, two each from joint fluid and bone and one from cerebrospinal fluid.

Table 18: Primary Clinical Presentations of Invasive group B *Streptococcus* – Alaska, 2017

Primary Presentation	n (%)
Cellulitis*	19 (31)
Osteomyelitis	12 (20)
Bacteremia	11 (18)
Pneumonia*	9 (15)
Septic arthritis	5 (8)
Meningitis	2 (3)
Endocarditis	2 (3)
Other	1 (2)
Total	61

*with bacteremia

Associated Risk Factors

The presence of one or more associated risk factors was reported in 87% of invasive GBS cases in 2017. Diabetes was the most prevalent risk factor observed in adults, followed by chronic lung disease and cigarette smoking.

Table 19: Associated Risk Factors Identified in Adult Invasive GBS Cases – Alaska, 2017*

Medical Condition/Risk Factor	Adult Cases (≥ 18 years) n=57, Cases (%)
Diabetes	28 (49%)
Chronic lung disease	14 (25%)
Cigarette smoking	13 (23%)
Alcohol abuse	5 (9%)
Injection drug use	4 (7%)
Immunosuppressive treatment	2 (4%)
Asplenia	0 (0%)

*Multiple risk factors may be reported for a given case

Antibiotic Resistance

Number of isolates tested for antibiotic resistance varied by the antibiotic tested, ranging from 20 to 57 isolates. Results of the testing are presented in the following table.

Table 20: Antibiotic Resistance in Invasive group B *Streptococcus* Isolates – Alaska, 2017

Antibiotic	Susceptible	Intermediate	Resistant	I + R	Total Tested
Penicillin	56 (100%)	0 (0%)	0 (0%)	0 (0%)	56
Ceftriaxone	56 (100%)	0 (0%)	0 (0%)	0 (0%)	56
Erythromycin	26 (46%)	0 (0%)	31 (54%)	31 (54%)	57
Vancomycin	57 (100%)	0 (0%)	0 (0%)	0 (0%)	57
Levofloxacin	57 (100%)	0 (0%)	0 (0%)	0 (0%)	57
Clindamycin	16 (80%)	0 (0%)	4 (20%)	4 (20%)	20

All isolates tested were susceptible to penicillin, ceftriaxone, vancomycin and levofloxacin. Resistance to erythromycin and clindamycin was seen in 54% and 20%, respectively, of isolates tested. The isolate for one early onset case was resistant to erythromycin.

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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.