Streptococcus pneumoniae Surveillance Report 2015

Oregon Active Bacterial Core Surveillance (ABCs)

Center for Public Health Practice
Oregon Health Authority

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Background

The Active Bacterial Core surveillance (ABCs) program is a core component of the Emerging Infections Program (EIP) Network sponsored by the Centers for Disease Control and Prevention (CDC). The purpose of the ABCs program is to determine the incidence and epidemiologic characteristics of invasive disease due to *Haemophilus influenzae*, *Neisseria meningitidis*, group A streptococcus (GAS), group B streptococcus (GBS), and *Streptococcus pneumoniae*. The entire EIP Network for invasive pneumococcal disease (IPD) represents almost 33 million persons in 10 surveillance areas around the United States. More information on the EIP/ABCs Network is found at: http://www.cdc.gov/abcs/index.html.

In Oregon, the surveillance area for IPD comprises the tri-county (Clackamas, Multnomah, and Washington) Portland metropolitan area, with a 2015 estimated population of 1,745,385.* More information on the Oregon ABCs program is found at: http://public.health.oregon.gov/DiseasesConditions/CommunicableDisease/EmergingInfections/Pages/ActiveBacterialCoreSurveillance.aspx.

Methods

IPD is defined as the isolation of *S. pneumoniae* from a normally sterile body site in a tri-county resident. Cases are reported via Electronic Laboratory Reporting (ELR). Additional cases are identified through regular laboratory record reviews. Tri-county hospital laboratories submit *S. pneumoniae* isolates to the Oregon State Public Health Laboratory, which forwards them to CDC for serotyping and antimicrobial susceptibility testing. Health record reviews of each case allow standardized reports of demographic characteristics, clinical syndrome manifestations, underlying illnesses or conditions, and illness outcome.

Surveillance Results

Descriptive Epidemiology

In 2015, 143 cases of IPD were reported in the tri-county Portland area, corresponding to an incidence rate of 8.2/100,000 persons (Figure 1). This is 15 percent lower than the average annual incidence rate in the Portland area from 2010-2014 (9.7/100,000), and 10 percent lower than the most recent national estimate of invasive disease (9.1/100,000).[1] Among these cases there were 10 deaths, for an annual mortality rate due to IPD of 0.57/100,000 (Figure 1). This is 18 percent lower than the 2010-

*Source: Portland State University Population Research Center (http://www.pdx.edu/prc/)

2014 Portland area average annual mortality rate (0.07/100,000) but 5 percent higher than the most recent national estimate (1/100,000).[1]
The mean and median ages of 2015 IPD cases were 61 and 62 years, respectively, while those of IPD deaths were 72 and 64 years, respectively. The 2015 case fatality rate for IPD in the Portland area was 7 percent. This is 7% lower than the figures reported in the Portland area from 2010-2014 and 36% lower than the entire ABCs network in 2014.[1] Over half (52%) of the cases were male; of 136 cases where race was known, 85 percent were white, 10 percent were black, and 5 percent were another race; of 138 cases where ethnicity was known, 6 percent were Hispanic or Latino.

Figure 1: Incidence and Mortality Rates of IPD Cases in Tri-county Area

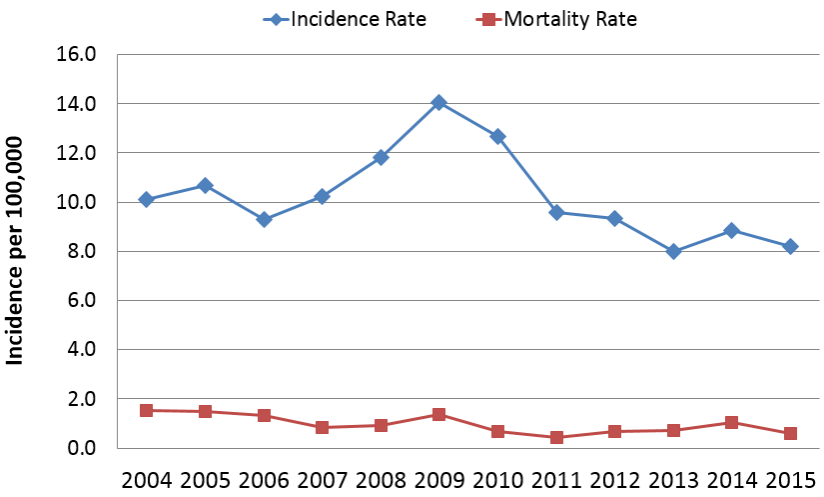
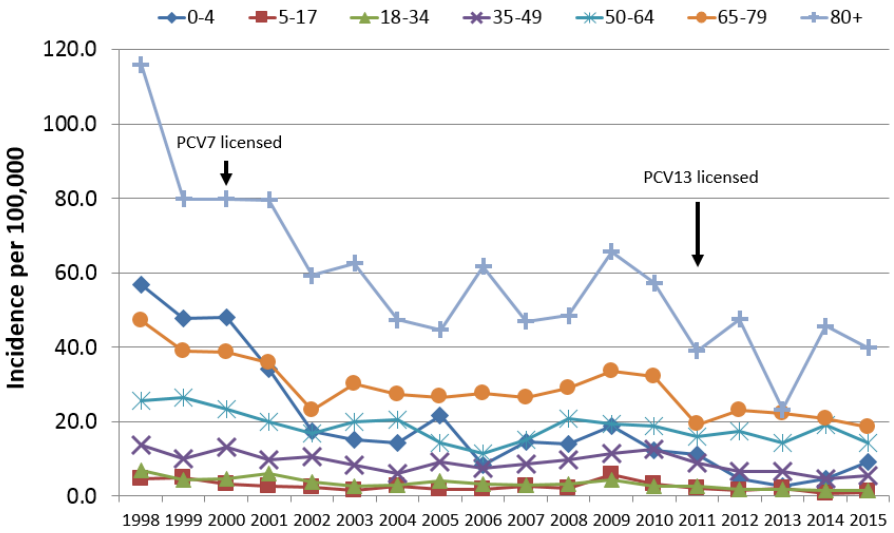


Figure 2. Incidence of IPD Cases in Tri-county Area by Age



The 2015 incidence of IPD was highest in Multnomah county (12/100,000), followed by Clackamas (7/100,000), and Washington (4/100,000) counties. Compared with the previous five-year average, the 2015 incidence rates were lower in all counties. In 2015, mortality due to IPD was highest in Multnomah county (0.8/100,000), followed by Clackamas (0.5/100,000) and Washington (0.3/100,000) counties. Compared with the previous 5-year average, IPD mortality in 2015 was lower in Clackamas and Washington counties; and higher in Multnomah county.

In 2015, the burden of disease was highest in those ≥80 years of age (23 cases; incidence 40/100,000 persons), followed by those 65-79 years of age (32 cases; 18.6/100,000) and those 50-64 years of age (47 cases; 14.3/100,000) (Figure 2). Compared with the previous 5-year average, IPD incidence in 2015 was lower across all age groups except for those under the age of five (29% increase). IPD mortality was also highest in 2014 in those> 65 years, with the highest incidence in those ≥80 years of age (4 deaths; 7/100,000), followed by those 50-64 years of age (5 deaths; 1.5/100,000) and 35-49 years of age (1 death; 1.3/100,000). There were no deaths reported in 2015 among individuals aged 0-34 years. Since 2003, six deaths due to

IPD have been reported in this age group. We have not had a fatal case of IPD among children aged 0-4 since 2001.

Clinical Manifestations

The common clinical syndromes tracked by our IPD surveillance system – bacteremic pneumonia (clinical pneumonia with a positive blood culture), primary bacteremia, and pneumococcal meningitis – are found in Table 1.

Table 1: Most Common Clinical Syndromes among IPD Cases, 2015 vs. 2010-2014

Syndrome	2015 (%)	2010-2014 (%)
Bacteremic pneumonia	77	76
Primary bacteremia	15	14
Meningitis	4	6
Other	6	5

† Some cases had more than 1 syndrome.

While the profile of IPD clinical syndromes has been stable over time, the syndromes do vary by age. For instance, with increasing age, bacteremic pneumonia becomes more common ($p<.0001$) while bacteremia and meningitis become less common ($p<0.0001$, and $p=0.0032$, respectively). After adjusting for age, pneumonia was less likely to be associated with mortality ($p<.0001$), while bacteremia was more likely to be associated with mortality ($p<0.0001$).

Underlying Conditions

Table 2 lists underlying conditions and behavioral risk factors that were found in greater than 5percent of IPD cases in the Portland metropolitan area during 2010-2015. Overall, 85 percent of cases had at least one underlying condition, with the presence of any underlying condition increasing with age ($p<0.0001$). Among those less than 18 years of age, asthma, cancer, and immunosuppression were the most common conditions (8%, 15% and 8%, respectively).

Among adults, smoking ($p<0.0001$) decreased with increasing age, while cardiovascular disease ($p<0.0001$), cerebrovascular accident (CVA) ($p<0.0001$), chronic obstructive pulmonary disease (COPD) ($p<0.0001$), and diabetes ($p<0.0001$) increased.

Table 2: Percent of IPD Cases† Reporting Underlying Conditions, 2010-2015

Condition	%
Smoking	33
Cardiovascular disease	23
COPD	22
Diabetes	20
None reported	15
Immunosuppression	13
Asthma	9
Cirrhosis	9
Obesity	7
Cancer	6
CVA (stroke)	7

† Some cases had more than 1 syndrome.

Serotype Analysis

While rates of PCV7-type IPD declined dramatically following PCV7 introduction in 2000 (Figure 3), rates of IPD caused by some serotypes (3, 7F, 19A) not included in PCV7 increased since PCV7 introduction. Fortunately, a 13-valent pneumococcal conjugate

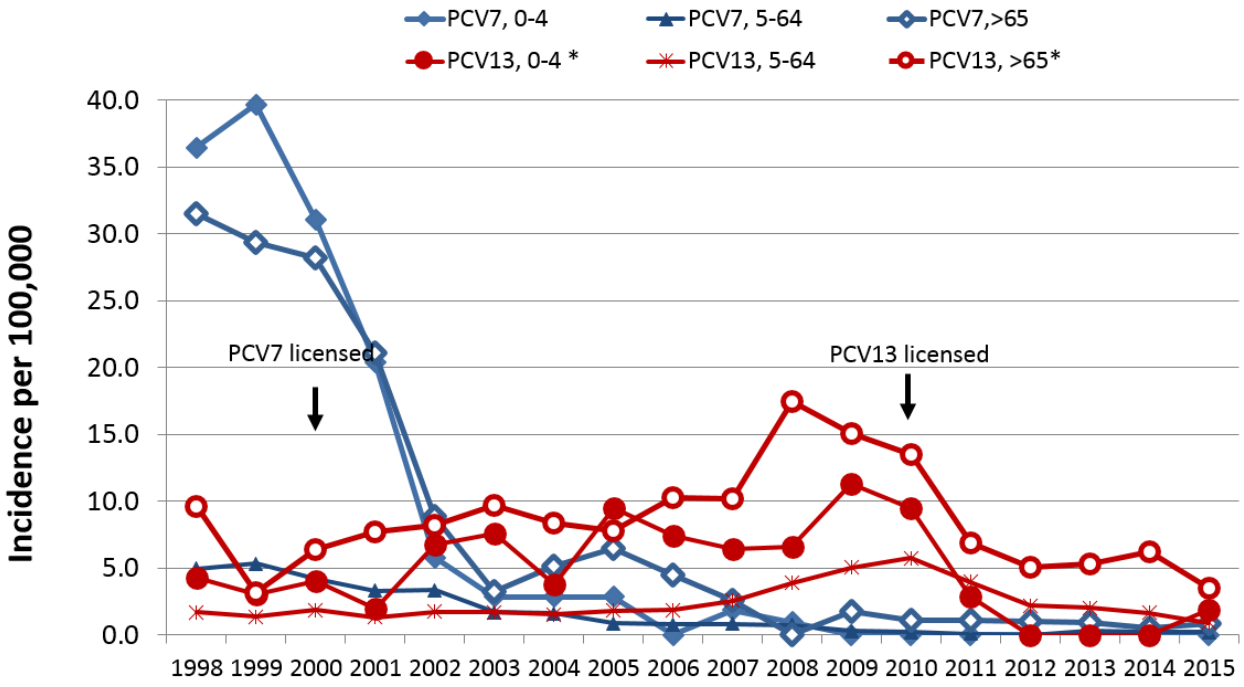
vaccine (PCV13), which includes serotypes 3, 7F and 19A, was licensed by the U.S. Food and Drug Administration (FDA) in February 2010 (Table 3).

Table 3: Pneumococcal Conjugate Vaccines Serotype Coverage

Vaccine	FDA Licensure	Serotypes Covered
PCV13	February 2010	4, 6B, 9V, 14, 18C, 19F, 23F, **1, 3, 5, 6A, 7F, 19A**
PCV7	February 2000	4, 6B, 9V, 14, 18C, 19F, 23F

The most common serotypes in 2015 were 3 (15%), 22F (10%), 12F (9%), 09N (7%), and 23A (6%). Figure 3 depicts the incidence of IPD due to serotypes of *S. pneumoniae* that are included in PCV7 and the six additional serotypes included in PCV13. From 1998 to 2009, the incidence of PCV7 serotypes *decreased* 96 percent among all age groups and 100 percent among those 0–4 years of age. During this same time period, the incidence of IPD due to the six additional serotypes now covered by PCV13 *increased* 130 percent among all age groups and 160 percent among those 0–4 years. However, since the introduction of PCV13 in 2010, the incidence of IPD due to the six additional serotypes in PCV13 has *decreased* 81 percent among all ages, 74 percent in those over 65 years, and 80 percent among the youngest age group.

Figure 3: Incidence of PCV7 and PCV13 by age group



* Only includes the six additional strains covered by PCV13 and not PCV7

The finding that the incidence of PCV7 serotypes has declined in the face of increased incidence of the remaining pneumococcal serotypes covered by the 23-valent pneumococcal polysaccharide vaccine (PPSV23) suggests that use of PCV7 in children has provided a herd immunity effect for older adults.

Antibiotic Susceptibility

In 2014, susceptibility testing was performed on 73% percent of the isolates (Table 4). At least 95 percent of the tested isolates were susceptible to amoxicillin, cefotaxime, ceftriaxone, cefuroxime, chloramphenicol, clindamycin, levofloxacin, linezolid, meropenem, synercid, and vancomycin.

Table 4: Antibiotic Susceptibility of IPD Isolates, 2015 (n=104)

Antibiotic	Susceptible (%)	Intermediate Resistance (%)	Full Resistance (%)
Levofloxacin	100		
Linezolid	100		
Synercid	100		
Vancomycin	100		
Ceftriaxone	100		
Chloramphenicol	98		2
Amoxicillin	99	1	
Cefotaxime	100		
Cefuroxime	97	2	1
Clindamycin	98		2
Meropenem	99		1
Penicillin*	90	9	1
Tetracycline	96		34
Erythromycin	84	1	15
Penicillin†	100		
Trimethoprim-sulfamethoxazole	86	13	1

*Based on old breakpoints **S**<=0.06; 0.12**<=I<**=1; **R** >=2)

† Based on 2012 CLSI (Clinical and Laboratory Standards Institute) breakpoints (**S**<=2;**I** =4 ; **R**>=8)

Based on *current* CLSI (Clinical and Laboratory Standards Institute) breakpoints, none of the 2015 IPD isolates were resistant to penicillin. Resistance to erythromycin, trimethoprim/sulfamethoxazole and cefuroxime appears to have decreased in 2015 and tetracycline resistance increased (Figure 4).

Figure 4: Proportion of Pneumococcal Isolates Resistant to Commonly Used Antibiotics, Portland, 2001-2015

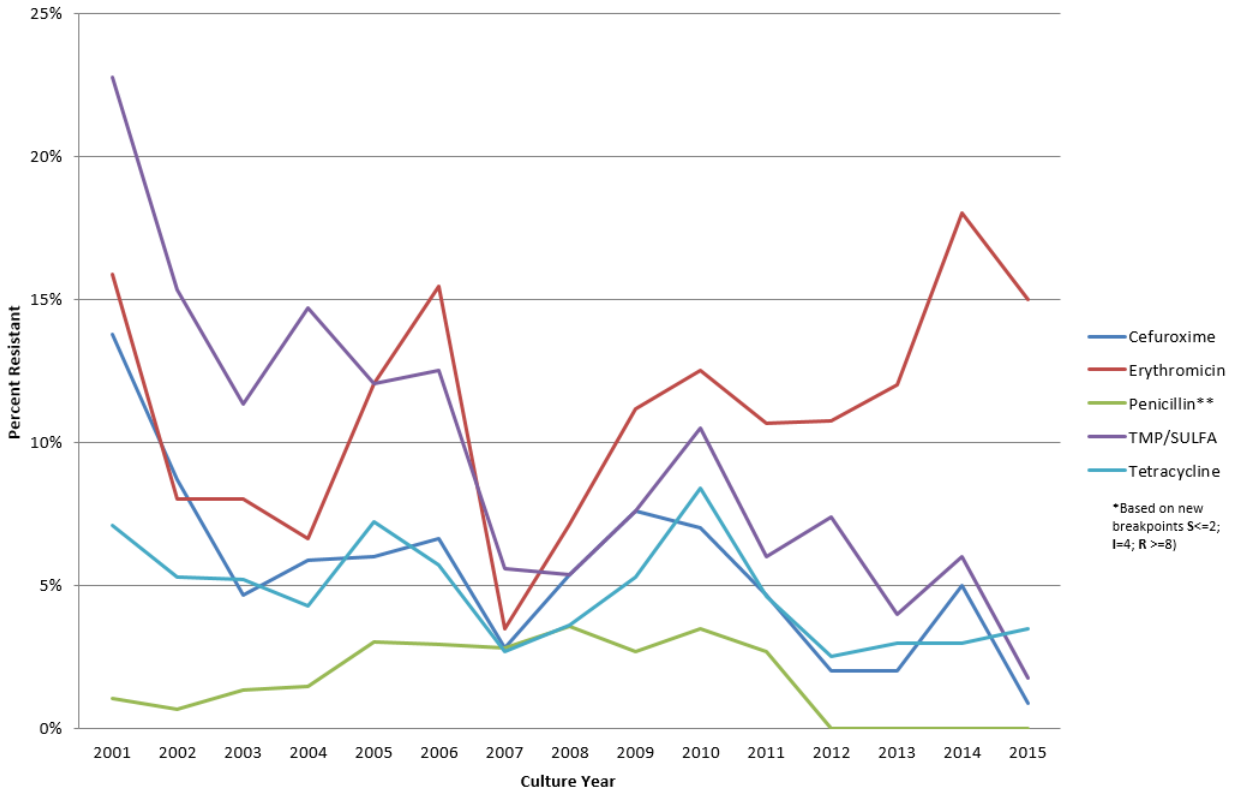
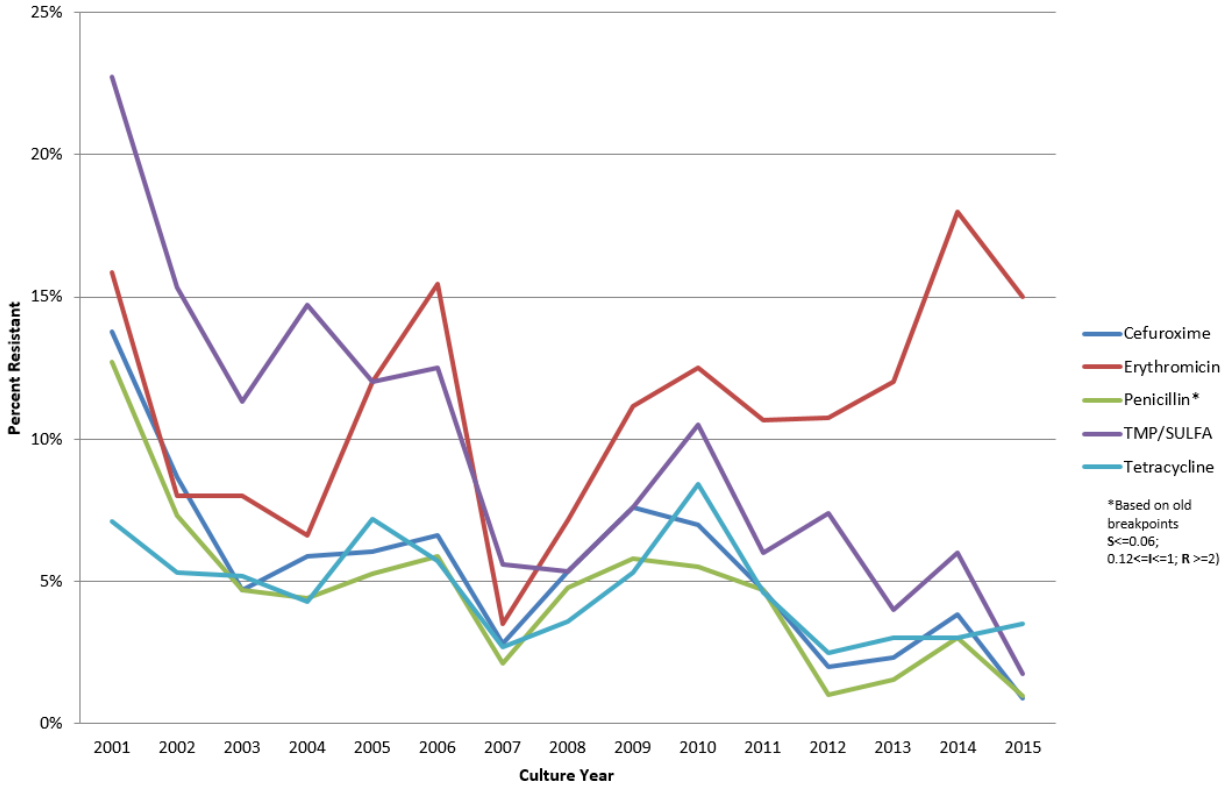


Figure 5 depicts antibiotic resistance using the old CLSI breakpoints. Using these breakpoints, penicillin resistance increase from 2012-2014, with a decrease in 2015.

Figure 5: Proportion of Pneumococcal Isolates Resistant to Commonly Used Antibiotics, Portland, 2001-2015



Discussion

The epidemiology of IPD has evolved in the last 15 years since the introduction of the first 7-valent conjugate vaccine in 2000. Initial dramatic declines in incidence of IPD, both in the pediatric age group targeted by the vaccine and in adults, suggested that herd immunity was playing a role in preventing IPD.[2] The second benefit of the conjugate vaccine was the impact it had on antibiotic-resistant serotypes; five of the 7 vaccine serotypes had previously accounted for the majority of penicillin-resistant infections, and rates of penicillin-resistant IPD decreased 57% between 1999 and 2004. [3]

ABCs surveillance data not only documented gradual increases in rates of IPD overall and in resistance due to the emergence of nonvaccine serotypes (in particular 19A), but were used by vaccine manufacturers to determine the additional serotypes added to the 13-valent conjugate vaccine approved for use in children in 2010. Initial declines in both incidence of infection and resistance have been impressive, but continued monitoring of these infections will be necessary to detect evidence of serotype replacement, especially since we have seen modest increases in rates of infection in children under 5 years of age.

The ABCs program is also actively involved in measuring the impact of recent recommendations for the use of PCV13 in adults with immunocompromising conditions and all adults over age 65 years.[4,5] In 2015, the ABCs network initiated an case-control study to evaluate the effectiveness of the PCV13 conjugate vaccine among adults over 65 years of age. Data collection is ongoing.

References

1. Centers for Disease Control and Prevention. 2014. Active Bacterial Core Surveillance Report, Emerging Infections Program Network, *Streptococcus pneumoniae*, 2014. Available via the Internet:http://www.cdc.gov/abcs/reports-findings/survreports/spneu14.html. Accessed 24 August 2016.
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4. CDC. Use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine for adults with immunocompromising conditions: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2012;61:816-819.
5. CDC. Use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine among adults aged ≥ 65 years; recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR 2014;63:822-25.