Current Epidemiology of Pneumococcal Disease and Pneumococcal Vaccine Coverage among Children, United States

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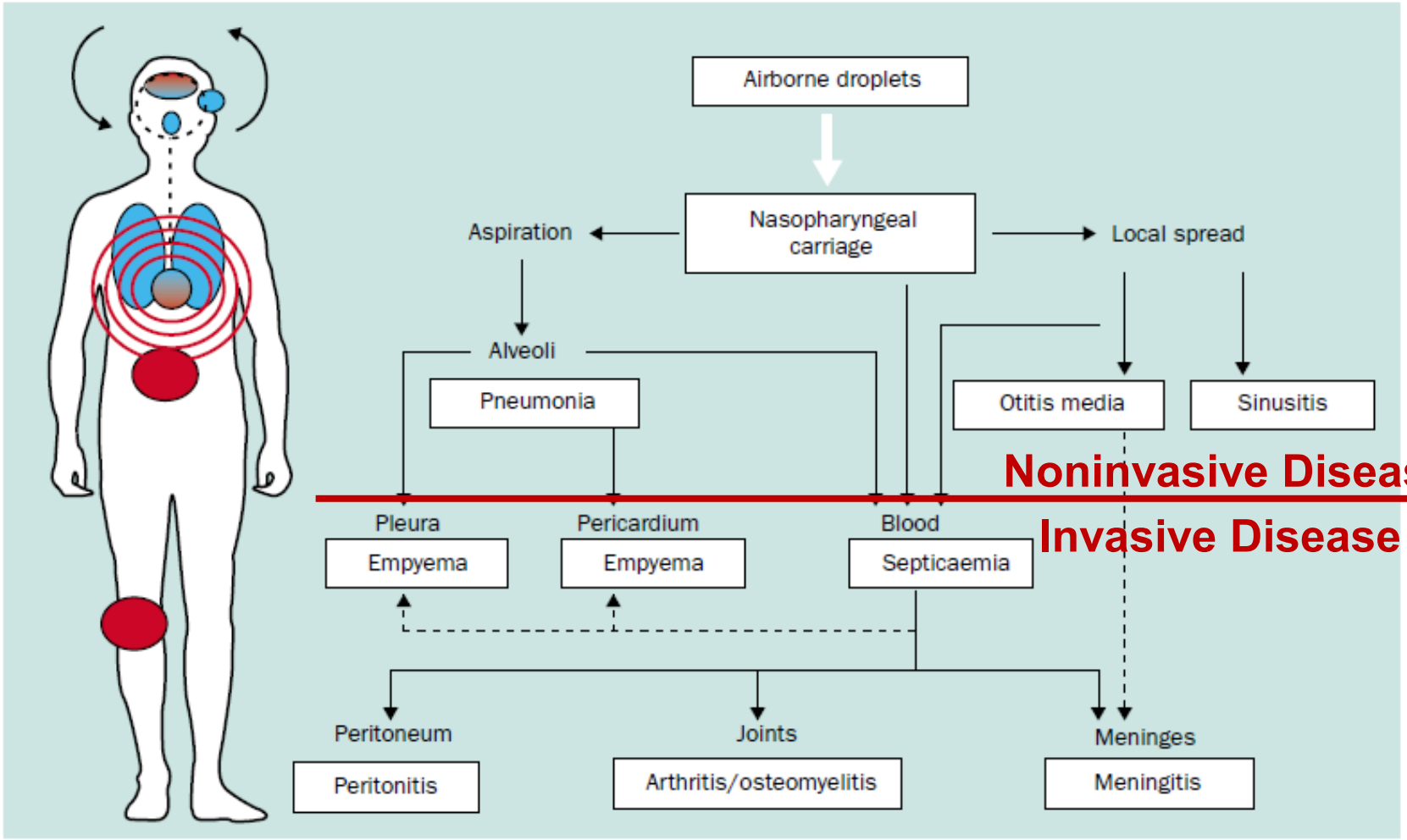
Advisory Committee on Immunization Practices

February 24th, 2022

Pneumococcal carriage is precursor to pneumococcal disease



More frequent

Less frequent

Figure 1. Pathogenic route for S pneumoniae infection. Redrawn from reference 2. Organs infected through the airborne and haematogenic routes are depicted in blue and red, respectively.

Bogaert, Lancet Infect Dis 2004;4:144-54

Outline

- Pneumococcal Vaccine Coverage in children
- Invasive Pneumococcal Disease (IPD) in children
  - Impact of PCV13 on IPD burden and the serotype distribution
  - IPD burden caused by serotypes in PCV15 and PCV20
- Pneumonia in children
  - Impact of PCV13 on all-cause, pneumococcal pneumonia
  - Pneumonia burden estimates
- Acute Otitis Media (AOM)
  - Impact of PCV13, burden, and serotype distribution
- Pneumococcal carriage serotype distribution

Serotypes contained in current pneumococcal vaccines

	1	3	4	5	6A	6B	7F	9V	14	18C	19A	19F	23F	2	8	9N	10A	11A	12F	15B	17F	20	22F	33F
PCV13																								
PPSV23																								

Current routine PCV13 schedule:
Doses given at ages **2, 4, 6, and 12–15** months (3+1)

PPSV23 recommended for children aged 2–18 years with certain medical conditions.

PCV Vaccination Coverage in Children

TABLE 1. Estimated vaccination coverage by age 24 months,* among children born during 2015–2018, by selected vaccines and doses — National Immunization Survey-Child, United States, 2016–2020

Return

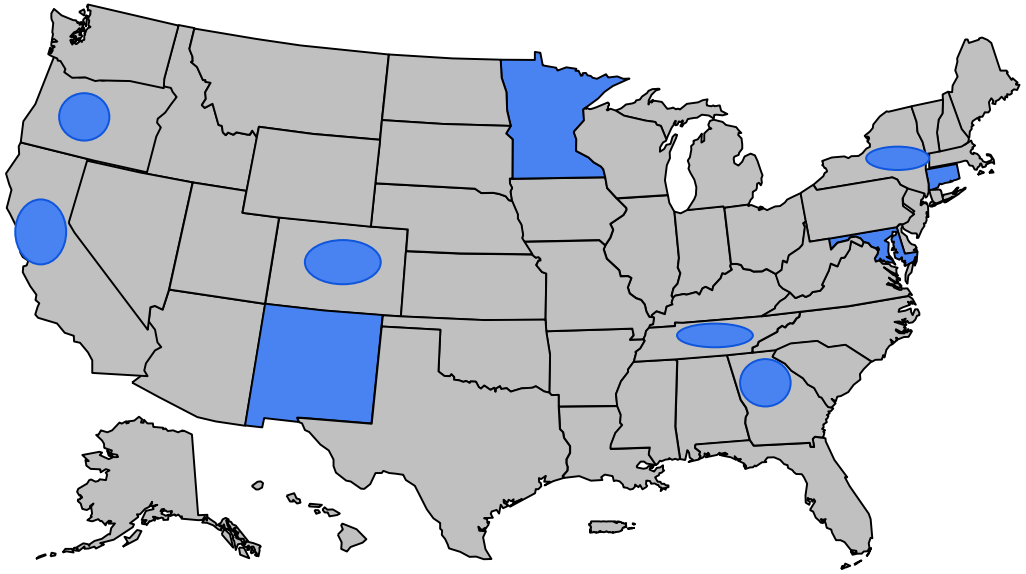
Vaccine/Dose	% (95% CI)		
	Birth years†		Difference (2015–2016 to 2017–2018)
	2015–2016	2017–2018	
PCV			
≥3 doses	91.9 (91.2 to 92.6)	92.4 (91.8 to 93.1)	0.5 (−0.4 to 1.4)
≥4 doses	81.2 (80.2 to 82.2)	82.3 (81.4 to 83.2)	1.1 (−0.3 to 2.4)

https://www.cdc.gov/mmwr/volumes/70/wr/mm7041a1.htm

Impact of PCV13 on Invasive Pneumococcal Disease (IPD) Incidence and Serotype Distribution among Children in the U.S.

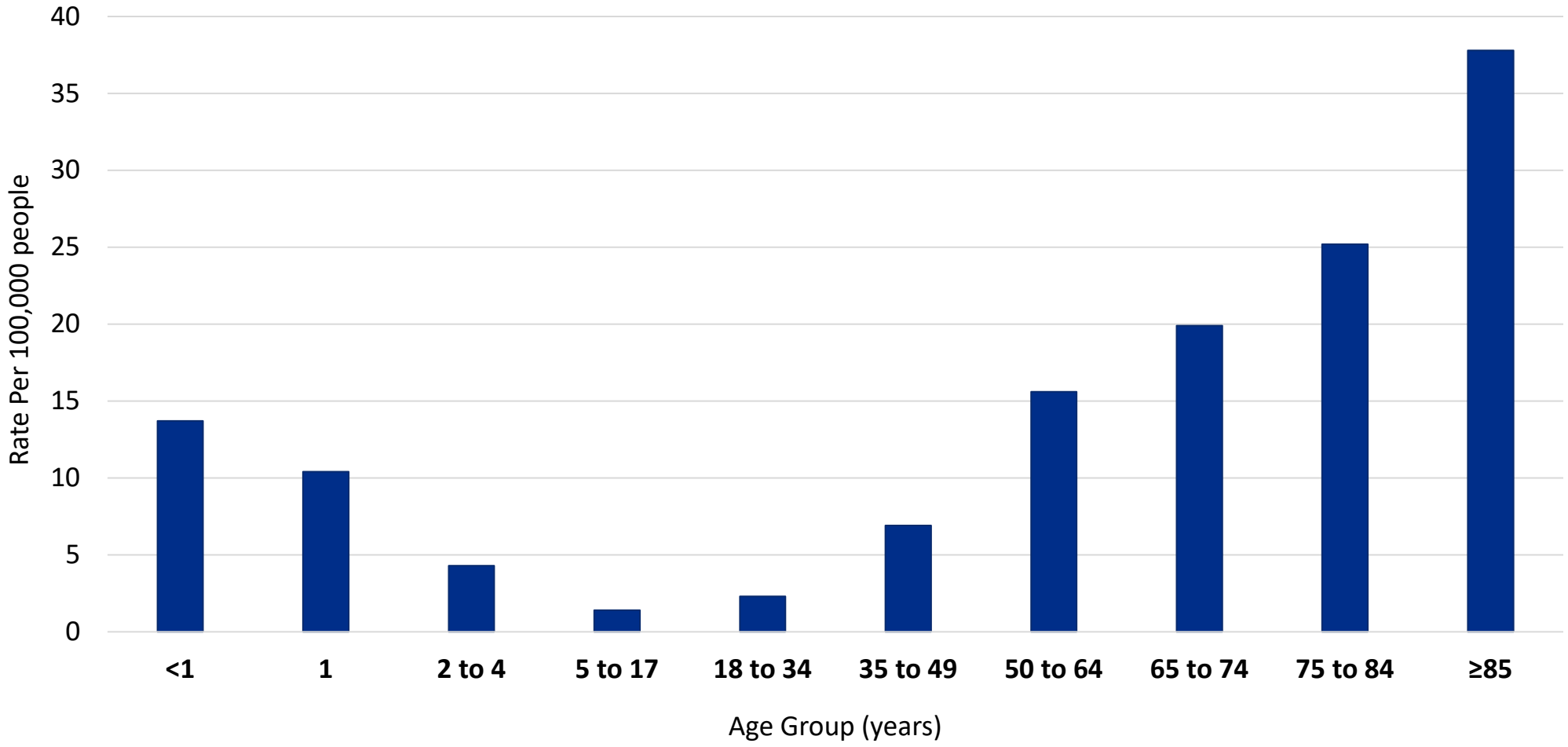
Methods

- **Active Bacterial Core surveillance (ABCs):**
  - Active laboratory and population-based surveillance, 10 sites
  - Pneumococcus isolation from sterile site



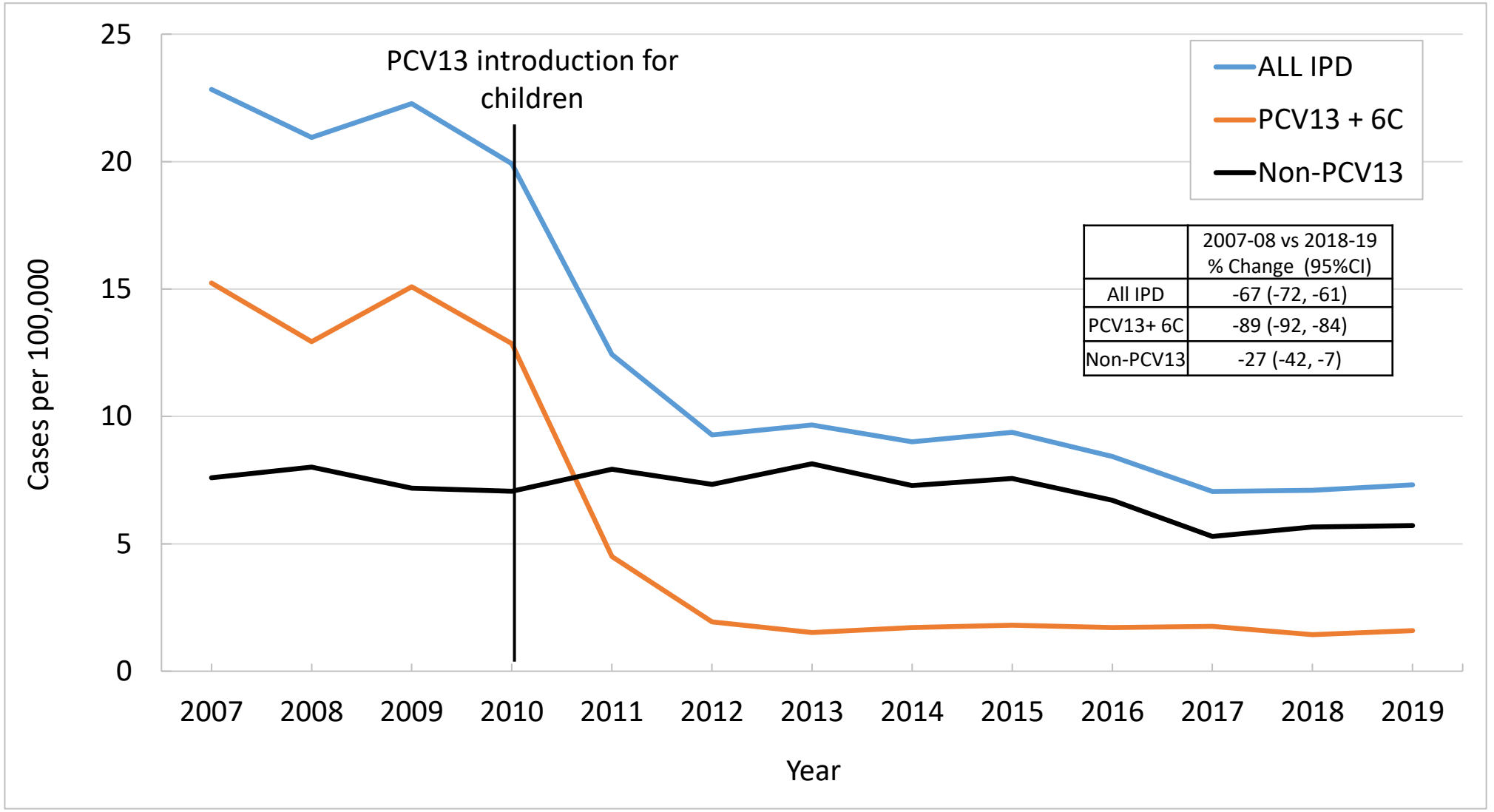
- **Isolates serotyped by whole genome sequencing, Quellung, or PCR at reference labs and grouped for analysis by vaccine type**
- **US Census Bureau race-bridged post-census population estimates used as denominators**
- **Overall and serotype-specific IPD incidence rates (cases per 100,000)**
  - 6C grouped with PCV13 serotypes (PCV13+6C)

2019 Incidence of IPD, by age group



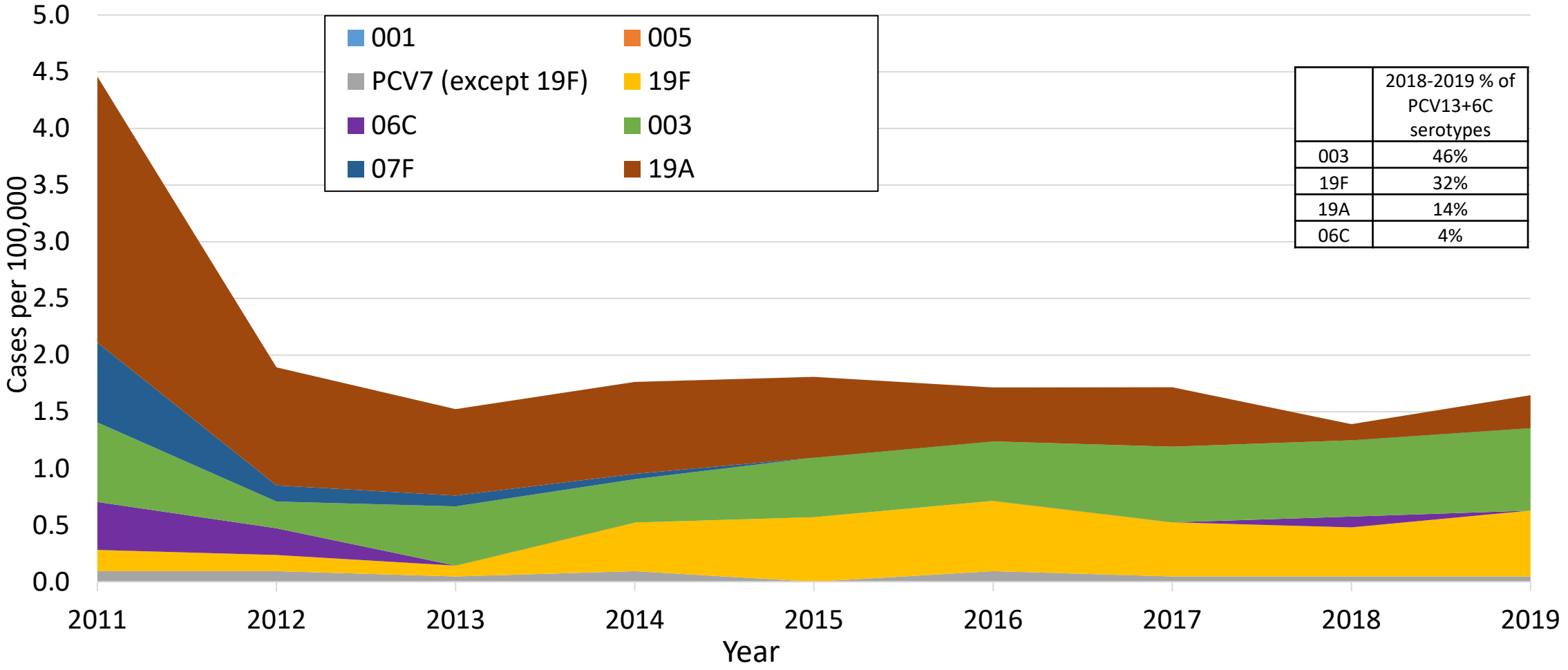
Active Bacterial Core Surveillance (ABCs) Report Emerging Infections Program Network Streptococcus pneumoniae, 2019. Available: SPN_Surveillance_Report_2019.pdf (cdc.gov)

Incidence rates of invasive pneumococcal disease (IPD) among children < 5 years old, 2007 - 2019



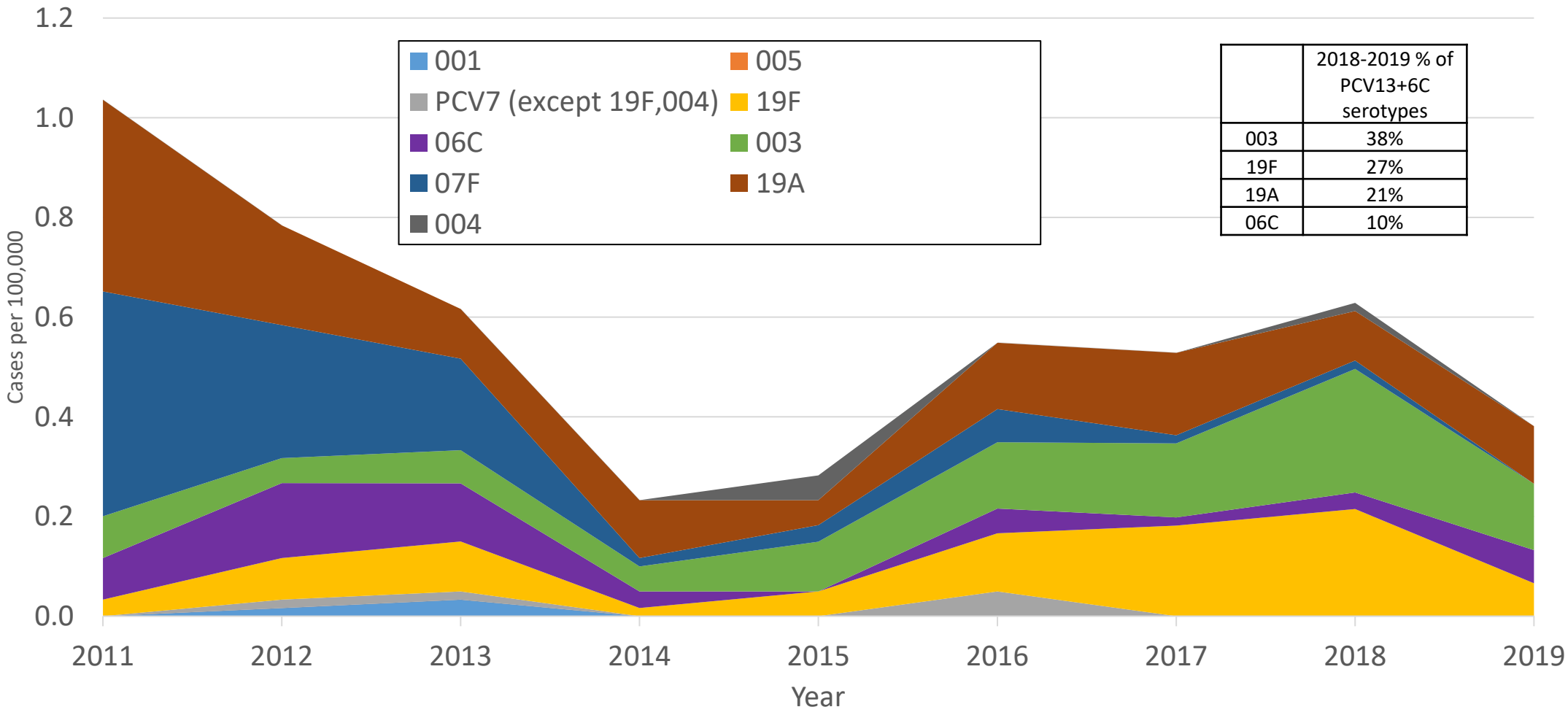
	2007-08 vs 2018-19 % Change (95%CI)
All IPD	-67 (-72, -61)
PCV13+ 6C	-89 (-92, -84)
Non-PCV13	-27 (-42, -7)

Incidence rates of IPD among children < 5 years old, 2011 – 2019, by PCV13+6C serotypes



	2018-2019 % of PCV13+6C serotypes
003	46%
19F	32%
19A	14%
06C	4%

Incidence rates of IPD among children 5-18 years old, 2011 – 2019, by PCV13+6C serotypes



	2018-2019 % of PCV13+6C serotypes
003	38%
19F	27%
19A	21%
06C	10%

Current Pediatric Invasive Pneumococcal Disease Burden Caused by Serotypes in PCV15 and PCV20

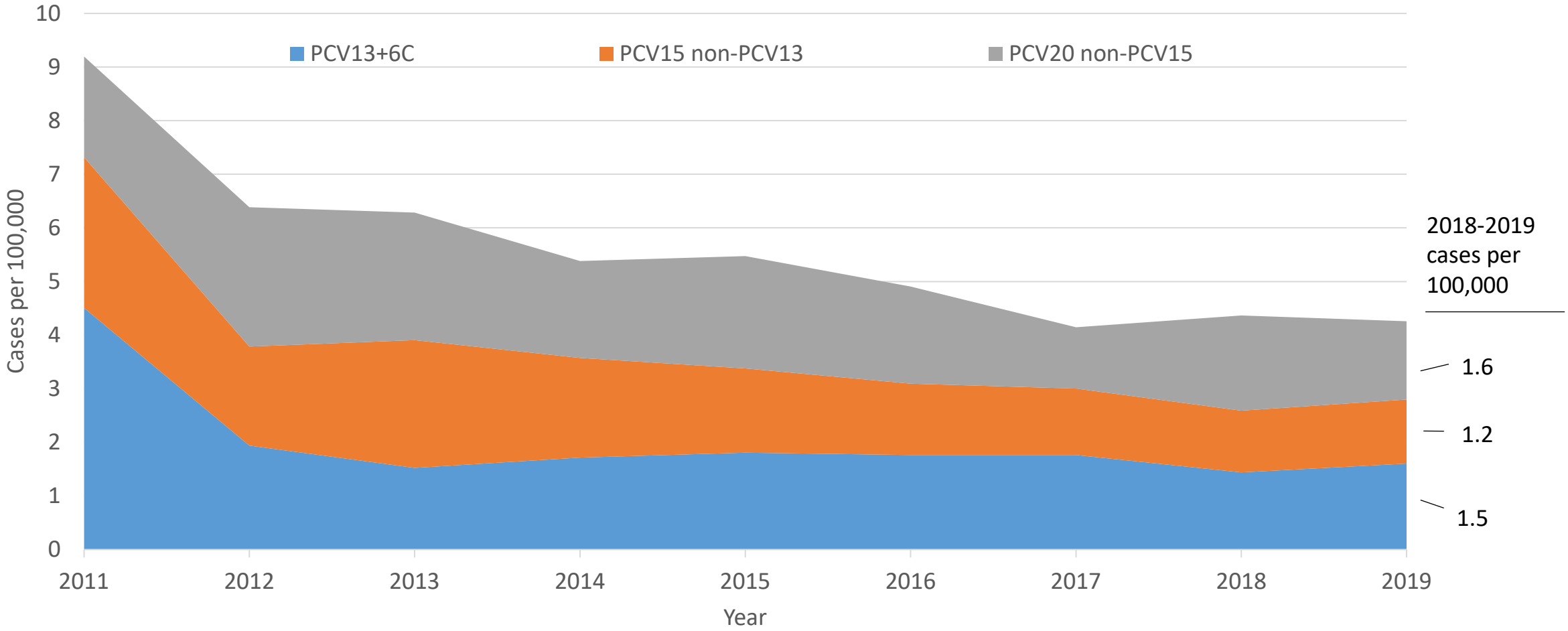
Serotypes contained in current and new pneumococcal vaccines

	1	3	4	5	6A	6B	7 F	9V	14	18 C	19 A	19 F	23 F	22 F	33 F	8	10 A	11 A	12 F	15 B	2	9N	17 F	20
PCV13																								
PCV15																								
PCV20																								
PPSV23																								

For analysis purposes:

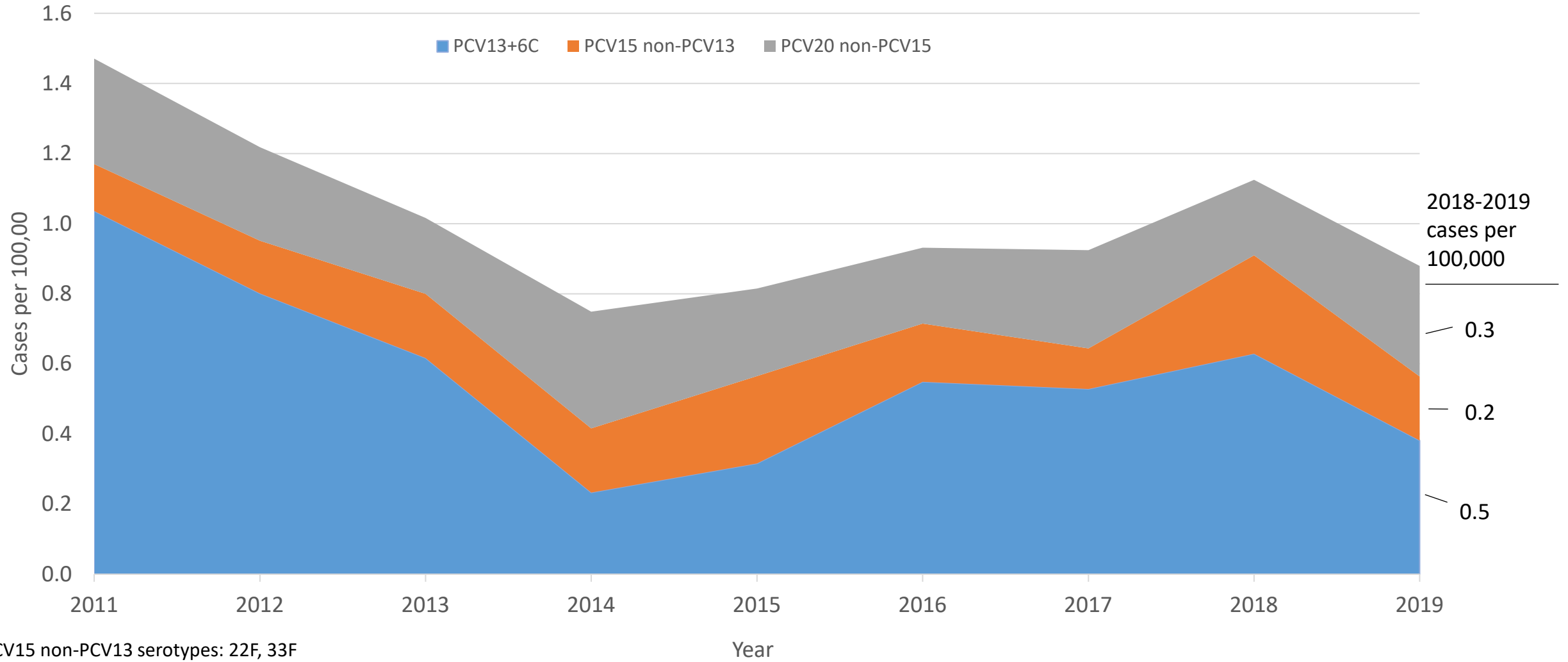
- **PCV15 non-PCV13**: includes serotypes **22F and 33F**
- **PCV20 non-PCV15**: includes serotypes **8, 10A, 11A, 12F, and 15B**
- **PPSV23 non-PCV20**: includes serotypes **2, 9N, 17F, and 20**

Incidence rates of IPD among children <5 years old, 2011 – 2019, by conjugate vaccine type



PCV15 non-PCV13 serotypes: 22F, 33F
PCV20 non-PCV15 serotypes: 8, 10A, 11A, 12F, 15B/C*
*15C grouped with 15B here becuase prior to whole genome sequencing (started in ABCs in 2015), 15B and 15C where indistinguishable using quellung

Incidence rates of IPD among children 5 -18 years old, 2011 – 2019, by conjugate vaccine type



PCV15 non-PCV13 serotypes: 22F, 33F
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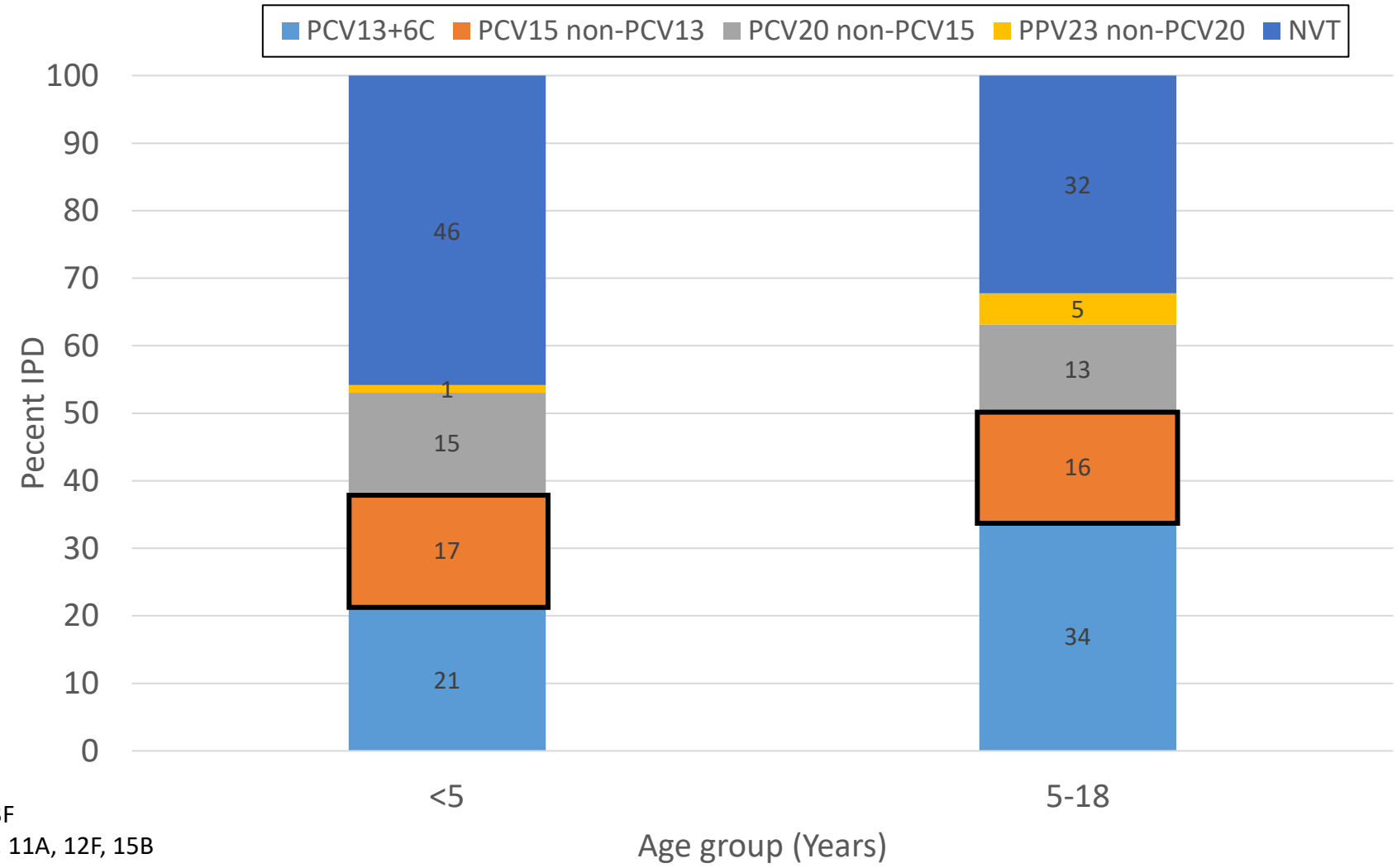
Proportion of IPD by vaccine-type and age group in 2018-2019



PCV15 non-PCV13 serotypes: 22F, 33F
PCV20 non-PCV15 serotypes: 8, 10A, 11A, 12F, 15B
PPSV23 non-PCV20 serotype: 2, 9N, 17F ,20

Pneumonia in Children

PCV13 impact on pneumonia in children

- Analysis of US insurance claims data 2008-9 vs 2014[1]
  - 17%-35% reduction in all-cause pneumonia rates depending on age group
  - Largest reductions among children <2 years old

- Analysis of US healthcare claims data 2007-9 vs 2011-2[2*]
  - 17%-21% reduction all-cause inpatient pneumonia cases among ages <2 and 2-4; no reductions in ages 5-17
  - 40% and 51% reduction inpatient pneumococcal pneumonia among ages <1 and 5-17 years, respectively; no reductions in ages 2-4 years

[1]Tong BMC 2018
[2] Simonsen Lancet 2014*

*Pfizer funded study

Pneumonia incidence among children

Age (years)	All-cause pneumonia (frequency per 100,000 person years)[1], 2014	All-cause inpatient pneumonia (cases per 100,000 population)[2], 2018–19
< 1	2,250	680
1	3,990	480
2–4	3,390	290
5-17	1,280	87

- Pneumococcal pneumonia among hospitalized children age <5 years (2011-2012)
  - 6-18 per 100,000[4]

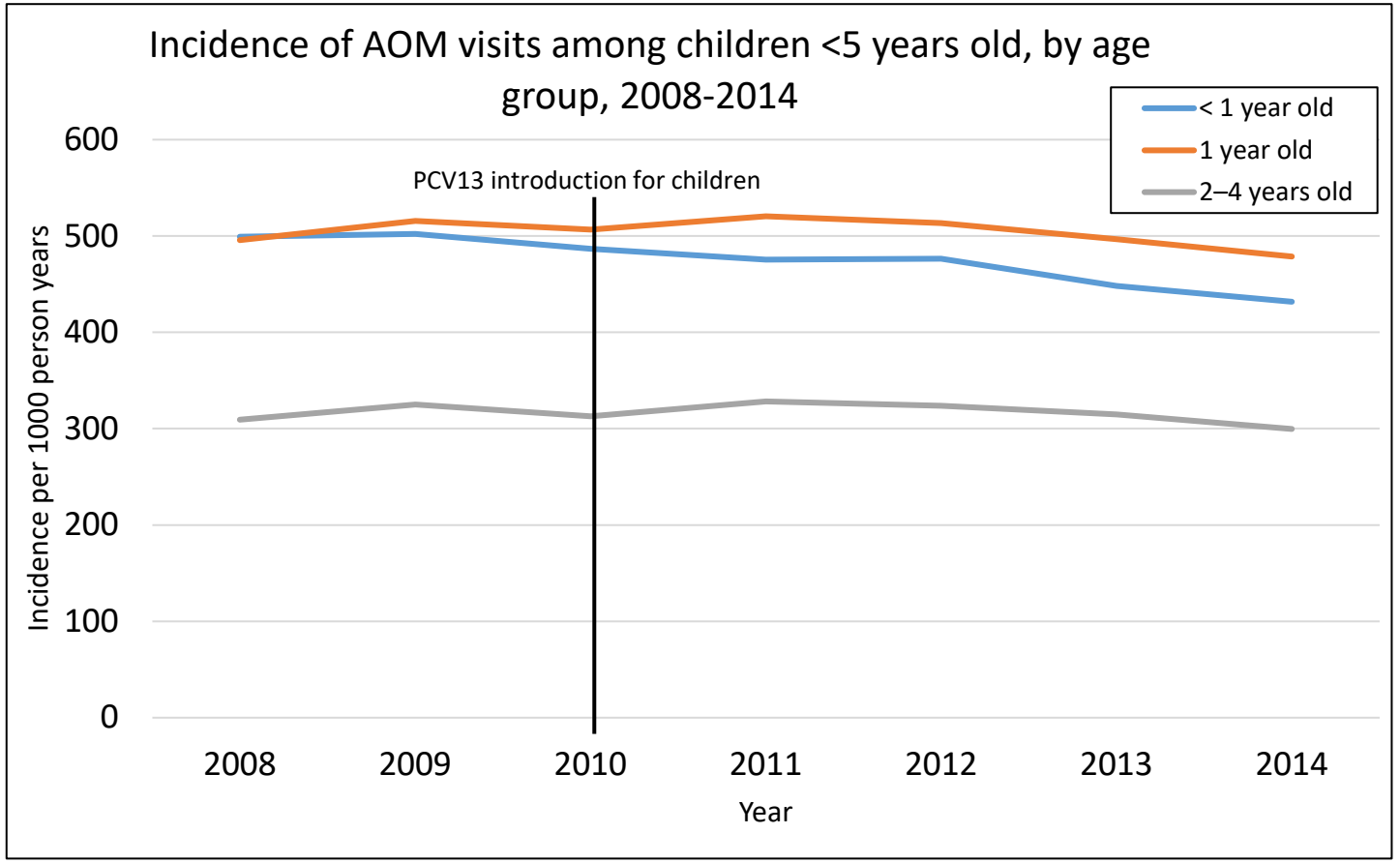
[1] Tong BMC 2018
[2] National Inpatient Sample, 2018-2019
[3] Simonsen et. al. lowest, Jain et. al. highest

*Pfizer funded study

Acute Otitis Media (AOM) in Children

PCV13 impact on Acute Otitis Media in children

- Analysis of US insurance claims data 2008 vs 2014[1]
  - 14% reduction in AOM among children ≤1



Tong et al, BMC 2018

Incidence of Acute Otitis Media among children

- Analysis of US insurance claims data, 2014[1]

Age (years)	AOM Incidence per 100,000 person years
< 1	43,180
1	47,860
2–4	29,980

- *S. pneumoniae* accounted for an estimated **24%** of disease in children with clinically diagnosed AOM[2]

[1]Adapted from Tong BCM 2018
[2] Kaur EJCMID 2022

Pneumococcal serotype distribution of children with AOM, 2015–2019

	NP swabs (N=209)	MEF taps (N=98)
PCV13+6C type	**8.1%**	**9.3%**
ST3	1.4%	3.1%
ST19F	3.3%	3.1%
ST19A	1.4%	3.1%
PCV15, non-PCV13 type	**6.2%**	**8.2%**
All other serotypes	**85.6%**	**84.7%**

Adapted from Kaur BCM 2022

Pneumococcal serotype distribution of children with AOM, 2015–2019

	NP swabs (N=209)	MEF taps (N=98)	IPD for children aged <5 years (NY EIP)
PCV13+6C type	**8.1%**	**9.3%**	**27%**
ST3	1.4%	3.1%	8%
ST19F	3.3%	3.1%	6%
ST19A	1.4%	3.1%	13%
PCV15, non-PCV13 type	**6.2%**	**8.2%**	**18%**
All other serotypes	**85.6%**	**84.7%**	**55%**

Adapted from Kaur BCM 2022
IPD from ABCs 2015–2019

Pneumococcal carriage serotype distribution in children, 2015-2019*

- Rochester, NY
  - Healthy children aged 6 or 9 months followed through 36 months of age
- Atlanta, GA
  - Children aged children 6-59 months presenting to a children's hospital ER

	NY NP swabs (N=492)	GA NP swabs (N=749)
PCV13 type	**7.9%**	**6.3%**
ST3	1.6%	0.7%
ST19F	2.6%	2.9%
ST19A	1.8%	1.2%
PCV15, non-PCV13 type	**2.6%**	**3.7%**
All other serotypes	**89.4%**	**91.0%**

Adapted from Kaur BCM 2022

Data curtesy of GA EIP, unpublished

*data for GA EIP available through March of 2019

Conclusions

- Among children aged <5 years, overall and PCV13-type IPD incidence plateaued since 2013-2014
- Incidence of invasive disease caused by PCV15 serotypes has also remained stable
- In children 5-18 years, rates of IPD are small
  - 25% had an indication for PCV13

Conclusions

- All-cause and pneumococcal pneumonia in children
  - Modest declines over time, varied by age group
  - Estimates of rates vary across study
  - Limited data on serotype distribution
- AOM
  - Modest declines among younger children, less in older children
  - Burden of AOM in children remains high
  - Pneumococcus contributes to 1/4 of clinically-diagnosed disease
- AOM and IPD data show that the two additional serotypes included in PCV15 cause 8–17% of remaining pneumococcal disease in children aged <5 years.

Questions

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.