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

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Advisory Committee on Immunization Practices
February 25th, 2021
Outline

- Invasive Pneumococcal Disease (IPD)
  - Impact of PCV13 on IPD burden and the serotype distribution
  - IPD burden caused by serotypes in PCV15 and PCV20
- Pneumonia in Adults
  - Impact of PCV13 on all-cause, pneumococcal, and vaccine type pneumonia
  - Pneumonia burden estimates and % caused by PCV15 and PCV20 serotypes
- Pneumococcal Vaccine Coverage in Adults
Impact of PCV13 on Invasive Pneumococcal Disease (IPD) Incidence and Serotype Distribution in the U.S.
### Serotypes contained in current pneumococcal vaccines

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<th>6 A</th>
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<th>7 F</th>
<th>9 V</th>
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<th>18 C</th>
<th>19 A</th>
<th>19 F</th>
<th>23 F</th>
<th>2</th>
<th>8</th>
<th>9 N</th>
<th>10 A</th>
<th>11 A</th>
<th>12 F</th>
<th>15 B</th>
<th>17 F</th>
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<td>PPSV23</td>
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</tbody>
</table>

For analysis purposes:

- **PCV13+6C**: Included serotype 6C with PCV13 types due to cross protection from 6A antigen
- **PPSV23 non-PCV13**: 11 unique serotypes not in PCV13
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 vaccine-type IPD incidence rates (cases per 100,000)
Incidence rates of invasive pneumococcal disease (IPD) among children < 5 years old, 2007 - 2018
Incidence rates of IPD among adults 19-64 years old, 2007-2018

### Adults 19-49 years old

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases per 100,000</th>
<th>PCV13 introduction for children</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>8</td>
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</tr>
<tr>
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<td>2010</td>
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<td>2011</td>
<td>2</td>
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<td>2013</td>
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<td>2014</td>
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<td>0</td>
<td></td>
</tr>
<tr>
<td>2018</td>
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</table>

### Adults 50-64 years old

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases per 100,000</th>
<th>PCV13 introduction for children</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
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<tr>
<td>2008</td>
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<td>2010</td>
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<td>2015</td>
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<tr>
<td>2016</td>
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<tr>
<td>2017</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

### 2007-08 vs 2017-18 % Change (95%CI)

- **All IPD**: -47 (-52, -42)
- **PCV13 + 6C**: -55 (-60, -48)
- **PPSV23 non-PCV13**: 20 (4, 39)
- **Non-vaccine type**: 5 (-11, 26)
Incidence rates of IPD among adults >65 years old, 2007 - 2018

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases per 100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>45</td>
</tr>
<tr>
<td>2008</td>
<td>40</td>
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<tr>
<td>2009</td>
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<td>2013</td>
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<td>2014</td>
<td>10</td>
</tr>
<tr>
<td>2015</td>
<td>5</td>
</tr>
<tr>
<td>2016</td>
<td>0</td>
</tr>
</tbody>
</table>

PCV13 introduction for children in 2007-08 vs 2017-18

- All IPD: -38 (-43, -33)
- PCV13+6C: -67 (-71, -62)
- PPSV23 non-PCV13: -12 (-24, 1)
- Non-vaccine type: -5 (-18, 9)
Incidence rates of IPD among children < 5 years old, 2011 – 2018, by PCV13+6C serotypes

Cases per 100,000


Year

2017-2018 % of PCV13+6C serotypes

| 003   | 42% |
| 005   |     |
| 19F   | 28% |
| 19A   | 22% |
| 06C   | 3%  |
Incidence rates of IPD among adults >65 years old, 2011 – 2018, by PCV13+6C serotypes

<table>
<thead>
<tr>
<th>Year</th>
<th>001</th>
<th>PCV7 (except 19F)</th>
<th>19F</th>
<th>06C</th>
<th>003</th>
<th>19A</th>
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</thead>
<tbody>
<tr>
<td>2011</td>
<td>16</td>
<td>14</td>
<td>12</td>
<td>10</td>
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<tr>
<td>2018</td>
<td>2</td>
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</tbody>
</table>

PCV13 introduction for adults ≥65 years old

2017-2018 % of PCV13+6C serotypes

<table>
<thead>
<tr>
<th>Serotype</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>003</td>
<td>60%</td>
</tr>
<tr>
<td>06C</td>
<td>14%</td>
</tr>
<tr>
<td>19A</td>
<td>10%</td>
</tr>
<tr>
<td>19F</td>
<td>9%</td>
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</table>
Remaining PCV13-type* disease among adults age 19-64 years old

- Similar trends in PCV13+6C serotypes observed in adults aged 19-64 years old
- Top PCV13+6C serotypes 2017-2018 (% of PCV13+6 serotypes)
  - 19-49 years old:
    - 003 (35%), 004 (26%), 19A (11%), 19F (11%)
  - 50-64 years old:
    - 003 (53%), 19A (11%), 004 (10%), 19F (9%)
- Serotype 4 increasing in recent years in adults age 19-64 years old
  - Primarily among adults experiencing homelessness¹

Current IPD Burden Caused by Serotypes in PCV15 and PCV20
Serotypes contained in current and new pneumococcal vaccines

<table>
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<th></th>
<th>1</th>
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For analysis purposes:

- PCV15 non-PCV13: includes serotypes **22F and 33F**
- PCV20 non-PCV15: includes serotypes **8, 10A, 11A, 12F, and 15B/C**
- PPSV23 non-PCV20: includes serotypes **2, 9N, 17F, and 20**
Incidence rates of IPD among adults 19-64 years old, 2011 – 2018, by conjugate vaccine type

PCV15 non-PCV13 serotypes: 22F, 33F
PCV20 non-PCV15 serotypes: 8, 10A, 11A, 12F, 15B/C
Incidence rates of IPD among adults >65 years old, 2011 – 2018, by conjugate vaccine type

PCV13+6C  PCV15 non-PCV13  PCV20 non-PCV15

2017-2018 cases per 100,000

PCV13 introduction for adults ≥65 years old

Cases per 100,000

PCV15 non-PCV13 serotypes: 22F, 33F
PCV20 non-PCV15 serotypes: 8, 10A, 11A, 12F, 15B/C
Proportion of IPD by vaccine-type and age group in 2017-2018

PCV15 non-PCV13 serotypes: 22F, 33F
PCV20 non-PCV15 serotypes: 8, 10A, 11A, 12F, 15B/C
PPSV23 non-PCV20 serotype: 2, 9N, 17F, 20
Pneumonia in Adults
PCV13 impact on all-cause pneumonia in adults

Indirect effects: pre-PCV13 introduction in adults ≥65 (before 2015)

- Analysis of Healthcare Cost and Utilization Project (HCUP) data, 2010-2014\(^1\)
  - No reductions in all-cause pneumonia

- Analysis of US adult healthcare claims data 2007-10 vs 2013-15\(^2*\)
  - 4%-19% reduction depending on risk groups and age group
  - No reductions among adults age ≥75 years

Direct and indirect effects: post-PCV13 introduction in adults ≥65 (after 2015)

- Louisville cohort study, 2014-2016\(^3*\)
  - 13.8 % reduction (95%CI: 8.5, 18.7) among adults age ≥65 years

\(^1\)Lessa ACIP October 2018
\(^2\)Pelton CID 2019*
\(^3\)Swerdlow Jun 2018 ACIP*

*Pfizer funded study
PCV13 impact on pneumococcal pneumonia in adults

Indirect effects: pre-PCV13 introduction in adults ≥65 (before 2015)

- Analysis of Healthcare Cost and Utilization Project (HCUP) data between 2010-2014 found declines in pneumococcal pneumonia¹
  - 35% reduction (-40% to -17%) for adults 65-74 years
  - No reductions among adults age ≥75 years

- Analysis of US adult healthcare claims 2007-10 vs 2013-15²*
  - 22%-51% reduction depending on risk groups and age
  - No reductions among adults age ≥75 years

¹Lessa ACIP October 2018
²Pelton CID 2019*
Estimated annual non-bacteremic pneumococcal pneumonia incidence by age group, 2013-2017

<table>
<thead>
<tr>
<th>Age, years</th>
<th>2013 vs 2014</th>
<th>2014 vs 2017</th>
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</thead>
<tbody>
<tr>
<td>18-49</td>
<td>-36 (-47, -25)</td>
<td>14 (-3, 34)</td>
</tr>
<tr>
<td>50-64</td>
<td>-34 (-45, -22)</td>
<td>17 (-1, 37)</td>
</tr>
<tr>
<td>≥65</td>
<td>-41 (-51, -28)</td>
<td>11 (-6, 31)</td>
</tr>
</tbody>
</table>

PCV13 introduction for adults ≥65 years old

Gierke, IDweek 2020
PCV13 impact on vaccine-type pneumococcal pneumonia in adults

Indirect effects: (UK data: no age-based adult PCV13 use)

- United Kingdom cohort study: Patients aged ≥16 years, 2013-2018
  - Increase in PCV13(non-PCV7) IRR 1.12 (95%CI 1.04-1.21)\(^1\)
  - Predominantly serotype 3 (57% of PCV13(non-PCV7) cases)

Direct and indirect effects: post-PCV13 introduction in adults ≥ 65 years (after 2015)

- Louisville cohort study: among ≥65 years old, 2014-2016
  - 31.5% reduction (95%CI: 8.3, 48.9) in PCV13-type pneumococcal pneumonia\(^2\)*
  - Serotype 3 (37% of PCV13 serotypes) 2015-2016\(^3\)*

\(^1\) Pick Thorax 2020
\(^2\) Swerdlow Jun 2018 ACIP*
\(^3\) Istruiz Vaccine 2020*

*Pfizer funded study
Pneumonia burden among adults

- All-cause pneumonia among adults age ≥65 years (2007-2016)
  - 630–2,300 per 100,000

- Recent systematic review of all-cause pneumonia (2010-2016)
  - 847–3,365 per 100,000 among adults age ≥65 years
  - 126–422 per 100,000 among adults age <65 years

- Approximately 11% (95% CI: 9 to 12) all-cause pneumonia are pneumococcal pneumonia

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1 Jain et al. lowest, Ramirez et al. highest, also includes Griffin et al., Hayes et al., and Simonsen et al.
2 McLaughlin et al. Vaccine 2020
3 Strategic Advisory Group of Experts on Immunization, October 2020

https://www.who.int/immunization/sage/meetings/2020/october/SAGE_eYB_Oct2020final.pdf?ua=1

*Pfizer funded study
Pneumonia vaccine-type burden among adults >65 years old

N=6347

9.0% All Cause CAP

4.2 ST3: 0.9%

N=585*

1.2 ST3: 1.9%

Time Period (Years)

2014-2016 2019-2020

PCV13+6C PCV15 non-PCV13 PCV20 non-PCV15 PPSV23 non-PCV20

*Preliminary data

US Prospective, Multicenter Surveillance Study of Hospitalized Community Acquired Pneumonia Using SSUAD, Courtesy of Pfizer, Inc.
Pneumococcal Vaccine Coverage in Adults
Proportion of Medicare beneficiaries aged ≥65 years with claims submitted for pneumococcal vaccination, regardless of prior vaccination – United States, 2010–2019*

* Each enrollment period is from January 1 through December 31 of the year. Denominators in each subgroup include all beneficiaries continuously enrolled in Medicare Parts A and B at least one year prior to December 31 of the respective year.

† Percentage with at least one claim for various vaccines categories since January 1, 1999 through the end of the enrollment period.

Data courtesy of Immunization Services Division, CDC - publication pending
Proportion of Medicare beneficiaries aged ≥65 years with claims submitted for pneumococcal vaccination, by race/ethnicity, 2019*

<table>
<thead>
<tr>
<th>Category</th>
<th>Total enrolled beneficiaries</th>
<th>Any pneumococcal</th>
<th>≥1 dose PPSV23</th>
<th>≥1 dose PCV13</th>
<th>Both PPSV23 and PCV13</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race/ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>14,248,613</td>
<td>65%</td>
<td>48%</td>
<td>51%</td>
<td>34%</td>
</tr>
<tr>
<td>Black</td>
<td>888,826</td>
<td>49%</td>
<td>35%</td>
<td>35%</td>
<td>21%</td>
</tr>
<tr>
<td>Asian</td>
<td>313,314</td>
<td>60%</td>
<td>43%</td>
<td>42%</td>
<td>25%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>184,605</td>
<td>46%</td>
<td>32%</td>
<td>30%</td>
<td>16%</td>
</tr>
<tr>
<td>Native American</td>
<td>69,870</td>
<td>57%</td>
<td>38%</td>
<td>40%</td>
<td>21%</td>
</tr>
<tr>
<td>Other Race</td>
<td>272,851</td>
<td>60%</td>
<td>44%</td>
<td>46%</td>
<td>29%</td>
</tr>
</tbody>
</table>

*Denominator in each subgroup includes all beneficiaries continuously enrolled in Medicare parts A and B from January 1, 2019 to December 31, 2019

Data courtesy of Immunization Services Division, CDC -publication pending
Changes in pneumococcal vaccine coverage among Medicare beneficiaries aged ≥65 years with immunocompromising conditions, U.S., 2010-2018

*Each enrollment period is from January 1 through December 31 of the year. Denominators in each subgroup include all beneficiaries continuously enrolled in Medicare Parts A and B at least one year prior to December 31 of the respective year.

†Percentage with at least one claim for various vaccines categories since January 1, 1999 through the end of the enrollment period.

Data courtesy of Immunization Services Division, CDC - publication pending
Vaccination coverage in adults aged 19–64 years with underlying conditions, National Health Interview Survey (NHIS) 2010–2018

PCV13 recommendations for immunocompromised adults ≥19 years old
### Estimated proportion of adults aged 19–64 years with underlying conditions who ever received pneumococcal vaccination, NHIS 2018

<table>
<thead>
<tr>
<th></th>
<th>Sample size</th>
<th>%</th>
<th>(95% CI)</th>
<th>Simple difference from 2017</th>
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</thead>
<tbody>
<tr>
<td>Overall</td>
<td>5,851</td>
<td>23.3 (22.0, 24.6)</td>
<td></td>
<td>-1.2</td>
</tr>
<tr>
<td>White</td>
<td>4,048</td>
<td>23.6 (22.1, 25.2)</td>
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<td>-1.3</td>
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<tr>
<td>Black</td>
<td>696</td>
<td>25.7 (21.8, 30.0)</td>
<td></td>
<td>3.1</td>
</tr>
<tr>
<td>Hispanic</td>
<td>656</td>
<td>18.5 (15.2, 22.4)*</td>
<td></td>
<td>-4.5</td>
</tr>
<tr>
<td>Asian</td>
<td>192</td>
<td>25.0 (17.3, 34.5)</td>
<td></td>
<td>1.7</td>
</tr>
<tr>
<td>Other</td>
<td>259</td>
<td>25.8 (19.3, 33.5)</td>
<td></td>
<td>-6.5</td>
</tr>
</tbody>
</table>

*p<0.05 for comparisons with white as the reference.*
Conclusions (Invasive Disease)

- Among children and adults, overall and PCV13-type IPD incidence plateaued since 2013-2014
- Incidence of invasive disease caused by PCV15 and PCV20 serotypes has also remained stable
- There are opportunities to prevent additional 30% IPD burden among adults through new PCV use
Conclusions (Pneumonia)

- All-cause pneumonia after pediatric PCV13 introduction
  - Modest declines among adults
  - Less impact among older adults
- Pneumococcal Pneumonia declined in adults after introduction of PCV13
  - Largest impact through indirect effects
  - Direct effects through adult PCV13 use not documented
- Reductions in vaccine-type pneumococcal pneumonia documented through PCV13 direct effects among adults
  - ST3 most common remaining PCV13-type pneumonia
- Burden estimates of all-cause, pneumococcal, and VT pneumococcal pneumonia vary across studies
- There are opportunities to prevent additional disease burden among adults through new PCV use
Conclusions (Coverage)

- Among adults age 65 years and older:
  - PPSV23 coverage has been relatively stable
  - PCV13 coverage has increased to around 50%, since 2014 recommendation for adults 65 or older

- PCV13 coverage among adults age ≥ 65 years with immunocompromising conditions remained low before 2014

- Pneumococcal vaccine coverage has been low (<25%) among adults 19-64 years with underlying conditions, despite long-standing recommendation for PPSV23 use and 2012 PCV13 recommendation for adults with immunocompromising conditions
Questions

For more information, contact CDC
1-800-CDC-INFO (232-4636)

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.