
Fernanda C. Lessa, Michael (Trey) Spiller, Elizabeth Soda, Daniel Weinberger, Marie R. Griffin, Carlos G. Grijalva, Nong Shang, Susan Petit, Melissa Tobin D’Angelo, Ann Thomas, Kirk Bol, Suzanne McGuire, Wei Xing, Tracy Pondo, Cynthia G. Whitney
Pneumonia and IPD Hospitalizations

- Decreases in US pneumonia and IPD hospitalizations after pediatric 7-valent PCV (PCV7)\textsuperscript{1,2,3} 
  - Vaccinated children and non-vaccinated individuals

- Rise in non-PCV7 serotypes (especially 19A) led to pediatric PCV13 introduction in 2010

Did the switch from PCV7 to PCV13 in 2010 result in further declines in Pneumonia and IPD hospitalizations in the US population?
Data Sources

- Statewide Hospitalization Data, 2005-2014
  - Healthcare Cost and Utilization Project (HCUP) (N=17)
  - State organizations or directly from Active Bacterial Core surveillance (ABCs) sites (N=6)

- Hospitalizations: Pre-PCV13 (Jan 1, 2005-June 30, 2009): 73.4 million
  Post-PCV13(July 1, 2010-December 31, 2014): 69.7 million
Case Definition: ICD-9-CM Codes

- All-cause pneumonia: 480-487
- Pneumococcal pneumonia: 481
- Invasive pneumococcal disease (IPD)
  - Combination of codes:
    a) Pneumococcal septicemia, meningitis or peritonitis
    b) Unspecified bacteremia, sepsis, meningitis, endocarditis, arthritis, pericarditis with a specific pneumococcal code
Control Conditions

Clinical classification software: up to 134 control categories used in each model
Data Analysis – Synthetic Control Method

- Data stratified by seven age groups
- Null model: model of monthly incidence controlling for seasonality
- Synthetic control model (SCM): time-series model of monthly incidence controlling for seasonality and including several control categories to adjust for confounders
- Rate Ratio (RR) < 1.0 = Vaccine Impact
RESULTS
Proportion of Hospitalizations with Outcome of Interest

Proportion of Hospitalizations Coded as All-Cause Pneumonia

Proportion of Hospitalizations Coded as Pneumococcal Pneumonia
Control categories with highest weights (varied by age group):
1) Respiratory Infections (excluding pneumonia codes, and other codes related to pneumococcal disease)
2) Viral infection
3) Skin and subcutaneous tissue infections
All-Cause Pneumonia among Adults

Rate Ratio (95% CrI)

Model type
- Null Model
- Synthetic Control
Pneumococcal Pneumonia
Pneumococcal Pneumonia among Children (ICD-9: 481)

Control categories with highest weights (varied by age group):
1) Respiratory infections
2) Other gastrointestinal disorders
3) Anemia
Pneumococcal Pneumonia among Adults

Rate Ratio (95% CrI)

- 18-39
- 40-64
- 65-74
- 75+

Model type:
- Null Model
- Synthetic Control
Invasive Pneumococcal Disease (IPD)
Control categories with highest weights (varied by age group):
1) Chronic ulcer of skin
2) Other upper respiratory disease (e.g. polyp of nasal cavity, nasal septum deviation, unspecified disease of larynx)
3) Biliary tract disease
IPD among Adults
Cumulative Number of Hospitalizations Averted since PCV13 Introduction, 2010–2014

<table>
<thead>
<tr>
<th>Age Group</th>
<th>All-Cause Pneumonia (95% CrI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>38,418 (18383–66824)</td>
</tr>
<tr>
<td>2-4</td>
<td>17,026 (6736–73763)</td>
</tr>
<tr>
<td>5-17</td>
<td>3,059 (-5283, 15922)</td>
</tr>
<tr>
<td>18-39</td>
<td>-10,385 (-38697, 30111)</td>
</tr>
<tr>
<td>40-64</td>
<td>-86,470 (-202457, 80953)</td>
</tr>
<tr>
<td>65-74</td>
<td>30185 (-20021,67478)</td>
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<tr>
<td>75+</td>
<td>107167(-113643,176998)</td>
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### Cumulative Number of Hospitalizations Averted since PCV13 Introduction, 2010–2014

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<td>743 (316–1443)</td>
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<td>1929 (796 – 3767)</td>
</tr>
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<td>18-39</td>
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<td>2032 (1134 – 4492)</td>
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<td>-86,470 (-202457, 80953)</td>
<td>5660 (3641 – 9446)</td>
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<td>5796 (3534 – 7876)</td>
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<td>75+</td>
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<td><strong>9067 (-194 – 12273)</strong></td>
</tr>
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6,370 (206–8765) cases averted by 2013
Cumulative Number of Hospitalizations Averted since PCV13 Introduction, 2010–2014

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<tr>
<th>Age Group</th>
<th>All-Cause Pneumonia n (95% CrI)</th>
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<th>IPD n (95% CrI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>38,418 (18383–66824)</td>
<td>743 (316–1443)</td>
<td>874 (469 –1497)</td>
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<tr>
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<td>1257 (756–2214)</td>
<td>368 (254 –700)</td>
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<tr>
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<td>1929 (796 –3767)</td>
<td>335 (95 –2027)</td>
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<td>2983 (-3418 –10328)</td>
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<td>5796 (3534 –7876)</td>
<td>1277 (433–5847)</td>
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<tr>
<td>75+</td>
<td>107167(-113643,176998)</td>
<td>9067 (-194 –12273)</td>
<td>1724 (-1736 –4981)</td>
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</tbody>
</table>
Summary

- Declines in all-cause pneumonia only observed in children < 5 years old after PCV13 introduction

- Pneumococcal pneumonia hospitalizations declined in all age groups, but for adults ≥75 years no significant declines observed in 2013 and 2014

- No decline in IPD hospitalizations for age group 40-64 years and ≥75 years old
Limitations

- Changes in hospital coding practices during analysis period may affect trends over time

- All-cause pneumonia includes healthcare-associated pneumonia

- Administrative data likely underestimate specific outcomes related to pneumococcal disease
  - Underreporting observed when comparing CT ABCs data and State inpatient data especially for adults
Conclusion

- Lack of measurable impact on all-cause pneumonia in persons ≥ 5 years likely related to:
  - Use of nonspecific outcome (only small fraction of all-cause pneumonia is vaccine-type pneumococcal pneumonia)
  - Small expected benefit given PCV7 effects already in place at baseline

- Direct and indirect effect observed for pneumococcal pneumonia and IPD hospitalizations after switching to PCV13

- No decline in IPD hospitalizations among age groups 40-64 years and ≥75 years when adjusting for confounders
  - Wide credible intervals
  - Under reporting/coding of IPD on hospitalization data
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THANK YOU!