Effect of the 13-valent Pneumococcal Conjugate Vaccine on Nasopharyngeal Colonization by *Streptococcus pneumoniae* — Alaska, 2008–2012

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What is *Streptococcus pneumoniae* (i.e., pneumococci)?

- **Gram positive diplococcus**
  - Gram positive = take up purple stain
  - Diplococcus = spherical shaped bacteria occurring in pairs
- >80 pneumococcal serotypes (distinguishable variants)
How does Strep pneumo make us sick?

- Asymptomatic nasopharyngeal colonization
- Mucosal disease (commonly middle ear infections)
- Pneumonia
- Invasive disease (e.g., blood-stream infection, meningitis)

Source: Immunopaedia.org
History of Invasive Pneumococcal Disease (IPD) in Alaska

- Alaska Native children suffered from higher rates of IPD than children in general US population
- 7-valent pneumococcal conjugate vaccine (PCV7) introduced into childhood immunization schedule in 2001
  - Protected against the 7 pneumococcal serotypes that accounted for a majority of IPD cases at that time
  - Reduced IPD in children
  - Indirectly reduced IPD in adults
- Observed increase in colonization and disease by pneumococcal serotypes not in PCV7
  - Eroded some of the benefits of PCV7
13-valent Pneumococcal Conjugate Vaccine (PCV13)

- FDA licensed PCV13 in February 2010
  - Included 6 additional serotypes
  - Introduced into Alaska childhood immunization schedule in April 2010
- FDA licensure based on *in vitro* immunogenicity studies
  - *in vitro* = laboratory based studies
  - Real world data that vaccine works in humans lacking
Objective

- To describe the impact of introducing PCV13 into childhood immunization schedule on pneumococcal colonization
METHODS
Alaska PCV13 Vaccination Schedule

- Four doses at ages 2, 4, 6 and 12–15 months
- If incomplete PCV7 schedule – one dose of PCV13 to children aged 24–59 months
- If completed 4 doses of PCV7 – one supplemental dose of PCV13 to children aged 14–59 months
Study Population

- Recruited convenience sample of participants
  - All ages at 8 rural villages
  - Children aged <5 years at 2 urban pediatric clinics
- Study period: 2008-2012
Data Collection

- Research staff visited each clinic/village same time annually
- Interviewed participants/guardians to obtain demographic information
- Inserted swab into nasopharynx to obtain specimen
- Swab placed in media for transport (STGG tube)
Laboratory Methods

- Swab specimen plated on to culture media
- Conduct tests to identify the presence of *S. pneumoniae*
- Determine the pneumococcal serotype
Data Analysis

- Determined frequencies of different serotypes by 3 age groups: <5 years, 5-17 years, >18 years
RESULTS
### Demographics of Participants Recruited 2008–2012 (Total Swabs Collected = 18,207)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. nasopharyngeal swabs</td>
<td>16098</td>
<td>2109</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5 years</td>
<td>14%</td>
<td>100%</td>
</tr>
<tr>
<td>5–17 years</td>
<td>34%</td>
<td></td>
</tr>
<tr>
<td>≥18 years</td>
<td>52%</td>
<td></td>
</tr>
<tr>
<td>Male sex</td>
<td>51%</td>
<td>54%</td>
</tr>
<tr>
<td>AI/AN Race</td>
<td>99%</td>
<td>51%</td>
</tr>
<tr>
<td>% of homes with running water</td>
<td>52%</td>
<td>100%</td>
</tr>
<tr>
<td>Antibiotic use &lt;90 days among children &lt;5 years</td>
<td>50%</td>
<td>29%</td>
</tr>
</tbody>
</table>
PCV Status Among Alaskan Children <5 years

Urban (Anchorage) Children

- One PCV13 Dose
- 2 PCV13 Doses
- 3 PCV13 Doses
- 4 PCV13 Doses
- UTDAge

Study Year

2008 2009 2010 2011 2012

% Children Vaccinated

0 20 40 60 80 100

Rural Children

Study Year

2008 2009 2010 2011 2012

% Children Vaccinated

0 20 40 60 80 100
Prevalence of Vaccine-serotype Pneumococcal Colonization by Age and Geography — Alaska, 2008–2012

P-value for trend <0.01 for all 4 groups

P-value for trend <0.01 for all 4 groups
DISCUSSION
Limitations

- Only 2 years of follow-up after PCV13 introduction
  - Unclear if changes in serotype distribution are ongoing

- Participants voluntarily recruited
  - Results might not be generalizable
Strengths

- **Large number of participants enrolled**
  - Allows for precise prevalence estimates

- **Excellent data available on children’s vaccination status**
  - Allows for correlating changes in serotypes with vaccine introduction

- **Among the first to report colonization data following PCV13 introduction**
  - Informs scientific community about the early impact of PCV13

- **Unique because it enrolled adults**
  - Allows for evaluating the indirect effect of vaccinating children on adult colonization
Conclusions

- PCV13 introduction resulted in reduced colonization by vaccine-serotype pneumococci
  - among vaccinated children aged <5 years (direct effect)
  - unvaccinated adults (indirect effect)
- Overall prevalence of pneumococcal colonization remained unchanged because increased colonization by non-vaccine serotype pneumococci
- IPD surveillance will be necessary to determine how the changes in colonization impact the epidemiology of IPD
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