**Dynamics of colonization of Streptococcus pneumoniae strains in healthy Peruvian children before and after PCV7 introduction**

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**Background**

Streptococcus pneumoniae (Spn) causes severe bacterial pneumonia, otitis media, bacteremia, and meningitis in young children.

- Typically, colonization is asymptomatic, but bacterial acquisition is the first step in pathogenesis.
- Little is known about the effects of pneumococcal conjugate vaccine introduction on complex carriage dynamics, including the order and frequency of Spn serotype colonization.

- In Peru, the 7-valent pneumococcal vaccine (PCV7) was introduced into the national immunization program in July 2009.

**Goal**

Assess Spn carriage dynamics before and after vaccine introduction among children in the Peruvian Andes.

**Methods**

- Prospective, household-based study (RESPA-PERU) of young children conducted in San Marcos, Cajamarca, Peru.
- Eligible children were less than three years of age at time of enrollment and anticipated remaining in the study area for at least one year.
- Children were followed until three years of age or until the end of the study, which lasted from May 2009 to September 2011.
- Additional newtons were added to the cohort to replace children leaving or aging out of the cohort.
- Nasopharyngeal (NP) samples were collected monthly. DNA was extracted from NP samples and bacterial density was quantified by PCR-based methods.
- S. pneumoniae strains were serotyped by Quellung reactions (2011) and multiplex PCR (2009).

**Statistical Analyses**

- Proportion of children with Spn colonization during the two years of the study period
- Distribution of serotypes detected in 2009 and 2011
- Identify persisters’ strains: strains present at both the first and last NP swab
- Identify recolonizers: strains that replaced a different, earlier strain and were detected at the last NP swab
- Differences in bacterial density between PCV7 and non-PCV7 types, as well as between first and last detected colonizing strains
- Seasonal trends in the carriage of PCV7 and non-PCV7 types

**Results**

**I. High rates of Spn carriage in Peruvian children**

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean age of cohort entry (months)</th>
<th>Mean age at last NP swab (months)</th>
<th>Total carriage events</th>
<th>Total carriage events (n=509)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>10 (5, 18)</td>
<td>35 (20, 45)</td>
<td>94%</td>
<td>32%</td>
</tr>
<tr>
<td>2011</td>
<td>14 (7, 24)</td>
<td>42 (26, 58)</td>
<td>100%</td>
<td>50%</td>
</tr>
</tbody>
</table>

**II. Similar distributions of first and last strain detected in both years**

**III. In 2009, non-PCV7 types increase relative to vaccine types in Sep-Nov; in 2011, non-PCV7 types dominate**

**IV. Persisting vs. re-colonizing strains**

**V. Most common strains, a. 2009, b. 2011**

**Limitations**

- Only the dominant serotypes in NP samples were detected, so the prevalence and effect of co-colonization is not known.
- Serotyping for 2009 and 2011 isolates was performed using two different methods (multiplex PCR and Quellung reactions, respectively), so we cannot directly compare serotype distributions.
- The 2011 cohort was younger, due to the recruiting of infants to replace older children, which may affect serotype distribution in 2011 as compared to 2009.

**Conclusions**

- Nearly all children in 2009 and 2011 (>89%) carried S. pneumoniae.
- Half were recolonized by a different serotype, with strains of serogroup 6 most likely to recolonize children in 2009 and serogroups 19A, 19F, and 15C most likely to recolonize children in 2011.

**Ethical approval**

The RESPRA-PERU study was approved by the Ethical Review Board (ERB) of the Institute of Investigación Nutricional, and the Institutional Review Boards (IRB) of Vanderbilt University and Emory University. The ERB/IRB-approved written informed consent form was obtained from one parent of participating subjects at enrollment. The study was also approved by the local health authorities and by community leaders.

**Acknowledgments**

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