



**Invasive *Streptococcus pneumoniae* in Canada 2011: Study of Antimicrobial
Resistance and Serotypes**

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Introduction

Infections caused by *Streptococcus pneumoniae* are of critical concern, as respiratory and invasive isolates are commonly resistant to many drug classes, including penicillins. They are also frequently multi-drug resistant (simultaneous resistance to ≥ 3 structurally unrelated classes). A conjugate vaccine Prevnar® (PCV-7: 4, 6B, 9V, 14, 18C, 19F, 23F) has been used in Canada to great effect, reducing the number of invasive *S. pneumoniae* infections observed in children. However, *S. pneumoniae* serotypes that are not related to the vaccine are rising in Canada. For this reason, a new vaccine, PCV-13 (PCV-7 + 1, 3, 5, 6A, 7F and 19A), was recently released in Canada to combat the rise of non-vaccine serotypes, especially 19A. This vaccination allows for broader coverage of *S. pneumoniae* serotypes.

The purpose of my summer research project was to study invasive *S. pneumoniae* in Canada (2011) and assess their serotypes and antimicrobial resistance.

Hypotheses

PCV-13 will provide greater coverage of *S. pneumoniae* isolates than PCV-7.

With the continued use of these conjugated vaccines, a greater proportion of non-vaccine serotypes will circulate in Canada. These serotypes will also be antimicrobial resistant.

Methods

Isolates tested were obtained from all geographic regions of Canada during the 2011 year. The recently formed partnership between the Canadian Antimicrobial Resistance Alliance (CARA) and the National Streptococcus Unit at the National Microbiology Lab (Public Health Agency of Canada) allowed these samples to be obtained. All isolates were invasive *S. pneumoniae* isolated from sterile sites, which were forwarded to the National Microbiology Lab (NML) from Canadian provincial public health laboratories, regional health units and reference centres. *S. pneumoniae* isolates were serotyped by the (NML) using a PCR multiplex, as described at: <http://www.cdc.gov/ncidod/biotech/strep/pcr.htm>. Antimicrobial susceptibility testing was done following CLSI methods using custom designed panels. The panels contain antimicrobials from the penicillin, cephalosporin, fluoroquinolone, carbapenem, macrolide, sulfonamide, glycopeptide and tetracycline drug classes.

Results

In 2011, 1255 isolates were collected. Of these, 73 were serotypes covered by PCV-7. This shows vaccine coverage of only 5.8%. 617 isolates were covered by PCV-13. This is a vaccine coverage of 49.2%, showing significant greater coverage of 2011 isolates than PCV-7 ($p < 0.001$).

Table 1: Susceptibility of the 10 most common *S. pneumoniae* serotypes to select antibiotics, using CLSI breakpoints.

| Serotype | Number of Isolates | Antibiotic Susceptibility (%) | | | | |
|----------|--------------------|-------------------------------|--------------|-------------------------------|--------------------------|-------------------------|
| | | Clarithromycin | Levofloxacin | Trimethoprim-Sulfamethoxazole | Ceftriaxone (meningitis) | Penicillin (meningitis) |
| 7F | 253 | 96.8 | 100 | 99.6 | 99.6 | 98.8 |
| 19A | 162 | 47.5 | 98.8 | 69.1 | 79 | 61.7 |
| 3 | 99 | 97 | 100 | 97 | 100 | 100 |
| 22F | 95 | 77.9 | 99 | 100 | 100 | 99 |
| 12F | 59 | 39 | 100 | 96.6 | 100 | 100 |
| 6C | 47 | 80.9 | 100 | 91.5 | 97.9 | 85.1 |
| 15A | 38 | 18.4 | 100 | 94.7 | 94.7 | 18.4 |
| 11A | 35 | 74.3 | 100 | 71.4 | 100 | 100 |
| 8 | 34 | 97.1 | 100 | 97.1 | 100 | 97.1 |
| 9N | 32 | 100 | 100 | 96.9 | 100 | 100 |

The most multi-drug resistant (MDR) serotypes were found to be 19A (found in PCV-13) and 15A (non-vaccine related). 15A was found to be resistant to clarithromycin, clindamycin and doxycycline in 27 isolates. 19A showed resistance to clarithromycin, clindamycin, trimethoprim-sulfamethoxazole and penicillin in 26 isolates. In total, 76.3% (29) of 15A and 26.5% (43) of 19A isolates from Canada were multi-drug resistant in 2011.

Conclusions

1. The PCV-13 vaccination provided coverage for 49.2% of the isolates collected in 2011, while PCV-7 only provided coverage for 5.8%.
2. The two most common serotypes of *S. pneumoniae* circulating in Canada are 7F and 19A, both of which are included in PCV-13.
3. The most multi-drug resistant serotypes of *S. pneumoniae* 19A and 15A.