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Introduction and Purpose

- Nasopharyngeal colonization by *Streptococcus pneumoniae* is a prerequisite for invasive pneumococcal disease (IPD)
- Heptavalent pneumococcal conjugate vaccines (PCV7) was added to the infant vaccine schedule in Switzerland in 2005 and was replaced by the 13-valent conjugate vaccine (PCV13) in 2011
- In some countries, adults have profited from indirect protection due to the use of PCV7 and/or PCV13 in infants ('herd immunity').
- A careful surveillance of the dynamics of pneumococcal serotypes within both invasive and colonizing *S. pneumoniae* is important.

Objectives of the study

- Analysis of serotype distribution within Swiss patients with IPD (2010-2012)
- Analysis of serotype distribution within Swiss individuals with colonizing *S. pneumoniae* (2010-2012)

Methods

- Swabs (mainly nasopharyngeal but also ear and oropharyngeal) were collected by general practitioners taking part in the Sentinel study and subsequently sent to the Swiss National Reference Centre for *S. pneumoniae* (NRCP). Samples were most often taken from children with acute otitis media.
- Invasive and colonizing *S. pneumoniae* isolates were received and typed at the NRCP using standardised methods (Quellung reaction).
- An exact *P* value was used for the Cochran-Armitage χ^2 test of trend, to examine single invasive and colonizing *S. pneumoniae* serotypes/serogroups in Switzerland (2010-2012) (Table 2 and 3). $P<0.05$ is considered significant. The same test was used to analyse the characteristics of included individuals (Table 1).

Results

1. Characteristics of individuals included in this study, 2010-2012 (Table 1)

- Invasive *S. pneumoniae* was isolated from 2936 individuals.
- The proportion of individuals with invasive *S. pneumoniae* of less than 2 years of age significantly decreased.
- For colonizing *S. pneumoniae*, 422 (2010), 539 (2011) and 439 (2012) swabs were analysed and pneumococci were isolated for 137 (32.5%), 145 (26.9%) and 108 (24.4%) individuals, respectively. This means that there was a decreasing trend of recovered *S. pneumoniae* (Cochran-Armitage χ^2 test; $P<0.01$).
- There were significantly fewer isolates available from toddlers less than 2 years old in more recent years.

Table 1: Characteristics of individuals having invasive or colonizing *S. pneumoniae*

| | Number of individuals with invasive or colonizing <i>S. pneumoniae</i> (%) | | | |
|--|--|------------|------------|-----------|
| | 2010 | 2011 | 2012 | <i>P*</i> |
| Invasive <i>S. pneumoniae</i> | 974 | 1031 | 931 | |
| Age | | | | |
| <2 years | 31 (3.2) | 31 (3.0) | 15 (1.6) | .03 |
| 2-15 years | 51 (5.2) | 61 (5.9) | 39 (4.2) | .3 |
| 15-64 years | 362 (37.2) | 353 (34.2) | 323 (34.7) | .2 |
| >64 years | 499 (51.2) | 532 (51.6) | 475 (51.0) | .9 |
| unknown | 31 (3.2) | 54 (5.2) | 79 (8.5) | <0.01 |
| Sex | | | | |
| Male | 532 (54.6) | 528 (51.2) | 482 (51.8) | .2 |
| Female | 384 (39.4) | 433 (42.0) | 406 (43.6) | .07 |
| unknown | 58 (6.0) | 70 (6.8) | 43 (4.6) | .2 |
| Colonising <i>S. pneumoniae</i> | 137 | 145 | 108 | |
| Age | | | | |
| <2 years | 59 (43.1) | 48 (33.1) | 32 (29.9) | .02 |
| 2-15 years | 60 (43.8) | 66 (45.5) | 47 (43.9) | 1 |
| 15-64 years | 17 (12.4) | 24 (16.6) | 19 (17.8) | .3 |
| >64 years | 1 (0.7) | 7 (4.8) | 9 (8.4) | .01 |
| Sex | | | | |
| Male | 63 (46.0) | 74 (51.0) | 45 (42.1) | .6 |
| Female | 73 (53.3) | 70 (48.3) | 59 (55.1) | .9 |
| unknown | 1 (0.7) | 1 (0.7) | 4 (3.7) | .1 |

*Exact *P* values for Cochran-Armitage χ^2 test

2. Changing epidemiology within invasive *S. pneumoniae* (Table 2)

- There were 974 (2010), 1031 (2011) and 931 (2012) strains of invasive *S. pneumoniae* isolated in Switzerland.
- The annual proportion of PCV7 serotypes continued to decrease (2010: 24.7% versus 2012: 16.0%, $p<0.001$), non-PCV7 serotypes included in PCV13 remained stable (43.1% versus 45.0%, $p=0.4$) and non-PCV13 serotypes significantly increased (32.1% versus 39.0%, $p=0.002$).
- As for the analysis of single serotypes, PCV7 serotypes 14, 18C and 9V decreased significantly.
- For non-PCV13 serotypes, two serogroups (12 and 24) were found to increase ($p=0.01$ and $p=0.003$, respectively).

3. Changing epidemiology within colonizing *S. pneumoniae* (Table 3)

- There were 137 (2010), 145 (2011) and 108 (2012) isolates of colonizing *S. pneumoniae* available for serotype analysis.
- Serotype 3 (15.2% ± 4.4) and 19A (13.7% ± 7.4) were identified most frequently.
- Serotype 6A and serogroup 21 were found to decrease significantly.
- Only serogroup 22 increased significantly ($p=0.03$).

Table 2: Proportion of serotypes/serogroups among invasive *S. pneumoniae*, Switzerland 2010-12

| Serotype/Serogroup ^a | Invasive <i>S. pneumoniae</i> , N (%) | | | <i>P</i> ^b |
|---------------------------------|---------------------------------------|---------------|--------------|-----------------------|
| | 2010 (n=974) | 2011 (n=1031) | 2012 (n=931) | |
| 14 | 63 (6.5) | 56 (5.4) | 30 (3.2) | .001 |
| 18C | 24 (2.5) | 17 (1.6) | 10 (1.1) | .02 |
| 19F | 31 (3.2) | 30 (2.9) | 20 (2.1) | .1 |
| 23F | 27 (2.8) | 28 (2.7) | 31 (3.3) | .5 |
| 4 | 51 (5.2) | 48 (4.7) | 33 (3.5) | .07 |
| 6B | 16 (1.6) | 22 (2.1) | 12 (1.3) | .5 |
| 9V | 29 (3.0) | 19 (1.8) | 13 (1.4) | .01 |
| 1 | 57 (5.9) | 49 (4.8) | 41 (4.4) | .1 |
| 19A | 99 (10.2) | 119 (11.5) | 120 (12.9) | .07 |
| 3 | 127 (13.0) | 168 (16.3) | 137 (14.7) | .3 |
| 7F | 108 (11.1) | 106 (10.3) | 97 (10.4) | .6 |
| 6A | 29 (3.0) | 21 (2.0) | 24 (2.6) | .5 |
| 8 | 46 (4.7) | 61 (5.9) | 53 (5.7) | .4 |
| 9 | 32 (3.3) | 32 (3.1) | 33 (3.5) | .8 |
| 22 | 61 (6.3) | 62 (6.0) | 55 (5.9) | .7 |
| 15 | 27 (2.8) | 22 (2.1) | 30 (3.2) | .6 |
| 11 | 16 (1.6) | 24 (2.3) | 19 (2.0) | .6 |
| 23 | 18 (1.8) | 22 (2.1) | 25 (1.7) | .2 |
| 38 | 7 (0.7) | 14 (1.4) | 7 (0.8) | 1.0 |
| 35 | 21 (2.2) | 5 (0.5) | 23 (2.5) | .7 |
| 20 | 9 (0.9) | 10 (1.0) | 6 (0.6) | .7 |
| 10 | 8 (0.8) | 19 (1.8) | 18 (1.9) | .06 |
| 12 | 5 (0.5) | 9 (0.9) | 16 (1.7) | .01 |
| 24 | 3 (0.3) | 7 (0.7) | 15 (1.6) | .003 |
| 6C | 21 (2.2) | 23 (2.2) | 16 (1.7) | .5 |
| others | 39 (4.0) | 38 (3.7) | 47 (5.0) | .3 |

Table 3: Proportion of serotypes/serogroups among colonizing *S. pneumoniae*, Switzerland 2010-12

| Serotype/Serogroup ^a | Colonising <i>S. pneumoniae</i> , N (%) | | | <i>P</i> ^b |
|---------------------------------|---|--------------|--------------|-----------------------|
| | 2010 (n=137) | 2011 (n=145) | 2012 (n=108) | |
| 14 | 0 (0.0) | 2 (1.4) | 1 (0.9) | .6 |
| 18C | 1 (0.7) | 1 (0.7) | 1 (0.9) | .8 |
| 19F | 7 (5.1) | 11 (7.6) | 3 (2.8) | .4 |
| 23F | 4 (2.9) | 6 (4.1) | 2 (1.9) | .5 |
| 4 | 2 (1.5) | 3 (2.1) | 2 (1.9) | 1.0 |
| 6B | 2 (1.5) | 1 (0.7) | 0 (0.0) | .09 |
| 9V | 0 (0.0) | 0 (0.0) | 1 (0.9) | .5 |
| 1 | 0 (0.0) | 1 (0.7) | 2 (1.9) | .2 |
| 19A | 19 (13.9) | 29 (20.0) | 9 (8.3) | .3 |
| 3 | 20 (14.6) | 27 (18.6) | 15 (13.9) | .9 |
| 7F | 4 (2.9) | 4 (2.8) | 2 (1.9) | .5 |
| 6A | 8 (5.8) | 4 (2.8) | 1 (0.9) | .02 |
| 8 | 1 (0.7) | 1 (0.7) | 1 (0.9) | .8 |
| 9 | 2 (1.5) | 0 (0.0) | 2 (1.9) | .9 |
| 22 | 1 (0.7) | 7 (4.8) | 7 (6.5) | .03 |
| 15 | 10 (7.3) | 9 (6.2) | 10 (9.3) | .7 |
| 11 | 11 (8.0) | 6 (4.1) | 11 (10.2) | .7 |
| 23 | 6 (4.4) | 7 (4.8) | 10 (9.3) | .2 |
| 35 | 10 (7.3) | 3 (2.1) | 11 (10.2) | .5 |
| 10 | 4 (2.9) | 6 (4.1) | 2 (1.9) | .5 |
| 21 | 7 (5.1) | 1 (0.7) | 0 (0.0) | .002 |
| 6C | 9 (6.6) | 8 (5.5) | 3 (2.8) | .1 |
| others | 9 (6.6) | 8 (5.5) | 12 (11.1) | .3 |

^a Serotypes/Serogroups occurring with a frequency of <1% are grouped as 'others'. PCV7 and non-PCV7 serotypes included in PCV13 serotypes are indicated in light and dark blue, respectively

^b Exact *P* values for Cochran-Armitage χ^2 test

Conclusions

- Introduction of PCV7 and PCV13 to the infant vaccination schedule resulted in a changing serotype epidemiology of invasive and colonizing *S. pneumoniae* in individuals of all age classes in Switzerland
- In contrast to the years before 2010, proportions of non-PCV7 serotypes included in PCV13 did not increase within invasive *S. pneumoniae* disease in 2010-2012.
- A careful monitoring of serotypes remains essential to survey the changing epidemiology, especially the increasing prevalence of the non-PCV13 serotypes.

Acknowledgements

The NRCP is funded by the Swiss Federal Office of Public Health. Markus Hilty received an educational grant from Pfizer AG. However, Pfizer AG has no influence on any aspects of this surveillance or decision to publish. All authors have no conflicts. We thank all the general practitioners of the Sentinel study for providing samples for the serotype detection of colonizing *S. pneumoniae*.