EPH115

Estimating the Public Health Impact of Pediatric Vaccination Programs on Invasive Pneumococcal Disease in France

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INTRODUCTION

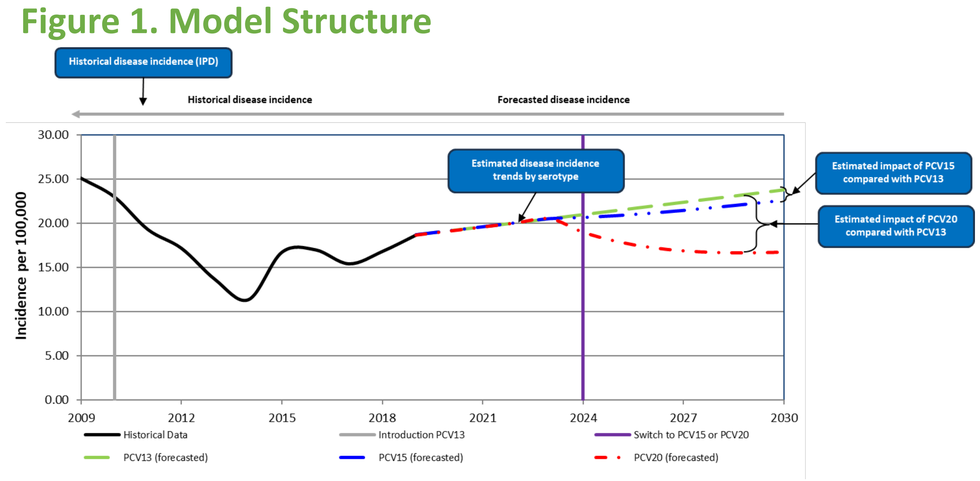
- Pneumococcal disease remains one of the most common vaccine-preventable diseases worldwide.
- The introduction of pneumococcal conjugate vaccines (PCVs) such as the 13-valent PCV (PCV13) in pediatric national immunization programs (NIPs) has had a substantial impact on invasive pneumococcal disease (IPD).
- Recently, two higher-valent vaccines have been licensed in Europe, a 15-valent vaccine (covering PCV13 serotypes plus 22F and 33F) and a 20-valent vaccine (covering PCV15 serotypes plus 8, 10A, 11A, 12F, and 15B).

- **Objective:**
- To evaluate the public health impact of the introduction of PCV20 in invasive pneumococcal disease (IPD) in France, compared to PCV15 or PCV13.

METHODS

- A decision-analytic forecasting model[1,2] was adapted to compare three vaccination strategies (1) maintaining the use of PCV13, (2) switching to PCV15, and (3) switching to PCV20.
- Historical age- and serotype-specific IPD incidences from France between 2009 and 2019 were used to project future IPD incidences for the entire French population over 5 years (**Figure 1**).

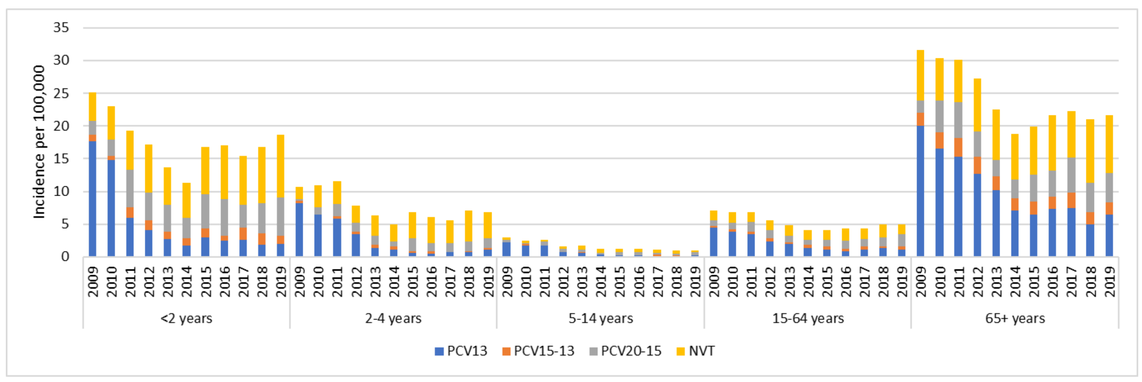
Figure 1. Model Structure



IPD = invasive pneumococcal disease; PCV13 = Prevenar 13; PCV15 = 15-valent pneumococcal conjugate vaccine; PCV20 = 20-valent pneumococcal conjugate vaccine

- Historical IPD incidence data by age group and serotype group were obtained from the Centre National de Référence des Pneumocoques[3] (**Figure 2**).

Figure 2. Annual Invasive Pneumococcal Disease Incidence per 100,000 for each Age Group



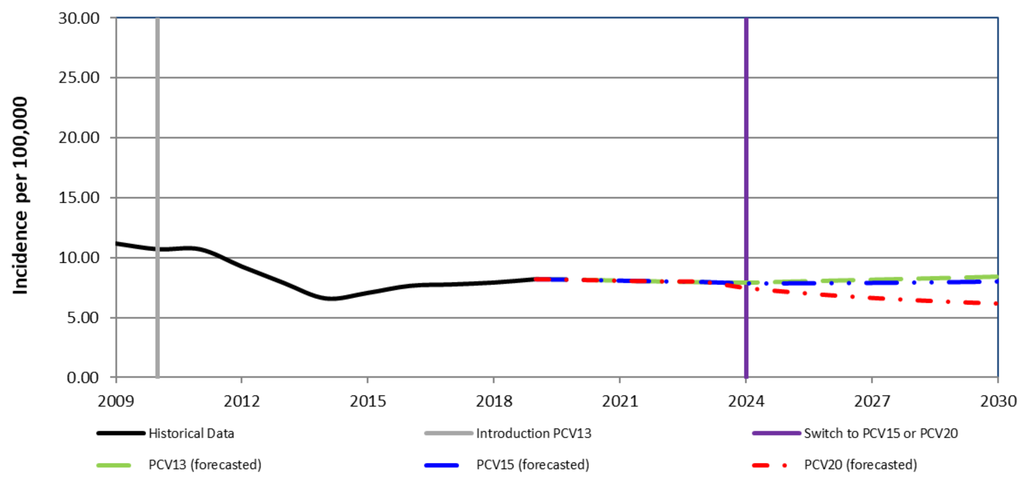
NVT = nonvaccine type serotypes; PCVX = X-valent pneumococcal conjugate vaccine; PCV13 = PCV13 serotypes; PCV15-13 = unique serotypes in PCV15; PCV20-15 = unique serotypes in PCV20

- Trendline equations were fit to historical incidence data to forecast incidence for each serotype- and age-group when the serotype group was not covered by the vaccine program (e.g., non-PCV20 serotypes, PCV20-15 serotypes when PCV15 is used, etc.) and when the serotype group was covered (e.g., PCV13 serotypes when PCV13 was introduced).
- Data up to 2019 were included to avoid the confounding effect of COVID on disease trends.
- Due to lack of observed real-world data, PCV15 and PCV20 were assumed to have a similar effect on incidence of covered serotypes as the observed impact of PCV13 on incidence due to PCV13-specific serotypes in France[3].
- Two scenario analyses were conducted using real-world evidence meta-analysis of PCV13[4]:
  - Setting the age-specific effect of PCV15/PCV20 on newly-covered serotypes is equal to the age-specific annualized relative incidence reduction of newly-covered PCV13 serotypes observed in PCV13 countries.
  - Assuming a 3+1 PCV20 schedule provides greater protection: 1.31 relative risk reduction of incidence vs a 2+1 (as PCV20 is indicated with 3+1 dosing whereas PCV13 and PCV15 are indicated for 2+1 dosing)

RESULTS

- Overall incidence (for all ages) was forecasted to decrease with PCV20 compared with PCV15 or continued use of PCV13 (**Figure 3**).

Figure 3. Forecasted Incidence by Vaccine Program for All Ages



- Under continuous use of PCV13 over the next 5 years, 27,670 IPD cases and 4,451 deaths across all ages are estimated to occur (**Table 1**).

Table 1. Base-case Results: Incremental 5-year Outcomes

Parameter	PCV20	PCV15	PCV13	PCV20-PCV15	PCV20-PCV13
IPD cases	24,819	27,168	27,670	-2,349	-2,850
Number of bacteremia cases	14,762	16,159	16,457	-1,397	-1,695
Ages <5 years	1,198	1,343	1,369	-145	-171
Ages 5+ years	13,564	14,816	15,088	-1,252	-1,524
Number of meningitis cases	10,058	11,009	11,213	-952	-1,155
Ages <5 years	816	915	933	-99	-116
Ages 5+ years	9,241	10,094	10,280	-853	-1,039
Number of IPD deaths	4,081	4,383	4,451	-302	-370

IPD = invasive pneumococcal disease; PCV13 = Prevenar 13; PCV15 = 15-valent pneumococcal conjugate vaccine; PCV20 = 20-valent pneumococcal conjugate vaccine

- Switching to PCV20 is expected to avert 2,850 IPD cases (370 deaths) compared to continued use of PCV13 and 2,349 IPD cases (302 deaths) compared with switching to PCV15.
- Scenario analyses (**Table 2**) suggest the base case results may be conservative and that PCV20 may lead to even greater case count reduction.

Table 2. Scenario Analysis Results: Total IPD Cases over 5 Years

Parameter	PCV20	PCV15	PCV13	PCV20-PCV15	PCV20-PCV13
Base case	24,819	27,168	27,670	-2,349	-2,850
Shiri et al[4] meta-analysis scenarios					
RR using data from all PCV13 countries	23,653	26,869	27,670	-3,216	-4,016
3+1 dosing RR vs 2+1 = 1.31[a]	24,155	27,168	27,670	-3,013	-3,514

IPD = invasive pneumococcal disease; PCV = pneumococcal conjugate vaccine; PCV13 = Prevnar 13; PCV15 = 15-valent PCV; PCV20 = 20-valent PCV; RR = risk reduction.
[a] In this scenario, we assume the annual incidence reduction for PCV20 to be multiplied by 1.31 to account for the observed difference in incidence reduction for PCV13 in countries which implemented a 3+1 schedule as compared with 2+1 schedule.

CONCLUSIONS

- Replacing PCV13 with PCV20 in the pediatric immunization program is estimated to provide greater health impact across all ages compared to PCV15 in France.
- PCV20 may reduce the disease burden across all ages by targeting additional serotypes not currently covered by pediatric vaccination programs.

References

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2. Wilson MR, McDade CL, Perdrizet JE, et al. Validation of a novel forecasting method for estimating the impact of switching pneumococcal conjugate programs: evidence from Belgium. Infect Dis Ther. 2021;10(3):1765-78.
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Disclosures

This study was funded by Pfizer Inc.

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Presented at ISPOR Europe 2024; November 17-20, 2024; Barcelona, Spain