Health Economic Analysis of Risk- and Age-Based Pneumococcal Vaccination with V116 (PCV21) versus PCV20 in France

EE488

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Background

- *Streptococcus pneumoniae* (*Sp*) is responsible for pneumococcal disease (PD), which includes:
  - Invasive pneumococcal disease (IPD): meningitis, bacteremia (including bacteremic pneumonia),
  - Non-invasive pneumococcal disease (nIPD): acute otitis media (AOM) in infants and children, and non-bacteremic pneumococcal pneumonia (NBPP)
- PD prevention relies on vaccination: a 20-valent pneumococcal conjugate vaccine (PCV20) is recommended in France for at-risk adults and those aged 65 years and more.[1] A new 21-valent adult-focused PCV (PCV21) protects against serotypes causing 86% of adult IPD (23 percentage points more than PCV20).

Objective

- To evaluate the cost-effectiveness of PCV21 compared to PCV20 in active immunization for the prevention of IPD and NBPP caused by Streptococcus pneumoniae in adults.

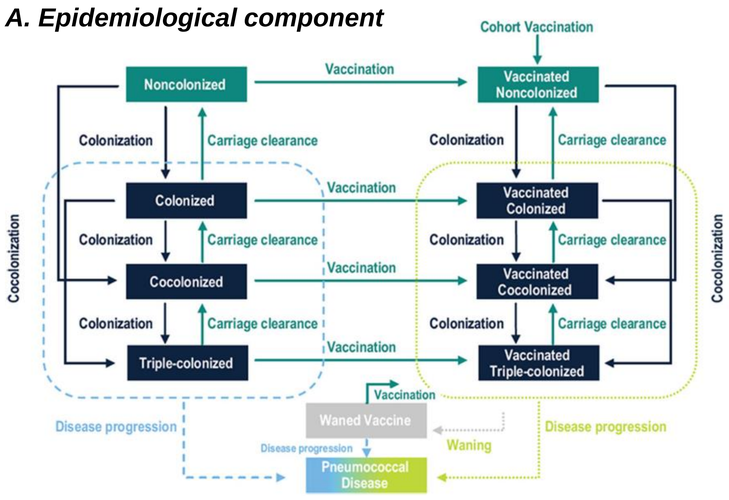
Method

Model structure

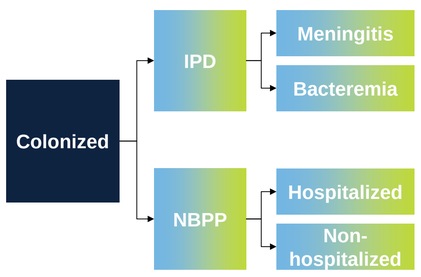
- An age- and serotype-specific dynamic transmission model, originally developed for pediatric PCV15 evaluation and whose methodology was deemed “acceptable” by the HAS, was adapted to the French adult population.
- The model comprised three components:
  - **Demographic component:** simulates the demographic characteristics of the French population by age group.
  - **Epidemiological component:** models the transmission of *Sp*, the epidemiology of PD, and the impact of vaccination on them.
  - **Cost-effectiveness component:** links epidemiological outcomes to cost and quality-of-life data.
- The entire French population was simulated due to:
  - **The indirect effect of pediatric vaccination on adults** through reduced *Sp* transmission (herd immunity).
  - **The direct effect of adult vaccination on adults** (no indirect effect of adult vaccination on the pediatric population was considered)

Figure 1. Structure of the DTM

A. Epidemiological component



B. PD clinical manifestations



Model calibration

- The model was calibrated to replicate historical IPD trends (2000–2019)[2] and estimate unknown parameters (e.g., vaccine efficacy against carriage).
- NBPP incidence was derived using age- and serotype-specific ratios.

Clinical parameters

Vaccine coverage rate (VCR)

- VCR for infants was assumed to be 95%[3] (50:50 split PCV13:PCV15).
- VCRs for older adults (≥ 65-year-olds), high-risk (< 65-year-old adults with immunocompromising conditions), and intermediate-risk (< 65-year-old adults with chronic medical conditions) were assumed to be 60%, 42%, and 20%, respectively.

Vaccine efficacy (VE)

- VE parameters were determined based on data from the international literature.
  - In adults, VE against IPD and NBPP for vaccine serotypes was estimated by age and risk profile, using PCV13 data, and assumed equal across all serotypes.
  - In children, PCV13 VE against IPD was estimated for each serotype, based on Savulescu et al. (2022).[4] For NBPP, VE was assumed equal across all serotypes[5].

Utility scores

- Annual disutility was applied for individuals with IPD or NBPP cases to baseline utilities from the general French adult population.
- For patients with post-meningitis sequalae (PMS), a disutility was applied the 1st year, and from the following year, an average utility of 0.693 was applied until death or the end of the simulation.

Cost parameters

- Direct medical costs (in €2024) were assessed, from a health system perspective, including costs of treatment acquisition and administration, inpatient management of IPD and nIPD, and outpatient management of nIPD.
- The per-dose acquisition costs (including €1.02 dispensation fee) were €83.46 for PCV21 and €59.26 for PCV20.
- Costs and QALYs were discounted 2.5% for the first 30 years, decaying to ~2% over the next 35 years.

Sensitivity analyses

- A scenario analysis assuming revaccination of individuals was conducted, ensuring that vaccine coverage reflects the proportion of individuals protected (revaccination of those with waned immunity).

Results

Base case analysis

- Over a 65-year time-horizon, the introduction of PCV21 at the claimed price in the adult population would allow :
  - To **avert 6,927 IPD cases and 221,113 NBPP cases vs. PCV20**, resulting in **4,417** fewer deaths, **22,400** fewer hospitalizations and **11,446** fewer antibiotic courses related to PD.
  - To **save 186 million € in PD management vs. VPC20**, in return for an additional investment of 506 million € in vaccination prevention.
  - Thus, VPC21 is associated with an **ICER of 68,144 €/QALY** compared to PCV20, over 65 years.

Table 1. Public health results – base-case analysis (Time horizon : 65 years)

Public health results	PCV20	PCV21	Increment *(PCV21 – PCV20)*
IPD	**312,709**	**305,782**	**-6,927**
Bacteremia	289,698	283,192	-6,506
Meningitis	23,011	22,590	-421
Post-meningitis sequelae	5,362	5,264	-98
NBPP	**12,457,271**	**12,236,157**	**-221,113**
Hospitalized NBPP	871,728	856,255	-15,473
Non-hospitalized NBPP	11,585,543	11,379,903	-205,640
Death	**207,423**	**203,006**	**-4,417**
IPD	42,245	41,162	-1,083
Hospitalized NBPP	95,033	93,099	-1,934
Non-hospitalized NBPP	70,145	68,745	-1,400
Hospitalizations	**1,184,436**	**1,162,037**	**-22,400**
Antibiotic courses	**605,247**	**593,801**	**-11,446**

Table 2. Cost results – base-case analysis (Time horizon : 65 years)

Cost results	PCV20	PCV21	Increment *(PCV21 – PCV20)*
Vaccine cost	**1,458,161,666 €**	**1,963,858,342 €**	**505,696,676 €**
IPD cost	**2,487,112,675 €**	**2,427,042,455 €**	**- 60,070,220 €**
Bacteremia	2,303,666,705 €	2,247,217,284 €	- 56,449,421 €
Meningitis	183,445,970 €	179,825,171 €	- 3,620,799 €
Post-meningitis sequelae	239,807,479 €	237,432,121 €	- 2,375,357 €
NBPP cost	**6,239,275,899 €**	**6,116,103,359 €**	**- 123,172,539 €**
Hospitalized NBPP	5,506,077,565 €	5,397,379,426 €	- 108,698,139 €
Non-hospitalized NBPP	733,198,333 €	718,723,933 €	- 14,474,400 €
Total costs	**10,424,357,718 €**	**10,744,436,278 €**	**320,078,559 €**

Table 3. Cost-effectiveness results – base-case analysis (Time horizon : 65 years)

Cost-effectiveness results	PCV20	PCV21	Increment *(PCV21 – PCV20)*
Cost	10,424,357,718 €	10,744,436,278 €	320,078,559 €
Lys	1,826,860,656	1,826,863,165	2,508
QALY	1,599,703,708	1,599,708,405	4,697
ICER (€/LY)	-	-	**127,599 €/LY**
ICER (€/QALY)	-	-	**68,144 €/QALY**

Sensitivity analyses

- When considering revaccination of “waned” individuals, vaccination with PCV21 versus PCV20 resulted in a reduction of approximately 20,589 IPD cases, 644,676 NBPP cases, 265 PMS cases, 13,063 deaths, and 33,574 antibiotic courses over 65 years. Discounted vaccination costs were around €1.2 billion greater for PCV21, while PD management costs were €483 million lower, leading to overall costs increase of €720 million. Discounted QALYs were 12,236 greater for PCV21 versus PCV20, resulting in an ICER of €58,835/QALY gained.
- **According to the deterministic sensitivity analysis, VE against carriage in children, VE against NBPP in low-risk adults aged 65+, inpatient NBPP cost in adults and VE against NBPP in intermediate-risk adults aged 65+ where the most influential parameters. Other parameters led to a variation of less than 20% of the ICER.**

Conclusions

- **Vaccination of at-risk adults and those aged 65 years and more with PCV21 is expected to be cost-effective compared to vaccination with PCV20 in France.**
- **These results stem from PCV21’s broader serotype coverage, as the vaccine was specifically designed for adults and optimized to complement infant vaccination strategies**
- **Sensitivity analyses confirmed the robustness of these findings, with the most influential parameters being vaccine effectiveness against carriage in children, NBPP in adults (low-risk and intermediate-risk aged 65+), and inpatient NBPP costs.**

References

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