Economic Evaluation of Pneumococcal Vaccination Strategies Considering Cardiovascular Events and Antimicrobial Resistance in Colombian Adults Aged 50 and Older

EE149

Authors: Jaime Ordóñez[1]

[1]True Consulting S.A.S., Medellín, Colombia.

BACKGROUND

- Pneumococcal disease remains a significant cause of morbidity and mortality in older adults globally[1].
- In Colombia, adults aged 50 and older face increasing risk of community-acquired pneumonia (CAP) and invasive pneumococcal disease (IPD), which result in a substantial healthcare utilization, antimicrobial resistance (AMR), and major adverse cardiovascular events (MACE) following infection[2].
- PPSV23 has historically been the primary adult vaccine in Colombia. However, introducing the 13-valent pneumococcal conjugate vaccine (PCV13) has shown greater efficacy in preventing CAP[3], the most prevalent form of pneumococcal disease in this population.

OBJECTIVE

- To assess the cost-utility of PCV13 and alternative pneumococcal vaccination strategies in Colombian adults aged 50 and older, incorporating the impact of cardiovascular events and antimicrobial resistance.

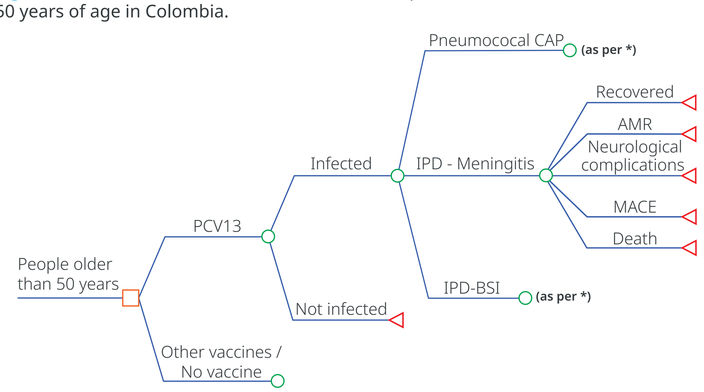
METHODS

Model Description

We constructed a decision-tree model (Figure 1) to compare the following five vaccination strategies over a 5-year time horizon:

1. Single-dose PCV13
2. Single-dose PPSV23
3. PCV13 followed by PPSV23 after 8 weeks
4. PPSV23 with a 5-year booster
5. PCV13 + PPSV23 + PPSV23 booster

Figure 1. Decision tree of the economic model for pneumococcal vaccines in adults over 50 years of age in Colombia.



IPD-BSI: Invasive Pneumococcal Disease - Bloodstream Infection.

METHODS (cont)

Model inputs

- Vaccine effectiveness: We extracted clinical data from the CAPITA trial (PCV13)[4] and a WHO-sponsored meta-analysis (PPSV23)[5]. Vaccine effectiveness estimates were adjusted according to serotype distribution in Colombia, based on the information reported by the National Institute of Health[6].
- **Epidemiology:** The model accounted for cases of CAP, IPD (meningitis and sepsis), MACE as post-pneumococcal complications, and costs related to antimicrobial resistance[1].
- **Costs:** Economic data was obtained from a national health insurer and expressed in 2024 USD using an exchange rate of 4,200 COP = 1 USD.
- **Discount rate:** We applied a 5% annual discount rate to costs and health outcomes. The analysis was conducted from the payer's perspective.

Analyses

- Incremental cost-effectiveness ratios (ICERs) for all strategies were calculated.
- Heterogeneity analysis was conducted across the following age groups: 50–64, 65–74, 75–84, and ≥85 years.
- Probabilistic sensitivity analysis with 1,000 Monte Carlo simulations was performed. Cost-effectiveness acceptability curves (CEACs) are presented using a willingness-to-pay (WTP) threshold of USD 7,170 per QALY[6].

RESULTS

- Vaccination strategies, including PCV13, consistently outperformed no intervention and PPSV23-only approaches. The single-dose PCV13 strategy was cost-saving, with an estimated USD 277.4 million in savings compared to no vaccination (Table 1).

Table 1. Cost-Utility Outcomes for Each Vaccination Strategy (USD 2024, 5-Year Horizon)

Strategy	Cost (Millions USD)	QALYs	ICER (USD/ QALY)	Cost-Effective?
No Intervention	$ 286,484,273	26,601,875	–	–
PPSV23	$ 341,886,704	26,603,581	$ 32,474	✗
PPSV23 + Booster	$ 400,684,668	26,603,646	$ 64,497	✗
PCV13	$ 283,441,823	26,689,916	Dominant	✓
PCV13 + PPSV23	$ 335,403,120	26,697,312	Cost-effective (WTP threshold)	✓
PCV13 + PPSV23 + Booster	$ 394,085,028	26,697,415	Cost-effective (WTP threshold)	✓

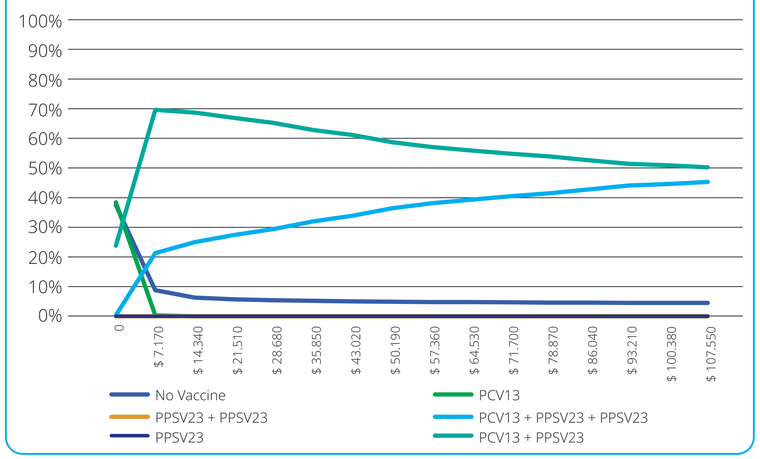
Dominant = more effective and less costly than comparator
For computing the ICERs, each strategy is compared with no intervention.
ICERs assessed using a willingness-to-pay threshold of USD 7,170/QALY

Compared to PCV13:

- PPSV23 had an ICER of USD 32,474 per QALY.
- PPSV23 + PPSV23 booster had an ICER of USD 64,497.
- The CEACs showed that strategies based on PPSV23 or no vaccination had a 0% probability of being cost-effective across all age groups. In contrast, PCV13 + PPSV23 had the highest likelihood of being cost-effective (69.5%) under the defined WTP threshold (Figure 2).

RESULTS (cont)

Figure 2. Willingness-to-pay curves for different PCV13 and PPSV23 strategies vs. no vaccination in older adults in Colombia



- Health benefits were more pronounced in older subgroups (75+), with the highest CAP incidence and MACE risk. PCV13 provided superior protection against both direct pneumococcal outcomes and cardiovascular complications.

CONCLUSION

- PCV13, alone or combined with PPSV23, is a cost-saving and clinically superior strategy to prevent pneumococcal disease in Colombian adults aged 50 and older. The benefits are primarily driven by its high effectiveness against CAP, prevention of cardiovascular complications, and reduced antimicrobial use. These findings support the inclusion of PCV13 in adult immunization programs and emphasize the value of comprehensive strategies to address the full burden of pneumococcal disease in aging populations.

REFERENCE

1. Ferreira-Coimbra J, Sarda C, Rello J. Burden of Community-Acquired Pneumonia and Unmet Clinical Needs. Adv Ther. 2020 Apr;37(4):1302-1318.
2. Anderson R, Feldman C. The Global Burden of Community-Acquired Pneumonia in Adults, Encompassing Invasive Pneumococcal Disease and the Prevalence of Its Associated Cardiovascular Events, with a Focus on Pneumolysin and Macrolide Antibiotics in Pathogenesis and Therapy. Int J Mol Sci. 2023 Jul 3;24(13):11038.
3. Marra F, Vadlamudi NK. Efficacy and Safety of the Pneumococcal Conjugate-13 Valent Vaccine in Adults. Aging Dis. 2019 Apr 1;10(2):404-418.
4. Bonten MJ, Huijts SM, Bolkenbaas M, et al. Polysaccharide conjugate vaccine against pneumococcal pneumonia in adults. N Engl J Med. 2015 Mar 19;372(12):1114-25.
5. Huss A, Scott P, Stuck AE, et al. Efficacy of pneumococcal vaccination in adults: a meta-analysis. CMAJ. 2009 Jan 6;180(1):48-58.
6. Instituto Nacional de Salud. Vigilancia por laboratorio de Streptococcus pneumoniae en Colombia, 2005 – 2022. Internet: Disponible en: https://www.ins.gov.co/BibliotecaDigital/vigilancia-por-laboratorio-de-streptococcus-pneumoniae-en-colombia-2005-2022.
7. Instituto de Evaluación Tecnológica en Salud. Manual para la elaboración de evaluaciones económicas en salud. Bogotá, D.C.: IETS; 2014.