Cost-Utility of Pneumococcal Vaccination Strategies for Adults Aged 50 and Older in Colombia: A Model-based Economic Evaluation

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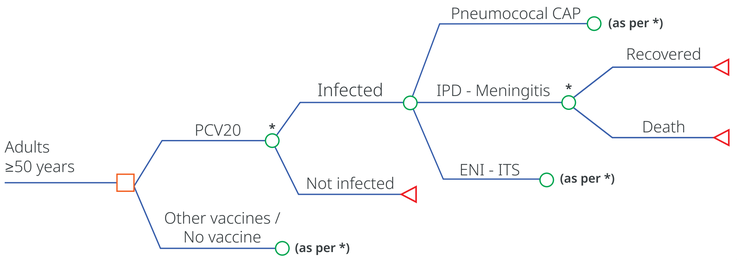
BACKGROUND

- In Colombia, pneumococcal vaccination is not included in the current National Immunization Program[1]. Historically, PPSV23 has been the primary vaccine offered to adults in Colombia through municipal health projects[2]. However, introducing the new available 20-valent pneumococcal conjugate vaccine (PCV20) may offer greater clinical benefits than existing strategies.
- This study aims to evaluate the cost-utility of available pneumococcal vaccination strategies for Colombian adults aged ≥50 years, comparing medium-term (5-year) and long-term (10-year) time horizons from the public health system perspective.

METHODS

- A decision-tree model (Fig. 1) was developed to compare six vaccination strategies at 5- and 10-year time horizons against no vaccination. The evaluated interventions were:
  1. Single-dose PCV13
  2. Single-dose PCV15
  3. Single-dose PCV20
  4. Single-dose PPPSV23
  5. PCV13 followed by PPSV23 after 8 weeks, with a booster dose at year 5
  6. PCV15 followed by PPSV23 after 8 weeks, with a booster dose at year 5

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



Model Inputs

- **Population:** All Colombian adults 50 years or older (n=13,621,154)[3].
- **Vaccine effectiveness:** The primary sources are the CAPITA trial for pneumococcal conjugated vaccines[4] and a WHO-sponsored meta-analysis for PPSV23[5]. The vaccine's effectiveness was adjusted based on the serotype distribution in Colombia, using information reported by the National Institute of Health with an average of observed cases from 2022 to 2024[6] (Table 1).

Table 1. Vaccine efficacy and serotype coverage

Vaccine	PCV13	PCV15	PCV20	PPSV23
Serotype Coverage	49.3%	51.5%	59.7%	63.6%

- **EPIDEMIOLOGY:** The model incorporated age-specific annual incidence rates of inpatient and outpatient pneumonia, meningitis, and BSI (bloodstream infection). These rates were extracted from local literature[7]. Additionally, to adjust for attributable cases of Streptococcus Pneumoniae, the following proportions were used: 26.1% for CAP cases[8], 42.8% for meningitis[9], and 10.0% for BSI[10] (Table 2).

Table 2. Annual incidences of pneumococcal disease in Colombia

Annual incidences					
Type of infection	50-64 years	65-74 years	75-84 years	≥ 85 years	Source
Hospital-treated CAP	0.06%	0.20%	0.36%	0.36%	(7,8)
Outpatient CAP	0.29%	0.59%	0.88%	0.88%	(7,8)
Meningitis	0.00%	0.00%	0.01%	0.01%	(7,9)
BSI	0.01%	0.03%	0.06%	0.06%	(7,10)

- **COSTS:** Expenses related to the medical management of CAP and IPD, as well as associated complications, were sourced from a published cost-of-illness study[11]. Costs were adjusted to 2025 Colombian pesos according to the corresponding inflation rate[12] and exchange rate (USD 1= COP 3,891)[13].

METHODS (cont)

- **VACCINE PRICES:** Extracted from the Pan American Health Organization (PAHO) vaccine price list[14]. For the PCV15 vaccine, the price was extracted from the Colombian Drug Price Information System (SISMED) as it is not included in the PAHO revolving fund[15].
- **DISCOUNT RATE:** A 5% annual discount rate is applied to both costs and health outcomes. The analysis was conducted from the payer's perspective.

Analyses

- Differential costs, benefits, and Incremental cost-effectiveness ratios (ICERs) for all strategies were calculated.
- Sensitivity analysis was performed through One-Way sensitivity analysis and a probabilistic sensitivity analysis with 1,000 Monte Carlo simulations. Cost-effectiveness acceptability curves (CEACs) were developed using a willingness-to-pay (WTP) threshold of USD 8,266 per QALY[16].

RESULTS

Base-case

- Conjugated vaccination strategies consistently outperformed no intervention and PPSV23-only approaches under both time horizons.
- Under a 5-year horizon, only PCV13 and PCV20 were cost-effective with ICERs of $3,629 and $4,322, respectively (Table 3). Savings in medical direct costs amount to $90.8M with PCV13 and to $118.5M with PCV20.
- Implementation of PCV20 yields 39,454 QALYs gained, giving the highest number of QALYs, followed by PCV15+PPSV23 and PCV15.

Table 3. Summary of Cost-Effectiveness Results by Strategy under a 5-year time horizon (USD 2025)

	5-year time horizon						
	No Vaccine	PCV13	PCV15	PCV20	PPSV23	PCV13 + PPSV23	PCV15 + PPSV23
Vaccine costs	$ –	$200,468,310	$510,178,905	$289,005,811	$315,940,619	$358,438,620	$668,149,215
Outcome cost	$416,010,907	$325,240,546	$320,918,148	$297,537,903	$406,088,752	$323,299,288	$319,356,932
Total costs	$416,010,907	$525,708,856	$831,097,053	$586,543,714	$722,029,371	$681,737,907	$987,506,147
Total QALYs	58,833,503	58,863,732	58,865,171	58,872,957	58,836,524	58,864,323	58,865,647
Δ Costs		$109,697,949	$415,086,146	$170,532,807	$306,018,464	$265,727,000	$571,495,240
Δ QALYs		30,229	31,668	39,454	3,021	30,820	32,143
ICER		$3,629	$13,107	$4,322	$101,294	$8,622	$17,779

- Under a 10-year horizon, the following strategies were cost-effective: PCV13 (ICER of $2,112), PCV15 (ICER of $7,630), PCV20 (ICER of $2,516), and PCV13 + PPSV23 (ICER of $8,003) (Table 4).

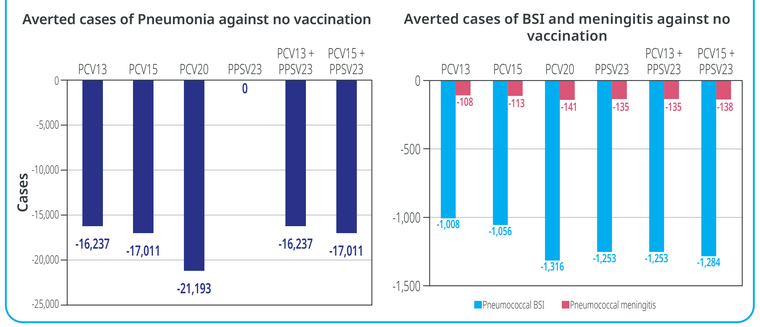
Table 4. Summary of Cost-Effectiveness Results by Strategy under a 10-year time horizon (USD 2025)

	10-year time horizon						
	No Vaccine	PCV13	PCV15	PCV20	PPSV23	PCV13 + PPSV23	PCV15 + PPSV23
Vaccine costs	$ –	$200,468,310	$510,178,905	$289,005,811	$315,940,619	$516,408,929	$826,119,524
Outcome cost	$416,010,907	$325,240,546	$320,918,148	$297,537,903	$406,088,752	$323,299,288	$319,356,932
Total costs	$416,010,907	$525,708,856	$831,097,053	$586,543,714	$722,029,371	$839,708,217	$1,145,476,457
Total QALYs	103,094,311	103,146,241	103,148,714	103,162,090	103,099,472	103,147,251	103,149,526
Δ Costs		$109,697,949	$415,086,146	$170,532,807	$306,018,464	$423,697,310	$729,465,550
Δ QALYs		51,930	54,403	67,779	5,161	52,940	55,215
ICER		$2,112	$7,630	$2,516	$59,299	$8.003	$13,211

- PCV20 averted the highest amount of pneumococcal pneumonia cases (21,193), followed by PCV15- and PCV13-containing strategies. PCV20 also averted the highest amount of meningitis and bacteremia, followed by PCV15+PPSV23 (Fig. 2).

RESULTS (cont)

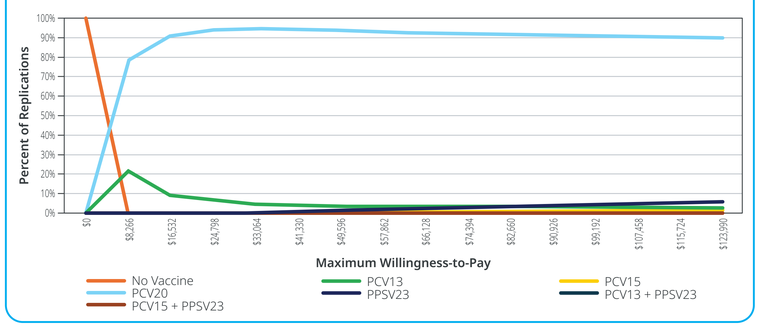
Figure 2. Events averted over the long-term horizon according to the vaccination strategy



Sensitivity Analyses

- PCV20 demonstrated the highest probability of being the most favorable strategy.

Figure 3. Cost-effectiveness acceptability curve.



CONCLUSION

- PCV13 and PCV20 offer the most favorable economic outcomes; however, PCV20 prevents the greatest number of pneumococcal events among all pneumococcal vaccination strategies for Colombian adults aged 50 years and older. Its use would maximize health gains, reduce healthcare costs over time, and support efficient resource allocation within the Colombian health system.

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