

Cost-Effectiveness Analysis of PCV13 vs PCV10 for the Prevention of Invasive Pneumococcal Disease in the Vietnam Pediatric Population

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INTRODUCTION

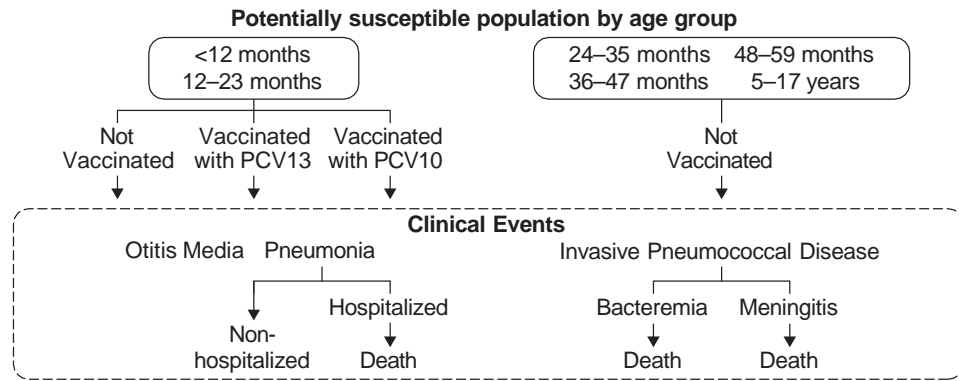
- In Vietnam, pneumonia contributed to 4,000 deaths in children annually out of a total of 2.9 million cases, making it the primary cause of death in children younger than 5 years.¹
- Pneumococcal conjugate vaccine has been shown to significantly reduce pneumococcal disease (PD) burden worldwide.
- Although 10- and 13-valent pneumococcal conjugate vaccines (PCV10 and PCV13) are available currently, PCVs are not included in the national immunization program.

OBJECTIVE

- The objective of the study was to compare clinical and budget impacts of vaccinating children with PCV13 versus PCV10 in Vietnam, as well as to assess PCV13 cost-effectiveness from a payer perspective.

METHODS

- A decision-analytic Markov model was adapted to estimate the clinical and economic outcomes of vaccinating Vietnamese children with PCV10 and PCV13, all under the 3+1 schedule, applying a 3% discount rate over a 10-year time horizon.



- Outcomes included pneumococcal disease cases and deaths, total costs, life-years (LYs), quality-adjusted life-year (QALY), and incremental cost-effectiveness ratio (ICER). Outcomes were modeled for children aged <18 years with a vaccinated cohort that included those aged <2 years.
- Age-specific epidemiologic inputs [invasive pneumococcal disease (IPD); pneumonia; otitis media (OM); case fatality rates; and serotype distribution, utility, and utility decrements] were sourced from local data or publicly available sources. Direct medical costs were obtained from published articles and adjusted to 2023 values in USD. Indirect costs were not considered. (Table 1 and Table 3)
- A literature review for IPD serotype distributions was conducted and compared to determine the serotype coverage for PCV13 and PCV10 for the analyses (Table 2).
- Direct vaccine effects (VEs) were informed by clinical efficacy and effectiveness studies of PCVs, and the indirect VE was not considered in the model (Table 3).
- This analysis assumed a willingness-to-pay (WTP) threshold of 3 × GDP per capita in Vietnam in 2023 (\$13,869).

Table 1. Key Inputs							
	Age Group						
	<12 Months	12–23 Months	24–35 Months	36–47 Months	48–59 Months	5–17 Years	
Population Size ^{1,2}	1,480,227	1,470,650	1,470,650	1,470,650	1,470,650	23,829,694	
Disease incidence per 100,000 individuals							
IPD ³	193.4	49.3	24.5	13.5	11.4	0.65	
Hospitalized pneumonia ⁴	2445	2445	2445	2445	2445	271	
Non-hospitalized pneumonia ⁴	1182	1182	1182	1182	1182	560	
Otitis media ⁴	601.8	601.8	601.8	601.8	601.8	1140	
IPD cases, %							
Source 1 ⁴							
Meningitis	39.40	39.40	39.40	39.40	39.40	39.40	
Bacteremia	60.60	60.60	60.60	60.60	60.60	60.60	
Source 2 ⁵							
Meningitis	67.1	67.1	14.6	14.6	14.6	18.3	
Bacteremia	32.9	32.9	85.4	85.4	85.4	81.7	
Fatality rate, %							
Source 1 ³							
Meningitis	3.2	3.2	3.2	3.2	3.2	3.2	
Bacteremia	8.0	8.0	8.0	8.0	8.0	8.0	
Hospitalized pneumonia	1.4	1.4	1.4	1.4	1.4	1.4	
Source 2 ⁵							
Meningitis	8.8	8.8	8.8	8.8	8.8	8.8	
Bacteremia	8.8	8.8	8.8	8.8	8.8	8.8	
Direct medical costs (per episode) ^{6,7}							
Meningitis	\$548.15	\$499.19	\$443.19	\$304.51	\$285.18	\$1,756.66	
Bacteremia	\$165.17	\$150.42	\$133.55	\$121.48	\$108.23	\$529.32	
Hospitalized pneumonia	\$143.92	\$131.05	\$116.35	\$105.84	\$94.30	\$461.21	
Non-hospitalized pneumonia	\$87.13	\$79.34	\$70.44	\$64.07	\$57.09	\$368.04	
Otitis media	\$71.82	\$65.42	\$58.09	\$52.84	\$47.06	\$47.06	
Vaccination costs		PCV10			PCV13		
Cost		\$42.06			\$48.74		
IPD, invasive pneumococcal disease; PCV10, 10-valent pneumococcal conjugate vaccine; PCV13, 13-valent pneumococcal conjugate vaccine. All direct medical costs were inflated to 2023 ⁸ and used an exchange rate of \$1 USD to 23,271.21 Vietnamese dong (VND).							

Table 2. Serotype Distribution						
Sources	Time Period	Age Group	Included in the Analysis, n	Serotype Coverage for PCV10	Serotype Coverage for PCV13	Included in the Analyses?
Pfizer Data on File (to be Published) ⁵	2019–2022	<5 y	141	66.00%	83.00%	Yes
Nguyen Thi Hien Anh et al. 2024 ⁹	Nov 2022–Sept 2023	<15 y	281	37.00%	49.10%	Yes
Truong et al. 2023 ¹⁰	2012–2021	<5 y	136	76.00%	84.00%	Yes
Bui An Son et al. 2022 ¹¹	Nov 2019–Mar 2021	<5 y	126	45.70%	52.60%	Yes
Nguyen Thai Bich Lien 2023 ¹²	2015–2021	<1 y	356	73.10%	78.80%	No. Only <1 y

METHODS (CONT.)

Table 3. Direct Effect, Utilities, and Utility Decrement					
	IPD*		All-Cause Hospitalized Pneumonia	All-Cause Non-Hospitalized Pneumonia	All-Cause Otitis Media
	Meningitis	Bacteremia			
Direct effects, % ¹³⁻¹⁶	88.70		25.50	6.00	7.80
Utility decrements ¹⁷	0.023	0.008	0.006	0.004	0.005
Baseline utilities (<18 y) ¹⁸	0.92				
IPD, invasive pneumococcal disease. *Direct vaccine effect in the first year of life (primary series) was assumed to be ~75% of the full vaccine effect.					

Analyses

- Base case**
 - Assumed the vaccination coverages for both PCV10 and PCV13 as 30%
 - Applied the serotype coverage, case fatality rate (CFR) of meningitis, and the proportion of meningitis included in all IPD reported by an unpublished manuscript (Pfizer data on file)
- Alternative base case**
 - Assumed the vaccination coverages for both PCV10 and PCV13 as 30%
 - Applied the serotype coverage reported by Anh et al (2024), CFR used by Dilokthornsakul et al (2019), and proportion of meningitis reported by Anh et al (2019)
- Scenario analyses by varying serotype coverages** – applied the CFR and proportion of meningitis used in the alternative base case but varying serotype coverages (scenario 1: Pfizer data on file, 2: Truong et al 2023, and 3: Bui An Son et al 2022)
- Scenario analyses by varying vaccination rates:** 10%, 20%, 40%, and 50%

RESULTS

- Over 10 years, PCV13 was estimated to prevent more than 1,697 IPD cases, 26,833 pneumonia cases, 3,091 OM cases, and 471 disease-associated deaths and save more than 3.8 million USD in disease-associated costs compared with PCV10 (Table 4).
- PCV13 is also predicted to provide 19,386 additional QALYs with an ICER of \$4,718/QALY.
- For the scenario analyses based on different serotype coverages, the conclusions were consistent, and compared with PCV10, PCV13 remained more cost-effective, especially with a higher vaccination rate.

Table 4. Base-Case Results			
	With PCV10 3+1 Implementation	With PCV13 3+1 Implementation	Impact: PCV13 vs PCV10
Clinical outcomes (cases)			
IPD	40,926	39,230	–1,697
Hospitalized pneumonia	2,276,754	2,252,921	–23,833
Non-hospitalized pneumonia	2,050,307	2,047,307	–3,000
OM	2,935,762	2,932,671	–3,091
Death due to PD	34,903	34,432	–471
QALY	2,192,451,562	2,192,470,948	19,386
Cost (in million USD)			
Vaccination cost	599.7	695.0	95.3
Total direct cost of disease	1,012.7	1,008.9	(3.8)
Net costs	1,612.4	1,703.9	91.5
ICER (USD)			4,718

Table 5. Alternative Base-Case Analysis			
	With PCV10 3+1 Implementation	With PCV13 3+1 Implementation	Impact: PCV13 vs PCV10
Clinical outcomes (cases)			
IPD	40,928	39,807	–1,121
Hospitalized pneumonia	2,276,835	2,260,310	–16,525
Non-hospitalized pneumonia	2,050,355	2,048,231	–2,124
OM	2,935,805	2,933,620	–2,185
Death due to PD	33,883	33,589	–294
QALY	2,192,493,830	2,192,505,921	12,091
Cost (in million USD)			
Vaccination cost	599.8	695.0	95.3
Total direct cost of disease	1,010.4	1,007.9	(2.5)
Net costs	1,610.2	1,702.9	92.7
ICER (USD)			7,668
ICER, incremental cost-effective ratio; IPD, invasive pneumococcal disease; OM, otitis media; PCV10, 10-valent pneumococcal conjugate vaccine; PCV13, 13-valent pneumococcal conjugate vaccine; QALY, quality-adjusted life-year; USD, US dollars;.			

Table 6. Scenario Analyses by Varying Serotype Distribution							
Scenarios	Disease Impact: PCV13 vs PCV10			Economic Impact: PCV13 vs PCV10			ICER
	PD Cases Averted	Death Averted	QALY Gained	Direct Medical Cost Saved (in Million USD)	Vaccination Cost (in Million USD)	Net Cost (in Million USD)	Per QALY
1. Using ST coverage from Pfizer data on file	–28,537	–428	17,634	–\$3.69	95.26	91.57	5,193
2. Truong et al. 2023	–15,017	–204	8,411	–\$1.75	95.26	93.51	11,118
3. Bui An Son et al. 2022	–12,613	–169	6,971	–\$1.47	95.26	93.79	13,455
ICER, incremental cost-effective ratio; IPD, invasive pneumococcal disease; PCV10, 10-valent pneumococcal conjugate vaccine; PCV13, 13-valent pneumococcal conjugate vaccine; QALY, quality-adjusted life-year; ST, serotype; USD, US dollars.							

Table 7. Scenario analyses by varying vaccination rates							
	Disease Impact: PCV13 vs PCV10			Economic Impact: PCV13 vs PCV10			ICER
	PD Cases Averted	Death Averted	QALY Gained	Direct Medical Cost Saved (in Million USD)	Vaccination Cost (in Million USD)	Net Cost (in Million USD)	Per QALY
10%	–10,151	–148	6,078	–1.21	31.75	30.54	5,025
20%	–20,682	–304	12,521	–2.47	63.50	61.03	4,874
40%	–43,002	–649	26,694	–5.18	127.01	121.83	4,564
50%	–54,864	–839	34,549	–6.64	158.77	152.13	4,403
ICER, incremental cost-effective ratio; IPD, invasive pneumococcal diseases; PCV10, 10-valent pneumococcal conjugate vaccine; PCV13, 13-valent pneumococcal conjugate vaccine; QALY, quality-adjusted life-year; USD, US dollars.							

Limitations

Due to the lack of Vietnam-specific incidence rates for pneumonia and OM, the incidence rate of pneumonia and OM used in the model is relatively low compared with other countries (eg, Taiwan, India, Indonesia). Serotype distributions for IPD were based on studies that were conducted in limited areas. The analyses did not consider sequelae due to pneumococcal disease.

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- The study suggested that based on the WTP threshold (ie, 3 × GDP per capita), PCV13 would be a cost-effective vaccination strategy compared with PCV10 from a payer perspective in Vietnam.
- The results were stable and robust in all sensitivity and scenario analyses. As such, replacing PCV10 with PCV13 could prevent more IPD, pneumonia, and OM cases and deaths in children in Vietnam, as well as save more direct medical costs for the healthcare system over a 10-year time horizon.

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