EE749

Cost-effectiveness Analysis of the Pediatric 20-Valent Pneumococcal Conjugate Vaccine Compared to Lower-Valent Alternatives in Argentina

Lucila Rey Ares[1], An Ta[2], Donata Freigofaite[3], Sophie Warren[4], Mercedes Mac Mullen[1], Carolina Carballo[1], and Liping Huang[5]

[1]Pfizer, Villa Adelina, Argentina; [2]Cytel, UK; [3]Cytel, Netherlands; [4]Global Health Economics & Outcomes Research, Pfizer, UK; [5]Global Health Economics & Outcomes Research, Pfizer, Collegeville, PA, US

INTRODUCTION

- The 13-valent pneumococcal conjugate vaccine (PCV13; Pfizer Inc) has been included into Argentina's National Immunization Program (NIP) for children younger than 2 years since 2012 Following the inclusion of PCV13 into its pediatric NIP, Argentina observed a significant reduction in cases of pneumococcal disease.[1]
- An unmet need remains, however, as PCV13 does not cover serotypes 8, 10A, 12F, 15B, 22F, and 33F, which are among the most prevalent invasive pneumococcal disease (IPD)-causing serotypes in children under 7. New generation vaccines, including PCV15 and PCV20, contain these serotypes[5]; licensure of these higher-valent vaccines is expected soon.[2,3]

OBJECTIVE

- The objective was to evaluate the cost-effectiveness of PCV20 compared with lower-valent vaccines including the current standard of care of PCV13 and PCV15, all under a 2+1 schedule (i.e., two doses plus one booster) in Argentina.

METHODS

- A state-transition Markov cohort model was developed to quantify the effects of the implementation of PCV20 into the Argentinian pediatric NIP compared with PCV13 and PCV15, all under a 2+1 schedule.
- Three main clinical events were estimated by the model: IPD (developing into either meningitis or bacteremia), hospitalized and non-hospitalized pneumonia, otitis media, and a non-disease state. Within each annual cycle, individuals could experience more than one clinical event of which costs and utility decrements were considered. Sequale was not included in the analysis.
- The time horizon was set to 10 years with an annual discount of 3% for both costs and benefits. At the start of each annual cycle, a new birth cohort would enter the model and get vaccinated.
- Argentina-specific inputs were obtained to populate the model (Table 1 and Table 2). Data from other countries such as Brazil, Chile, Mexico, or the United States were used when country-specific inputs were unavailable. Epidemiology inputs for Argentina are presented in Table 1, serotype distribution in Table 2, and vaccine effectiveness, medical costs, and utilities are reported in Table 3.
- Children younger than 5 years were stratified into age groups by 12-month periods; individuals 5 years and older were grouped as follows: 5–17, 18–34, 35–49, 50–64, and ≥65 years.
- Direct vaccine effectiveness in the model is referred as the immediate protection for vaccinated individuals (i.e., reduction of cases) was based on PCV13 effectiveness and PCV7 efficacy data.[4] The indirect vaccine effectiveness (herd effects) that assesses the impact on the unvaccinated populations was based on impact studies.[5-12]
- Model assumed that the price of PCV20 vaccine is 10% higher than the price of PCV13.

Table 1: Epidemiology: Incidence and case fatality rates

Age	Observed disease incidence per 100,000				Breakdown of IPD cases[29]		Case Fatality rate			
	IPD[23,24]	Hospitalized pneumonia[25,26,27]	Non-hospitalized pneumonia[25,26,28]	OM[2]	Meningitis	Bacteremia	Meningitis[3,30]	Bacteremia[3,25]	Hospitalized pneumonia[25,26,27]	Non-hospitalized pneumonia[26,27,28]
<12 months	10.0	772.5	288.6	8943.0	38.1%	61.9%	14.3%	1.5%	3.5%	0.0%
12-23 months	10.0	285.8	106.8	7690.5	21.4%	78.6%	14.3%	1.5%	3.5%	0.0%
24-35 months	10.0	189.6	70.8	7690.5	13.0%	87.0%	14.3%	1.5%	1.5%	0.0%
36-47 months	10.0	189.6	70.8	7690.5	13.0%	87.0%	14.3%	1.5%	1.5%	0.0%
48-59 months	10.0	189.6	70.8	7690.5	13.0%	87.0%	14.3%	1.5%	1.5%	0.0%
5-17 years	3.3	16.1	100.7	NA	23.9%	76.1%	14.3%	1.5%	1.0%	0.0%
18-34 years	3.3	16.1	100.7	NA	25.0%	75.0%	15.0%	3.2%	0.4%	0.0%
35-49 years	27.7	88.0	157.3	NA	20.0%	80.0%	15.0%	9.0%	3.8%	0.0%
50-64 years	60.6	181.9	245.8	NA	38.9%	61.1%	15.0%	15.2%	8.4%	1.9%
65+ years	143.3	709.9	968.5	NA	18.0%	82.0%	15.0%	26.6%	14.1%	1.9%

Table 2: Current overall serotype coverage by vaccine

Age (years)	PCV-7 serotypes	PCV-10 serotypes	PCV-13 serotypes	PCV-15 serotypes	PCV-20 serotypes
<5[13]	9.8%	18.1%	30.5%	34.2%	51.6%
5–17[6]	7.1%	38.1%	48.4%	51.5%	69.2%
18–34[6]	13.3%	29.4%	38.8%	41.6%	67.2%
35–49[6]	6.9%	17.3%	35.2%	36.5%	59.8%
50–64[6]	14.5%	21.0%	41.4%	45.7%	68.9%
65+[6]	10.0%	17.3%	39.7%	45.7%	62.4%

Table 3: Vaccine effectiveness, cost, and utility parameters

Parameters						
Direct effects	**IPD**		**Hospitalized pneumonia**	**Non-hospitalized pneumonia**	**Otitis Media**	
	88.7%[14]		25.5%[15]	6%[15]	7.8%[16]	
Total acquisition cost (full schedule)	**PCV13**		**PCV15**	**PCV20**		
	$77.85		$77.85	$83.79†		
Medical cost (per episode)	**Meningitis**	**Bacteremia**	**Hospitalized pneumonia**	**Non-hospitalized pneumonia**	**Otitis Media**	
≤17 years	$2,741.34	$3,529.78	$2,158.00	$150.04	$30.64	
18–64 years	$3,462.95	$4,625.51	$1,448.87	$102.58	-	
≥65 years	$2,814.42	$3,669.14	$962.91	$117.61	-	
QALY decrements per episode	**Meningitis**	**Bacteremia**	**Hospitalized pneumonia**	**Non-hospitalized pneumonia**	**Otitis Media**	
0–17 years[17-19]	0.023	0.008	0.006	0.004	0.005‡	
≥18 years[20-21]	0.130	0.130	0.130	0.045	-	
Baseline utilities[§22]	**0–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65–74**	**≥75**
	0.951	0.936	0.919	0.898	0.874	0.835	0.756

Abbreviations: IPD, invasive pneumococcal disease; PCV, pneumococcal conjugate vaccine; QALY, quality-adjusted life year. *100% indicates that the maximum incidence reductions have been achieved, and a steady state is established. †Price of PCV20 was assumed to be 10% higher than PCV15. ‡Assumption. §Assuming same utilities for children and 18–24 years group.

RESULTS

Table 3: Base-case incremental results

Model outcomes	Incremental	
	PCV20 vs PCV13	PCV20 vs PCV15
Cases of IPD	-11,990	-9,663
Cases of hospitalized pneumonia	-56,007	-44,464
Cases of non-hospitalized pneumonia	-7,449	-6,286
Cases of OM	-172,389	-142,366
Number of deaths due to disease	-6,718	-5,168
Total QALYs	116,135	92,384
Total LYs	71,777	56,731
Total direct cost of doses	$27,269,766	$27,268,749
Total direct cost of disease	-$110,450,157	-$89,574,963
Total costs	-$83,180,391	-$62,306,215
ICER per QALY	Dominant	Dominant

Abbreviations: ICER, incremental cost-effectiveness ratio; IPD, invasive pneumococcal disease; LY, life year; OM, otitis media; PCV, pneumococcal conjugate vaccine; QALY, quality-adjusted life year

Base-case analyses

- Compared to PCV13, PCV20 clinical benefits constituted a savings of $83,180,391 in total costs with an incremental increase of 71,777 LYs and 116,135 QALYs.
- Compared to PCV15, PCV20 was predicted to yield incremental LY and QALY gains of 56,731 and 92,384, respectively, and cost savings of $62,306,215.

Sensitivity analyses

- The most influential parameters were similar in comparisons of PCV20 vs PCV13 and PCV20 vs PCV15. In the deterministic sensitivity analysis for costs, the key parameter was the vaccine coverage of PCV20. The key driver of quality-adjusted life year (QALY) was the current overall serotype coverage by vaccine for both pairwise comparisons.
- Probabilistic sensitivity analysis (PSA) results were consistent with the deterministic results. PCV20 was the dominant strategy in 78.50% of 1,000 iterations when compared with PCV13 and in 62.30% of 1,000 iterations vs PCV15.
- PCV20 was the dominant strategy in all scenarios vs both alternatives. The greatest increase in incremental cost-effectiveness ratio was observed when using a 5% annual discount for both cost and benefits and when excluding the vaccinated adult population from indirect effects.

Figure 2: Deterministic sensitivity analysis results: PCV20 vs PCV13

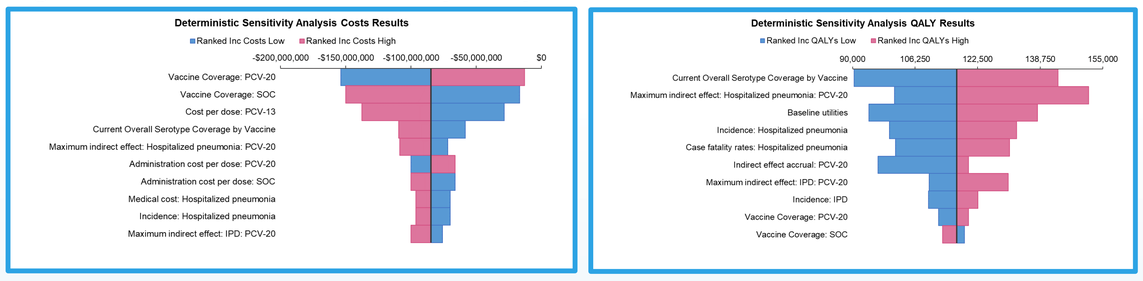
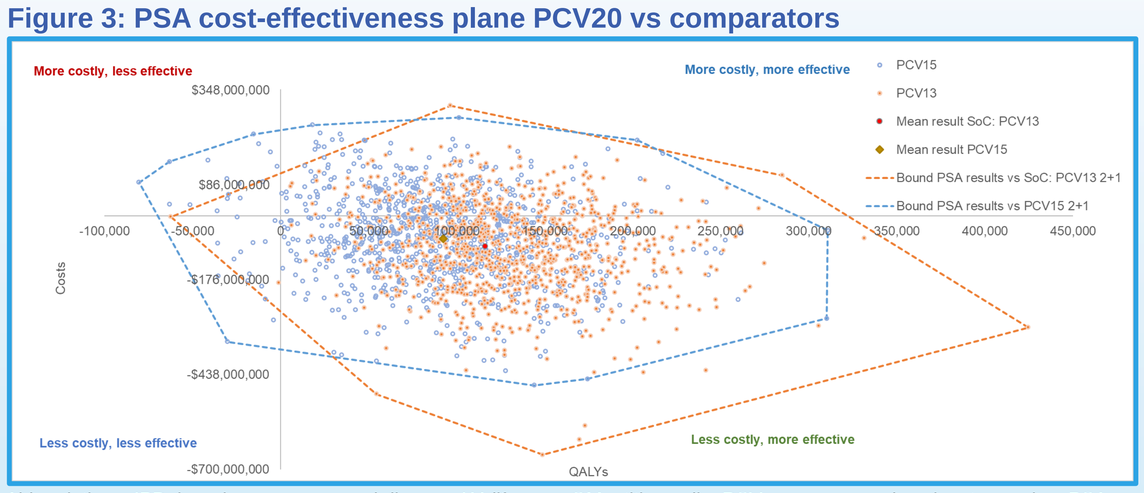


Figure 3: PSA cost-effectiveness plane PCV20 vs comparators



Abbreviations: IPD, invasive pneumococcal disease; LY, life year; OM, otitis media; PCV, pneumococcal conjugate vaccine; PSA, probabilistic sensitivity analysis; QALY, quality-adjusted life year; SoC, standard of care
Note: PSA was assessed at a willingness-to-pay threshold of $13,686 per QALY.

CONCLUSIONS

- **Implementation of the PCV20 2+1 schedule in Argentina's NIP has the potential to substantially decrease the economic and clinical burden of pneumococcal disease due to its broader serotype coverage.**
- **PCV20 is estimated to be the cost-saving strategy in all scenarios compared with the lower-valent alternatives, PCV13 and PCV15.**
- **Given the potential for better outcomes and cost-savings, PCV20 should be considered as a preventative tool against pneumococcal disease for children in Argentina.**

References: **1.** López et al. J Pediatric Infect Dis Soc. 2018;7(1):30–5; **2.** Martí et al. Cost Eff Resour Alloc. 2013;11(1):21; **3.** Urueña et al. Vaccine. 2011;29(31):4963-72; **4.** Lytle et al. Human Vaccines & Immunotherapeutics. 2023; 19(2): 1-11; **5.** Statistics Canada. https://www150.statcan.gc.ca/n1/daily-quotidien/210503/dq210503b-eng.htm; **6.** Zintgraff et al. Rev Argent Microbiol. 2020;52(3):189-94; **7.** Zintgraff et al. Vaccine. 2022;40(3):459-70; **8.** Levy et al. Vaccine. 2017;35(37):5058-64; **9.** Janoir et al. Open Forum Infect Dis. 2016;3(1); **10.** Rodrigo et al. Eur Respir J. 2015;45(6):1632-41; **11.** Ladhani et al. Lancet Infect Dis. 2018;18(4):441-51; **12.** Lau et al. Vaccine. 2015;33(39):5072-9; **13.** SIREVA, Argentina (2017-2019). Available at: http://antimicrobianos.com.ar/category/resistencia/sireva/ **14.** Savulescu et al. Vaccine. 2022;40(29):3963-74; **15.** Black et al. Pediatr Infect Dis J. 2002;21(9):810-5; **16.** Black et al. Pediatr Infect Dis J. 2000;19(3):187-95; **17**. Rozenbaum et al. BMJ. 2010;340:c2509-c2509; **18.** Stoecker et al. Pediatrics. 2013;132(2):e324-32; **19**. Melegaro A, Edmunds WJ. Vaccine. 2004;22(31-32):4203-14; **20**. Mangen et al. Eur Respir J. 2015;46(5):1407-16; **21.** Mangen et al. BMC Infect Dis. 2017;17(1):208; **22**. Janssen et al. Eur J Health Econ. 2019;20(2):205-16. **23.** Guevara et al. Hum Vaccin Immunother (2021);17(11):4667–72. **24.** Lopardo et al. BMJ Open (2018);8(4):e019439. **25**. Gentile et al. Arch Argent Pediatr (2015);113(6):502–9. **26.** Buzzo et al. Int J Infect Dis (2013): e673–7. **27.** Pelton et al. Clin Infect Dis (2019); 68(11):1831–8. **28.** Nelson et al. Vaccine (2008); 26(38):4947–54. **29.** SIREVA RS (2019). **30.** Centers for Disease Control and Prevention. (2019). **31** Rejas et al. Expert Rev Pharmacoecon Outcomes Res (2022);22(5):853–67.

Acknowledgments: We would like to thank Susannah Sadler and Colleen Dumont for taking the necessary time and effort to review the poster.

Disclosures: Lucila Rey Ares, Mercedes Mac Mullen, and Carolina Carballo are employees of Pfizer Argentina. Sophie Warren and Liping Huang are employees of Pfizer Inc. An Ta and Donata Freigofaite received consulting fees from Pfizer Inc for the study and poster development.

For more information please contact:
Lucila Rey Ares, MD MSc
Colectora Panamericana 1804 B1607EEV Villa Adelina, Buenos Aires, Argentina
Phone: +54911136113444
Email: lucila.reyares@pfizer.com
www.pfizer.com.ar

Presented at ISPOR EU; 12–15 November 2023; Copenhagen, Denmark