Cost- effectiveness of pneumococcal vaccination for adults aged 60 years and older in Peru

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Introduction

- In 2018, a 13-valent pneumococcal conjugate vaccine (PCV13) was introduced in the national immunization program for adults aged ≥60 years in Peru. The vaccination coverage rates (VCR) were 62.0%, 90.3%, 6.6%, and 13.9% from 2019 to 2022, respectively. This vaccine is also available for infants <1 year old since 2015, with high 3-dose schedule VCR[1,2]
- PCV13 targets 13 serotype-specific polysaccharides of *Streptococcus pneumoniae*, namely 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F, and 23F. On the other hand, the 23-valent pneumococcal polysaccharide vaccine (PPSV23) covers 12 serotypes that overlap with PCV13, excluding 6A, and an additional 11 serotypes (2, 8, 9N, 10A, 11A, 12F, 15B, 17F, 20, 22F, 33F)[3]
- **This study evaluated the cost-effectiveness of a vaccination strategy with PPSV23 alone compared to PCV13 for adults aged ≥60 years from the perspective of the Peruvian public health system**

Methods

- A published Markov model was used to estimate costs and health outcomes of a Peruvian cohort of adults aged ≥60 years.[4] The model assumed 1-year cycle length, a 10-year time horizon, a 30% vaccine uptake, and annual discount rate of 5% for the health and costs outcomes
- The population was divided into healthy (52.6%), at risk (37.8%),[5] and high-risk (10%) for pneumococcal disease[6]. Five health states were considered: no disease, invasive pneumococcal disease (IPD), non-bacteremic pneumococcal pneumonia (NBPP), post-meningitis sequelae (PMS), and death (**Figure 1**)
- Epidemiological parameters (**Table 1**) and costs (**Table 2**) were obtained from Peruvian-specific data sources; where not available, regional data were used
- Costs were converted into US dollars (exchange rate 1 US$=3.65 soles)[7]
- The economic outputs were the incremental cost-effectiveness ratio (ICER), number of life-years gained (LYG) and cost per LYG. In Peru, the 2022 threshold for determining the cost-effectiveness of interventions is 4.4 Peruvian Tax Units (each unit is equal to 4600 soles), which is equivalent to $5545.2 dollars per LYG[8]

Figure 1. Markov model structure

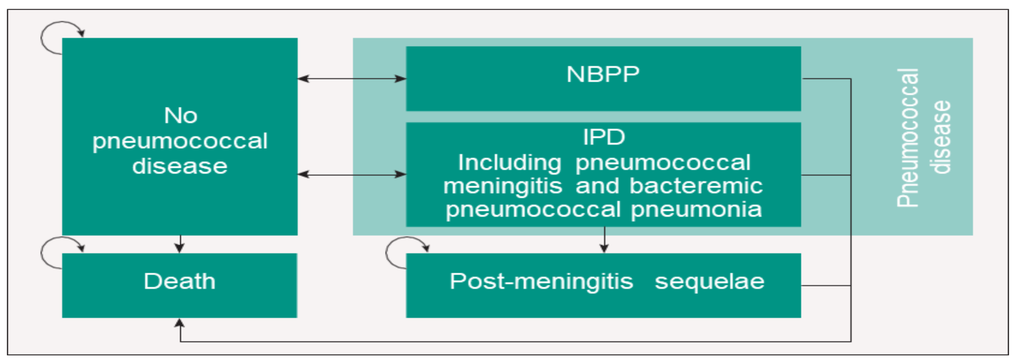

Table 1. Clinical input parameters

Variable	Age 60-64	Age 65-74	Age ≥75	Reference
IPD				
Incidence (cases per 100,000)				
Low-risk	21.4	21.9	26.4	[9]
High-risk immunocompetent	49.6	52.4	57.3	[9]
High-risk immunosuppressed	36.1	32.7	23.3	[9]
Case fatality rate (%)	53.6%	53.6%	53.6%	[10]
Meningitis in IPD cases (%)	14.8%	14.8%	14.8%	[11]
PMS in IPD meningitis cases (%)	31.7%	31.7%	31.7%	[12]
NBPP				
Incidence (cases per 100,000)				
Low-risk	84.8	114.6	156.3	[9]
High-risk immunocompetent	406.5	386.4	388.9	[9]
High-risk immunosuppressed	164.6	154.9	110.8	[9]
Case fatality rate (%)	16.8%	16.8%	16.8%	[13]
Hospitalization rate (%)	40.0%	40.0%	40.0%	[13]
Vaccine				
PCV 13 effectiveness*	Against IPD	75%		[14]
	Against NBPP	45%		[14]
PPSV23 effectiveness*	Against IPD	73%		[15]
	Against NBPP	33.5%		[16]

*Duration of protection, 15 years. For PCV13, no decline for 5 years, linear decline to 0 over 10 years; and for PPSV23, linear decline to 0 over 15 years.

Methods (cont.)

Table 2. Vaccination and medical cost inputs

Item	Cost (US dollars)	Reference
PPSV23 vaccine	$13.7	[17]
PCV13 vaccine	$19.6	[17]
Vaccine administration	$5.5	[18]
IPD	$9391.5	[19]
NBPP inpatient	$2038.5	[19]
NBPP outpatient	$193.8	[19]
Meningitis	$6729.3	[19]
PMS	$3132.1	[19]

Results

- Among a cohort of 4.5 million adults aged ≥60 years, vaccination with PPSV23 was projected to avert 263 additional cases of pneumococcal disease (22 NBPP and 241 IPD) and 130 deaths (129 IPD and 1 NBPP) and to gain 655 life-years compared with PCV13. It should be noted that 36 of the 241 IPD cases averted were meningitis
- PPSV23 dominated PCV13 with a total cost savings of US$ 10.3 million (**Table 3**)

Table 3. Incremental model outcomes and life-years gained vs total costs

	Alternative scenario (PPSV23)	Current scenario (PCV13)	Difference (PPSV23-PCV13)
Cases (n)			
IPD cases (meningitis + bacteremia)	7744	7985	-241
Meningitis	1146	1182	-36
PMS	363	375	-12
NBPP (total)	52,957	52,979	-22
Outpatient	31,774	31,787	-13
Inpatient	21,183	21,192	-9
Total cases	60,701	60,964	-263
Deaths (n)			
IPD	4151	4280	-129
NBPP	3559	3560	-1
Total deaths	7710	7840	-130
Direct costs			
Vaccine costs	$18,932,616.11	$27,074,132.40	$-8,141,516.29
Administration costs	$7,646,373.01	$7,646,373.01	-
IPD treatment (meningitis + bacteremia)	$60,922,023.15	$62,986,408.02	$-2,064,384.87
Meningitis	$6,460,568.86	$6,679,489.70	$-218,920.84
PMS treatment	$953,213.93	$985,514.25	$ -32,300.31
NBPP outpatient treatment	$5,168,948.21	$5,176,222.01	$-7273.80
NBPP inpatient treatment	$36,246,029.05	$36,297,034.88	$-51,005.82
Total costs	$129,869,203.47	$140,165,684.56	$-10,296,481.10

Limitations

- The state-transition model employed a static approach, ie, it did not account for changes in the dynamics of disease transmission over the 10-year period considered
- Since the analysis assumed the perspective of the health care payer, the indirect costs of pneumococcal disease were not considered. Nevertheless, we consider this would not affect the results since the health care payer's perspective is usually the most conservative
- The costs of vaccine wastage or the programmatic costs of mass vaccination campaigns were not considered.

Conclusions

- Under model assumptions, PPSV23 was a dominant strategy over PCV13 in adults aged ≥60 years in Peru, leading to better health outcomes and cost savings of US$ 10.3 million
- Health care decision-makers may take these findings into account when considering which pneumococcal vaccines to use in national immunization programs for older adults

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