

Cost-Effectiveness Assessment of 20-Valent Pneumococcal Conjugate Vaccine Among At-Risk and High-Risk Adults in India

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INTRODUCTION

- Clinical practice guidelines in India recommend 13-valent pneumococcal polysaccharide conjugate vaccine (PCV13) followed by 23-valent pneumococcal polysaccharide vaccine (PPV23; PCV13→PPV23) for older adults as well as younger adults who are at elevated risk of pneumococcal disease¹; however, vaccination with PPV23 or PCV13 alone is common in clinical practice, particularly in private settings
- In August 2025, a novel 20-valent PCV (PCV20) that targets a wider range of serotypes than earlier PCVs and offers longer-lasting immunity than PPV23 was licensed in India²

OBJECTIVE

- To evaluate the cost-effectiveness of PCV20 versus PCV13→PPV23, PCV13 alone, and PPV23 alone, respectively, from the private/patient perspective in adults aged ≥50 years who are at elevated risk of disease
- To evaluate the cost-effectiveness of PCV20 versus PCV13→PPV23 from the government/payer perspective in adults aged ≥60 years who are at elevated risk of disease

METHODS

Model Overview

- Lifetime risks and costs of invasive pneumococcal disease (IPD), including bacteraemia and meningitis, and all-cause non-bacteraemic pneumonia (NBP) were projected using a probabilistic cohort model with a Markov-type process
- Inputs for medical care costs and vaccine price were estimated from private/patient perspective (i.e., pricing for self-funded patients visiting a private healthcare facility), and, alternatively, government/payer perspective (i.e., pricing for government-funded medical care)
- Model population included adults aged 50-99 years and, alternatively, 60-99 years who are considered at-risk or high-risk of pneumococcal disease:
 - Population was characterised by age (in 1-year increments) and risk profile (i.e., healthy [immunocompetent without underlying medical conditions], at-risk [immunocompetent with ≥1 underlying medical condition], or high-risk [immunocompromised])³
- Vaccination strategies included PCV20 alone, PCV13→PPV23, PCV13 alone, or PPV23 alone:
 - In single-dose strategies, vaccine was administered at model entry; in the sequential strategy, persons received PCV13 at model entry and PPV23 one year later (if alive)
- Clinical and economic outcomes for each strategy were projected annually based on age, risk profile, disease/fatality rates, vaccination status/type, time since vaccination, and unit costs and include cases of IPD and all-cause NBP, deaths due to IPD and all-cause NBP, life-years (LYs) and quality-adjusted LYs (QALYs), and costs of vaccination and medical treatment for IPD and all-cause NBP

Model parameters

- Model population comprised at-/high-risk adults aged 50-99 years (N = 160.0M) (Table 1) and, alternatively, at-/high-risk adults aged 60-99 years (N = 93.0M)^{4,5}
- Herd effects were not considered due to low paediatric vaccine uptake; serotype coverage for each vaccine per age group was constant throughout the duration of the modelling horizon (Figures 1 & 2)
- VE-PCV20 and VE-PCV13 against VT disease was assumed to be durable for 5 years and to wane to 0% by year 16⁶; VE-PPV23 vs. VT-IPD was assumed to wane to 0% by year 10⁷
- QALY losses for persons with IPD, inpatient NBP, and outpatient NBP were 0.13, 0.13 and 0.004, respectively^{8,9}
- Costs (in Indian rupee, ₹) included:
 - Medical care from private/patient perspective: bacteraemia, ₹ 539,380; meningitis, ₹ 783,769; inpatient NBP, ₹ 380,068; outpatient NBP, ₹ 12,039¹⁰
 - Medical care from government/payer perspective: bacteraemia, ₹ 72,692; meningitis, ₹ 34,923; inpatient all-cause NBP, ₹ 30,460; outpatient all-cause NBP, ₹ 3,860¹¹
 - Vaccines (prices employed are confidential)
- Vaccine uptake was assumed to be 7.5% for all age and risk groups in the private/patient perspective, and to vary by risk profile only (low-risk: 7.5%; at-risk: 15%; high-risk: 30%) from government/payer perspective
- Other model inputs are summarized in Table 1

Figure 1. Percentage of IPD due to vaccine serotypes, by age

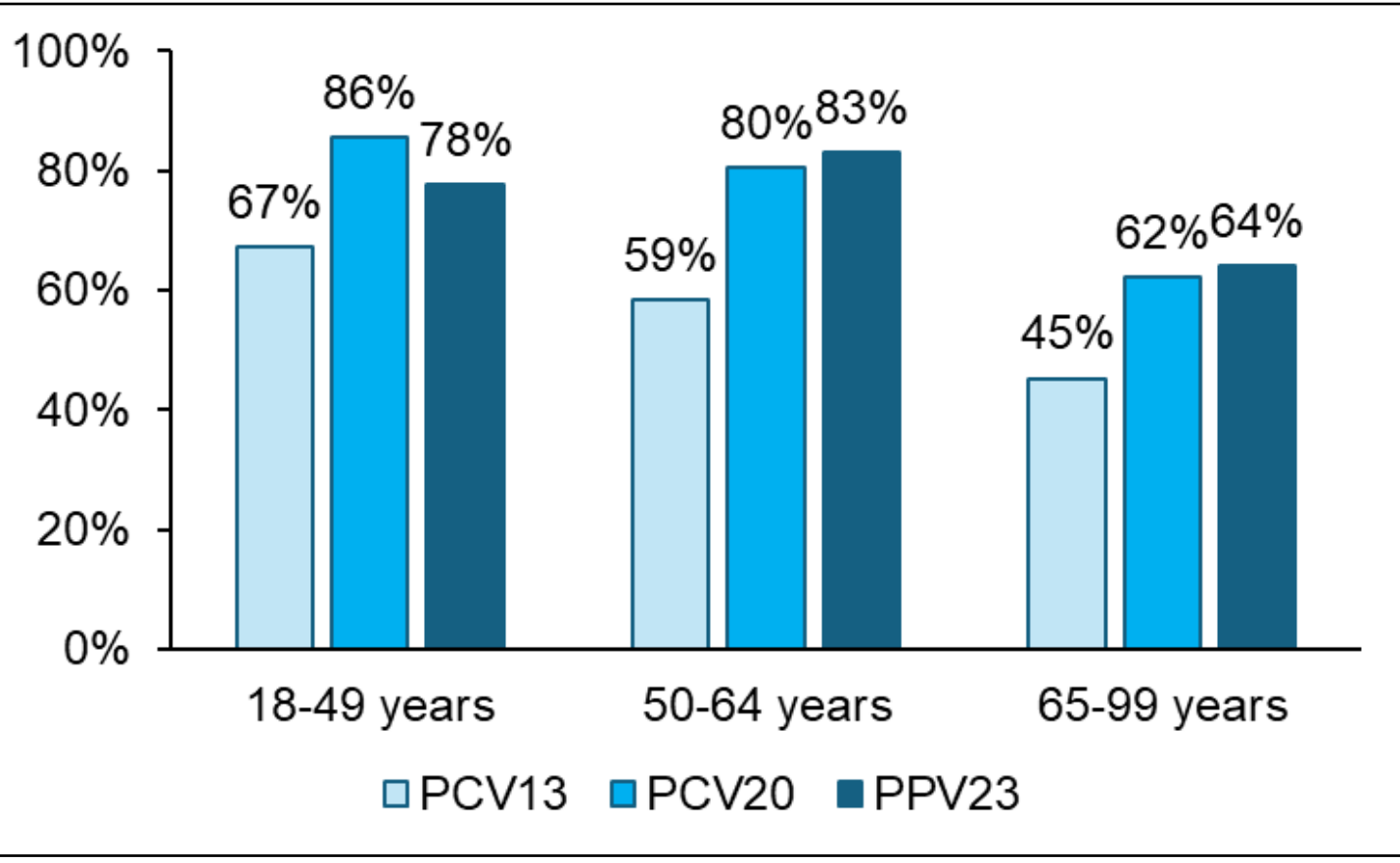


Figure 2. Percentage of pneumococcal NBP due to vaccine serotypes, by age

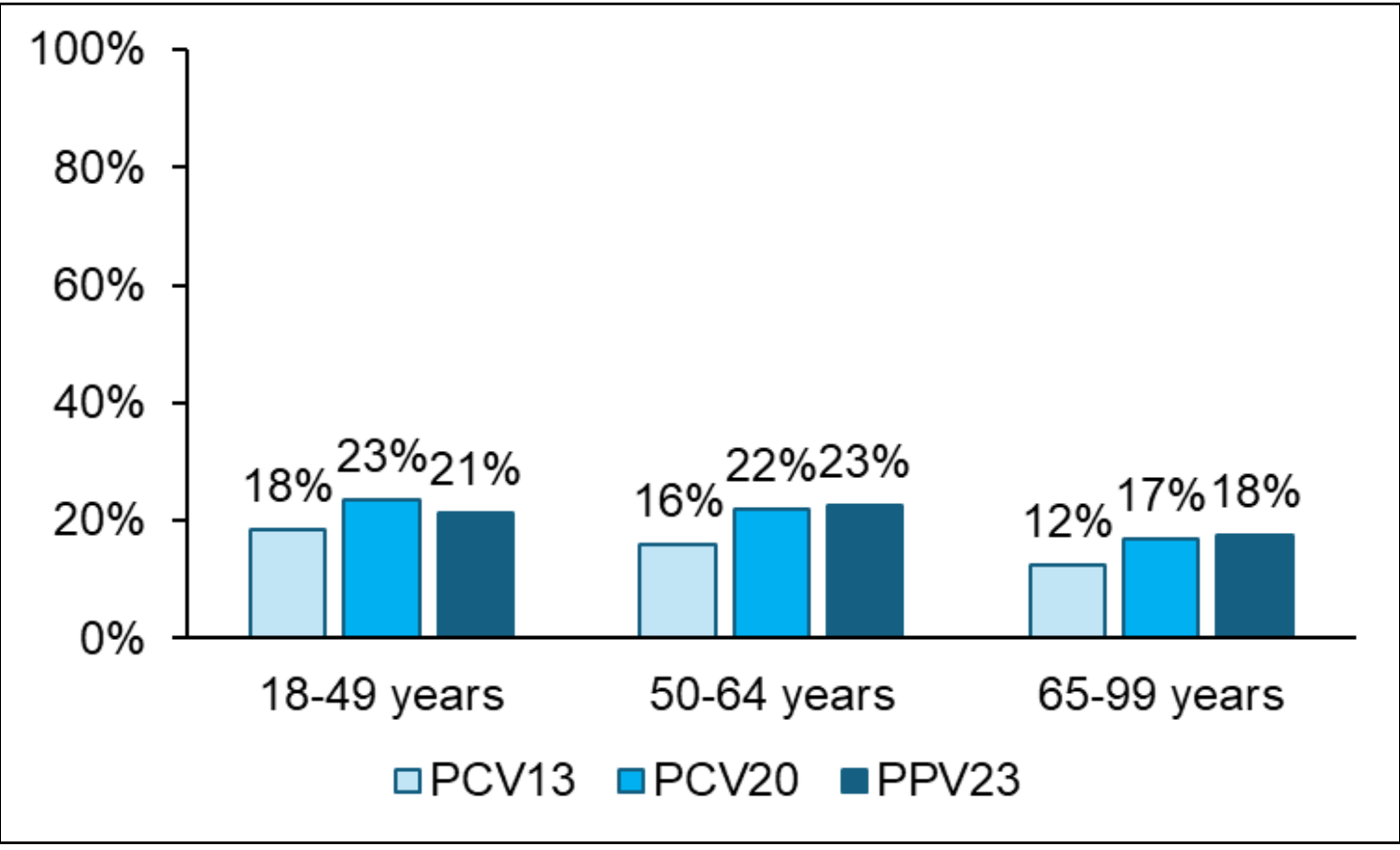


Table 1: Base case model input values, by age and risk

	Age (years)/Risk							
	50-64		65-74		75-84		85-99	
	At-Risk	High-Risk	At-Risk	High-Risk	At-Risk	High-Risk	At-Risk	High-Risk
Population (millions) ^{4,5}	73.4	22.5	31.6	10.6	12.7	4.6	3.3	1.3
Incidence of bacteraemia (per 100K) ^{12,13}	5.7	16.8	9.6	23.2	14.8	22.8	20.4	21.4
Incidence of meningitis (per 100K) ^{12,13}	0.4	1.2	0.7	1.6	1.0	1.6	1.4	1.5
Incidence of inpt NBP (per 100K) ¹²	434	1,208	905	2,005	2,304	3,380	3,694	4,749
Incidence of outpt NBP (per 100K) ¹⁴⁻¹⁶	902	1,690	1,662	2,255	2,560	3,475	3,564	4,837
General population mortality ¹⁷	1.5	1.9	3.5	4.7	6.9	9.2	14.1	18.7
CFR for bacteraemia (per 100) ¹⁸⁻²⁰	24.1	37.4	31.6	42.9	40.1	44.2	48.4	38.4
CFR for meningitis (per 100) ¹⁸⁻²⁰	24.1	37.4	31.6	42.9	40.1	44.2	48.4	38.4
CFR for inpatient NBP (per 100) ²¹	2.5	5.4	4.6	6.8	8.4	9.1	8.4	11.0
CFR for outpatient NBP (per 100)	0	0	0	0	0	0	0	0
Yr. 1 VE-PCV20/13 vs. VT-IPD ^{6,22}	79.2%	63.3%	75.0%	60.0%	75.0%	60.0%	75.0%	60.0%
Yr. 1 VE-PCV20/13 vs. VT-NBP ^{6,22}	32.3%	16.8%	30.9%	16.1%	28.1%	14.6%	20.5%	10.6%
Yr. 1 VE-PPV23 vs. VT-IPD ⁷	51.3%	41.1%	45.0%	36.0%	45.0%	36.0%	45.0%	36.0%
General population health utility ^{23,24}	0.69	0.65	0.60	0.58	0.46	0.45	0.33	0.30

Abbreviations: CFR: case-fatality rate; inpt: inpatient; IPD: invasive pneumococcal disease; NBP: non-bacteraemic pneumonia; outpt: outpatient; PCV13: 13-valent pneumococcal polysaccharide conjugate vaccine; PCV20: 20-valent pneumococcal polysaccharide conjugate vaccine; PPV23: 23-valent pneumococcal polysaccharide vaccine; Yr: year

Analyses

- Cost-effectiveness was calculated in terms of cost per QALY gained and evaluated using a 3x gross domestic product (GDP) per capita willingness-to-pay (WTP) threshold
- Analyses were conducted from the healthcare system perspective with benefits and costs discounted 3% annually
- Base case analysis compared PCV20 vs. PCV13→PPV23 among at-/high-risk adults aged ≥50 years and at-/high-risk adults aged ≥60 years from the private/patient and government/payer perspectives, respectively
- Scenario analyses compared PCV20 vs. PCV13 alone and vs. PPV23 alone among at-/high-risk adults aged ≥50 years from the private/patient perspective
- Probabilistic sensitivity analyses (PSA; 1,000 replications) were conducted on analyses comparing PCV20 vs. PCV13→PPV23 to account for uncertainty surrounding estimates of key model parameters

RESULTS

Private/Patient Perspective – At-/High-Risk Adults Aged ≥50 Years

- In base case analysis, PCV20 was cost-saving versus PCV13→PPV23 (ΔCosts = -₹2,401 million [M]; ΔQALYs = 11,385; cost/QALY = Dominant) (Table 2)
- In scenario analyses, PCV20 was cost-effective versus PPV23 alone (ΔCosts = ₹7,783M; ΔQALYs = 40,965; cost/QALY = ₹189,982) and versus PCV13 alone (ΔCosts = ₹7,677M; ΔQALYs = 11,639; cost/QALY = ₹659,591)
- In PSA comparing PCV20 versus PCV13→PPV23, 36.0% of replications were cost saving (in the southeast quadrant) and 94.6% of replications were below the 3x GDP per capita WTP threshold from the private/patient perspective (Figure 3)

Government/Payer Perspective – At-/High-Risk Adults Aged ≥60 Years

- In base case analysis, PCV20 was cost-effective versus PCV13→PPV23 (ΔCosts = ₹10,209M; ΔQALYs = 17,669, cost/QALY = ₹577,810) (Table 3)
- In PSA comparing PCV20 versus PCV13→PPV23, 70.6% of replications were below the 3x GDP per capita WTP threshold from the government/payer perspective (Figure 4)

Table 2: Results - Private/Patient Perspective

	PCV20	Difference in Outcomes (vs. PCV20)					
		Base Case	Scenarios		Difference		
		PCV13→PPV23	Difference	PPV23	Difference	PCV13	Difference
No. cases							
IPD	388,960	390,945	-1,985	395,490	-6,531	391,140	-2,181
Inpatient NBP	47,744,217	47,780,159	-35,942	47,877,021	-132,804	47,780,139	-35,922
Outpatient NBP	57,290,489	57,340,016	-49,527	57,473,826	-183,337	57,339,994	-49,505
No. deaths	3,812,643	3,815,647	-3,004	3,823,447	-10,804	3,815,713	-3,070
LYs (discounted)	1,594,535,290	1,594,519,327	15,963	1,594,478,343	56,947	1,594,518,867	16,424
QALYs (discounted)	902,392,529	902,381,144	11,385	902,351,564	40,965	902,380,890	11,639
Costs (millions)							
Medical care	₹ 10,318,158	₹ 10,329,649	-₹ 11,492	₹ 10,360,221	-₹ 42,064	₹ 10,329,735	-₹ 11,578
Vaccination	₹ 71,978	₹ 62,887	₹ 9,091	₹ 22,132	₹ 49,846	₹ 52,723	₹ 19,255
Total healthcare costs	₹ 10,390,136	₹ 10,392,536	-₹ 2,401	₹ 10,382,353	₹ 7,783	₹ 10,382,459	₹ 7,677
Cost per QALY	--	--	Dominant	--	₹ 189,982	--	₹ 659,591

Table 3: Results - Government/Payer Perspective

	PCV20	Base case	
		PCV13→PPV23	Difference
No. cases			
IPD	187,256	190,223	-2,967
Inpatient NBP	26,588,493	26,648,939	-60,446
Outpatient NBP	30,073,916	30,145,998	-72,082
No. deaths	2,251,211	2,256,968	-5,757
LYs (discounted)	776,297,668	776,271,219	26,449
QALYs (discounted)	395,658,393	395,640,725	17,669
Costs (millions)			
Medical care	₹ 582,114	₹ 583,889	-₹ 1,775
Vaccination	₹ 67,875	₹ 55,890	₹ 11,985
Total healthcare costs	₹ 649,988	₹ 639,779	₹ 10,209
Cost per QALY	--	--	₹ 577,810

Abbreviations: IPD: invasive pneumococcal disease; LYs: life years; NBP: non-bacteraemic pneumonia; PCV13: 13-valent pneumococcal polysaccharide conjugate vaccine; PCV20: 20-valent pneumococcal polysaccharide conjugate vaccine; PPV23: 23-valent pneumococcal polysaccharide vaccine; QALYs: quality-adjusted life years

Figure 3: PSA Scatterplot - Private/Patient Perspective: PCV13→PPV23

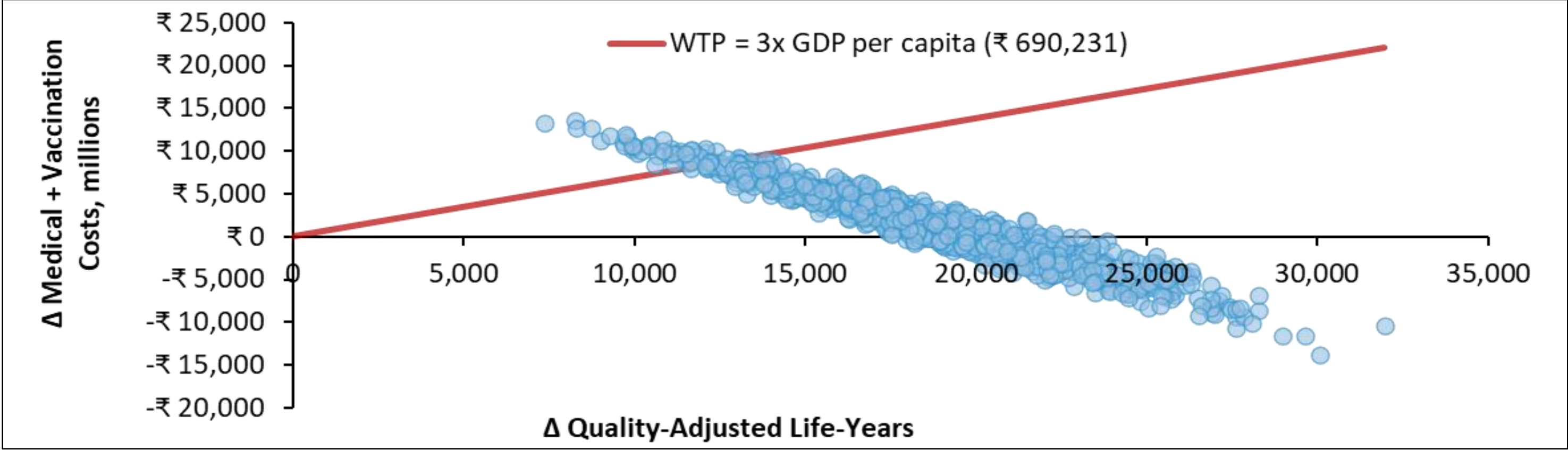
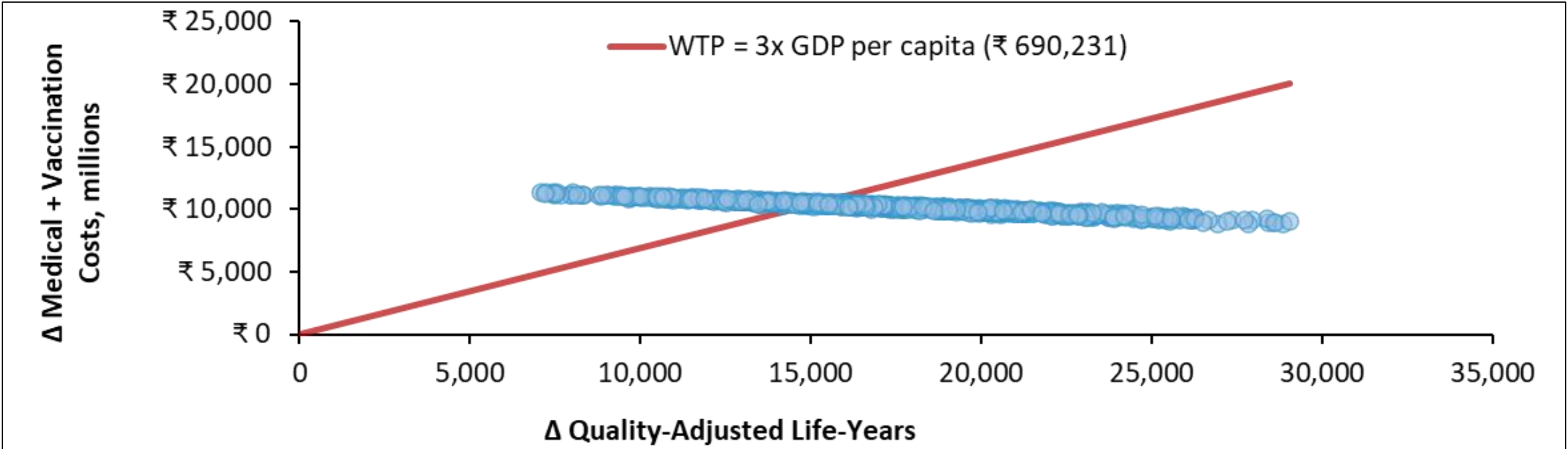


Figure 4: PSA Scatterplot – Government/Payer Perspective: PCV13→PPV23



Abbreviations: GDP: gross domestic product; PSA: probabilistic sensitivity analysis; WTP: willingness-to-pay

LIMITATIONS

- In the absence of Indian data, disease rates and CFR for inpatient all-cause NBP were based on US data
- Medical care costs were assumed to be invariant by age and risk and potential downstream adverse events and costs of IPD and NBP were not factored in, which may conservatively bias against PCV20 use
- Vaccine coverage assumptions may overestimate uptake given the lack of national policy for adult pneumococcal vaccination in India
- The analysis did not assume effectiveness of PPV23 against VT-NBP even though there is limited evidence to suggest PPV23 may provide some protection against VT-NBP^{25,26}

CONCLUSIONS

- Compared to PCV13→PPV23, PCV20 in at-risk/high-risk older adults would be cost-saving and cost-effective from both the private/patient and government/payer perspectives, respectively
- Furthermore, from private/patient perspective, PCV20 would also be cost-effective compared with either PCV13 alone or PPV23 alone

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