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COST-EFFECTIVENESS ANALYSIS OF THE 13-VALENT AND 20-VALENT PNEUMOCOCCAL CONJUGATE VACCINE IN THE KAZAKH ADULT POPULATION

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BACKGROUND

- Adult pneumococcal vaccination is recommended in Kazakhstan but not included in the adult national immunization program (NIP), leaving vulnerable risk groups without proper protection against pneumococcal disease (PD).[1-6]
- The 13-valent pneumococcal conjugate vaccine (PCV13) is being considered for inclusion, while PCV20 has recently become available, offering broader serotype coverage.

OBJECTIVE

- To evaluate the cost-effectiveness of implementing PCV13 or PCV20 compared to no vaccination for the prevention of PD in adults of all risk groups aged ≥50 years or ≥60 years in Kazakhstan.

METHODS

- A probabilistic Markov model capturing the lifetime risk of clinical outcomes and economic costs of IPD in the defined population was used to evaluate the cost-effectiveness of a single dose of PCV13 or PCV20 vs. no vaccination.
- The model population was grouped by age and risk profiles (i.e., low, moderate, or high risk of PD).[7]
- Epidemiologic parameters, serotype coverage, costs, and population inputs were obtained from Kazakhstan-specific sources and relevant literatures. [7-13]
- Cost and health outcomes were discounted at 5% annually from a payer perspective.
- Utility reductions for persons with IPD, inpatient NBP , and outpatient NBP were 0.13, 0.13 and 0.004, respectively in the year in which PD occurred.[10,11]
- Vaccine effectiveness (VE) against IPD and NBP for PCV13 and PCV20 was based on data from the CAPiTA trial[14] and Mangen et al.[15] Initial VE was assumed to be persist for the first five years for all ages and risk groups, then wane at 5% annually during years 6-10 and 10% during years 11-15 years, resulting in no efficacy from year 16 onward.[16]
- List of several scenarios evaluated over a lifetime horizon (75 years):
  - **1)** Adults of all risk groups aged 50+ years at a 50% vaccination coverage.
  - **2)** Adults of all risk groups aged 50+ years at a 100% vaccination coverage.
  - **3)** Adults of all risk groups aged 60+ years at a 50% vaccination coverage.
  - **4)** Adults of all risk groups aged 60+ years at a 100% vaccination coverage.

Table 1. Epidemiology, Medical Cost, and Utility Inputs of PD in Kazakhstan

Outcome	Risk Group[7]	Disease Incidence per 100,000 individuals, Age group, years				Fatality rates, %[12,13], Age group, years				Direct medical cost (per episode), KZT[7]
		50-64	65-74	75-84	85+	50-65	65-75	75-85	85+	
Bacteremia[7-9]	*Low*	15.9	28.2	33.7	30.6	10.6%	7.4%	10.6%	19.4%	2,672,134 ₸
	Moderate	54.0	78.9	94.3	85.7	11.8%	13.9%	13.6%	23.7%	
	High	154.2	123.9	148.2	134.7	12.5%	12.9%	10.6%	20.0%	
Meningitis[7,8]	*Low*	13.7	6.7	5.4	12.5	-	-	-	-	1,572,504 ₸
	Moderate	46.6	18.6	15.1	35.0	-	-	-	-	
	High	132.8	29.3	23.7	55.0	-	-	-	-	
Inpatient NBP[7,8]	*Low*	1,381.3	5,529.6	7,225.7	8,785.8	1.0%	3.1%	6.8%	8.2%	2,965,382 ₸
	Moderate	4,972.7	16,588.7	21,677.0	26,357.5	2.5%	4.6%	8.4%	8.3%	
	High	9,392.8	22,671.2	29,625.2	36,021.9	5.4%	6.8%	9.0%	11.0%	
Outpatient NBP[7,8]	*Low*	1,137.4	5,306.1	4,609.4	4,594.8	-	-	-	-	74,135 ₸
	Moderate	4,094.5	15,918.3	13,828.1	13,784.5	-	-	-	-	
	High	7,734.1	21,755.1	18,898.4	18,838.9	-	-	-	-	

Table 2. Direct Effects

Vaccine effectiveness, % [14,15]					
Vaccine		PCV (non-serotype 3/serotype 3)			
Outcome		IPD		NBP	
Risk Group		Low/mod	High	Low/mod	High
Age group, years	*50-64 years*	79.2	63.3	51.3	41.1
	65+ years	75	60	45	36

Table 3. Serotype Coverage

Age group	Serotype coverage: IPD, %[17]			
	PCV13	PCV20	Serotype 3	Serotype 6A
50-64 years	70	90	20	8
65+ years				
Serotype coverage: NBP, %[17-19]				
50-64 years	30.6	39.3	8.7	3.5
65+ years	53.2	68.4	15.2	6.1

Abbreviations: PCV, pneumococcal conjugate vaccine; IPD, invasive pneumococcal disease; NBP, non-bacteremic pneumonia.

RESULTS

- Across both vaccination coverage scenarios (50% and 100%) for both target age groups (≥50 and ≥60 years), a single dose of PCV13 or PCV20 would offer superior health and economic outcomes compared to no vaccination. (Table 5 and 6)

RESULTS (continued)

- In all scenarios evaluated, PCV13 and PCV20 were estimated to avert 424,117-1,685,489 PD cases (meningitis, bacteremia, inpatient and outpatient NBP) and prevent 14,431-49,113 deaths.
- Despite the additional cost of a single-dose, PCV13 or PCV20, were estimated to yield incremental QALY gains of 6,679 and 89,413 and a cost saving range of 558,208 ₸ and 2,039,778 ₸ million over a lifetime horizon versus no vaccination.
- PCV20 vs. no vaccination was estimated to provide higher health and economic gains compared to PCV13 vs. no vaccination, reflecting PCV20's broader serotype coverage.

Table 5. Base case results of cost-effectiveness of implementing PCV13 or PCV20 compared to no vaccination in Kazakh adults of all risk groups aged ≥50 years.

Scenario #	Scenario 1 (Estimated vaccinated individuals: 2,454,139)		Scenario 2 (Estimated vaccinated individuals: 4,908,278)	
	PCV13 vs. no vaccination	PCV20 vs. no vaccination	PCV13 vs. no vaccination	PCV20 vs. no vaccination
Clinical Outcomes (Cases)				
PD*	-654,107	-842,742	-1,308,212	- 1,685,486
Deaths due to PD	-19,047	-24,557	-38,095	- 49,113
Utilities				
Total QALYs	17,355	28,765	69,421	89,413
Economic Outcomes (millions KZT)				
Cost of vaccination	26,207 ₸	66,688 ₸	52,415 ₸	133,377 ₸
Cost of disease	- 843,607,665 ₸	- 1,086,577,725 ₸	- 1,687,215 ₸	- 2,173,155 ₸
Total Costs	- 817,399,777 ₸	- 1,019,889,188 ₸	- 1,634,799 ₸	- 2,039,778 ₸
ICER per QALY	Dominant	Dominant	Dominant	Dominant

Table 6. Base case results of cost-effectiveness of implementing PCV13 or PCV20 compared to no vaccination in Kazakh adults of all risk groups aged ≥60 years.

Scenario #	Scenario 3 (Estimated vaccinated individuals: 1,413,754)		Scenario 4 (Estimated vaccinated individuals: 2,827,508)	
	PCV13 vs. no vaccination	PCV20 vs. no vaccination	PCV13 vs. no vaccination	PCV20 vs. no vaccination
Clinical Outcomes (Cases)				
PD*	- 424,117	- 546,708	- 848,234	- 1,093,415
Deaths due to PD	- 14,431	- 18,612	- 28,861	- 37,225
Utilities				
Total QALYs	6,679	8,606	26,718	34,425
Economic Outcomes (millions KZT)				
Cost of vaccination	15,173 ₸	38,610 ₸	30,347 ₸	77,221 ₸
Cost of disease	- 573,381 ₸	- 738,822 ₸	- 1,146,763 ₸	- 1,477,645 ₸
Total Costs	- 558,208 ₸	- 700,212 ₸	- 1,116,416 ₸	- 1,400,424 ₸
ICER per QALY	Dominant	Dominant	Dominant	Dominant

Abbreviations: PCV, pneumococcal conjugate vaccine; PD, pneumococcal disease; QALY, quality-adjusted life year; ICER, incremental cost-effectiveness ratio.
*Includes meningitis, bacteremia, inpatient and outpatient NBP cases.

CONCLUSIONS

- **Vaccinating adults of all risk groups aged 50+ or 60+ years with a single-dose of PCV13 or PCV20 is expected to yield considerable health benefits, preventing further clinical burden from PD alongside substantial cost savings in medical expenses in Kazakhstan.**
- **Higher vaccination coverage of PCV13 and PCV20 resulted in superior outcomes in adults.**
- **Introducing PCV13 vaccination in Kazakhstan's adult NIP could enable future transition to PCV20, adding value through broader protection.**

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Disclosures

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