COST-EFFECTIVENESS OF 13-VALENT VERSUS 10-VALENT PNEUMOCOCCAL CONJUGATE VACCINE USE IN THE CZECH NATIONAL IMMUNIZATION PROGRAM

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Introduction

- Pneumococcal diseases pose a serious health as well as an economic burden on national health care systems[1,2]. Invasive pneumococcal disease (IPD) due to its severity and high mortality, and non-invasive disease such as Community Acquired Pneumonia (CAP) and Acute Otitis Media (AOM) due to its higher incidence[3].
- The Czech Republic (CR) as well as many other European countries have only a limited local evidence on the underlying epidemiology.
- The 7-valent pneumococcal conjugate vaccine (PCV7) was introduced in the CR in 2005 and became a state funded program in 2007 (risk-based only). The pediatric national immunization program (NIP) on a voluntary basis was introduced in 2010. At the same time two new PCVs were launched including the 10-valent pneumococcal conjugate vaccine (PCV10) and the 13-valent pneumococcal conjugate vaccine (PCV13).

Objective

- The objective was to estimate the expected outcomes, costs, cost-effectiveness of the pediatric NIP with PCV13 and conjugated vaccine PCV10 as a comparator among specific populations of children and adults in preventing and reducing the incidence of IPD, CAP and AOM in CR.

Methods

- A Markov decision-analytic model was developed to examine impacts of infant vaccination with PCV13 versus PCV10.
- PCV13 direct effectiveness was extrapolated from PCV7 efficacy data from clinical trials, using assumptions regarding serotype prevalence and PCV13 protection against additional serotypes, while indirect (herd) effect was extrapolated from US surveillance data following universal PCV7 use[4].
- Base case (BC) assumptions: Indirect Effects (IE) of PCV13 was extrapolated from PCV7 IE and the serotype coverage mathematically; no indirect effect in PCV10 was assumed; percentage of the birth cohort vaccinated was 80%; discount rate 3%.
- The local epidemiology and cost data were used to achieve maximum national specificity.
- Population data obtained from Czech Statistical Office[5] for the year of 2010.
- Vaccine price assumed EUR 42.12 for PCV10 and EUR 62.7 for PCV13[6]. Administration fee was EUR 6.69 (for both vaccination).
- Utility was taken over by the published literature[4].
- Sensitivity analysis tested IE of PCV7 at 50% and 100% level.

Figure 1: Incidence per 100 000 - from the era before introduction of NIP (2008-2010).
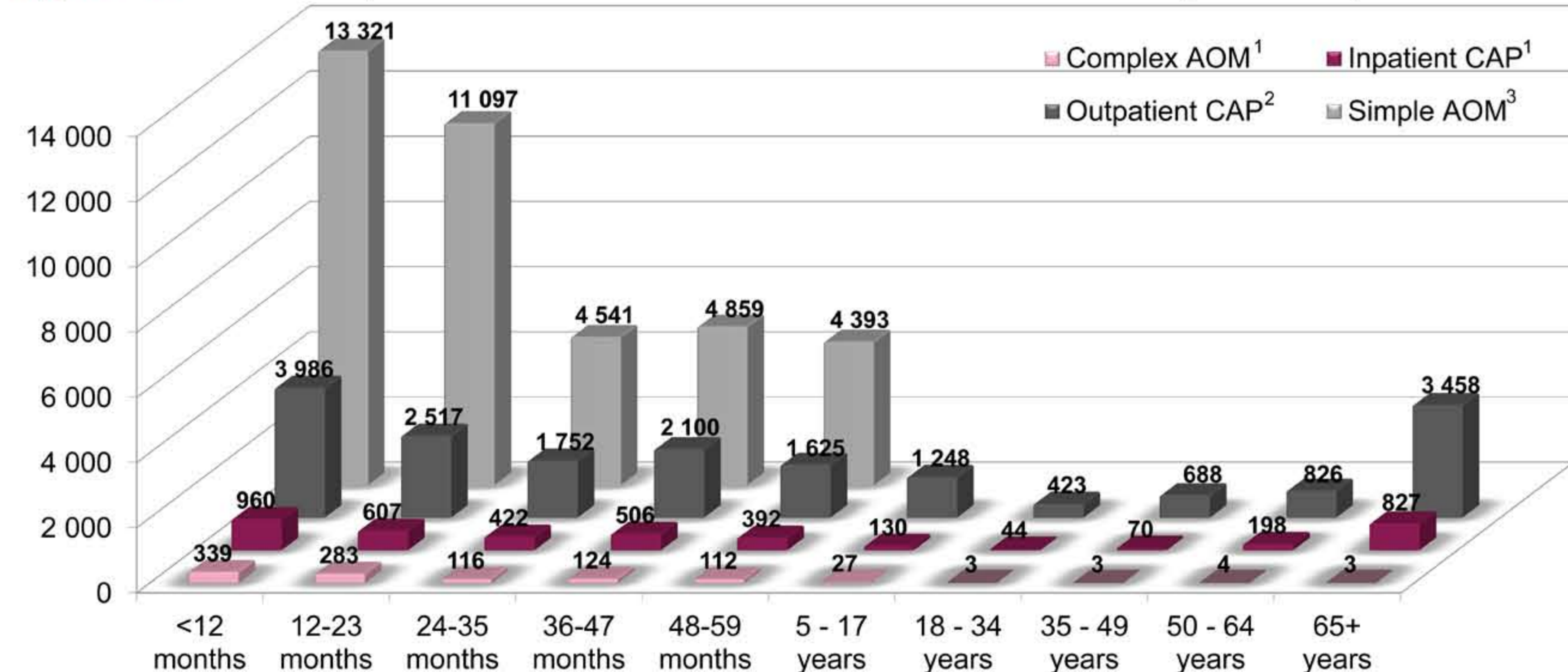
Notes: 1 … National Register of Hospitalizations (NRH); 2 … Estimated from percentage of hospitalized cases of CAP from VZP and the inpatient CAP incidence from NRH; 3 … Estimated by using published incidence data from: Prymula et al.[7]
IPD incidence – not included in the graph; values between 1.05 and 8.19; surveillance data provided upon request by the National Reference Laboratory (NRL) for Pneumococcal Diseases for the years 2009-2010.

Table 1: Case Fatality rate and Serotype coverage - from the era before introduction of NIP (2008-2010)

Age group	Case fatality rate			Serotape coverage[3]		
	Meningitis[1]	Sepsis[1]	Inpatient CAP[2]	PCV7	PCV10	PCV13
< 1 year	13.3%	5.9%	0.3%	45.5%	54.5%	63.6%
1 – 4 years	13.3%	5.9%	0.0% – 0.2%	51.7%	69.0%	86.2%
5 - 17 years	6.3%	0.0%	0.3%	38.2%	85.3%	91.2%
18 - 34 years	41.7%	9.3%	1.8%	28.2%	66.2%	80.3%
35 - 49 years	20.0%	9.7%	4.0%	34.7%	49.8%	68.5%
50 - 64 years	15.8%	14.1%	9.4%	34.7%	49.8%	68.5%
65+ years	39.5%	15.3%	24.8%	30.9%	45.5%	71.7%

Notes: 1 … Surveillance data provided upon request by the NRL for Pneumococcal Diseases (Prague, CR) for the years 2009-2010; 2 … NRH; 3 … Motlova J et al. Invasive pneumococcal disease in CR in 2010.Zprávy epidemiologie a mikrobiologie (SZÚ, Praha) 2011; 20(2).

Figure 2: Direct medical costs

Notes: 1 …Retrospective data from VZP affiliate, CEEOR retrospective patient chart review; 2 …Czech DRG system, length of stay from NRH Simple AOM … not included in the graph; values between EUR 43.5 and EUR 57.8; Retrospective data from VZP affiliate.

Results

- Model predicts incremental EUR 64.5 million for the PCV13 NIP from the payer's perspective in the 10-year horizon, as compared to PCV10. This would lead to an reduction in IPD, all cause inpatient and outpatient CAP and AOM by approximately 921, 22 900, 56 796 and 40 598 cases, respectively, thus savings EUR 35.4 million. This gives a total cost of EUR 29.0 million in the 10 years. The incremental cost per LYG or QALY gained is estimated as EUR 929 or EUR 1 164, respectively, from the payer's perspective as compared to PCV10.

Figure 3: Health outcomes: PCV13 as compared to the PCV10 (BC)

Note: 1...No deaths caused by Outpatient CAP were assumed
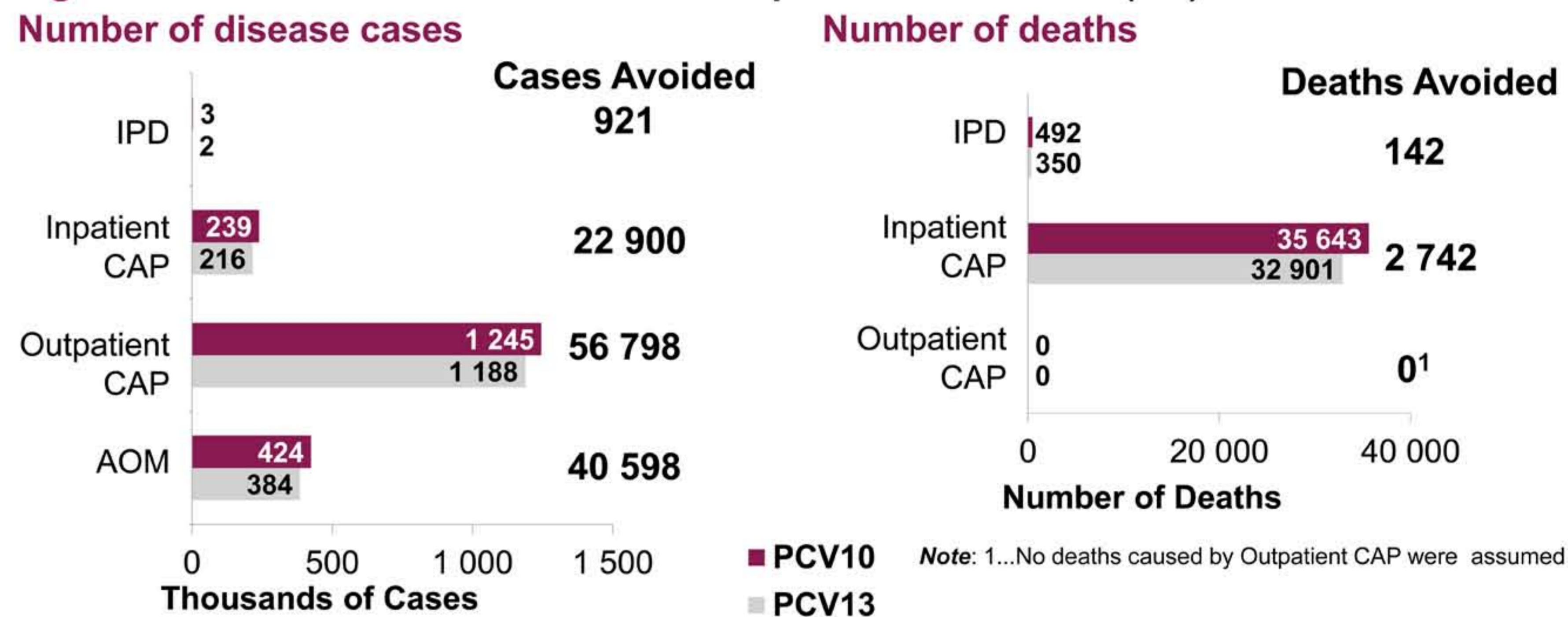
Table 2: Results Comparison of Different PCV10 IE from the Payer's and Societal Perspective - BC Results are highlighted in pink

Perspective	Payer's Perspective		Societal Perspective	
	Cost/LYG	Cost/QALY	Cost/ LYG	Cost/ QALY
PCV10 IE 0%	€929	€1 164	€581	€728
PCV10 IE 50%	€1 993	€2 505	€1 664	€2 091
PCV10 IE 100%	€5 191	€6 585	€4 920	€6 240

Table 3: Results overview depending on time horizon - BC Results are highlighted in pink

Perspective	1 Year Horizon		5 Year Horizon		10 Year Horizon	
	Total Cost	Cost/QALY	Total Cost	Cost/QALY	Total Cost	Cost/QALY
Payer's	€5 865 440	€12 627	€21 564 302	€2 299	€29 041 416	€1 164
Societal	€5 652 113	€12 168	€17 415 079	€1 857	€18 155 123	€728

Figure 4: Total Costs: PCV13 as compared to the PCV10, Societal perspective (BC)

Note: Total costs from the payer's perspective is calculated as the total cost without Non-medical cost.
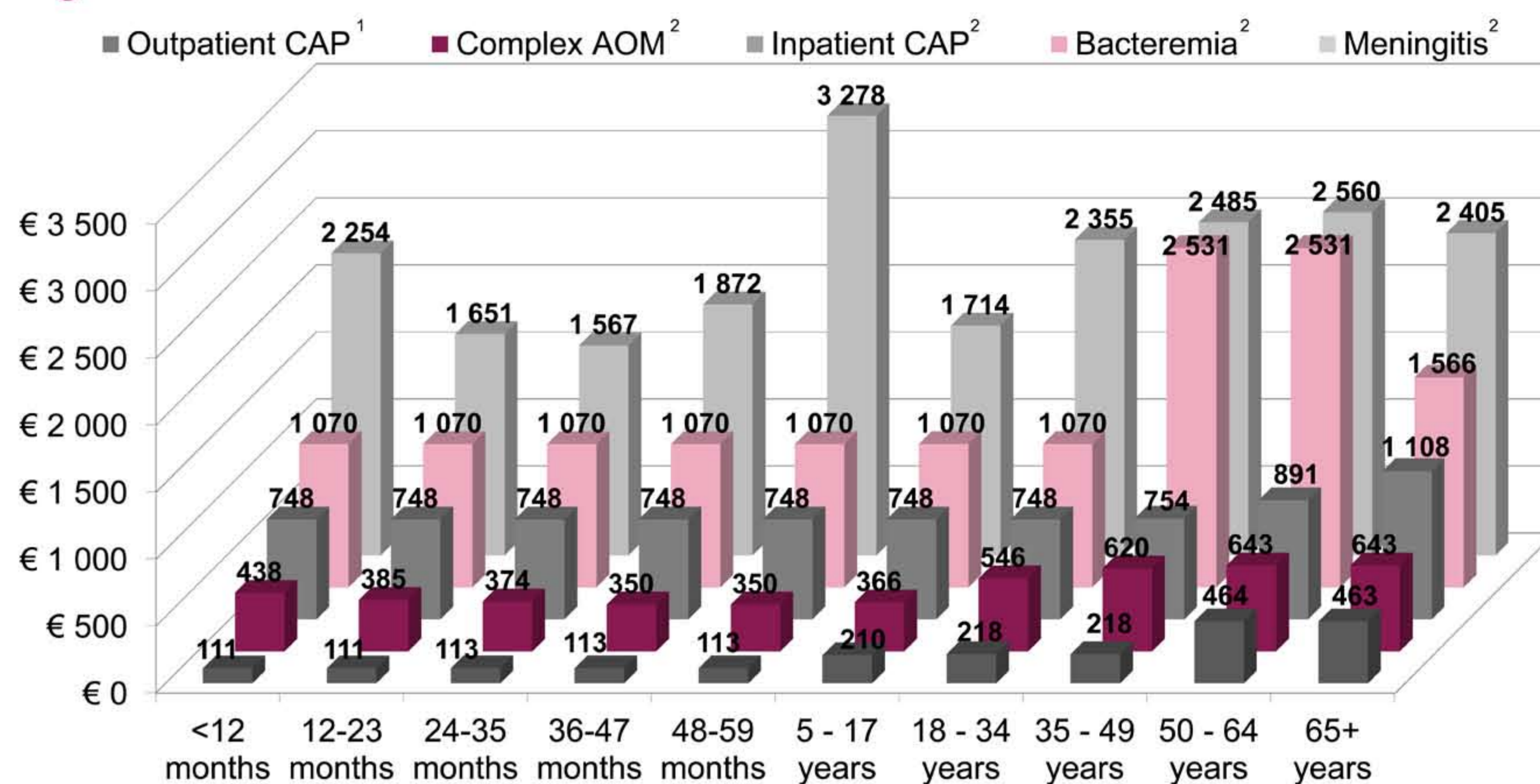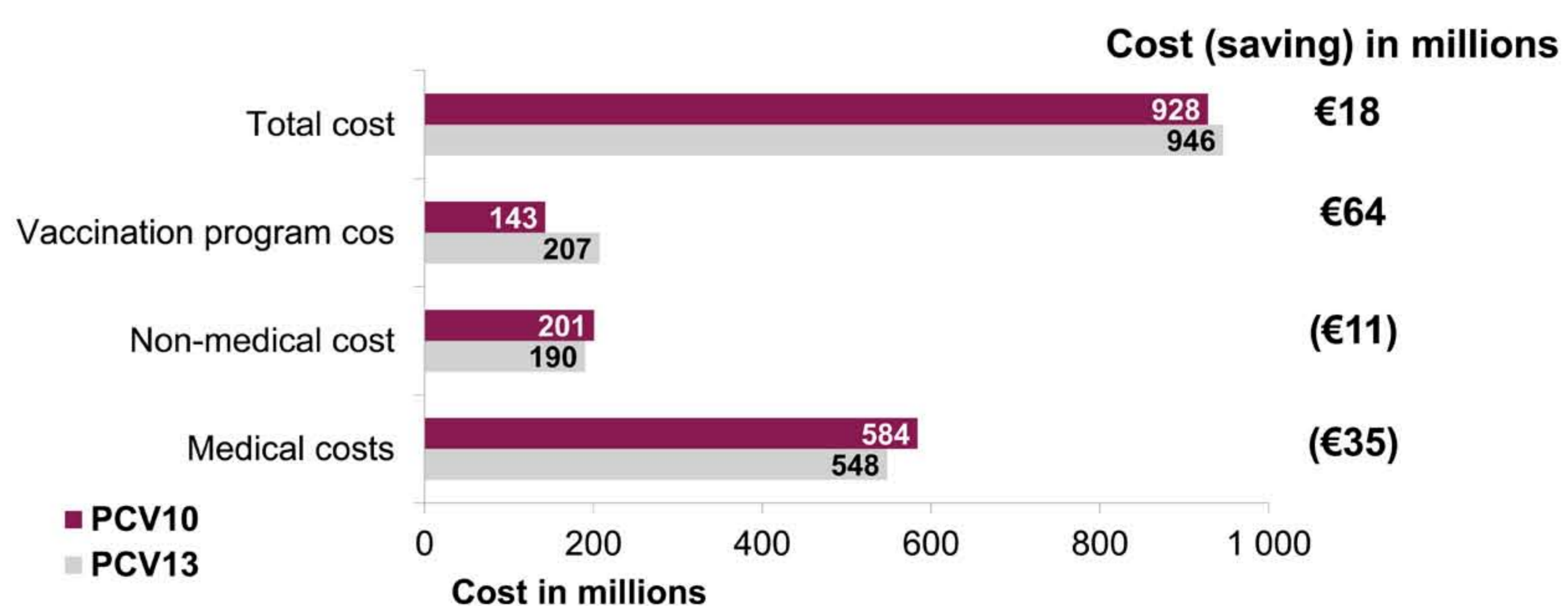
Conclusions

- Comparing the national GDP per capita with the WHO recommendation on health care spending per QALY gained, PCV13 NIP in Czech Republic can be considered cost-effective.
- The inclusion of the indirect effect in either of the vaccines considered played the major role in driving the health outcomes and cost-effectiveness.

 # PIN68

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