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How cost effective is switching universal vaccination from PCV10 to PCV13? A case study from a developing country

Carlos Castañeda-Orjuela [a,b,*], Fernando De la Hoz-Restrepo [a]

[a] Epidemiology and Public Health Evaluation Group, Public Health Department, Universidad Nacional de Colombia, Bogotá, Colombia
[b] Colombian National Health Observatory, Instituto Nacional de Salud, Bogotá, Colombia

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ABSTRACT

Background: Children immunization with pneumococcal conjugate vaccine (PCV) had profound public health effects across the globe. Colombian adopted PCV10 universal vaccination, but PCV incremental impact need to be revalued. The objective of this analysis was to estimate the cost-effectiveness of switch to PCV13 versus continue PCV10 in Colombian children.

Methods: A complete economic analysis was carried-out assessing potential epidemiological and economic impact of switching from PCV10 to PCV13. Epidemiological information on PCV10 impact was obtained from lab-based epidemiological surveillance on pneumococcal isolates at the Colombian National Institute of Health. Economic inputs were extracted from the literature. Incremental PCV13 effectiveness was based in additional serotypes included. Comparisons among alternatives were evaluated with the Incremental Cost-Effectiveness Ratio (ICER) at a willingness to pay of one GDP per capita (USD$ 6631) per Year of Live Saved (YLS). All costs were reported in 2014USD. Deterministic and probabilistic sensitivity analyses were performed, and 95% confidence interval reported.

Results: After four years using PCV10 for universal vaccination on children the Colombian health surveillance system showed a relative increment on non PCV10 isolates. To change from PCV10 to PCV13 would avoid 587 (CI95% −49–1008) ambulatory Rx community-acquired pneumoniae (CAP), 1622 (CI95% 591–2343) Inpatient RxCAP, 10 (CI 95% 6–11) pneumococcal meningitis, and 79 (CI95% 76–98) deaths. ICER per YLS was USD$ 2319 (CI95% Dominated – USD$ 4225) for Keep-PCV10 and USD$ 1771 (CI95% USD$ 1285–9884) for Switch-to PCV13. In spite of its cost-effectiveness Keep-PCV10 is an extended dominated alternative and Switch-to PCV13 would be preferred. Results are robust to parameters changes in the sensitivity analyses.

Conclusion: A national immunization strategy based in Switch-to PCV13 was found to be good value for money and prevent additional burden of pneumococcal disease saving additional treatment costs, when compared with to Keep-PCV10 in Colombia, however additional criteria to decision making must be taken into account.

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1. Introduction

Infections due to *Streptococcus pneumoniae* are major causes of morbidity, hospitalization, and mortality in children and adults. *S. pneumoniae* causes invasive pneumococcal disease (IPD) such as meningitis and bacteremia as well as non-invasive disease, including community-acquired pneumonia (CAP) and acute otitis media (AOM) [1,2]. O'Brien et al estimated in 2000 there were about 14.5 million cases of serious pneumococcal disease around the world with 826 thousand deaths in children less than 5 years old [3]. In Latin America and the Caribbean (LAC), during 2009 were estimated between 12,000 and 28,000 deaths due to pneumococcus, 182 thousand hospitalization and 1.4 million outpatient consults [4,5].

Colombia already evaluated the cost-effectiveness of the Pneumococcal Conjugate Vaccines (PCV) and implemented in 2011 the universal vaccination at free of charge with ten-valent PCV (PCV10) in a 2 + 1 schedule (2, 4 and 12 months) for children less than one year old, through the public health system [6]. The PCV10 implementation, the cost-effective alternative at that moment, produced a switch on the pneumococcal serotypes reported to the SIREVA II initiative after six years [7–9]. Especially a relative increase in 19A serotype had been observed, similarly to other countries those included PCV10 [10]. Compared with the initial Colombian

* Corresponding author at: Colombian National University, Colombia.
E-mail addresses: cacastanedao@unal.edu.co, ccastanedao@ins.gov.co (C. Castañeda-Orjuela).

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cost-effectiveness analysis (CEA), new evidence had emerged about disease occurrence, vaccine effectiveness and costs of pneumococcal disease. For the Colombian Ministry of Health (MoH) is needed to evaluate the up-to-date cost-effectiveness of the available PCVs in the Colombian children population, to reconsider the initial decision about the PCV to be finance through the Expanded Program on Immunization (EPI).

In spite of the initial PCV10 inclusion in the Colombia EPI was informed and discussed with a CEA, the effectiveness of this intervention should be monitored in the population and the inclusion of other alternatives considered for the decision-makers considering the new available evidence, seeking the bigger population welfare. To update the cost-effective profile of available PCVs is useful for EPI's manager to wisely invest the scarce public resources. The objective of this analysis was to estimate the cost-effectiveness to switch the immunization to PCV13 versus to continue PCV10 vaccination in the Colombian children.

2. Methods

2.1. Model and target population

We adapted a previous built simulation model [6] for the present CEA. Due to pneumococcal disease incidence and mortality vary across ages, we implemented an age-dependent Markov model, including a cohort of children younger than one year old (870,130 children according with the *Departamento Nacional de Estadística – DANE*), followed up to the life expectancy (76 years). This population corresponds to the total target vaccination groups for PCV in Colombia in a 2 + 1 doses schedule applied at 2, 4 and 12 months of age. Five states were included: Healthy, AOM, Radiological confirmed CAP, Pneumococcal Meningitis, and death (Fig. 1). The model runs in MS Excel with annual cycles and implemented half cycle corrections. Transitions between states were based in annual probabilities. The occurrence of related pneumococcal disease was considered only during the first five years of life.

2.2. Setting and location

Colombian is a middle-income tropical country located in northwestern South America. The health system is funded entirely by public resources and delivered by both public and private providers. Immunization is delivered in Colombia through this public health system free of any charge for the target population, mainly under one-year children. Vaccines and immunization supplies are bought directly by the MoH and distributed to public and private health facilities, most of them of primary care, that deliver the immunization shots in a continuous way during all the year. The MoH defines the vaccines included in the EPI, through discussion in a National Immunization Technical Advisory Group (NITAG).

2.3. Comparators

In the present CEA three alternatives were evaluated: (1) No vaccination (leave the PCV vaccination), (2) Continue the PCV10 vaccination, and (3) Switch to PCV13 vaccination. To model the current Colombian pneumococcal related burden an additional scenario was simulated (Initial PCV10 vaccination), however it was not included in the comparison to evaluate the cost-effectiveness ratios (Fig. 1). PCV10 covers serotypes 1, 4, 5, 6B,

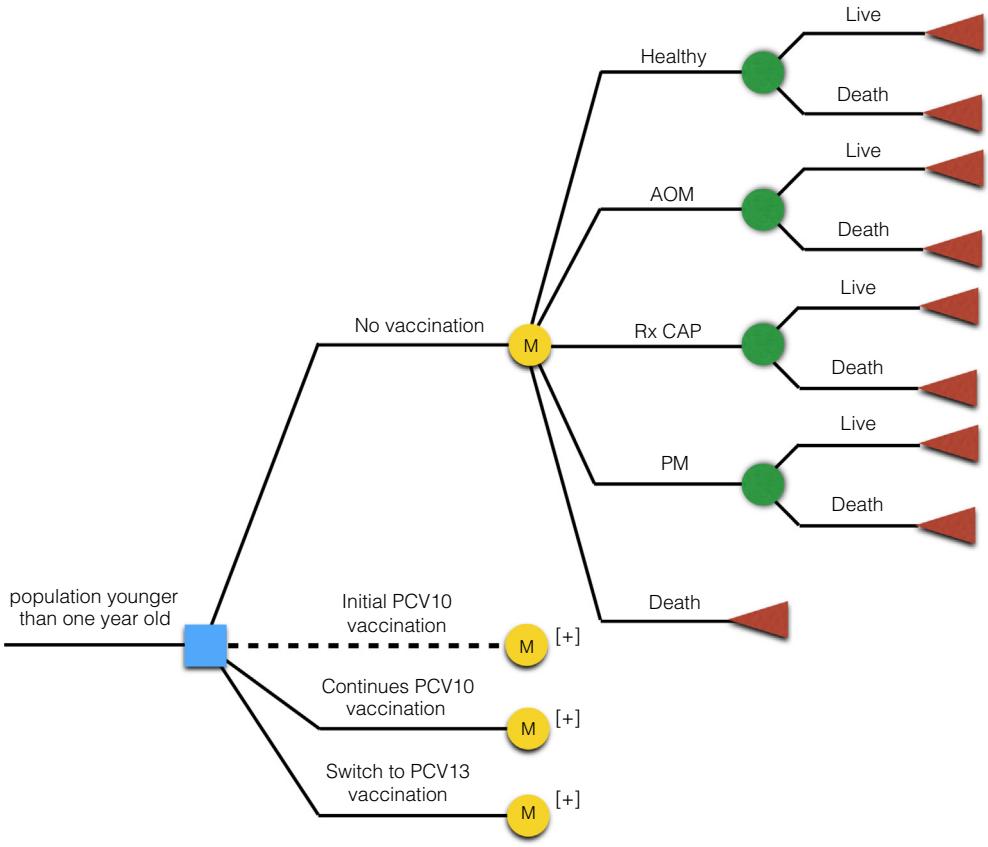

Fig. 1. Decision tree model for the PCVs costs-effectiveness analysis. Colombia, 2014. AOM: Acute Otitis Media; Rx CAP: Radiological confirmed community-acquired pneumonia; PM: Pneumococcal Meningitis. The mark [+] in the 'M' node means inclusion of the showed Markov model. Dashed line represents a base line scenario to model the impact of the considered alternatives.

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