

## VACCINE DELIVERY RESEARCH DIGEST

---

UNIVERSITY OF WASHINGTON GLOBAL HEALTH START PROGRAM  
REPORT TO THE BILL AND MELINDA GATES FOUNDATION

MAY 15, 2015



PRODUCED BY: FARLEY JM, ROWHANI-RAHBAR A

## TABLE OF CONTENTS

---

1. <a href="#">Assessing the economic benefits of vaccines based on the health investment life course framework: a review of a broader approach to evaluate malaria vaccination.</a>	<b>3</b>
○ A framework for considering economic benefits over generations.	
2. <a href="#">Outsourcing vaccine logistics to the private sector: The evidence and lessons learned from the Western Cape Province in South-Africa.</a>	<b>4</b>
○ Two supply chain assessments comparing public and private sector performance.	
3. <a href="#">Effectiveness of an oral cholera vaccine campaign to prevent clinically-significant cholera in Odisha State, India.</a>	<b>5</b>
○ A case-control study to determine the effectiveness of an oral cholera vaccine in India.	
4. <a href="#">Drivers of routine immunization coverage improvement in Africa: findings from district-level case studies.</a>	<b>6</b>
○ In-depth case studies in Ethiopia, Cameroon, and Ghana to identify drivers of immunization coverage improvement.	
5. <a href="#">Vaccine storage and cold chain monitoring in the North West region of Cameroon: a cross sectional study.</a>	<b>7</b>
○ A cross-sectional study to evaluate knowledge, availability, and function of cold chain equipment.	
6. <a href="#">Estimating the costs of the vaccine supply chain and service delivery for selected districts in Kenya and Tanzania.</a>	<b>8</b>
○ A study to examine vaccine supply chain costs in Kenya and Tanzania.	
7. <a href="#">Opportunities and challenges in delivering influenza vaccine by microneedle patch.</a>	<b>9</b>
○ A qualitative study conducted with key informants to determine perceived opportunities and challenges associated with MNPs.	
8. <a href="#">Assessing providers' vaccination behaviors during routine immunization in India.</a>	<b>10</b>
○ A study using parent interviews and direct observation to compare the behavior of healthcare providers during illness and vaccination visits for children.	
9. <a href="#">An analysis of government immunization program expenditures in lower and lower middle income countries 2006-12.</a>	<b>11</b>
○ An analysis using regression to examine the relationship between gross national income (GNI) and country immunization spending.	
10. <a href="#">Cost-effectiveness analysis of the available pneumococcal conjugated vaccines for children under five years in Colombia.</a>	<b>12</b>
○ A cost-effectiveness analysis from the Colombian health system perspective to compare the 13-valent and 10-valent pneumococcal conjugated vaccines.	
<a href="#">Appendix: PubMed Search Terms</a>	<b>13</b>



## 1. ASSESSING THE ECONOMIC BENEFITS OF VACCINES BASED ON THE HEALTH INVESTMENT LIFE COURSE FRAMEWORK: A REVIEW OF A BROADER APPROACH TO EVALUATE MALARIA VACCINATION.

---

Constenia D.

Vaccine. 2015 Mar 24;13(13):1527-40. Epub 2015 Feb 18.

PMID: 25701316

### ABSTRACT

**BACKGROUND:** Economic evaluations have routinely understated the net benefits of vaccination by not including the full range of economic benefits that accrue over the lifetime of a vaccinated person. Broader approaches for evaluating benefits of vaccination can be used to more accurately calculate the value of vaccination.

**METHODOLOGY:** This paper reflects on the methodology of one such approach – the health investment life course approach – that looks at the impact of vaccine investment on lifetime returns. The role of this approach on vaccine decision-making will be assessed using the malaria health investment life course model example.

**RESULTS:** We describe a framework that measures the impact of a health policy decision on government accounts over many generations. The methodological issues emerging from this approach are illustrated with an example from a recently completed health investment life course analysis of malaria vaccination in Ghana. Beyond the results, various conceptual and practical challenges of applying this framework to Ghana are discussed in this paper.

**DISCUSSION AND CONCLUSIONS:** The current framework seeks to understand how disease and available technologies can impact a range of economic parameters such as labour force participation, education, healthcare consumption, productivity, wages or economic growth, and taxation following their introduction. The framework is unique amongst previous economic models in malaria because it considers future tax revenue for governments. The framework is complementary to cost-effectiveness and budget impact analysis. The intent of this paper is to stimulate discussion on how existing and new methodology can add to knowledge regarding the benefits from investing in new and underutilized vaccines.

**WEB:** <http://dx.doi.org/10.1016/j.vaccine.2015.01.059>

**IMPACT FACTOR:** 3.49

**CITED HALF-LIFE:** 4.90

**UW EDITORIAL COMMENT:** This article describes a new methodology for assessing economic benefits of vaccines called the health investment life course framework. It is defined as a way to measure “potential full and downstream impact on growth and development, education, productivity, social equity, and other indirect yet important effects.” This approach is characterized by a larger scope, multiple perspectives, and different frameworks for measurement. The article includes a model using malaria vaccination in Ghana using a hypothetical cohort of 100,000 people. Figure 4 shows the net present value over the lifetime of the vaccinated and unvaccinated cohorts from the government perspective, while Figure 5 shows the same from the societal perspective.



## 2. OUTSOURCING VACCINE LOGISTICS TO THE PRIVATE SECTOR: THE EVIDENCE AND LESSONS LEARNED FROM THE WESTERN CAPE PROVINCE IN SOUTH-AFRICA.

---

Lydon P, Raubenheimer T, Arnot-Krüger M, Zaffran M.

Vaccine. 2015 Mar 27. pii: S0264-410X(15)00350-3. [Epub ahead of print].

PMID: 25819709

### ABSTRACT

With few exceptions, immunization supply chains in developing countries continue to face chronic difficulties in providing uninterrupted availability of potent vaccines up to service delivery levels, and in the most efficient manner possible. As these countries struggle to keep pace with an ever growing number of vaccines, more and more Ministries of Health are considering options of engaging the private sector to manage vaccine storage, handling and distribution on their behalf. Despite this emerging trend, there is limited evidence on the benefits or challenges of this option to improve public supply chain performance for national immunization programmes. To bridge this knowledge gap, this study aims to shed light on the value proposition of outsourcing by documenting the specific experience of the Western Cape Province of South Africa. The methodology for this review rested on conducting two key supply chain assessments which allowed juxtaposing the performance of the government managed segments of the vaccine supply chain against those managed by the private sector. In particular, measures of effective vaccine management best practice and temperature control in the cold chain were analysed. In addition, the costs of engaging the private sector were analysed to get a better understanding of the economics underpinning outsourcing vaccine logistics. The results from this analysis confirmed some of the theoretical benefits of outsourcing to the private sector. Yet, if the experience in the Western Cape can be deemed a successful one, there are several policy and practice implications that developing countries should be mindful of when considering engaging the private sector. While outsourcing can help improve the performance of the vaccine supply chain, it has the potential to do the reverse if done incorrectly. The findings and lessons learnt from the Western Cape experience can serve as a step towards understanding the role of the private sector in immunization supply chain and logistics systems for developing countries.

**WEB:** <http://dx.doi.org/10.1016/j.vaccine.2015.03.042>

**IMPACT FACTOR:** 3.49

**CITED HALF-LIFE:** 4.90

**UW EDITORIAL COMMENT:** This supply chain assessment addresses a gap in the literature on the effectiveness of private sector vaccine supply chain management, with effective vaccine management, temperature control, and economic analyses as outcomes. Figure 2 shows differences among effectiveness vaccine management indicators between private and public sector supply chains. Figure 3 shows differences in temperature profiles. Finally, Figure 4 details the cost breakdown of outsourcing to the private sector in this study.



### 3. EFFECTIVENESS OF AN ORAL CHOLERA VACCINE CAMPAIGN TO PREVENT CLINICALLY-SIGNIFICANT CHOLERA IN ODISHA STATE, INDIA.

---

Wierzba TF, Kar SK, Mogasale VV, Kerketta AS, You YA, Baral P.

Vaccine. 2015 May 15;33(21):2463-9. Epub 2015 Apr 4.

PMID: 25850019

#### ABSTRACT

**BACKGROUND:** A clinical trial conducted in India suggests that the oral cholera vaccine, Shanchol, provides 65% protection over five years against clinically-significant cholera. Although the vaccine is efficacious when tested in an experimental setting, policymakers are more likely to use this vaccine after receiving evidence demonstrating protection when delivered to communities using local health department staff, cold chain equipment, and logistics.

**METHODS:** We used a test-negative, case-control design to evaluate the effectiveness of a vaccination campaign using Shanchol and validated the results using a cohort approach that addressed disparities in healthcare seeking behavior. The campaign was conducted by the local health department using existing resources in a cholera-endemic area of Puri District, Odisha State, India. All non-pregnant residents one year of age and older were offered vaccine. Over the next two years, residents seeking care for diarrhea at one of five health facilities were asked to enroll following informed consent. Cases were patients seeking treatment for laboratory-confirmed *V. cholera*-associated diarrhea. Controls were patients seeking treatment for *V. cholerae* negative diarrhea.

**RESULTS:** Of 51,488 eligible residents, 31,552 individuals received one dose and 23,751 residents received two vaccine doses. We identified 44 *V. cholerae* O1-associated cases and 366 non *V. cholerae* diarrhea controls. The adjusted protective effectiveness for persons receiving two doses was 69.0% (95% CI: 14.5% to 88.8%), which is similar to the adjusted estimates obtained from the cohort approach. A statistical trend test suggested a single dose provided a modicum of protection (33%, test for trend,  $p=0.0091$ ).

**CONCLUSION:** This vaccine was found to be as efficacious as the results reported from a clinical trial when administered to a rural population using local health personnel and resources. This study provides evidence that this vaccine should be widely deployed by public health departments in cholera endemic areas.

**WEB:** <http://dx.doi.org/10.1016/j.vaccine.2015.03.073>

**IMPACT FACTOR:** 3.49

**CITED HALF-LIFE:** 4.90

**UW EDITORIAL COMMENT:** Table 2 shows the dose response effectiveness of the Shanchol vaccine against clinical cholera and Shigellosis during the study period. Table 3 shows the incidence rate for cholera and non-cholera diarrhea and protective efficacy of the vaccine using cohort approach. Given that results were obtained using existing local human resources, there are positive implications for delivery of this vaccine.



#### 4. DRIVERS OF ROUTINE IMMUNIZATION COVERAGE IMPROVEMENT IN AFRICA: FINDINGS FROM DISTRICT-LEVEL CASE STUDIES.

---

LaFond A, Kanagat N, Steinglass R, Fields R, Sequeira J, Mookherji S.

Health Policy Plan. 2015 Apr;30(3):298-308. Epub 2014 Mar 10.

PMID: 24615431

##### ABSTRACT

There is limited understanding of why routine immunization (RI) coverage improves in some settings in Africa and not in others. Using a grounded theory approach, we conducted in-depth case studies to understand pathways to coverage improvement by comparing immunization programme experience in 12 districts in three countries (Ethiopia, Cameroon and Ghana). Drawing on positive deviance or assets model techniques we compared the experience of districts where diphtheria-tetanus-pertussis (DTP3)/pentavalent3 (Penta3) coverage improved with districts where DTP3/Penta3 coverage remained unchanged (or steady) over the same period, focusing on basic readiness to deliver immunization services and drivers of coverage improvement. The results informed a model for immunization coverage improvement that emphasizes the dynamics of immunization systems at district level. In all districts, whether improving or steady, we found that a set of basic RI system resources were in place from 2006 to 2010 and did not observe major differences in infrastructure. We found that the differences in coverage trends were due to factors other than basic RI system capacity or service readiness. We identified six common drivers of RI coverage performance improvement-four direct drivers and two enabling drivers-that were present in well-performing districts and weaker or absent in steady coverage districts, and map the pathways from driver to improved supply, demand and coverage. Findings emphasize the critical role of implementation strategies and the need for locally skilled managers that are capable of tailoring strategies to specific settings and community needs. The case studies are unique in their focus on the positive drivers of change and the identification of pathways to coverage improvement, an approach that should be considered in future studies and routine assessments of district-level immunization system performance.

**WEB:** <http://dx.doi.org/10.1093/heapol/czu011>

**IMPACT FACTOR:** 3.00

**CITED HALF-LIFE:** 7.20

**UW EDITORIAL COMMENT:** This article used in-depth case studies in Ethiopia, Cameroon, and Ghana to identify drivers of immunization coverage improvement. Six drivers were identified: cadre of community health workers, health system and community partnership, regular review or health care workers, immunization services tailored to community needs, political/social commitment to routine immunization, and actions of development partners. Table 3 provides definitions of these drivers.



## 5. VACCINE STORAGE AND COLD CHAIN MONITORING IN THE NORTH WEST REGION OF CAMEROON: A CROSS SECTIONAL STUDY.

---

Yakum MN, Ateudjieu J, Walter EA, Watcho P.

BMC Res Notes. 2015 Apr 14;8:145.

PMID: 25884186

### ABSTRACT

**BACKGROUND:** The cold chain must be monitored continuously in order to guarantee vaccines' quality. From field reports and previous studies, cold chain monitoring for expanded program on immunization (EPI) is still not satisfactory in Cameroon. This study was conducted to evaluate the availability and functioning of cold chain equipment as well as knowledge.

**RESULTS:** It was a cross-sectional study involving a multistage sampling. 3urban and 5rural districts were selected randomly from the 19 health districts of the North West region. In each district all the health facilities taking part in the EPI were targeted. Data were collected using a questionnaire administered face to face to health personnel and with an observational grid to assess availability, functioning, and monitoring of cold chain equipment and power supply. The data were analyzed using the epi-info software. A total of 70 health facilities were contacted and 65(88.6%) of them included in the study. Fifty-three (81.5%) out of 65 health facilities had at least one functional vaccine refrigerator. The national guideline of EPI was not present in 21(33.9%) health facilities. Temperature chart was complete/correctly filled in 25(50.0%) of the 50(96.2%) facilities having it. About 14 (26.9%) of the health facilities record at least one abnormal temperature during the last 2 months following data collection. Seventeen (28.3%) personnel did not know the correct vaccine storage temperature.

**CONCLUSION:** The availability of vaccine storage equipment for EPI is acceptable in the North West Region of Cameroon but the capacity of those in charge to properly monitor it in all health facilities is still limited. To ensure that vaccines administered in the North West Region are stored at the recommended temperature, all District Health Services should train and regularly supervise the health personnel in charge of cold chain monitoring.

**WEB:** <http://dx.doi.org/10.1186/s13104-015-1109-9>

**IMPACT FACTOR:** 0.00

**CITED HALF-LIFE:** 0.00

**UW EDITORIAL COMMENT:** Given the results, the study team makes the following recommendations to improve vaccine storage and cold chain monitoring: mapping the power supply and exploring alternative energy sources, providing the EPI Standard Operating Procedure at all facilities, stocking alternative sources of energy, and increasing training and supervision capacity and regularity.





## 6. ESTIMATING THE COSTS OF THE VACCINE SUPPLY CHAIN AND SERVICE DELIVERY FOR SELECTED DISTRICTS IN KENYA AND TANZANIA.

---

Mvundura M, Lorenson K, Chweya A, Kigadye R, Bartholomew K, Makame M.

Vaccine. 2015 Apr 9. pii: S0264-410X(15)00414-4. [Epub ahead of print]

PMID: 25865467

### ABSTRACT

Having data on the costs of the immunization system can provide decision-makers with information to benchmark the costs when evaluating the impact of new technologies or programmatic innovations. This paper estimated the supply chain and immunization service delivery costs and cost per dose in selected districts in Kenya and Tanzania. We also present operational data describing the supply chain and service delivery points (SDPs). To estimate the supply chain costs, we collected resource-use data for the cold chain, distribution system, and health worker time and per diems paid. We also estimated the service delivery costs, which included the time cost of health workers to provide immunization services, and per diems and transport costs for outreach sessions. Data on the annual quantities of vaccines distributed to each facility, and the occurrence and duration of stockouts were collected from stock registers. These data were collected from the national store, 2 regional and 4 district stores, and 12 SDPs in each country for 2012. Cost per dose for the supply chain and immunization service delivery were estimated. The average annual costs per dose at the SDPs were \$0.34 (standard deviation (s.d.) \$0.18) for Kenya when including only the vaccine supply chain costs, and \$1.33 (s.d. \$0.82) when including immunization service delivery costs. In Tanzania, these costs were \$0.67 (s.d. \$0.35) and \$2.82 (s.d. \$1.64), respectively. Both countries experienced vaccine stockouts in 2012, bacillus Calmette-Guérin vaccine being more likely to be stocked out in Kenya, and oral poliovirus vaccine in Tanzania. When stockouts happened, they usually lasted for at least one month. Tanzania made investments in 2011 in preparation for planned vaccine introductions, and their supply chain cost per dose is expected to decline with the new vaccine introductions. Immunization service delivery costs are a significant portion of the total costs at the SDPs.

**WEB:** <http://dx.doi.org/10.1016/j.vaccine.2015.03.084>

**IMPACT FACTOR:** 3.49

**CITED HALF-LIFE:** 4.90

**UW EDITORIAL COMMENT:** This costing study adds to the literature on data for the economic costs of vaccine supply chain and delivery, in order to create a reference point for cost improvements to the system. Table 1 shows the annual vaccine supply chain costs for the national and regional vaccine stores in Kenya and Tanzania in 2012 (US\$), while Table 2 shows Annual average and standard deviations of the vaccine supply chain costs for the study districts in the same time period.





## 7. OPPORTUNITIES AND CHALLENGES IN DELIVERING INFLUENZA VACCINE BY MICRONEEDLE PATCH.

---

Jacoby E, Jarrahan C, Hull HF, Zehrung D.

Vaccine. 2015 Apr 1. pii: S0264-410X(15)00381-3. [Epub ahead of print].

PMID: 25842218

### ABSTRACT

**INTRODUCTION:** Simple and efficacious delivery methods for influenza vaccines are needed to improve health outcomes and manage possible pandemics both in the United States and globally. One approach to meeting these needs is the microneedle patch (MNP), a small array of micron-scale needles that is applied to the skin like a bandage.

**METHODS:** To inform additional technical developments and the eventual introduction of MNPs for influenza vaccination, we interviewed key opinion leaders in the United States for insights into the opportunities and challenges associated with this technology, particularly its potential for self-administration.

**RESULTS:** All interviewees expressed high support for administration of influenza vaccine in MNPs by health care providers and for self-administration in groups supervised by a provider. Self-administration via prescription and over-the-counter purchase of MNPs received lower levels of support. Interviewees also highlighted priorities that should be considered in the ongoing development of an influenza vaccine MNP, such as confirming efficacy and ensuring safety for self-administration. For patient and health care provider acceptability, important attributes are ease of use, short wear times, and an easily accessible application site.

**DISCUSSION AND CONCLUSIONS:** Stakeholders agreed that using MNPs can help increase coverage, facilitate easy and safe delivery, reduce the cost of vaccination, and decrease the global morbidity and mortality associated with influenza. Another opportunity for this delivery method is the potential for self-administration. The prospect of reduced provider training requirements, increased thermostability, and high patient and provider acceptability makes it an attractive option for use in remote and low-resource settings worldwide. However, in addition to the technological challenges associated with producing the patch, developers must be mindful of cost considerations and key product attributes or requirements, such as usability, wear time, and proper disposal, that can affect how the product will be received in the marketplace.

**WEB:** <http://dx.doi.org/10.1016/j.vaccine.2015.03.062>

**IMPACT FACTOR:** 3.49

**CITED HALF-LIFE:** 4.90

**UW EDITORIAL COMMENT:** This qualitative study with key informants identified a number of suggestions for improving the target product profile of the microneedle patch. These include short wear time, an accessible administration site, such as the forearm, thermostability, minimal packaging, and dissolvability. Figure 2 shows perceived support for different administration scenarios with varying levels of oversight, from health care professional administration to over-the-counter self-administration.



## 8. ASSESSING PROVIDERS' VACCINATION BEHAVIORS DURING ROUTINE IMMUNIZATION IN INDIA.

---

Cohen MA, Gargano LM, Thacker N, Choudhury P, Weiss PS, Arora M.

J Trop Pediatr. 2015 Mar 31. pii: fmv023. [Epub ahead of print].

PMID: 25833096

### ABSTRACT

Progress has been made toward improving routine immunization coverage in India, but universal coverage has not been achieved. Little is known about how providers' vaccination behaviors affect coverage rates. The purpose of this study was to identify provider behaviors that served as barriers to vaccination that could lead to missed opportunities to vaccinate. We conducted a study of health-care providers' vaccination behaviors during clinic visits for children <3 years of age. Information on provider behaviors was collected through parent report and direct observation. Compared with illness visits, parents were eight times more likely to report vaccination status was verified ( $p < 0.001$ ) and three times more likely to report receiving counseling on immunization ( $p = 0.022$ ) during vaccination visits. Training of all vaccination practitioners should focus on behaviors such as the necessity of verifying vaccination status regardless of visit type, stressing the importance of counseling parents on immunization and emphasizing what is a valid contraindication to vaccination.

**WEB:** <http://dx.doi.org/10.1093/tropej/fmv023>

**IMPACT FACTOR:** 0.86

**CITED HALF-LIFE:** 8.30

**UW EDITORIAL COMMENT:** Different platforms for vaccine verification and status within primary care settings are explored in this study, and particularly the low proportion of this behavior during illness (non-vaccination) visits. Table 2 shows the difference in parent-reported vaccine counseling between illness and vaccination visits, both overall and stratified by provider type (auxiliary nurse midwives and Public Health Centre physicians).



## 9. AN ANALYSIS OF GOVERNMENT IMMUNIZATION PROGRAM EXPENDITURES IN LOWER AND LOWER MIDDLE INCOME COUNTRIES 2006-12.

---

Nader AA, de Quadros C, Politi C, McQuestion M.

Health Policy Plan. 2015 Apr;30(3):281-8. Epub 2014 Feb 21.

PMID: 24561878

### ABSTRACT

Financing is becoming increasingly important as the cost of immunizing the world's children continues to rise. By 2015, that cost will likely exceed US\$60 per infant as new vaccines are introduced into national immunization programs. In 2006, 51 lower and lower middle income countries reported spending a mean US\$12 per surviving infant on routine immunization. By 2012, the figure had risen to \$20, a 67% increase. This study tests the hypothesis that lower and lower middle income countries will spend more on their routine immunization programs as their economies grow. A panel data regression approach is used. Expenditures reported by governments annually (2006-12) through the World Health Organization/UNICEF Joint Reporting Form are regressed on lagged annual per capita gross national income (GNI), controlling for prevailing mortality levels, immunization program performance, corruption control efforts, geographical region and correct reporting. Results show the expenditures increased with GNI. Expressed as an elasticity, the countries spent approximately \$6.32 on immunization for every \$100 in GNI increase from 2006 to 2012. Projecting forward and assuming continued annual GNI growth rates of 10.65%, countries could be spending \$60 per infant by 2020 if national investment functions increase 4-fold. Given the political will, this result implies countries could fully finance their routine immunization programs without cutting funding for other programs.

**WEB:** <http://dx.doi.org/10.1093/heapol/czu002>

**IMPACT FACTOR:** 3.00

**CITED HALF-LIFE:** 7.20

**UW EDITORIAL COMMENT:** Table 2 shows panel data models of government routine immunization expenditures. Figure 2 graphs the projected government routine immunization expenditures per surviving infant with varying levels of elasticity. Overall findings are positive; countries will spend more on vaccines as gross national income increases. However, this increase in spending has come more slowly than previous models predicted. Additionally, there are still measurement issues that the study team needs to address as these models are refined, which include how to break down costs in integrated health systems and how to access subnational expenditures that are not consistently reported at the national level. Interestingly, there is no significant correlation between government expenditure on immunization and vaccine coverage levels. This highlights the continued need to explore innovative delivery methods, regardless of financial investment.



## 10. COST-EFFECTIVENESS ANALYSIS OF THE AVAILABLE PNEUMOCOCCAL CONJUGATED VACCINES FOR CHILDREN UNDER FIVE YEARS IN COLOMBIA.

---

Ordóñez JE, Orozco JJ.

Cost Eff Resour Alloc. 2015 Apr 10;13:6. eCollection 2015

PMID: 25878563

### ABSTRACT

**BACKGROUND:** Pneumococcal diseases in children under five years are common and preventable. In Colombia there are two pneumococcal conjugate vaccines (PCV) that have proved clinical efficacy. The aim was to estimate the cost-effectiveness of 13-valent PCV (PCV13) and 10-valent PCV (PCV10) in terms of prevention of Invasive Pneumococcal Diseases (IPD), radiologically-confirmed pneumonia, and their related mortality, as well as, acute otitis media (AOM) in a cohort of newborns in Colombia.

**METHODS:** We developed an analytical decision tree model with national data including the distribution of pneumococcal serotypes in Colombia between 2009 and 2013. A simulation of vaccination of 90% of newborns in Colombia took place with a time horizon of 5 years. The analysis was done from the Colombian health system perspective. Vaccines efficacy parameters were measured as life-years gained (LYG) and avoided morbidity by pneumococcal diseases; they were determined by a systematic review of literature. A health insurance company provided the costs. A probabilistic and a univariate sensitivity analysis for epidemiological, efficacy and cost parameters were done.

**RESULTS:** After 5 years projection, PCV13 would prevent 437 deaths due to pneumococcal infections versus 321 that would be prevented by PCV10, compared to no vaccination. PCV13 would generate 25 396 LYG, and PCV10 would generate 18 708 LYG. Medical costs avoided would be US\$ 19 479 395 for PCV13 and US\$ 13 703 271 for PCV10. Compared to no vaccination, PCV13 and PCV10 were cost-effective, with an incremental cost-effectiveness ratio (ICER) of US\$ 489.26 and US\$ 813.41 per additional LYG, respectively; besides, PCV13 was dominant over PCV10 due to lower costs and better outcomes.

**CONCLUSION:** PCV13 is a cost-saving strategy compared with PCV10, as part of a universal coverage vaccination program in Colombian children under one year. PCV13 is expected to lead to a greater decrement in infant mortality from pneumococcal diseases, and a higher cost saving by preventing more pneumococcal diseases compared with PCV10 in a 5 years projection.

**WEB:** <http://dx.doi.org/10.1186/s12962-015-0032-1>

**IMPACT FACTOR:** 0.87

**CITED HALF-LIFE:** 0.00

**UW EDITORIAL COMMENT:** Table 1 shows both the efficacy of the PCV10 and PCV13 vaccines, as well as the cost of care for Colombian children. Table 3 shows the prevented cases of sepsis, meningitis, pneumococcal AOM, and radiographically confirmed pneumonia for both vaccine. Figure 4 shows cost-effectiveness acceptability curves for PCV10, PCV13, and no vaccine in the study cohort.



## APPENDIX: PUBMED SEARCH TERMS

---

(((((vaccine[tiab] OR vaccines[tiab] OR vaccination[tiab] OR immunization[tiab] OR immunisation[tiab] OR vaccine[mesh] OR immunization[mesh]) AND (logistics[tiab] OR supply[tiab] OR "supply chain"[tiab] OR implementation[tiab] OR expenditures[tiab] OR financing[tiab] OR economics[tiab] OR "Cost effectiveness"[tiab] OR coverage[tiab] OR attitudes[tiab] OR belief[tiab] OR beliefs[tiab] OR refusal[tiab] OR "Procurement"[tiab] OR timeliness[tiab] OR systems[tiab])) OR ("vaccine delivery"[tiab])) NOT ("in vitro"[tiab] OR "immune response"[tiab] OR gene[tiab] OR chemistry[tiab] OR genotox\*[tiab] OR sequencing[tiab] OR nanoparticle\*[tiab] OR bacteriophage[tiab] OR exome[tiab] OR exogenous[tiab] OR electropor\*[tiab] OR "systems biology"[tiab] OR "animal model"[tiab] OR cattle[tiab] OR sheep[tiab] OR goat[tiab] OR rat[tiab] OR pig[tiab] OR mice[tiab] OR mouse[tiab] OR murine[tiab] OR porcine[tiab] OR ovine[tiab] OR rodent[tiab] OR fish[tiab])) AND (English[LA]) AND ("2015/3/15"[PDAT] : "2015/04/14"[PDAT])))

\*On April 24, 2015, this search of English language articles published between March 15, 2015 and April 14, 2015 and indexed by the US National Library of Medicine resulted in 177 unique manuscripts.

