

Estimates of the potential public health impact and cost-effectiveness of adopting pneumococcal vaccination in the routine immunization programme in African GAVI countries: a modelling study

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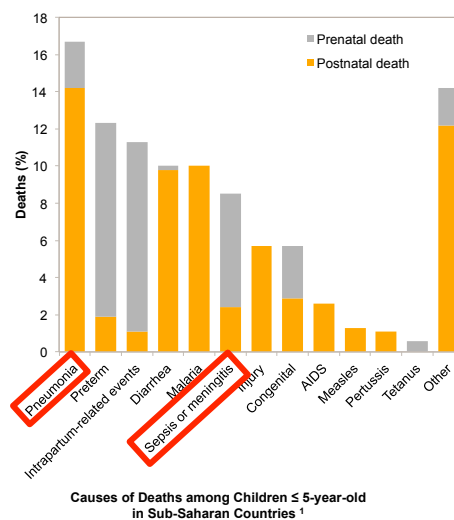
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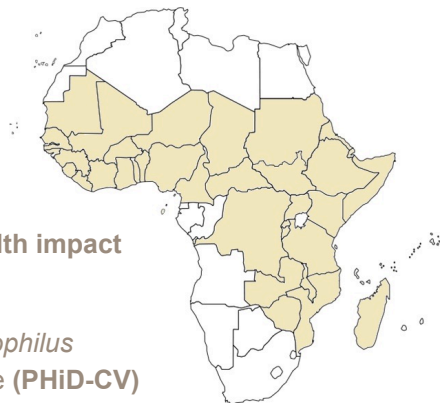
Background

- Pneumonia, meningitis and sepsis are the leading cause of vaccine-preventable mortality in children under 5 years of age in sub-Saharan Africa¹
- *Streptococcus pneumoniae* (Sp) is an important cause for these diseases
- GAVI (Global Alliance for Vaccines and Immunization) provides funding for pneumococcal conjugate vaccines in eligible countries



Liu et al. in Disease Control Priorities, Third edition, 2016

Objectives



To estimate the potential public health impact and cost-effectiveness

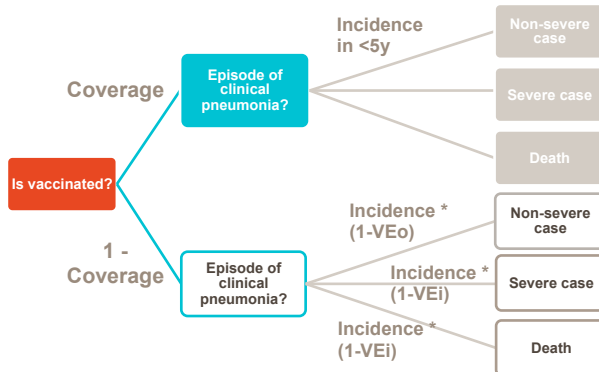
of pneumococcal non-typeable *Haemophilus influenzae* protein D conjugate vaccine (PHiD-CV) versus no vaccination

in 36 African GAVI countries

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Methods: Model structure

- A decision-tree model was used to assess the vaccine impact in children under 5 years of age
- The number of events in children under 5 years are calculated based on incidence of each outcome, vaccination coverage and efficacy data for each disease and each country
- One tree was developed for each disease: pneumonia, meningitis, non-pneumonia non-meningitis IPD and otitis media
- Static modelling approach without herd effect or serotype replacement



IPD, Invasive Pneumococcal Disease; VEo, Vaccine efficacy against outpatient visits
VEi, Vaccine efficacy against inpatient visits

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Methods: Epidemiology

- Analysis for 36 GAVI countries in Africa

Disease	Incidence	Mortality in absence of vaccination	Reference
Clinical pneumonia	0.27 [Min: 0.14, Max: 0.36] per child-year	9.64 [Min: 0.79, Max: 19.66] per 1,000 cases	Rudan 2013 ¹
<i>Sp</i> Meningitis	38 per 100,000	73%	O'Brien 2009 ²
Non- <i>Sp</i> /Non Meningitis IPD	192 per 100,000	58%	
AOM	14.71-43.37 per 100	0.34-0.96 per 100,000	Monasta 2012 ³

IPD, Invasive Pneumococcal Disease; AOM, Acute Otitis Media; *Sp*, *Streptococcus pneumoniae*

1. Rudan *et al.* J Glob Health. 2013 Jun;3(1):010401 2. O'Brien *et al.* Lancet. 2009 Sep 12;374(9693):893-902
3. Monasta *et al.* PLoS One. 2012;7(4):e36226

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Methods: Disease management costs

Disease	Outpatient	Inpatient	Reference
<i>Sp</i> Pneumonia	USD 5.41	USD 40.25	Tasslimi 2011 ¹
<i>Sp</i> Meningitis	No cost	USD 40.77	
Non- <i>Sp</i> /Non Meningitis IPD	No cost	USD 31.31	
AOM	Visit and Amoxicillin/Clavulanic USD 3.81	Not included	International price list and WHO-CHOICE
Access to care	48% [Min: 22%, Max: 79%]		DHS/WHO report

IPD, Invasive Pneumococcal Disease; AOM, Acute Otitis Media; *Sp*, *Streptococcus pneumoniae*

1. Tasslimi *et al.* Int Health. 2011 Dec;3(4):259-69

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Methods: Vaccination parameters

- Synflorix™ cost: USD 3.05 per dose
- Vaccination schedule with 3 doses
- Vaccination coverage is based on third dose Diphtheria-Tetanus-Pertussis coverage in each country

Disease	Efficacy	Reference
Clinical pneumonia	Against outpatient visit: 7.3% Against inpatient care: 23.4%	Tregnaghi 2014 ¹
Meningitis and other IPD	67%	
AOM	19%	

IPD, Invasive Pneumococcal Disease; AOM, Acute Otitis Media

1. Tregnaghi et al. PLoS Med. 2014 Jun 3;11(6):e1001657

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Results: estimated number of events averted per year in children under 5 years

- More than 90,000 deaths are expected to be averted with PHiD-CV annually
- The largest impact is expected on pneumonia for both hospitalizations and mortality

	Disease burden		
	Cases	Hosp./ Sequel	Deaths
All cause Clinical pneumonia	41,445,869	4,766,275	426,489
Sp Meningitis	53,588	5,091	39,119
Sp NPNM	270,761	21,153	12,269
All-cause AOM	251,797,562	277,748	1,160

NPNM, Non-Pneumonia Non-Meningitis; AOM, Acute Otitis Media; Sp, *Streptococcus pneumoniae*

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Results: total cost and cost-effectiveness of the vaccination programme

- Almost USD 40 M are projected to be saved in treatment and hospitalization costs
- Costs and outcomes are discounted with 3%

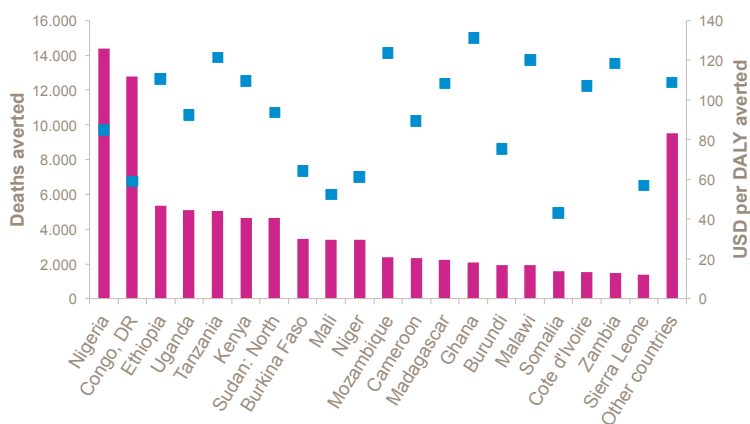
	No vaccination	PHiD-CV	Difference
Vaccination cost	USD 0	USD 275.0 M	USD 275.0 M
Treatment cost	USD 284.1 M	USD 245.1 M	USD -39.0 M
Net additional cost			USD 236.0 M
DALYs	14.03 M	11.41 M	2.62 M averted
Cost-effectiveness ratio			90 USD/DALY averted

DALY, disability adjusted life years; PHiD-CV, pneumococcal non-typeable *Haemophilus influenzae* protein D conjugate vaccine

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Countries with the largest potential impact

- 20 countries with the largest reduction in mortality and 16 others aggregated
- In these countries the ICER stays within USD 40 to 140 per DALY averted



DALY, disability adjusted life years; ICER, incremental cost-effectiveness ratio

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Limitations of the analysis

- This study is based on a static model and does not account for the dynamic transmission mechanisms, including indirect effect, serotype replacement or circulation of pathogens.
- Vaccine efficacy is transposed from a study in Latin America¹ -where a different vaccination schedule is recommended- to African countries settings. However, post-marketing data analysis in Kenya shows consistent results with the Latin America study².
- Limitations in this study are related to the limitations from the original estimates of disease incidence and costs.

1. Tregnaghi *et al.* PLoS Med. 2014 Jun 3;11(6):e1001657 2. Silaba *et al.* ISPPD 2016 conference, Abstract 143

Conclusions

- **The implementation of PHiD-CV is projected to have a substantial public health impact**
- **The impact on the pneumonia burden would be the largest.**
- **These results are likely to be underestimated because indirect effects are not included in the model.**
- **Considering the treatment cost averted, the annual budget required would reach USD 236 M to introduce PCV vaccination in 36 countries and cover 20 M infants.**
- **The cost-effectiveness ratio shows that PHiD-CV is likely to be highly cost-effective based on WHO threshold (1x GDP per capita).**

PHiD-CV, pneumococcal non-typeable *Haemophilus influenzae* protein D conjugate vaccine

Disclosures

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