Impact of pneumococcal conjugate vaccine in Africa

Summary of evidence

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Outline

1. Background
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PATH’s Center for Vaccine Innovation and Access (CVIA)

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DISEASE AREAS

Enteric and Diarrheal Diseases
rotavirus • enterotoxigenic *Escherichia coli* • *Shigella* • typhoid

Malaria
*Plasmodium falciparum* • *Plasmodium vivax*

Polio

Respiratory Infections and Maternal Immunization
pneumococcus • meningococcus • group B *Streptococcus* • pertussis • influenza • respiratory syncytial virus

Zoonotic, Emerging, and Sexually Transmitted Infections
human papillomavirus • Japanese encephalitis • Nipah • yellow fever • COVID-19 • outbreaks
Background

- *Streptococcus pneumoniae* (pneumococcus) is a Gram-positive encapsulated bacterium with nearly 100 serotypes identified.

- Pneumococcal infection leads to various clinical manifestations, including:
  - sinusitis,
  - otitis media
  - pneumonia,
  - meningitis
  - sepsis
Pneumococcal infection is a leading cause of morbidity and mortality globally (O’brien KL, 2009).

Pneumonia accounted for 16% of all pediatric deaths in 2015 (WHO, 2016).
- Not all pneumonia cases are caused by *S. pneumoniae*.
- Yet, the bacterium is the most common cause of bacterial pneumonia and of vaccine-preventable severe pneumonia.

Nearly all pneumonia deaths are recorded in LMICs (Walker CLF, 2013).

Pneumococcal meningitis is highly lethal, and survivors often live with long-term neurological sequelae, especially in the African meningitis belt (WHO, 2019).
Pneumococcal conjugate vaccines (PCVs) are the latest generation of vaccines to prevent pneumococcal infections

- The polysaccharide capsular antigen is conjugated to a specific biochemical agent to improve immunogenicity
- 3 different PCVs so far prequalified by WHO
- Unlike polysaccharide vaccines, PCVs confer long-lasting protection, including in children < 2 years
Background (ctd.)

PCV introductions in Africa

Current Vaccine Intro Status
- Introduced
- Planning
- Not Introduced
- Program Suspended

PCV  ▶  Vaccine Introduction  ▶  Current Vaccine Intro Status
Universal use of PCVs in high-income countries had a dramatic impact on the burden of pneumococcal disease:

- Direct effects: substantial reduction in disease and carriage among vaccinated cohorts
- Indirect effects: reduction in disease and carriage among unvaccinated cohorts

PCV introduction in Africa is expected to yield at least similar public health benefits as in HIC

After several years of PCV implementation, what do we know about vaccine impact?
PCV impact of mortality

- PCV introduced in 2009
- Looked at PCV impact on all-cause pneumonia mortality in all ages (except < 1 month) from 2009 to 2016
- Compared deaths from vital registry to expected deaths if no vaccine (counterfactual)
- Estimated reduction of pneumonia mortality:
  - 1-11 mos: 33% (26-43)
  - 1-4 yrs: 23% (17-29)
  - 5-9 yrs: 25% (19-32)
  - 8-18 yrs: 23% (11-32)
PCV impact of mortality (ctd.)


- Predicted PCV impact on mortality among children aged up to 5 years in 180 countries

- Considered the period 2015-2045

- Median yearly estimated outcomes of PCV13 vaccination compared with no vaccination in Africa:
  - 275,000 deaths averted
  - 5.65 million DALYs averted
PCV impact on disease

- Absolute reductions in all-cause pneumonia related hospitalizations 5 years after PCV13 introduction: **348 cases pers 100 000** children < 5 yrs.

- VE against all-cause pneumonia hospitalization: **34%** (16–49%)

PCV impact of disease (ctd.)

- Surveillance study in the Gambia by Mackenzie et al, Lancet Infect Dis. 2017 Sep;17(9):965-973

- PCV7 introduced in 2007 and replaced by PCV13 in 2011

- Looked at pneumococcal pneumonia incidence before and after PCV in children aged 2-59 months

- Reductions in adjusted disease incidence:
  - 2-11 mos.: 58% (22-77)
  - 12-23 mos.: 75% (47-88)
PCV impact of disease (ctd.)

- PCV7 introduced in 2007 and replaced by PCV13 in 2011
- Estimated change in IPD incidence from baseline to post-vaccine years
- Reductions in IPD incidence, all serotypes:
  - < 2 yrs.: 69% (65-72)
  - 25-44 yrs.: 34% (29-39)
- Reductions in IPD incidence, PCV7 serotypes:
  - < 2 yrs.: 89% (86-92)
  - 25-44 yrs.: 57% (50-63)
PCV impact of disease (ctd.)


- PCV10 introduced in 2011 in Kenya, with a catch-up campaign targeting all < 5 years in Kilifi

- Estimated adjusted IRR and percent reductions in IPD, comparing pre- and post-PCV periods

- Reductions in IPD incidence, all serotypes:
  - < 5 yrs.: 68% (40-83)

- Reductions in IPD incidence, PCV10 serotypes:
  - < 5 yrs.: 92% (78-97)
  - 5-14 yrs.: 74% (41-89)
  - 15+ yrs.: 81% (49-93)
PCV impact on asymptomatic carriage

PCV impact on asymptomatic carriage (ctd.)

- 2 population-based cross-sectional coverage surveys conducted in Western Burkina Faso after PCV13 introduction (2015 and 2017, compared with pre-PCV carriage rates (2008)

- Significant reductions only among vaccine-eligible cohorts
Current challenges

RESEARCH ARTICLE

Continued occurrence of serotype 1 pneumococcal meningitis in two regions located in the meningitis belt in Ghana five years after introduction of 13-valent pneumococcal conjugate vaccine

Catherine H. Bozio1,2,*, Abass Abdul-Karim3,*, John Abenyeri1, Braimah Abubakari4, Winfred Ofosu3, Justina Zoya3, Mahamoudou Ouattara1, Velusamy Srinivasan1, Jeni T. Vuong5, David Opare6, Franklin Asiedu-Bekoe7, Fernanda C. Lessa1

Persistent and Emerging Pneumococcal Carriage Serotypes in a Rural Gambian Community After 10 Years of Pneumococcal Conjugate Vaccine Pressure

Effua Ofot1, Christian Bottomley1, Rebecca Gladstone1, Enima Bojang1, Saidi Ashton1, Jelma Coak1, Edrissa Jallow1, Abdoulaye Bojang1, Brian Greenwood1, Richard A. Adegbile6, Stephen D. Berley6, Philip C. Hill1, and Anna Roca1

RESEARCH ARTICLE

An outbreak of pneumococcal meningitis among older children (≥5 years) and adults after the implementation of an infant vaccination programme with the 13-valent pneumococcal conjugate vaccine in Ghana

Brenda Anna Kwambana-Adams1, Franklin Asiedu-Bekoe2, Badu Sarkodie3, Osei Kuffour Afreh3, George Khumailo Kuma4, Godfred Owusu-Dikyere5, Ebenezer Foster-Nyanke5, Sally-Ann Ohene5, Charles Okof6, Archibald Rwame Wonusi7, Catherine Oclo7, Madikay Senghore1, Jacob Nweku Otu1, Chinelo Ebrute1, Tekele Temesgen8, Tim Tewolde8, David Cote9, Mauro Buffoni9, Timothy Walsh9, and Paweł Jureczko9

World Health Organization

Pneumococcal meningitis - Togo

11 April 2023

Situation at a glance
Current challenges (ctd.)

- Slow, low or even lack of indirect effects in some high transmission settings (lack of protection of unvaccinated persons)
- Persistence of VT carriage after PCV introduction
- Persistence of serotype 1 disease despite PCV implementation in some countries (e.g. Burkina Faso)
- Serotype replacement
Conclusion and way forward

- Most African countries have been implementing PCV for at least 10 years
- There is currently a robust body of evidence across the continent that PCVs save lives, protect health and reduce hospitalizations
- Indirect effects of PCV have yet to be fully observed to the level seen in high-income countries
- Remaining countries (Chad, Guinea, South Sudan, Somalia) should introduce PCV without further delay to avert unnecessary deaths and disease
- Post-introduction studies are needed to generate evidence to inform optimal delivery strategies, including:
  - Preferred dosing schedule
  - The role and feasibility of catchup vaccination
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