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Impact of pneumococcal conjugate vaccine in Africa

Summary of evidence

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Outline

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PATH's Center for Vaccine Innovation and Access (CVIA)

CVIA accelerates the development and delivery of lifesaving vaccines for the most vulnerable children and communities around the world. We focus on deadly and disabling diseases that pose the greatest threats to long-term health and development.

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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

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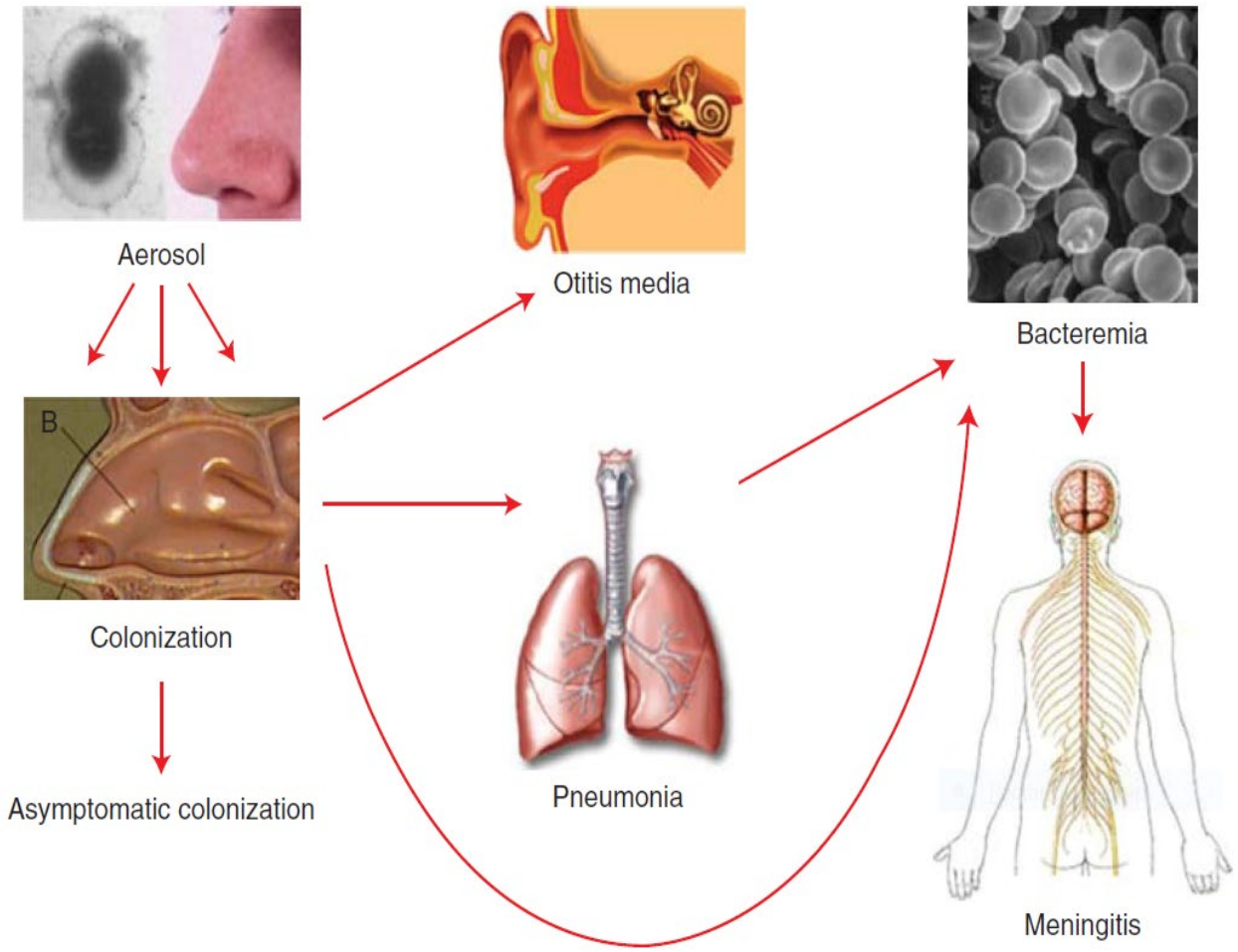
Background

- *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



Henriques-Normark, 2015

Background (ctd.)

- 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. pneumonia*
  - 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)**

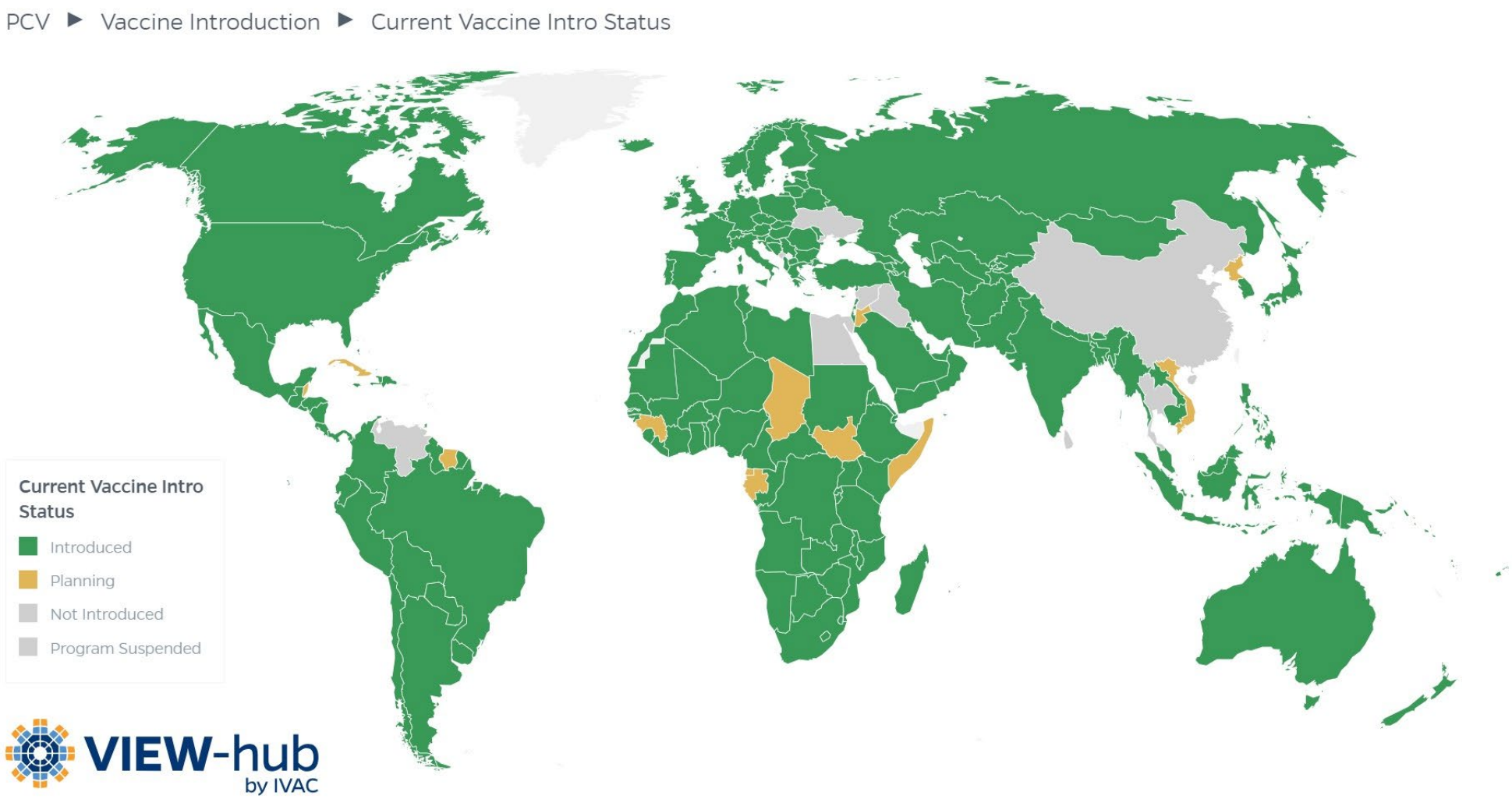
Background (ctd.)

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



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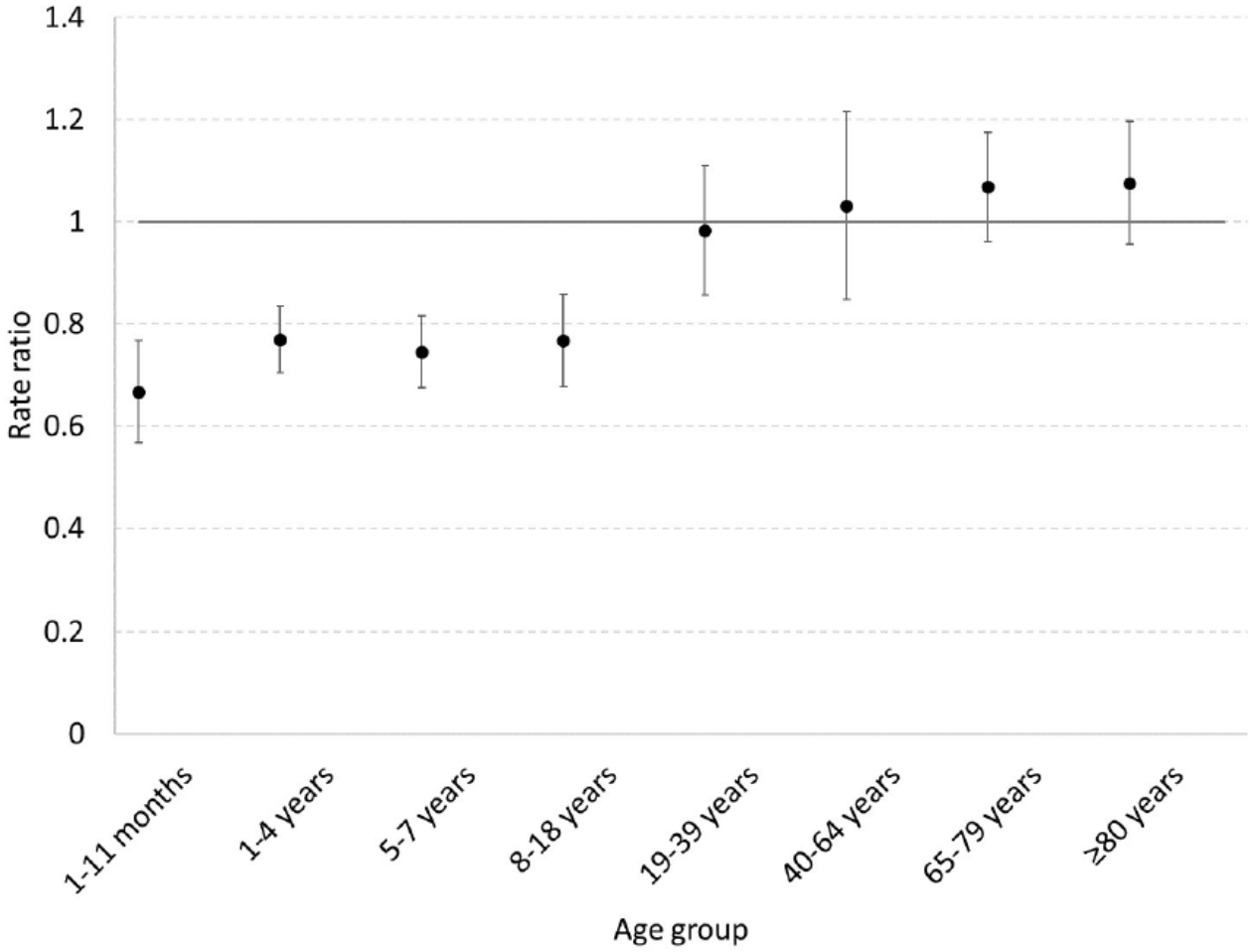
Background (ctd.)

- 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?

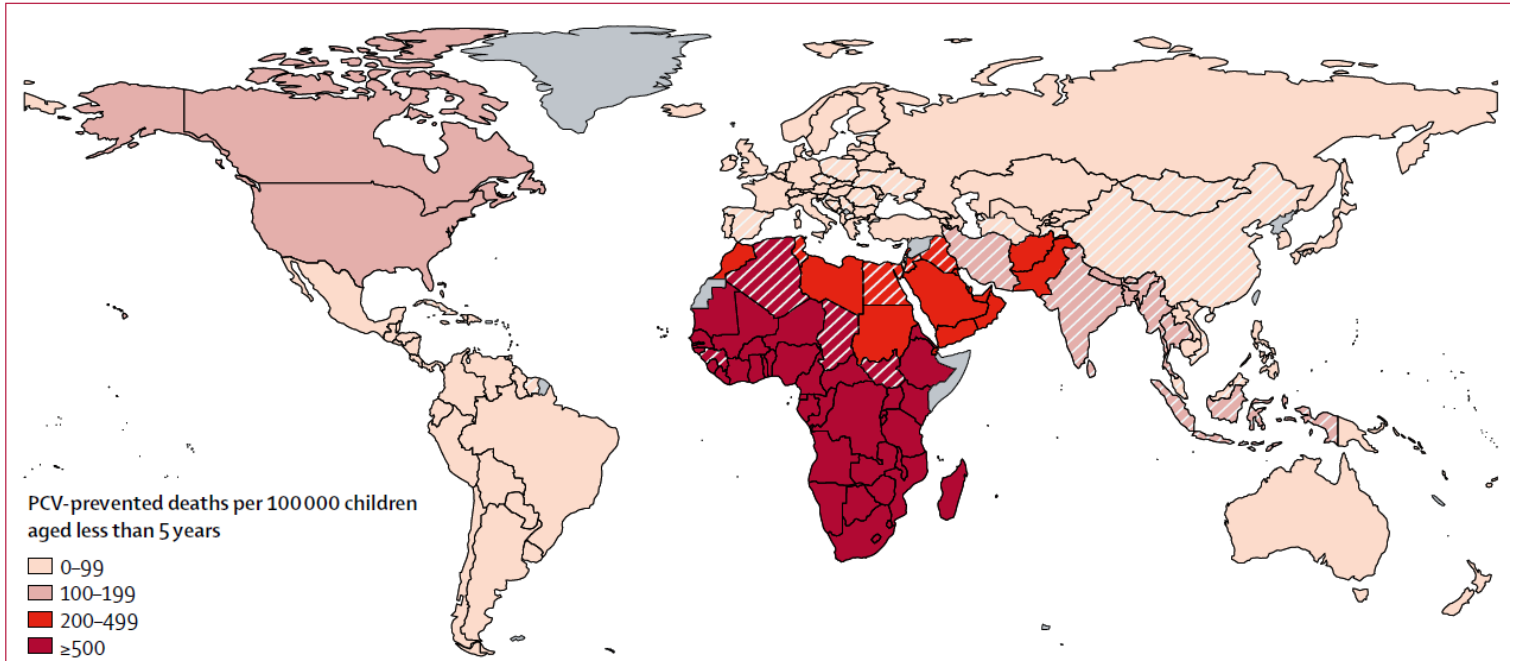
PCV impact of mortality

- Modelling study by Kleynhans et al, PLoS Med 18(2): e1003537, 2021.
- 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.)

- Global modelling study by Chen et al, Lancet Glob Health 2019; 7: e58–67
- 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

Contents lists available at ScienceDirect

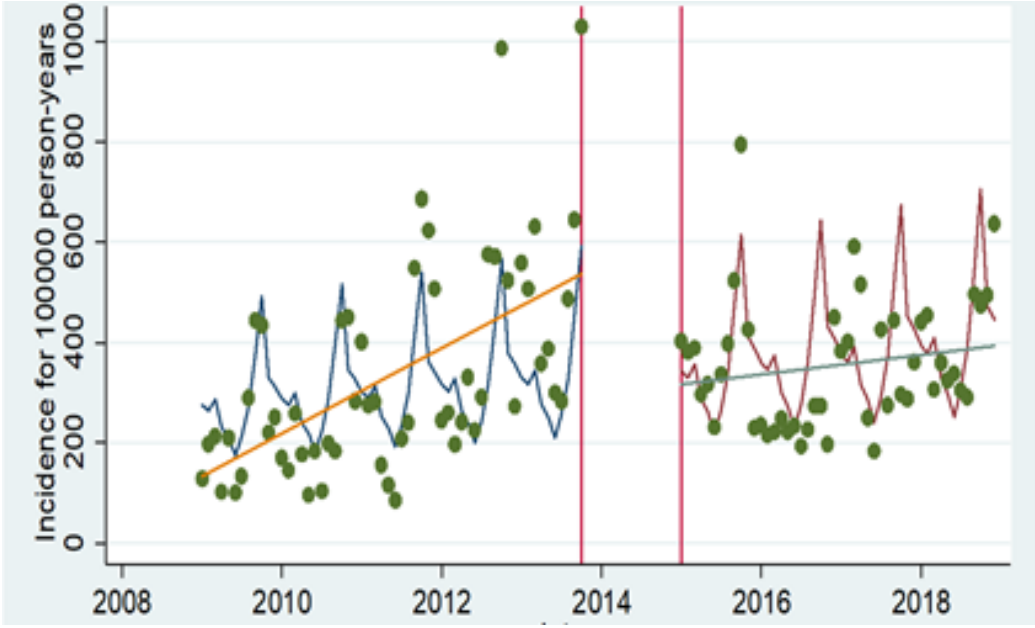
International Journal of Infectious Diseases

journal homepage: www.elsevier.com/locate/ijid

Impact of 13-valent pneumococcal conjugate vaccine on the incidence of hospitalizations for all-cause pneumonia among children aged less than 5 years in Burkina Faso: An interrupted time-series analysis

Lassané Kaboré[a,b,*], Seydou Ouattara[c], François Sawadogo[a], Alain Gervaix[d], Annick Galetto-Lacour[d], Robert Karama[c], Amado T. Traoré[c], Bertrand Méda[a], Haoua Tall[a], Alima T. Essoh[a], Bradford D. Gessner[e,f], Jennifer C. Moïsi[e,g]

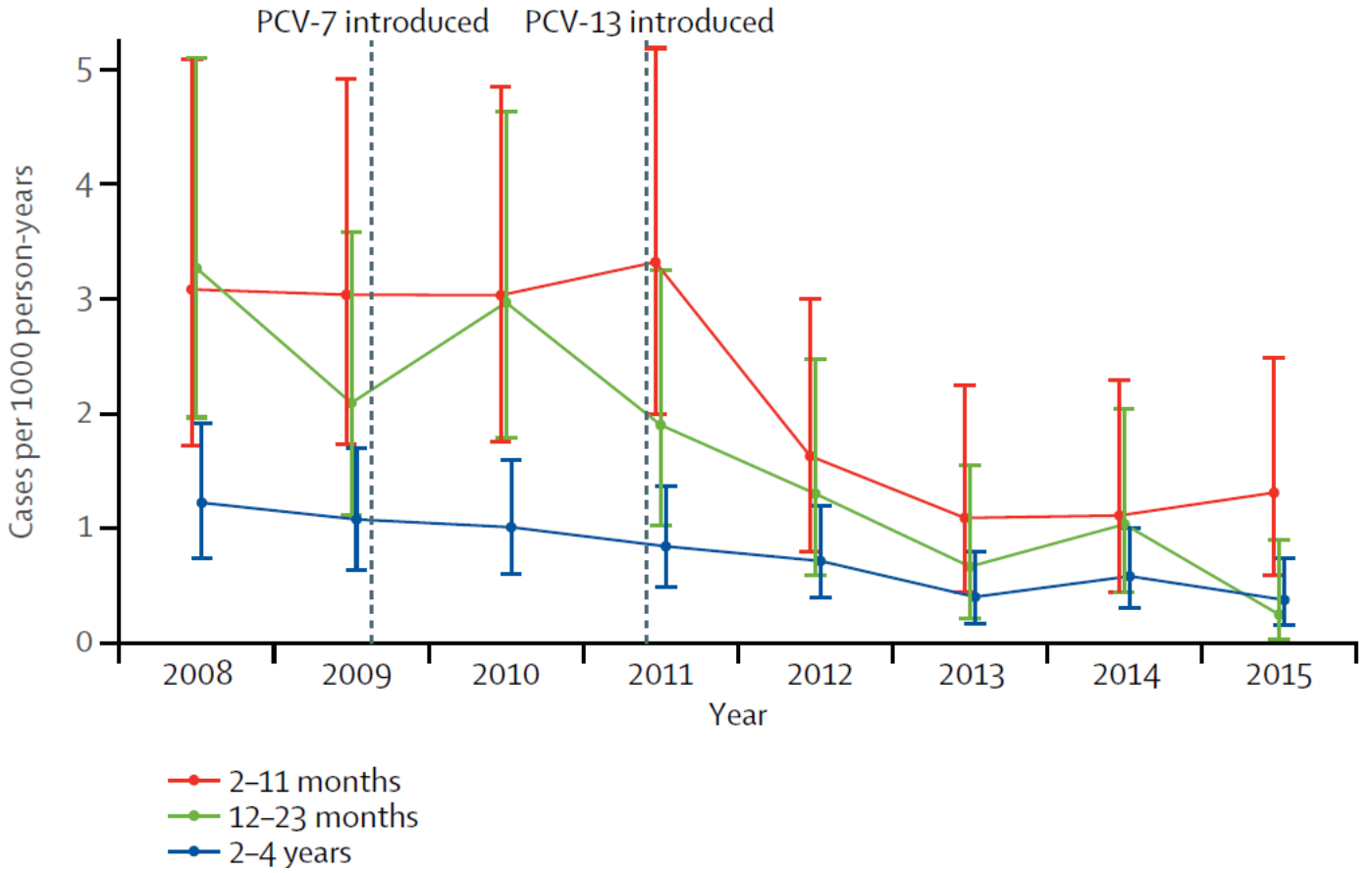
- Absolute reductions in all-cause pneumonia related hospitalizations 5 years after PCV13 introduction: **348 cases pers 100 000** children < 5 yrs.
- VE against all-cause pneumonia hospitalization: **34% (16–49%)**



Trends in monthly hospital admission rate for all-cause pneumonia before (2009–2013) and after (2015–2018) PCV in children < 5 years.
Vertical lines: Nov. 1st, 2013 and Dec. 31st, 2014; they define the 14-month PCV deployment phase.

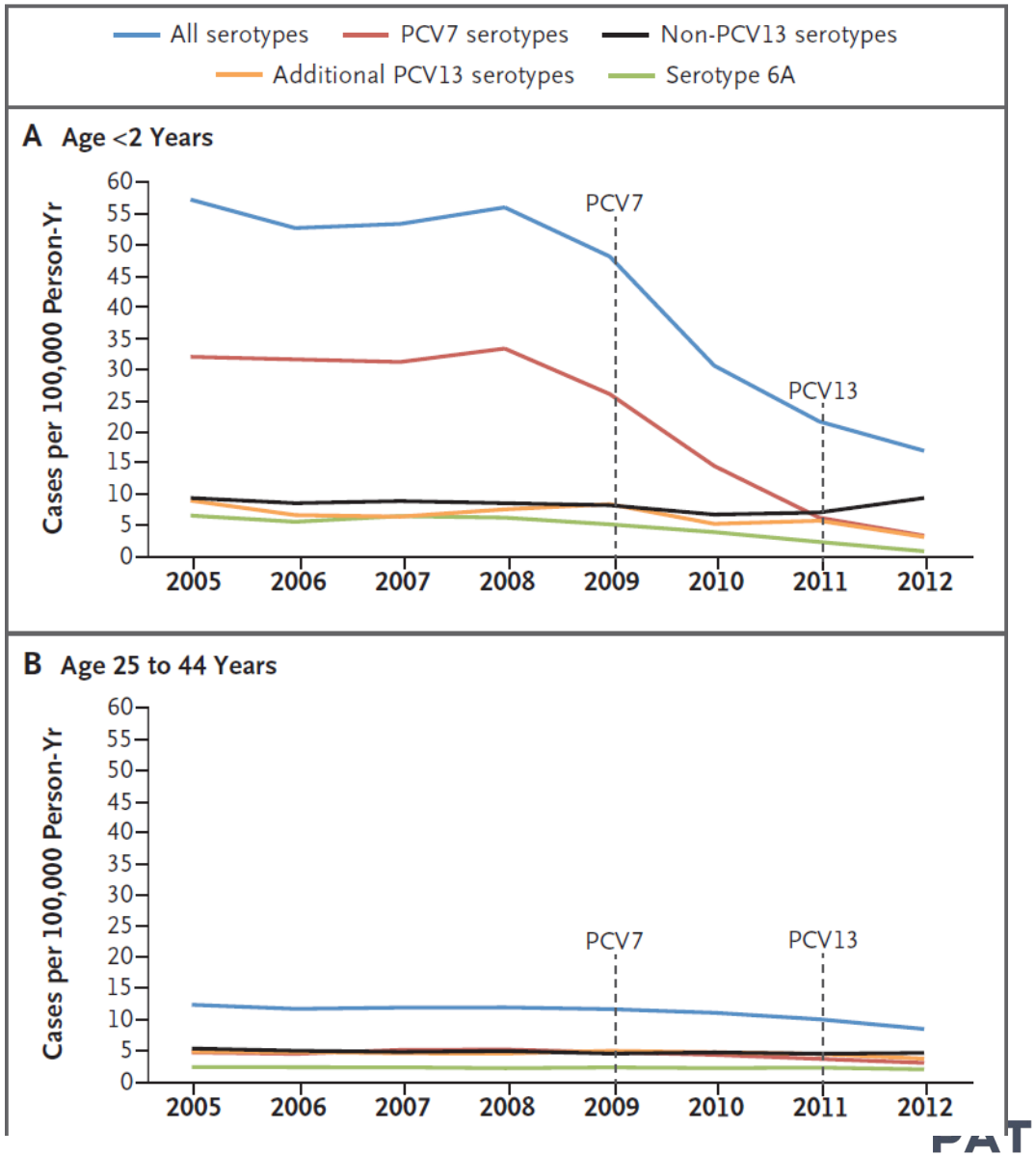
PCV impact of disease (ctd.)

- 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)



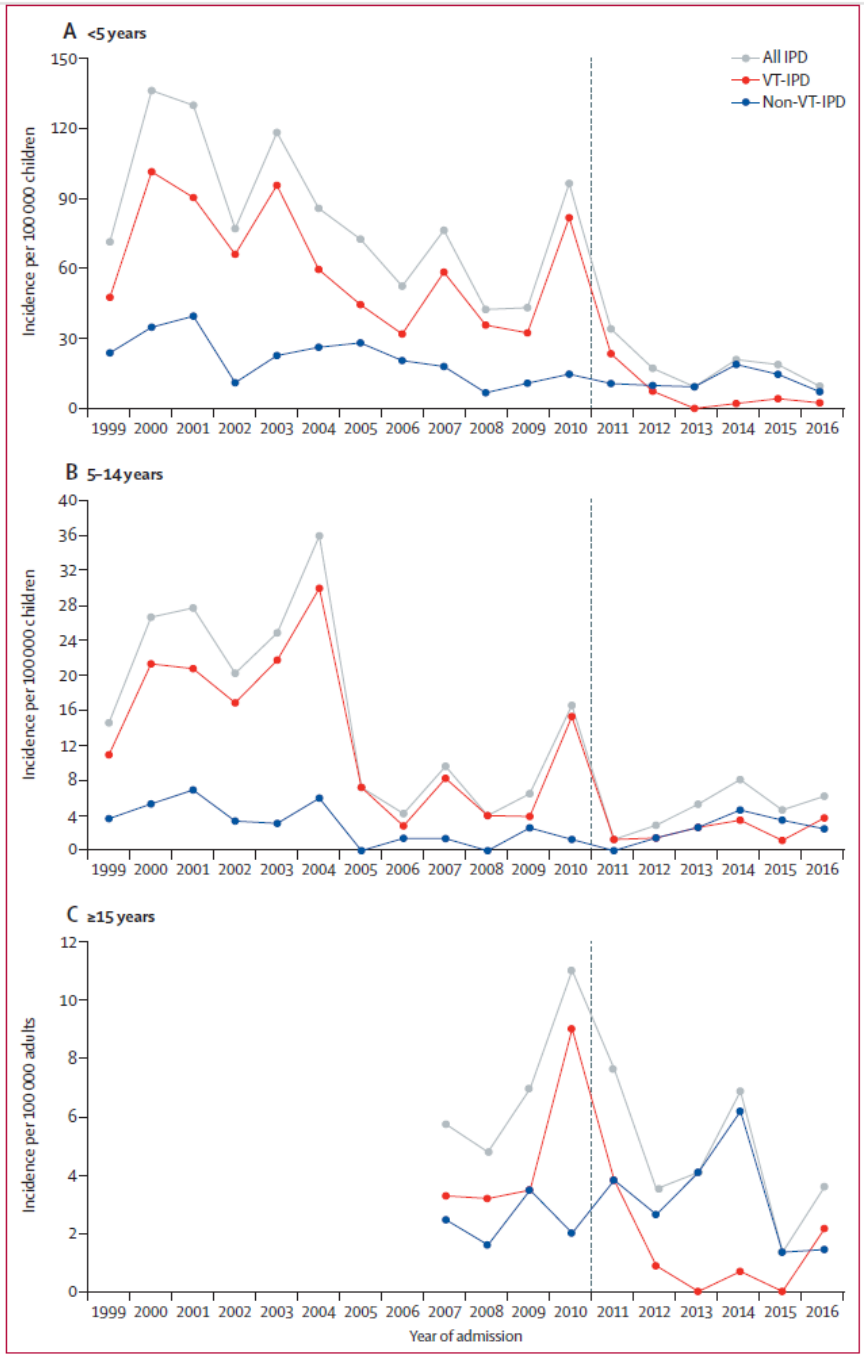
PCV impact of disease (ctd.)

- National lab-based surveillance study in South Africa by von Gottberg et al, N Engl J Med. 2014 Nov 13;371(20):1889-99
- 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.)

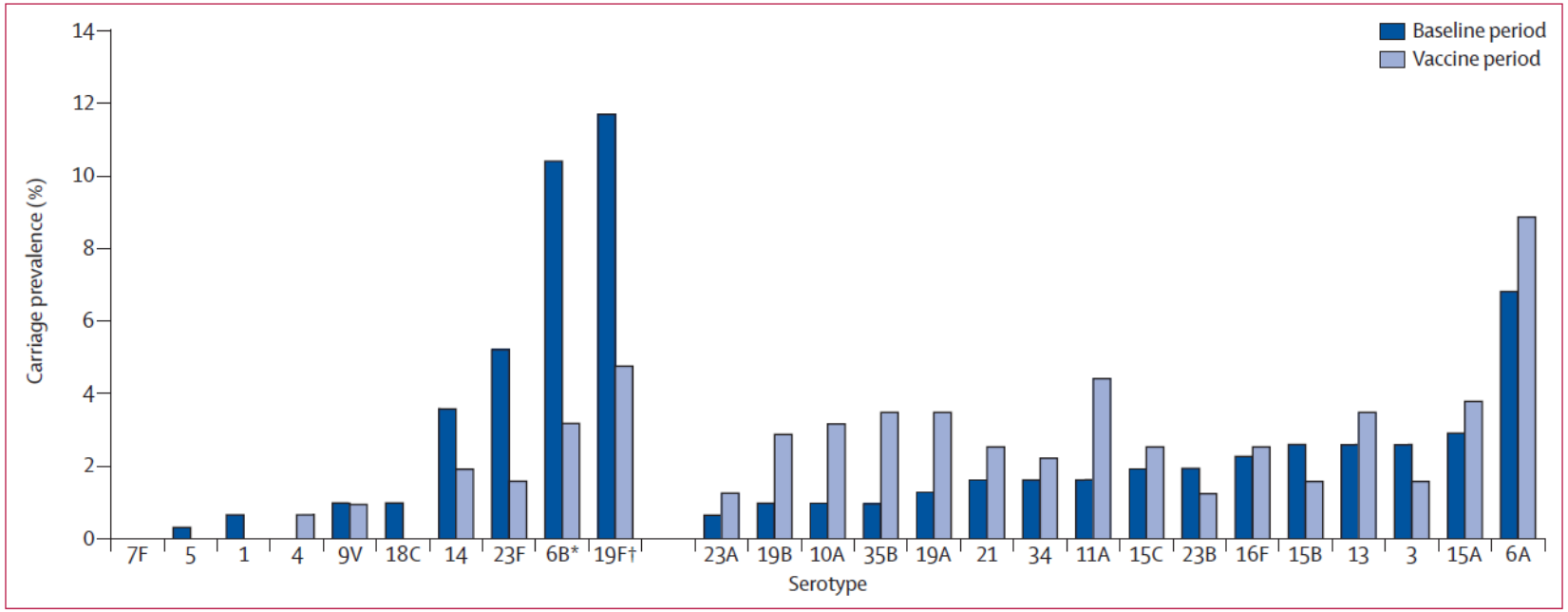
- Integrated clinical and microbiological surveillance study (1999-2016) in the Kilifi HDSS, Kenya, by Hammitt et al, Lancet 2019; 393: 2146–54
- PCV10 introduced in 2011 in Kenya, with a catch-up campaign targeting all < 5 years in Kilifi
- Estimated adjusted IRR and percent reductions in IPD, comparing 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

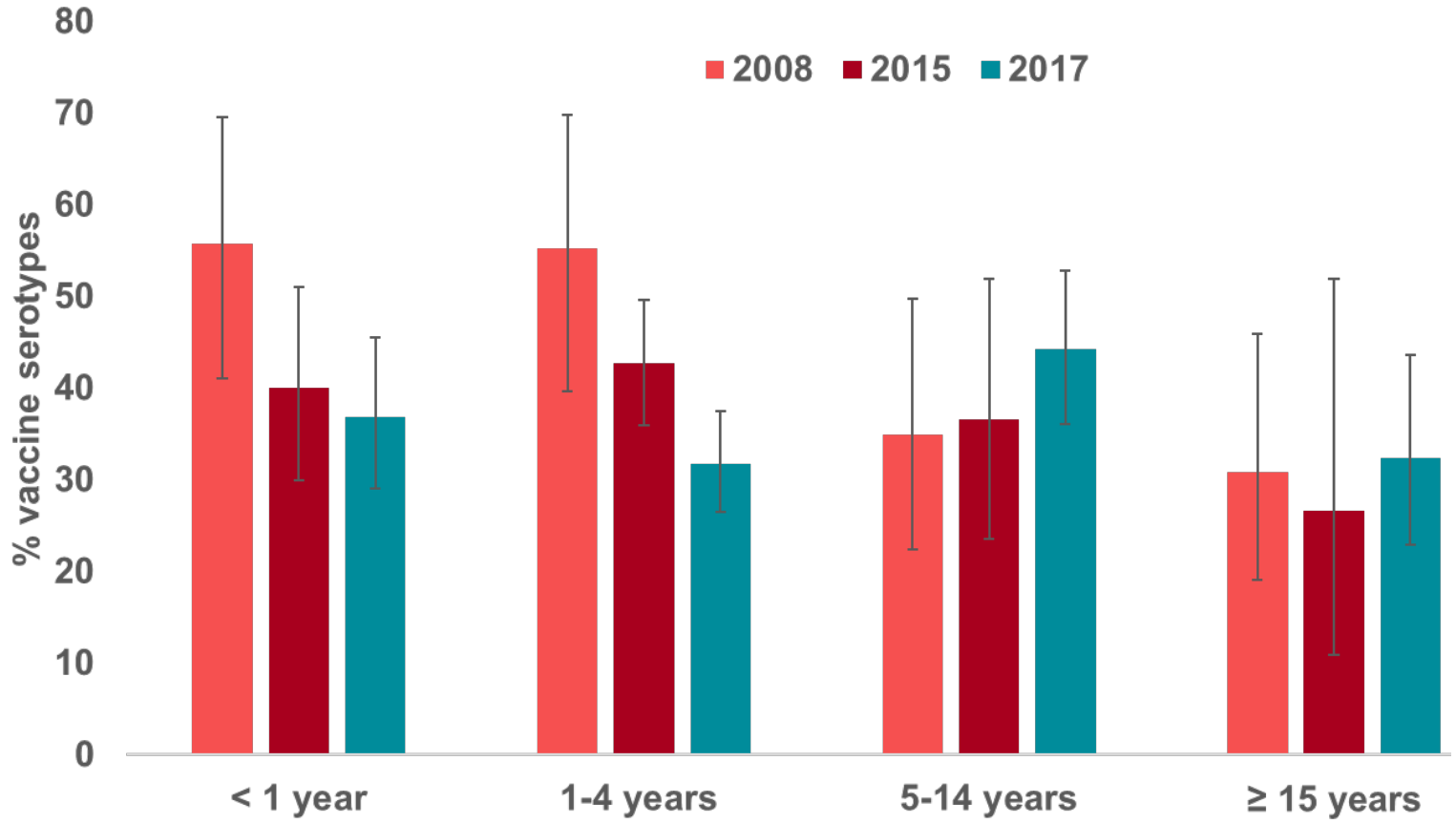
- 4 cross-sectional carriage surveys conducted in Kenya, 2 before PCV (2009-2010) and 2 post-PCV (2011-2012), by Hammitt et al, Lancet Glob Health 2014; 2: e397–405.

	Carriage prevalence baseline period (2009–10)	Carriage prevalence vaccine period (2011–12)	Crude prevalence ratio (95% CI)	Age-standardised adjusted prevalence ratio (95% CI)*
Vaccine-serotype *Streptococcus pneumoniae*				
<5 years	104/308 (34%)	41/315 (13%)	0·39 (0·28–0·53)	0·36 (0·26–0·51)
≥5 years	59/709 (8%)	25/699 (4%)	0·43 (0·27–0·68)	0·34† (0·18–0·62)
Non-vaccine-serotype *S pneumoniae*				
<5 years	125/308 (41%)	179/315 (57%)	1·40 (1·19–1·65)	1·37 (1·13–1·65)
≥5 years	167/709 (24%)	186/699 (27%)	1·13 (0·94–1·35)	1·13 (0·92–1·38)



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. Bozio[1,2☯*], Abass Abdul-Karim[3☯], John Abenyeri[4], Braimah Abubakari[4], Winfred Ofosu[5], Justina Zoya[5], Mahamoudou Ouattara[1], Velusamy Srinivasan[1], Jeni T. Vuong[1], David Opare[6], Franklin Asiedu-Bekoe[7], Fernanda C. Lessa[1]

RESEARCH ARTICLE Open Access

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-Adams[1†], Franklin Asiedu-Bekoe[2†], Badu Sarkodie[2], Osei Kuffour Afreh[3], George Khumalo Kuma[4], Godfred Owusu-Okyere[5], Ebenezer Foster-Nyarko[1], Sally-Ann Ohene[6], Charles Okot[6], Archibald Kwame Worwui[1], Catherine Okoi[1], Madikay Senghore[1], Jacob Kweku Otu[1], Chinelo Ebruke[1],

World Health Organization

Clinical Infectious Diseases

MAJOR ARTICLE

IDSA Infectious Diseases Society of America | hivma hiv medicine association | OXFORD

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

Effua Usuf,[1] Christian Bottomley,[2] Rebecca Gladstone,[3] Ebrima Bojang,[1] Kaddijatou Jawneh,[1] Isatou Cox,[1] Edrissa Jallow,[1] Abdoulie Bojang,[1] Brian Greenwood,[2] Richard A. Adegbola,[4] Stephen D. Bentley,[3] Philip C. Hill,[5] and Anna Roca[1]

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Pneumococcal meningitis - Togo

11 April 2023

Situation at a glance

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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 despites 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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