PCV Impact and the paediatric meningitis surveillance in West Africa

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The British Museum, London
6th November, 2019
Africa’s meningitis belts

- Long history (>100 years) of periodic meningitis outbreaks associated with meningococcus (Greenwood, 2006)

Strategy for managing meningitis epidemics in Africa

The WHO strategy for the control of epidemic meningitis is based on three key pillars:

- Surveillance
- Treatment and care
- Vaccination
MRC Gambia @LSHTM hosts WHOCC for New Vaccines Surveillance

- MRCG designated WHO RRL (2010) and WHOCC (2017)
  - IBD surveillance in West and Central Africa (2009-2018)
  - Supports 17 sentinel sites (largest paediatric hospitals) in ten West and Central African countries
- WHO CC provides technical support during meningitis outbreaks in West Africa - Platform for Research

MRC Unit The Gambia at the London School of Hygiene & Tropical Medicine
IBD surveillance

IBD surveillance is part of:

- The global VP-IBD surveillance network
- Collects data related to the detection of 3 vaccine-preventable organisms: *Haemophilus influenzae*, *Streptococcus pneumoniae* and *Neisseria meningitidis*.

The global VP-IBD sentinel surveillance utilizes a 3-tiered approach:

- **Tier 1**: surveillance targets children under-five with suspected meningitis
- **Tier 2**: surveillance also targets children under-five with pneumonia and/or sepsis
- **Tier 3**: Population-based Surveillance (seeks to determine incidence rates of VP-IBD) *e.g.* MRC Basse, The Gambia
Goal: IBD surveillance

- Production of high quality, local information on the causes of two major killers of children in West Africa; Meningitis and Pneumonia.

- Enable decision makers to assess the possible value of new vaccines using the best local evidence – their own data not estimates

- Monitor the effect of vaccines post-introduction; sharing information widely

- All West Africa countries are using PCV-13 except Nigeria (PCV10)
Standardized Structure
Study population

- Sentinel surveillance at the largest paediatric hospitals in West & Central Africa

- Children <5 years of age admitted to the hospital with signs & symptoms of probable bacterial meningitis &/or symptoms of invasive bacterial disease (e.g. sepsis) were recruited into the study.

- Probable meningitis is a suspected case with examination of CSF showing at least Turbid appearance or WBC (>100 cells/mm3) or WBC (10-100 cells/mm3) AND either an elevated protein (>100 mg/dl) or decreased glucose (<40 mg/dl)
Summary of specimens received and processed 2010 - 2016

Suspected cases at sentinel sites
38,404(100%)

CSF samples collected
18034(48%)

Confirmed & probable
Screened by PCR
1171(7%)

PCR +ve
311(27%)

Serotyped
205(66%)

Suspected Screened by PCR
7587(42%)

PCR +ve
606(8%)

Serotyped
418(69%)

Bacterial Isolates
327

Confirmed and serotyped
270(82%)

Whole Genome sequenced
176(65%)
Clinical Infectious Diseases

Early Impact of Pneumococcal Conjugate Vaccines in African Countries

Guest Editors:
- Jason M. Mwendwa, MPhil, PhD
- Martin Antonio, PhD
- Fernanda C. Lessa, MD, MPH
- Anne Von Gottberg, MD
- Brenda A. Kwambana-Adams, MSc, PhD
- Adam Cohen, MD, MPH

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Sheep blood collection for media preparation
## Baseline characteristics of suspected meningitis cases in West & Central Africa: 2010 - 2016

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Category</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0-11m</td>
<td>18793</td>
<td>48.7%</td>
</tr>
<tr>
<td></td>
<td>12-23m</td>
<td>6570</td>
<td>17.0%</td>
</tr>
<tr>
<td></td>
<td>24-59m</td>
<td>12796</td>
<td>33.1%</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>442</td>
<td>1.2%</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>16969</td>
<td>44.0%</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>21464</td>
<td>55.6%</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>168</td>
<td>0.4%</td>
</tr>
<tr>
<td><strong>Antibiotic before admission</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>5516</td>
<td>14.3%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>17055</td>
<td>44.2%</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>16030</td>
<td>41.5%</td>
</tr>
<tr>
<td><strong>Outcome</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discharged Alive</td>
<td>23829</td>
<td>61.7%</td>
</tr>
<tr>
<td></td>
<td>Died</td>
<td>2181</td>
<td>5.7%</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>12591</td>
<td>32.6%</td>
</tr>
<tr>
<td><strong>Sequelae</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>11758</td>
<td>30.5%</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>352</td>
<td>0.9%</td>
</tr>
<tr>
<td></td>
<td>Unknown</td>
<td>26491</td>
<td>68.6%</td>
</tr>
<tr>
<td><strong>Case type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Confirmed</td>
<td>821</td>
<td>2.1%</td>
</tr>
<tr>
<td></td>
<td>Suspected</td>
<td>37780</td>
<td>97.9%</td>
</tr>
</tbody>
</table>
Trends in meningitis and mortality among suspected cases pre and post PCV in West & Central Africa (2010 – 2016)
Trends in confirmed cases pre and post PCV in West & Central Africa (2010 – 2016)

- Sharp decline in *S. pneumoniae* meningitis cases and deaths
- Steady decline in *N. meningitidis* cases and deaths
- *H. influenzae* counts are stable
- Decline in meningitis caused by PCV13 types
Modelling pre and post PCV introduction trends in suspected meningitis (2010-2016)

- PCV impact appears variable across different countries
  - Benin and Ghana (high)
  - Nigeria and Niger (low)
- Short surveillance period post PCV implementation
PVC impact by age (2010 – 2016)

- Modelling pre and post PCV introduction trends in suspected meningitis by age
  - Red: 0-11 months
  - Blue: 12-23 months
  - Green: 23 – 59 months

- PCV impact appears consistent across age strata < 5 years old
## Trend estimates for PCV impact across West and Central Africa (2010 – 2016)

### A) Suspected Meniningitis

**Long post vaccine follow up**

<table>
<thead>
<tr>
<th>Country</th>
<th>Ratio [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin</td>
<td>0.282 [0.206, 0.385]</td>
</tr>
<tr>
<td>Cameroon</td>
<td>0.213 [0.166, 0.275]</td>
</tr>
<tr>
<td>Gambia</td>
<td>0.428 [0.303, 0.604]</td>
</tr>
<tr>
<td>Ghana</td>
<td>0.722 [0.637, 0.817]</td>
</tr>
<tr>
<td>Senegal</td>
<td>0.838 [0.652, 1.078]</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>1.416 [0.412, 4.868]</td>
</tr>
</tbody>
</table>

**Short post vaccine follow up**

<table>
<thead>
<tr>
<th>Country</th>
<th>Ratio [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ivory Coast</td>
<td>0.851 [0.547, 1.325]</td>
</tr>
<tr>
<td>Niger</td>
<td>1.491 [0.740, 3.006]</td>
</tr>
<tr>
<td>Nigeria</td>
<td>0.700 [0.362, 1.356]</td>
</tr>
<tr>
<td>Togo</td>
<td>1.241 [0.854, 1.804]</td>
</tr>
</tbody>
</table>

**RE Model, Subgroup**

<table>
<thead>
<tr>
<th>Country</th>
<th>Ratio [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE Model, All</td>
<td>0.650 [0.430, 0.981]</td>
</tr>
</tbody>
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Trend estimates for PCV impact on mortality across West and Central Africa (2010 – 2016)
Trend estimates for PCV impact on mortality across West and Central Africa (2010 – 2016)

### C) Confirmed Meniningitis

#### Long post vaccine follow up
- **Benin**: 0.989 [0.403, 2.429]
- **Cameroon**: 0.886 [0.568, 1.382]
- **Gambia**: 0.133 [0.030, 0.576]
- **Ghana**: 0.707 [0.398, 1.255]
- **Senegal**: 0.836 [0.410, 1.705]
- **RE Model, Subgroup**: 0.777 [0.581, 1.040]

#### Short post vaccine follow up
- **Ivory Coast**: 0.534 [0.106, 2.680]
- **Niger**: 0.032 [0.004, 0.297]
- **Nigeria**: 0.367 [0.085, 1.584]
- **Togo**: 1.265 [0.324, 4.938]
- **RE Model, Subgroup**: 0.360 [0.094, 1.379]

#### RE Model for All Countries
- 0.728 [0.554, 0.957]
PCV vaccine introduction and coverage in WA 2018 (WUENIC)

PCV in 15/17 countries except
Guinee: Gavi country
Capo Verde: Non Gavi country
PCV vaccine introduction and coverage in WA 2018 (WUENIC)
Concluding remarks

- PCV has had an impact on suspected meningitis and mortality among across the sub-region
  - The impact is greater in some countries than others
  - Short post-PCV surveillance in some countries is a problem
- Overall, counts of *N. meningitidis* meningitis have also declined while *H. influenzae* has remained stable.
Love them
or loathe them
UK Secretary of State for Foreign and Commonwealth Affairs Rt Hon Boris Johnson MP visits MRC Unit The Gambia
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