Meningococcal Meningitis in Africa: Overview
Response strategies and Current challenges

Eric Bertherat
The disease
What is Meningitis?

- Meningitis is an inflammation of the meninges, the thin lining that surrounds the brain and the spinal cord.
- Different origins:
  - Mechanical: e.g. tumours
  - Infectious: Cerebrospinal fluid (CSF) found infected
    - Viruses
    - Fungi
    - Parasites
    - BACTERIA
Bacterial causes of Meningitis

Many bacteria but some are of specific importance in public health:

Streptococcus pneumoniae
Haemophilus influenza
Neisseria meningitidis (Nm)
The meningococcus

Source: IMTSSA, Marseilles

Epidemic and Pandemic Alert and Response
Spread of *Nm* A of the ST-5 clonal complex

1996-1997: 250,000 cases in the Belt

Epidemics caused by subgroup III
Meningococcal meningitis

- Worldwide distribution
- Sporadic, cluster or large epidemic
- 12 serogroups:
  - Europe, Americas: B, C
  - Asia: A
  - Africa: A, C, W135, X
- Africa: 80% of the burden
Transmission:

- Strictly a human disease
- Direct transmission, person to person
- Close and prolonged contact.
- Average incubation period 4 days, ranging between 2 and 10 days.
- Carried in the pharynx – can overwhelm the body’s defenses allowing infection to spread through the bloodstream and to the meninges.
- 1-10% of asymptomatic carriers. Up to 10-25% during epidemics.
SYMPTOMS

- Stiff neck (babies opposite: "the rag doll")
- High fever
- Headaches
- Vomiting
The Meningitis Belt

- 21 countries and 300 million people at risk
- 700,000 cases in the past 10 years
- 10-50% case fatality rates
- 10-20% of survivors suffer permanent brain damage
## Impact of meningitis epidemics
### the example of Burkina Faso, 2006

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of the outbreak</td>
<td>5 months</td>
</tr>
<tr>
<td>Number of cases/deaths</td>
<td>19,000 / 1,500</td>
</tr>
<tr>
<td>Number of districts affected</td>
<td>35</td>
</tr>
<tr>
<td>Number of vaccinated</td>
<td>4 million (3 months)</td>
</tr>
<tr>
<td>Number of health workers mobilized</td>
<td>9,000</td>
</tr>
<tr>
<td>Direct cost</td>
<td>4 million USD (5% of total health expenditure)</td>
</tr>
</tbody>
</table>
Current WHO Strategy
How to reduce the burden of meningitis?

The WHO strategy in the Belt

Based on:

- Characteristics of meningitis in the Belt
- Technical and financial capacities of the concerned countries
- Performance and Availability of vaccines
The Meningitis Belt: a region presenting distinct epidemiological features

- Hyper incidence
  - 10-150 per 100,000 in non-epidemic yrs
  - 250-1000 per 100,000 in epidemic yrs
  (Europe-USA: 1-3 per 100,000)

- Seasonal increase

- Large epidemics during the dry season
WHO strategy:
Capacities of the concerned countries

Multiple endemic and epidemic diseases

Limited resources

Lack of laboratory capacities
WHO strategy: Performance and Availability of vaccines

- PS vaccines
  - Poorly immunogenic in children < 2y
  - Immunity short lived: requires multiple doses
  - Does not protect from carriage
  - Routine immunization not feasible in the Belt countries

- Limited supply, affordability
  - Bivalent AC
  - Trivalent ACW
  - Tetravalent ACWY
Outbreak control: 2 Core Components

➢ To prevent the lethality = case management
  • Presumptive treatment
  • Cheap and efficient on the most probable causative agent
  Ceftriaxone / Oily chloramphenicol: single dose IM

➢ To prevent the cases = reactive vaccination

Epidemic and Pandemic Alert and Response
Reactive Vaccination

60% of cases averted when vaccination is implemented within 2-4 weeks (Leake et al)

- District level
- Targeted on the high risk population: usually < 30yrs
- Targeted on the responsible Nm serogroup: A, C, W
- Timely
Reactive vaccination: the good timing

AR /100 000/wk

Too early!

expected incidence rise or beginning of an outbreak?
the principle of the thresholds

Alert threshold
5/100 000/week
Clinical samples + lab confirmation

Epidemic threshold
10/100 000/week
Immediately conduct district mass vaccination
Strengthen case management
To immunize with the right vaccine: a rational choice

epidemic threshold reached
---------
laboratory test results available
---------

Mainly Nm identified

yes

in 10 or more samples

W135 not identified

> 30% of W135 out of 10-19
  - Nm positive samples,
  OR
  > 20% of W135 out of 20 or
  more Nm positive samples

AC PS

no

in less than 10 samples

W135 not identified

at least one W135
identified

ACW PS

W135 epidemic in a neighboring district

yes

no

Specimens obtained

Conduct active field investigation and obtain specimens

Epidemic and Pandemic Alert and Response

World Health Organization
Meningitis Surveillance in the Belt

- Early detection = weekly AR
- Identification of the target population = AR/age group
- Identification of responsible germs = confirmation + serogrouping

Enhanced surveillance (epid./lab.)
From the reaction to the prevention..

The reactive vaccination: a frustrant strategy

Toward a true prevention: a conjugate vaccine for Africa…
The natural history of the disease: still many question marks…
Figure 1. Trends of epidemic meningitis disease in the African Belt, 1970-2006
Periodicity of Epidemics

Meningitis weekly ARs /100,000 Burkina Faso

Country-level Attack Rates - Burkina Faso, 1997-2006

Year

Cases/100000

0

5

10

15

20

25

30

35


Number of meningitis cases per year.
Sudan 1977-2007

Years

N° Cases


Meningitis weekly ARs /100,000 Niger

Meningitis weekly cases Sudan
Epidemic districts, Burkina Faso 1999-2004

Epidemic and Pandemic Alert and Response
Classical Epidemic Curve at District level

Weekly attack rates, Banfora District, Burkina Faso 1997

AR/100,000

Weeks

6-8 weeks
Meningitis outbreaks dynamics

- Magnitude of the outbreak determined by simultaneous occurrence of multi-focal outbreaks geographically not related
  - A given community/district can be affected while contiguous communities/districts are not

- Meningitis outbreaks in the African belt do not "spread"

- Transmission is likely to occur throughout the year (rainy and dry seasons) (Blakebrough, 1979 – Greenwood 1985)
The Belt, a conjunction of risk factors: climatic, socio-demographic, immunologic...
Relation of seasonal climatic factors to meningococcal meningitis cases

- Cases start increasing at beginning of the dry season (January)
- Sharp decrease with the beginning of rains, May-June

Causes of meningitis epidemics still poorly understood

- Introduction of new epidemic strains
  - 1996-1997 epidemic associated to spread of *Nm A* of the ST-5 complex

- Accumulation of susceptible cohorts

- Environmental factors
  - Low absolute humidity
  - Land cover
  - Atmospheric dust…

- ....and millions of doses of vaccine injected
From a public health view...

- Knowledge of the natural history of the disease:

  What can we expect from the research community (environment, socio-demography, mathematical analysis..)?
From a public health view...

- How much this added knowledge can improve the control strategy (reactive response / preventive vaccination)?
From a public health view...

- Long term strategy: What will be the Belt in the coming decades?
"Everything in the spread of the diseases, like in any natural biological phenomenon, is a matter of circumstances"

Charles Nicolle