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Monographic issue

Meningococcal outbreak risk in Burkina Faso

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Letter from the editors

The Emergency and Disaster Reports is a journal edited by the Unit for Research in Emergency and Disaster of the Department of Medicine of the University of Oviedo aimed to introduce research papers, monographic reviews and technical reports related to the fields of Medicine and Public Health in the contexts of emergency and disaster. Both situations are events that can deeply affect the health, the economy, the environment and the development of the affected populations.

The topics covered by the journal include a wide range of issues related to the different dimensions of the phenomena of emergency and disaster, ranging from the study of the risk factors, patterns of frequency and distribution, characteristics, impacts, prevention, preparedness, mitigation, response, humanitarian aid, standards of intervention, operative research, recovery, rehabilitation, resilience and policies, strategies and actions to address these phenomena from a risk reduction approach. In the last thirty years has been substantial progress in the above-mentioned areas in part thanks to a better scientific knowledge of the subject. The aim of the journal is to contribute to this progress facilitating the dissemination of the results of research in this field.

This monographic issue is about disaster risk profile of meningococcal outbreak in Burkina Faso, a West African Sahel landlocked country with 270,000 square kilometres located in the African Meningitis Belt where meningitis is seasonal endemic.

The present monographic issue gives an overview of the vulnerabilities and risks of meningococcal outbreak in the country and the national system of risk management and response.

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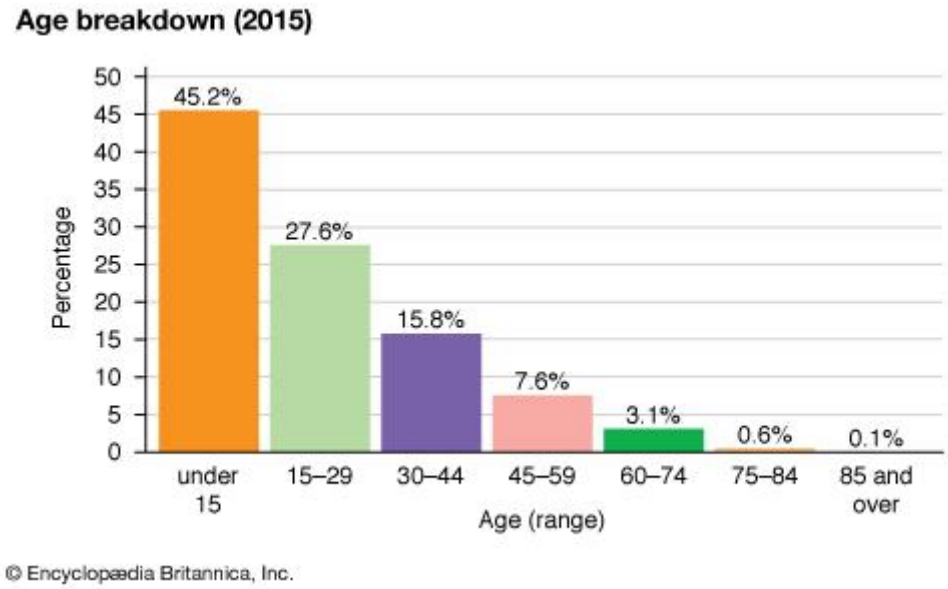
Table of content

I.Background

Burkina Faso is a West African Sahel landlocked country with 270,000 square kilometres. It is a low-income country with an economy based on agriculture which has 80% of the population active in this sector. (1)

Approximately half of the population is below age 15 with an average life expectancy of 60 years. The population of Burkina Faso was about 18.6 million in 2016 and grows by 3% every year with a child mortality of 84.6 in 2016 and total fertility rate per woman 5.3. (2)



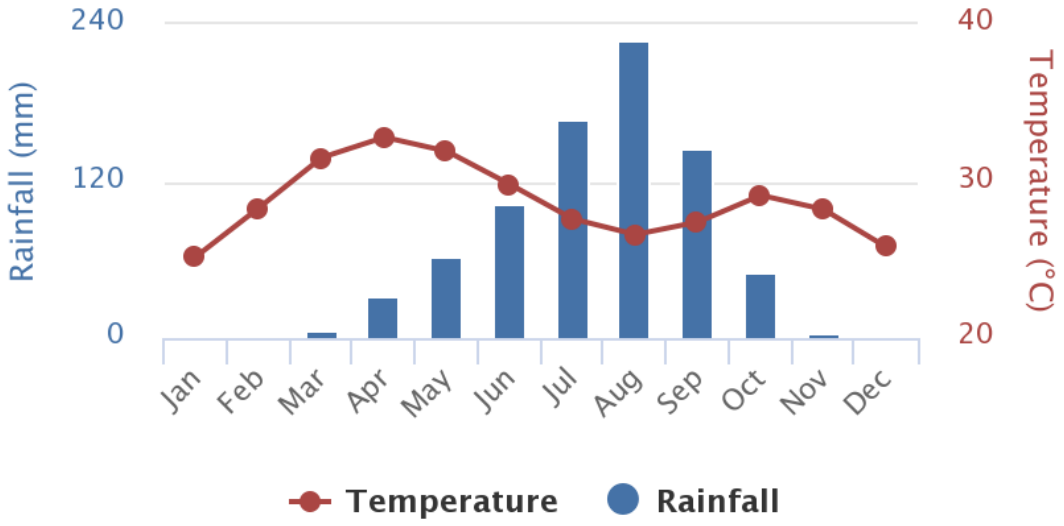
I.1. Climate

The country is located between the Sahara Desert in the North and the costal rainforest in the South. It is mainly covered by savanna, grassy in the North and more sparse forest like, in the South.

Burkina Faso has a varying tropical climate north to south and the temperatures are generally high. There are mainly two seasons: a dry season with the harmattan, a hot dry and dust-laden wind from Sahara Desert which blows from end of February to May and a rainy season from May to September.

The country has three climates zones: the Sahelian zone with rainfall less than 600mm per year in the north; the Sudanian-Sahelian zone in the center with 600- 900 mm/year and the Sudanian zone with 900 to 1200 mm/year.

But the Potential Evapotranspiration is high during the whole year, it is more than 100 mm per month and can be 200 mm in February and March (1).



Temperatures and rainfalls during the year

The variability of the climate is a major constraint on environment, health and associated with disasters.

I.2. Main Disasters

In Burkina Faso, the major hazard are floods, droughts, heat waves and dust storms, these lead to desertification, land degradation, food insecurity, migration, poverty and epidemics like cholera and meningitis. (1)

- **Drought**: the country experiences recurrent drought, because of the short rainy season, 2 months in the North, and the High PET. The agriculture is reliant on the rainfalls since the rivers are most of the time intermittent. This can lead to food insecurity, water shortage desertification and destruction of the fauna.

- **Flooding**: Burkina Faso rainy season is heavy and hostile, this can destroy human settlement and crops yield.

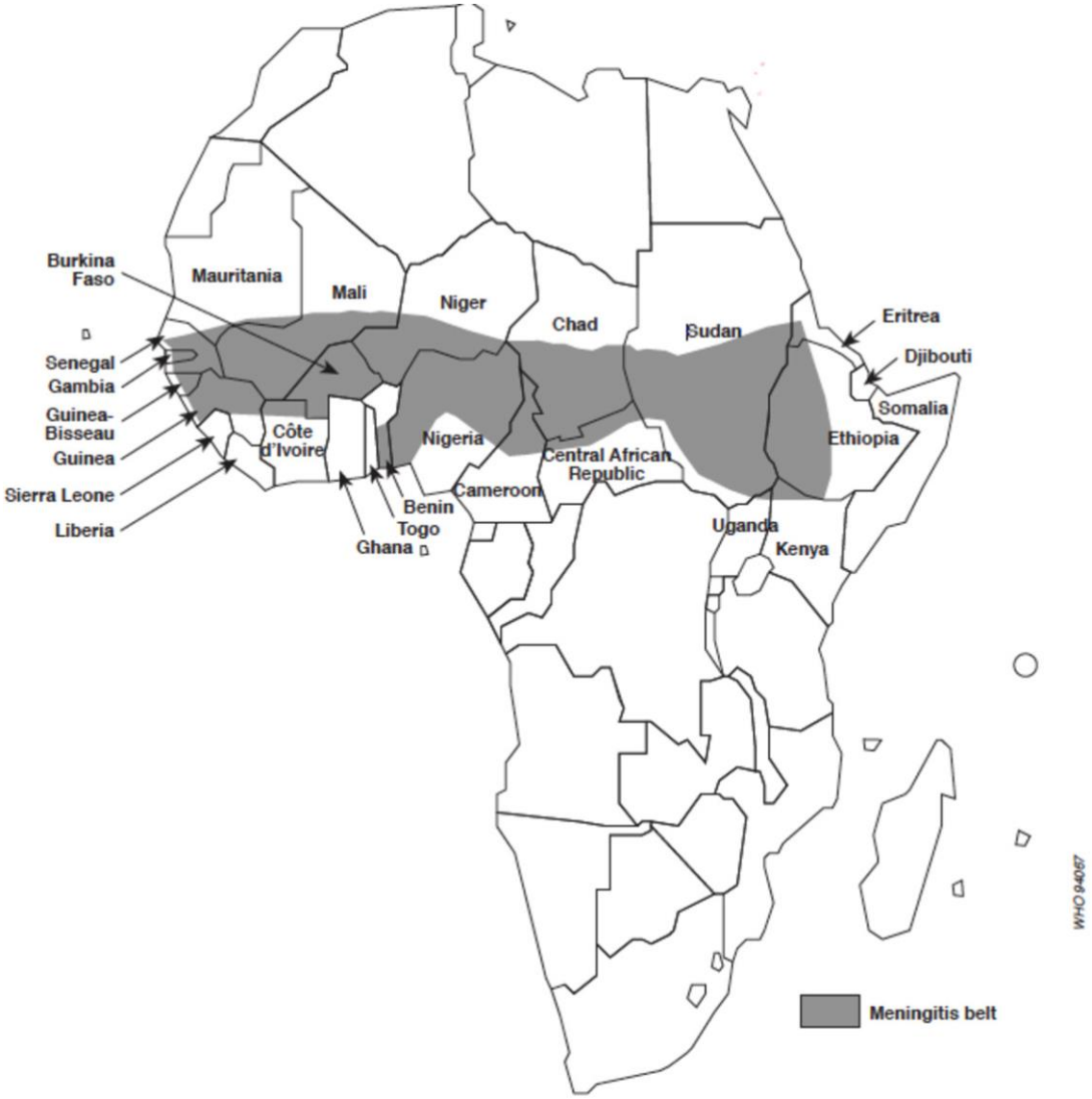
- **Epidemics:** There is epidemic of measles**.** Also, because the dry and hot climate of the country allows outbreak of cholera and meningitis.

II. Meningococcal meningitis

Burkina Faso is in the African Meningitis Belt. A region described by Lapeyssonies in 1963 as a zone of sub-Saharan African from Senegal to Ethiopian (17) with isohyet 300mm per year in the north and 1100 mm in the south where meningitis is pandemic. (3)

The African Meningitis Belt has more than half of meningococcal case in the world. It is the third cause of under 15 years child mortality, after malaria, respiratory diseases and diarrhoeal diseases. (3)

Meningitis is seasonal endemic in Burkina Faso, with important epidemic every 5-10 year since 1905 like other countries of the Belt. (4)



African meningitis belt region in Africa

Until 2010 the prevention has been through a reactive vaccination campaign after crossing out the epidemic threshold in a district. This has been inconvenient to deal with the delivery delay during an outbreak.

From 2010, with the introduction of meningococcal conjugate vaccine for immunization, which prevent the carriage and reduce the transmission, less epidemics have been recorded. (21)

II.1. Bacteriology

Neisseria meningitis is an anaerobic diplococcus gram-negative bacterium, it is also catalase and oxidase positive.

The bacterium is encircled by a capsule of polysaccharide which gives the serogroups. There are 13 serogroups and 6 of them (A, B, C, W-135, X, Y) are associated with disease. (4). the serogroup A is most responsible of epidemic in African belt.

The immunogenicity and the virulence of the bacteria are related to the polysaccharide capsule and the outer membrane.

II.2. Pathology

The human nasopharyngeal mucosae are the natural reservoir of Neisseria meningitidis.

The transmission of meningococci occurs through respiratory secretion in close contact with someone ill of meningococcal disease or with an asymptomatic carrier (transient) of *Neisseria meningitidis*. (5,6)

The pathogenicity occurs when the meningococci penetrate the cells of the nasopharynx (colonization process) and then reach the blood stream (the invasion). (3)

Non-immunized children are particularly inclining to develop disease. It results death and deafness and mental retardation as neurological sequalae for 15% of survivors. (6)

One of the predisposing factor for the meningococcal disease is the lack of protective bactericidal antibodies. The risk is increased for children who have lost antibodies acquired from the mother. (6,7).

II.3. Immunology and vaccines

After a week, the meningococcal induce humoral immune response with production of antibodies, whatever is the case of infection or immunization. (7,8) These bacterial antibodies target the capsular polysaccharide and the outer-membrane proteins of Neisseria meningitidis.

The immunoglobin G (IgG) antibodies of the mother go through the placenta and give immunization to the child for first three months.

More than 66%of adults in Burkina- Faso as well as other countries of the African meningitis belt have protective level of bactericidal antibodies. (7)

The first meningitis vaccine was manufactured in 1976, the Meningococcal Polysaccharide Vaccine (MPV), because of the immunogenic capacity and virulence of the capsular polysaccharide.

There are the bivalent vaccine A/C (for serogroup A and C) and the quadrivalent vaccine A/C/Y/W (for serogroup A, C, Y and W).

The MPV gives T-cell independent immune response and no real memory cells. The consequence is a need of frequent vaccination for more duration protection. (8)

The immunization is a function of age, less lasting duration in children under four than in children more aged. (7,8). Explanation may be the bad B-cell immunity and T-cell independent response to MPV.

These vaccines were mostly for reactive vaccination campaign not preventive because of the short duration of protection and the price and availability. About 20 million doses for more than 350 million peoples at risk in the Belt.

Because of this problem, the research was target protein antigen of *Neisseria meningitidis* as a suitable vaccine, as protein lead to T-cell dependent immune response with long lasting memory.

A meningococcal serogroup A polysaccharide- tetanus toxoid conjugate vaccine (PsA-TT, MenAfricVac) was introduce in the immunization campaign in Burkina- Faso in 2010. (10)

It was a joint initiative of WHO and PATH (Program of Appropriate Technology in Health) funded by Bill and Melinda Gate Foundation, to have this conjugate vaccine for Africa. The Serum Institute of India has manufactured the vaccine and after clinical trial, the vaccine is affordable at $0.5 per dose. Burkina-Faso the first country of the Meningitis Belt to conduct a preventive vaccination with the MenAfricVac.(22)

II.4. Diagnosis – treatment

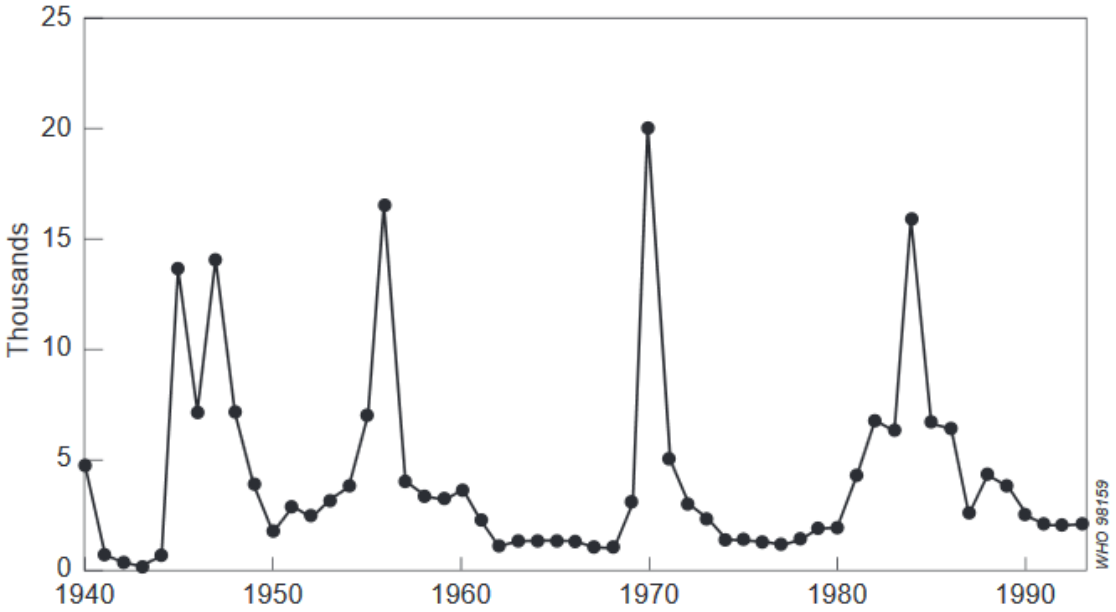
Symptoms occurs within 10 days after exposure to meningococci. Pleocytosis on Gram strain and culture of cerebrospinal fluid are needed for confirmation (11)

A lumbar puncture is done for the analysis of the cerebrospinal fluid and Gram stain. And by latex agglutination, the meningococcal antigen is isolated or by PCR the DNA of *Neisseria meningitidis* can be detected. (11)

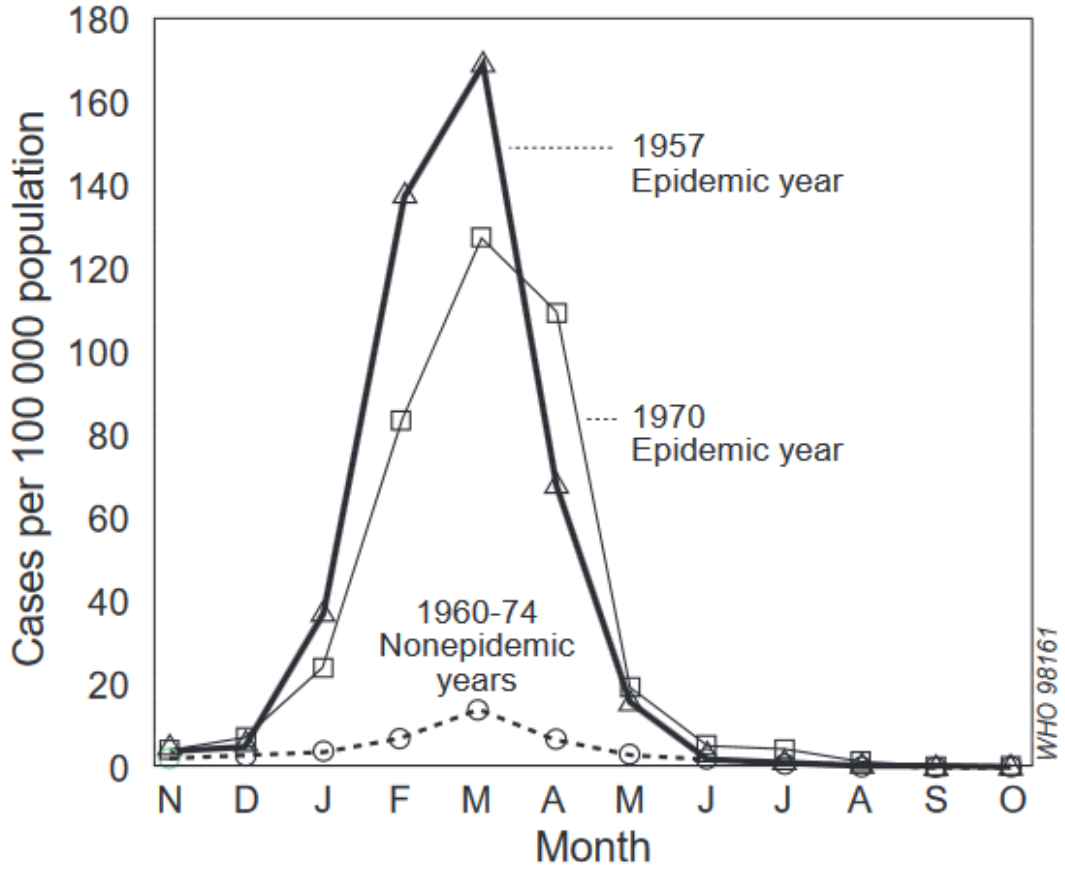
Indicated antibiotics are chloramphenicol, benzylpenicillin and third generation of cephalosporin like ceftriaxone and cefotaxime. But because of potentially problem of resistance, the use of benzylpenicillin should be reduced. (4)

III. Epidemiology

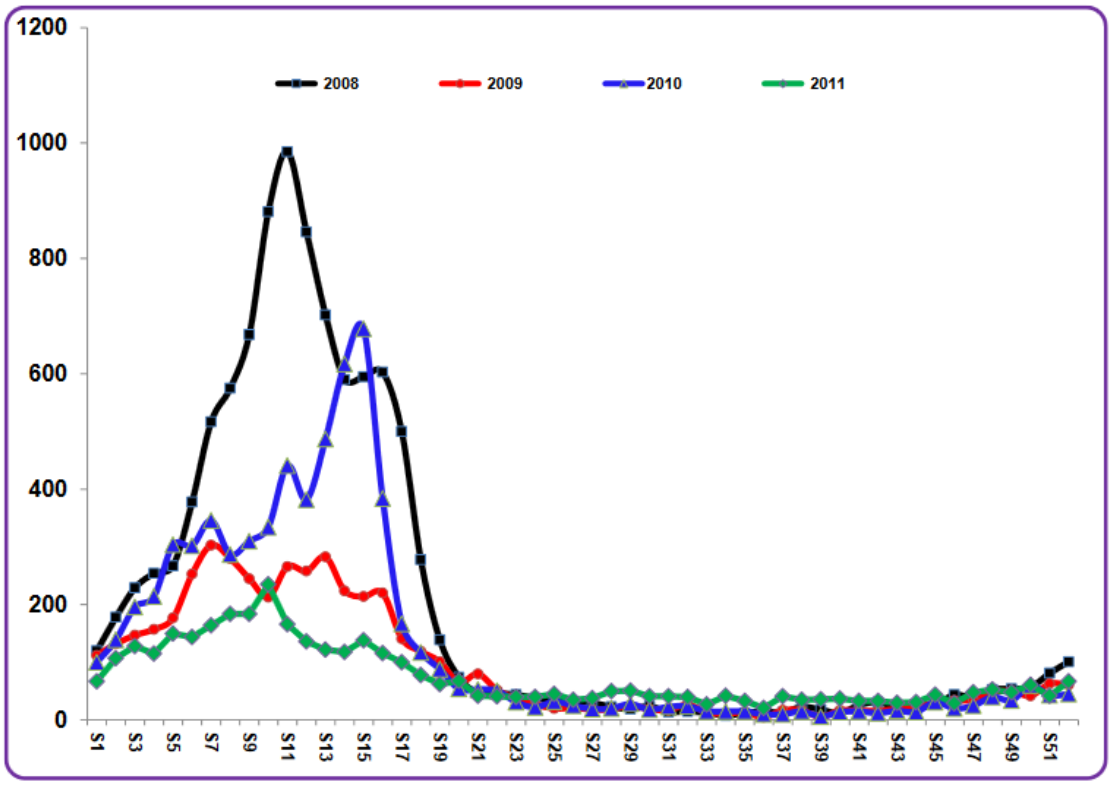
Every 5 to 10 years since 1905, in the Sahelian countries, a pandemic of serogroup A occurs. The epidemic starts with the dry season and end at the arrival rains. (3)

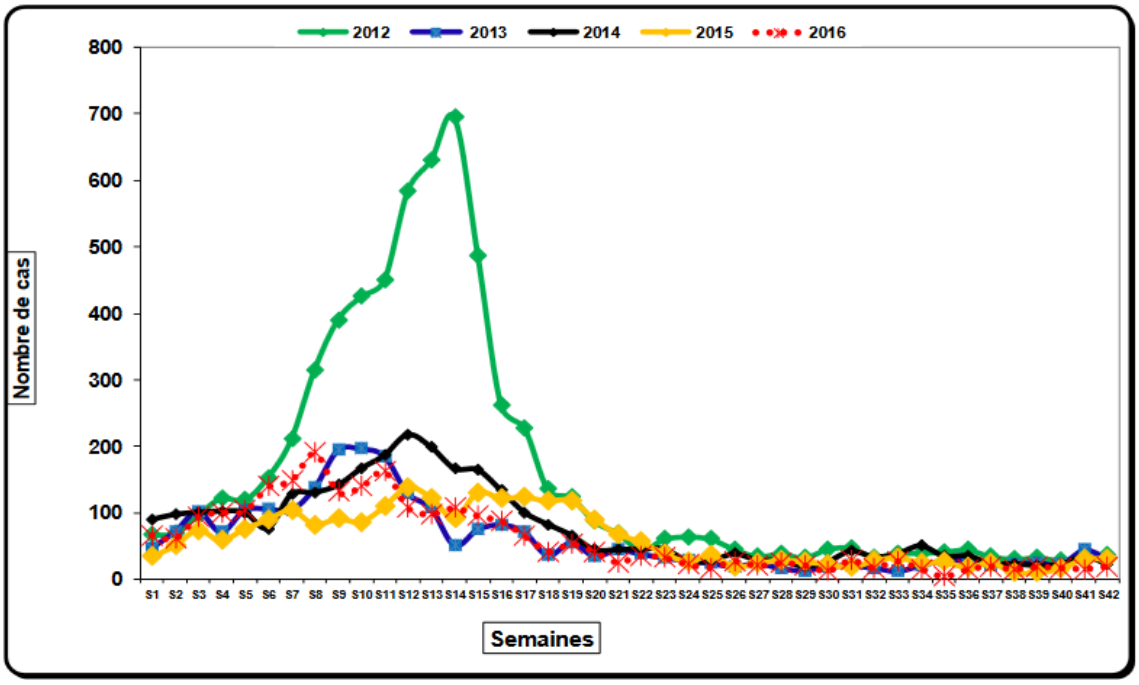


Number of meningococcal case from 1940 to 1990 in Burkina-Faso



Graph showing the period of outbreak during the year





Number of meningococcal case from 2008 to 2016

Because of the end of the protective maternal antibody in young children, this group has the highest rate of meningitis. (4)

Neisseria meningitidis is a natural inhabitant of human healthy nasopharynx. And one of the important factors in the spread of meningococci in population is the asymptomatic carriage. Its frequency is seasonal within all groups of age. (14)

A percentage of 5% to 10% of the population are estimated to be asymptomatic carrier (11).

The serogroup A, is mainly the major strain of epidemic in the African belt, and many strains of *Neisseria meningitidis* can be found within a same population at the same time and sometime in the same person (13,14).

In the transmission of meningococci, the asymptomatic carriers are more important than are sick persons. (16)

The duration of asymptomatic carriage can be from one month to more than ten. (14). The asymptomatic carriage of *Neisseria meningitidis* is influence by age, the incidence is lower in children under 2 years than adult above 20 years. (14)

The change from the carriage to the infection is dependent of the climatologic factors, the virulence and susceptibility. (3)

Regarding the rainfalls, Lapeyssonie described the African Meningitis Belt as a geographical zone in the Sahel between isohyet 300 mm per year in the north and 11000 mm per year in the South. (17)

Rain, dryness, dust and wind (the Harmattan) play important role in the epidemiology of meningitis. It is established that after five consecutive days with dryness less than 30%. (18), this parameter set the period of meningitis epidemic in countries of meningitis belt, from February to May. (3)

During the dry season, the meningococci invasion from the pharyngeal mucosa to the blood is favoured by dryness and hot wind which dries and irritates the mucosa. African social events which gathers people and “communities-induced promiscuity” can be considered as factor of transmission.

IV. Control of epidemic

The health system in Burkina Faso is structured in:

The national level, the highest level of the health system, responsible for the conception of health policy of the country

The regional level, it is in the 13 administrative regions of the country and it is the responsibility of the Minister of Health policy at regional level.

The district level, there are 63 health districts, responsible for the operational planning and implementation of health program and the coordination of their health centres.(19)

Prevention is therefore the key the control of epidemics, it is based one hand on environmental conditions to reduce the spread of epidemic, such as climate and person to person contact during gathering of people like social event in Africa such as wedding, village meeting, market. In the other hand, on the immunization of person in contact with patients (3).

According to the WHO, the response to meningitis outbreaks is a function of the weekly incidence of threshold., There are two thresholds, the alert one and the epidemic one.

The alert threshold is crossed when per week there are 5 cases per 100,000 inhabitants per week for population larger than 30,000 and 2 cases per week for population less than 30,000 inhabitants.

The epidemic threshold is crossed when 10 cases are recorded per week for 100,000 inhabitants for a population larger than 30,000 and 5 cases per week for population less than 30,000 inhabitants. (20)

	POPULATION	
Intervention	30 000–100 000	Under 30 000
Alert threshold — Inform authorities — Strengthen surveillance — Investigate — Confirm (including laboratory) — Prepare for eventual Response	3 suspected cases / 100 000 inhabitants / week (Minimum of 2 cases in one week)	2 suspected cases in one week *Or* An increased incidence compared to previous non-epidemic years
Epidemic threshold — Mass vaccination within four weeks of crossing the epidemic threshold — Distribute treatment to health centres — Treat according to epidemic Protocol — Inform the public	10 suspected cases / 100 000 inhabitants / week	5 suspected cases in one week *Or* Doubling of the number of cases in a three-week period (e.g. *Week 1*: 1 case, *Week 2*: 2 cases, *Week 3*: 4 cases)
	If a neighbouring area to a population targeted for vaccination is considered to be at risk (e.g. cases early in the dry season, no recent relevant vaccination campaign, high population density), it should be included in a vaccination programme.	
	In special situations such as mass gatherings, refugees, displaced persons or closed institutions, two confirmed cases in a week should prompt mass vaccination.	

Incidence thresholds for detection and control of epidemic meningococcal meningitis (2014) (WHO manual reference)

According to the WHO, the strategy for the control of meningitis is based on three pillars: the surveillance, the treatment and care, and the vaccination. (20)

IV.1. The Surveillance

In Burkina-Faso an enhanced surveillance system is capable for early detection of meningitis case and the corresponding serogroup.

The first cases detection are identified by standard case definition and confirmed by laboratory tests.

During a meningitis epidemic, the responsible serogroup of Nesseria meningitidis identification is relevant to know the epidemiology of the outbreak and the choice of the vaccine to be used. (3)

Reporting data should be standardized for analysis and give the spread of the outbreak.

IV.1.1 Meningococcal meningitis surveillance systems

INTEGRATED DISEASE SURVEILLANCE AND RESPONSE (IDSR)

IDSR is a framework adopted by 46 country member states of WHO African regional office for Africa (WHO/AFRO) in 1998 in Zimbabwe.

IDSR framework aims to strengthen national health capacities for surveillance and response. Its explains the roles, activities and abilities needed by every level of health system for implementation of an adequate surveillance and response.

At each level of health system (the communities, health facilities, districts, provinces and national level) this framework illustrates disease detection, report and analysis and communication of health data. It also designs the response, monitoring and preparedness towards the disease.

The IDSR framework aims:

- To ensure the use of standard case definition for identification and report of disease and related events.
- To ensure the knowledge of different outbreak thresholds and strategies for diseases management and control.

- To ensure the investigation on suspected outbreak and obtain confirmation by laboratories.
- To ensure that the surveillance activities come form data analysis during an outbreak situation.
- To ensure the effectiveness of communication with health professionals and communities.
- To evaluate the performance of disease surveillance by IDSR indicators, and improve it.

National systems of surveillance

In Burkina-Faso, there are two national systems for meningitis surveillance:

- A meningitis case-base surveillance through the Télégramme lettre Officiel Hebdomandaire (TLOH), a weekly aggregate report on clinically detected cases of meningitis from health centres and related death information at district level. This system has only few demographic data on age and sex and no laboratory data.
- An enhanced meningitis surveillance based on IDSR framework, which combine demographic, clinical data and laboratory data of cerebrospinal fluid examinations. (9,10)

IV.1.2. Treatment and care

The country Guarantees adequate and timely treatment to patients. Health centers are supplied before the outbreak. Priority need to be given to the health centres in the zone of epidemic risk. (20)

IV.1.3. Vaccination

There are two kinds of vaccination, reactive and preventive.
The reactive vaccination is for person exposed to meningococci. This relates to the proximity of outbreak and the age. (18) This strategy is ineffective when the epidemic is ongoing.

The preventive vaccination is done before the outbreak by vaccination campaign.

Many aspects of the vaccination like coordination, distribution, logistic and public health information for the campaign should be arranged.

- During the epidemic preparedness: the vaccination campaign is conducted immediately when the alert threshold has been crossed in a district.

- During the outbreak: A vaccination campaign should be done as soon as the epidemic threshold has been crossed in population affected. The choice of the vaccine should be based on the laboratory and epidemiology data of the outbreak.

- Post vaccination follow up: When the attack rate is below the alert threshold up to 14 days, the epidemic is considered ended. An immunization coverage survey should be done.

Evaluation on the epidemic response and the feedback to the stakeholders are done afterwards in Burkina-Faso.

V. Discussion

Even though the season of these epidemic of meningococcal disease in Burkina-Faso is well known, the geographical area in which the outbreak could occur, and the prediction of the outbreak serogroup are difficult to detect.

With the arrival of serogroup A conjugate vaccine, a new dawn was coming in the eradication of meningococcal epidemics, since the serogroup A is the main cause of meningitis in Burkina Faso as well as throughout the African meningitis belt, unfortunately there are threats of other serogroup especially serogroup C. (21)

The use of polyvalent conjugate vaccine in vaccination campaign is suitable because of the unpredictability of the outbreak serogroup.

Burkina Faso has implemented efficiency surveillance system for meningococcal outbreak alert and the country has adapted mechanism response for reactive vaccination and treatments.

The country has limited resources and depends on the International Coordinating Group (ICG) of WHO for vaccines doses supply. This complicates the timely delivery in outbreak setting.

There are also problems of logistic for vaccination campaign and this can be overwhelming for health centres. (22)

VI. Conclusion

Considerable improvements have been done in the control and response to the meningococcal outbreak in Burkina Faso.

Despite the roll back of the epidemic these recent years after the deployment of serogroup A conjugate vaccine, it is urgent to introduce routine vaccination campaign, a polyvalent conjugate vaccine to face other meningococcal serogroups.

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