

PREDICTION OF MENINGOCOCCAL MENINGITIS INCIDENCE TREND IN BURKINA FASO AND NIGER FOR YEAR 2012

I. Background

In the case of activities of Burkina National Working Group on Climate and Health, and ongoing conjoint activities of Burkina Meteorological office, Health Protection General Department (Burkina Health Ministry), Laboratory of Ocean and Climate Science: Experimentation and Numerical Approach (LOCEAN-France) and African Desk - National Centre for Environmental Prediction (NCEP-United States of America), a prediction of the trend of meningococcal meningitis (MCM) incidence in Burkina Faso and Niger for year 2012 and an evaluation of what have been done in 2011 are established.

This prediction is based on two approaches: the first one on analyzing epidemiological data and medical information, of meningitis surveillance by Direction of Straggling against Disease (DLM) from Burkina Ministry of Health.

The second one comes from statistical Multidimensional analyze between meningococcal meningitis (MCM) epidemiological data in Niger and Burkina Faso (from 1968 to 2005) and reanalysis I from National Centre of Environmental Prediction (NCEP). These data have been performed to show the relationships between climate and MCM incidence variability. It has been shown that MCM outbreak and upsurge case are mostly related to enhancement of Easterly wind (Harmattan) of October in Burkina Faso, then, November and December in Niger.

So, MCM incidence trend prediction model in these two countries has been elaborated. The model skill has been attested by cross validation coefficient (0,50) and explained variance (0,25) for Niger, showing that 25% of MCM annual incidence total variance could be explained by the variability of climatic factors (meridional wind component).

For Burkina Faso, the cross validation coefficient is less high than Niger (0.33) but still significant. These models could be used to be integrated into a system of MCM incidence trend monitoring for early warning. This system should be performed by adding other predictors like socio-demographic, economical, biological and other risk

factors. For more information, read the article on the website: <http://www.ij-healthgeographics.com/content/7/1/34> .

II. Prediction of meningococcal meningitis incidence trend in Burkina Faso for year 2012

II.1. Prediction based on epidemiological monitoring data.

Analysis based on meningococcal meningitis (MCM) morbidity yearly fluctuations from 1996 to 2011 shows us that high amplitude (peak) of MCM epidemics is occurring during two years consecutively, following by three years of low MCM amplitude epidemics

So after high amplitude of MCM epidemics occurred in 2006 and 2007, we observe low MCM amplitude epidemics from 2008 to 2011. According to that analyze, (MCM high amplitude epidemic cycle), we might be affected by a MCM high amplitude epidemic in 2011 (see graph n°1).

However after the mass preventive vaccination campaign of conjugate vaccine A (MenAfricVac immunizes against serogroup A meningococci for 10 years) done in 2010 in the totally of Burkina health districts, we have noticed a decreasing of meningitis annual cases in 2011 due to serogroup A meningococci, usually responsible of most of the MCM cases during the epidemic periods.

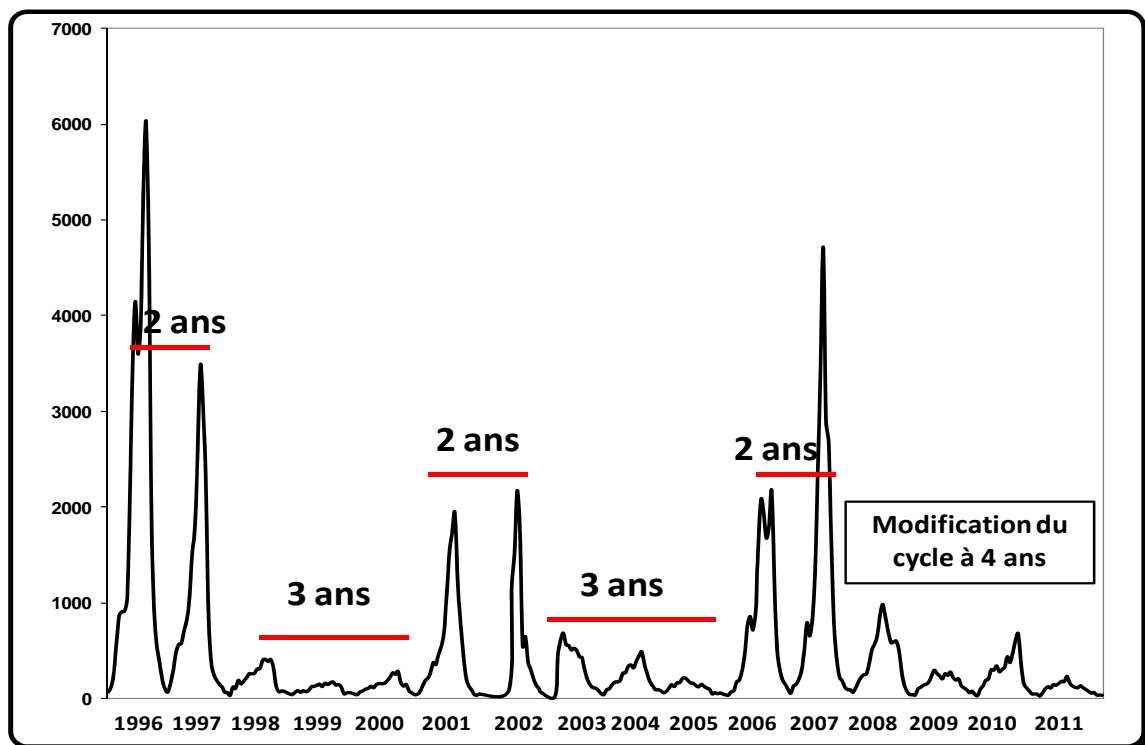
In another part, due to the propagation of serogroup NmX, Y and W135 meningococci, we could observe MCM epidemics in some health districts due to these bacteria. In fact, serogroup X and W135 meningococci has already caused MCM epidemics in Burkina Faso (2002 and 2003 for the serogroup W135 meningococci and 2010 for the serogroup X meningococci). That, because mass vaccination against serogroup A meningococci (MenAfriVac) has not an effect on them (serogroup X and W135 meningococci).

In addition, some regions of Burkina like frontier areas are characterized by intense circulation (going out and coming back for rural and trading activities, seasonal migrations...). These areas, although MenAfriVac mass vaccination, could be

affected by localized MCM epidemics due to the presence of people who have not been vaccinated.

Also, the crowd, mass or grouping together activities, during dry season (promiscuity, extreme climatic aggression on oro-rhino-pharynges, low immunization rate...) due to socio-cultural and economic events (funerals, weddings, festivals, mineral extractions...) are favorable to MCM transmission and propagation.

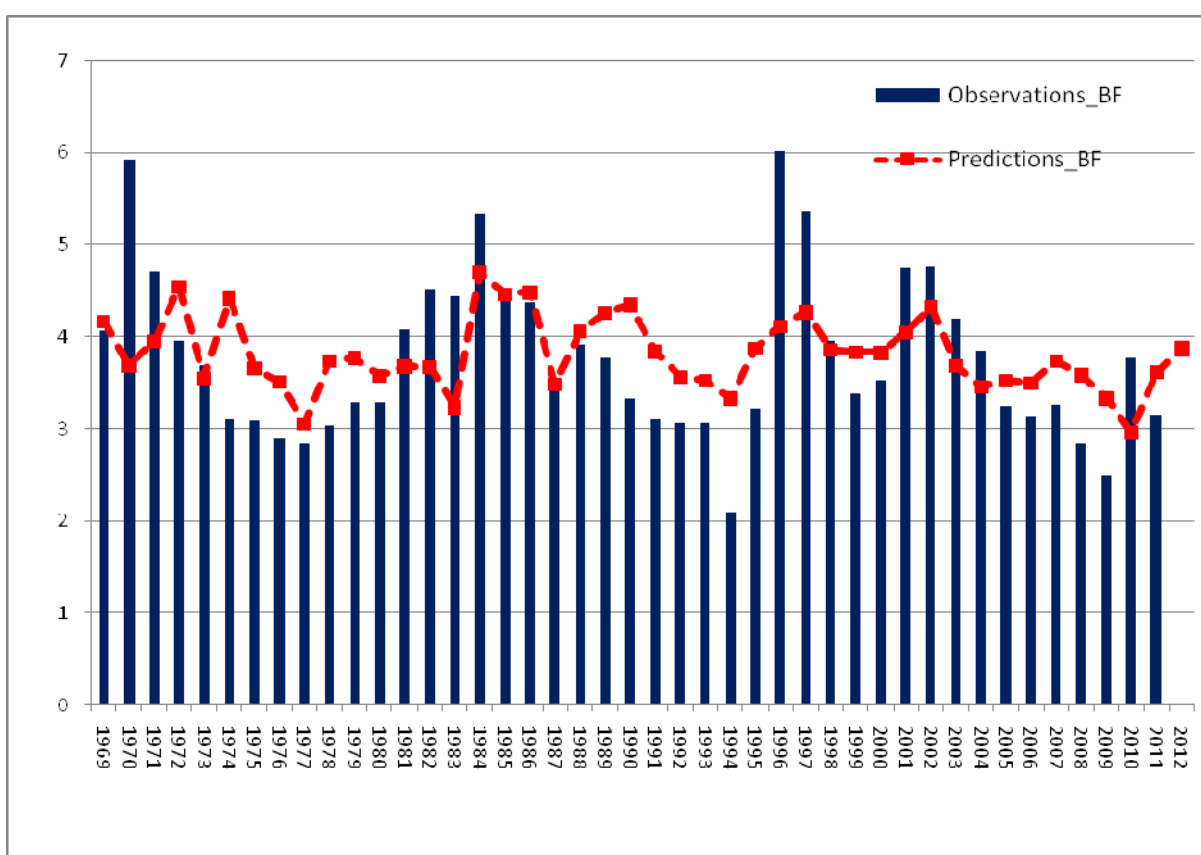
Taking into account these analyzes, we could conclude an absence of high amplitude (peak) of MCM epidemic due to serogroup A meningococci in Burkina Faso in 2012. Nevertheless, low to intermediate amplitude of MCM epidemics in some health districts in Burkina Faso due serogroup NmX, Y, W135 meningococci could be observed.



Graph n°1 : Meningococcal Meningitis Morbidity fluctuations in Burkina Faso from 1996 to 2010.

II.2. Prediction based on climatic factors.

In 2012, by analyzing forcing of climate factors on meningococcal meningitis (MCM) yearly incidence in Burkina Faso, **the amplitude (peak) of MCM epidemic should be intermediate** (that's means intermediate to high and low meningitis epidemics amplitude frequently observed over forty passed years). Also, the epidemic amplitude (peak) could be slightly higher than what has been observed last year, in 2011 (see graph n°2).



Graph n°2: Meningococcal meningitis incidence rate predicted and observed in Burkina Faso from 1969 to 2012. (years in abscissa and logarithm of MCM annual incidence rate in ordinate)

Histogram : Observed MCM logarithm incidence rate from 1969 to 2011.

Curved line: Predicted MCM logarithm incidence rate from 1969 to 2012

III. Evaluation of Prediction of meningococcal meningitis incidence trend in Burkina Faso for year 2011

III.1. Prediction based on epidemiological monitoring data

By analyzing the trend of meningitis cases (graph n°1), we remark that Burkina has been affected by low MCM amplitude epidemic in 2011. ***That's conforming the prediction made in beginning month of 2011.***

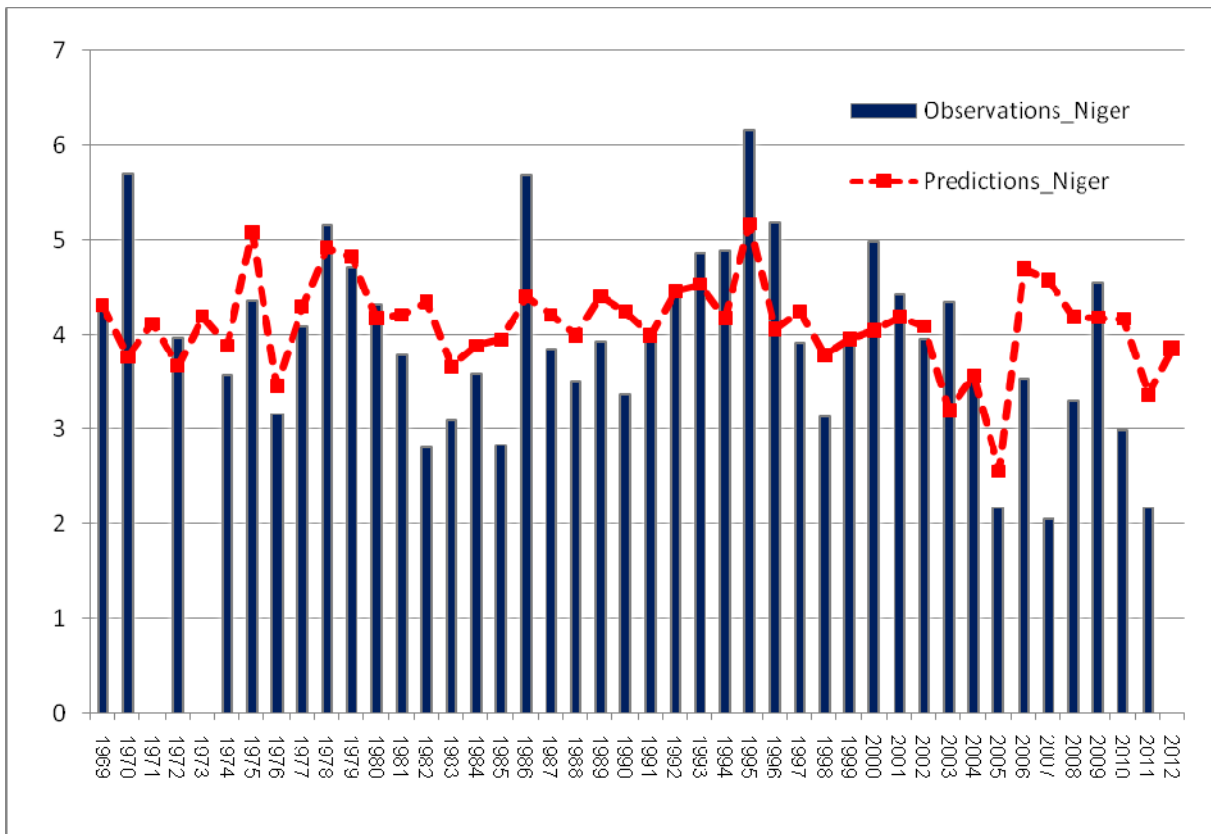
III.2. Evaluation based on climatic factors

In this graph above (graph n°2), we remark that the MCM predicted and observed incidences values in 2010, are located in the median threshold, that's means between the threshold of separation of MCM low incidence rate (values below (log (MCM IR) = 3) and those of MCM high incidence rate (log (MCM IR) = 5).

That's significantly confirms the prediction made in the beginning of 2011, on the forecast of a MCM epidemic with intermediate amplitude (peak) in 2011.

IV. Prediction of meningococcal meningitis incidence trend in Niger for year 2012

In Niger, for 2012, by analyzing forcing of climate factors on meningococcal meningitis (MCM) yearly incidence, ***the amplitude (peak) of MCM epidemic should be intermediate*** (that's means intermediate to high and low meningitis epidemics amplitude frequently observed over forty passed years). Also, the epidemic amplitude (peak) could be slightly high than what has been observed last year, in 2011. (see graph n°3).



Graph n°3: Meningococcal meningitis incidence rate predicted and observed in Niger from 1969 to 2012. (years in abscissa and logarithm of MCM annual incidence rate in ordinate)

Histogram : Observed MCM logarithm incidence rate from 1969 to 2011.

Curved line: Predicted MCM logarithm incidence rate from 1969 to 2012

V. Evaluation of Prediction of meningococcal meningitis incidence trend in Niger for year 2011.

By analyzing the graph above (graph n°3), we remark that MCM incidence logarithm predicted value for 2011, is located inside the threshold representing MCM low incidence rate (values below $(\log(\text{MCM IR}) = 3)$).

So, the value of the MCM incidence in 2011 did not conform to the prediction made in the beginning month of 2011 on the forecast of a MCM epidemic with intermediate amplitude in Niger.

That proves that the prediction made at the beginning of 2011, forecasting an intermediate MCM IR during 2011 is not accurate. The observed incidence rate

is low by comparison to what has been predicted. The prediction has overestimated the MCM incidence rate really observed.