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Climate change impacts and action – learning from the meningitis risk information technologies (MERIT) project

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The successful roll-out of the group A meningococcal conjugate vaccine (MenAfriVac) has dramatically changed the epidemiology of meningococcal meningitis (caused by *Neisseria meningitidis* (Nm)) in the Sahel. However, although enormous progress has been made, problems remain. For example, despite substantial reductions in numbers of cases in Burkina Faso since 2010, when the MenAfriVac vaccine was first introduced, the burden of disease remains unacceptably high. Not only has NmA transmission persisted in the face of the vaccination campaigns but other meningococcal groups and the pneumococcus continue to ravage the region. In addition there are particular concerns regarding the emergence of *N. meningitidis* group C (NmC) strain in Nigeria 2013 and its implications for the region.

As has been historically the case, there remains considerable year-to-year variation in meningitis incidence with case numbers commonly varying by ten-fold on an annual basis. This variation, which challenges current prevention and response strategies for non NmA strains, is likely significantly related to variations in environmental drivers, namely high dust, temperatures and low humidity that dominate the Sahelian dry season. Prior work has indicated that between 25-40% of variations in cases can be attributed to climatic and environmental factors. The Meningitis Environmental Technologies (MERIT) Project sought to use the emerging evidence in the development of NmA early warning systems in the region and some initial trials were undertaken with limited success. These trials highlighted the fact that early warning is not only dependent on the identification of significant relationships between environmental drivers and health outcomes but also requires institutional mechanisms and capacities that can translate those relationships into practical operational tools that can inform real-time decision-making.

The climate of the Sahel has been intensively studied since the devastating persistent droughts of 1968-73 and 1982-84. These droughts led to widespread food insecurity, loss of livelihoods, high levels of morbidity and mortality as well as outward migration. This climatic shift in rainfall patterns from the wet 1950s and 1960s to persistent dry conditions in the 1970s and 1980s is, in magnitude and spatial extent, unparalleled globally in the meteorological record. Early studies suggested that a positive feedback loop, created from overgrazing and deforestation on marginal land, was responsible for atmospheric changes but this was later refuted when evidence emerged at the turn of the century of the significant correlation between decadal variations in Sahelian rainfall and sea surface temperatures in different regions. In addition, aerosols from coal-fired power plants in Europe were shown to have contributed to the drought and that the current wetting in the Sahel can be in part attributed to the cleaning up of Europe's air. Thus the persistent Sahelien droughts of the 1970's and 1980's were likely the result of anthropogenic forcing connected to both global climate change and pollution from Europe.

Given the significance of environmental drivers of meningococcal meningitis incidence, new scientific understanding of the drivers of climate change in the Sahel and knowledge of the institutional gaps connecting environmental information to health decision-making - what is the likely impact of climate change on the environmental suitability for meningitis in the Sahel and what are the opportunities for the development of meningococcal meningitis early warning systems going forward?