Epidemic disease preparedness in Africa: a role for seasonal forecasting

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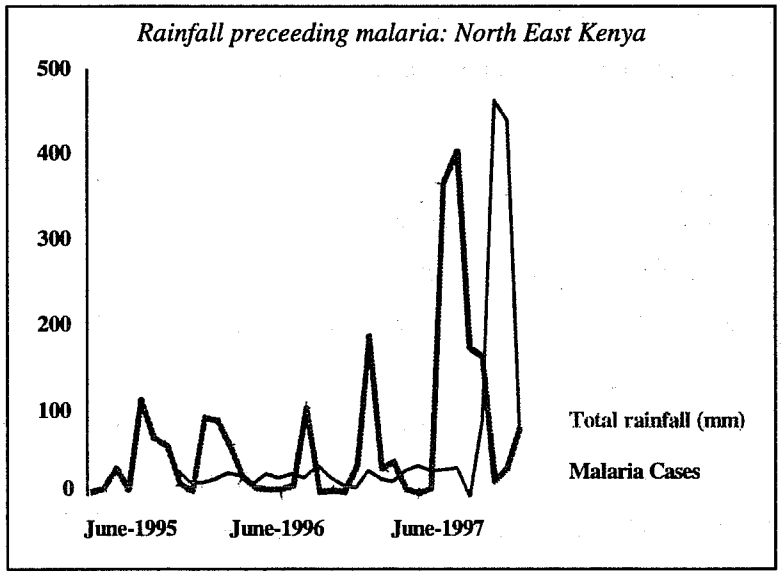
Epidemics of preventable diseases are a scourge of the developing world. Essential to their prevention and control is early detection, which demands developing adequate health surveillance systems. Unfortunately in many resource-limited settings health surveillance, if functioning at all, is often inadequate and other resources need to be identified which help predict the timing and spatial extent of outbreaks. Two diseases, malaria and meningitis, cause an enormous burden in terms of ill-health and associated mortality and consequently have a devastating effect on socio-economic development in Africa. However they show a close link to weather patterns and with reliable forecasts may therefore be predictable months in advance. So can environmental monitoring and weather predictions be used to identify potential epidemics of these and other diseases in Africa?

Malaria is the cause of an estimated 1.5-2.7 million deaths each year world-wide. For many countries in Africa south of the Sahara, where 80% of the world's malaria and 90% of all malaria deaths occur, it is one of the most serious problems facing over-stretched health services. Anopheles mosquitoes transmit the causative organism, *Plasmodium spp.*, when environmental conditions allow. Essential for effective transmission are rainfall, which produces breeding sites increasing mosquito numbers, high humidity, supporting adult mosquito survival, and temperature, which speeds up mosquito and parasite development. The geographic and seasonal distribution of malaria is therefore defined in turn by the distribution of these environmental limiting factors.



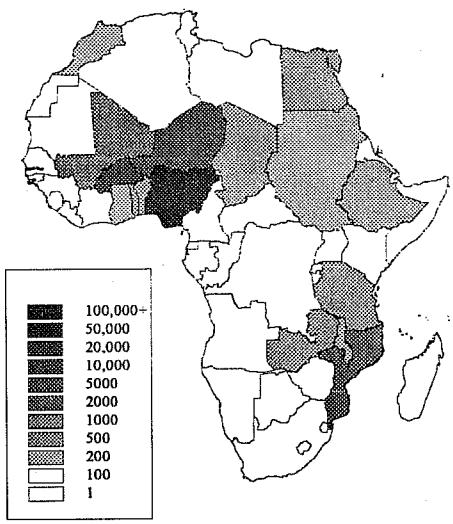
In January to May 1998 a major epidemic of malaria occurred in north-eastern Kenya (Brown 1998)(see graph). At its peak in February over 9 deaths per 10,000 population were occurring daily in Wajir town (over 10 times greater than normal). The epidemic occurred in a non-immune population; people had experience little malaria in the past and the region was described as a "malaria-exclusion area" according to a recent map of malaria transmission intensity for Kenya. Consequently there was no operational malaria surveillance in the area and the region was unprepared for the very high levels of malaria morbidity and mortality that subsequently occurred. This epidemic was one of the wave of malaria epidemics that swept across East Africa following the exceptionally heavy "El Niño" rains of 1997/1998. It followed extremely unusual and very heavy and prolonged rainfall associated with the "short rainy season". In Wajir 450mm were recorded at the local meteorological station in November 1997 three months prior to the peak of the epidemic. Could the ECMWF seasonal forecasts have been used to signal the increase in epidemic potential in East Africa in advance of the epidemics occurring? Studies elsewhere have indicated that climate forecasts based on ENSO may be used to predict annual variation in malaria incidence up to a year in advance. With medium range weather forecasts the potential for disease-associated weather events can be flagged. Once the rains had started to fall in Kenya, the extent and excess of rainfall in the normally arid north-east was picked out by local meteorological services as well as the international weather monitoring community. So with adequate forewarning of adverse weather events preceeding their actual occurrence, health service may have been better prepared to take preventative action. Unfortunately it was not until the high numbers of cases were noted in Wajir local hospital that action to contain and control the epidemic was initiated.

While the association between malaria and environmental parameters is well established, that between meningitis epidemics and weather conditions is unclear and any causal links poorly understood. However evidence suggests that monitoring the environment may be of huge benefit to those governments and emergency relief organisations needing to prepare for a response to epidemic meningitis in Africa. *Neisseria meningitidis* (the meningococcus) is responsible for endemic and epidemic disease world-wide. One part of Africa, the sahel, stretching from Senegal in the West to Sudan in the East, has historically been particularly affected by repeated epidemics which stand out in their devasting impact. This region is loosely termed the "meningitis belt" of Africa - originally defined by the shear scale of epidemics occurring repeatedly within the 1100mm and 300mm rainfall isohytes which delimit this area to the north and south respectively (Lapeysonnie 1963). However it is likely to be factors other than just rainfall that determine the geographic and seasonal distribution of meningitis in Africa. Epidemics tend to occur in the latter half of the dry season, often

associated with the dust storms that characterise the Harmattan, and end abruptly with the onset of the rains (coinciding with a rise in absolute humidity at this time).

The epidemics of 1995-1997 which covered numerous areas were unprecedented in the numbers of people affected. In 1996 alone there were over 150,000 cases in one epidemic season, of which 10% were fatal (see map). Weak surveillance systems resulted in an inability to detect the characteristic rise in case numbers in the lead up to an epidemic and consequently left very little or no time for prevention and the planning of control measures. But as with malaria, if seasonal forecasts can be used to alert health services to the likelihood of an epidemic starting, or its end then much can be done towards cost-effective control and the social and economic benefits that result as a consequence of this.

From Senegal across to Sudan and Ethiopia: in 1996 countries in the meningitis belt reported tens of thousands of cases in epidemics of meningococcal meningitis. (Source: WHO)



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