Malaria mortality and morbidity in Africa

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A visit to the paediatric ward or to the general outpatient department of most hospitals in tropical Africa is all that is needed to convince a visitor that malaria remains a major cause of mortality and morbidity in African children. A conversation with the families of children in the ward would quickly elicit the same message. In most parts of tropical Africa, malaria is recognized by both health providers and by the general public as one of their major health problems which should be high on the list of the priorities of their Ministry of Health. Thus, it can be questioned whether it is necessary to try to collect accurate information on the mortality and morbidity caused by malaria in Africa when the importance of the infection is already widely recognized. Is it important, for example, to know whether malaria kills half a million or three million children a year since even the lower estimate is unacceptable and indicates the need for a major initiative to control this infection? I believe that attempts to obtain as accurate information as possible on the rates of mortality and morbidity attributable to malaria in Africa and elsewhere are important for several reasons, as outlined below.

Malaria is accepted as a major killer of African children but, unfortunately, it is not the only one and in some areas pneumonia, gastroenteritis and measles kill as many children as malaria. In such circumstances, African Ministries of Health, constrained by very limited budgets, may be faced with tough decisions. For example, should priority be given to improving measles vaccination rates or to the introduction of an insecticide-treated bednet programme if resources are insufficient for both? Rational decisions on issues such as this can be made only if reasonably accurate information on the burden of disease attributable to each condition is available. Maps of the distribution of malaria usually depict nearly the whole of tropical Africa in dark red, indicating high risk, but this is a gross simplification of a complex epidemiological picture. The burden of illness attributable to malaria varies substantially between countries within tropical Africa and between different regions of the same country. Thus, obtaining information on the burden of malaria by region or district is important so that interventions, such as an insecticide-treated bednet programme, can be targeted at areas where they are likely to be most effective rather than at areas where introduction of the control programme would be administratively most convenient. Finally, measurements of mortality and morbidity provide benchmarks against which the success or otherwise of control strategies can be measured.

Thus, a strong case can be made that it is important to have accurate data on rates of mortality and morbidity from malaria in Africa. But is it possible to obtain this information? Unfortunately, obtaining data of this kind is not easy. Measuring malaria mortality is difficult since, in many parts of rural Africa, as many as 90% of deaths from the disease occur at home and are not registered in any formal way. In such communities, overall mortality rates can be measured only by some system of active surveillance, while estimation of cause-specific mortality rates depends upon use of a post-mortem questionnaire. Such questionnaires have only a modest sensitivity and specificity for detecting death from malaria because the symptoms of the severe form of the disease and those of other severe childhood infections such as pneumonia and septicaemia are similar. An alternative way of estimating malaria mortality is to measure the impact of a successful malaria control programme on overall mortality. Estimates made in this way measure both the direct effect of malaria on mortality and its indirect effects mediated through factors such as nutrition. In general, estimates of malaria mortality made on the basis of intervention studies give higher rates than direct estimates.

Hospital records of admissions with severe malaria provide some idea of the importance of malaria as a cause of severe disease and death within a community but underestimate the mortality rate unless a high proportion of all severely ill children in the community attend hospital. However, follow-up of children admitted to hospital with severe malaria does allow a relatively accurate estimate to be made of the prevalence of long-term sequelae after an episode of cerebral malaria; these occur in 5–10% of survivors.

Estimating attack rates for uncomplicated malaria is almost as difficult as determining malaria mortality rates, since the symptoms of acute malaria are similar to those of many other acute infectious diseases of childhood and facilities for investigation of suspected cases by microscopy are rarely available. Even when microscopy is possible, diagnosis of clinical malaria can be difficult because, in many parts of tropical Africa the majority of children are parasitaemic for most of the time although not always at a level high enough to be detected by microscopy. Thus, a febrile African child infected with a respiratory virus will frequently have malaria parasitaemia, and it is difficult or impossible to determine which organism is responsible for their illness. Measurement of parasite density may help in this respect, and threshold values can be determined which differentiate parasitaemias that are likely to be associated with clinical illness from those that are not. Unfortunately, these thresholds vary somewhat with age and with the level of malaria endemicity.

Despite these many difficulties, increasingly sophisticated attempts have been made during the past few years to estimate the overall burden of malaria in Africa. Early attempts to do this, in which rough estimates of malaria mortality in different parts of Africa were matched to the population living in those areas, suggested a mortality of around 0.5–1.0 million deaths per year. Recently, Snow et al. have improved on these early efforts using more sophisticated techniques, and the results of their latest study appear in this issue of the *Bulletin* (pp. 624–640). Snow et al. have used a combination of methods to estimate malaria mortality and morbidity rates for Africa as accurately as possible. One of these approaches involved a search for all

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published and unpublished data on malaria prevalence in Africa, while a second approach used geographical information systems. Through use of the technique of fuzzy logic, the authors calculated the risk of malaria transmission in different parts of Africa on a scale of 0 to 1.0 on the basis of recorded climatic data and prior knowledge of the effects of different climatic variables on mosquito survival and parasite development. Study of climatic factors also permits an estimate to be made of the period of the year during which malaria transmission is likely to occur. Superimposition of a map of population density upon that of malaria risk permits numbers of expected deaths and cases of malaria to be calculated. Despite the elegance of this approach it must be borne in mind that mortality data depend ultimately upon estimates of mortality from malaria determined for only a few areas and measured by the imprecise methods discussed above. In addition, present models do not take into account the fall in transmission levels in the centres of large urban areas, which lack suitable mosquito breeding sites. The mortality rates calculated by Snow et al. reflect only direct mortality from malaria, so that the figures presented should be considered as minimum estimates.

On the basis of their calculations, Snow et al. conclude that in tropical Africa malaria is responsible for about 1 million deaths and just over 200 million episodes of clinical disease, levels that are in the same range as previous estimates. These figures, the most accurate to be produced so far, will form the baseline against which current efforts to improve malaria control in Africa will be judged. The techniques developed by Snow et al. to produce overall malaria figures for Africa can be used also to produce figures for individual African countries and for regions within a country. This has been carried out already for Kenya, where it has been shown that although the risk of malaria is high in both the coastal region and around Lake Victoria, the public health importance of the disease is highest around Lake Victoria because of the high population of this area. Information of this kind will help Ministries of Health to decide which regions of their country should be the first targets for an expanded malaria control programme and will set the baseline against which the success of these programmes can be measured. ■