**Methodological Approaches in Estimating the Number of Malaria Cases and Deaths**

**Background**

Systems for tracking malaria cases and deaths are weakest in areas that malaria is most prevalent. Consequently, precise information on the number of malaria cases and deaths is rarely available and various procedures have been used to estimate them.

For estimating the number of cases the approaches include:

(C1) Using data on reported deaths, adjusting them for incomplete reporting, and dividing by an estimated case fatality rate (Mendis *et al*, 2001)

(C2) Mapping climatic suitability for malaria, linking it to malaria incidence rates and adjusting over time and space to account for differences in intervention coverage (Snow *et al* 2003, Korenromp 2005, Cibulskis *et al* 2011, World Malaria Report 2011)

(C3) Mapping parasite prevalence and linking it to malaria incidence rates (Snow *et al* 2005, Hay *et al* 2010).

(C4) Using data from routine information systems and adjusting them for incomplete reporting, diagnostic testing and use of public sector facilities (Cibulskis *et al* 2011, World Malaria Report 2011).

For estimating the number of deaths the approaches include:

(D1) Using data on reported deaths and adjusting them for incomplete reporting and use of public sector facilities (Mendis *et al*, 2001)

(D2) Using results of verbal autopsies and adjusting over time and space to account for progress in intervention coverage (Rowe *et al* 2005, Black *et al* 2008, IHME unpublished)

(D3) Using an estimated number of cases and multiplying by an estimated case fatality rate (World Malaria Report 2011).

WHO uses a combination of approaches. Outside of Africa - and for a small number of countries in Africa where data from routine health information systems is considered sufficiently reliable - WHO uses method C4 for cases and method D3 for deaths. For countries where data from routine health information systems is not sufficiently complete WHO uses C2 for cases and D2 for deaths; in practice methods C2 and D2 are limited to countries in sub-Saharan Africa. In the estimation of deaths in sub-Saharan Africa, the number of malaria deaths under age 5 is estimated by the Child Health Epidemiology Reference Group (CHERG), while adult deaths are inferred from an empirical relationship between endemicity and the proportion of deaths that occur in children.
The different approaches have resulted in disparate sets of estimates globally, regionally and at country level particularly outside of Africa (see Figure 1).

Figure 1. Estimated number of *P. falciparum* malaria cases according to different sources

![Graphs showing estimated number of malaria cases worldwide](image-url)
For malaria-related deaths, a particular issue concerns the proportion occurring in adults. In 2007 WHO noted that a high proportion of deaths recorded in the Medical Certification of Cause of Death (MCCD) system in India were in adults. This seemed unusual given the current understanding of malaria epidemiology. Accordingly, WHO commissioned a small study to determine if the malaria deaths recorded in 6 Indian hospitals were truly due to malaria. The study was undertaken by Prabhat Jha and colleagues of the Centre for Global Health Research, University of Toronto, Canada and found that of 30 malaria deaths that had received a parasitological test, only 15 were test positive, raising doubts about the accuracy of medical certification. When the validation study was extended to look at the results of verbal autopsy, it found that of 48 deaths classified as malaria by verbal autopsy that had also attended hospital only 4 had a medical diagnosis of malaria. The majority of deaths classified as malaria by verbal autopsy were recorded as septicaemia in medical records. Despite these results, verbal autopsy results were considered to be reliable and a paper was published in the Lancet claiming there are approximately 200,000 deaths in India (Dhingra et al 2010); WHO's estimate for the same period is approximately 24,000.

In the near future, a paper will be published by IHME in the Lancet claiming that there were 1.4 million deaths from malaria globally in 2010 -- compared to 655,000 estimated by WHO. The numbers of deaths estimated by IHME for under 5's in Africa (700,000) is similar to WHO (560,000) but IHME has estimated many more deaths in adults in Africa (450,000 versus 55,000) and many more deaths outside of Africa (280,000 versus 58,000 of which 223,000 are in adults). In support of their work, IHME undertook a "Gold Standard" validation study to assess the sensitivity and specificity of verbal autopsy in four countries. In most sites, however, there was little or no malaria1 and in the one site where malaria deaths might be expected, Dar es Salaam, the quality of diagnostic testing has been questioned (Kahama-Maro J et al).

IHME's estimates for the numbers of cases (223 million globally in 2010) are similar to WHO's (216 million), implying that case fatality rates are higher than those assumed by WHO, particularly in adults.

**MPAC Decision Point**

Given the current lack of consensus on estimates of cases and deaths WHO proposes to establish an Expert Review Group (ERG) to examine approaches to burden estimation with a view to identifying procedures that:

- Provide robust burden estimates around which there is consensus
- Are open/ transparent
- Can be readily updated to reflect latest situations e.g. changes in program coverage
- Can be applied by endemic countries

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1 Mexico (no malaria deaths), Philippines (an island with no malaria), India (areas with very little malaria), Tanzania - Pemba (few if any malaria deaths) and Dar es Salaam (relatively light malaria burden).
Advice is sought on how this group should operate and on what particular studies may be required to resolve issues of contention. If endorsed, the ERG would report back to the MPAC at its second meeting in 2012.

References


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