New approaches to risk stratification to support malaria elimination: an example from Cambodia

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Introduction
Accurate, reproducible malaria stratification is essential for effective targeting of interventions but is difficult to achieve in pre-elimination settings where malaria transmission is typically low and patchy. Here, estimates of malaria risk at sub-district or village level are needed but routine, aggregated surveillance data are not well suited to this task. Strengthening and modifying these systems is required if routinely generated case data are to be used to stratify malaria risk and guide the transition between pre-elimination to elimination phases. We explored the utility of routine malaria surveillance data collected through Cambodia’s Malaria Information System (MIS) for the stratification of malaria risk in Cambodia, where the target is malaria elimination by 2025.

The Malaria Information System
MIS development started in 2008 as part of a wider strategy to contain artemisinin tolerant malaria parasites in Southeast Asia (ARCE). In 2010 the MIS was scaled up to include all malaria risk districts in Cambodia (Figure 1). The MIS enables districts to compile village-level summaries of malaria case data reported by government health facilities and village malaria workers (VMWs). It also incorporates village census information and intervention coverage data. Each month district teams use a customized Access database to enter new malaria case data and email updated data extracts to the national programme (CMN). To gauge the utility of the MIS for malaria stratification we analyzed MIS data for the period January 2010 to June 2012.

Results

Coverage and completeness
Health facilities: the MIS covers 681 facilities (61% of the national total). 93.5% reported data during the study period. The overall reporting rate was 76.1% but was highest in 2011 (81.6%). VMWs: the MIS covers all VMW districts (Figure 1). At the start of 2012, the VMW network incorporated 24.5% of MIS health facilities and 15.1% of villages. The reporting rate for VMWs was 96.5%. The number of active VMWs increased from 1385 to 1520 over the study period.

Malaria cases in 2011
86,684 cases were reported, 55.9% by VMWs. A small percentage (1.3%) were excluded from subsequent analysis due to coding errors or lack of a definitive diagnosis, 5,713 MIS villages reported cases in 2011 (57.8%). Of 1,489 VMW villages, 1,371 (92.1%) reported malaria.

Data rules for stratification

Inclusion criteria: a threshold of 9 monthly reports over the year, including at least 3 reports from the high transmission season (Jun.-Dec.), was selected. Incidence estimates were considered valid if reporting from either VMWs or health facilities met this threshold. 1,048 villages were excluded from the stratification (10.6% of all MIS villages) as a result.

Incidence-based stratification for 2011
Village-level case data were matched to population data (resulting in the exclusion of 4.5% of villages), leaving a total of 8,420 villages – or 85.3% of all villages covered by the MIS - within the stratification.

Discussion and recommendations

- Incidence-based stratification at village level is possible for large majority of villages within MIS, but still significant gaps
- Core malariometric data required for the micro-stratification can be generated routinely and automatically, allowing for regular updates that can guide transition between control to elimination phases
- Infection likely to often occur outside the resident village: likely to be a large (but unknown) number of infections attributed to the wrong location
- HMIS data for 2011 indicate likelihood of some non-MIS districts supporting transmission
- In 2011 8% of VMW villages reported no malaria cases; in selected provinces this figure was as high as 17%
- Analysis of HMIS data at the level of health facility catchment required to inform potential scaling up of MIS
- Village risk estimates should be screened by experts at national, province and district level and upgraded or downgraded as necessary
- In the short term expert opinion can also be used to allocate risk categories to villages excluded from the stratification. Use of geo-statistical techniques to impute missing data and geospatial and mapping should also be explored
- Currently there is no way to capture travel history information from routine data; this should be addressed in the medium term
- The MIS stratification represents an objective, reproducible means of targeting interventions and resources. It is already apparent that adjustments to the VMW network are necessary

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