World Malaria Report 2013: surveillance and monitoring, getting to the heart of the matter

Professor William Brieger extracts key data from the latest global report

Although 'Malaria surveillance, monitoring and evaluation' is the seventh of eight chapters in the *2013 World Malaria Report* (WMR), it is in fact the heart of the matter. Progress on goals, finance, vector control, preventive therapies, diagnosis and treatment and of course impact (chapters 2 to 6 and 8) could not be produced without the documentation processes discussed in chapter 7. So what does WMR 2013 tell us about the status of malaria surveillance?

The global press has been taken by World Health Organization estimates that deaths from malaria worldwide have reduced by 50% since 2000.[1] These claims have been made despite the note in WMR 2013 that, 'In 2012, in 62 countries of 103 that had ongoing malaria transmission in 2000, reporting was considered to be sufficiently consistent to make a reliable judgment about malaria trends for 2000–2012. In the 41 remaining countries, which account for 80% of estimated cases, it is not possible to reliably assess malaria trends using the data submitted to WHO. Information systems are weakest, and the challenges for strengthening systems are greatest, where the malaria burden is greatest.'[2]

Fortunately most endemic countries also acquire malaria data from household surveys such as the Demographic and Health Survey, the Multi Indicator Cluster Survey, and the Malaria Information Survey.[3] Because of the expense of these surveys which interview thousands of households, they may be carried out once every 3 to 5 years. While more accurate population-based data may be obtained through the surveys, they do not provide real time, actionable information to guide programme management. Table 1 shows these two main information sources from which the WMR envisions data for calculating 15 key malaria indicators can be found.

Barclay and colleagues describe a good surveillance system as one that 'can gather, store and process information, from communities to national levels, in a centralized, widely accessible system (allowing) tailoring of surveillance and intervention efforts.[4] Different systems and, thus reactions, will be effective in different endemic, geographical or socio-cultural contexts.' They are quick to point out that such a system meets many challenges including coordination among partner organisations and different levels of the health system. They also note that monitoring information is not enough; it must be used to plan appropriate interventions and

subsequently to further monitor the effects of those interventions. Fortunately, guidance in establishing surveillance systems has been provided by WHO's Global Malaria Program.

Test. Treat. Track

The World Health Organization has issued a series of documents focusing on 'Test. Treat. Track.' or '3T'. In short these documents support malaria-endemic countries in their efforts to achieve universal coverage with 1) diagnostic testing, 2) antimalarial treatment, and 3) strengthening their malaria surveillance systems to track the disease.[5] This results in an ongoing process wherein patients who are tested at clinic or point-of-service using parasitological tests including rapid diagnostic tests (RDTs) or microscopy are, after receiving treatment, tracked back to their homes where household members and neighbours are in turn tested using parasitological testing methods. Testing thus, undergirds the system of surveillance.

WHO stresses that 'Continued presumptive treatment of malaria would lead to both drug wastage and under-treatment of other febrile illnesses.' Therefore, WHO recommends that every suspected malaria case be confirmed parasitologically prior to treatment. Only in areas where diagnostic testing is not possible should malaria treatment be initiated solely on clinical suspicion.

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Key indicators that can be derived from routine information systems	Key indicators that require population-based household surveys
Proportion of suspected malaria cases that receive a parasitological test	All-cause under-5 mortality rate
Proportion of confirmed malaria cases that receive first-line antimalarial treatment according to national policy	Proportion of children under 5 years old with fever in the last 2 weeks who had a finger or heel stick
Proportion of population protected by IRS within the last 12 months	Proportion receiving first-line treatment among children under 5 years old with fever in the last 2 weeks who received any antimalarial drugs
Percent of districts reporting monthly numbers of suspected malariacases, number of cases receiving a diagnostic test and number of confirmed malaria cases	Parasite prevalence: proportion of children aged 6–59 months with malaria infection
Number of new countries in which malaria has been eliminated	Proportion of population with access to an ITN within their household
Inpatient malaria deaths per 1000 persons per year	Proportion of population that slept under an ITN the previous night
Confirmed malaria cases (microscopy or RDT) per 1000 persons per year	Proportion of households with at least one ITN for every two people and/or sprayed by IRS within the last 12 months
	Proportion of women who received at least three or more doses of IPTp during ANC visits during their last pregnancy

Table1   Key malaria indicators and source of data for each

While improving, the testing process that starts the ball rolling on 3T, there is much room for improvement. WHO reports that in the WHO African Region, the testing rate in the public sector rose from less than 5% in 2000 to 45% in 2010. 'However, most endemic countries in Africa are still far from achieving universal access to diagnostic testing and will need to substantially expand access to RDTs or microscopy. In half of all endemic countries in Africa, over 80% of cases are still being treated without diagnostic testing.' If we cannot test the initial patient who comes into clinic, we will have difficulties tracking him or her back to the community to continue surveillance.

WHO explains that, 'Improved surveillance for malaria cases and deaths will help ministries to determine which areas or population groups are most affected and help to target resources to communities most in need.' WHO suggests that the design of malaria surveillance systems focuses on two fundamental factors. First, the level of malaria transmission should be ascertained, and the resources available to conduct surveillance must be made available. WHO has released two manuals to strengthen malaria surveillance depending on whether the country is high burden and still at the level of 'Malaria Control,'[6] or the country is approaching 'Malaria Elimination.'[7]

In high-burden countries, malaria cases are so numerous that it is not possible to examine and react to each confirmed case individually. National malaria control programmes therefore need to base their surveillance on aggregate numbers and undertake action on a population level. In contrast, as scaled-up malaria prevention and control interventions gradually reduce malaria transmission, it becomes increasingly possible, and necessary, to track and respond to individual cases. WHO notes that in elimination settings, surveillance systems should seek to identify and immediately provide notification of all malaria infections, whether they are symptomatic or not. A summary of WHO's recommendations for the 'Track' or surveillance aspect of 3T follow:

- Individual cases should be registered at health facility level. This allows for the recording of suspected cases, diagnostic test results, and treatments administered.
- In the malaria control phase, countries should report suspected, presumed and confirmed cases separately, and summarise aggregate data on cases and deaths on a monthly basis.
- Countries in elimination phase should undertake a full investigation of each malaria case.

Examples of country surveillance efforts

Malaria-endemic countries in Africa are at different stages of malaria elimination. The high-burden countries like Nigeria, Democratic Republic of the Congo. Uganda, and Tanzania are still scaling-up major control efforts nationally. They are still trying to reach Roll Back Malaria targets for interventions such as long lasting insecticide-treated nets (LLINs) and intermittent preventive treatment in pregnancy (IPTp). Cases are still so numerous that efforts to track back to the community are not feasible. Scaling-up of community case management of malaria that includes both testing, treating and reporting, would be a major help to th surveillance efforts in these settings.

Other countries have a location, ecology, and epidemiology that provide less opportunity for malaria transmission and place them closer to malaria elimination. A good example of these is seen in the South African Development Community's 'Malaria Elimination Strategic Framework.'[8] The Framework observes that, 'Worldwide, most countries that have achieved elimination have done so in a nationwide approach. In SADC countries, due geographic and economic variations the practical approach would be to adopt a gradual district/province approach. The starting point could be identifi-
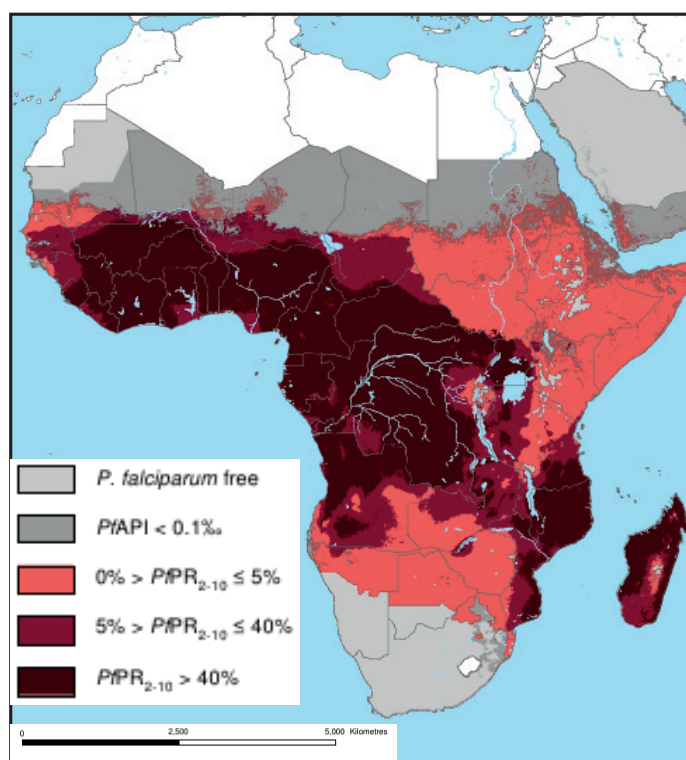
Figure 1 Spatial distribution of Plasmodium falciparum *malaria stratified by endemicity class map in 2010 in Africa*

cation of districts where malaria case loads are already very low due to natural conditions and/or programme successes in recent years.'

In the process the framework identified four countries in a front-line tier of the region that could approach pre-elimination because they have a limited number of districts where malaria is seasonal or epidemic including Swaziland, South Africa, Namibia, and Botswana. At a Ministerial Meeting in 2009, SADC Health Ministers formalised the elimination effort by including the higher burden neighbours (or second tier) of the four front-line countries, Angola, Mozambique, Zambia, and Zimbabwe, and thus constituted the countries of the Malaria Elimination 8 (E8).[9] The E8 built on existing cross border collaborative efforts and strengthened systems to eliminate malaria, especially surveillance.

Swaziland, one of the four front-line countries borders another front-line country, South Africa, but also a more highly endemic neighbour, Mozambique. Movement and migration because of family and work means that if Swaziland wants to eliminate the disease it must be able to identify and track patients who acquired malaria in Mozambique and are in a position to aid transmission within its own borders.

Swaziland has established a system of 'reactive case detection', which as used in Swaziland takes advantage of the fact that infections are clustered spatially and temporally within transmission 'hotspots.'[10] At the end of 2009, Swaziland's National Malaria Control Programme initiated a surveillance programme that aimed to conduct a case investigation on all confirmed cases at household level to determine source of infection as well as conduct case detection using a screening radius of

1 km around each passively detected case (that is the cases detected at clinic). A special surveillance team was formed and a surveillance manual for the operation was developed.

In its initial phases Swaziland's reactive case detection effort tracked 67% of patients who tested positive at clinic and found that they were nearly equally divided between imported cases (based on their recent travel history) or locally acquired. Screening in the surrounding areas resulted in identifying 74 previously undetected malaria cases.

Building on the fact that a large portion of the cases had resulted from travels, particularly to Mozambique, Swaziland's National Malaria Control Program went further to study social networks of identified cases to learn about social interactions and patterns. They learned through, 'Interviews of network members and key informants (that) common congregation points, such as the urban market places in Manzini and Malkerns, as well as certain bus stations, where people with similar travel patterns and malaria risk behaviors could be located and tested for malaria.'[11]

The practical implications included 'novel methods for screening high-risk groups of travellers using both snowball sampling and time-location sampling of networks to identify and treat additional malaria cases. Implementation of a proactive screening programme of importation networks may help Swaziland halt transmission and achieve malaria elimination by 2015.' These two innovations, reactive case detection and social network-based surveillance, provide good lessons to other countries, or regions of countries, where malaria transmission is dropping and elimination becomes feasible.

Zambia, a second tier in the E8 effort demonstrates the value of planning surveillance according to the situation in different districts. Zambia's three-step surveillance programme was described at the First Malaria Forum in Kigali, Rwanda in 2012.[12] In Zambia, as intervention measures have been applied, the distribution of malaria burden has become more focalised. Some areas of the country have reached parasitemia rates <5% (pre-elimination). Zambia's goal is to achieve five malaria-free zones by 2015.

The Zambia experience builds on guidance that requires us to identify and measure malaria incidence through surveillance in order to ensure that it is truly eliminated. Campbell and Steketee explain that, 'Clearing all malaria infections is only possible with access to real-time data on where the residual infections are today and in the future. All countries striving for elimination will need to know when elimination has occurred and will need surveillance, diagnostic capability, and monitoring and evaluation systems that have sufficient reach and quality to provide that information in real time.'[13] Zambia's three-step approach includes the following: Step 1: Rapid reporting system at facility level in higher burden areas; Step 2: Test and treat campaigns in moderate burden areas; Step 3: Community-based malaria surveillance in very low malaria burden area.

Step 1 involves a simple weekly mobile phone-based reporting system of confirmed malaria cases from front-line services. Step 2 is based on a strategy to actively test and treat individuals with malaria parasite infections through intensified community outreach. This is applied during the dry season when vector habitat shrinks and transmission is reduced thus decreasing the transmission potential when the rainy season returns. In Step 2 surveillance is an active part of intervention to reduce malaria burden. Step 3 resembles the reactive case detection of Swaziland. Confirmed cases of local malaria transmission are followed up. Family and neighbours of this 'index case' are tested with RDTs.

Confirmed cases whether symptomatic or asymptomatic are treated and LLINs and behaviour change communication is provided. Importantly, community health workers are active participants in Step 3.

Ethiopia is another country that is closing in on malaria elimination. Ethiopia's experience shows us that it may not always be feasible to establish malaria-specific surveillance systems. Ethiopia has an Integrated Disease Surveillance and Response System. The system covers all hospitals and health centres using a one page form. Most diseases are reported on the monthly form, but certain high priority indicators are reported immediately. Only 8 of 86 reporting units had average annual estimated incidence of confirmed malaria above 20 per 1000 persons. The Integrated Disease Surveillance and Response System functioned well for malaria in those endemic areas even though it was not exclusively devoted to malaria. The researchers suggested that the data from this integrated system can be used to stratify areas for improved targeting of control efforts to steadily reduce incidence.[14]

The West African Sahel is another area of seasonal and fluctuating malaria transmission. Littrell and co-researchers examined the relevance of reactive case detection in this environment (see Figure 2).[15] They too found that travel history is an important element of transmission in areas where the incidence of malaria is low and variable. Malaria cases were identified through facility-based passive case detection and investigated within 3 days. Rapid diagnostic tests (RDT) and a brief questionnaire were administered to individuals living within the index case compound or within five neighbouring compounds. One hundred and eighty-three (183) index cases identified at clinic led to 43 additional cases in the community.

In conclusion, we must put in place a surveillance system that detects and tracks malaria incidence, even when disease is asymptomatic in order to confirm that an area has eliminated malaria. The various surveillance systems described above work, but some depend on an existing integrated surveillance system, a designated surveillance team or community based health workers, while others are part of a research effort to test new ideas. Health planners should not get the idea that scale-up of malaria by increasing access to nets and medicines is the main cost of their efforts. Resources, human and financial, are needed too, for surveillance that can document the end of malaria in a district or country.

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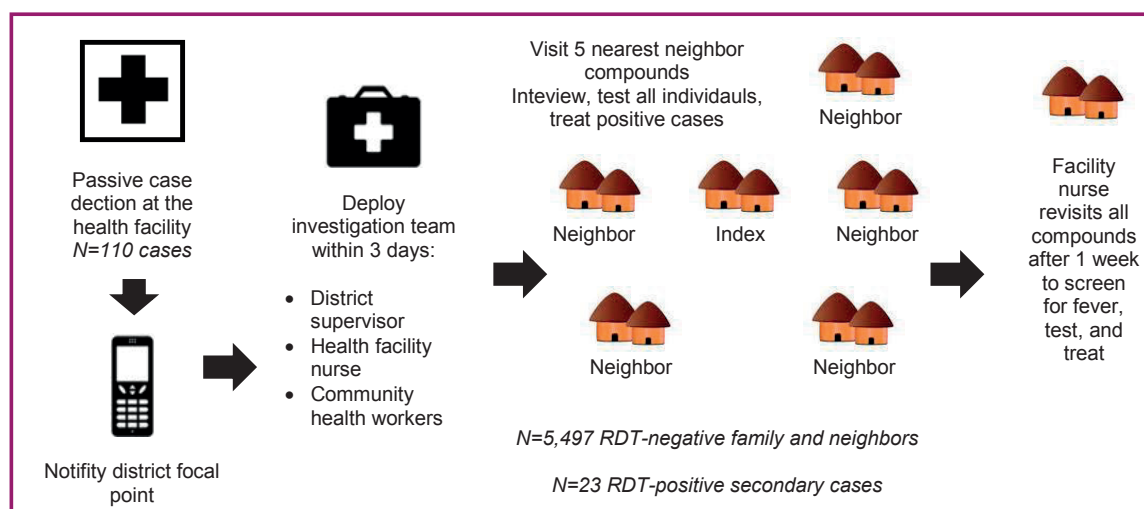
For map see: http://www.map.ox.ac.uk/References.

Figure 2 Case investigation and reactive case detection procedures[15]