Field Evaluation of Malaria Surveillance System in Sai Yok District, Kanchanaburi Province, Thailand

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Abstract
Evaluation of the malaria surveillance system was conducted in Sai Yok District, Kanchanaburi Province, Thailand. The objective of the study was to describe the surveillance system and assess the system performance in reporting malaria cases. The study applied cross-sectional approach. Key qualitative and quantitative attributes were assessed. Document review on malaria cases treated in Sai Yok Hospital and data collection at Vector Borne Disease Control Unit (VBDU) in 2015 were performed. In-depth interviews with policy makers and health care workers were exercised. Findings showed that sustainability of the surveillance system might be undermined if the Global Fund support would curtail after 2017. There were some discrepancies between number of cases reported by VBDU and those by health facility via the R506 national reporting system. Sensitivity of VBDU reports was slightly higher than the reports by the hospital though the overall sensitivity of the whole district was of acceptable quality. Concerning policy recommendations, a substantial shift of budgetary support from the Global Fund to domestic resources was suggested. Health personnel at the hospital should be more emphasized on the utilization of R506 reporting system. In addition, the R506 reporting system and the VBDU system should be harmonized.

Keywords: malaria, surveillance evaluation, Global Fund, human resources

Introduction
Malaria has been one of the most critical global health problems for years. In 2014, approximately 3.2 billion people were at risk of malaria with 214 million reported cases and 438,000 deaths. In Thailand, there were 32,953 malaria cases with 38 deaths in the same year. The Thai Ministry of Public Health
Malaria in many developing countries with high disease burdens amidst limited capacities to address them, including Thailand.\(^7\)

Despite several initiatives introduced to eliminate malaria, a systemic evaluation of the surveillance system was still lacking. Therefore, the objective of this study was to evaluate malaria surveillance system in Thailand using Sai Yok, a border district between Thailand and Myanmar in Kanchanaburi Province, as a case study.

**Methods**

**Study Design**

A cross-sectional approach was applied. Both qualitative and quantitative methods were employed.

**Study Site**

The study was conducted during 2015 in Sai Yok District, including four subdistricts that are covered by VBDU. Sai Yok District was amongst areas with the highest malaria incidence along the Thai-Myanmar border. To be more specific, Sai Yok Hospital was selected as the main study site.

**Data Collection Techniques and Participants**

In-depth interviews with 27 key informants were performed, including six policy makers, 18 health workers and three information and technology (IT) staff. Narrative analysis was exercised on qualitative attributes. The R506, VBDU reports, laboratory logbooks and medical records in all related health facilities were reviewed in order to address quantitative attributes. Descriptive statistics were applied on quantitative data.

**Attributes to be Measured**

The analysis started with a system description, followed by a scrutiny in each attribute. Qualitative interview data were used to describe the system and address the following attributes: ‘public health importance’, ‘usefulness’ and ‘stability’. The key informants were asked whether and to what extent they were aware of the surveillance system, including case definition and data flow. The quantitative data captured different aspects of the system, that is, ‘sensitivity’ (proportion of cases reported to the system to all malaria diagnosed cases), ‘positive predictive value’ (PPV) (proportion of malaria-diagnosed cases to all reported cases), ‘timeliness’ of reporting cases (as measured by difference between diagnosis date and data-submitting date, which should not exceed five days until the data reached the
BOE), and ‘completeness’ (as measured by the completion of key variables entered in the system).

**Results**

**System Description**

The flow of data started when the patients visited malaria post (MP), border malaria post (BMP), malaria clinic (MC), and Sai Yok Hospital. The patients were confirmed by either thick film microscopic exam or rapid diagnosis test (RDT). Both negative and positive cases were recorded in a form, called EP1. If the patient’s test found positive, more information would be further collected in another form, namely EP3, which included additional variables, such as risk factors and signs and symptoms. The MP, BMP and MC reported VBDU with EP1 and EP3 forms. VBDU reported the same information in paper to Vector Borne Disease Control Centre (VBDC), and then submitted these data to the Office of Disease Prevention and Control Region 5.

In Sai Yok Hospital, the providers directly entered the data into the R506 system, which was further incorporated into Malaria Online. The frequency of data submission from Sai Yok Hospital to Provincial Health Office which then submitted to BOE, and from BOE to Malaria Online took around a week on average. Apart from the formal communication, there was an informal communicating mean between Sai Yok Hospital and VBDU through a weekly telephone call (Figure 1).

**Qualitative Attributes**

**Public health importance**

The majority of interviewees underpinned that malaria surveillance system was of critical importance for malaria control in the whole country. Two thirds of the interviewees flagged that the purposes and objectives of the system were to detect the outbreak, and make the providers understand the trend and situation of malaria. The informants also articulated that they understood and recalled the definition of malaria suspected and malaria confirmed cases very well.

“In my opinion, the malaria surveillance system provides information for malaria situation and timely control when there is an outbreak.” – One of health worker interviewees

“Malaria confirmed case is a case that shows positive with lab results” – One of health worker interviewees

Yet, around one third of the interviewees opined that the surveillance for malaria should be given less priority compared to other surveillance systems due to its low prevalence relative to other infectious illnesses. Besides, seven out of eight health workers in Sai Yok Hospital stated that they were not aware of the objectives of the system. Only one interviewee in Sai Yok Hospital who could well describe the purpose of the system was the hospital director.

**Usefulness**

The usefulness of malaria surveillance program was illustrated in various angles. Of 27 interviewees, 16 mentioned that the surveillance system was beneficial in introducing appropriate control measures. About 11 interviewees highlighted that the surveillance system was helpful in identifying hot spot areas. Around a quarter of the interviewees pointed that the surveillance data were of help in reflecting the providers’ performance in malaria control. A few interviewees (~4/27) flagged the value of the system in terms of budget planning and setting research priority.

![Figure 1. Data flow of malaria surveillance system in Sai Yok District, Kanchanaburi Province, Thailand](image-url)
Stability

Most health workers raised concern over the stability of the surveillance program. This issue was related to the possibility that GF support would be weaning off. With reference to the 23rd GF Board meeting in 2011, a new eligibility, counterpart financing and prioritization policy was adopted for all funding channels, by taking into account the country income level, disease burden and recent funding history\(^5\). The GF policy change affected funding opportunities to Thailand, not only for malaria, but also for HIV/AIDS and tuberculosis. Although the burden was high, with a history of recent funding, Thailand was neither eligible to submit a proposal for General nor Targeted Funding Pool (Table 1).

At present, the GF support was earmarked for material (such as computers and tools used for active case detection) and salary costs for health workers. The extent of salary support varied across authorities. BMP and MP might be affected most if GF sponsorship withdrew. This was because all salary costs for BMP and MP staff were subsidized by GF. The reliance on GF support in PHO, VBDC and VBDU was also observed, yet to a lesser extent\(^9\). Thus, detection and co-ordination function which was the main responsibility of BMP and MP would be undermined by termination of GF funding more severely than other functions (Table 2).

Quantitative Attributes

Sensitivity

In Sai Yok Hospital, a total of 39 malaria cases were identified and reviewed. Eleven cases were found without notification in R506; thus, these missing reports were not submitted to Malaria Online. In VBDU, total 157 malaria cases met case definition for malaria. Amongst these, one was not notified to Malaria Online. Thus, sensitivity of reporting was 71.8% (28/39) in Sai Yok Hospital and 99.4% (156/157) in VBDU.

After combining two data sources (39 cases and 157 cases) and dropping the duplicated cases, a total of 184 cases were identified. Of these 184 cases, 172 were reported to Malaria Online. Hence, the sensitivity of case reporting to Malaria Online over the whole district was approximately 93.5% (172/184) (Figure 2).

Positive predictive value

PPV of the surveillance system was calculated by reviewing EP1 forms in VBDU and medical records in Sai Yok Hospital. It appeared that all 172 cases presented in Malaria Online had evidence of positive laboratory test, reflecting 100% of PPV.

Completeness

Completeness for date of diagnosis, date of investigation and case classification were reviewed in the data entry system. It revealed that all 172 cases had complete information on these variables. This might be due to the ‘Must Enter’ function in the software which did not allow data submission if these variables were missing.

Timeliness

The R506 system was evaluated for timeliness by measuring lag time between dates of diagnosis and data submission to higher-level health facilities. The median lag time in Sai Yok Hospital was two days (range 0-18 days). The lag time in VBDU was also the same, yet with a much narrower range (median 2 days, range 0-4 days). This corresponded to the fact that about 73% of data from Sai Yok Hospital were submitted to BOE in the recommended period while VBDU demonstrated 100% of timely submission.

![Table 1. Profiles of eligibility to the Global Fund support in Thailand](image_url)

<table>
<thead>
<tr>
<th>Eligibility Criteria</th>
<th>HIV/AIDS</th>
<th>Tuberculosis</th>
<th>Malaria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the country on the OECD-DAC list of ODA recipients?</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>What is the disease burden of the country for each component?</td>
<td>High</td>
<td>Severe</td>
<td>Severe</td>
</tr>
<tr>
<td>Does the country have a history of recent funding?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>General Funding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the country eligible to submit a proposal in the General Funding Pool?</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Partial prioritization score (income level and disease burden, the minimum partial score is 3 and the maximum is 12)</td>
<td>NA</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Targeted Funding Pool</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the country eligible to submit a proposal in the Targeted Funding pool?</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Source: GF Eligibility List (2013)

Acronyms: OECD-DAC = Organisation for Economic Co-operation and Development-Development Assistance Committee, ODA = Official Development Assistance, UMI = Upper middle income, NA = Not applicable
### Table 2. Summary of functions related to malaria surveillance in each organization and the extent of salary support by the Global Fund

<table>
<thead>
<tr>
<th>Organization</th>
<th>Detection</th>
<th>Response</th>
<th>Co-ordination</th>
<th>Salary supported by the Global Fund</th>
</tr>
</thead>
<tbody>
<tr>
<td>BVBD</td>
<td>Not involved</td>
<td>Data management and logistic support</td>
<td>Coordinate with BIOPHICS in data integration*</td>
<td>None</td>
</tr>
<tr>
<td>BOE</td>
<td>Not involved</td>
<td>RS06 data management</td>
<td>Coordinate with PHO and ODPC for data collection and distribution*</td>
<td>None</td>
</tr>
<tr>
<td>ODPC</td>
<td>Not involved</td>
<td>Logistic support*</td>
<td>Coordinate with VBDC</td>
<td>None</td>
</tr>
<tr>
<td>PHO</td>
<td>Not involved</td>
<td>Evaluate malaria situation and logistic support</td>
<td>Receive RS06 report from hospitals and submit these data to BOE*</td>
<td>About a quarter of staff (1/4) involved in malaria surveillance</td>
</tr>
<tr>
<td>VBDC</td>
<td>Not involved</td>
<td>Surveillance on malaria vectors and chemical resistance</td>
<td>Submit data (EP3 and EP4) of malaria cases to ODPC on a monthly basis*</td>
<td>About 11.2% of staff (11/98) involved in malaria surveillance</td>
</tr>
<tr>
<td>VBDU</td>
<td>Case investigation</td>
<td>Mosquito spraying</td>
<td>Submit data (EP2, EP3, EP4 and EP6) of malaria cases to VBDC and receive malaria data from BMP, MP and hospitals*</td>
<td>About a quarter of staff (2/8) involved in malaria surveillance</td>
</tr>
<tr>
<td>MC</td>
<td>Screen patients with suspected symptoms and perform blood test for malaria</td>
<td>Provide treatment and follow cases</td>
<td>Submit data (EP1 and EP3) of malaria cases to VBDU on a daily basis</td>
<td>None</td>
</tr>
<tr>
<td>Hospital</td>
<td>Screen patients with suspected symptoms and perform blood test for malaria</td>
<td>Provide treatment and follow cases</td>
<td>Collaborate with VBDU for information sharing and dead case investigation*</td>
<td>None</td>
</tr>
<tr>
<td>MP and BMP</td>
<td>Screen patients with suspected symptoms and perform blood test for malaria (with test kit)</td>
<td>Provide basic treatment and refer patients to higher level health facilities</td>
<td>Submit data of malaria cases (EP1 and EP3) to VBDU and District Health Office (DHO)</td>
<td>All staff (5/5) in MP and BMP had their salary supported by GF.</td>
</tr>
<tr>
<td>Health center</td>
<td>Screen patients with suspected symptoms and refer them to receive treatment at higher level facilities</td>
<td>Not involved</td>
<td>Not involved</td>
<td>None</td>
</tr>
<tr>
<td>Private clinic</td>
<td>Screen patients with suspected symptoms and refer them to receive treatment at higher level facilities</td>
<td>Not involved</td>
<td>Not involved</td>
<td>None</td>
</tr>
<tr>
<td>BIOPHICS</td>
<td>Not involved</td>
<td>Not involved</td>
<td>Merge and analyse data from BVDB and BOE, then present the data on the webpage*</td>
<td>None</td>
</tr>
<tr>
<td>DHO</td>
<td>Not involved</td>
<td>Not involved</td>
<td>Train health volunteers and support the function of MP and BMP*</td>
<td>None</td>
</tr>
</tbody>
</table>

*Main function

**Acronyms:** BVBD = Bureau of Vector Borne Diseases, BOE = Bureau of Epidemiology, ODPC = Office of Disease Prevention and Control, PHO = Public Health Office, VBDC = Vector Borne Disease Control Center, VBDU = Vector Borne Disease Control Unit, MC = Malaria clinic, MP = Malaria post, BMP = Border malaria post, DHO = District Health Office

### Discussion

Overall, this study was amongst the first few studies in Southeast Asia that focused on malaria surveillance. Actually, in the sphere of international literature, there were some studies on malaria surveillance evaluation. However, most of which were conducted outside Southeast Asia, like Chehab et al from Qatar and Ibrahim et al from Nigeria. In addition, the study by Chehab et al limited the evaluation only on quantitative attributes whereas qualitative attributes were still missing.
One of the few studies on malaria evaluation in Southeast Asia was a research by Rae et al from Myanmar. However, Rae et al paid much attention on the process of diagnosis and treatment over the surveillance system per se\textsuperscript{13}. Therefore, this study was probably the first study in Southeast Asia that delved into both qualitative and quantitative attributes of the malaria surveillance system. Sai Yok District was used as a case study for evaluation.

It was found that the system involved a vast range of stakeholders, from frontline health posts (for example, MC, MP and BMP) to well-established health facilities (like Sai Yok Hospital, VBDU and VBDC). There were two strands of data flow: first from VBDU which receives data from MC, MP and BMP, and second from Sai Yok Hospital.

Some discrepancies between these two strands were noticed. The data flow in the VBDU strand was still in a paper-based form (though these data would be keyed into Malaria Online later) while that in Sai Yok Hospital was in electronic form. Though, at the time of study, the sensitivity and timeliness of data reporting in the VBDU strand was still acceptable (99.4% sensitivity with 2-day lag time), a heavy reliance on the paper-based reporting system might pose a risk of reporting delay and data loss. Thus, data flow from both strands should be harmonized.

High sensitivity and timeliness of the surveillance system in VBDU could be explained by the fact that the main responsibility of VBDU and its affiliated health posts was to provide timely case detection. This was evidenced by the observation that almost all health workers working there were quite aware of this responsibility. Besides, the functions in VBDU encompassed various components, including diagnosis, treatment and reporting like a one-stop service unit. By contrast, the main function of Sai Yok Hospital was to provide appropriate treatment rather than perform active case finding. Accordingly, reporting data to R506 was done in a passive manner. This idea coincided with the field observation which demonstrated that most health workers in the hospital did not show a clear understanding of the purpose and objectives of the surveillance system. This factor might help explain lower sensitivity of malaria report in Sai Yok Hospital relative to that of VBDU. Nevertheless, from a macro-perspective, the quantitative attributes of the surveillance system over the whole district (sensitivity, PPV, timeliness and completeness) were of acceptable quality.

Another worth-discussing point was while the interviewees mentioned the usefulness of the system in diverse angles, most of them conspicuously raised concern over the system stability. This issue was directly linked with the tendency that GF support might be curbed. Similar story was flagged in a study by Patcharanarumol et al, underlining that the curtailment of GF sponsorship might undermine HIV/AIDS prevention programs in Thailand, especially for the prevention programs exercised by civic groups and non-government organizations\textsuperscript{7}. Patcharanarumol et al also proposed a pooled funding mechanism that mobilized budget mainly from domestic sources\textsuperscript{7}. This idea originated from the fact that Thailand has always relied on domestic resources to fight HIV/AIDS for years while in some countries, like Bhutan, this proposal might not be
able to operationalize easily as around 80% of the fund to tackle HIV/AIDS and malaria were from international donors. The same idea might apply to the case of malaria surveillance as well. Further study on this issue was recommended.

There remained some limitations in this study. First, a case study with single province made it difficult to generalize the findings to other settings. Second, this study did not explore the functions of private health facilities or non-governmental affiliated facilities. Last but not least, the situation of GF support to Thailand (and other countries in the Southeast Asia region) is quite dynamic and at the time of the study, there was a public discussion about whether there were other mechanisms that could secure GF support without breaching the GF eligibility criteria (for instance receiving financial support through a regional proposal). Therefore, information from the interviews might be obsolete when this article was publicly launched.

Conclusion
This study illuminated the surveillance system for malaria in Sai Yok District. There were two strands of data flow: from VBDU which received data from MC, MP and BMP, and from Sai Yok Hospital. The data flow in the VBDU strand was still in a paper-based form, though these data would be keyed into Malaria Online later. By contrast, Sai Yok Hospital employed electronic data-entering form for the whole system. Both strands were merged together and the final data were presented in Malaria Online. Sensitivity, PPV, timeliness and completeness of the reporting system from both Sai Yok Hospital and VBDU were of acceptable quality. Most participants recognized the usefulness and importance of the surveillance system. However, the main concern was centered on system stability given the withdrawal of GF support. If the GF financial assistance was to curtail, the detection functions performed by MP and BMP would be affected most.

Recommendations for Public Health Actions
Concerning policy recommendations, there should be a substantial shift of budgetary support from GF to domestic resources. Health personnel at the hospital should more emphasize on submission of malaria data to the R506. In addition, the R506 reporting system and the VBDU system should be harmonized.

Acknowledgement
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Suggested Citation

References


