

Moving towards malaria elimination

Developing innovative tools for malaria surveillance in Cambodia

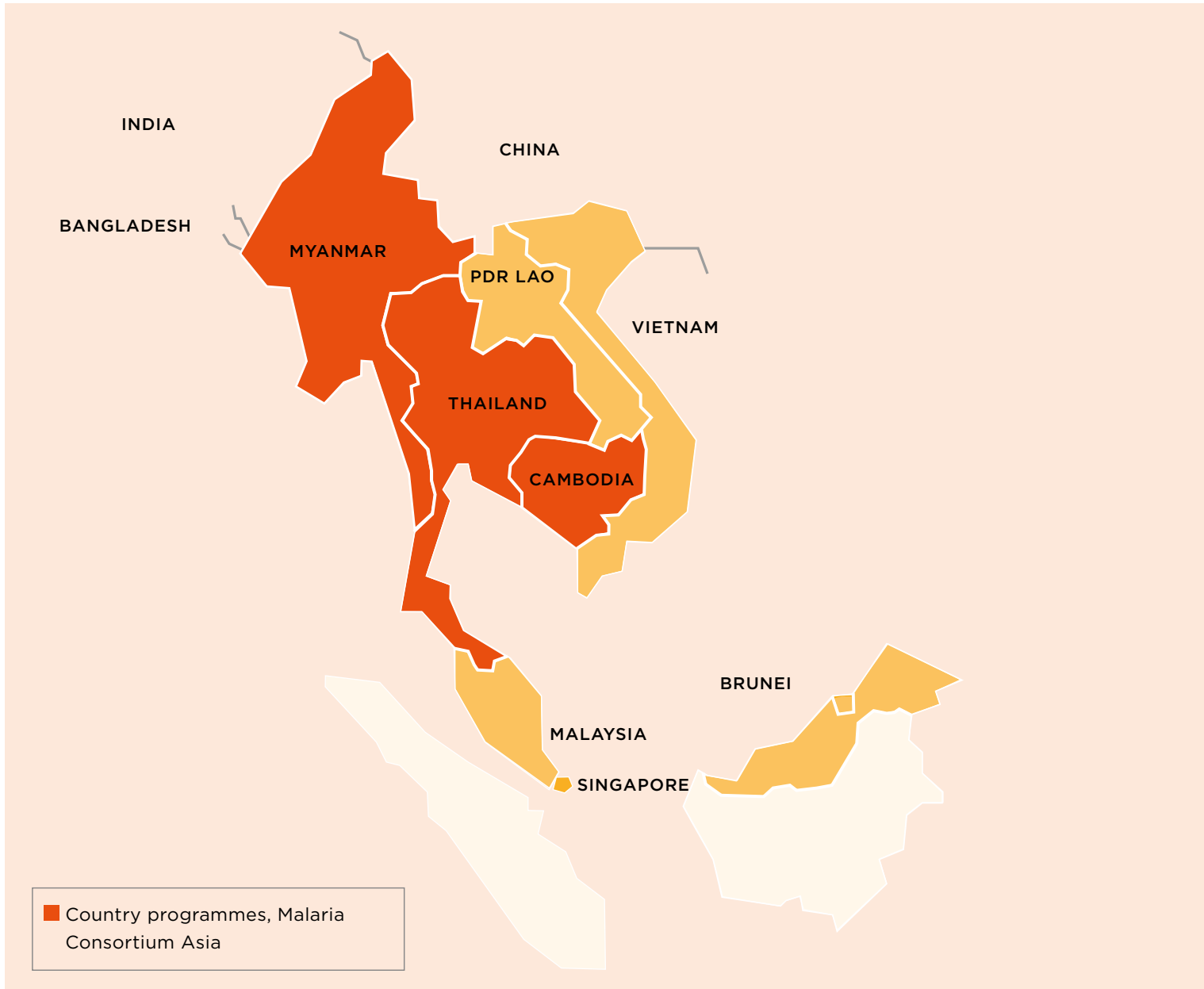


Learning paper series

Since starting operations in 2003, Malaria Consortium has gained a great deal of experience and knowledge through technical and operational programmes and activities relating to the control of malaria and other infectious childhood and neglected tropical diseases. Organisationally, we are dedicated to ensuring our work remains grounded in the lessons we learn through implementation. We explore beyond current practice, to try out innovative ways – through research, implementation and policy development – to achieve effective and sustainable

disease management and control. Collaboration and cooperation with others through our work has been paramount and much of what we have learned has been achieved through our partnerships.

This series of learning papers aims to capture and collate some of the knowledge, learning and, where possible, the evidence around the focus and effectiveness of our work. By sharing this learning, we hope to provide new knowledge on public health development that will help influence and advance both policy and practice.



Contents

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Introduction

In Cambodia, 57,423 confirmed cases of malaria were reported from the public sector in 2011¹. The country has set a goal of eliminating malaria by 2025.

Malaria Consortium has been working in Cambodia since 2003 with support from the World Health Organization, Centers for Disease Control and Prevention and others. From 2009, it was part of a project funded by the Bill & Melinda Gates Foundation to contain artemisinin resistant malaria along the Cambodian-Thai border, and since 2008, contributed to Global Fund activities. The organisation has been providing overall monitoring and evaluation (M&E) support and technical assistance to Cambodia’s national malaria programme to strengthen surveillance by developing efficient, timely systems for ongoing information management and feedback.

The national malaria programme in Cambodia manages malaria case data from a wide variety of sources – including from government health facilities, more than 1,500 village malaria workers (VMWs) and private sector practitioners. The programme also monitors the stock levels of critical malaria supplies at government health facilities. However, it was clear that no single tool would be able to provide the mix of routine and real-time data required for the national malaria programme due to the variety of conditions and transmission areas in Cambodia. Furthermore, given the resource constraints in funding, manpower in the field and technical capacity at central level to develop and manage systems, simple, sustainable and cost effective solutions was needed.

In collaboration with the national malaria control programme in Cambodia (CNM), Malaria Consortium developed a diverse set of tools to improve malaria surveillance and to provide the information needed by national and district staff to manage the national malaria programme, respond to malaria outbreaks and individual cases and monitor in real-time the levels of critical malaria supplies at health facilities.

The surveillance tools developed were a mix of routine reporting systems using eHealth and mobile phone-based (mHealth) solutions that would enable resource-constrained environments to provide real-time data for immediate action. This learning paper documents the lessons learned in developing an appropriate tool and the specific considerations in the implementation of mHealth solutions.

eHEALTH	mHEALTH
According to the World Health Organization, eHealth is the combined use of electronic communication and information technology in the health sector. It includes using information and communication technology such as computers, mobile phones, and satellite communications, for health services and information.	In recent years, mobile Health, or mHealth, has emerged as an important part of eHealth and is defined as the use of mobile communications (such as mobile phones) for health services. mHealth programmes can serve as the access point for entering patient data into national health information systems, and as remote information tools that provide information to healthcare clinics, home providers, and health workers in the field.

Characteristics of eHealth and mHealth

eHEALTH (EXCLUDING MOBILE DEVICES)	mHEALTH
Very few people have access to PC/web/email	Most people have access to a mobile phone
Users more educated and affluent	Users not defined by education or wealth
Easier to create applications	Harder to create applications
Not dependent on communications people	Very dependent on communications people and telecoms companies
Innovation from developed countries	Innovation from developing countries
Impersonal	Personal
Trendy and exciting ten years ago	The next big thing

Rapid response from mHealth systems

1. Case investigation to be conducted to identify possible sites (hotspots) of drug resistance
2. Vector control (top-up of mosquito nets and indoor residual spraying) and/or focal screening and treatment deployed at identified hotspot
3. Ensure appropriate testing, directly observed therapy with recommended drug (in 2013 atovaquone-proguanil (Malarone™)) and follow up
4. To prevent stock outs and supply drugs in a timely manner

Migrant workers are among the most at risk from malaria along the Cambodian-Thai border



National malaria programme: information requirements

Prior to 2009, malaria case data in Cambodia came from the national Health Information System (HIS), which provided aggregate data at operational district level. While this data was useful for reporting total cases, it was not sufficient to support identification of villages based on their malaria incidence; malaria risk stratification of villages in was conducted on the basis of distance from the forest using outdated maps.

Parallel to the HIS and since 2004, individual malaria case data was collected by VMWs, through funding from the Global Fund to Fight AIDS, Tuberculosis and Malaria. These case data were collected in paper form and sent to the national programme.

However, as experiences from other countries have shown, the official HIS system is no longer sufficient to cover

the data needs for eliminating a disease, and therefore, a disease-specific case-based surveillance system with its own database is required. As a country moves towards pre-elimination and eventually elimination, there is a need not only for case-based reporting but also for case-based reporting in real time to allow for direct response to each case as soon as it is detected and not until the end of a particular reporting period.

CNM and Malaria Consortium analysed existing data sources, infrastructure and human resource capacity at national and sub-national levels. Through this analysis, the essential data requirements for the national malaria programme as it moves towards elimination and to achieve containment of resistance were identified:

1. Demographic data of all at-risk villages for planning interventions such as mosquito net distribution
2. Data relating to mosquito net distribution and treatment
3. Monthly malaria data at village level to identify villages with high incidence and possible transmission; data should include all individual (sex and age) simple, severe and death cases, treatments and referrals
4. Village-level malaria incidence rates for risk stratification of villages
5. Health facility data relating to stock outs of essential malaria drugs and supplies
6. Real-time data about individual patients who are still parasitaemic after three days (an indication of drug resistance). Patients need to be investigated to identify possible sites of transmission.

The following data is also required at a later stage as the programme moves towards elimination:

1. Data relating to private sector outlets that may be used as an alternative to the government facilities
2. Real-time data about all *Plasmodium falciparum* (Pf) cases, and ultimately *Plasmodium Vivax* (Pv) cases
3. Real-time data about malaria outbreaks in high transmission settings

Taking these requirements into consideration, Malaria Consortium and CNM identified that the best way forward is to have a mix of a village-level malaria database at the district level and a number of innovative mobile phone-based solutions for the real-time data requirements.

Using real-time data to facilitate rapid response

ALERT

- Real-time data about individual patients still positive after three days (an indication of drug resistance)
- Rapid identification of all Pf cases in drug resistant areas of Western Cambodia
- Real-time data from health facilities about stock levels of malaria drugs

RESPONSE

- Case investigation to be conducted to identify possible sites (hotspots) of drug resistance and deploy vector control and/or focal screening and treatment
- Ensure appropriate testing, directly observed therapy and follow up
- To prevent stock outs and supply drugs in a timely manner

The risk of malaria in rural communities required stratification based on distance from the forest



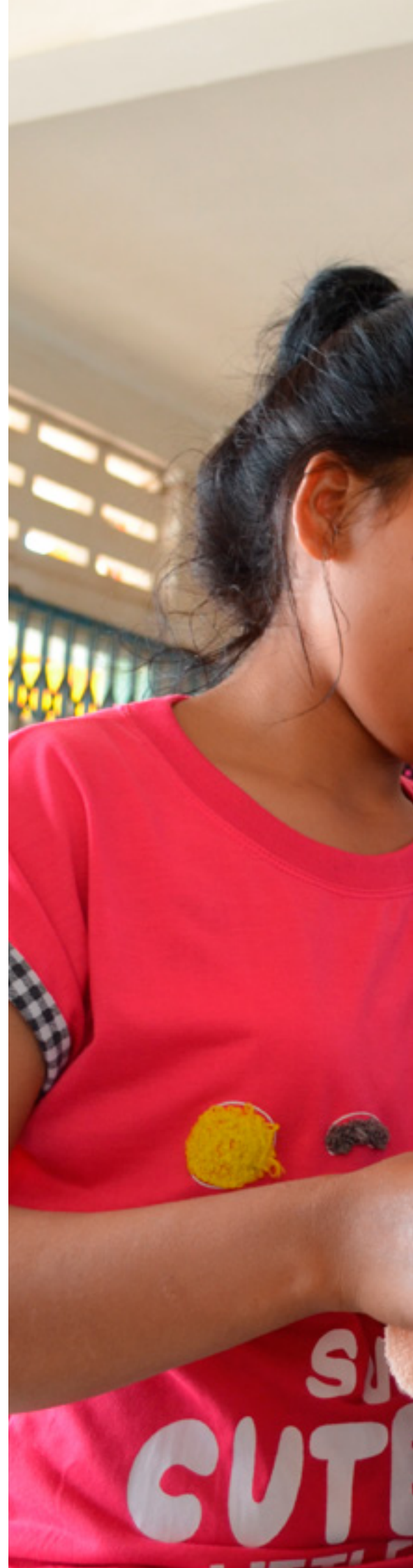
Malaria information system (MIS)

To address the identified routine data requirements for the national malaria programme, Malaria Consortium, together with national programme staff, developed the malaria information system (MIS) to help process malaria data from VMWs and health facilities.

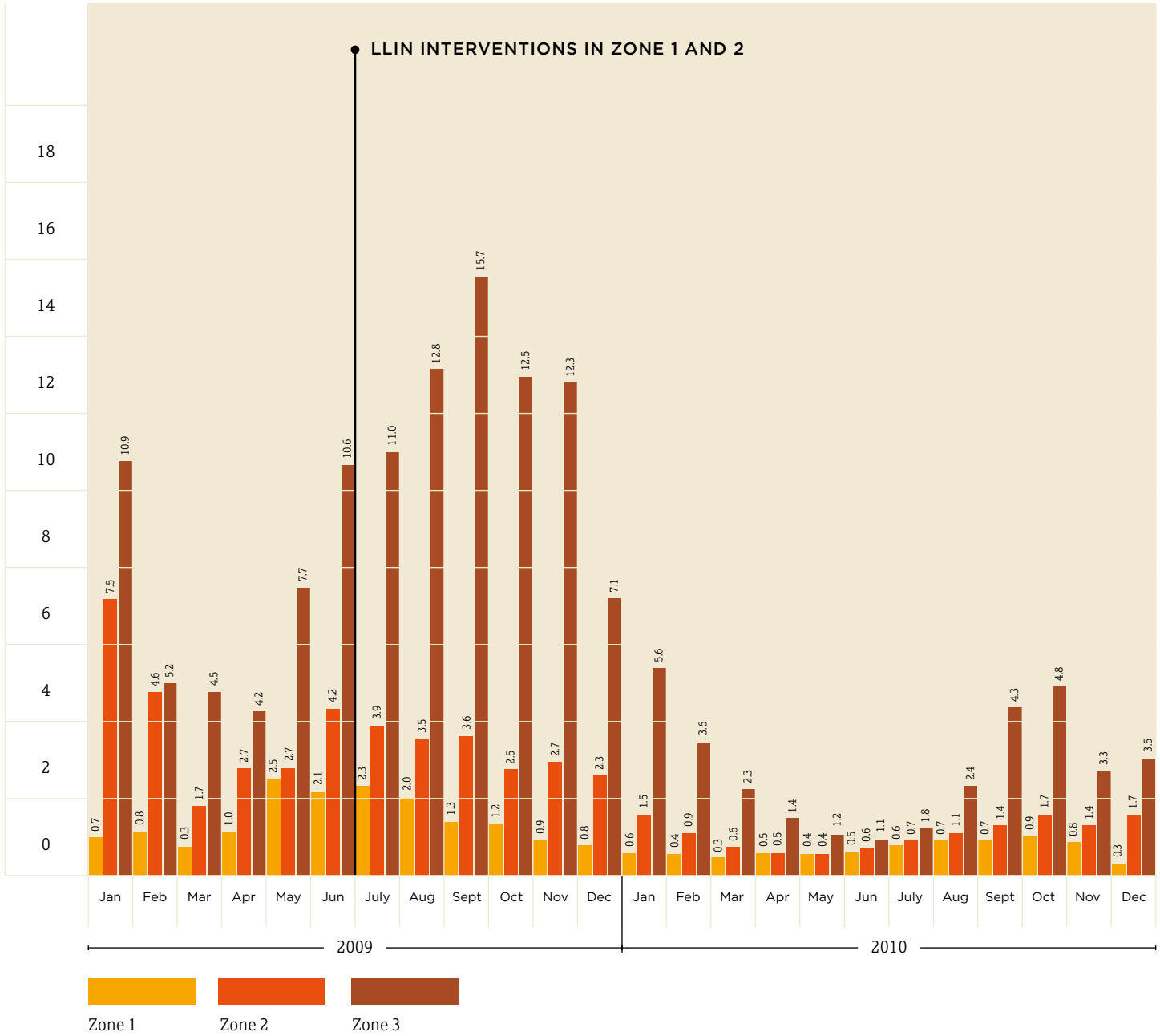
The aim of the MIS was to provide a tool for district staff to manage their activities, such as mosquito net distribution and stratification at village level, and to manage the data from VMWs – which is not included in the HIS. The MIS, however, is not meant to duplicate or replace the Health Information System (HIS), which is still used as the main source of malaria data from government health facilities in the annual statistics.

A new form, similar to the existing form used by VMWs, was developed to capture individual case data for all patients seen by VMWs and at public health facilities. The case data for positive patients, as well as mosquito net distribution data, demographic data on villages and data on the type and location of private sector outlets such as clinics and pharmacies is entered into a simple MS Access database at operational district level. The MIS, developed in 2009, is a standalone system and not web-based as this was considered to be more practical, sustainable and cheaper. The MIS follows the standard monthly reporting cycle for disease statistics in Cambodia. Monthly updates are sent by email from each district and are automatically applied to the national database.

A child is checked for malaria at a private pharmacy in Pailin, Cambodia







Graph showing malaria cases per village health worker from the MIS

The malaria bulletin

By linking malaria information system data (particularly data from the VMW programme and mosquito net data) with the national facility-based HIS data using a common coding system, a comprehensive 'malaria bulletin' is produced. The bulletin, which provides a summary of the malaria situation in Cambodia at any point in time, can be generated automatically from the MIS and contains:

1. A national overview of key malaria statistics and trends over time
2. Containment indicators: data related to containment tiers (areas with suspected or possible drug resistance)
3. In depth malaria data by individual health facility by district
4. Border areas: trends in malaria in areas bordering neighbouring countries

A district version of the malaria bulletin is also currently being piloted in selected districts.

Surveillance data by district, January-June 2013

Province/District	Malaria Incidence						Malaria Mortality						Malaria Containment					
	Jan	Feb	Mar	Apr	May	Jun	Jan	Feb	Mar	Apr	May	Jun	Jan	Feb	Mar	Apr	May	Jun
Banteay Meanchey	120	150	180	160	140	130	5	8	10	12	10	8	1	1	1	1	1	1
Battambang	180	220	250	230	200	180	10	15	18	16	14	12	2	2	2	2	2	2
Bien Hoa	100	120	140	130	110	100	4	5	6	7	6	5	1	1	1	1	1	1
Borey	150	180	200	190	170	160	7	9	11	10	9	8	1	1	1	1	1	1
Breidevong	130	160	180	170	150	140	6	8	10	9	8	7	1	1	1	1	1	1
Bundet	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Burien	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Chhnang	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Chhmar	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Khe	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Meanchey	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Pongkha	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Prey	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Prey Veng	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Sra	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
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Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
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Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
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Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
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Buth Thmar North	120	150	170	160	140	130	6	8	10	9	8	7	1	1	1	1	1	1
Buth Thmar West	130	160	180	170	150	140	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar East	110	130	150	140	120	110	5	6	7	8	7	6	1	1	1	1	1	1
Buth Thmar South	140	170	190	180	160	150	7	9	11	10	9	8	1	1	1	1	1	1
Buth Thmar North	120	150	170															

Stratification of at risk villages

Those villages that are included are automatically stratified according to user-defined categories based on incidence rates

Prior to 2012, malaria risk stratification of villages in Cambodia was based on the distance from the forest using maps which were created in 1996 and which included many forested areas that have since been cleared. This stratification has been slightly updated using the local knowledge of senior staff at the CNM and in the provinces. With the MIS, it is now possible to automate the stratification of villages based on incidence, and since 2012, districts have been using the individual case data from VMWs and health facilities to re-stratify their at risk villages.

The stratification process involves combining the individual case data obtained from VMWs and health facilities and calculating the village level incidence

rates. The completeness of this data is then assessed, and villages that have incomplete data (due to lack of reports or no record of village population) are excluded from the automatic stratification. Those villages which are included are automatically stratified according to user-defined categories based on incidence rates. The stratification is then reviewed by national or district staff and adjusted according to local knowledge. Malaria Consortium is currently working with the national programme to use the new village stratifications to guide village-level interventions as the programme transitions from control to pre-elimination and elimination phases.

Village	Province	District	Pop	Inc	Stratification
181000001	Siem Reap	Siem Reap	480	0.0	Low
181000002	Siem Reap	Siem Reap	308	0.0	Low
181000003	Siem Reap	Siem Reap	308	0.0	Low
181000004	Siem Reap	Siem Reap	308	0.0	Low
181000005	Siem Reap	Siem Reap	308	0.0	Low
181000006	Siem Reap	Siem Reap	308	0.0	Low
181000007	Siem Reap	Siem Reap	308	0.0	Low
181000008	Siem Reap	Siem Reap	308	0.0	Low
181000009	Siem Reap	Siem Reap	308	0.0	Low
181000010	Siem Reap	Siem Reap	308	0.0	Low
181000011	Siem Reap	Siem Reap	308	0.0	Low
181000012	Siem Reap	Siem Reap	308	0.0	Low
181000013	Siem Reap	Siem Reap	308	0.0	Low
181000014	Siem Reap	Siem Reap	308	0.0	Low
181000015	Siem Reap	Siem Reap	308	0.0	Low
181000016	Siem Reap	Siem Reap	308	0.0	Low
181000017	Siem Reap	Siem Reap	308	0.0	Low
181000018	Siem Reap	Siem Reap	308	0.0	Low
181000019	Siem Reap	Siem Reap	308	0.0	Low
181000020	Siem Reap	Siem Reap	308	0.0	Low
181000021	Siem Reap	Siem Reap	308	0.0	Low
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181000051	Siem Reap	Siem Reap	308	0.0	Low
181000052	Siem Reap	Siem Reap	308	0.0	Low
181000053	Siem Reap	Siem Reap	308	0.0	Low
181000054	Siem Reap	Siem Reap	308	0.0	Low
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181000056	Siem Reap	Siem Reap	308	0.0	Low
181000057	Siem Reap	Siem Reap	308	0.0	Low
181000058	Siem Reap	Siem Reap	308	0.0	Low
181000059	Siem Reap	Siem Reap	308	0.0	Low
181000060	Siem Reap	Siem Reap	308	0.0	Low
181000061	Siem Reap	Siem Reap	308	0.0	Low
181000062	Siem Reap	Siem Reap	308	0.0	Low
181000063	Siem Reap	Siem Reap	308	0.0	Low
181000064	Siem Reap	Siem Reap	308	0.0	Low
181000065	Siem Reap	Siem Reap	308	0.0	Low
181000066	Siem Reap	Siem Reap	308	0.0	Low
181000067	Siem Reap	Siem Reap	308	0.0	Low
181000068	Siem Reap	Siem Reap	308	0.0	Low
181000069	Siem Reap	Siem Reap	308	0.0	Low
181000070	Siem Reap	Siem Reap	308	0.0	Low
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181000072	Siem Reap	Siem Reap	308	0.0	Low
181000073	Siem Reap	Siem Reap	308	0.0	Low
181000074	Siem Reap	Siem Reap	308	0.0	Low
181000075	Siem Reap	Siem Reap	308	0.0	Low
181000076	Siem Reap	Siem Reap	308	0.0	Low
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181000078	Siem Reap	Siem Reap	308	0.0	Low
181000079	Siem Reap	Siem Reap	308	0.0	Low
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181000081	Siem Reap	Siem Reap	308	0.0	Low
181000082	Siem Reap	Siem Reap	308	0.0	Low
181000083	Siem Reap	Siem Reap	308	0.0	Low
181000084	Siem Reap	Siem Reap	308	0.0	Low
181000085	Siem Reap	Siem Reap	308	0.0	Low
181000086	Siem Reap	Siem Reap	308	0.0	Low
181000087	Siem Reap	Siem Reap	308	0.0	Low
181000088	Siem Reap	Siem Reap	308	0.0	Low
181000089	Siem Reap	Siem Reap	308	0.0	Low
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181000091	Siem Reap	Siem Reap	308	0.0	Low
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181000096	Siem Reap	Siem Reap	308	0.0	Low
181000097	Siem Reap	Siem Reap	308	0.0	Low
181000098	Siem Reap	Siem Reap	308	0.0	Low
181000099	Siem Reap	Siem Reap	308	0.0	Low
181000100	Siem Reap	Siem Reap	308	0.0	Low

Automatic stratification of villages in the malaria database



Malaria Consortium trainer, shows a class of village malaria workers how the SMS system works

Real-time malaria data for direct action

The malaria programme not only needs routine data for reporting and to support operational activities, but also specific real-time data that could not be captured by the routine data collection tools. In order to address these requirements, Malaria Consortium teamed up with InSTEDD² a Cambodia-based non-government organisation specialising in innovative surveillance solutions in the public health sector, to develop a number of innovative tools.

Considering limited staff capacity and the need to keep maintenance costs of any system as low as possible, it was important to ensure that the tools developed use the simplest technologies and are easy to maintain. With these considerations, and because using SMS is becoming the de facto standard for surveillance in resource challenged environments, it was decided to base these tools around simple SMS rather than more expensive internet solutions.

Village malaria workers open up their equipment: mobile phone, light and solar charger



Day 3 positive alert system

Containment of the spread of artemisinin resistant parasites requires tracking the emergence of these cases in real time as they occur and identifying the transmission sites of these cases so that proper responses are put in place in a timely manner.

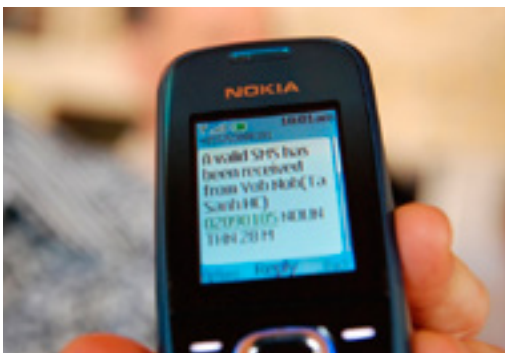
The day 3 positive alert system was developed³ as part of a larger pilot to identify day 3 positive cases in the community. This unique system uses SMS to identify patients who are still parasitaemic after three days and alerts appropriate district officials.

The day 3 positive alert system was developed as part of a larger pilot to identify day 3 positive cases in the community

Village malaria workers are shown how to use their new equipment



Map showing day 3 hotspots



Day 0 SMS alert system



The system was piloted in a number of villages and health centres. Health facility staff read blood slides taken by VMWs and sent a simple coded SMS to an open source software, Frontline SMS⁴. This software links to the MIS to determine the location of the patient using the village code; it then sends a customised SMS to the appropriate local district malaria officer (based on the location of the village) to take action.

The day 3 positive cases are mapped using Google Earth in order to identify whether the cases are spread evenly or whether there are hotspots of potential resistance – a number of which have been followed up by focal screening and treatment programmes. The day 3 positive alert system is currently being scaled up by the CNM in areas where potential resistance is suspected, focusing on areas where it has not been confirmed.

The software automatically alerts appropriate district officials to take action

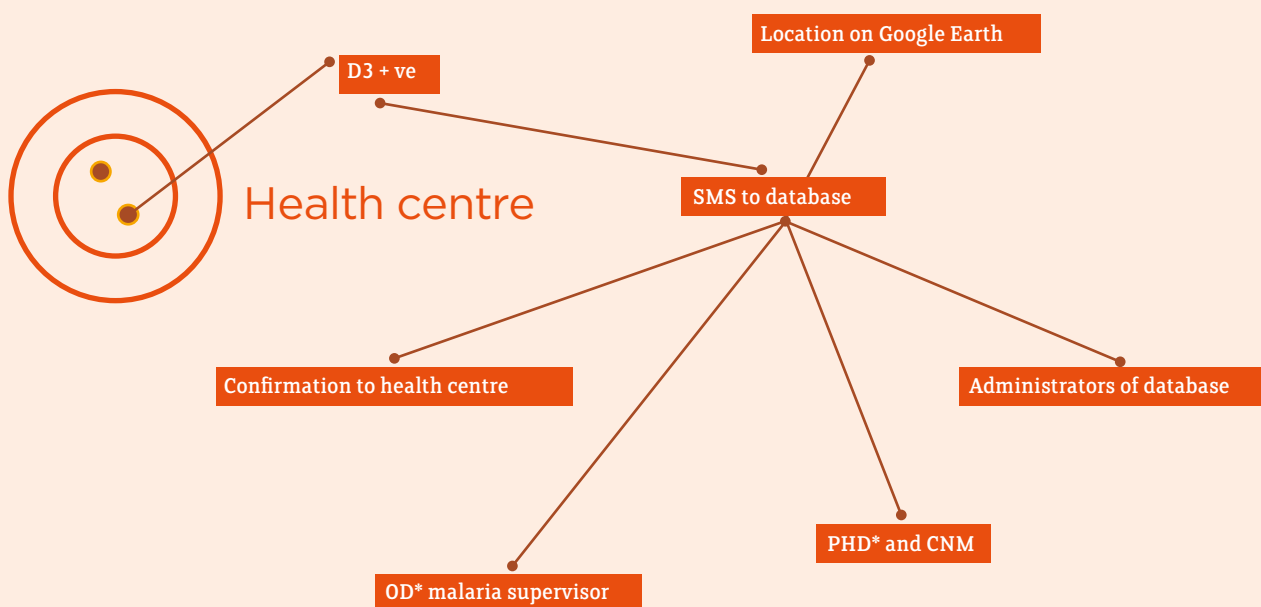
Day 0 SMS alert system

As the malaria programme moves towards elimination phase, there will be a need to react to every Pf (and ultimately Pv) case immediately and not wait for information to flow through the routine system.

Building on the success of the SMS model in the day 3 positive system, the day 0 alert system was developed, where simple SMS for day 0 cases are sent by VMWs (4 digits) and health centre staff (12 digits). The software then automatically alerts appropriate district officials (based on the location of the village) to take action. The system, designed by Malaria Consortium and CNM staff in collaboration with InSTEDD, was successfully implemented in four operational districts, covering 184 VMWs and 17 health centres to report all cases of Pf.

The day 0 alert system uses web-based software as it is designed to be a permanent system and handle more SMS than the day 3 system. A partnership with Mobitel, Cambodia's largest telecommunications company, allows free SMS and provides SIM cards, therefore

How a text message from the Ta Sanh Health Centre gets disseminated with Frontline SMS



*OD - operational district
 PHD - provincial health district
 Source: WHO/Sony Krishnan

Referral system

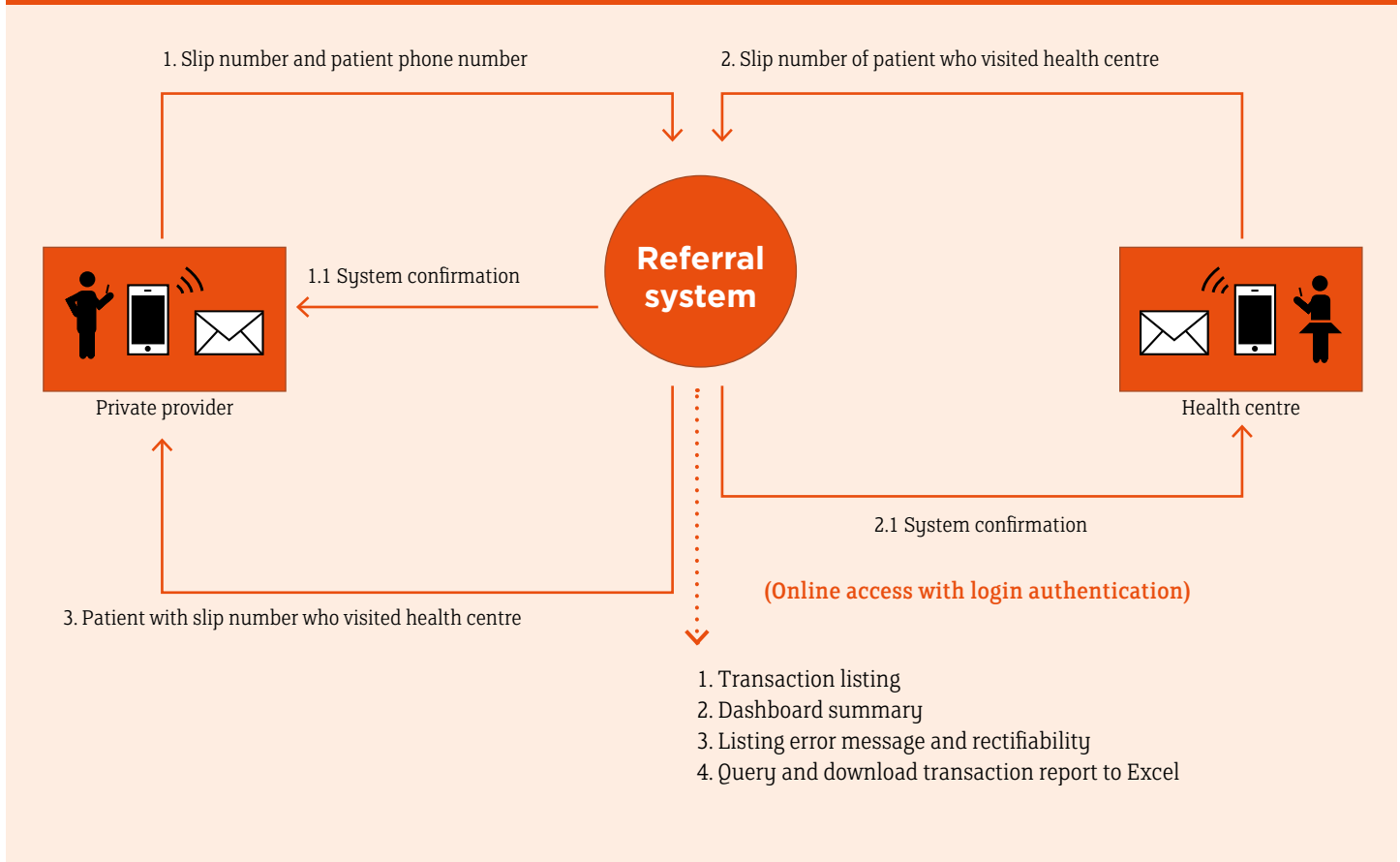
About 70 percent of malaria patients in Cambodia are reported to seek treatment via the private sector. Through the Public-Private Mix (PPM) project, initiated by the CNM and partners, public sector staff select private providers are provide them with training in accordance with National Treatment Guidelines. This training includes appropriate diagnosis, treatment and referral procedures. Private providers in malaria risk zones 2 and 3 are permitted to diagnose and treat malaria cases, however, children under five, pregnant women, and cases of serious/recurrent malaria should be referred to the public sector. Private providers in malaria risk zone 1 are recommended to refer all malaria patients to the public sector.

While there are mechanisms in place to gather case data from selected private providers, tracking referrals from the private to the public sector continues to be

problematic. People who seek treatment via the private sector are often lost to follow up once they leave the private provider's facility. The CNM in collaboration with Malaria Consortium, the Clinton Health Access Initiative (CHAI) and InSTEDD, developed a referral system to more effectively track patients and determine what happens after they are referred (e.g. whether patients continue to seek treatment and where, or why they do not go to the public sector). Without a tracking mechanism for these cases, it is impossible to know if these patients are receiving the treatment they need.

The referral system is an SMS and web-based application that enables private providers to send information about each referred patient via SMS to an online database. Private providers send an SMS message which includes the referral slip number and patient's phone number. When a patient arrives at a public clinic, health centre

Private sector referral system



Drug stock out system

staff send their referral slip information and number to the system. This information is matched with the original referral submitted by the private provider, making it possible for the CNM to monitor whether referred patients have or have not been accounted for at public facilities. The system is integrated into the existing day 0 website for easy management. It is currently being implemented with registered private practitioners in Pailin and Battambang.

SMS is being used as a pilot for monitoring malaria drug stock outs in a number of health centres, where stock levels are reported every two weeks or when levels drop below a set threshold. All participating health centres are displayed on Google Maps and are colour coded depending on stock levels. This is an efficient way of enabling national staff to relocate resources to where they are needed.

The system is based on a customised version of the open source software, Dynamic Resource Mapper, developed by InSTEDD⁴ in cooperation with the CNM, CHAI⁵ and Malaria Consortium.

All participating health centres are displayed on Google Maps and are colour coded depending on stock levels. This is an efficient way of enabling national staff to relocate resources to where they are needed

A mobile phone and solar charger used by village malaria workers for the day 0 SMS Alert System

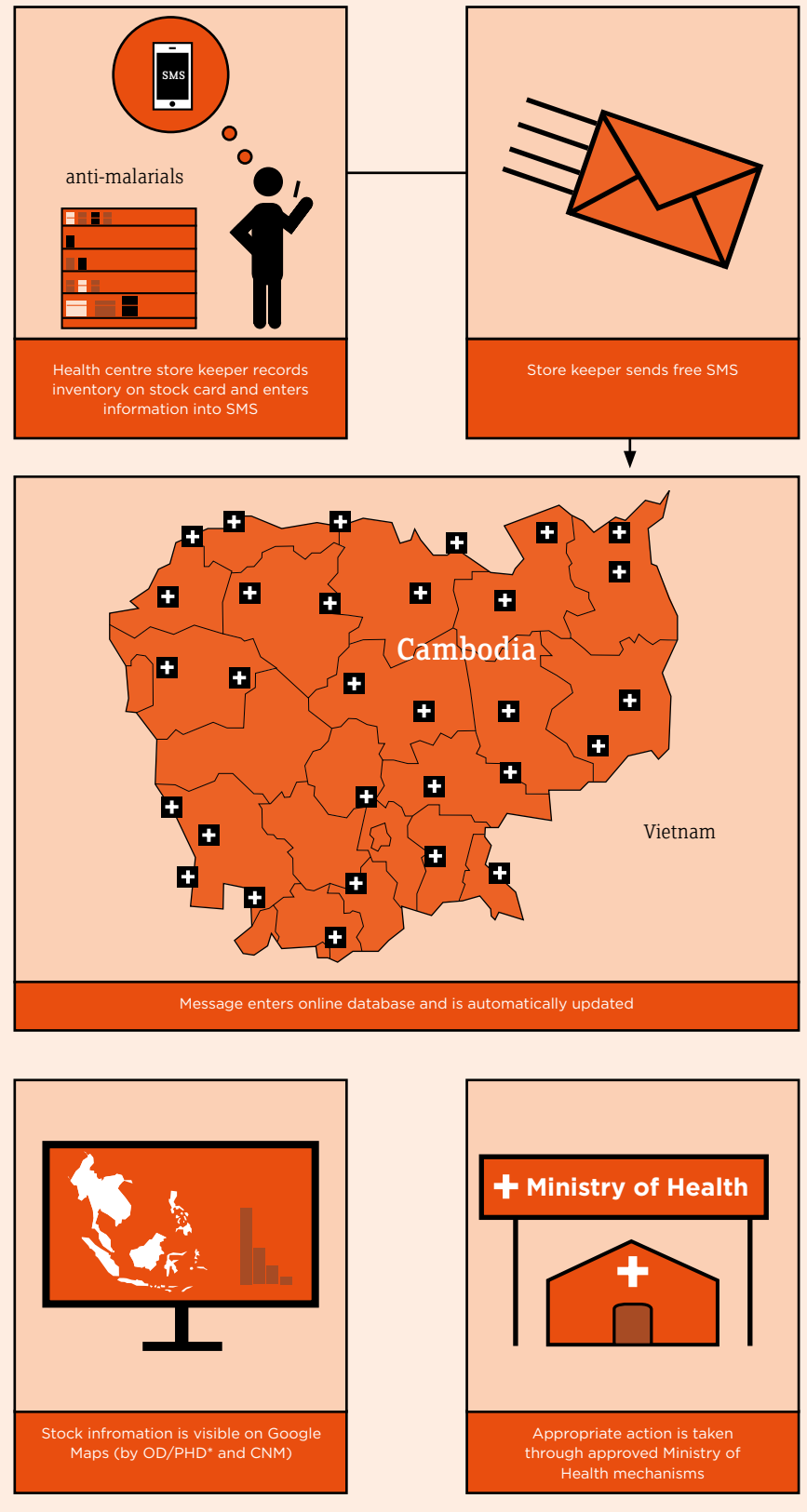


Defining the problem

Current tools to monitor stock at the peripheral supply chain level are not able to capture and relay data quickly enough to allow for rapid response and avoid stock outs, overstocking and expiry of artemisinin combination therapy and rapid diagnostic tests.

- Stock information in the public sector is too infrequent to allow for real-time monitoring
- Health centres and operational district stores make requests to the CNM on an ad-hoc basis, which is time consuming and hard to track
- Response to impending stock outs or over stock is difficult, especially during the peak malaria transmission season, with limited insight into supply chain

Data flow of the alert system



Source: CHAI
 *OD - operational district
 PHD - provincial health district

Case study

Private sector referral system for potential malaria cases through SMS technology

Mrs Sean Sonida runs a pharmacy and a clinic on the main street in Pailin, Western Cambodia, where she provides general treatment to her patients. As a native of Pailin, she has seen the dramatic decrease in malaria cases in recent years.

"Nowadays, the majority of people with a fever are not infected with malaria, but are mostly due to colds," she says.

"In the past, many malaria patients used to come to my clinic and I diagnosed and treated them. Now, the government does not allow private providers to do this. They are afraid of the wrong diagnosis and treatment being provided to patients because of parasite resistance to artemisinin drugs. The government strongly suggests that we refer malaria suspects to public health facilities."

Mrs Sonida has taken part in a series of Malaria Consortium's on-site trainings about the importance of referring patients to public health facilities, where diagnosis and treatment is free to malaria patients.

Mrs Sean Sonida has been trained to use the SMS alert system to ensure patients get rapid diagnosis and treatment for malaria

"I now understand better the SMS system and process, and am now able to send messages", she says. "It is very easy to do the on-site training as Malaria Consortium staff come to my clinic and I do not need to travel far. This would otherwise be a problem as distances are long and I do not have time to leave my clinic unattended. The training materials provided are also in my language and contain very clear instructions on how to send the SMS messages."

Mrs Sonida believes that the SMS system has many benefits for her patients. "I care about my patients; by referring them to public health facilities, they are able to get easier access to proper malaria diagnosis and treatment. As my clinic is very far from the health centre, the SMS system saves time. I am glad I can use the SMS to refer a patient to the right place and on time, and receive confirmation by SMS when the health centre has treated the patient."

"I am glad I can use SMS to refer my patients to the right place and on time."



Challenges and lessons learned

Challenges

1. ADDING TO THE WORKLOAD OF HEALTH STAFF

Creating new reporting systems is likely to add (or be perceived as adding) to the workload of health centre staff and village volunteers. In general, VMWs were motivated to adopt some of the mHealth solutions, whereas there was some resistance among district staff to adopt the malaria database without additional financial incentives. Care must be taken to ensure that staff understand the need for new reporting systems and its benefits to them personally and to the community they serve.

2. KHMER LANGUAGE

In Cambodia, the use of Khmer fonts on mobile phones is rare, thus limiting the usefulness of SMS to send meaningful messages (other than codes). With the day 0 system, volunteers were provided with phones that could receive SMS in Khmer; with the private sector system, they used their personal phones which do not support Khmer fonts. Until the use of Khmer fonts on mobile phones becomes more widespread, other innovative ways of providing information must be considered, for example, using picture or voice messaging.

Lessons learned

1. IF A SYSTEM DOES NOT WORK MANUALLY, TECHNOLOGY IS UNLIKELY TO HELP

Owing to the limitations in using technology in reporting systems, it should only be considered when it can improve a system that is sound but may be inefficient. An example is the stock management system, where technology makes it easier for health centre staff to report stock outs and for national staff to manage the stock outs. If the existing management procedures did not allow for staff to call the national level directly, and for the national level to respond accordingly, this problem needs to be addressed before other tools are developed to make such processes easier.

2. USE EXISTING SOURCES OF DATA AS MUCH AS POSSIBLE, AND ADD ONLY TO THE DATA COLLECTION WORK OF HEALTH WORKERS IF ABSOLUTELY NECESSARY

Health staff at all levels are faced with large amounts of work on a daily basis, and by using existing sources of data, the data collection system is much more likely to work. In Cambodia, the basic case data required for the malaria programme can be obtained from existing patient registers in health centres. It was decided not to collect other 'nice to have' data that was not in the main register, such as the method of diagnosis (RDT or microscope), as this would have caused more difficulty for health staff to collect.

3. KEEP IT SIMPLE

Systems should be kept as simple as possible, especially in countries where resources and manpower may be limited.

- Use appropriate technology, which may not necessarily be the latest; using a simple SMS on a \$20 phone is better than a smartphone application for village health workers
- Consider local conditions and sustainability
- Consider costs
- Be careful about using web-based applications for routine reporting where internet connections may be slow and expensive to maintain

4. SMALLER SYSTEMS MAY BE BETTER THAN A SINGLE BIG SYSTEM

Due to the variety of conditions and transmission areas in Cambodia, it was clear that no single tool would be able to provide the required mix of routine and real-time data for the national programme. Whereas

All the systems described in this paper use similar coding systems for villages and can be linked back to the malaria database. This enables the national programme to retrieve data from one centralised system

a standardised tool (the village database) is required for routine surveillance across the whole country, different parts of the country may require specific tools for a number of reasons, such as monitoring the Malarone™ trial in Pailin and identifying hotspots of potential resistance.

5. DECENTRALISE THE SURVEILLANCE SYSTEM TO A LEVEL WHERE DECISIONS ARE MADE

The operational district level is the lowest decision-making level of the malaria programme in Cambodia. The malaria database is located at this level, as district staff have the capacity and knowledge to carry out data entry and update demographic data. They are also able to check the data from volunteers and health facilities to ensure its quality and to provide feedback.

6. MONITORING AND EVALUATION (M&E) AND TRAINING

Regular M&E and refresher training are required to ensure the completeness and accuracy of the data and to quickly address any challenges encountered. This is best incorporated into existing M&E processes. Lessons related to mHealth

7. CONSIDER MOBILE-BASED SOLUTIONS ONLY FOR SITUATIONS WHERE REAL-TIME DATA IS REQUIRED AND/OR IMMEDIATE ACTION IS REQUIRED

Mobile-based solutions are often more difficult to create and maintain and should only be used for routine reporting if there is no other alternative. For example, these applications can offer a solution when real-time data is required or when data should trigger an immediate response. In the day 0 system, VMWs sent data by SMS to the nearest district officer, but this was initially discontinued as there was no capacity to respond to the alerts at district level. However, the day 0 system is successful in monitoring Malarone™ treatments for Pf in Pailin where the capacity and the need for an immediate response is there.

8. TRY TO MAKE THE SYSTEM FREE FOR THE USERS BY WORKING WITH THE TELECOMS COMPANIES

Malaria Consortium and partner InSTEDD ensured that the SMS sent by volunteers and health facility staff were free through discussions with telecoms companies

to supply special SIM cards that allowed sending SMS to a nominated number even with a zero balance. This made a significant contribution to saving management time required to ensure that the phones always had a small balance. Without this initiative, the systems would be impossible to maintain.

9. KEEP CODES SIMPLE

It is important to keep the SMS short and it contain only essential information to make it easier for village based staff to manage. The day 0 system only requires a 4-digit code; any additional information can be obtained by the staff who responds to the alert. For health facility staff who are more literate, larger codes (including a village code or product code) may be used.

10. SYSTEMS MUST BE COMPATIBLE WITH EACH OTHER

All the systems described in this learning paper are, as far as possible, compatible with each other. All use similar coding systems for villages and can be linked back to the malaria database. This enables the national programme to retrieve data from one centralised system.

11. THERE MUST BE FEEDBACK

The user must be provided with at least basic feedback that the SMS has been received. Ideally, they should also be informed of a response that is being initiated or instructions for further actions. All the mHealth tools described in this paper allow for mass SMS of all (or subsets of) users; therefore, these can also be used for health education messages.

12. CONSIDER USING OFF THE SHELF SOLUTIONS FOR PROTOTYPING

There are several free resources available, such as Frontline SMS⁷, which can be customised to provide mHealth solutions and do not require a high level of technical skills. This is especially important for short term – or very localised – trials such as the day 3 pilot, to avoid the cost of developing a new system. These resources also allow for flexibility to design and change the system, with can become a basis for scaling up to a more robust system. This was the case with the day 3 pilot, which evolved into the day 0 system.

Conclusion

The Cambodian national malaria programme now has a number of tools available to improve routine surveillance. These tools have been decentralised to the operational district level, allowing district officials to gain improved access to relevant information for their operational activities. At national level, these tools allow for better risk stratification and easier production of donor and other reports.

Additionally, the national programme now has a number of innovative mHealth solutions for its specific real-time data needs. The success of these tools will depend to a large extent on the response to the SMS alert generated by these systems. The focus of the surveillance effort should now be directed towards designing appropriate responses for the different zones in Cambodia.

The national programme now has a number of innovative mHealth solutions for its specific real-time data needs. The success of these tools will depend to a large extent on the response to the SMS alert generated by these systems

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The CNM is ensuring routine surveillance tools are being used at all levels
Photo: Mimi Mollica



Malaria Consortium

Malaria Consortium is one of the world's leading non-profit organisations specialising in the comprehensive control of malaria and other communicable diseases – particularly those affecting children under five.

Malaria Consortium works in Africa and Asia with communities, government and non-government agencies, academic institutions, and local and international organisations, to ensure good evidence supports delivery of effective services.

Areas of expertise include disease prevention, diagnosis and treatment; disease control and elimination; health systems strengthening, research, monitoring and evaluation, behaviour change communication, and national and international advocacy.

An area of particular focus for the organisation is community level healthcare delivery, particularly through integrated case management. This is a community based child survival strategy which aims to deliver life-saving interventions for common childhood diseases where access to health facilities and services are limited or non-existent. It involves building capacity and support for community level health workers to be able to recognise, diagnose, treat and refer children under five suffering from the three most common childhood killers: pneumonia, diarrhoea and malaria. In South Sudan, this also involves programmes to manage malnutrition.

Malaria Consortium also supports efforts to combat neglected tropical diseases and is seeking to integrate NTD management with initiatives for malaria and other infectious diseases.

With 95 percent of Malaria Consortium staff working in malaria endemic areas, the organisation's local insight and practical tools gives it the agility to respond to critical challenges quickly and effectively. Supporters include international donors, national governments and foundations. In terms of its work, Malaria Consortium focuses on areas with a high incidence of malaria and communicable diseases for high impact among those people most vulnerable to these diseases.

www.malariaconsortium.org



Malaria Consortium is committed to a practical approach that integrates engagement between the community and health services, and national and global policy makers. It is an approach that is underpinned by a strong evidence base and driven by shared learning within and between countries

Children in Pailin, Cambodia





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