



Evaluation of community- and health facility-based
systems for the surveillance of cases of day-3 positive
Plasmodium falciparum in Cambodia

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CONTENTS

1. SUMMARY	
1.1. Background	3
1.2. Principal findings: quantitative outcomes	3
1.3. Principal findings: qualitative outcomes	3
1.4. Implications	4
2. INTRODUCTION	
2.1. Background and rationale for day-3 positive surveillance	5
2.1. The pilot phase	6
2.2. Focus, scope and objectives of the current review	6
2.3. Methodological approach	8
3. ANALYSIS OF DATA FROM THE PILOT STUDIES	
3.1. Community-based pilots: data summary	11
3.2. Community-based pilots: spatial and temporal patterns of day-0 and day-3 cases	13
3.3. Community-based pilots: data on process indicators	17
3.4. Health facility-based pilot: data summary	21
4. FIELD EVALUATION OF THE COMMUNITY- AND FACILITY-BASED PILOT SYSTEMS	
4.1. FHI community-based pilot activities	23
4.1.1. Overview of the FHI community pilot	23
4.1.2. VMW roles and responsibilities under FHI	24
4.1.3. HC roles and responsibilities under FHI	26
4.1.4. Additional user feedback	27
4.1.5. Key strengths and weaknesses of the FHI system	29
4.2. URC community-based pilot activities	31
4.2.1. Overview of the URC community pilot	31
4.2.2. VMW roles and responsibilities under URC	31
4.2.3. HC roles and responsibilities under URC	35
4.2.4. Additional user feedback	36
4.2.5. Key strengths and weaknesses of the URC system	38
4.3. CNM community-based pilot activities	40
4.3.1. Overview of the CNM community pilot	40
4.3.2. VMW roles and responsibilities under CNM	40
4.3.3. HC roles and responsibilities under CNM	42
4.3.4. Additional user feedback	43
4.3.5. Key strengths and weaknesses of the CNM system	44
4.4. CNM health facility-based pilot activities	45
4.4.1. Overview of the facility-based pilot	45
4.4.2. Activities within the health facility	45
4.4.3. Additional user feedback	47
4.4.4. Key strengths and weaknesses of the health facility-based system	49
5. SYNTHESIS OF MAIN FINDINGS AND RECOMMENDATIONS	
5.1. Principal themes and recommendations	50
ANNEX 1 : LIST OF PERSONS MET IN PILOT PROVINCES	57
ANNEX 2 : SUMMARY OF PILOT PROJECT COSTS	59

1. SUMMARY

1.1. Background

The development and testing of surveillance/mapping systems to detect day-3 *Plasmodium falciparum* (*Pf*) cases in Cambodia is a core objective of the BMGF supported containment project. Under this objective a pilot project to test the feasibility of surveillance delivered through existing networks of VMWs and health centres was conducted between August 2010 and July 2011.

Pilot systems were introduced by CNM and partners in four provinces in containment zone 1. CNM implemented a pilot system of health facility-based surveillance at seven sites in Kampot, Pursat, Battambang and Pailin. In addition, a number of pilot studies to test the feasibility of a community-based surveillance system (incorporating VMWs) were carried out by CNM, the University Research Company (URC) and Family Health International (FHI). Pilot activities, originally scheduled to run for six months were later extended to run to the end of September 2011.

Evaluation visits to project sites were carried out in mid-July 2011. The focus of the evaluation was on core data collection functions of the pilot systems, with an emphasis on how data for day-3 *Pf* positive individuals are captured and disseminated and how patients are managed (particularly with regard to DOT).

1.2. Principal findings: quantitative outcomes

Surveillance data from the three community-based pilots indicated that 326 day-0 slide positive *Pf* cases were detected over the pilot period, with three-quarters of these being reported by VMWs in Ta Sanh. The distribution of *Pf* cases showed distinct clustering in space and time. Of the 112 villages included in the pilot studies only 42 reported *Pf* cases over the course of the pilot.

Of the 352 day-3 blood slides obtained across all sites, 54 were positive for *Pf*, representing an overall day-3 positivity rate of 18%. Most day-3 *Pf* cases were detected at the Ta Sanh site. Seven day-3 *Pf* cases were detected in Pailin and two were detected in Pursat. No day-3 *Pf* cases were detected at Trang or Kampot.

The dataset provided for the facility-based pilot appears to be incomplete. Across all facilities included in this study three individuals tested positive for *Pf* on day-3, from a total of 54 slides obtained.

1.3. Principal findings: qualitative outcomes

This review revealed significant variations in the characteristics of the pilot systems implemented by different partners. These differences related to administration of DOT, arrangements for obtaining and transporting day-3 slides, provision of training and supervision and use of financial incentives. Section 4 of this report provides a full account of the different arrangements adopted within each pilot study. It also documents user feedback obtained from semi-structured interviews carried out with key informants at each site.

Strengths and weaknesses associated with individual pilot systems are outlined in relevant parts of Section 4. Although comparative analysis across the range of different systems is

difficult, it is evident that pilot activities have been more effective at some sites than at others. This variation partly reflects the extent to which different partners have managed to motivate and effectively engage VMWs and HC staff. But experiences at each site were also influenced by a range of contextual factors over which project partners had relatively little control. The most important of these related to the capacity of the local health system at each locality. Pilot activities were least successful at sites where the existing VMW network was poorly managed or where the capacity of supervising health centres to carry out additional tasks was limited.

The range of experience at the various pilot sites suggests that a number of basic conditions have to be met for day-3 surveillance to be viable (see Section 5). As noted above, full engagement on the part of VMWs and HC staff is critical – and pragmatically the most effective way to ensure this is through providing adequate financial compensation for specific tasks and duties. VMWs, in particular, are responsible for a range of individual tasks including preparing blood slides on day-0, completing CIFs, administering DOT on days 0-2, obtaining follow-up slides on day-3 and transporting slides and paperwork to their supervising health centre. An inherent weakness of day-3 surveillance is that all of these components have to be carried out in a timely and conscientious way if the system is to work effectively. In practice this means that each task must in some way be linked to a financial incentive.

On the positive side, evidence from this evaluation indicates that, when suitably motivated, VMWs are willing and able to produce good quality blood smears and to achieve very high rates of DOT and day-3 follow-up. Also, it should be noted that VMW willingness to participate is not entirely linked to financial considerations. In the context of day-3 surveillance most VMWs professed to being primarily motivated by the opportunity to improve management of *Pf* cases in their communities. It is important, therefore, that appropriate mechanisms of feedback and support are developed to help VMWs achieve this.

1.4. Implications

On balance, the evidence presented in this review suggests that community-based surveillance of day-3 *Pf* cases is feasible. At the same time it should be recognized that this is a highly intensive activity that places significant new demands on VMWs and health facility staff. To succeed, these systems need strong and continuous support, particularly in terms of supervision and training. The capability and capacity of health centres (and in particular their labs) to backstop VMW activities is an important element of this.

There appears to be little to justify the development of standalone day-3 surveillance delivered through health facilities. We found no real evidence to suggest that significant numbers of outpatients diagnosed with *Pf* can be expected to return to the facility on day-3 for a follow-up slide. In addition, in the absence of DOT there is no reliable way to gauge the rate of non-adherence among patients who do return. Given these considerations, the value of facility-based monitoring of outpatients is questionable.

Although technically feasible, the purpose and role of community-based day-3 surveillance may need to be reassessed in the light of the apparent resource requirements involved. Certainly any scaling-up of the system will need to be done in a systematic and targeted way, with decisions about where to implement the system being based on clearly defined epidemiological criteria. More generally the role of day-3 surveillance in the context of alternative surveillance mechanisms (sentinel sites, point-of-care reporting of all incident cases) needs to be defined and an over-arching strategy incorporating all malaria surveillance components developed.

2. INTRODUCTION

2.1. Background and rationale for day-3 positive surveillance

In June 2010 CNM, supported by a joint WHO-Malaria Consortium (MC) mission, developed a comprehensive framework for malaria surveillance strengthening in Cambodia. This framework set out a number of linked components that were considered necessary to support both the short-term objectives of the BMGF-supported containment project and the longer-term goal of malaria elimination in Cambodia.

A key element of this framework was the creation of a surveillance/mapping system to passively detect day-3 positive *Pf* cases and facilitate appropriate response activities. It was envisaged that this system would operate both at health facilities (covering inpatients and outpatients) and at the community level, based on the existing VMW system. The main characteristics of this system have been described in previous reports, but are summarized below.

At health facilities:

- Patients presenting with suspected malaria follow the routine consultation procedure at the health centre/hospital, with diagnosis of malaria by microscopy.
- Individuals testing positive for *Pf* on day-0 have an additional clinical consultation and a special day-3 case investigation form (CIF) is filled in. The patient is prescribed the standard three-day treatment course of duo-cotecxin (dihydroartemisinin-piperaquine; DHA-PPQ) and is provided with a patient card. An appointment is made for the patient to return on day-3 for a follow-up blood slide.
- On day-3 a second blood smear is prepared and examined. The lab-specific part of the CIF is completed by lab staff. If the day-3 slide is positive for *Pf* a pre-coded SMS message is sent to a CNM server using a dedicated phone number. From there text alerts are relayed to relevant partners, including staff at operational districts (OD) and provincial health departments (PHD).

In the community:

- On day-0 VMWs obtain blood smears for all individuals presenting with suspected malaria and testing positive for *Pf* by RDT.
- For RDT *Pf* positive individuals, VMWs are also responsible for administering directly observed therapy (DOT) on days 0-2, preparing a follow-up blood smear on day-3 and completing the first part of the CIF.
- Blood slides are sent to (or collected by) the VMW's supervising health centre (HC) to be examined by lab staff. As for health facility-based surveillance, key data on individuals testing positive for *Pf* on day-3 are sent to CNM using pre-coded SMS messages.

Within this basic framework a certain amount of flexibility was retained to allow individual implementing partners to adjust their protocols to best suit the existing situation on the ground. For example, details concerning the logistics of patient follow-up (DOT and day-3 slide), the method of transporting blood slides from VMWs to HCs, local staffing and supervision arrangements and staff remuneration were determined individually by partners. An important function of the current evaluation, therefore, is to thoroughly document the protocols adopted by each partner, to identify their relative advantages and disadvantages and highlight examples of best practice.

2.1. *The pilot phase*

It was recognized from the outset that developing systems to detect and report day-3 *Pf* positive cases would require the introduction of a set of entirely new surveillance activities at various levels of the health system, and that in practical terms introducing such a system would be far from trivial. For the system to be effective patients testing positive for *Pf* malaria on day-0 need to be successfully traced and re-tested on day-3. Also, administration of DOT is required for purposes of drug adherence and to ensure that “day-3 *Pf* positivity” is a meaningful indicator. Moreover, to minimize costs the system needs to make extensive use of existing staff resources, including VMWs and health facility staff. Given that the system introduces either entirely new forms of activity (e.g. slide preparation by VMWs or the filling out of CIFs by clinical staff) or, at the very least, increased workload (e.g. a larger number of slides to be processed by lab staff), the viability of such a system is in no way guaranteed.

For these reasons it was considered necessary to implement and test community and health facility-based systems on a pilot basis before any decisions concerning wider implementation could be made. From July 2010 CNM and partners introduced pilot systems in four provinces in containment zone 1. CNM implemented a pilot system of health facility-based surveillance at seven sites in Kampot, Pursat, Battambang and Pailin. In addition, a number of pilot studies to test the feasibility of a community-based surveillance system (incorporating VMWs) were carried out in the same four provinces by CNM, the University Research Company (URC) and Family Health International (FHI). The principal objective of these pilot studies was to assess the feasibility and viability of community- and health facility-based systems to capture and disseminate information on day-3 positive *Pf* cases. A secondary objective was to collect and analyze basic epidemiological data relating to day-3 positive cases in order to inform the design and deployment of future containment/elimination activities.

Table 1 lists the geographic focus of the pilot activities under each implementing partner. To date pilots have focused on containment zone 1¹, often with considerable physical overlap between the activities of different partners. Pilot surveillance activities started between July and October 2010, depending on the implementing partner, and were originally scheduled to run for six months. Delays in the start-up of some activities, together with a smaller than expected number of malaria cases at some sites in the first few months of the project, led to the pilot period subsequently being extended to run to the end of September 2011.

2.2. *Focus, scope and objectives of the current review*

As noted above, the main objective of the day-3 surveillance pilots was to test the feasibility of the new data collection and dissemination activities being introduced at the peripheral level. This evaluation therefore focuses on the core data collection functions of the pilot systems, with an emphasis on how information on day-3 *Pf* positive individuals is captured and disseminated and how patients are managed (particularly with regard to DOT). It is important to recognize that the ability of the day-3 surveillance system to achieve its primary purpose (*i.e.* to contain drug resistant parasites) will also depend on other components of the surveillance system – and especially on the development of an effective strategy for responding to reported day-3 positive

¹ Although the main phase of the day-3 surveillance pilot was restricted to zone 1, from March 2011 URC's community-based pilot was extended to include villages in Oddar Meachey province (zone 2). These extension activities are not covered by the current evaluation, however.

Table 1. Geographic focus of day-3 positive surveillance pilot projects by partner.

<i>Partner</i>	<i>Community surveillance</i>	<i>Health facility surveillance</i>
URC	Battambang (28 villages in 2 ODs)*	
FHI	Pailin (28 villages in 1 OD)**	
CNM	Kampot (36 villages in 1 OD) Pursat (20 villages in 1 OD)	Kampot (1 RH, 1 FDH) Pursat (1 HC) Battambang (1 RH, 2 FDHs) Pailin (1 RH)

* Expanded in Mar 2011 to include 2 additional ODs; these extension activities are not covered by this review

**Initially 17 villages; expanded to 23 villages from Jan 2011; expanded to 28 villages from March 2011

cases. This in turn depends on having clear, predefined response procedures, agreed roles and responsibilities among stakeholders and effective communication between partners. Although these issues are touched upon in the discussion section of this document, they fall outside the main scope of this exercise. Likewise, although the evaluation touches on wider issues related either to the general operations of CNM (and, more specifically, the routine VMW network) or to other areas of malaria surveillance (*e.g.* the development of day-0, point-of-care case reporting systems), these issues also fall outside the main remit of the current evaluation.

Within this review pilot systems are evaluated on the basis of technical quality (*e.g.* alignment of activities to project aims and objectives, quality and appropriateness of surveillance activities introduced, operational procedures and data management, data timeliness and completeness, user friendliness) and from a project management perspective (*e.g.* appropriateness of project management, clarity of partner roles, appropriateness and justification of resource allocation).

The principal focus of this report is the effectiveness of surveillance activities introduced at village and health facility levels and the bulk of this report relates to interviews carried out with VMWs, HC staff and other project staff. The evaluation attempts to identify key strengths and weaknesses in the design and implementation of the pilot systems introduced by each partner and from there to distinguish a number of cross-cutting issues that are common to all the systems. This evidence base is used to gauge the overall viability of day-3 surveillance at community and health facility level and to make specific recommendations in relation to future activities. The primary objectives of this review, therefore, are to:

1. Collate and describe day-0 and day-3 data available from day-3 surveillance pilots
2. Describe key characteristics of the pilot systems implemented by each partner, including main operational costs
3. Evaluate the effectiveness, efficiency, appropriateness and sustainability of pilot project activities (by partner)
4. Assess user practices, perceptions and opinions related to pilot surveillance activities (by partner)
5. Identify project limitations, strengths and best practice (cross-cutting and by partner)
6. Make recommendations on potential improvements to project design and scope for wider implementation

2.3. Methodological approach

This evaluation focuses on pilot activities in the three provinces of Pailin, Battambang and Pursat (Figure 1). For URC and FHI this covers the original community-based pilots implemented from July 2010 in Battambang and Pailin respectively, but does not include the subsequent expansion of URC activities in March 2011 to cover additional villages in Battambang OD and also in Samrong OD (in zone 2, Oddar Meachey province). For CNM the evaluation covers community- and health facility-based activities in Battambang, Pailin and Pursat, but not activities in Kampot province (although some sites in Kampot were visited as part of pre-evaluation fieldwork; see previous MC trip reports).

Qualitative data relating to system performance and provider experiences were collected through a series of semi-structured, open-response interviews with key informants. Separate Interview guides for VMWs and health facility staff were prepared in advance on the basis of pre-evaluation field visits. Khmer-English translation was provided by Sophal Uth, a senior field officer working with MC. Interviews were conducted with VMWs (either individually or in pairs) at village level. Health facility staff officially connected with the day-3 surveillance pilots (including health centre chiefs/hospital directors, other clinical staff and lab staff) were interviewed at their respective health facility. Field staff from FHI and URC were interviewed at provincial level. Project principal investigators were interviewed at the national level. A full list of individuals interviewed during the main fieldwork phase of the evaluation (11-21 July 2011) is included as an annex to this report.

For CNM's facility-based pilot field visits were made to two referral hospitals (RH), two former district hospitals (FDH) and one HC (see Figure 1). This represents five of the seven facilities included in the pilot system (the remaining two are located in Kampot province).

Table 2. Health facilities and number of VMW villages visited during the evaluation. (Facilities listed in grey text were not visited).

Partner	Province	OD	Supervising health facility	Villages in catchment	No. of pilot villages	Villages visited
URC	Battambang	Sampov Luon	Trang HC (FDH)	27	15	6
		Battambang	Ta Sanh HC (FDH)	17	13	6
FHI	Pailin	Pailin	Krachab HC	11	9	4
			Ou Chra HC	21	3	2
			Suon Koma HC	21	6	2
			Phnom Preal HC	16	1	
			Phnom Spung HC	36	3	
			Phsar Prum HC	10	1	
CNM	Pursat	Sampov Meas	Pramaoy HC	25	17	7
			Thmarda HC	3	3	

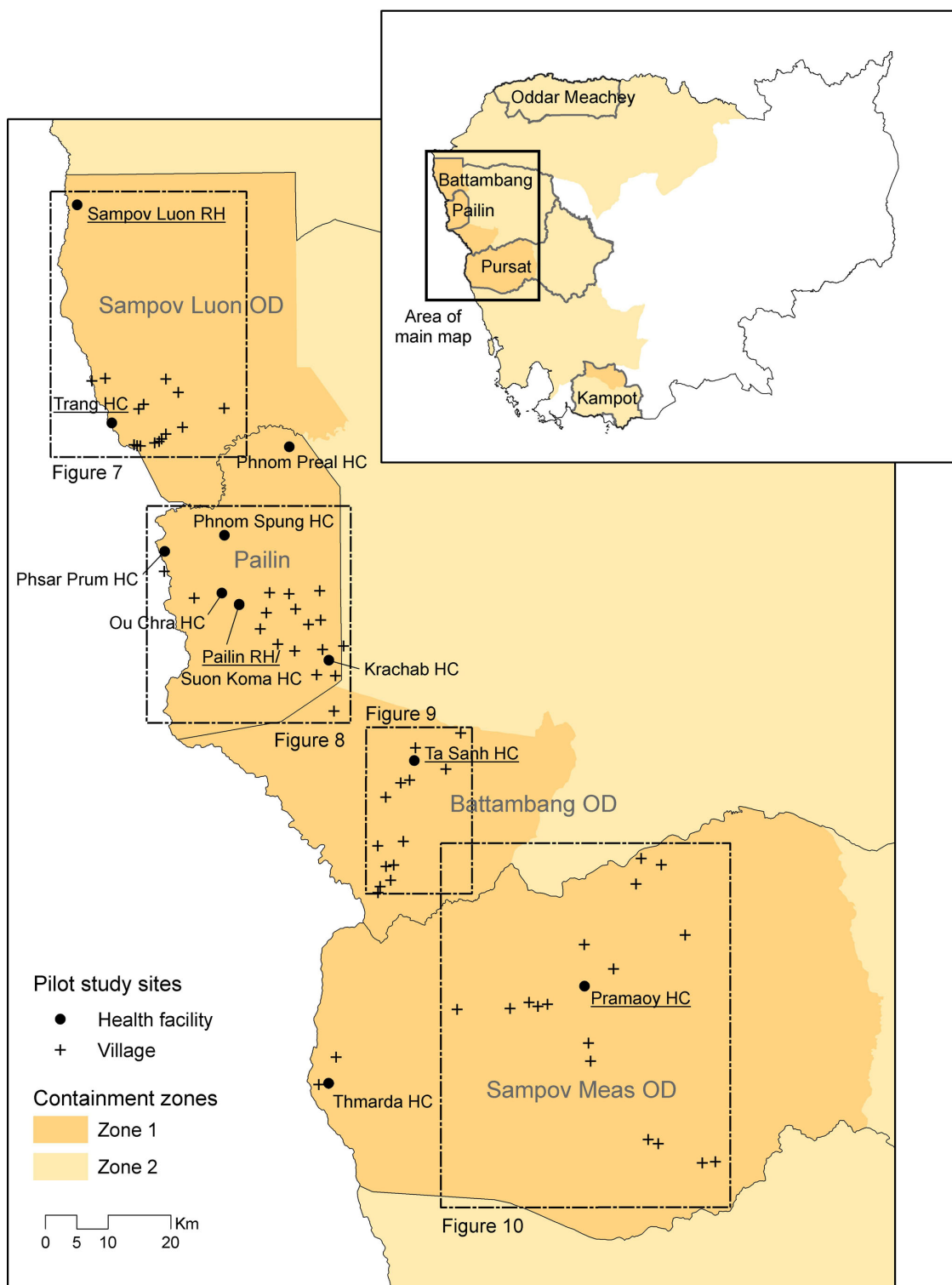


Figure 1. Map of health facilities and villages included within the CNM, URC and FHI pilot surveillance systems in Battambang, Pailin and Pursat districts. Health facilities included in CNM's facility-based pilot are underlined; other marked facilities supervise VMWs in the community-based pilots. The map indicates links to more detailed maps of sites visited during this evaluation.

For the community-based study a cross-section of VMWs and staff at supervising health facilities were interviewed. Six supervising health facilities and 27 VMW villages (out of 63 being supervised) were visited as part of this process and a total of 32 VMWs were interviewed (Table 2). Given the nature of the pilot system – and particularly the fact that a minority of villages had reported any *Pf* cases during the pilot phase – this selection was essentially non-random but was stratified in such a way as to capture variations in village population size, malaria case loads and accessibility.

As part of this evaluation surveillance data from both the facility- and community-based pilots were collated and analyzed. Partners were asked to provide a range of data, including information on RDT and blood slide results and “process” data relating to the timings of blood slide preparation, transport and examination. These data were assembled into standard datasets and are described in the next section of this report.

3. ANALYSIS OF DATA FROM THE PILOT STUDIES

The following section describes the main characteristics of the day-0 and day-0 *Pf* data provided by the three implementing partners. It is worth noting at the outset that the completeness and comprehensiveness of these datasets varied. In some cases this limited the types of analyses that could be carried out (for example some basic indicators, such as day-0 slide positivity rates could not be determined). Most importantly partner datasets effectively included different samples of people. The CNM dataset, for example, only included records for individuals for whom a day-3 slide had been examined – and so excludes any RDT or day-0 slide results for patients who were not successfully followed up. The FHI dataset does include demographic information on all individuals sampled on day-0, but does not include day-0 slide results for those who were not followed up on day-3. These basic differences should be borne in mind when interpreting some of the cross-site data summaries presented as graphs and tables.

3.1. Community-based pilots: data summary

Table 3 presents summary data on day-0 and day-3 *Pf* cases recorded during the pilot period. Across all sites a total of 326 slide positive *Pf* cases were detected on day-0, with three-quarters of these (245/326) being reported by VMWs in the catchment of Ta Sanh HC. Of the 112 villages included in the pilot studies only 42 (37%) reported any *Pf* cases over the period of the pilot study. This proportion varied substantially between sites. In Ta Sanh 85% of pilot villages reported at least one *Pf* case. In Pailin, Pursat, Kampot and Trang this figure was 50%, 40%, 19% and 13% respectively.

The 326 day-0 slide positives came from a pool of 398 RDT-positive cases (*Pf* or mixed infections). However, as noted in Table 3, this is not representative of all RDTs carried out over the pilot period. Data on RDT positivity rates are not available for the FHI and URC pilot sites. For URC the overall RDT positivity rate was reported separately from the main day-3 dataset. Among VMWs in Ta Sanh a total of 1,861 RDTs were carried out between September 2010 and June 2011, of which 625 (34%) were positive. Only 15% of tests, however, were positive for *Pf* or mixed infections. In Trang VMWs used 236 tests in the same period. The positivity rate for malaria was 17% and for *Pf* and mixed infections only 3%.

Data from the URC community pilot indicate that the *Pf* positivity rates by microscopy for individuals diagnosed with *Pf* or mixed infections by RDT were 89% (245/276) and 67% (4/6) at Ta Sanh and Trang respectively. As noted in Table 3 it is not possible to calculate corresponding positivity rates at other pilot sites. The CNM datasets for Pursat and Kampot only include information on RDT outcomes for individuals for whom a day-0 slide was obtained (*i.e.* only a small minority of individuals presenting to VMWs, see below). The FHI dataset does appear to include complete RDT data for the study period but day-0 slide results are only reported for individuals who can be linked to a day-3 slide (again, a minority of individuals presenting to VMWs).

A breakdown of parasitological results from RDTs and microscopy is included in Table 4. The data presented are for individuals with slide-confirmed *Pf* or mixed infections at day-0. At both the URC and FHI sites a large proportion of RDT mixed infections turned out to be *Pf* infections only. Data for CNM suggest that some sort of forward or backward correction of parasite species has been carried out.

Table 3. Site-specific summary data for day-0 and day-3 cases generated by URC, FHI and CNM community pilots

	URC			FHI		CNM		
	Ta Sanh	Trang		Palin	Pursat	Kampot	Total	
Villages included in pilot	13	15		28	20	36	112	
Villages reporting Pf cases	11	2		14	8	7	42	
Number of RDT Pf+ reported	276	6		60	27 ¶	29 ¶	398	
Number of day-0 slides prepared	276	6		60 *	27	29	398	
Number of day-0 slides Pf+	245	4		21	27	29	326	
Number of cases followed up on day-3	245	3		21	25	24	318	
Number of day-3 slides Pf+	54	0		7	2	0	63	
Overall % day-3+	22.0	0.0		33.3	8.0	0	19.8	

* Note that the FHI dataset only includes day-0 slide results for individuals who can be matched to a day-3 slide

¶ Note that CNM datasets only include RDT data for individuals who can be matched to a day-0 slide

Table 4. Summary of parasitological data reported by each community pilot study. Note that the table includes only individuals who tested positive for *Pf* or mixed infections on day-0.

	URC*			FHI			CNMJ		
	RDT	Microscopy		RDT	Microscopy		RDT	Microscopy	
	Day-0	Day-0	Day-3	Day-0	Day-0	Day-3	Day-0	Day-0	Day-3
<i>P. f</i>	39 14%	230 82%	54 19%	19 79%	2 8%	7 29%	25 45%	25 45%	2 4%
Mixed	243 86%	19 7%		24 100%	2 8%		31 55%	31 55%	
<i>P. v</i>			2 1%		1 4%				
Negative		33 12%	192 68%		2 8%	14 58%		46 82%	
Missing slide			34 12%			3		8 14%	
Total	282	282	282	24	24	24	56	56	56

*Ta Sanh and Trang combined

J Pursat and Kampot combined

Table 3 indicates that of 318 day-3 blood slides obtained across all sites, 63 were positive for *Pf* (and an additional two for *Pv*, see Table 4)². This represents an overall day-3 positivity rate of 20%. The vast majority of day-3 *Pf* cases (54/63, 86%) were detected at the Ta Sanh site, where the overall day-3 positivity rate was 22%. In Pailin the day-3 positivity rate, based on a relatively small denominator, was slightly higher – at 33.3%. In Pursat two day-3 *Pf* cases were detected from 25 day-3 slides (positivity rate = 8%). No day-3 *Pf* cases were detected at the Trang or Kampot pilot sites.

In terms of basic demographic characteristics, 76% of day-0 *Pf* and mixed infection cases and 70% of day-3 cases were male (compared to a background ratio of males to females in the study provinces which is roughly 50/50 according to 2008 census data). Taking all sites together, 78% of day-0 *Pf* and mixed infections were among individuals over the age of 14. The corresponding figure for day-3 cases (79%) was almost identical.

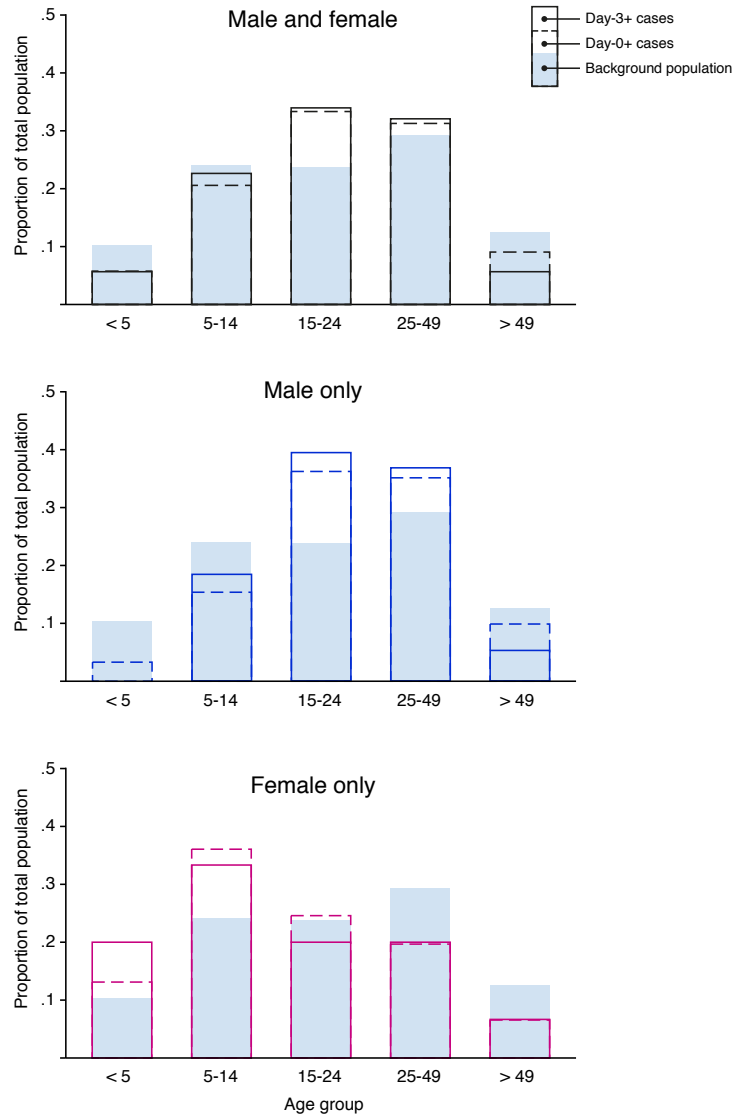
A more detailed representation of the age distribution of day-0 and day-3 *Pf* cases at the Ta Sanh site is provided in Figure 2. Because (at the time of writing) age and sex breakdowns are not available for all individuals presenting to VMWs in Ta Sanh, this comparative analysis incorporates age profiles derived from data for Battambang province included in the Cambodia 2008 census. The three graphs in Figure 2 show the relative proportions of day-0 and day-3 *Pf* cases for a variety of age groups, expressed as a fraction of the sample tested. These distributions are overlaid with the overall age structure of the general population in Battambang (represented by grey bars), as reported in the census. If the risk of malaria infection was constant across age groups and consistent between day-0 and day-3 cases the bars for each age group would be the same. In the first panel, however, it appears that fewer individuals under five or over fifty are infected with *Pf* than would be expected based on the background population structure. In contrast a disproportionate number of individuals in the 15-24 age range are infected. When stratified by sex these patterns change considerably. In the “male only” plot, adult males between 15 and 49 years appear to be at much greater risk of infection than males in other age groups. For females it appears to be the younger age groups that are at greatest risk of infection. Overall, relative patterns among the day-0 and day-3 datasets are broadly similar (perhaps surprisingly so, given the small size of the day-3 dataset).

3.2. Community-based pilots: spatial and temporal patterns of day-0 and day-3 cases

Among villages reporting *Pf* cases there was significant variation in case incidence rates both within and between study sites. Panel A in Figure 3 shows variations in *Pf* incidence based on VMW data reported through the pilot system. The map indicates a cluster of relatively high incidence villages at the southern end of the Ta Sanh HC catchment but suggests that levels of malaria incidence in Sampov Luon, Pailin and Pursat were relatively low over the reporting period. However, a slightly different picture emerges when data from standard VMW monthly reports (rather than data reported internally within the pilot day-3 system) are used to map incidence. In Panel B of Figure 3, incidence rates at villages in Pailin and Sampov Luon remain low, but estimated rates increase markedly in a number of villages in Pursat. This suggests that a large proportion of RDT positive cases in Pursat have not been captured by the pilot day-3 surveillance system. This is confirmed by data in Table 5, which indicate that in Pursat only 27 day-0 blood slides were prepared from the 713 individuals who tested positive for *Pf* by

² While there is some value in presenting day-3 *Pf* positivity rates, it should be noted that not all VMWs at all sites were able consistently to provide DOT to those patients testing positive for *Pf* on day-0. As such the reliability of day-3 positivity as an indicator is likely to vary significantly between partners.

Figure 2. Graphs showing age structures of different population groups in the Ta Sanh study. Note that bars are overlaid, not stacked. Grey bars indicate the distribution of ages across the population of Battambang as a whole (as derived from 2008 census data). Empty bars with dashed outlines indicate the age distribution of individuals with slide-positive *Pf* infections. Empty bars with solid outlines indicate the age distribution of individuals with *Pf* infections at day-3.



RDT. This means that day-0 blood slides were only obtained for 4% of RDT-positive *Pf* cases at this site. In Pailin, conversely, it appears that many of the *Pf* cases detected through the pilot system were not captured through routine VMW reporting (see, for example, data for Ou Preus and Phnum Dambang). It is not clear at this stage what the reasons for this are, given that the monthly reports from villages in Pailin seem to be more or less complete. In Battambang (Ta Sanh and Trang) the number of *Pf* cases captured by the day-3 system are near identical. The small variations that do exist probably reflect the fact that data from the routine system are aggregated by month, while data from the pilot are not.

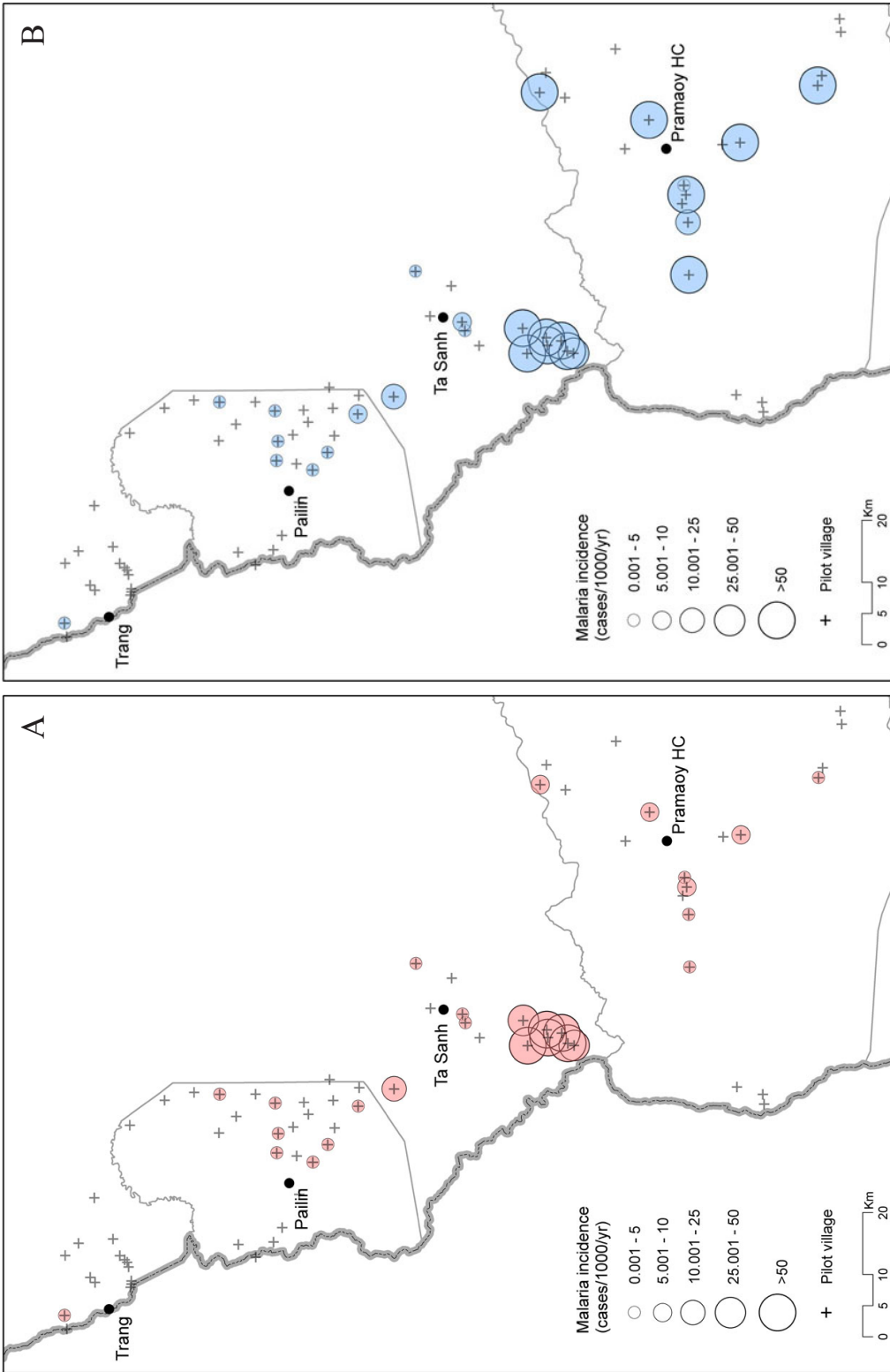


Figure 3. Spatial patterns of day-0 Pf incidence across the community-based study sites in Battambang, Pailin and Pursat. Panel A shows patterns of Pf malaria incidence based on RDT data reported within the pilot systems. Panel B shows corresponding incidence estimates based on case data reported through the routine VMW system. Notably there are substantial differences between the two incidence estimates for villages in the catchment of Pramaoy HC (Pursat).

Table 5. Absolute numbers and incidence rates of RDT *Pf* cases reported through the routine CNM reporting system compared to cases reported through the pilot studies. The number of day-0 blood slides prepared at each pilot village is also presented.

Site	Village*	Cases reported to CNM	Cases reported in pilot	Incidence (CNM data)	Incidence (pilot data)	Day-0 slides
Ta Sahn (URC)	Peamta	11	12	44	49	12
	Ou Traeng	29	30	139	134	28
	Veal Roleum	36	32	142	118	30
	Tataok	10	10	53	53	10
	Ou Nonoung	31	27	241	202	26
	Ou Kroch/Ou Thmor	32	30	58	47	26
	Phnom Rai	122	116	227	198	106
	Chamka Stoeng/Ou Totem	0	12	0	0	0
	Tasanh Cheung	5	4	6	5	4
	Anlong Pouk	2	2	2	2	2
	Don Tret	1	1	1	1	1
Trang (URC)	Ou Koki Oda	1	1	1	0	0
	Dey Kraham	6	5	4	3	4
Pailin (FHI)	Khork Moush	1	1	2	2	1
	Dei Kraham	1	2	2	2	1
	Ou Preus	1	10	0	1	3
	Krachab Leu	3	6	6	4	2
	Prey MongKol	3	0	3	0	0
	Phnum Dambang	7	24	11	17	11
	O Treng Krom	0	1	0	0	0
	Tuek Phos	2	1	2	1	1
	O Ta Tus	0	1	0	0	0
	Phnom Reang	0	1	0	0	0
	Pich Kiri	2	2	2	1	1
	O Suor Sdei	1	1	1	0	0
	Bar Thmei	0	6	0	0	0
	Koun Damrei	1	1	2	0	0
	O Chet Prait	0	3	0	2	1
Pursat (CNM)	Ou Saom	6	0	25	0	0
	Kandal (Ou Saom)	10	0	84	0	0
	Chhay Louk	85	1	324	4	1
	Kien Chongruk	5	0	23	0	0
	Krapeu Pir Leu	67	0	150	0	0
	Krapeu Pir Kraom	70	2	188	5	2
	Samlanh	27	0	33	0	0
	Kandal (Anlong Reab)	1	3	1	4	3
	Krang Rongieng	44	5	87	10	5
	Chamkar Chrey Cheung	19	0	55	0	0
	Chamkar Chrey Tboung	17	2	23	3	2
	Dei Kraham	70	4	62	4	4
	Chheu Teal Chrum	44	2	131	6	2
	Pchoek Chrum	28	0	93	0	0
	Stueng Thmei	176	8	151	7	8
	Tompaor	3	0	12	0	0
	Ekhapheap	11	0	15	0	0
	Kandal	23	0	77	0	0
	Sangkum Thmei	7	0	19	0	0

*This table excludes 29 villages with no reported RDT positive cases during the pilot period (2 villages in Ta Sahn, 13 villages in Trang and 14 villages in Pailin)

As noted above, the geographical distribution of both day-0 and day-3 *Pf* cases is heavily skewed towards the Ta Sanh site. However, considerable spatial variability in day-0 and day-3 cases is also evident within each pilot site. As presented in Table 3, only 14 of 28 villages in the Pailin pilot reported any RDT *Pf* or mixed infections between September 2010 and July 2011 – and only four villages reported more than three cases over this period. Of the 60 day-0 *Pf* and mixed infections detected by RDT cases detected, more than half came from just two villages: Ou Preus (10 cases) and Phnum Dambang (24 cases).

At the Trang site only two villages out of the fifteen included in pilot reported any *Pf* or mixed infections by RDT. In the event, all of the four slide-confirmed day-0 *Pf* cases came from a single village (Dei Kraham).

For Ta Sanh, Figure 4 shows local spatial variations in day-0 incidence rates (Panel A) and day-3 incidence rates (Panel B) among pilot villages. Most of the villages in the northern part of the field area saw few if any day-0 *Pf* cases. Malaria transmission was highest in villages at the southern end of the field site, which are located close to primary forest. In two villages (Phnom Rai and Ou Nonoung) day-0 *Pf* incidence was around 200 cases per 1000 per year. Interestingly, however, day-0 and day-3 incidence rates were not strongly correlated. In the case of Ou Nonoung, for example, the day-3 positivity rate was 58%, which translates into a day-3 incidence rate of 117 cases per 1000 per year. In contrast, the day-3 positivity rate in Phnom Rai was only 7.5%, which translates into a much lower rate of day-3 incidence of 15 cases per 1000 per year.

Data from the pilot studies demonstrate temporal as well as spatial clustering. Figure 5 shows weekly totals of day-0 and day-3 *Pf* cases for pilot sites in Ta Sanh, Trang and Pailin. The apparent peak in day-0 cases in Pursat in weeks 47-50 of 2010 is probably an artifact related to the timing of training workshops run by CNM and the availability of slides and other consumables. The distribution of cases reported by VMWs through the routine surveillance system is actually somewhat different – with high caseloads in November-January being followed by relatively low case loads in February-April and then a return to high case loads from May. In this respect the temporal pattern of day-0 cases at Ta Sanh (Figure 4) is probably a better representation of seasonality of transmission in this part of Cambodia. The dataset for Ta Sanh represents a small sample but the ratio of day-0 to day-3 positive cases does appear to be highly variable between months. Most notably, 26 of the 54 day-3 cases reported in Ta Sanh were detected in a four-week period between 26 September and 21 October, soon after the start of the pilot. This translates into 48% of the day-3 *Pf* cases being reported within a time window representing 8% of the study period. The reasons for this temporal clustering are not immediately evident.

3.3. Community-based pilots: data on process indicators

When compiling datasets for the community-based pilot, project partners were asked to collate (where possible) additional information relating to the timing of various activities within the case reporting/management process. In terms of VMW activities this included time and date data relating to the preparation of day-0 and day-3 slides and the administration of DOT. At the health facility this included data on times and dates for when day-0 and day-3 slides were received and examined.

In the event this was not possible in all cases. The most complete process data came with the FHI dataset for Pailin, which included times as well as dates for all the activities listed above, including individual doses of DOT. The URC datasets included dates and times for the

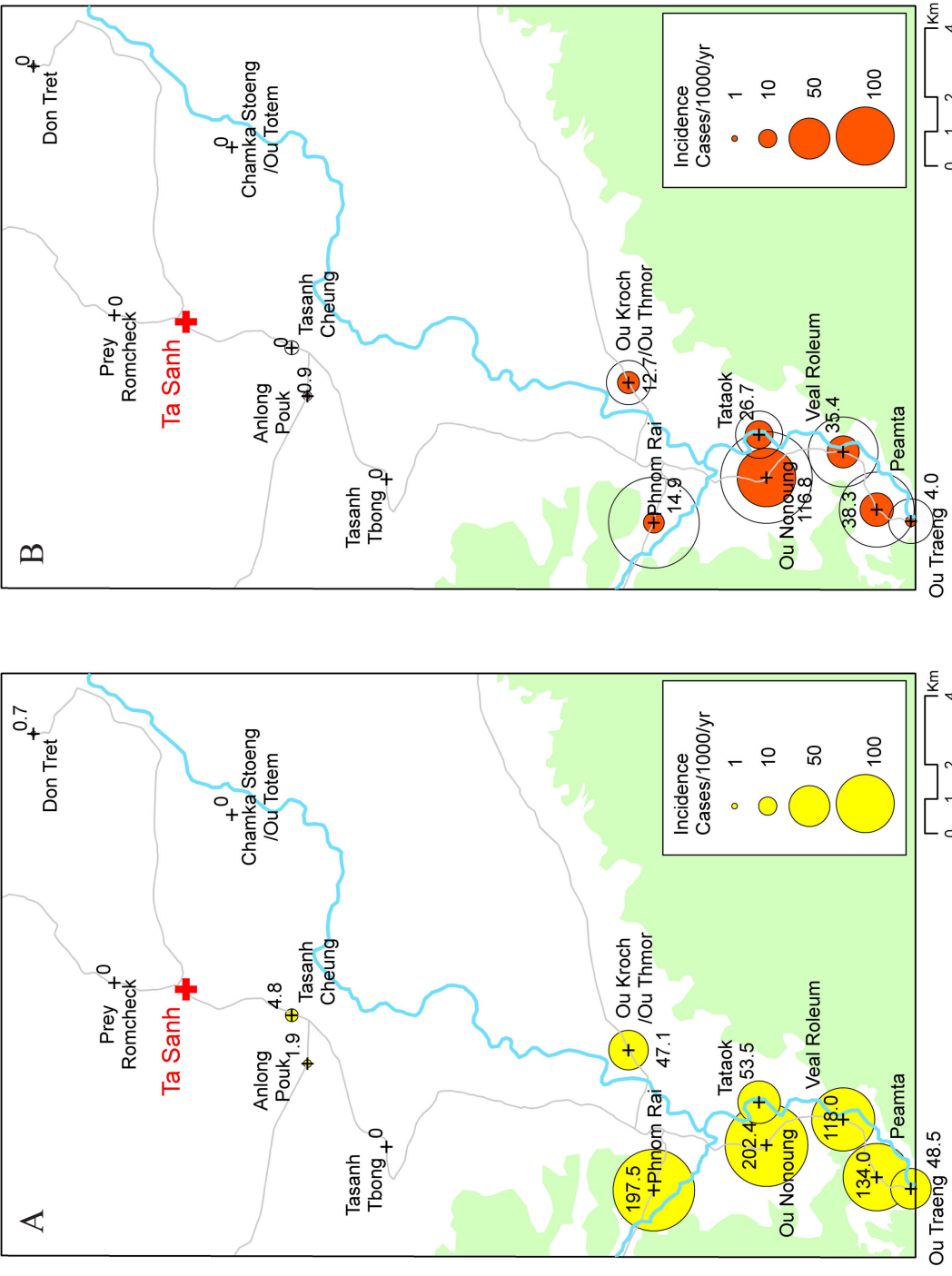


Figure 4. Ta Sanh: spatial variations in village-level incidence rates for Pf for day-0 cases (Panel A) and day-3 cases (Panel B). Note that in Panel B empty rings are retained to indicate day-0 incidence rates and so highlight considerable variations in the ratio of day-0 to day-3 cases between different villages. Green shading indicates forested areas (as digitized from Google Earth).

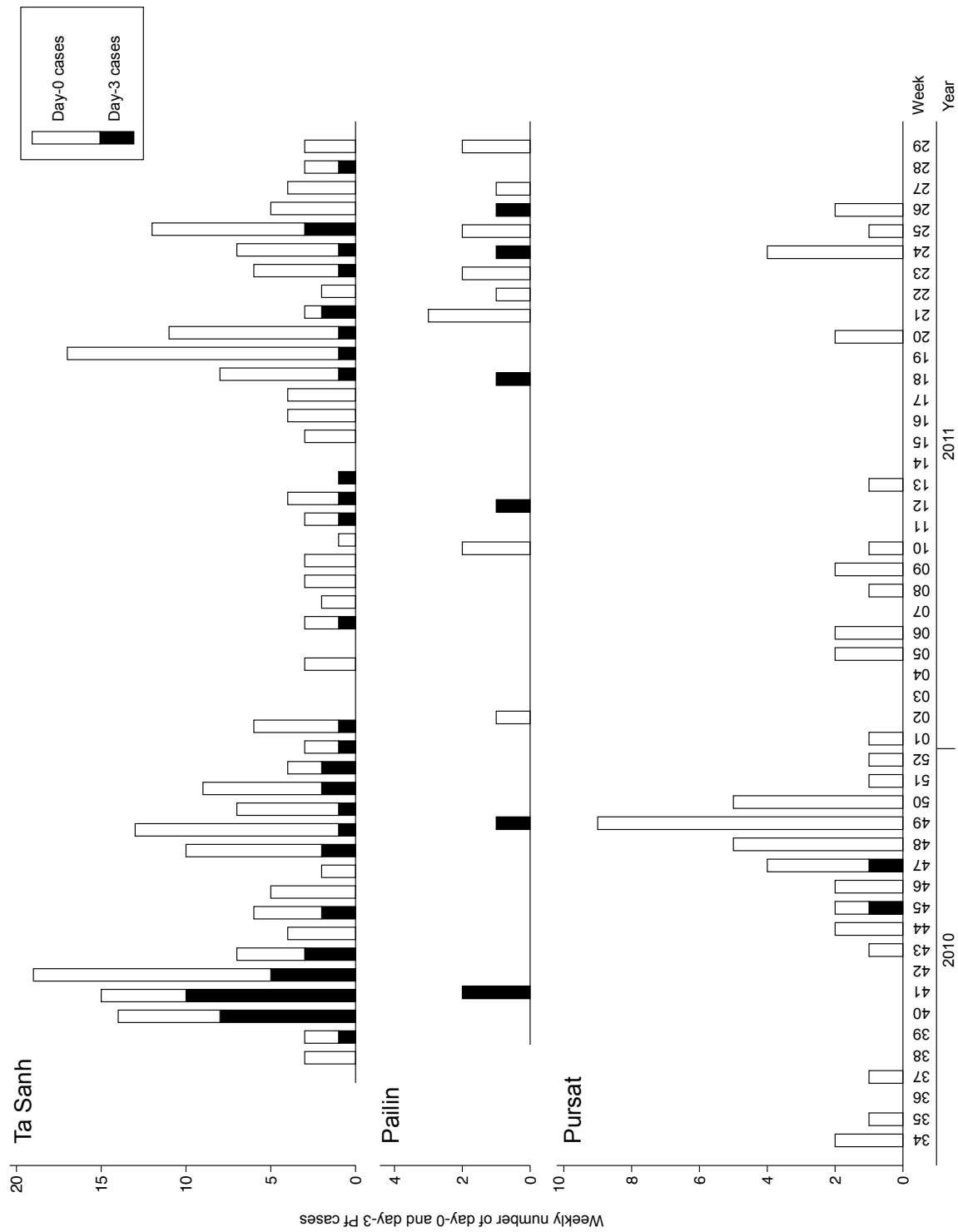


Figure 5. Weekly totals of day-0 and day-3 *Pf* cases reported by VMWs in Ta Sanh, Pailin and Pursat. (Note data from Trang are not shown. Here only four day-0 *Pf* cases were recorded over the period of the pilot [2011: 1 case in each of weeks 5, 12, 15 and 20] and no day-3 cases were detected).

preparation of day-0 and day-3 slides, as well as dates for the initiation of treatment and the reading of blood slides at the HC. The CNM datasets included time and date information for the preparation of day-0 and day-3 slides, but no information relating the timing of slide reading or treatment.

Table 6 represents an attempt to summarize process indicators relating to management of day-0 and day-3 slides that are common to both the URC and FHI datasets. CNM sites are not included in the table because the only relevant indicator that can be calculated is the time gap between the preparation of day-0 and day-3 slides. URC data from Trang are not included partly because of the very small sample size and partly because there was a relatively high error rate among the dates entered.

A notable feature of the data presented for Pailin is the very low rate of follow-up achieved at day-3. VMWs were able to obtain day-3 blood slides for only 21 of the 60 individuals for whom day-0 slides had been taken previously. The principle reason for this appears to be active recruitment of people with *Pf* and mixed infections into ongoing research studies in Pailin (see Section 4.1.1). Within the FHI dataset process information is only available for the 21 individuals who were followed up to day-3. All appear to have received treatment on day-0 and all had their follow-up day-3 slide prepared on the correct day. Within the FHI system day-0 and day-3 slides are transported individually to the health centre to be stained and examined. Taking data for day-0 and day-3 slides together 88% of slides were received by the HC on the same day they were prepared. The remaining 12% arrived at the HC the next day. The majority (83%) of day-0 and day-3 slides appear to have been examined on the same day they

Table 6. Selected process indicators related to community-level pilot activities.

	<i>Pailin</i>		<i>Ta Sanh</i>	
Number of day-0 slides prepared:	60		276	
Number of day-3 slides prepared:	21		276	
Treatment initiated: Same day (day-0)	21	100%	268	98%
+1 day			6	2%
	21		274	
Day-3 slide prepared: On day-3	21	100%	266	98%
On day-4	-		6	2%
	21		272	
Slides* received by HC: Same day	36	88%	171	62%
+1 day	5	12%	82	30%
+2 days	-		15	5%
+ 3 days or more	-		7	3%
	41		275	
Day-0/day-3* read by HC: Same day as received	34	83%	108	45%
+1 day	7	17%	92	38%
+2 days	-		22	9%
+ 3 days or more	-		17	7%
	41		239	

*For URC slides only one date is provided to cover both day-0 and day-3 slides

were received at the HC – again, with the remainder being read the following day.

Process data for Ta Sanh are similarly impressive. The data on treatment delay probably cannot be taken at face value, as they most likely reflect data entry errors on the part of VMWs (although this itself is an important issue, as is evident in the data from Trang). It appears that only in six instances (2%) was a day-3 slide not obtained on the correct day. As in Pailin the vast majority of slides (92%) were then either transported to Ta Sanh HC on the same day or, occasionally, on the following day (*i.e.* day-4). Around 85% of slides were examined at the HC either on the day they were received or the day after. Only a small minority of slides (7%) had not been examined after two days. The longest delay between a slide being received and examined was six days.

3.4. Health facility-based pilot: data summary

Compared to the output of the community pilot studies, the available data record from the facility-based study is relatively sparse and appears to be incomplete. Data are available for seven health facilities in five provinces. Data provided by CNM from CIFs collected from health facilities indicate that in the period 15/7/2010 to 4/1/2011 65 day-0 *Pf* or mixed infections were detected at pilot facilities using microscopy (Table 7 and Figure 6). Most of the day-0 cases were from outpatients (57/65; 88%). It is not clear whether or not inpatients who received ACT via injection/drip are included in this dataset – although the very small number of inpatients (8) suggests not.

Day-3 slides were obtained for 54 of the 65 individuals testing positive for *Pf* on day-0. Only three individuals tested positive for *Pf* on day-3. One of these was an inpatient at Sampov Luon RH; the others were outpatients presenting at Pramaoy HC and Ta Sanh HC. The latter was

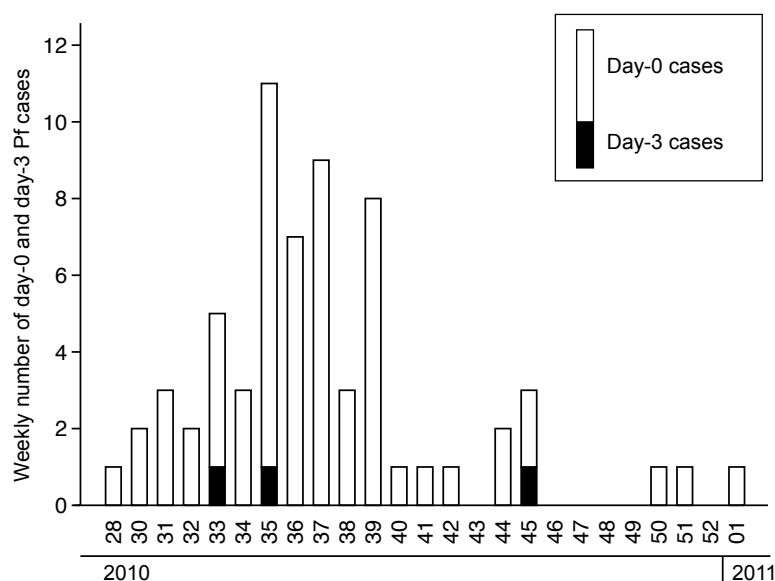
Table 7. Summary of Day-0 and day-3 data reported through the CNM facility-based pilot

Province	Health facility	Type	Data from day-3 pilot				Data from MIS
			OPD	IPD	Total	Day-3+	Total¶
Pailin	Pailin	RH	1 *	1	2	0	-
Sampov Luon	Sampov Luon	RH	1	5	6	1	-
Battambang	Ta Sanh	FDH	1	0	1	1	48
	Trang	FDH	3	1	4	0	4
Pursat	Pramaoy	HC	48	0	48	1	69
Kampot	Trapeang Reang	FDH	3	1	4	0	9
	Chhouk	RH	0	0	0	0	-
Total			57	8	65	3	

* Case presenting at neighbouring health centre (Suon Koma)

¶ Data for referral hospitals are not available in the MIS

Figure 6. Weekly totals of day-0 and day-3 *Pf* cases reported through the health facility pilot.



detected before the start of the URC community-based pilot in Ta Sanh. From interviews with staff at Ta Sanh it would appear that day-3 follow-up among outpatients effectively stopped once the community study was underway (see Section 4.2.3).

In Figure 6 there is a spike in cases in weeks 35-39 of 2011 (31 August to 30 September – *i.e.* slightly later, but roughly synchronous with, a similar peak in cases at Ta Sanh (see Figure 4)). The data record stops in January 2011. At this stage it is not clear whether this is because data collection activities ceased at this time point, or whether there are additional CIFs for 2011 that have not yet been entered into the database. What is clear, however, is that not all patients presenting to pilot facilities in the period up to January were effectively captured by the day-3 system. Data in last column of Table 7 are from CNM’s malaria database and show the number of *Pf* cases reported by each health facility for the period of July-December. With the exception of Trang HC, the “official” number of *Pf* cases at each site exceeds the number reported through the day-0/day-3 system. Again, the reasons for this are not entirely clear. It may be that some patients were diagnosed by RDT (and not by microscopy) and have not been included in the database. Alternatively variations in staff availability over time might have had an effect on the capacity of facilities to collect data.

The CNM dataset suggests that rates of day-3 follow-up achieved during the pilot were high (54 out of 65 individuals, as noted above). This figure is surprisingly high, given that many of the health facility staff were interviewed as part of this evaluation reported that getting patients to come back for to be re-tested on day-3 was a real issue (see Section 4.4.2). For Pramaoy, for example, the data provided by CNM indicate a day-3 follow-up rate of 87%. The opinion of the vice-chief of the HC was that fewer than 20% of patients returned to be tested on day-3. Clearly further investigation of data from the facility pilot is required.

4. FIELD EVALUATION OF THE COMMUNITY- AND FACILITY-BASED PILOT SYSTEMS

As noted in the introduction, individual day-3 surveillance pilots were carried out within a general framework that provided implementing partners with a significant amount of scope to adjust their protocols according to local contextual factors, as well as their own ideas about what would work best logistically. As a consequence, many of the key characteristics of the different pilot systems – for example procedures for patient follow-up and slide transport, staffing arrangements, structures of financial incentives, policies on training and supervision, *etc.* – varied considerably between partners and between individual sites. The purpose of this main section of the report is to thoroughly document the protocols adopted by each partner, to assess how these were interpreted and implemented on the ground, and, where appropriate, to highlight the strengths and weaknesses of the different approaches used. Separate sections (4.1-4.3) cover community-based activities led by FHI, URC and CNM respectively. Activities under CNM's facility-based pilot are described under Section 4.4.

4.1. FHI community-based pilot activities

4.1.1. Overview of the FHI community pilot

The FHI community pilot in Pailin started in September 2010 and initially comprised a network of 17 villages supervised by three health centres. In January 2011 a further six villages and three HCs were added to the pilot system, largely as a response to the low number of malaria cases that had been detected up to that point. A further five villages were subsequently added to the pilot system from March 2011. For this evaluation fieldwork focused on villages and HCs that had been included at the beginning of the pilot. Interviews were carried out with staff at Suon Koma HC, Ou Chra HC and Krachab HC and with ten VMWs in eight villages supervised by these facilities (see Table 2; also Figure 7).

An orientation workshop for VMWs and other stakeholders was held in Pailin in September 2010, followed by a two-day training workshop on slide preparation for VMWs (conducted by FHI and the Provincial Health Department). In March 2011, VMWs from extension villages were trained and additional refresher training was provided to VMWs already in the system. Data collection under the FHI system started in late September.

Day-to-day coordination of the FHI pilot system is provided by two staff members in the FHI office in Pailin. The malaria coordinator oversees the project and communicates with the FHI office in Phnom Penh. In addition, a programme officer (PO) is responsible for carrying out all field activities, supervision of VMWs and HC staff, record keeping, data entry and budget management. The PO's own view is that the day-3 pilot takes up around 50% of his time – but in reality this figure is hard to estimate as he is also responsible for other projects, the logistics of which overlap substantially with day-3 surveillance activities. Notably, the FHI PO also acts as the official liaison between VMWs and a drug efficacy study based in Pailin being conducted by MORU. Within this role he facilitates the recruitment of individuals with *Pf* and mixed infections into the MORU study. In addition, FHI has been using the day-3 pilot as a platform for a parallel project looking at RDT sensitivity and specificity compared to microscopy. This study, which involves the preparation, transport and examination of a relatively large number of slides taken from RDT-negative individuals, adds substantially to the workloads of VMWs, HC and FHI project staff. Arguably this piggy-backing of activities makes the evaluation of core surveillance functions (*i.e.* those included in the original surveillance framework) more difficult.

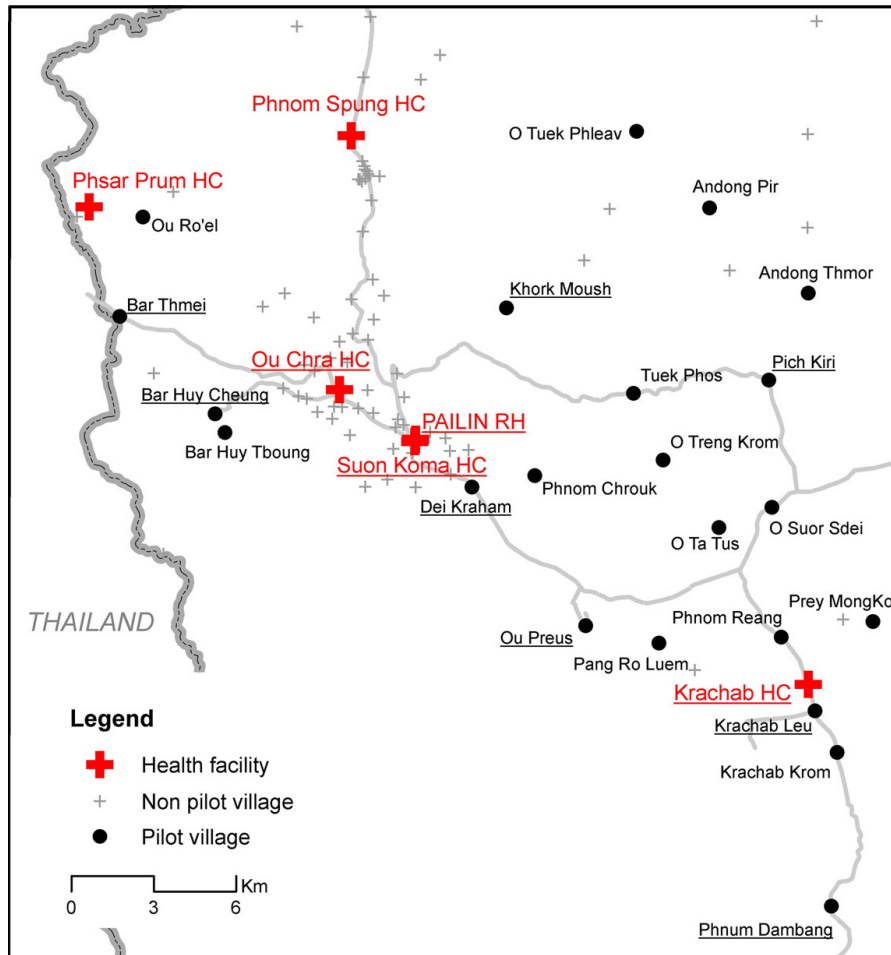


Figure 7. Map of health facilities and VMW villages included in the day-3 surveillance pilot in Pailin province. Names of villages and health facilities visited as part of this review are underlined. (Note: Phnom Preal HC and the one pilot village it supervises are not covered by the map and were not visited).

4.1.2. VMW roles and responsibilities under FHI

Within the FHI pilot (and distinct from the URC and CNM arms), day-0 and day-3 slides taken by VMWs are sent individually to the local HC. On day-0 the VMW screens the patient (on the basis of travel history, symptoms and temperature) before deciding whether or not to test the patient for malaria using an RDT. Under the original FHI protocol, VMWs were then required to wait for the RDT test result and prepare thick and thin films only for those individuals diagnosed with *Pf* or mixed infections. VMWs were initially trained to follow this procedure – but it appears that this was unpopular and most VMWs elected to do the RDT and smears simultaneously. Only two of the eight VMWs interviewed in Pailin used separate finger pricks for the RDT and slide; the remainder had switched to a single puncture either because this was deemed more acceptable to patients or because they wanted more practice taking slides. As noted previously, in order to collect slides for a separate FHI study on RDT diagnostic performance, VMWs were also asked to make blood slides for the next RDT-negative individual presenting after a RDT-positive case with a *Pf* or mixed infection. Because of this, some VMWs stated that the simplest option was to prepare slides for all individuals and then work out afterwards which slides to keep and which to discard. This mixing of protocols was clearly confusing to some VMWs.

All VMWs we visited had pads of project-specific CIFs and slide referral slips. None of the VMWs we interviewed seemed to have any problems completing the CIFs – and all the completed forms we saw appeared to be filled in fully and accurately. VMWs fill out separate referral slips for each slide, which are then sent individually to their supervising HC. For reasons that are not totally clear, the CIF remains with the VMW rather than being sent to the HC with the day-3 slide. As a first step in the data entry process the FHI PO is therefore required to visit individual VMWs and produce additional hard copies of data from the CIF. This is clearly inefficient as a process and arguably is only viable because numbers of *Pf* cases in Pailin are so low.

Arrangements for transporting slides from the village to the HC appear to vary somewhat between VMWs. All the VMWs we interviewed said they would contact the FHI PO each time they obtained a day-0 smear. From there the standard arrangement is that the VMW is responsible for taking slides to the HC. However, only one of the VMWs we spoke to claimed to always take the slides himself. Other VMWs said that in some cases they would take the slides themselves and in other cases they would ask the FHI PO to collect the slides from them. More than one VMW claimed that they would only deliver the slides to the HC if the PO was too busy to do so himself.

In practice it seems that the logistics of the day-3 pilot overlap substantially with other ongoing projects. As noted above, not all of the slides obtained by VMWs are linked directly to pilot activities – and this presumably explains some of the reported variability in the way slides are transported. More importantly, the main reason for VMWs contacting the FHI PO on day-0 is to alert him to the fact that there is a potential recruit for the MORU study. Individuals who are diagnosed with a *Pf* or mixed infection by RDT have the option of entering the study and in practice most individuals opt to do so (see Section 3.3). Only a minority of *Pf* cases, therefore, remain in the village to be followed up by their VMW on day-3. It is worth noting that for each case successfully referred to MORU, VMWs receive \$4. This is far more generous than any incentives VMWs get through their involvement day-3 pilot system (see below).

VMWs were asked a variety of questions relating to patient follow-up (DOT and day-3 slide). However, given that a large proportion of *Pf* cases in Pailin are effectively lost to follow-up after day-0 it should be recognized that most responses to these questions were either hypothetical or based on very limited experience. Some of the VMWs we spoke to had either not yet detected a day-0 *Pf* case (e.g. at Bar Huy) or had not yet needed to attempt follow-up because all day-0 cases had been recruited by MORU (e.g. at Bar Thmei). Among the VMWs who had experience of providing DOT and preparing day-3 slides, only one VMW had done this on more than three occasions over the course of the nine-month pilot.

All VMWs who had experience of DOT under the day-3 pilot stated that they would observe the first treatment dose and stay with the patient for around 30 minutes to check for vomiting. They would then ask the patient to return to the VMW house for treatment on the following two days. Based on responses of VMWs and data extracted from CIFs, it appears that only on very rare occasions did patients not keep to these appointments. Most VMWs said that in their experience patients tended to live close by and so were happy to return for treatment, although some needed prompting with phone calls. In one instance a patient had to be followed-up at their home because they claimed to be feeling better and so refused to travel to the VMW's house. In another instance involving a patient who lived far away, a VMW opted to provide

drugs to a relative accompanying the patient, rather than make appointments for the patient to come back. The VMW explained the importance of DOT to the relative and phoned the patient daily to check that DOT had been carried out. In the FHI dataset there is only one instance of a VMW failing to obtain a day-3 slide from patient they had treated.

Under the FHI system VMWs receive a standard payment for attending the VMW monthly meeting at their supervising HC. The size of this payment varies between VMWs (depending on how far they have to travel), but is typically around \$15 and is only paid to the one VMW per village who attends the monthly meeting. Under the day-3 pilot VMWs also receive a payment of \$0.25 for each blood slide they obtain, plus a transport allowance (between \$2 and \$7) if they are required to take the slide to their supervising HC. Notably no payments are provided to cover either travel associated with patient follow-up (for DOT or the day-3 slide), or for communication.

4.1.3. HC roles and responsibilities under FHI

Three HCs in Pailin were visited as part of this evaluation (Figure 7). In principle two members of staff – one lab officer and the HC chief – are responsible for day-3 surveillance activities at each HC. The role of the HC chief is primarily to oversee pilot activities, with specific responsibility for supporting the VMW network (and including running the VMW monthly meeting and carrying out supervision visits). The role of the lab officer is to receive and examine VMW slides, to fill in a special slide examination form and to send a coded SMS to CNM in the event of a day-3 positive case. All lab staff interviewed saw their roles as restricted to slide reading and reporting of day-3 positive cases – none were involved in training or supervision of VMWs and HCs played no role in arranging or facilitating transport of slides from the villages. Slides were either brought by VMWs themselves or by the FHI PO.

In practice, activities under the pilot system varied substantially between the three HCs. At Suon Koma HC the project lab officer claimed not to have received any formal microscopy training since 2007 (training under the pilot project did not specifically address microscopy) and did not feel confident enough to examine slides or estimate parasite density. Her role was therefore limited to preparing slides that were then taken (by FHI) to be examined at Ou Chra HC. Lab staff interviewed at Krachab HC claimed to be busy with other projects and had also recently become involved in FSAT activities, which involved them being away from the HC for long periods. They were not available to examine slides from the day-3 pilot, which again meant that FHI was required to transport day-0 and day-3 slides to Ou Chra HC for examination.

Until recently FHI forms did not include a section on the coding and sending SMS alerts of day-3 *Pf* cases. Lab staff at Krachab HC and Ou Chra HC were aware of the requirement to SMS alerts to CNM, but to date had not done so. At both sites lab staff claimed to be unable to send text messages in English, so instead preferred to provide the information to FHI by voice call. Both used their private mobile phones for this purpose and received \$2 per month to support this.

Within the VMW system there is no requirement for HCs to follow up patients presenting directly to the facility and testing positive for *Pf*. However, at Krachab and Ou Chra HCs it did appear that staff were attempting to extend certain elements of the VMW system to outpatients. At Ou Chra there is no attempt to administer DOT but patients were asked to come back on day-3 for a follow-up slide (according to the lab officer very few, if any, actually

did). In the absence of DOT the value of this exercise is questionable. At Krachab HC staff claimed to attempt to provide DOT to patients living close to the facility, with appointments being made for patients to return to the HC on day-1 and day-2. HC staff claimed that most patients did return for treatment – and that those who failed to do so would be traced through their VMWs. It is not possible to verify this version of events but in the light of comments from FHI staff it seems unlikely that such an approach is used often, especially as a large proportion of outpatient *Pf* cases are recruited by MORU. However, if true, this does raise the question of the wisdom of attempting to give DOT on an informal basis, particularly if the onus is on the patient to return to the health facility for treatment. Unless sufficient resources are made available to HC staff (or VMWs) to trace non-returning patient's at their homes, there is a real danger in this scenario of cases not receiving a full therapeutic dose.

Under the FHI system lab staff receive \$0.25 per slide examined, plus \$2 per month for communications. All of the HC staff that we interviewed used to receive a monthly payment of \$70 from the containment project, but this was discontinued in May 2011. As for VMWs, HC staff referring individuals with *Pf* or mixed infections to MORU receive a \$4 payment.

4.1.4. Additional user feedback

As well as being asked to describe their principal roles and responsibilities, VMWs and HC staff were also asked their overall opinion of the day-3 pilot and their views on specific aspects of the project related to training and supervision, communication and feedback, and financial and non-financial incentives.

All VMWs reported that they were satisfied with the training they had received on slide preparation. Significantly, out of ten VMWs interviewed, seven reported having had previous experience in preparing slides before the start of the day-3 pilot. Before the introduction of the combo-RDT, VMWs in Pailin had routinely taken slides, with training provided by FHI or MSF. Those VMWs with no previous experience all claimed to now be confident about taking slides. All felt they needed more practice but only one said they wanted additional training. It is worth noting, however, that not all VMWs in the villages included in day-3 system had received project training. Several VMWs claimed that their partners were either unable to prepare slides, or had problems doing so. In two cases the senior VMW was taking it upon themselves to provide on the job training to their partner.

Lab staff at Ou Chra and Krachab HCs reported that there were a number of problems with VMW smears at the beginning of the pilot (most commonly relating to the wrong quantity of blood, usually too much), but felt that slide quality had improved over the course of the project – and particularly since refresher training in March. Lab staff estimated that between half and two-thirds of slides could be rated as “good”. At Ou Chra HC, where the majority of project slides are examined, the lab officer reported that while all slides were essentially readable, it could take anywhere between 30 and 60 minutes to read a poor quality slide (compared to 20 minutes for a good quality slide).

All VMWs reported having frequent supervision visits from FHI and stated they were very happy with the level of support they received. All were subject to unscheduled weekly or bi-weekly spot-checks from the FHI PO, in addition to routine monthly supervisory visits. Most VMWs claimed to get routine feedback on the quality of their slides from HC staff and FHI. VMWs were not routinely informed of the results of negative day-3 slides but would be contacted in the event of a day-3 positive and asked to check on the individual's condition in

the following days (and to inform the supervising HC of any issues). Since March they are also asked to obtain an additional follow-up slide on day-28. In terms of communication all the VMWs we interviewed had their own phones and none reported any regular network/reception problems.

VMWs were asked whether they thought that the new surveillance system introduced a lot of extra work. Given the low number of cases seen in most villages (and the large proportion of day-0 *Pf* cases lost to follow-up), it is perhaps unsurprising that most VMWs did not consider this to be the case. Most VMWs acknowledged that taking a slide on day-0 added some extra work, but none saw this as a problem. Typically VMWs would point out either that any extra work involved was worth doing because the objectives of the project were good; or that, as volunteers, it was their duty to provide good care to people in their village regardless of how much work was involved.

On the issue of financial incentives opinions were more divided. Around half of the VMWs interviewed were either satisfied or neutral about the incentives they received for their work in the pilot. Most VMWs thought that the system of compensation for travel to be fair – but nearly everyone who voiced an opinion considered the payment of \$0.25 per slide to be very low. One VMW pointed out that the incentive system was acceptable in a situation where there are very few cases – but that it would become a problem if caseloads increased, particularly because no incentives are provided for VMWs to administer DOT or obtain day-3 slides. Another felt that adding on extra activities such as patient follow-up was only viable because the number of malaria cases seen by VMWs (and hence VMW workload) had dropped substantially over the last few years. More than one VMW pointed out that the structure of incentives in the pilot system was essentially irrelevant because MORU was prepared to provide much more generous payments without any requirement for providing DOT or making blood slides.

In terms of VMW incentives the strongest negative comments were related to routine payments made under the wider VMW system. Under the current system only one VMW per village receives the payment for attending the monthly meeting. In instances where VMWs are not married or otherwise related, this creates potential problems – as was apparent at two villages visited in Pailin. Several VMWs complained that the overall level of incentives for routine VMW work was too low. Clearly broader contextual issues of this type will have knock-on and potentially demotivating effects for add-on activities that are predicated on the basic VMW system. At the same time, however, it should be noted that many VMWs alluded to non-financial motivational factors when the subject of incentives was raised. Many VMWs pointed out that financial remuneration was not primary reason for taking on VMW responsibilities. Most were keen to highlight the satisfaction they derived from serving their community and/or to their increased level of knowledge through training.

All HC staff interviewed felt strongly that the current payment for slide reading (at \$0.25 per slide) was far too low, particularly given the extra time and effort required to estimate parasite density. One lab officer also considered the monthly \$2 communication payment to be insufficient because he was required to phone through the results of each slide to FHI. One HC chief felt that the demotivating effect of low payments was a serious risk for the viability of the day-3 system, pointing out that lab staff were key to the success of the project and often considered themselves over-burdened in the first place. This issue was particularly acute at Ou Chra HC, which receives day-0 and day-3 from other facilities in the project lacking either the capability or capacity to examine blood slides obtained by VMWs. Unlike at other HCs,

staff here did feel that the introduction of the day-3 pilot had had a significant impact on the workload of the HC.

4.1.5. Key strengths and weaknesses of the FHI system

The most obvious strength of the day-3 pilot in Pailin is that it clearly works. This is evident from the responses of staff at all levels involved in the project and also from the process data presented previously in Section 3.3. All the indications are that in the vast majority of cases VMWs are successfully carrying out DOT and obtaining a day-3 slide. VMWs have a clear sense of their roles and responsibilities and appear very satisfied with the training, support and feedback provided by FHI and HC staff. Delays in the transfer of blood slides to the HC are minimal, as are delays in slide examination once they arrive at the HC. Significantly most of the VMWs involved with the pilot had previous experience in producing blood smears and slide quality did not appear to be a major issue. There have been some problems with implementation but many of these are relatively minor. For example, the forms used in the study could probably be improved and streamlined, as could the data entry process at provincial level.

Arguably, however, the apparent success of the pilot can be put down to two main factors: (a) low caseloads in the pilot villages and (b) efficient and highly conscientious support of pilot activities on the part of FHI provincial staff, particularly the malaria programme officer. It is clear that a combination of these two factors has been important in terms of minimizing burden on VMWs and HC staff. Many of the VMWs that we interviewed, for example, clearly felt that the financial incentives offered through the project were far too low. Because VMWs were required to prepare very few day-0 slides (and in even fewer cases to administer DOT or obtain a day-3 slide) this did not become a problem in practical terms. But it seems unlikely that this would be true if VMWs were faced with higher caseloads and day-3 surveillance activities started taking up a larger proportion of their time. In such a scenario it is unlikely that offering such a small financial incentive per blood slide would be viable.

More particularly it would be difficult to envisage a high coverage of DOT being achieved without some payment for patient follow-up being provided. Again, because of the very small number of cases that have required follow-up in Pailin (21 individuals across a network of 23 VMWs, over a nine month period) and because almost all of these individuals appear to have agreed to return to the VMW's house for treatment, to date this has not been a problem. But it is unlikely that this would remain the case in a scenario involving a larger number of cases to follow up – or one where, as is more typical at other field sites, the onus is on the VMW to trace patients back to their houses. During interviews many VMWs did claim that they would always try to trace non-returning patients back to their homes for DOT and/or to obtain a day-3 slide but there is not sufficient evidence to gauge how realistic such claims actually are. One VMW we spoke to made it explicitly clear that following up patients at home would not be possible unless financial incentives to do so were introduced. Some VMWs thought that migrant workers would represent a special problem because they were difficult to trace, tended to live far away and would possibly leave the area before DOT could be completed. Others conceded that they would not try and administer DOT if the patient lived far away – and instead would either provide drugs to a relative or, failing that, would give the drugs to the patient themselves and try their best to get across to the patient the importance of adherence. Many of these discussions were hypothetical, as most VMWs had seen too few *Pf* cases for these problems to arise.

Despite the small number of blood slides involved in this study it is apparent that some HCs struggled to support the pilot activities. At one facility this was due to a lack of diagnostic capability, at another it was because lab staff were fully occupied with other projects. In practice this meant that one HC (Ou Chra) had to examine the bulk of slides being received from VMWs. It also meant that the FHI PO had to spend significant amounts of time overseeing the transfer of material between sites. This sort of flexibility is only achievable when small numbers of slides are involved and where an external partner is available to manage the process and make up for weaknesses in the underlying health system. It is difficult to envisage such an arrangement working effectively in a routine context without this type of support. Clearly the lab staff play a pivotal role in the day-3 system and lack of engagement on their part is a major risk to the system's viability.

Overall it appears that a number of features of the FHI system make it effectively non-reproducible in other settings. As noted previously the presence of research projects led by MORU, AFRIMS and other groups has a fundamental and direct effect on the number of malaria infections present in the community – but indirectly these projects create programme capacity that makes it easier to support field-based activities and provide the sort of intensive supervision and support that VMWs and HC staff have received from FHI over the course of the pilot.

4.2. URC community-based pilot activities

4.2.1. Overview of the URC community pilot

Under URC day-3 surveillance pilot activities have principally been focused on villages in the catchments of Trang HC (Sampov Luon OD) and Ta Sanh HC (Battambang OD). In March 2011 pilot activities were extended to cover containment additional villages in Battambang OD and Samrong OD (Oddar Meachey province).

At Ta Sanh the community-based day-3 system is being piloted in 13 villages, six of which were visited as part of this evaluation (Figure 8). At Trang, the pilot includes 15 villages, of which six were visited for the evaluation (Figure 9). A total of 16 VMWs were interviewed at their respective villages. In addition clinical and lab staff were interviewed at Ta Sanh and Trang HCs.

Field activities at the URC sites started in September 2010. URC central and provincial staff conducted a series of training sessions in September-October. These included an orientation workshop for provincial and OD malaria supervisors and HC lab staff from Ta Sanh and Trang, as well as separate training for HC lab staff on blood slide examination and SMS reporting of day-3 *Pf* cases. VMWs received training on study protocols, smear preparation and DOT. Separate training courses were run in Ta Sanh (26 VMWs, September 2010) and Trang (30 VMWs, October, 2010).

Day-to-day coordination of the URC pilot system is provided by one provincial URC staff member based at the URC office in Battambang town. The coordinator contacts (or is contacted by) the pilot HCs at least once or twice a week to get updates or respond to specific technical issues. He also visits the pilot HCs every month (to coincide with the monthly VMW meeting) and carries visits to study villages on an ad hoc basis as required.

4.2.2. VMW roles and responsibilities under URC

All VMWs interviewed within the URC pilot were able to clearly describe the purpose of the project and their roles and responsibilities within it. As in Pailin, individuals presenting to VMWs are first screened and a decision on whether or not to test for malaria using an RDT is made on the basis of the individual's travel history, signs and symptoms and temperature. At Ta Sanh all VMWs interviewed reported waiting for a positive *Pf*/mixed RDT result before going on to prepare a blood slide (*i.e.* no slides are obtained for *Pv* or negative cases). Half of the VMWs interviewed said that this did sometimes lead to complaints from patients, although none reported having had a patient refuse the second puncture. As one VMW put it – “patients never refuse because by then they know that they are positive for malaria”. At Trang, the situation seems a bit less clear-cut. Of those VMWs that had had experience preparing blood slides more than half obtained slides for all patients, using a single puncture for the RDT and blood smears. It appears that this change in protocol had been introduced to provide the VMWs with more practice in taking slides and to provide data on the rate of false-negatives by RDT.

VMWs start to fill out a CIF for the patient once *Pf* has been confirmed by RDT. The form includes a field for the patient's phone number – which more than one VMW saw as critical for effective follow up (all VMWs we spoke to indicated that the large majority of their patients had a phone – or had access to one through a relative). The URC paperwork is well designed – with the VMW and HC sections included on one sheet of paper – and unlike in the FHI system copies of forms are not left with the VMW.

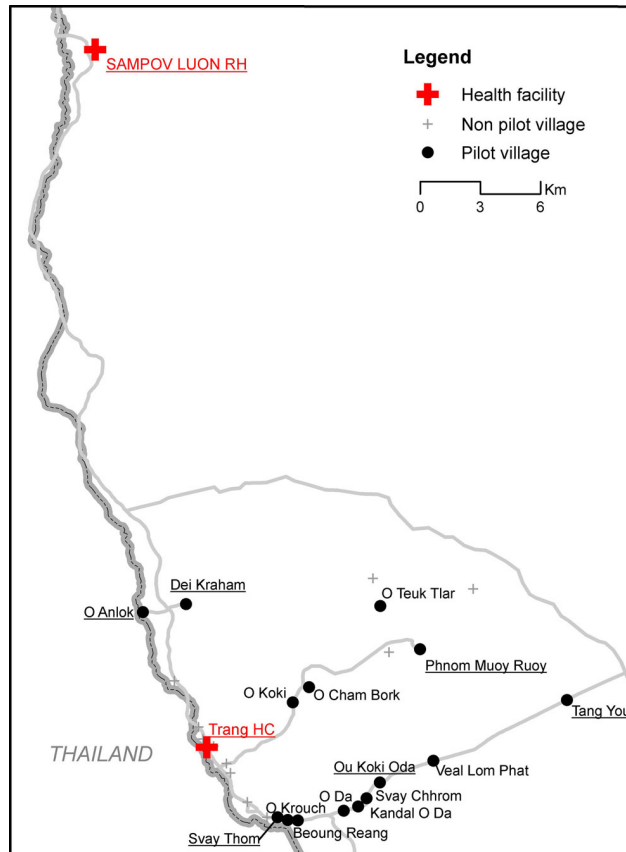


Figure 8. Map of health facilities and VMW villages included in the day-3 surveillance pilot in Sampov Luon OD. Names of villages and health facilities visited as part of this review are underlined.

At Ta Sanh all VMWs reported carrying out DOT for all patients. Five of the six VMWs interviewed stated that they always carried out DOT at the patient's house; one VMW reported that patients living close by would sometimes visit them at home. Half of the VMWs said they visited the patient's house because this was the instruction during training. But most also felt that this was necessary because patients could not be relied upon to keep to their appointments, or might be too sick to do so. Overall, the level of awareness of the importance of DOT – and of the need to stick to a strict treatment schedule – was very high at Ta Sanh. In Trang relatively few VMWs had had any experience of trying to deliver DOT because the incidence of cases is very low. One VMW reported that she would ask patients to return to her house for treatment (although this had happened only once). Another VMW we visited had had no *Pf* cases but was currently carrying out DOT on a *Pv* patient, using DHA-PPQ (because of a CQ stock-out) and using the day-3 pilot forms to record patient and treatment details.

All VMWs we spoke to in Ta Sanh had motos but would also walk or use a bicycle for follow-up visits, depending on the location of the patient. None reported any problems in tracing permanent residents in the village, although travel could become very difficult in the

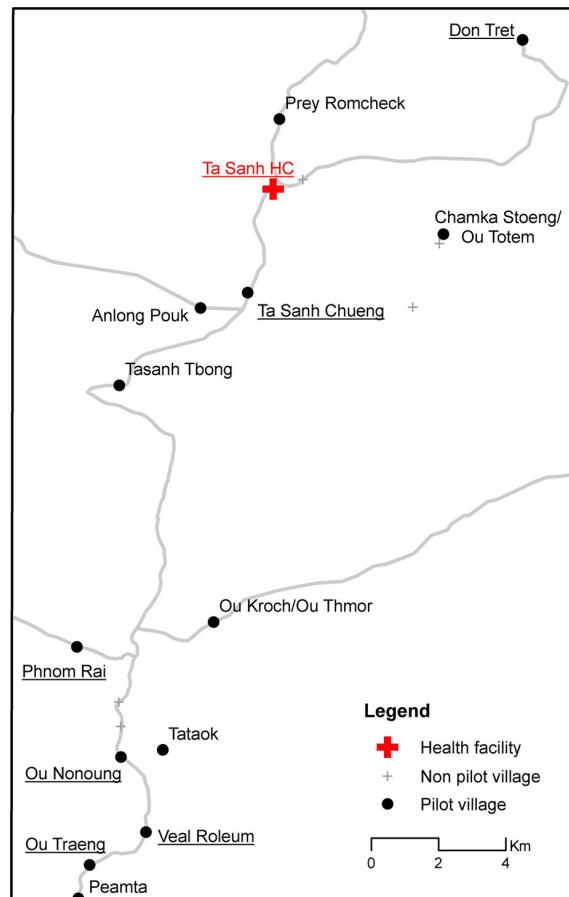


Figure 9. Map of health facilities and VMW villages included in the day-3 surveillance pilot in Sampov Meas OD. Names of villages and health facilities visited as part of this review are underlined.

rainy season. Most also felt that migrants were not a problem and could be traced successfully through friends or relatives or, in the case of farm workers, through the farm manager. Several of the VMWs stressed that the key was to record the phone number of the migrant or their local contact and to get detailed information on their address. The main practical problems identified were (i) the long distances involved in following up migrants and (ii) the fact that some migrants would leave the area before the end of the DOT course. One VMW reported that they always asked the migrant how long they intended to stay in the area – and would provide them with drugs to take away if it was likely that they would move on before the final day of treatment.

Most of the VMWs interviewed in Trang appeared to appreciate the importance of DOT and did not consider tracing patients to be a problem (although in most instances this assertion was hypothetical because the VMW had not yet had to supervise treatment). With the exception of one VMW, who stated that by default they would give drugs to patients to take away with them (unless they lived very close by), the majority said that they would attempt to provide DOT at the patient's home. Few of the VMWs in Trang considered migrants to represent a particular problem – although one VMW, who did claim to see a large number of migrants workers, thought that tracing them would be difficult, especially during harvest periods. For these cases he would be inclined to provide the drugs for them to take away, having re-enforced the

importance of completing the course. He did not think taking a day-3 slide would be practical in these situations. At Dei Kraham, where the large majority of Trang's malaria cases have been reported, the VMW claimed that she was always able to trace migrants, although this could be problematic. Her biggest concern was that migrants would move away from the area before treatment could be completed.

Within the URC system VMWs are entirely responsible for transporting day-0 and day-3 slides to the HC for reading. The main distinction between the URC and FHI system is that under the URC system VMWs wait until day-3 and transport both slides (and CIF) to the HC. All the VMWs we interviewed at Ta Sanh indicated that they would usually try to take slides to the HC on day-3 where possible – and would only delay until the next day if the day-3 slide was taken in the afternoon (this is borne out by the data presented in Section 3.2, which shows that more than 90% of slides reached the HC on day-3 or day-4). Slides are delivered to a lab officer or someone else on duty. If a lab officer is available most VMWs reported getting instant feedback on slide quality. The majority of VMWs used their own motos to reach the HC; those that used moto-taxis paid a return fare of around \$4-5 and reported journey times could be as long as 1-2 hours depending on village location and weather conditions.

In Trang slide transport arrangements appeared to be more ad hoc. Some VMWs claimed to take all slides (including those from RDT-negatives) to the HC on the same day and mostly by moto-taxi (fare range \$1.5-7.5). Others waited until a more convenient time, or waited until the monthly meeting to deliver their slides. The two VMWs at Trang who had actually seen *Pf* cases during the pilot study said they waited until day-3 to transport slides from *Pf* cases to the HC, taking the day-0 and day-3 slides together.

VMWs are not routinely informed of slide results. It appears that at the beginning of the study this was the case regardless of the diagnosis – and even in the case of day-3 *Pf* cases. VMWs only saw their data when summary statistics were presented to VMWs at quarterly meetings. Only when additional follow-up visits at day-7 and day-28 were introduced did VMWs begin to be informed of day-3 *Pf* cases (although they still do not get feedback on negative cases). Under the new arrangements VMWs are asked to take follow-up slides on these days but there is no requirement for them to visit the patient to check on their condition before day-7. Several VMWs voiced concerns about this and stated that they would like more feedback on slide results and more training in case management of day-3 cases. More than one VMW said they would sometimes telephone the HC to find out about slide results – and one VMW said that he would visit day-3 cases regardless of what advice they received from HC staff. Clearly feedback is something that is important to the VMWs, who see the main benefit of the day-3 surveillance as being improved patient care.

Under the URC system the scale of financial support provided to VMWs varies depending on distance of village to HC. The payment they get for delivering day-0 and day-3 slides to the health centre is pegged to the standard payment they receive for attending monthly VMW meetings (between \$4 and \$8 among the VMWs interviewed). In addition VMWs get a \$4 payment if they travel to the patient's house to provide DOT (\$2 per visit), plus an additional \$2 per month to cover mobile phone costs. None of the VMWs we spoke to considered these payments to be a major incentive for carrying out day-3 related work. Indeed the prevailing view was that in reality payments were barely sufficient to cover the costs and opportunity costs of the extra work involved (see below).

4.2.3. HC roles and responsibilities under URC

Supervising HCs at Trang and Ta Sanh were visited as part of this evaluation (Figures 8 and 9). At Ta Sanh HC pilot activities were led by the HC chief. At Trang HC day-to-day management of the project was provided by the malaria supervisor. Both described the key elements of their roles as being to assist with training, liaise with URC staff, supervise pilot activities and support the VMW network more generally.

Two lab officers supported the community pilot at Ta Sanh; at Trang only one lab officer was available. Lab staff took an active role in the initial training of VMWs in smear preparation and in refresher training offered at VMW meetings. Operationally, the role of lab staff was primarily restricted to receiving and reading VMW slides, filling in relevant sections of the CIF and, for day-3 *Pf* cases, sending SMS alerts to CNM.

At Ta Sanh lab staff aimed to examine day-0/day-3 slides on the day they are received, or on the following day if that was not possible. Data on processing delays presented in Table 6 indicate that more than 90% of slides received at Ta Sanh were indeed read in this time window. Once slides have been examined lab staff complete relevant sections on the reverse of the CIF and send a pre-coded SMS to CNM in the event of a day-3 *Pf* case. For this they use their own private phones as no project phone has been provided. Under the URC system CIFs are filed and kept at the HC. Provincial URC staff photograph the forms email the images to the URC office in Phnom Penh where data entry is carried out.

Operations at both Ta Sanh and Trang are somewhat complicated by the fact that these HCs also host the CNM facility-based pilot (described in more detail in Section 4.4). At Ta Sanh HC the URC system appears to have largely superseded the CNM system, with efforts to follow-up outpatients at day-3 being conspicuously absent (see Section 4.4). At Trang HC the two systems do seem to coexist but running both activities in parallel appears to have created tensions among HC staff. Specifically, the lab officer felt himself primarily responsible for the URC study and had no responsibility for the CNM project. Conversely, the malaria supervisor oversees the CNM system but appears to have little to do with, or indeed little knowledge of, the URC system. His involvement in the URC system appears to be limited to his role in leading monthly VMW meetings and carrying out routine supervisory visits – responsibilities that predated the day-3 pilot. He felt that the presence of the URC project effectively undermined his role in the HC.

Under the URC system the only payments made at HC level comes in the form of a \$5 monthly payment to lab staff to cover communication costs. Lab staff also receive a one-off payment (\$5) if they attend the VMW monthly meeting. There is no per-slide or per-patient payment to either lab or clinical staff.

4.2.4. Additional user feedback

In addition to questions about their roles and responsibilities, HC staff and VMWs were asked about their opinion of the day-3 pilot and their views on specific aspects of the project related to training and supervision, communication and feedback and incentives.

At Ta Sanh all VMWs we interviewed had attended initial training and had received refresher training at monthly meetings. None of the VMWs had any previous experience of making slides and most felt that they still had problems with slide preparation – either because their slides did not conform to high quality examples that they had been shown, or because they had had direct feedback from HC staff. Almost all of the VMWs indicated that the thin film was the biggest issue.

All VMWs at Ta Sanh seemed happy with the amount of feedback and support they were getting from HC staff. All also felt, however, that they needed either additional training or more practice – or both. Half of the VMWs interviewed specifically stated that they wanted more formal training, while almost all said that they felt they needed to have more practice preparing slides. In Trang only one VMW had had previous experience of making blood slides and all VMWs reported having received formal training from the project. Many noted that they found refresher training/demonstrations during routine VMW monthly meetings particularly useful. These sessions are held every three months (at both URC sites), cover the whole day-3 surveillance process and are attended by URC and OD staff.

Lab staff at Ta Sanh HC reported that poor quality slides were a major issue at the start of the project (with less than 20% considered “good”), but that the quality of slides has improved over the life of the project – with 80-90% of slides being rated as good in the latter stages of the pilot. The lab officer at Trang HC considered almost half the slides he receives to be more-or-less unreadable. A common problem appears to be that too much blood is used, which leads to cracking and subsequent problems with staining. His view was that only VMWs who had prepared a substantial number of slides were getting better at making slides – while the majority of VMWs, who only prepared slides occasionally, were not. Lab staff at both sites felt that VMWs needed more formal training in slide preparation. At Trang the lab officer also felt that VMWs needed more training in record keeping. Among the eight CIFs reviewed at Trang HC as part of this review, only two did not contain some sort of recording error.

Within the URC system there is relatively little extra VMW supervision above and beyond the pre-existing routine VMW system, with HC staff following fixed schedule visits to three villages every two months. In practice the frequency of supervision appears to vary somewhat between villages – with some VMWs getting supervisory visits from HC and/or URC staff every 1-2 months and others claiming to be visited only occasionally. All VMWs seemed to be satisfied with the supervision they were receiving – with more than one saying that in their view the monthly meeting was the most important opportunity to get support. No VMWs reported having experienced problems with supplies of RDTs, slides or other consumables, which they receive regularly at their monthly meetings.

In Trang, the provision of supervision by HC staff appears to be patchier. Half of the VMWs we visited reported having had routine supervisory visits during the life of the pilot – however, half claimed not to have been visited. It should be recognized, however, that VMWs are supervised by a number of different groups – and are not always able to accurately recollect the exact purpose of each visit.

Most VMWs claimed to get routine feedback on the quality of their slides from HC staff – either at the point of dropping off their slides or at VMW meetings. As noted above, VMWs are not routinely informed of slide results – although since April they have been informed of day-3

Pf cases³. Most of the VMWs we spoke to felt that this lack of feedback was a weakness in the system. From their perspective the main benefit of the day-3 system is the introduction of DOT and day-3 follow-up as a means of improving patient care. Many stated that they would like better and more timely information about their slides from the HC – as well as more training on patient management of day-3 positive cases. HC staff, conversely, felt that informing VMWs of negative slide results was inefficient use of their time.

In Ta Sanh none of the VMWs we interviewed complained about the amount of extra work associated with the day-3 pilot, even in villages with very high caseloads. Some VMWs did, however, point out that there were practical limitations to how much time they could provide to the project given other existing commitments (either related to their regular work or to other voluntary roles).

At both sites most VMWs were keen to stress that they considered non-financial benefits associated with the project (particularly increased knowledge, training and the opportunity to better serve their communities) more important than financial incentives. At the same time, the predominant opinion was that payments for project activities were insufficient to compensate either for the amount of work involved or the transport costs associated with patient follow-up. VMWs in Trang were generally less concerned about financial aspects of the project than their counterparts in Ta Sanh – perhaps reflecting the relative rarity of day-0 and day-3 *Pf* cases at that site.

Among HC staff opinions on workload and financial motivation differed between Trang and Ta Sanh. At Ta Sanh the HC chief recognized that the day-3 system introduced a significant amount of new work in a setting where there is already a number of other external projects and programmes – however, overall, he did not think that the introduction of the pilot had had any negative impact on the operation of the HC. Neither of the lab officers at Ta Sanh considered the additional work associated with the pilot to be a major issue, although they also identified competition from other roles to be a major constraint. This sentiment was echoed at Trang, where the lab officer complained that he was already over-worked and so found it difficult to find time for the day-3 project. He also felt that he should be paid for each slide examined (and considered fair compensation to be around \$0.5-\$1 per slide).

The URC provincial coordinator of the day-3 pilot confirmed that HC staff frequently complained about lack of payments for the day-3 surveillance work. He considered effective engagement by lab staff to be crucial to the success and sustainability of the project and felt that incentives in the form of a per-slide payment (of \$1-\$2) would be the most likely way to achieve this.

When asked to sum up their overall opinion of the pilot project and to identify the most important strengths and weaknesses of its implementation, VMWs at both sites were unanimously positive about the project. Most VMWs felt that the main benefit of the pilot was the provision of better case management to people in their communities. Many also felt that it had enhanced their role as VMWs in terms of training and skills – and more than one VMW said that they felt the project had improved their standing in the local community. In terms of areas for improvement a large proportion of VMWs wanted additional training on slide

³ URC staff in Phnom Penh subsequently explained that in the early stages of the pilot they were reluctant to provide feedback on cases in the absence of clear directives from CNM regarding appropriate response strategies.

preparation and/or case management and better feedback on slide results (including negative sides). Many also wanted to be better compensated financially and to receive other incentives in the form of boots, raincoats and bicycles. A number of VMWs (and HC staff) voiced concerns about the future of the project and about how they should approach patient care after the end of the pilot. Several said they would like to carry on providing DOT but would not be able to do so without financial support. Others felt they might be able to provide some limited follow-up to patients living close by after the pilot – either by visiting some patients at their homes or by asking them to return for treatment. This is an area for real concern; if VMWs begin to withhold providing the full-treatment course of DHA-PPQ and expecting patients to return each day for DOT, the number of individuals that end up not completing treatment is likely to increase.

4.2.5. Key strengths and weaknesses of the URC system

The URC pilot has been extremely effective, particularly at the Ta Sanh site. The challenges involved in setting up the community-based system in a setting where VMWs had no previous experience of preparing blood slides or providing follow-up should not be underestimated, particularly where village-level *Pf* incidence is relatively high.

Arguably a major strength of the URC system is that the roles and responsibilities of VMWs, HC and URC staff are clearly demarcated and universally understood. This is particularly important for VMWs, who have been provided with very clear and specific guidelines relating to slide preparation and provision of DOT. At Ta Sanh in particular, these are followed more or less without exception and the completeness and timeliness of patient follow-up is highly impressive. Even here, however, some sort of flexibility is required when it comes to following up migrants or individuals who live far from the VMW – and it seems that VMWs have been able to choose not to attempt DOT in situations where they think this might be counter-productive.

At Trang, where the same project framework has been used, the URC system appears to operate less smoothly at village level. A principal reason for this seems to be the low number of cases seen by VMWs. Because of this VMWs have few opportunities to practice making slides and maintain familiarity with project protocols and procedures. More generally the rationale for, and relevance of, the project are less compelling in a very low transmission setting. As a result – and perhaps somewhat counter-intuitively – it may be that routine day-3 surveillance activities will be more difficult to implement and sustain in low transmission settings than in areas where *Pf* cases are relatively common.

A key strength of the URC system has been a focus on continued training and support over the course of the pilot period. Significantly this has been achieved largely within the framework of routine VMW supervision. Critical to this success has been the effective use of VMW monthly meetings as a platform for regular refresher training – and the involvement of OD and URC staff in this process. It is clear from VMW responses that a significant amount of training and practice is required before they consider themselves comfortable with preparing blood smears – but the lesson from the URC pilot seems to be that this can be achieved without the type of very intensive support provided by FHI in Pailin. Differences in VMW experiences at Trang and Ta Sanh do suggest, however, that bringing VMW slides up to an acceptable standard is practically more difficult in low transmission settings where opportunities for VMWs to practice techniques covered in training are few and far between. This issue also extends to basic record keeping, which emerged as a particular problem at Trang.

One of the reasons that day-3 surveillance has worked so well in Ta Sanh is that all the VMWs we spoke to appreciate the benefits that the project brought in terms of improved case management. Typically when asked what was good about the project, or what motivated them to be involved, VMWs focused on DOT and the importance of the day-3 slide in checking whether a patient had cleared their malaria infection. They never mentioned wider programmatic concerns relating to the containment of drug resistance or the need to generate better datasets on day-3 *Pf* incidence. As such a key to the success of the VMW system is providing VMWs with sufficient resources to achieve their main aim, which is better case management. Sufficient financial compensation is clearly one element of this – but other motivational factors will be important too. For example, a common complaint among VMWs at Ta Sanh was that they received too little feedback on slide results and too little guidance on how to manage individuals who remained positive for *Pf* on day-3. This is one area where the URC system could be strengthened (essentially at no added cost).

Although financial incentives do not appear to be a major motivational factor for VMWs in the URC system, it is clear that realistic payments for the extra tasks are a prerequisite for its operational viability. Although VMWs felt that payments were too low to fully compensate for the time and effort involved, clearly they were sufficient to cover their basic costs. Most VMWs made it clear that they would be unable to continue following up *Pf* cases in the absence of these basic payments.

As was apparent in the FHI pilot, day-3 surveillance can only be effective if lab staff at supervising HCs are sufficiently motivated to examine VMW slides in a timely and consistent manner. At Ta Sanh HC there was clearly sufficient capacity to backstop the pilot and lab staff appeared to be fully engaged with the project, despite the absence of financial incentives. At Trang the situation was quite different (and perhaps more generally representative). Despite the very low numbers of slides being received from VMWs, here the lab officer complained about lack of capacity and of being over-burdened with existing responsibilities. In this situation it is clear that some sort of payment (per slide) would be required to ensure effective involvement at lab level. Here, and at other sites with capacity constraints, lack of financial incentives for HC staff represents a significant weakness in the URC approach.

Overall it is clear that URC pilot activities have been well designed and implemented in a professional, systematic way. However, the different experiences of Trang and Ta Sanh indicate that the effectiveness of day-3 surveillance activities owes as much to the capabilities, capacities and motivation of VMWs and HC staff as it does to the quality of programme design and implementation. In this sense Ta Sanh has to be seen as a fairly atypical site – which raises the question of how reproducible the Ta Sanh experience can be in settings where the VMW network is less effective.

4.3. CNM community-based pilot activities

4.3.1. Overview of the CNM community pilot

The CNM community pilot incorporates 36 villages in Kampot province and 20 villages in Pursat. Because of time constraints, activities in Kampot were not included in the current review (although this site was visited as part of pre-evaluation fieldwork and outcomes from the exercise did inform the design of the current evaluation).

Pilot VMW villages in Pursat are supervised by two HCs: Pramaoy and Thmarda (see Table 2; also Figure 10). For this evaluation only staff at Pramaoy HC were interviewed because a combination of adverse weather and time constraints made visiting Thmarda impractical. In addition seven VMWs in the Pramaoy HC catchment were interviewed (Figure 10).

Within the CNM pilot initial sensitization and training of HC staff and VMWs began in July 2010 and additional refresher training has been provided for VMWs in Pursat relatively recently (see below). On the basis of data supplied by CNM the first slide results from the pilot were reported as early as mid-August 2010. However, judging from temporal patterns in the number of day-0 *Pf* cases detected by VMWs (see Figure 3), and from responses of VMWs and HC staff (described below), it appears that continuity of data collection has been a problem at the CNM sites.

Within the CNM system overall coordination is provided principally by two staff members in CNM based in Phnom Penh. They have been largely responsible for setting up the pilot activities and coordinating training. Unlike in the URC and FHI systems there is no mechanism for provincial level staff to provide day-to-day oversight and support.

4.3.2. VMW roles and responsibilities under CNM

In principle the basic responsibilities of VMWs in the CNM project are similar to those in the URC and FHI systems: VMWs are expected to screen patients, prepare blood slides for individuals diagnosed with *Pf* or mixed infections by RDT, provide DOT to *Pf*-positive individuals and prepare follow-up blood slides on day-3. In reality, however, the way in which VMWs interpreted their own roles and responsibilities within the pilot system varied considerably between villages. Moreover, in contrast to other pilot sites, many of the VMWs we interviewed were unable to articulate clearly the rationale for the day-3 pilot study and most failed to appreciate the specific relevance of DOT and day-3 slides in this context.

At Pursat the initial screening process for patients presenting to VMWs is the same as elsewhere (although, as none of the VMWs we visited had a thermometer, no attempt was made to record temperature). All VMWs we spoke to used a single finger prick for both the RDT and blood smears and claimed to always get sufficient blood this way.

It is worth noting that although the villages we visited were mostly served by two VMWs, typically only one had been trained to prepare slides. Whether or not an individual presenting to their VMW has a blood slide prepared is therefore dependent on which VMW is on duty at the time. Clearly this can have significant implications for the effectiveness of day-3 surveillance. At one village, for example, six *Pf*/mixed infections had been detected by RDT during the previous month but only one blood slide had been obtained in the same period. This was because the VMW who had been trained to take slides had rarely been on duty. This situation was replicated in other villages we visited in the Pramaoy catchment.

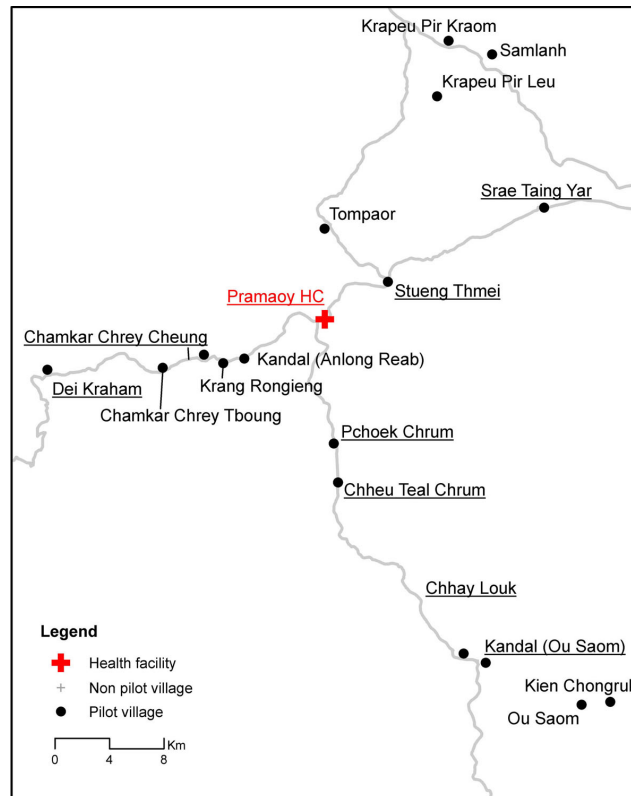


Figure 10. Map of health facilities and VMW villages included in the day-3 surveillance pilot in Battambang OD. Names of villages and health facilities visited

All the VMWs we interviewed were aware that a CIF should be completed for all individuals presenting with *Pf*/mixed infections. Actual practice seemed to vary, however. One VMW claimed never to have received the forms, while others clearly had forms but did not complete them routinely, even after a day-0 slide had been prepared.

For individuals with *Pf* and mixed infections VMWs reported routinely observing the first dose of DHA-PPQ (when it is available – see below) and checking for vomiting. They would then provide the remainder of the drugs to the patient to take away with them, having explained to the patient (or preferably a companion) the importance of keeping to the treatment schedule. None of the VMWs we spoke to had attempted to provide DOT at the patient's home. One VMW claimed that they did ask patients living close to their house to return on subsequent days for treatment – but it is clear that this approach was not adopted systematically.

All the VMWs we interviewed said that by default they would ask patients to return to the VMW house on day-3 for a follow-up blood slide, rather than attempt to follow the patient up at home. The large majority of patients, it appears, elect not to return and day-3 slides are rarely obtained (see Table 3; CNM have reported results for only 25 day-3 slides over the course of the pilot). The VMWs we spoke to recognized this as a problem, but in general there seemed to be little appetite for following up patients in the community. Some VMWs said they had tried on one or two occasions to trace patients on day-3, but apparently with not much success. In two cases VMWs had attempted to follow-up migrant workers – but in both instances the individuals concerned had left the area before they could be tracked down.

In terms of slide transport the original intention within the CNM arm was for HC staff to collect day-0 and day-3 blood slides from VMWs according to a predefined schedule. However, in practice this arrangement has not been put in place. Instead VMWs are expected to deliver day-0 and day-3 slides together, as soon as the latter has been obtained. In the absence of relevant process data for this pilot site (see Section 3.3) it is not possible to gauge how often this actually happens. In any case, the very low rate of follow-up described above effectively means that few day-0 slides would have a corresponding day-3 slide. In this scenario VMWs recognize that there is little justification for making special journeys to the HC to deliver their slides. Instead they usually either elect to wait for the next monthly VMW meeting to deliver day-0 slides, or wait for a suitable time when multiple slides can be delivered in one batch.

The situation regarding payments to VMWs within the CNM pilot system is somewhat complex. For the first six months of the pilot VMWs did receive a flat-rate payment of \$5 per month in addition to the standard payment received at the VMW monthly meeting. These payments were discontinued in January 2011, at the end of the initial six-month pilot period. Between February and the time of this evaluation none of VMWs interviewed had received any payments in connection to the day-3 pilot. VMWs had, however, been told during the June training that from July 2011 they would receive payments to cover costs of slide transport. But none had been informed how much they could expect to receive, or for how long this arrangement was planned to last.

4.3.3. HC roles and responsibilities under CNM

Principal responsibility for activities at HC level rests with a senior clinical staff member (in this case the HC vice-director) and two lab officers. In addition, there appears to be some limited involvement on the part of the primary nurse, pharmacist and HC chief. We were able to interview the HC vice-chief, one lab officer and the primary nurse as part of this review. It should be noted that the senior lab officer was absent at the time of our visit. The description of lab activities that follows is based on an interview with a more junior staff member who appears to have had limited involvement with day-3 pilot activities.

As at other sites a senior clinical staff member (in this case the HC vice-chief) is responsible for providing oversight to both the community- and facility-based day-3 pilots. The lab officer on duty is responsible for receiving day-0 and day-3 slides delivered by VMWs. He checks the labelling and coding and provides initial feedback on the quality of the slide if he thinks it necessary. The lab officer claims to examine most slides the same day, after which he completes the second part of the CIF. Overall, the lab officer thought that around half the slides he receives could be rated as “good” and that so far all slides had been readable.

In the event of a day-3 positive *Pf* case an SMS is sent to CNM following a predetermined format. A dedicated phone has been supplied for this but the lab officer we interviewed did not have access to it (and in any case did not know how to send an SMS).

None of the HC staff we interviewed were currently receiving payments for day-3 related work. The lab officer, nurse and vice-chief had all previously received the standard containment top-up of \$70 per month, but this payment was discontinued in April (and according to various respondents had not always been received regularly or promptly up to that point).

4.3.4. Additional user feedback

As at other sites, HC staff and VMWs were asked about their opinion of the day-3 pilot overall and their views on specific aspects of the project related to training and supervision, communication and feedback and incentives.

None of the VMWs interviewed claimed to have previous experience of preparing blood slides and most still felt uncomfortable doing so. In principle all the VMWs we interviewed should have received training at the start of the CNM pilot in August/September 2010 – but some clearly had not. All had participated in a recent training workshop held in June 2011, however. This workshop included a day dedicated to slide preparation and data management. All VMWs said that while they had found this training very useful, they still wanted more training as well as more opportunities to practice making slides. Many pointed out that their VMW partners had not been trained.

To some VMWs the training workshop in June 2011 clearly represented the effective start of the day-3 study. Up to that point village-level activities had been hampered by delays in the provision of slides and consumables and frequent stock-outs of both. VMWs were re-supplied with slides and new slide boxes as part of the training provided in late June 2011.

As noted above there has been little continuity in the payments made to VMWs at the CNM sites. This was clearly a major issue for many VMWs. Several suggested that the extra work associated with the pilot activities (primarily preparation and transport of slides, given that no VMWs attempted to provide DOT) was significant and that they could not support the project unless their basic costs were covered. One VMW pointed out that he was already very busy – and that in the absence of incentives there was little justification for him to prioritize day-3 activities.

Many of the issues that were raised by VMWs were not specific to the day-3 pilot but instead related to wider problems with the routine VMW system. Most VMWs complained that they received little support from HC staff. A minority did appear to get regular supervisory visits but many said they were visited rarely, if at all.

Of the various issues raised by VMWs at Pramaoy, by far the most serious appears to be the chronic problems they face in maintaining stocks of drugs, RDTs and other materials (including slides and forms). Of the seven villages visited as part of this review five had no supplies of DHA-PPQ and/or CQ and two had run out of RDTs. One staff member at Pramaoy HC confirmed that VMWs regularly complained about drug stock-outs.

These stock-outs make it impossible for VMWs to provide adequate case management in many situations. In one village we visited a patient presenting earlier the same day had been diagnosed with *Pf* by RDT, but was not treated because the VMW had run out of DHA-PPQ ten days previously. The patient was asked to return to the VMW in three days' time (*i.e.* after the next VMW meeting), at which point the VMW expected to have drugs available. In the previous week the same VMW had referred a *Pf* case to Pramaoy HC for treatment, again because of a lack of drugs. Another VMW we interviewed had run out of RDTs three weeks previously and during that period had routinely referred individuals to Pramaoy HC for diagnosis and treatment. In the most extreme case one VMW, having missed the last VMW meeting, had had no stock of RDTs for a period of six weeks and no DHA-PPQ or slides for

nearly two months. Since early June she had been referring all individuals to a VMW in a neighbouring village. The challenges of implementing additional case management roles associated with day-3 surveillance against this sort of background are self-evident.

Despite the various problems faced in the Pramaoy pilot, all VMWs considered the day-3 surveillance to be an important and worthwhile exercise and only two VMWs questioned the value of the project in the absence of active case follow-up or DOT. HC staff also seemed broadly positive about the aims of the day-3 project and did not seem to think that the project introduced a lot of extra work to the HC. The main complaints from HC staff related to lack of support from higher levels. In particular one staff member observed that while many staff from CNM and elsewhere had been involved in the initial training, very few people were available to help with the day-to-day running of the project.

4.3.5. Key strengths and weaknesses of the CNM system

It is evident from data presented previously in Section 3.2 (and in particular from Figure 3 and Table 5) that the community-based pilot in Pursat has faced a number of serious problems. A very large proportion (over 90%) of RDT positive cases reported through the routine VMW system are clearly not being captured by the day-3 system – or at least are not being tracked to the point that a day-3 slide is obtained and examined. On the ground VMWs show little engagement with new surveillance activities. None attempt to provide patients with DOT and efforts to obtain day-3 slides can at best be described as halfhearted. In essence it would seem that, at least up to their refresher training in June 2011, most VMWs have felt unable to fully engage with the pilot project.

It would be easy to oversimplify the situation in Pursat and to try and explain the apparent lack of effectiveness of the day-3 system purely in terms of factors directly related to its design and implementation. Certainly there are aspects of the CNM pilot that in hindsight could be changed and improved. (This is, after all, the point of a pilot phase.) It has proved very difficult, for example, for CNM staff based in Phnom Penh to provide the type of day-to-day support that is required to ensure effective operation of the system – and while the URC and FHI systems have both benefitted from a strong layer of support at the provincial level, this element is clearly lacking in CNM's case. Training of VMWs within the CNM pilot could probably have been more comprehensive. Most importantly, the management of VMW supplies and allowances could certainly have been done better. It should be stressed, however, that none of these limitations necessarily reflect badly on CNM staff members involved in setting up and maintaining the pilot system. It is clear from interviews at central level that CNM staff faced with own obstacles and constraints in managing this process. Overall, it would appear that CNM underestimated the amount of resources (financial and human) that are required to implement and sustain this type of community-based activity.

Fundamentally the problems faced in developing the day-3 system in Pursat had less to do with design or implementation issues associated with new surveillance activities and more to do with existing problems related to the routine VMW system at Pramaoy. Most importantly there appear to be chronic issues relating to the supply of ACTs, RDTs and other basic materials to VMWs that need to be addressed urgently. Many VMWs we visited were unable to provide basic case management in their communities either because of their inability to diagnose malaria, treat malaria, or both. In this scenario it is difficult to see how any “add-on” surveillance activities could have been viable.

4.4. CNM health facility-based pilot activities

4.4.1. Overview of the facility-based pilot

The health facility-based component of the day-3 pilot has been coordinated exclusively by CNM and incorporates seven facilities (three RHs, three FDHs and one HC) in four provinces (see Table 1 and Figure 1). As with the evaluation of the CNM community-based day-3 system, project activities in Kampot were not included in the current review. However all five of the remaining facilities in Battambang, Pailin and Pursat were visited. Two of these facilities (Sampov Luon RH and Pailin RH) hosted only the CNM facility-based system. The remaining sites (Ta Sanh HC, Trang HC and Pramaoy HC) supported both facility-based surveillance activities and the community-based day-3 project. At each site as many of the staff involved directly with the facility-based pilot were interviewed as possible. In all cases this included at least one or two lab staff and at least one or two clinical staff members (medical assistants, nurses and facility vice-chiefs and chiefs as applicable).

Clinical staff form the hub of the facility-based system. They provide initial screening of outpatients and inpatients (where applicable) for malaria on the basis of signs and symptoms, travel history and presence of fever. For slide confirmed *Pf* cases clinical staff are responsible for filling out the study-specific CIFs and administering treatment on day-0. On day-3 clinical staff provide a further consultation for the patient, complete CIFs and alert CNM of any day-3 positive cases using a standard SMS. The role of lab staff is limited to preparing and reading slides as directed by the clinical staff – activities that are effectively already included within their existing routine duties. Roles and responsibilities of staff under the facility-based pilot therefore differ slightly from those in the community-based pilot, where it is the lab officer who is primarily responsible for completing CIFs and alerting CNM of any day-3 positive cases.

4.4.2. Activities within the health facility

The basic workflow within the health facility-based pilot was broadly similar at all the facilities visited – and in all cases was consistent with the general principles outlined above, with clinical staff being responsible for screening patients for malaria, treating slide-confirmed *Pf* infections, completing CIFs and sending SMS alerts of day-3 positive cases to CNM. The role of the lab officer in all cases was limited to preparing and reading blood slides, as directed by the clinical staff member on duty.

Within this framework some amount of variation in practice between sites was observed, primarily related to specific staffing or capacity issues at the different facilities. One important factor appears to be the balance between the number of outpatients and inpatients seen. Of the five sites visited one had no inpatient facility (Pramaoy), one saw very few outpatients (Pailin), while the remainder saw a mixture of inpatients and outpatients.

In most facilities the day-3 surveillance process begins with an OPD consultation. Individuals suspected of having malaria are sent to the lab together with a standard form and a slide is prepared and examined. Results are recorded in the lab register and are communicated back to the consultant, again using standard paperwork. Patients with confirmed malaria have a second consultation during which the consultant starts to fill out the CIF and decides whether or not to admit the patient. Non-severe *Pf* cases are observed taking the first dose of PHP-PPQ and provided with the remainder of the treatment course to take home with them. An appointment is made for the patient to return on day-3 for a follow-up blood slide, at which point the CIF is

completed. Patients who are admitted will also have a day-3 slide and have a CIF completed, regardless of whether they are treated orally (for three days) or by injection/infusion (for five days), which is more common.⁴

As alluded to above, there are some variations within this basic framework. At Pailin, for example, where outpatients mainly present at the neighbouring HC (Suon Koma, adjacent to the RH), most malaria cases have been referred by a HC or VMW. These are often severe cases and tend to be admitted. In addition, MORU's drug efficacy study, which recruits *Pf* cases mainly through the VMW network (see Section 4.1.1) is also based in the same compound as the RH. The RH receives patients that have been screened by MORU but who do not then go on to be enrolled in their study (*e.g.* due to exclusion criteria related to patient age or parasite density). Patients coming through either route will have a new blood slide prepared – but usually the clinician first carries out an RDT and then takes a blood sample for individuals with *Pf* or mixed infections. He sends the sample to the lab and admits/begins treatment before the slide result is available. This is because he cannot expect a timely result from the hospital lab; experienced lab staff being mainly committed to external projects (FSAT and MORU).

At Trang HC the malaria supervisor appears to act as an intermediary between clinical and lab staff. Any OPD patients suspected of having malaria at the initial consultation are referred to the malaria supervisor, who then carries out an RDT for that individual. Only individuals who test positive for *Pf* or a mixed infection will be sent on to the lab officer for a blood slide. This process appears inefficient but was apparently introduced to protect the single lab officer at Trang, who claims to be overworked (see Section 4.2.4). The malaria supervisor does not wait for slide confirmation to begin completing the CIF, administering initial treatment and providing the individual with a patient card and the rest of the treatment course. Given that only a small fraction of patients return on day-3 for a follow-up slide (see below), the value of reading the day-0 slide is in any case questionable. Also questionable is the observed practice of routinely filling out the dates of DOT administration in the CIF before the therapy is complete (and with no evidence that DOT was achieved).

Pramaoy HC has no inpatient facility. The vice-chief appears to have developed his own method of attempting to provide DOT to outpatients with *Pf*, in which he observes the first dose of DHA-PPQ, provides the second dose (only) to the patient to take at home and then makes an appointment for the patient to return to the HC on the third day for the final dose. The respondent was asked to explain this process several times to ensure that we had understood the process correctly. His justification for introducing this system was that many patients live far from the HC and cannot, therefore, be expected to travel everyday to receive treatment. When asked how many patients actually returned on the third day to complete their treatment, the response was “less than 20%” (again we asked this question in a variety of ways to ensure that this was his intended response). The implication, therefore, is that 80% of *Pf* cases presenting at Pramaoy do not receive a full treatment course, essentially because the HC has tried to introduce its own type of quasi-DOT system. This clearly needs to be investigated further, preferably using observation of the case management process.

⁴ The day-0/day-3 facility data provided by CNM (Section 3.4) appear to exclude patients not receiving standard oral ACT.

Reported day-3 follow-up rates at other facilities in the day-3 pilot varied considerably. At Sampov Luon RH the medical assistant we interviewed thought that more than 90% of patients returned to have the day-3 slide done. The response was similar at Pailin – although it was noted that the absolute number of people involved was very small (most outpatients are managed by Suon Koma HC). At Trang, in contrast, it seems that very few people returned to the HC on day-3. The malaria supervisor claimed that, depending on how busy he was, he might call patients to remind them to revisit the HC – but that they mostly declined because they already felt better. At Ta Sanh, staff made no attempt to ask patients to return on day-3.

Facility staff were asked about case management of day-3 positive cases. Admittedly this question was largely hypothetical, as across the network very few day-3 cases have been detected. At one site the response was that no further treatment would be provided – and that the patient would simply be told that they had not yet cleared and should come back again if they felt ill. At another site the medical assistant said she would continue the course of DHA-PPQ beyond day-3 as necessary. At none of the facilities was the option of switching to Malarone raised.

All facilities in the CNM system had been provided with a project mobile phone for sending SMS alerts, although these did not always end up in the possession of the staff member responsible for sending the SMS. None of the facility staff who had previously sent out an alert reported any difficulties composing or sending the SMS. At Pailin, however, the medical assistant said that, although he knew he was expected to send an SMS, in all cases he had elected to call CNM staff instead – primarily so that he discuss each case individually with them.

Staff involved with the CNM health facility pilot received a monthly salary top-up of \$70 for at least part of the pilot period. For HC staff this effectively meant no change to pre-existing arrangements (the containment top-up was already being paid to HC staff in Zone 1 but was discontinued in May 2011). Staff at RHs had not previously received salary top-ups as part of the containment project. Monthly payments (of \$70) were introduced specifically for the day-3 pilot, but money was only available to keep these going for six months. In addition some project staff said they had been told to expect payment either for each day-3 slide examined or for each day-3 positive case detected. The amount of money involved (\$0.5 per day-3 slide, or \$1 per day-3 case, depending on who you talked to) was generally considered to be too small to be considered an incentive and it is not clear whether payments along these lines were ever made. In addition to financial incentives, one staff member per site received a mobile phone. No contributions to call/SMS costs were made.

4.4.3. Additional user feedback

All staff that we interviewed in connection with the facility pilot had attended a three-day training workshop at the beginning of the project. All considered the training to be useful and the majority said they would like to receive more training (particularly on management of resistant cases). One medical assistant said that the training workshop was instrumental to his involvement in the project, as it had convinced him of the importance of day-3 positivity (otherwise he would have been unlikely to be able to commit time to the project, given his other responsibilities). In sites where community- and facility-based pilots were running in parallel, some staff mentioned that receiving two lots of training had been confusing. At Ta Sanh, for example, project staff were trained first by CNM and then by URC – and this appeared to create the impression in their minds that the URC project had actually superseded the CNM project.

All clinical staff we interviewed reported having received at least one supervisory visit from CNM staff during the pilot. Most (but not all) seemed to find this sufficient. One medical assistant complained that the visits seemed to mainly entail checking and collecting CIFs, and that there was little time to discuss the project.

Project staff were asked to what extent the pilot activities added to their existing workload. Typically lab officers felt that the effect of the project was negligible because (a) lab activities associated with the day-3 project overlapped with their existing duties; and (b) there were very few day-3 slides to examine. Clinical staff tended to see the project (and, more specifically, the form filling element of it) as a bigger time commitment and often highlighted the problem of taking on new tasks when their existing workload was so high. One medical assistant thought that the system could be made more efficient by reducing the length of the CIF.

As noted above, although project staff received the standard containment salary top-up of \$70 per month for part of the pilot period, effectively no other financial incentives were paid. This seemed to be less of an issue for lab staff than for clinical staff. Few felt they could continue to support the day-3 system without a direct financial incentive. One medical assistant had already stopped filling out CIFs – although she was continuing to make day-3 appointments for outpatients and to have a day-3 slide prepared for those that came back. She said that she felt these elements of the day-3 pilot should be considered as “routine” and represented good patient management. Other activities – essentially the CIF, patient card and day-3 SMS – she did not consider routine or of immediate benefit to the patient and so would not carry out without a direct incentive.

More broadly one hospital director felt that the way that staff incentives had been structured in the past was unhelpful and provided him with little flexibility in terms of motivating individuals to do specific tasks. At his hospital four people has been receiving a \$70 monthly payment for six months of the pilot project – but in the director’s view some financial autonomy at the facility level was required so that payments could be varied between staff and over time and thereby be linked more explicitly to specific tasks or duties. He believed that increased flexibility of this sort would enable extra activities to be included within the day-3 system including, potentially, provision of DOT for outpatients.

At another RH one medical assistant was clearly unhappy that he and a colleague were receiving similar payments even though he felt he was doing the vast bulk of the day-3 specific work. He felt this to be demotivating and said he would discontinue the activity if the situation persisted. In general many staff complained that in terms of incentives there was a general lack of transparency about who was getting what, for how long the payments would continue and what activities the incentives were supposed to cover. At one HC there was also clearly an issue in terms of the overlapping remits of the community- and facility-based studies and the fact that different projects appeared to be providing different levels of support.

Despite reservations about workloads and incentives, all the facility staff we spoke to were positive about the purpose of the day-3 pilot and many felt they had gained personally through training and improved knowledge. As at other project sites, most respondents saw the chief benefit of the project as being improved patient care through its focus on parasite clearance at day-3. Only one person felt that the lack of DOT was a major weakness in the system. For most day-3 positivity was less important as a general indicator of drug resistance than as a specific

guide to managing individual patients. In this respect the low numbers of patients returning to the facility for a follow-up slide on day-3 appeared to be of more concern than the absence of DOT.

4.4.4. Key strengths and weaknesses of the health facility-based system

Some aspects of the health-facility pilot have been encouraging. Most importantly there has been a clear willingness on the part of clinical and lab staff to participate in the project. From a logistical standpoint the engagement of clinical staff is particularly important – and it seems this was largely achieved because staff saw clear benefits in terms of improving the way patients are managed. The fact that one medical assistant had retained the practice of making day-3 appointments after she had stopped working on the project illustrates this.

Experience at Pramaoy, however, demonstrates the potential danger of protocols for patient follow-up being adapted by health facility staff. Here, outpatients were being provided with ACT for two days but were required to revisit the HC on the third day to complete their therapy. This certainly shows some initiative on the part of clinical staff at Pramaoy – and the modification was certainly well intentioned. In practice, however, it appears that few *Pf* cases being treated at the HC get a full therapeutic dose of ACT as a result.

The major impediment to staff involvement in the pilot seemed to come from basic pressures on their time. In addition staff received incentives in the form of standard monthly payments, rather than getting specific payments for defined duties. This system seems to have done little to motivate most of the staff we spoke to – and a more explicit linking of payments to specific task is required. Issues to do with financial transparency and lack of clarity over roles and responsibilities appeared to be most acute at facilities where facility- and community-based pilot activities were running in parallel.

As it stands there are two fundamental problems inherent to the facility-based approach that limit its usefulness for day-3 surveillance. Firstly, the system depends on outpatients to voluntarily return for a follow-up smear after the end of their treatment. Although interviews with facility staff indicated that some patients do keep to these appointments, it is clearly unrealistic to expect all, or perhaps even the majority, of patients to do so. Secondly, there is no way of estimating the rate of non-adherence among patients who do return to the health facility on day-3. As such it is not possible to gauge whether or not individuals diagnosed with *Pf* infections on the basis of their follow-up slide represent “true” day-3 positives.

It is therefore difficult to see how facility-based monitoring of day-3 status among outpatients can be viable, unless it is linked directly to a parallel system of VMW-based monitoring. There may be scope for expanding the inpatient component of the pilot (notwithstanding the fact that most patients admitted with malaria are not treated using a standard oral course of ACT). This would provide a strong basis for a sentinel site approach for monitoring overall incidence of day-3 positivity at the provincial level, but clearly could not provide a comprehensive picture of patterns of day-3 *Pf* positivity at the community level.

5. SYNTHESIS OF MAIN FINDINGS AND RECOMMENDATIONS

Overall, it is clear from Section 4 that some pilot activities have been more effective than others. However, when comparing the experiences of different partners it is imperative to appreciate the significance of external factors in determining the apparent success or otherwise of pilot activities. Fundamental differences exist between the pilot sites, not least in terms of levels of malaria incidence, capacities and capabilities of VMWs and their supervising HCs, and the presence and influence of external partners. These differences have effectively determined the likelihood of success of pilot activities at each site – and, more fundamentally, influenced the protocols adopted at each site in the first place.

Because activities overseen by different partners have been designed (and adapted) to best suit local contexts it is not possible to simply assess the success or wider applicability of different systems based solely on the quality/completeness of data collected or on user experiences reported at each site. It is more constructive to look for common themes that cut across different partners/sites and to use these as a basis for making recommendations concerning the design (and general viability) of day-3 surveillance systems in the future. The following section attempts to do this. Crosscutting themes are highlighted and, where applicable, specific recommendations related to these themes are included.

5.1. Principal themes and recommendations

(i). Implementing day-3 surveillance is a non-trivial exercise

Findings from this review have highlighted the non-trivial nature of implementing and sustaining day-3 surveillance activities. The technical challenges represented by this exercise should not be underestimated and the achievements of partners involved in the pilot studies, which have been considerable, should be viewed in this light. In essence day-3 surveillance is a highly intensive activity that introduces entirely new roles and responsibilities for VMWs and health facility staff. In many cases it also adds significantly to existing staff workloads (particularly in the case of VMWs). Any future plans to scale-up day-3 surveillance activities should explicitly recognize these facts (and should be resourced accordingly – see also point v and ix).

Recommendation. Any proposals to scale up day-3 surveillance in Cambodia should acknowledge explicitly the additional roles and responsibilities of VMW and health facility staff required to support activities at the peripheral level. Proposals should be budgeted accordingly.

(ii). The limited role of IT

In the early planning stages of the day-3 surveillance pilots, the novel use of IT to provide rapid alerts of day-3 *Pf* cases to CNM and other stakeholders was a prominent feature of planned activities. In practice, however, this technological component represents a very small component of the overall work flow and any problems users had with the system (e.g. inexperience in sending texts) appear to be entirely tractable. It is important to recognize that within the current day-3 framework IT is used to essentially increase the effectiveness of surveillance data once they have been generated. IT does not make the gathering of these data any easier. In reality the principal impediments to achieving effective surveillance of day-3 *Pf*

cases relate to basic health system constraints (outlined below) and there are clear limits to the extent that technology can support this process.

(iii). Levels of acceptability of project are high – levels of engagement vary

A striking feature of all interviews conducted with VMWs and HC staff was the very high level of acceptability of the project. Almost universally, people felt strongly that the aims of the project were good. Most importantly there was clearly an appetite on the part of VMWs and HC staff to improve the quality of care provided to *Pf* cases. Day-3 surveillance was seen to contribute directly to this through its emphasis on treatment and monitoring of parasite clearance. These high levels of acceptability do not, however, always translate into high levels of user engagement. For most VMWs and facility staff issues relating to existing workloads, financial incentives and availability of basic supplies create practical limits to the amount of time and effort they can justify in supporting the project. Increasing levels of engagement will require careful consideration of existing capacity constraints and appropriate use of financial incentives. It is important that the potential benefits to case management that the day-3 surveillance system offers are fully realized (see point *viii*).

(iv). VMWs are willing (and able) to prepare blood smears

A clear outcome from the pilot phase has been a strong evidence base to support the feasibility of surveillance predicated on blood slides obtained by VMWs. VMWs at all sites demonstrated that they were willing to prepare smears as part of their routine activity and none appeared to consider this a major imposition. As reported by HC lab staff, in reality the quality of blood smears is highly variable and some VMWs clearly struggled – but it is also apparent that by the end of the pilot period many VMWs with no previous experience of preparing slides were capable of producing good quality smears. A significant amount of training is required to achieve this, however. At the URC sites, for example, VMWs benefitted from regular refresher training throughout the project – but at the end of the pilot phase most still felt that they needed more formal training. In addition, many VMWs in villages with few malaria cases complained about limited opportunities to practice the skills they had learned during training. Protocols at some sites were adapted to take this into account. An issue at other sites (and especially at Pramaoy) was that not all VMWs in the study villages had been trained in slide preparation, which meant slides might or might not be obtained depending on which VMW is on duty.

Recommendations. There is a need to harmonize the training approaches used by the project partners. Refresher training should be offered regularly at VMW monthly meetings, at least for the first 6-12 months of implementation. In low transmission villages VMWs should be encouraged to obtain slides for all symptomatic patients. Training should be provided to all VMWs in targeted villages. Instruments need to be developed to allow lab staff to routinely record and monitor quality of smears provided by VMWs. Through this system extra training and support should be provided to VMWs who struggle to prepare good quality slides.

(v). Operational systems will need to be flexible about DOT, or pay for it

This review demonstrated considerable variability between (and sometimes within) pilot sites in terms of VMW provision of DOT. At Ta Sanh, VMWs routinely provided DOT and travelled to patients' houses to do so. At all other sites arrangements were more variable – but in practice VMWs mainly opted to make appointments for patients to return to their house for treatment.

Some VMWs reported using accompanying friends and relatives to administer DOT. Others clearly had never attempted to provide DOT.

The experience of VMWs at the pilot sites suggests that comprehensive provision DOT cannot be achieved unless VMWs are provided with the resources (finance) to allow them to follow up patients at home. It is unrealistic to expect all patients to re-visit VMWs on the second and third day to receive treatment. Indeed, instituting such a system would arguably be counter-productive (and for migrants and others living far from the VMW would be a fairly sure way to guarantee that treatment schedules are neither adhered to nor completed). We came across worrying instances in villages and at facilities (see Section 4.4.3) of ACTs being withheld in situations where future follow-up of the individual concerned was unlikely to be achieved.

Experience at Ta Sanh suggests that VMWs are willing to provide active follow-up of patients as long as they receive a financial incentive to do so. At FHI and CNM pilot sites, where no incentives are provided to VMWs for DOT, active follow-up was much less likely, at least for patients who did not live in close proximity to the VMW house. Even where incentives are provided, however, it is probable that active follow-up will not be feasible for a significant number of individuals.

Recommendations. Where possible, incentives should be provided for VMWs to administer DOT to patients in their community. VMWs should only attempt to administer DOT in situations where they know that timely and complete follow-up of patients is achievable. In all other situations patients should be provided with the full treatment course once the initial dose has been observed. Alternative mechanisms for maximizing adherence rates (e.g. information cards, asking friends or relatives to administer DOT, daily phone contact with the patient) should be explored. Clear guidelines for VMWs should be produced and VMW practice monitored.

(vi). Specific incentives are required to ensure day-3 follow-up

Unsurprisingly, many VMWs observed that they found it more difficult to get patients to return for a day-3 follow-up slide than to return for treatment. Even if no incentive is provided for DOT, therefore, there is a strong rationale for providing payments to VMWs to obtain day-3 slides. On a related point, many VMWs found it strange that day-3 slide results were not being used to guide case management. Moreover, for much of the pilot period VMWs were not routinely informed of day-3 *Pf* cases in their communities. As most VMWs saw improved management of *Pf* cases as the primary benefit of new surveillance activities, this absence of feedback can represent a significant demotivating factor. There is also a need to respond to a strong demand from both VMWs and health facility staff for clearer guidance on the management of day-3 *Pf* cases.

*Recommendations. VMWs should be provided with financial incentives to obtain and deliver day-3 slides. VMWs should be routinely advised of slide results and given clear guidance on the management of day-3 *Pf* cases. The possibility of providing Malarone for this purpose should be explored.*

(vi). The importance of adequate lab capacity

An issue that emerged frequently within this evaluation was the need to ensure adequate capacity at HC labs to support both community- and facility-based activities (where applicable). Many of the labs we visited lacked suitably qualified staff. Where such staff did exist they were often already heavily committed to other projects and were reluctant to take on extra duties. Several of the lab officers we spoke to were clearly demotivated by the fact that no incentives (under URC and CNM), or very modest incentives (under FHI), were paid for examining slides coming from the pilot study. One HC lacked a functioning lab. Others had experienced shortages of basic reagents and consumables. It is clear that in some cases more refresher training should have been provided to lab staff as part of the pilot project.

Recommendations. The capacity of health facilities to provide suitable diagnostic support for day-3 surveillance should be assessed. Additional staff training should be provided where necessary and a system of routine refresher training introduced for all lab staff. Labs should be supplied with new microscopes, reagents and supplies where necessary.

(viii). The importance of appropriate supervision and feedback

At a simplistic level the relatively smooth running of pilot activities in Ta Sanh and Pailin can be attributed, at least in part, to strong supervisory support provided by URC and FHI at the provincial level. In contrast, some of the problems experienced at Pramaoy can be linked to the absence of equivalent support mechanisms at province or OD level.

At a less simplistic level it is difficult on the basis of this evaluation to recommend a specific model or framework for supervision. The model adopted by FHI, which involved very intensive project support to individual VMWs and HCs, is unlikely to be viable in anywhere other than very low transmission settings where suitable project partners already exist. URC's model still involves major inputs from technical staff at provincial level, but is likely to be more reproducible in other settings. A key characteristic of the URC pilot was that support to VMWs was provided principally through VMW monthly meetings. Direct supervision at the village-level was rare. At all sites there was a noticeable lack of involvement of OD and PHD staff in the management of pilot activities (although OD and PHD staff often assisted with training in the start-up phase). In the context of a pilot project this is understandable – but clearly in a more routine operational setting active OD and PHD involvement will be critical.

Recommendation. Appropriate frameworks incorporating support and supervision from OD and PHD staff need to be developed and resources made available to facilitate this.

(ix). The importance of financial incentives

The importance of financial incentives was a constant theme during this evaluation and has been touched upon already. Payments were structured differently in each of the three community pilots but at all sites attracted some form of criticism. Specific feedback has been described in detail in Section 4 and will not be repeated here. In essence, however, the prevailing view of most VMWs and HC staff was that some form of financial payment was required to compensate for activity on the project. Notice that the word “compensate” rather than “incentivize” is used here; on the whole VMWs were keen to stress that their motivation

came from non-financial considerations (such as improved case management, alluded to above) and that payments were required primarily to cover their basic costs. Whether one take these comments at face value or not, it is clear that many of the extra tasks required of VMWs were not specifically covered by financial payments.

At health facilities the standard system of salary top-ups was generally not well suited to motivating individual staff members to carry out additional tasks (see Section 4.4.3). Most staff we spoke to wanted to see a much more explicit link between the workloads associated with new activities and the payments received.

Recommendations. As a minimum VMWs need to be realistically compensated for all costs related to patient follow-up and slide transport. Where possible, additional payments should be made in recognition of additional roles and responsibilities associated with day-3 surveillance system (notably slide preparation and DOT). Payments should be directly related to workload and flat rate monthly incentives should be avoided (this applies to both VMWs and health facility staff).

(x). The importance of existing capacity constraints

The significance of existing capacity constraints has already been mentioned in relation to lab staff. Similar issues apply to VMWs and clinical staff. While little can be done to reduce these existing commitments, where possible day-3 activities and procedures should be streamlined as far as possible to maximize the efficiency of the process. Standard operating procedures should be developed that incorporate best practice from different sites. For example, on the basis of slide results from the URC it seems difficult to justify the approach piloted by FHI in which day-0 and day-3 slides are transported separately to the local HC. In the same vein, content of CIFs should be reviewed and trimmed where possible. Unnecessary paperwork should be withdrawn and procedures for data entry streamlined.

(xi). The need for strong routine VMW networks

The general importance of pre-existing external factors in influencing the outcomes of different pilots has already been stressed. For community-based activities the most significant of these contextual factors appears to be the strength (or weakness) of the routine VMW operations supervised at each HC. This is illustrated clearly by the contrasting experiences of VMWs at Ta Sanh and Pramaoy (and to a more limited extent between VMWs at Ta Sanh and Trang). Essentially, day-3 surveillance has very little chance of succeeding in settings where serious problems to do with VMW supervision and stock-outs of drugs and other supplies already exist. In this respect closer coordination of day-3 surveillance and routine VMW operations within CNM would be beneficial.

Recommendations. Individual VMW networks should be appraised before additional day-3 surveillance activities are introduced. Community-based day-3 surveillance should only be attempted within networks that have been demonstrated to be sufficiently robust.

(xii). The limited usefulness of standalone facility-based monitoring

Findings presented in Section 4.4 raise serious questions about the value of standalone day-3 surveillance delivered through health facilities. The pilot does not provide strong evidence to

suggest that a large proportion of individuals diagnosed with *Pf* can be successfully encouraged to return on day-3 for a follow-up slide. In addition, under current arrangements there is no way of estimating the rate of non-adherence among patients who do return to the health facility on day-3. As such it is not possible to gauge whether or not individuals diagnosed with *Pf* infections on the basis of their follow-up slide represent “true” day-3 positives.

Whether or not there is a future role for health facility-based surveillance of day-3 cases depends on two considerations. The first is that facility-based monitoring may still provide a useful platform for identifying and treating individuals who, three days after being initially diagnosed with *Pf*, are still contributing to the overall parasite pool. In other words, if the day-3 system is seen effectively as an intervention aimed primarily at reducing the *Pf* biomass in areas of incipient drug resistance (rather than merely as a platform for generating day-3 indicator data), facility-based surveillance may still have a role to play.

A second (linked) consideration is the extent to which day-3 surveillance should constitute a comprehensive system that attempts to detect all day-3 positive individuals in the community. Any truly comprehensive system will necessarily have to incorporate a facility-based component, although ideally this should be fully integrated with community-based surveillance activities. This issue is explored in more detail below.

(xiii). How comprehensive should the system be and what is its primary purpose?

On balance, evidence from this evaluation suggests that an appropriately resourced and well-supported community-based system for day-3 surveillance is viable. As distinct from a standalone facility-based approach (see point *xii*, above) such a system would be capable of providing fairly robust indicator data on day-3 positivity and of ensuring that all *Pf* infections diagnosed in the community are effectively cleared. However, on its own such a system cannot be considered comprehensive. MIS data for the period September 2010- to July 2011 indicate that for localities in the pilot provinces (and covered by the VMW system), 61% of reported *Pf* cases were detected by VMWs, with the remainder presenting at health facilities. Nationwide this figure is somewhat higher – with 73% of *Pf* cases being detected through the VMW network. Even putting aside the issue of private providers, this means that around a third of *Pf* cases bypass the VMW system.

Creating a more comprehensive day-3 surveillance system would involve effective integration of community- and facility-based systems. In theory a suitable blueprint for such a system is relatively easy to envisage. In practice, however, achieving the sort of close coordination of facility- and village-based activities required to make this work would be very difficult.

Fundamentally, this discussion boils down to a simple question: what is the main purpose of introducing day-3 surveillance? If it is primarily to serve as a platform for monitoring temporal changes in day-3 positivity rates then arguably an extensive sentinel site system, most likely consisting of inpatient facilities, would almost certainly be a more efficient and cost-effective approach to generating suitable datasets. If the purpose of day-3 surveillance is to identify and clear as many *Pf* infections in the community as possible, other mechanisms (FSAT, MDA) are likely to be more appropriate.

If, however, the main purpose of the day-3 system is to provide a general alert system to allow CNM to identify potential clusters of day-3 positives, the type of systems piloted in this exercise

may have a potential role to play, especially if the system is explicitly linked to a well-defined plan for response. The main problem is that the very intensive nature of day-3 surveillance, as illustrated by this review, effectively means it is not suitable for wide-scale deployment and should be instead targeted towards areas of specific epidemiological interest. This presumably would mainly include localities where drug-resistance is already known to be a threat (as identified by sentinel site studies). In this case there would be an argument for dispensing with day-3 surveillance altogether and moving towards day-0 (point-of-care) reporting for all VMWs and facilities, backed up by an effective response system to deal with clusters/outbreaks and more persistent transmission hot-spots. Clearly decisions of this type need to be made soon – but for now it seems sensible to keep all options on the table.

Recommendations: CNM and national partners need to clarify and articulate specific objectives of the day-3 surveillance. Any scaling-up of surveillance activities should be based on clearly defined epidemiological criteria. The role of day-3 surveillance in the context of alternative surveillance mechanisms (sentinel sites, point-of-care reporting of all incident cases) needs to be defined and an over-arching strategy incorporating all malaria surveillance components developed.

ANNEX 1: LIST OF PERSONS MET IN PILOT PROVINCES

July 11, 2011:

Mr. Ros South, Suon Koma HC Chief.
Ms. Long Sinath, Lab-Technician of Suon Koma HC.
Ms. Yean Sophy, VMW in Dei Kraham village
Mr. Chea Lim, VMW in Pich Kiri village
Ms. Chean Sokhoeun, VMW in Pich Kiri village
Ms. Sin Voleak, VMW in Kork Moush village

July 12, 2011:

Ms. Chan Kolap, VMW in Ou Preush village
Ms. Rin Samphors, VMW in Ou Preush village
Mr. Pril Kim Sour, Lab-Staff at Krachap HC
Mr. Long Vuthy, VMW in Phnom Dambang village
Mr. Phy Theavy, VMW in Krachap Leu village
Mr. Long Bunthong, Krachap HC Chief

July 13, 2011:

Ms. Chun La, VMW in Bor Houy Cheung village
Ms. Pouk Kim, VMW in Bor Thmey village
Mr. Hak Pan, Ou Chra HC Chief
Mr. Chen Eang, Lab-Staff at Ou Chra HC
Mr. Hak Map, FHI staff

July 14, 2011:

Mr. Bun Huy, VMW in Ou Treng village
Ms. Ouk Phal, VMW in Veal Roleum village
Ms. Keo Chenda and Ms. Cheav Khea, VMW in Ou Nonoung village
Mr. Chhourm Hull and Ms. Pin Sophany, VMW in Phnom Rei village
Ms. Chea Nay, VMW in Ta Sanh Cheung village

July 15, 2011:

1. Mr. Pov Pheng, Vice Chief of Ta Sanh HC
1. Mr. Yom Nop and Ms. Tith Phany, Lab-Staff at Ta Sanh HC
3. Ms. Chan Phorp, VMW in Doun Tred village

July 16, 2011:

1. Mr. Sao Bunchhon, Lab-staff at Trang HC
2. Mr. Soum Ya, Chief of malaria program in Trang HC
3. Mr. Ton Teang and Ms. Ouch Sopheap, VMW in Phnom Muoy Ruoy (Phnom 100) village
4. Ms. Chea Reun and Ms. Neak Ron, VMW in Svay Thom village
5. Ms. Nguon Sarom, VMW in Tang Yoo village

July 17, 2011:

1. Mr. Ky Sang Heng, VMW in Ou Kaki village
2. Ms. Eang Doeun, VMW in Ou Anlork village
3. Ms. Ros Nim, VMW in Dei Kraham village

July 18, 2011:

1. Men Thoeun, Lab-staff in Sampov Luon Referral Hospital
2. Ms. Sok Samoeun, Medical Assistant (MA) in Sampov Luon Referral Hospital
3. Dr. Meas Maisak, Sampov Luon Referral Hospital Director
4. Mr. Bun Sopheap, Lab-staff in Pailin Referral Hospital
5. Mr. Nov Hon, Medical Assistant (MA) in Pailin Referral Hospital
6. Mr. Sam Ossophea and Mr. Hak Map, FHI staff in Pailin

July 19, 2011:

1. Mr. Chan Sophorn, URC staff in Battambang
2. Mr. Prom Thy, VMW in Tang Yor village
3. Mr. Sok Chhong, Chief of Pramaoy HC
4. Mr. Sok Bunthoeun, Lab-staff in Pramaoy HC
5. Mr. Thou Thorn, Primary Nurse in Pramaoy HC

July 20, 2011:

1. Ms. Sem Sokhun, VMW in Chay Louk village
2. Mr. Nou Teng, VMW in Cheuteal Chrum village
3. Mr. Sorn Yuth, VMW in Pcheuk Chrum village
4. Mr. Khen Vou, VMW in Dei Kraham village
5. Ms. Yin Channa, VMW in Chamka Chrey Cheung village
6. Ms. Sorn Thida, VMW

July 21, 2011:

1. Mr. Ngov Bunthorn, Vice Chief of Pramaoy HC

ANNEX 2: SUMMARY OF PILOT PROJECT COSTS

The following sections provide an overview of partner budget breakdowns (A2.1) and outline the main operational costs associated with each of the community pilot studies (A2.2).

A2.1 Partner budget breakdowns

Details of budget requests from URC and FHI were obtained from WHO. Budgets for CNM's community- and health facility-based studies were obtained directly from CNM. The budget sheets provided by different partners varied in detail and each had a specific background. The budget figures provided by CNM were not subsequently approved and in practice the amount of funding made available for CNM pilot activities was substantially less than that originally requested. The budget information available for the FHI pilot includes estimated costs under relatively broad budget lines prior to the start of activities. The budget available for URC represents an extension budget request (following the initial six month pilot phase). This budget is particularly useful as budget lines reflect actual costs of activities in the first phase of the pilot.

It is not appropriate in this review to present details of specific budget lines for each partner. However, it is instructive to examine the proportion of each budget allocated to different activities and budget lines. These data are presented in Figure A1, which categorizes estimated costs for each partner budget according to nine major headings.

It should be re-iterated that most of the data represented in Figure A1 reflect estimated rather than actual project costs. It is also worth noting that not all budget lines are easily attributable to a single cost heading. The budget structures in Figure A1 should therefore be considered as illustrative rather than definitive.

Nevertheless, some notable features are common across all budgets – not least the rather small proportion of total costs that relate directly to VMW and HC activities (“VMW operational costs” and “materials”). These budget lines represent only 9% of CNM and FHI budgets. In the URC budget (based on actual costs and including higher rates of VMW compensation – see below) this figure is substantially higher, at 19%.

Across all sites training and other workshops/meetings represented a significant proportion of total budgets (36%, 10% and 39% for URC, FHI and CNM respectively). The portion of budgets allocated to supervision differed substantially between sites – and was highest (at 27%) in the FHI study, which incorporates relatively intensive support and supervision of VMWs and HC lab staff by the provincial project team (see Section 4.1.1). FHI also included more generous provision for salary support for its own staff (at 36% of the total budget) than URC and CNM (15% and 18% respectively).

The structure of pilot budgets cannot be considered to be indicative of the final structure of a scaled-up, fully operational system. However, the figures presented here – together with wider evidence presented in this review (particularly regarding the importance of intensive and continuous training and the need for strong supervisory structures) point to the fact that a substantial proportion of the operational budget will still be required to support operational roles and activities not directly related to the day-to-day surveillance activities of VMWs and HC staff.

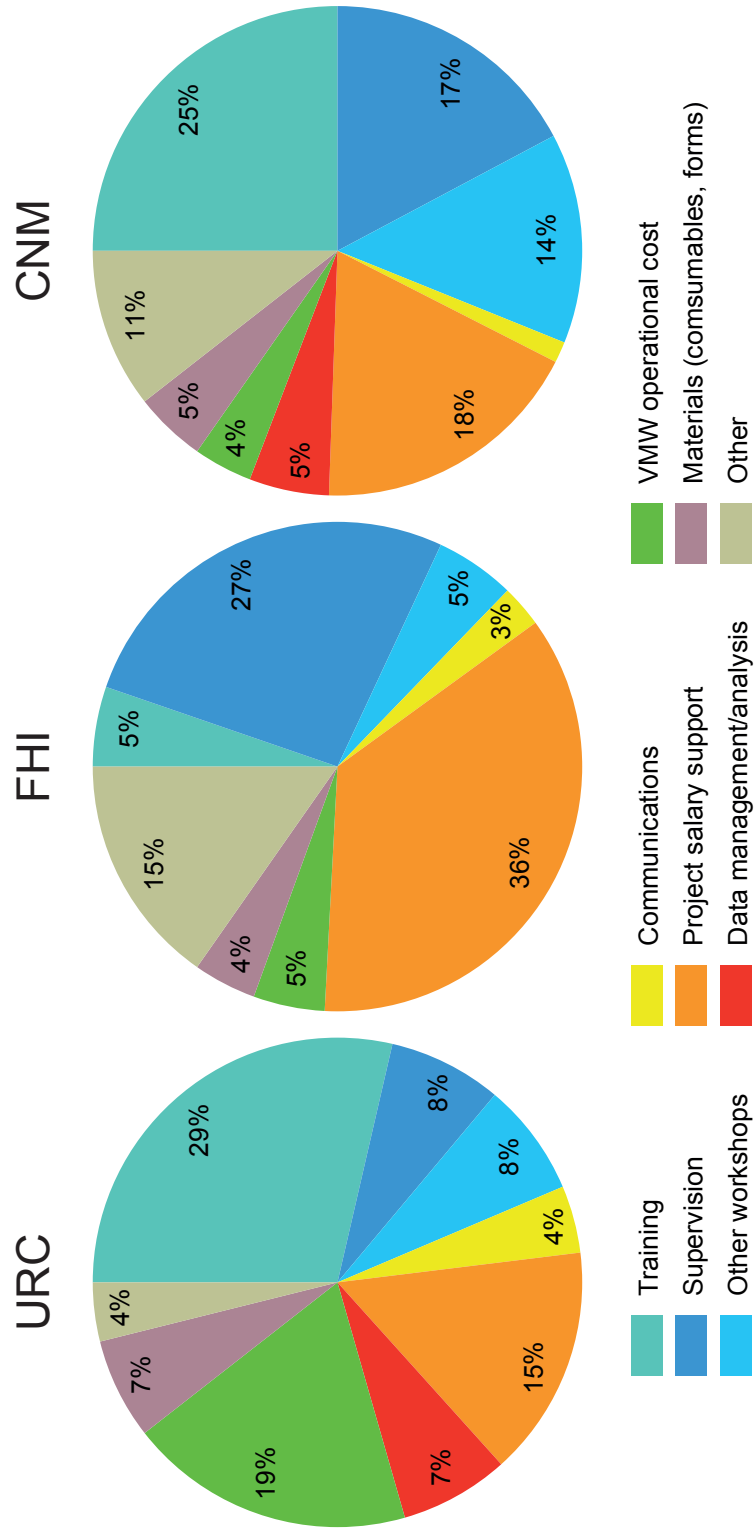


Figure A1. Structure of partner budgets for pilot activities, categorized under nine cost headings. Note caveats outlined in the main text

Table A1. Table indicating (i) payments made for core VMW and HC activities under the day-3 pilot systems and (ii) projected monthly costs under a “typical” HC/VMW scenario (see main text for details)

Activity level	Activity type		(i) Estimated costs from day-3 pilot			Optimum?
			URC	FHI	CNM	
VMW	Slide preparation	Per case	-	\$ 0.5	\$ 5**	
	DOT	Per case	\$ 4	-		\$ 4
	Slide transport	Per case	\$ 4-8	\$ 4-14*		\$ 4-8
	Communication	Per month	\$ 2	-		\$ 2
Health Centre	Slide examination	Per case	-	\$ 0.5	-	\$ 1.5
	Communication	Per month	\$ 5	\$ 2	-	\$ 5

	(ii) Projected monthly cost per HC [‡]			Optimum?
	URC	FHI	CNM	
VMW	\$ 120	\$ 95	\$ 50	\$ 115
Health Centre	\$ 5	\$ 7		\$ 25
Total	\$ 125	\$ 102	\$ 50	\$ 140

*Under the FHI pilot day-0 and day-3 slides are transported separately, hence these estimates cover two trips

**Monthly payment; discontinued after 6 months

‡ Assumes 10 VMWs per HC and an average of one Pf presentation per VMW per month; see main text

A2.2. Principal operational costs associated with each of the community pilot studies

For each partner the direct costs of VMW- and HC-related activities have been described in relevant sub-sections of Section 4. Table A1 represents an attempt to bring these field-validated costs together for the sake of comparison. The top portion of the table indicates costs of pilot activities either on a per case basis or, where applicable, on a monthly basis.

It is evident from the table that the scale and structure of payments for different activities varied between partners. At village-level:

- Under URC VMWs were not directly compensated for preparing day-0 and day-3 slides but they did get specific per-case payments to cover DOT ($2 \times \$2$) and to transport slides to the HC (\$4-8 depending on distance). VMWs also received a \$2 monthly cash allowance to cover communication.
- Within the FHI system VMWs did get a payment for preparing blood smears ($2 \times \$0.25$ per case) but were not paid an incentive to provide DOT. The costs for transporting slides (\$4-14 depending on distance) are relatively high under the FHI system because day-0 and day-3 slides are taken to the HC separately.
- Under CNM VMWs initially received a flat payment of \$5 per month, regardless of the number of cases they saw. This arrangement was only in place for the first six months, however – after which VMWs received no payments for pilot activities. In the future it appears that CNM will only provide a payment to cover slide transport costs.

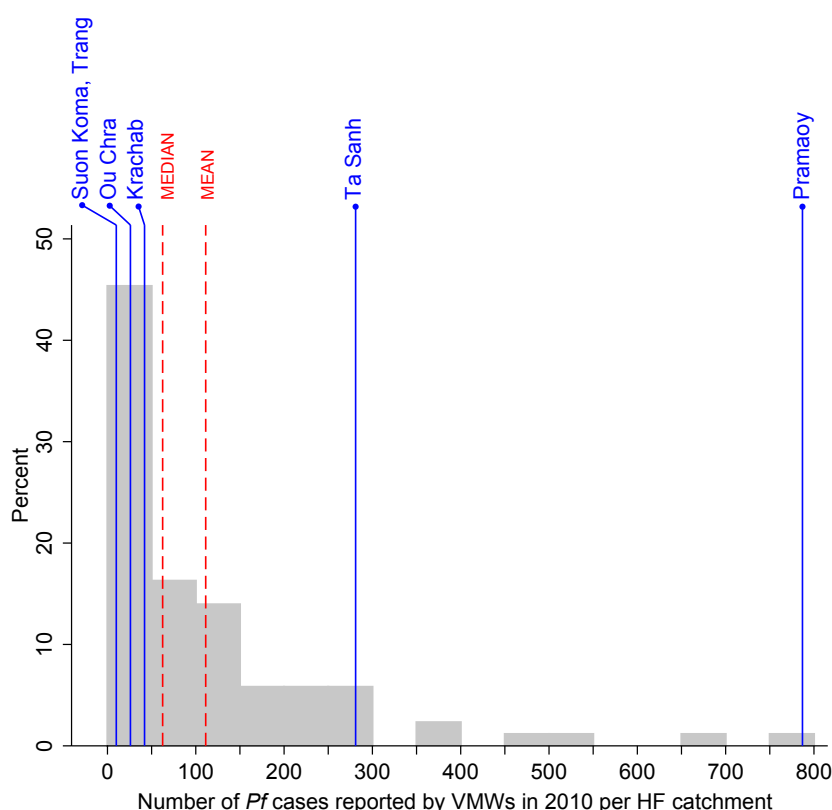


Figure A2. Histogram showing the frequency distribution for the number of VMW-detected *Pf* cases reported by health facilities in containment zones 1 and 2 in 2010. The mean number of VMW-detected *Pf* cases per facility was around 120; however this is heavily influenced by a small number of facilities with relatively high caseloads (notably Pramaoy). In practice 76% of facilities reported fewer than 150 *Pf* cases annually through the VMW system and almost half (45%) reported fewer than 50 *Pf* cases.

At HC level:

- Under URC the only incentive payable at the HC was a monthly \$5 cash payment to one staff member to cover communication costs.
- Under FHI lab staff at HCs were paid \$0.25 for each blood slide examined.
- No pilot-specific payments were made to HC staff under the CNM system – although for some of the pilot period selected staff members received the general containment salary top up (\$70 per month).

The last column in Table A1 includes what, on the basis of evidence gathered within this review, could be considered an “optimum” financial provision for each activity. At the VMW level this essentially involves replicating the system of payments used by URC. These appeared to be largely sufficient to compensate VMWs for the extra activities associated with day-3 surveillance but were certainly not set at a level where they could be classed as financial “incentives”.

At the HC, where engagement of lab staff is critical to the success of day-3 surveillance, evidence from this evaluation suggests that some form of payment for slide examination is required. Under URC the lack of such payments has arguably caused problems at Trang HC. Within the FHI system lab staff considered the per-slide payment of \$0.25 to be too low to justify the work involved in reading VMW slides. It would appear that a payment of \$0.5-1 per slide would be considered more appropriate.

The lower portion of Table A1 shows a simple example of aggregated monthly costs of each system for a single HC under a “typical” scenario. This scenario is based on using MIS data for 2010 to calculate for zones 1 and 2: (i) the average number of VMWs supervised by HCs operating within the VMW network; and (ii) the total annual *Pf* caseloads of VMWs supervised by each facility (see Figure A2). Data for 2010 indicate that, on average, participating HCs in zones 1 and 2 supervised 10 VMWs. The mean annual number of *Pf* cases per VMW was just under 12 (median ≈ 6 , which shows the influence of a small number of relatively high transmission sites – including Ta Sanh and Pramaoy (see Figure A2)).

Using this “typical” scenario in Table A1, and adding a further assumption that the average transport cost payable to VMWs is \$6, monthly costs for VMW and HC activities would be \$125 *per HC* under the URC system and \$102 under the FHI system. This works out as \$12.50 and \$10.20 *per Pf* case successfully followed up on day-3. Under “optimum” funding arrangements (final column in Table A1) this cost rises to \$14.00 per case. This figure would be reduced to \$10 per case, however, if the requirement to provide DOT were removed.

Because some payments are made on a per-case basis and others on a monthly basis, the actual cost per case varies with VMW caseload. Essentially, as *Pf* case numbers increase the cost per case falls. For example in a scenario where, instead of seeing just one *Pf* case a month a VMW sees three cases, the per-case cost would fall from \$14 to \$11.

It should be noted that these calculations only relate to activities carried out at the village level and at HCs. They do not incorporate additional costs related to provision of training and supervision that, as is clear from the discussion above, are likely to be substantial.