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Closing in on the Reservoir: Proactive Case Detection in High-Risk Groups as a Strategy to Detect *Plasmodium falciparum* Asymptomatic Carriers in Cambodia

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Background. In the frame of elimination strategies of *Plasmodium falciparum* (*Pf*), active case detection has been recommended as complementary approach to the existing passive case detection programs. We trialed a polymerase chain reaction (PCR)–based active detection strategy targeting asymptomatic individuals, named proactive case detection (PACD), with the aim of assessing its feasibility, the extra yield of *Pf* infections, and the at-risk population for *Pf* carriage status.

Methods. A pilot of PACD was conducted in 3 villages in Chey Saen district (Preah Vihear province, Cambodia), from December 2015 to March 2016. Voluntary screening and treatment, following health promotion sensitization, was used as mobilization strategy.

Results. A total of 2802 persons were tested, representing 54% of the population. PACD (n = 30) and the respective reactive case detection (RACD) (n = 3) identified 33 *Pf* carriers, approximately twice as many as the *Pf* infections (n = 17) diagnosed in passive case detection and respective RACD, by health centers and village malaria workers using PCR, in the same villages/period. Final positivity rate was 1.07% (30/2802). People spending nighttime in forests and plantations were found to be at increased risk for *Pf* infection (odds ratio [OR], 3.4 [95% CI, 1.6–7.2], $P = .002$ and OR, 2.3 [95% CI, 1.1–4.9], $P = .03$, respectively).

Conclusions. We demonstrated the usefulness of the PACD component in identifying *Pf* asymptomatic carriers. Social mobilization and promotion led to good attendance of specific risk groups, identified to be, in the Cambodian context, individuals spending nighttime in forest and plantations.

Keywords. malaria elimination; proactive case detection; voluntary screening and treatment; asymptomatic malaria.

As Cambodia moves toward *Plasmodium falciparum* (*Pf*) elimination [1], malaria programs need to adapt accordingly, by devoting more and more efforts to target the parasite reservoirs. Rigorous passive surveillance, while essential for malaria elimination [2], may not be sufficient to reach all *Pf* carriers. Subpatent infections, not identified through passive case detection (PCD), might represent a sizeable *Pf* reservoir [3]. Additionally, transmission may not be clustered only in geographically defined "hotspots," but also in specific populations ("hotpops") that often are characterized by a combination of malaria vulnerability, asymptomatic infections, and high degree of mobility, which renders them difficult to intercept through PCD [4, 5].

In this regard, the Greater Mekong subregion (GMS), and Cambodia in particular, represents a unique challenge for *Pf* elimination. First, the recent emergence and spread of multidrug-resistant parasites in this region is a serious threat preventing the effective management of all malaria cases. Second, the recent proliferation of land development projects, mainly in the agricultural sector, has led to the increased interaction between the local/immigrant populations and the forests [6]. These changes come on top of a preexisting complex mobility pattern, with many resettlements of farmers from rural communities in large-scale plantations; cross-border migrations; and indigenous individuals with multiple residences—the latter mainly related to short-term movements driven by subsistence and economic requirements [5]. Such mobility patterns are detrimental to *Pf* elimination, as they increase the risk of importation of new infections that can maintain the active foci at local level [7–9].

Novel strategies to reach such highly mobile "hotpops" are called for: in this sense, proactive case detection (PACD) has been proposed in recent years, by some authors and institutions, as a possible option [1, 4]. So far, few studies in Cambodia and in the GMS have documented the proactive targeting of mobile, asymptomatic subgroups [10]. In response to the above rationale, Médecins Sans Frontières (MSF) conducted a PACD intervention in the northern province of Preah Vihear, Cambodia: active case detection in high-risk groups through repeated rounds of polymerase chain reaction (PCR)–based voluntary screening and treatments. In this region, where MSF has been present since 2014, around 90% of the observed *Pf* cases

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reported a recent history of staying overnight in forests/plantations/rice fields prior to diagnosis, and displayed the aforementioned short-term, cyclical migration patterns [11]. Here, we document (1) the yield of additional cases through the PACD approach; (2) the opportunity and convenience of defining both conventional (forest-goers) and nonconventional at-risk populations; and (3) the feasibility of sensitizing and specifically mobilizing such populations.

METHODS

Study Site and Population

The study was conducted in Chey Saen district, Preah Vihear province, Cambodia. This district has an estimated population of 22 499, dispersed over 23 villages, as described elsewhere [11] (Figure 1). Malaria transmission is seasonal (August–January), with a peak occurring at the end of the rainy season. In 2016, the incidence of symptomatic *Pf* cases, identified through passive surveillance, was 3.6/1000 inhabitants per year. Three villages (Thmea, 2024 inhabitants; Chrach, 897 inhabitants; Chamreun 529 inhabitants) were selected for the PACD intervention, based on *Pf* incidence and prevalence collected in 2014–2015 [11].

PACD Strategy

In Chey Saen, PCD is delivered through a network of village malaria workers (VMWs), health centers, and registered private providers. Since 2014, this network has been supported and trained by MSF. In each of the 23 villages, 2 VMWs are able to diagnose malaria infections using rapid diagnostic tests (RDTs) and provide treatment according to national guidelines [11]. Since October 2015, MSF strengthened diagnosis in PCD by adding the collection of dried blood spots for subsequent PCR diagnosis. Upon identification of *Pf* cases, a round of reactive case detection (RACD) is triggered, consisting of an investigation of the household of the index case and her/his travel and work history, to identify possible coexposed individuals (mostly coworkers and cotravelers) and offer them RDT and PCR testing. The RACD is implemented by MSF supporting staff [12].

The PACD strategy was introduced on top of the existing PCD system between December 2015 and March 2016. The strategy consisted of the sensitization and mobilization of high-risk groups in the 3 villages for voluntary screening and treatment (VSAT). In the 2 weeks prior to the PACD activities, specific health promotion (HP) activities were implemented in each village. Multiple

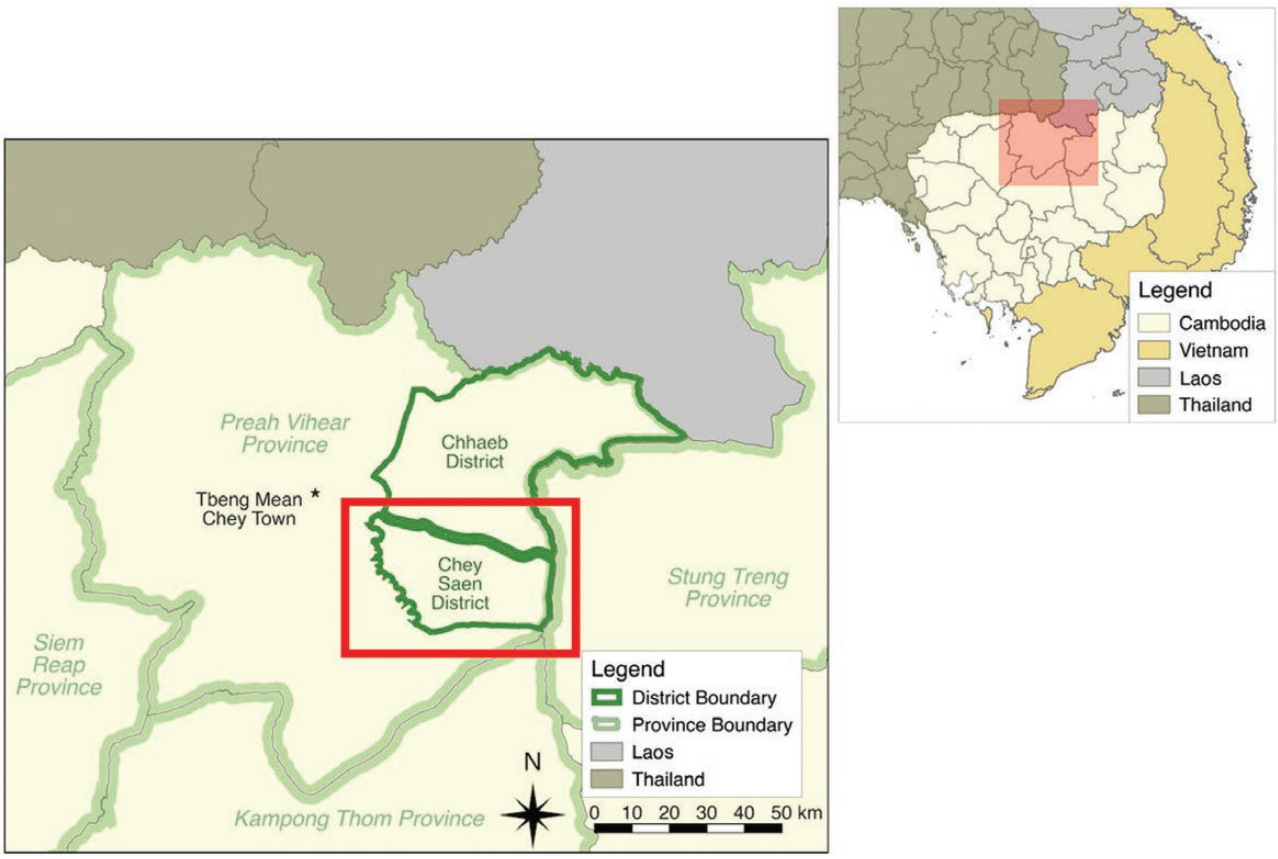

Figure 1. Map of Cambodia, Preah Vihear province and Chey Saen district. *Provincial capital of Preah Vihear.

information and sensitization sessions took place, in which the concept of asymptomatic malaria carriage was explained and the VSAT service was promoted. The concept of asymptomatic malaria is new in the body of malaria HP messages in Cambodia and in the GMS: MSF created specifically tailored material on this topic to help local villagers better understand this condition. The rationale was that, although asymptomatic malaria does not represent an immediate health problem, it could create future health issues if not treated, potentially leading to economic loss for the patient and his/her family. The HP messages were conveyed by the HP officers through village meetings and door-to-door sensitization. On the testing days, the HP officers announced the timing and exact location of the testing activities via a megaphone and speakers while circulating the village.

High-risk groups were defined as people who had spent at least 1 night in a forest, plantation, and/or rice field prior to the screening day. People with a reported history of malaria were also considered at risk and were asked to participate in the VSAT. These case definitions of risk groups were in line with other studies conducted in Cambodia [10, 13, 14]. People not meeting these criteria, but still presenting for VSAT, were also tested, which allowed analysis of the specificity of the risk criteria.

Multiple testing rounds (with 2 evening sessions and 1 early morning session), were carried out at monthly intervals. Three rounds were completed in Thmea and Chrach villages (December 2015, January and February 2016), while only 2 rounds were done in Chamreun (January and March 2016). No age limits were set on participation.

Positive cases triggered a round of RACD, as explained above. Six nurses and 3 health promoter officers were involved in the implementation of the strategy. Funding was provided by MSF.

Sample Acquisition and Data Collection

Two capillary blood samples (finger-prick) were collected from all VSAT participants: 1 was used to conduct an RDT (SD FK60 HRP-2/pan pLDH Malaria Antigen Rapid Test, Standard Diagnostics) and the other was sent for PCR diagnosis at the Phnom Penh Institut Pasteur in Cambodia. Concomitantly to the sampling, a questionnaire was administered to gather information on risk factors for *Pf* malaria, including demographic factors such as age, sex, working habits, exposure to high-risk environments, use of long-lasting insecticidal nets and long-lasting insecticidal hammock nets, and previous malaria history.

RDT-positive cases were treated immediately and PCR-positive cases were traced back, with a target of treating them within 14 days after sampling. Treatment was in accordance with Cambodian national guidelines consisting of 3 days of dihydroartemisinin-piperaquine and single, low-dose primaquine 0.25 mg/kg, provided as directly observed treatment. Twenty-eight days after the treatment, a second blood sample was collected and analyzed by PCR to assess for possible *Pf* recurrences.

Inclusion Criteria and Consent

All individuals presenting for VSAT were tested; before testing, participants were informed of the study and were asked to provide oral consent. Assent was obtained from minors >13 years of age in the presence of an impartial witness. For children <13 years of age, oral consent was provided by the parents or guardians of the minor.

Detection of *P. falciparum* Infection

Blood spots were dried and individually sealed in plastic bags. Samples were transferred to Phnom Penh Institut Pasteur in Cambodia for PCR analysis within 48 hours. Samples were lysed overnight in a Saponin solution, and DNA was subsequently extracted using Instagene Matrix resin (Bio-Rad, Singapore), as previously described [15] for speciation and analysis of artemisinin resistance [16].

Data Entry and Analysis

All data were double-entered into an Excel database and cross-checked for validity. Each participant was anonymized and identified by a 9-digit code and the PCR results were digitally merged with the survey data based on this unique code.

Data were analyzed using Stata version 14 software (StataCorp, College Station, Texas). Descriptive statistics were used to map the different characteristics. Bivariate analysis was performed on pooled data from PACD and RACD to identify participant characteristics associated with PCR-positive *Pf* cases. All variables with $P < .10$ in a Pearson χ^2 test or Fisher exact test were included in a multivariate logistic regression model. Risk factors independently associated with *Pf* positivity were identified through a stepwise-backwards protocol. Population data were obtained from the census analysis performed at district level by MSF in June 2014.

Ethics Approval

The study was approved by the Ethics Review Board of MSF and by the Cambodian National Ethics Committee on Health Research (0094NECHR, approved 24 June 2013).

RESULTS

Study Population and Mobilization

Across the 3 villages, 2802 individuals participated in at least 1 round of the PACD testing (Table 1). A weighted mean attendance rate of 29% per round was achieved. The number of repeat participants (individuals returning on subsequent rounds

Table 1. Characteristics of the Study Population, Including Demographic Indicators, Number (Median) of Nights Spent in the Forest, Plantation, and/or Rice Field, History of Malaria, and Key Risk Factors Supposed to Be Associated With *Plasmodium falciparum* Infection

	Total	
Characteristic	No.	% (95% CI)
Tests	2802	
Male sex	1326	47.3 (45.5–49.2)
Female sex	1476	52.7 (50.8–54.5)
Age, y		
<4	154	5.5 (4.7–6.4)
5–14	687	24.5 (22.9–26.2)
15–24	715	25.5 (23.9–27.2)
25–49	992	35.4 (33.6–37.2)
≥50	254	9.1 (8.1–10.2)
Median No. of nights in forest	3	
Median No. of nights in plantation	4	
Median No. of nights in rice field	10	
Use of LLIN[a] , No. (%)	1730	86.6
Use of LLIHN[a], No. (%)	630	31.5
Malaria history, No. (%)	861	30.7

Abbreviations: CI, confidence interval; LLIHN, long-lasting insecticidal hammock net; LLIN, long-lasting insecticidal net.

[a]Use of LLIN and use of LLIHN has the participants who spent night(s) in a forest, plantation, and/or rice field, as denominator. The participants who did not report having spent night(s) in a forest, plantation, and/or rice field were not included in the denominator.

to be tested again) increased from 238 in the second round to 700 in the last round (Table 2). The total coverage for the 3 villages (number of villagers who were tested at least once during the whole PACD activity) was 54% overall, ranging from 51% in Thmea to 59% in Chamreun (Table 2). Comparing the demographics of the attending villagers with those of the mid-2014 census showed that the age categories 15–35 years and 35–65 years were the most mobilized, with coverage rates of 59% and 58%, respectively (Figure 2).

The proportion of the people presenting for testing, without holding any of the aforementioned mobilization criteria, increased consistently across the rounds, from 17% (first session) to 28% (third session).

In addition to the 2802 individuals screened directly through PACD, the activities also triggered 273 instances of RACD in the 3 villages, for a total of 3075 people tested.

P. falciparum–Positive Cases

Thirty-three *Pf* cases were identified over the study period (30 in PACD, 3 in RACD), resulting in an overall *Pf* detection rate of 1.07%.

The age group with the highest detection rate was 25–49 years (1.65% [18/1087]) (Table 3). No cases were detected in the age group 0–5 years (0/154).

Pf infections were 2-fold higher in males (n = 23) compared with females (n = 10), and the detection rates were estimated to 1.57% and 0.62%, respectively ($P = .01$; Table 3).

The number of *Pf* cases detected by PACD/RACD was 2-fold higher than those detected by PCD in the same villages over the same period (n = 33 vs 17). Of the 33 *Pf*, only 6 were identified by RDT (compared with PCR: RDT sensitivity 18.2%, specificity 99.9%, positive predictive value 85.7%, and negative predictive value 99.1%) (Table 4).

Overall, 94% of the *Pf* cases completed the 3 days of directly observed treatment; the average delay from the testing day to treatment was 12.8 days.

Potential artemisinin-resistant *Pf* (K13 mutants) was also assessed. Among the 33 *Pf* infections, only 12 samples yielded

Table 2. Key Indicators of Population Mobilization for the Proactive Case Detection

Indicator	Round 1	Round 2	Round 3	Total
No. of participants	718	1070	1014	2802
Attendance rate[a]	24.6%	31.1%	29.4%	28.5%
People with no mobilization criteria[b]	122	211	280	613
People with no mobilization criteria ratio[c]	17.0%	19.7%	27.6%	21.9%
No. of repeat participants[d]	…	238	700	938
Coverage rate[e]	849 (24.6%)	831 (24.1%)	313 (9.1%)	1863 (54.0%)
Coverage rate Thmea	437 (21.6%)	417 (20.6%)	172 (8.5%)	1026 (50.7%)
Coverage rate Chrach	281 (31.3%)	135 (15.1%)	58 (6.5%)	474 (52.9%)
Coverage rate Chamreun	…	281 (53.1%)	32 (6.1%)	313 (59.2%)

Data are presented as No. (%). Average attendance rate was 28.5%, while total cumulative coverage rate for the villages of Thmea, Chrach, and Chamreun reached 54%. Thmea displayed the lowest coverage rate (50.7%), while Chamreun recorded a coverage rate of 59.2% (following only 2 rounds of voluntary screening and treatment [VSAT]). The 4 so-called "negative" participants represented by the 21.9% of the total participants across the 3 VSAT rounds.

[a]Attendance rate refers to the number of participants per rounds divided the total population of the 3 villages.

[b]People with no mobilization criteria: people not holding any of the 4 mobilization criteria (having spent nighttime in the forest and/or plantation and/or rice field, and/or having reported past history of malaria).

[c]People with no mobilization criteria ratio: ratio between the number of people presenting without any of the mobilization criteria divided by the number of screened people.

[d]Repeat participant is defined as a person coming back to be tested in subsequent rounds of proactive case detection. R1 stands for a single time returnee. R2 indicates that the person already returned to be tested in 2 subsequent different rounds.

[e]Coverage rate refers to the number of participants that have been tested at least once divided by the total population of the 3 villages.

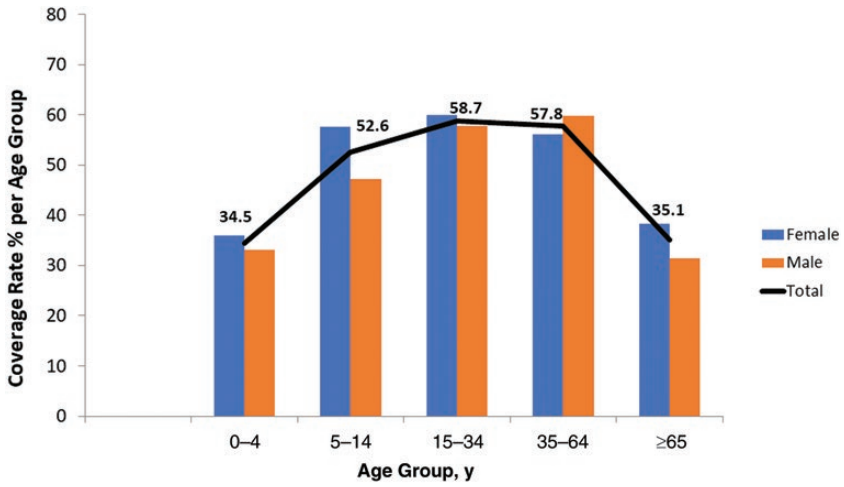

Figure 2. Cumulative coverage rate by age group of the population expressed in percentage (%), compared with census data in the three villages of Thmea, Chrach and Chamreun (Chey Saen district).

sufficient DNA for K13 mutation analysis, and 8 of these (67%) had mutations in the target sequence (5 C580Y mutations, 1 I551I + C580Y, 1 C580Y + I646T, 1 K610R).

Six *Pf* cases were still positive at day 28.

Risk Factors for Malaria *P. falciparum* Infection

Sex, age group, and sleeping a night in the forest and/or in a plantation were found to be associated with *Pf* positivity in the bivariate analysis ($P < .10$). In multivariate analysis, those spending night in forests and/or plantations were found to be significantly associated with *Pf* positivity (odds ratio [OR], 3.4 [95% CI, 1.6–7.2], $P = .002$ and OR, 2.3 [95% CI, 1.1–4.9], $P = .03$, respectively). After stratifying for sex, multivariate analysis showed that spending a night in the forest was still a significant risk for malaria for males (OR, 4.2 [95% CI, 1.4–13.1], $P = .01$), while females spending a night in a plantation were significantly at risk for *Pf* infection (OR, 8.0 [95% CI, 1.6–41.5], $P = .01$) (Table 5).

DISCUSSION

In this study, we report on an innovative VSAT approach, by showing its feasibility in reaching more than half the population of the targeted villages, while leading to the identification of almost double the number of *Pf* cases found through passive screening.

Table 3. Detection Rate of *Plasmodium falciparum* Infection

	PCR-Based Detection Rate (PACD and RACD Included)			
Variable	Round 1 (n = 832)	Round 2 (n = 1126)	Round 3 (n = 1117)	Total (N = 3075)
Overall	15 (1.80%)	8 (0.71%)	10 (0.90%)	33 (1.07%)
Age, y				Total (detection rate)
0–4				0/173 tested (0%)
5–14				2/738 tested (0.29%)
15–24				10/786 tested (1.27%)
25–49				18/1087 tested (1.65%)
≥50				3/291 tested (1.03%)
Sex				
Female	7	2	1	10/1605 (0.62%)
Male	8	6	9	23 (1.57%)
Location				
Thmea	10/515 tested (1.94%)	2/555 tested (0.36%)	9/585 tested (1.54%)	21/1655 tested (1.27%)
Chrach	5/317 tested (1.57%)	2/254 tested (0.78%)	0/263 tested	7/834 tested (0.84%)
Chamreun	…	4/317 tested (1.26%)	1/269 tested (0.37%)	5/586 tested (0.85%)

Abbreviations: PACD, proactive case detection; PCR, polymerase chain reaction; RACD, reactive case detection (around the *Plasmodium falciparum* carriers detected in the proactive case detection).

Table 4. Comparison of the Diagnostic Performances of Rapid Diagnostic Tests Versus Polymerase Chain Reaction in the Proactive Case Detection Pilot to Detect *Plasmodium falciparum* Subpatent Infections

	PACD			RACD			
	RDT	PCR	Performance Indicators	RDT	PCR	Performance Indicators	Total (RDT and PCR)
No. tested	2802	2802		273	273		3075
No. of *Pf* positive	6	30		0	3		33
Pf positivity rate	0.21%	1.07%		0%	1.1%		1.07%
RDT/PCR ratio			0.20%			0%	0.18%
RDT vs PCR sensitivity							18.2% (95% CI, 7.0%–35.5%)
RDT vs PCR specificity							99.9% (95% CI, 99.8%–100%)

The PACD-related RACD activity has been added in the analysis.

Abbreviations: CI, confidence interval; PACD, proactive case detection; PCR, polymerase chain reaction; *Pf*, *Plasmodium falciparum*; RACD, reactive case detection (around the *Plasmodium falciparum* carriers detected in the proactive case detection); RDT, rapid diagnostic tests; RDT/PCR ratio, number positive by rapid diagnostic test divided by number positive by polymerase chain reaction.

Some key observations are highlighted by this study. First, the participation rates in PACD, in particular among the adult male workers, were relatively high, when compared to similar interventions elsewhere [17]. Although it was not possible to assess the coverage rate for specific high-risk groups (people spending nighttime in forest and plantation), we speculate that the community sensitization campaigns, along with the offer of screening services in early morning and late evening, were instrumental in achieving higher participation rates. Second, 1 in 3 PACD participants returned for repeat testing in a subsequent round, with 8 having negative results in the first round and then testing positive in the subsequent round. Such individuals may have acquired the infection between rounds, while spending time in an at-risk environment. The results underscore the importance of implementing several periodic VSAT sessions, sufficiently spaced to allow for new infections to develop.

Third, the combined PACD/RACD activities detected approximately twice as many of *Pf* cases compared to those identified through PCD over the same period, illustrating how the subpatent infections presumably represent a large part of the whole infectious parasite reservoir, likely responsible for maintaining the endemicity of malaria *Pf* infection [18]. The introduction of PCR-based diagnostics was likely an essential component of the higher PACD/RACD detection rates, as they were able to identify 5 times more *Pf* infections among asymptomatic individuals than classical RDT. However, we cannot exclude that a number of them might have been detected later through PCD.

Fourth, a (self-reported) overnight stay in forest appeared to be the single most important independent risk factor for acquiring *Pf* infections. Previous studies in Cambodia suggested that male sex was associated with an increased risk for *Pf* infection [19, 20]. In our study, male sex was also associated with reported overnight stays in the forest, but it was not identified as independent risk factor, suggesting that males are mainly occupationally at risk. The multivariate model highlighted plantations

Table 5. Bivariate and Multivariate Logistic Regression Analysis to Assess Risk Factors for *Plasmodium falciparum* Infection Detected by the Proactive Case Detection

Characteristic	No. With *Pf* Infection	Positivity Rate, %	Bivariate Analysis *P* Value	Multivariate Analysis *P* Value	Odds Ratio (95% CI)
Sex			.01	.33	
Male	23	1.57			
Female	10	0.62			
Age			.01	.9	
Spending night in the forest	21	2.47	**<.001**	**.002**	3.4 (1.6–7.2)
Spending night in the plantation	18	1.97	.001	**.03**	2.3 (1.1–4.9)
Spending night in the rice field	19	1.15	.6	.6	
Malaria history			.3	.7	
Yes	12	1.39			
No	18	0.93			
Stratification male, forest				**.01**	4.2 (1.4–13.1)
Stratification female, plantation				**.01**	8.0 (1.6–41.5)

Values in bold indicate statistical significance (two-side $P < .05$).

Abbreviations: CI, confidence interval; *Pf*, *Plasmodium falciparum*.

(forest-farms) as important site of *Pf* transmission: after stratifying by sex, females had a strong association between spending nighttime in plantations and acquiring *Pf* subpatent infections. This information complements other studies on recognized risk groups (ethnic minority groups, forest workers, and migrants) of the GMS, which had already documented the "indigenous farming" profile, with overnight stays at places on the field often embedded in forested areas, as a specific risk behavior [14, 21]. Fifth, the evolution of positivity rate of PACD voluntary screening among asymptomatic high-risk people, when done on a periodic basis, could constitute a proxy indicator for assessing the trend of malaria prevalence among high-risk groups and, as such, could represent a potential complementary tool able to evaluate the overall impact of existing malaria elimination interventions.

Overall, PACD proved to contribute to identify *Pf* carriers, thus impacting the reservoir of subpatent infections: these data are compounded by its feasibility to produce a very low rate of patients lost to follow-up (6%). Moreover, the intervention, by raising and keeping malaria awareness in the targeted villages (through the delivery of health promotion messages around the importance of early consultation of healthcare providers), could have created indirect long-term beneficial effects in the communities: future qualitative investigations can be helpful in assessing such benefits, especially in terms of malaria awareness/prevention. However, the "rapidity" of such intervention can be challenged, as the time between testing and treatment spanned >12 days [22, 23]. Sufficiently sensitive molecular diagnostics cannot currently be offered at point of care, and new diagnostic approaches are warranted. In this sense, hypersensitive RDTs hold great promise. Field validation is ongoing and, once finalized, these tools could be meaningfully employed in the frame of an enhanced VSAT strategy [24, 25]. Obviously the introduction of cheaper hypersensitive points of care, when coupled with targeted screenings of people spending nighttime in forest/plantations, should result in more cost-effective approaches.

The study faced some limitations. Although the rationale of identifying the asymptomatic reservoir with the goals of interrupting transmission was supported by studies suggesting that asymptomatic/subpatent infections represent the source of 20%–50% of all human–mosquito transmissions in low-transmission areas [3], the present study could not meaningfully speculate on any effect on falciparum malaria transmission in the villages for the following reasons: (1) the trial was not structured in a way to compare the transmission in villages with and without screening and treating intervention; (2) only a fraction of all the villagers were screened, while the *Pf* prevalence in the nonparticipants was not known; (3) the PCR diagnostic tools used, although more sensitive than RDT, might have detected only a fraction of the total number of infections. Moreover, as the study was small in scale and explorative in nature (pilot), cost/effectiveness insights could not be extrapolated and generalized, also in view of the high supervision costs and the use of PCR here employed.

Few attempts of screening and treatment strategy have been recently deployed in low- to moderate-transmission areas to interrupt malaria, but all of them failed. Some of these studies used a strategy of reactive case detection around *Pf* index cases, while others employed a mass screening and treatment approach, under the form of controlled trials [17, 26–28]. These studies used always RDTs as a screening tool, and none was developed in a very low-transmission setting like ours, in Preah Vihear province, Cambodia. In view of that, it would be, therefore, interesting to assess the efficacy on *Pf* transmission of a highly sensitive detection tool (PCR or hypersensitive RDT) in larger and randomized controlled studies in preelimination settings.

In conclusion, we demonstrated the feasibility and usefulness of introducing a PACD component in identifying asymptomatic *Pf* carriers in a rural region in Cambodia, Social mobilization and promotion led to good attendance rates of specific risk groups (namely, individuals spending nighttime in the forest and the plantations). Based on the more precise profiling of people at risk, these findings may provide a roadmap for the development of a lighter, more affordable, replicable template of PACD, to be used in the next wave of interventions aiming to eliminate falciparum malaria in areas with multidrug resistance, while harnessing the presence of more sensitive and, hopefully, cost-effective diagnostic tools.

Notes

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