Cross border surveillance initiatives targeting mobile and migrant populations: lessons learnt from Cambodia

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Introduction

- Population mobility and the threat of artemisinin resistance are some of the challenges that countries in the Great Mekong Subregion (GMS) face in achieving malaria elimination.
- Cross border surveillance platforms can strengthen overall malaria surveillance efforts in GMS countries and support the progress towards malaria elimination in the region.
- This study assessed the underlying factors associated with malaria infection in mobile and migrant populations (MMP), as well as the differences between official and unofficial border points, to optimise and guide targeted deployment of mobile malaria posts at scale.

Methods

- Seven border points were established between Lao PDR and Cambodia (one official and six unofficial) (Figure 1).
- Data was collected from September 2015 to September 2016.
- Individuals crossing the border who provided written consent were tested with a malaria rapid diagnostic test (mRDT) (SD BIOLINE Malaria Ag P.f/P.v®). A dry blood spot was collected for real-time polymerase chain reaction (RT-PCR) analysis. *Plasmodium falciparum*-positive samples were screened for mutations in the K13 propeller domain gene.
- A standardised questionnaire was used to assess participants' socio-demographic, clinical and travel characteristics. Knowledge on malaria prevention was also assessed.
- Individuals with a positive mRDT were given treatment according to national guidelines.

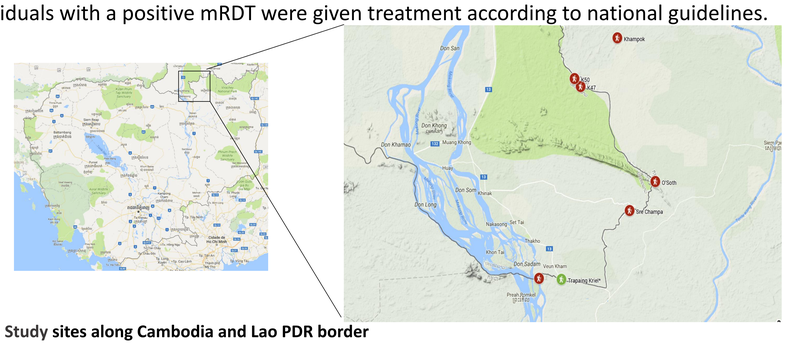

Figure 1: Study sites along Cambodia and Lao PDR border

Results

- A total of 2,010 individuals were screened along the seven border points. Majority were male (72.2%), adults (68.9%) and rice farmers/agriculture workers (65.9%). Most individuals tested were Cambodian nationals (77.2%).
- The overall positivity rate was 5.9% by mRDT and 19.9% by PCR (Figure 2). Two unofficial border points (K47/50 and Khampok) registered higher positivity rates than the other border points (17.8% mRDT and 34.6% by PCR in K47/K50 and 8.0% by mRDT and 33.3% by PCR in Khampok).

Results

- 66% of infections detected by mRDT were symptomatic (defined as presence of fever: temperature >37.5 C) (Figure 3). Among the asymptomatic reservoir detected by mRDT, a large proportion was *P. falciparum* (35%) infections that would not be detected through common passive case detection approaches (Figure 3).
- Overall mRDT sensitivity when compared to PCR was 29.0%. Among febrile infections, mRDT sensitivity was 39.6% while among asymptomatic infections, sensitivity was only 18.2%.
- Infections were statistically associated with gender: males crossing the border were more at risk of being infected with malaria (OR=4.2, p<0.001) (Table 1). Multivariate analysis found that forest workers and construction workers were significantly more at risk of being infected with malaria after controlling for confounding. A previous malaria episode and being febrile were identified as strong predictors of malaria infection.
- No differences were found between formal and informal border points after controlling for confounding. However, multivariate regression analysis showed that there were increased odds of being positive for those individuals crossing at K47 and K50 and at Khampok.
- Around 67% of positive *P. falciparum* infections had mutations in the K13 propeller domain. Most of these mutations (27%) were found at the K47/50 border point.

Discussion and conclusions

- Interpretation of the results of this study should consider that the sample may not represent the whole cross border population in the GMS region. There was also a high proportion of individuals who refused to participate (56%) and their results could differ from those who partook in the study.
- Current point-of-care diagnostic tools may not be enough to detect all malaria cases presenting in cross border sites even when febrile.
- Assessing the best approach for deploying effective malaria cross border surveillance is key to implementing cost-efficient strategies. The characteristics of cross border individuals identified in the study could be useful to build screening tools that improve cross border surveillance activities.
- Assessing the travel history and potential place of infection from positive cases may help to identify active foci of malaria transmission. This could trigger a cascade of interventions focused on interrupting transmission as soon as possible.
- Effective cross border malaria surveillance has the potential to support foci identification and response in both sides of the border. This can contribute to accelerated responses towards malaria elimination in the GMS.
- Malaria cross border surveillance can play an important role in identifying and controlling the spread of malaria between bordering countries. This is particularly important in remote, unofficial border points.

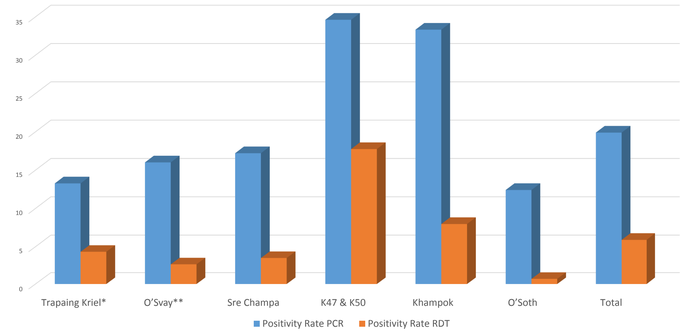

Figure 2: Positivity rates by border point

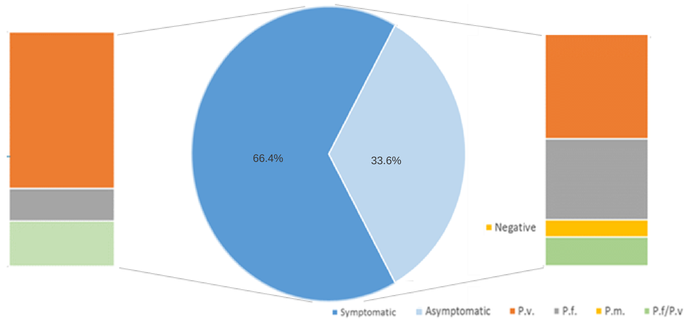

Figure 3: Proportion of symptomatic vs asymptomatic malaria cases detected by mRDT and disaggregated by species (based on RT-PCR)

Table 1: Factors associated with malaria infection (RT-PCR)

Factors associated with malaria infection (through RT-PCR)	n (%)	Odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Gender			
Male	370 (92.5%)	6.0 (4.1-9.0)***	4.2 (2.8-6.2) ***
Occupation			
Rice farmer/agricultural worker	240 (60.0%)	1	1
Security worker	48 (12.0%)	1.8 (1.2-2.5)**	1.2 (0.8-1.7)
Forest worker	30 (7.5%)	4.4 (2.6-7.4)***	2.7 (1.6-4.6)***
Construction worker	38 (9.5%)	3.7 (2.4-5.9)***	3.5 (2.2-5.6)***
Other	44 (11%)	0.6 (0.4-0.9)**	0.7 (0.5-1.0)
Fever			
Yes	197 (49.3%)	1.4 (1.1-1.7)**	1.5 (1.2-1.8)***
Previous malaria infection			
Yes	295 (73.8%)	2.7 (2.1-3.4)***	2.1 (1.6-2.8)***
Border point			
Unofficial border point	357 (89.3%)	1.8 (1.2-2.5)**	1.3 (0.9-1.8)

** p-value <0.05; ** p-value <0.01; *** p-value <0.001*

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