

Study of utilization of rapid diagnostic tests by community health workers and acceptance of the served community of the diagnostic tests in remote malaria-endemic areas

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A descriptive study using quantitative and qualitative methods was conducted in seven remote malaria-endemic villages of Pyinmana Township, Central Myanmar from September 2006 through May 2007 with the main objective of studying the utilization of rapid diagnostic test (RDT) for malaria in remote endemic areas by community health workers (CHWs) and the community. The study revealed that RDT, 'HEXAGON MALARIA COMBI' has a good efficacy (sensitivity 88.64%, specificity 88.89% and accuracy 88.68%) emerged under an enthusiastic endeavour by seven CHWs among fifty-three study subjects of clinically suspected malaria. It was also noted that RDT was well-utilized by CHWs and well-accepted by the served community. It is concluded that RDT should be equipped to CHWs together with appropriate anti-malarials under the supervision of one of the basic health staff to ensure early diagnosis and effective treatment for the cases suffering from deadly malaria in remote endemic areas.

INTRODUCTION

Malaria causes one of the health problems in Myanmar resulting in about 600,000 reported cases and about 3,000 deaths annually [1]. The global malaria control strategy includes four main components with the first one - provision of early diagnosis and prompt treatment of the disease aiming at the elimination of mortality [2]. Diagnosis is very important in treating malaria and performed in three ways-by clinical methods, by microscopic examination of blood film and by a rapid diagnostic test (RDT) strip using a principle of immunochromatographic technology. People in remote rural areas have less access to proper health care, solely depending on basic health staff (BHS) and their community health workers (CHWs) there. Diagnostic facility is also very scarce and sometimes almost nil. Diagnosis based on signs and symptoms alone is found to be unreliable for treatment purpose. In such a condition RDT facilities are urgently needed

especially for those suffering from life-threatening falciparum malaria. Therefore, the present study is conducted with the objectives of: (i) to study the efficacy of RDT used by CHWs in remote malaria-endemic areas in Pyinmana Township, (ii) to study the utilization of RDT by CHWs to diagnose malaria and (iii) to study the acceptance of the community to have a diagnosis by RDT.

MATERIALS AND METHODS

It is a descriptive study using both quantitative and qualitative methods conducted in Gamontaung, Mepauk, Pinye, Myaymyo, Kyoedan, Gadoeseik and Inntha villages, Pyinmana Township in Central Myanmar (C 19° 43'N, 96° 11'E). The areas are characterized by extensive forests, mountains and hard-to-access. They are situated in remote hilly areas and about 40-45 miles away from downtown Pyinmana. The numbers of household in each village is estimated to be about 50-130 mainly living

on semisubsistence agriculture. In each village there is at least one CHW who had attended the basic health training on common diseases including malaria. Malaria occurring in these areas is featured with a generally low perennial transmission of *P. falciparum* and *P. vivax* with pockets of high transmission and marked seasonality. Study period is from September, 2006 through May, 2007. Study populations are local residents of above-mentioned villages. Sample size is estimated to be about fifty subjects (ie. $n = z^2 pq / d^2$; $p = 0.8$, proportion of patients with fever, chill and rigor seeing BHS during a transmission season: $n = 1.96^2 \times 0.8 \times 0.2 / 1.1^2 = 51$ subjects).

Data collection instruments and technique

A five-day training course, led by Principal Investigator (PI), for malaria diagnosis and treatment was held in Pinyinana Township Health Department and attended by seven CHWs, seven other BHS and ten research assistants (RAs) of Department of Medical Research (Central Myanmar) in August, 2006.

In phase I, during September, PI and RAs visited each village and performed field demonstrations which included diagnosis of malaria by signs and symptoms, RDT [HEXAGON MALARIA COMBI (HMC)] and blood film preparation. Then CHWs were let to perform the similar procedure by themselves on two malaria patients in front of RAs and BHS.

Then results of RDT (Illustration. 1) were read and blood films were examined by RAs and results were compared. Then CHWs were provided with RDT strips, anti-malarials [Tablet Mefloquine and Tablet Artesunate for Artemisinin-based Combination Therapy (ACT)], glass slides, lancets and Giemsa stain. HMC is an immunochromatographic rapid test for the detection of Plasmodium spp. in human whole blood. It is for the qualitative detection of histidine-rich protein 2 (HRP2) released from *P. falciparum* and aldolase, a pan-plasmodium antigen released from all Plasmodium species.

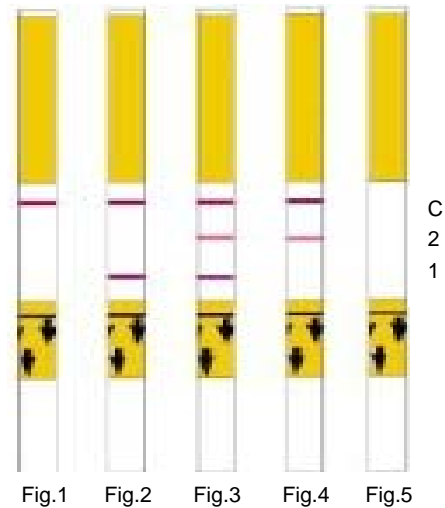


Illustration 1. Different results by HMC RDT:

Fig 1. Negative

Fig 2. Positive (*P. falciparum*)

Fig 3. Positive (*P. falciparum* or *P. falciparum* plus non-*P. falciparum*)

Fig 4. Positive (Non-*P. falciparum*, ie. *P. vivax*, *P. malariae*, *P. ovale* or mixed infection of them)

Fig 5. Invalid test

(1=line for HRP2, 2=line for aldolase, C=control line)

In phase II, from October onwards, CHWs treated malaria patients after asking about symptoms especially fever with chill and rigor in last 1-3 days and examining the signs in their villages using RDT and at the same time prepared blood films under supervision of public health supervisors or midwives till the end of May, 2007. If RDT showed positive result of *falciparum* malaria patient was administered ACT. If it was non-falciparum malaria mainly *P. vivax* Tablet Chloroquine followed by Tablet Primaquine were given as a radical cure [3]. If it showed negative result and fever still persisted Tablets Chloroquine were first given and patient was under watch. If he was not relieved and fever was still unresolved for another 12- 24 hours, treatment was changed to ACT paralleled with performing other investigatory methods for differential diagnosis at nearest hospital.

During Phase II CHWs had to report the cases including RDT results, and sent the prepared blood films weekly to DMR (CM) where they were examined microscopically by a well-experienced technician according to WHO criteria (100 thick film fields

before negativity declared). The results of blood films were sent back to CHWs. During the last week of May, PI and RAs visited the villages again and performed indepth interviews with nine key informants including three village heads there and seven CHWs using an interview guideline mainly on two diagnostic methods followed by treatment. Their opinion and ideas were recorded on tapes as their actual wordings and they were transcribed and translated.

Consent and data analysis

Ethical approval was obtained from Ethical Review Committee of DMR (CM). The study was explained to and consent was obtained from all participants. Data analysis was done by SPSS version 10.0. Efficacy of RDT was calculated against the microscopy as a gold standard method to produce (i) sensitivity (proportion of diseased people who are correctly identified as 'positive' by the test), (ii) specificity (proportion of non-diseased people who are correctly identified as 'negative' by the test) [4], (iii) positive predictive value (probability of the person having the disease when the test is 'positive'), (iv) negative predictive value (probability of the person not having the disease when the test is 'negative') [5] and (v) accuracy (the degree to which a measurement or an estimate based on measurements represents the true value of the attribute that is being measured) [6]. Indepth interview results were also analyzed and assessed.

RESULTS

Quantitative method

During study period, seven CHWs examined fifty-three clinically suspected malaria (CSM) patients, out of them forty-four (83%) were confirmed malaria cases (i.e. 42 *P. falciparum* cases and 2 *P. vivax*) finally diagnosed by microscopy. Out of confirmed cases 15 (34.1%) were contributed by children of 15 years and below and 27 (61.4%) by those of 16 - 60 years. Among total CSM patients 31 (58.5%) were males and 22 (41.5%) females. Their mean ages

\pm SD were 23.13 \pm 14.59 years and 23.14 \pm 20.49 years respectively. The results of CSM patients diagnosed by CHWs with RDT and by microscopy as a gold standard method are shown in Table 1. Sensitivity of RDT is 88.64%, specificity 88.89%, positive predictive value (PPV) 97.5% and negative predictive value (NPV) 61.54%. Accuracy is 88.68% meaning that the degree to which detection of malaria parasites by two diagnostic tests - microscopy and RDT- represents true value (ie. presence and absence of the parasites among the CSM patients) is 88.68%.

Table 1. The results of clinically suspected malaria patients diagnosed by RDT and microscopy

Methods	Microscopy result		Total
	m.p. +	m.p. -	
RDT result	m.p. +	39	40
	m.p.-	5	13
Total		44	53

m.p.+ = malaria parasite positive,

m.p.- = malaria parasite negative

Sensitivity = $(39/44) \times 100 = 88.64\%$

Specificity = $(8/9) \times 100 = 88.89\%$

PPV = $(39/40) \times 100 = 97.5\%$

NPV = $(8/13) \times 100 = 61.54\%$

Accuracy = $[(39+8) / 53] \times 100 = 88.68\%$

Qualitative method

To study the utilization of RDT by CHWs and acceptance of RDT by served community, indepth interviews were performed on seven CHWs and nine key informants of study villages. Their opinion and ideas were elicited and they did not fully represent for other areas. Findings by some interviewees are as follows:

The study areas are remote rural areas where locals mainly depend on their CHWs, some usually use RDT for malaria diagnosis there and some never using it also became to use after a training course.

“Our village is very far away ie about thirty-five miles and separated by several mountains from downtown Pyinmana. We solely depend on BHS and CHW for our health.”

(A 45-year-old villager)

"On diagnosis of malaria I use 'paracheck Pf test'. Blood film preparation was not usually done because our village is very far from Pyinmana and it is very difficult to get the result."

(A 26-year-old CHW)

"I have never used the rapid test before. After a training course by the present malaria research team, I use it."

(A 45-year-old CHW)

Regarding feasibility and time, RDT is very feasible for CHWs and it is time-saving and results are obtained in minute. Therefore both CHWs and villagers were found to be satisfied with it.

"It is very easy and time-saving. It also gives immediate results. Generally I prefer RDT to blood film."

(A 45-year-old CHW)

"On detecting the disease malaria, I knew two methods – microscopy and RDT. I prefer RDT because disease causing germs and their types can be known within minutes ... say about fifteen minutes."

(A 55-year-old village head)

"According to the voluntary health worker in our village RDT could detect malaria germs nearly 99% correctly. I also know that the results can be read in 10 – 15 minutes. Compared to it, it takes longer to send a blood film to downtown where a microscopic facility exists. Therefore I like RDT more and accept it in treatment of malaria and do our villagers as well."

(A 40-year-old village head)

"Regarding treatment of malaria using RDT and blood film, I prefer the former to the latter as a result of the fact – a more rapid and easier method."

(A 45-year-old villager)

RDT's cost is reasonable and it is not expensive in terms of benefits obtained and so it is accepted by the user.

"If a blood film was used, the cost including the charges of transport and meals on the

way to Pyinmana was 6,000 Kyats. Out of two diagnostic methods – RDT and blood film, the former is better because of immediate delivery of the result and its (HMC) cheaper cost of 2,175 Kyats per strip."

(A 26-year-old CHW)

DISCUSSION

Malaria is by far the world's most important tropical parasitic disease killing more people than any other communicable diseases except tuberculosis. It is a public health problem in more than ninety countries inhabited by a total of some 2.4 billion people or 40% of the world's population with the prevalence of 300-500 million clinical cases and 1.5- 2.7 million deaths each year [7]. In Southeast Asia Region the disease is a major public health problem. Out of eleven countries all except Maldives have malaria accounting for 30% of global morbidity and 8% of mortality [8]. In Myanmar it is also the number one life-threatening disease. To fight against it WHO had laid down the global malaria control strategy comprising four components - disease management through early diagnosis and prompt treatment, planning and application of selective and sustainable preventive measures, early detection or prevention of epidemics and their containment, and regular assessment of malaria situation [2].

To carry out the first component effectively a health care provider who usually first contacts the patient at peripheral level should be a good health care provider. The provider is a CHW. CHW is defined as a community member who works almost exclusively in community settings and serves as a connector between health care consumers and providers to promote health among groups that have traditionally lacked access to care. If a CHW is trained to give treatment to those suffering from illnesses he will be able to do so. In one of the studies in Nigeria consumers preferred the CHW malaria treatment strategy over self-treatment at home [9]. In Myanmar, like

in other countries, CHWs are basic health care givers closest to the communities and thus in the present study they were conferred with the diagnostic aids and assigned to management of uncomplicated malaria cases in their villages situated very far away from urban settings. Within about eight months seven CHWs treated fifty-three CSM patients using RDT paralleled with preparation of blood films which were forwarded to and checked at DMR (CM).

CHWs had treated 15 children of 15 years and below – about one third of total confirmed malaria cases and 27 adults of productive age – about two thirds of total, so saving their lives in time using RDT. Regarding sex, males are more prone to get malaria due to their nature of occupation. *P. falciparum* species was found to be more prominent and there was no mixed infection. Falciparum vivax ratio was 21:1. So, life-threatening malaria dominated in the study areas.

The efficacy of RDT was found to be satisfactory showing sensitivity 88.64%, specificity 88.89% and accuracy 88.68% calculated on the sample size of 53 cases obtained in study period. Sensitivity is slightly lower than that prescribed [10] (ie. 90.2% - 99.2%) due to three factors - increased environmental temperature may alter the immune complex reaction on the strip, parasite count contained in blood drop tested may be less than 100/ μ l of whole blood [10], and mature gametocytes do not produce HRP2 while a very low trophozoite number may not provide sufficient levels of antigen to be detected by RDT strip [11, 12].

Regarding environmental temperature, in one of the studies [13], RDT could be safely used at rural health centre level without cold storage up to two months of store during which sensitivity and specificity did not vary significantly. Specificity was also lower than that prescribed [10] (ie. 100%) because of the fact that parasite could not be found when its density is low by micro-

scopy. Accuracy was nearly 90%. Anyway RDT is acceptable when compared to microscopy. When compared to other RDTs (14, 11), sensitivity and specificity were slightly lower than the respective values [ie. *ParaSight*TM-F, 90.9% and 97% (Shiff *et al.*) and ICT Malaria[®] Pf, 92.7% and 95.1% (Thepsamarn P *et al.*]. The only thing that HMC outweighs other RDTs is it can differentiate between *P. falciparum* and non- *P. falciparum* malaria.

In the present study, symptom-based diagnosis was not compared with RDT and microscopy because symptom fever is non-specific for malaria [15]. Regarding utilization of RDT by CHWs and acceptance of RDT by community indepth interview on CHWs and key informants expressed that almost all of them accepted the test and preferred to when compared to conventional blood film examination because of the facts that RDT provides the result within minutes thus immediate treatment can be followed, it is easy to perform by CHWs and it is not expensive. RDT was also found to be well-accepted by community in a Philippine study [15].

In future, if CHWs are empowered with RDT and ACT they may be satisfied in their villages where light microscopy is hardly possible or microscopy cannot be maintained at an appropriate standard. In connection with the cost it is quite justifiable in terms of benefits obtained. One thing to be considered is that ACT is the last resort treatment and if it was wrongly used the resistant parasites may develop. Thus, CHWs are to be kept under supervision of BHS.

In conclusion, RDT was found to have a good efficacy and be well-utilized by CHWs and well-accepted by the served community as well. Therefore such a rapid diagnostic test is recommended to be utilized by CHWs together with appropriate anti-malarials, under the supervision of one of the BHS, in remote malaria-endemic areas to ensure the early diagnosis and effective treatment for those suffering from life-threatening and economy losing disease malaria.

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