IDENTIFYING MALARIA CONTROL ISSUES: A DISTRICT HOSPITAL-BASED EVALUATION

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Abstract. Chuk district hospital is centrally located in a rural malarious region in southern Cambodia. It was the site of a hospital-based evaluation (KAP assessment and *in vivo* IV quinine/oral tetracycline drug study) done to identify relevent issues for establishing a rational malaria control strategy. The KAP assessment identified the young, male forest worker as the highest risk group. Of 112 study patients, 73% were male and 82% reported various forest activities. The primary reason found for patient delay (8.9 days) in seeking hospital care was self-treatment at home (N = 102, 91%) with drugs purchased through private sellers (104/105). Using the 7-day WHO field test methodology, resistance rates were calculated (N = 22); S1/R1, 73%; R1, 9%; R2, 0%; R3, 18%. A modified version of the 7-day test was used to calculate its utility in this particular rural setting. It showed a negative predictive value of 93% and a positive predictive value of 71%. The case fatality rate for the study period was 2.7%. Information from this study, which correlates a confirmed malaria diagnosis with prior patient behavior and response to anti-malarial therapy, is intended for realizing the goals set forth by the national malaria control program.

INTRODUCTION

In Cambodia, there is currently no information on patients with severe and complicated malaria correlating health seeking behavior with hospital use, treatment outcome and *in vivo* response to standard antimalarial therapy. Chuk district (population 60,744) is located in the southwestern coastal province of Kampot (population 454,269) and connected by national highway with the capital Phnom Penh, 100 km to the north. It is located at a major crossroads easily accessed in part or whole from five surrounding districts (districts, grouped to form provinces, are divided into numerous communes, which include several villages each). Malaria, predominately from *P. falciparum,* is an important regional problem closely tied to its economy that disproportionately affects male forest workers. While the most important economic activity is rice production, the Elephant Mountain range, extending to the border with Thailand, dominates the region. Its forests provide many primary and secondary economic opportunities for the population.

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In October, 1990, a major malaria epidemic occurred in the Chuk region. Subsequently, in 1992, Médecins Sans Frontières (MSF-Holland) received permission to open a project in Chuk district hospital. Local conditions and distance from the provincial town guided its quick development as a regional treatment center with a catchment area of some 130,000 inhabitants. Over a period of several months, the hospital was expanded to more than 100 beds due to a rising malaria caseload.

Given the hospital's proximity to many malarious zones and the growth in both outpatient and inpatient activities, it was evident that there was insufficient information for developing a rational malaria control program. While a district-based survey would follow artificial malaria "boundaries," security concerns did not allow for a survey in some of the most affected areas. MSF decided, therefore, to study patients already accessing the hospital. Given a recently completed community-based malaria survey in another MSF supported district (Hilderbrand and Valverde, 1993), a hospital-based survey in Chuk could provide complementary information for planning control activities. There were two immediate objectives: First, an assessment of patient knowledge, attitude and practice (KAP) with regard to malaria, including incurred costs. Second, a companion *in vivo* study of parasite response to intravenous antimalarial drug

therapy designed to evaluate treatment realities in a rural district hospital setting.

MATERIALS AND METHODS

Study site and patients

The KAP survey was administered from 20 September through 3 November, 1993. The *in vivo* study was done from 27 September through 14 October, 1993. All smear positive malaria patients, regardless of age and sex, who presented to Chuk hospital and were subsequently admitted (n = 112) were eligible. Patients who received mefloquine at the outpatient department and admitted for observation (n = 10) as well as patients started on oral quinine treatment in hospital (n = 37) were included in the KAP assessment but excluded from the *in vivo* study. The criteria used for admission were based on the WHO guidelines for severe and complicated malaria (Warrel *et al,* 1990). During the three months prior to the study, malaria accounted for 23% (904/3,930) of outpatient consultations. Approximately 25% of all malaria cases diagnosed at Chuk hospital are admitted (MSF data).

KAP assessment

The KAP assessment was done using a pretested questionnaire. A single interviewer performed all interviews with consecutively admitted patients. In total, 112 patients were enrolled. The family answered questions in cases where the patient was unable to communicate (n = 36, 32%). No one refused participation in the study.

In vivo study

Evaluation of patient response to malaria treatment was made according to the WHO standard "7-day" field test methodology (WHO, 1973). This scheme is based on daily blood smears from days 0-7: (a) If no asexual parasites are found by day 6 and none are present on day 7, the infection may be either sensitive (S) or resistant at the R1 level. (b) If asexual parasites disappear for at least 2 consecutive days but return and are present on day 7, they are resistant at the R1 level. (c) If asexual parasitemia does not clear but is reduced to 25% or less of the original pre-test level during the first 48 hours of treatment, the parasites are resistant at the R2 level. (d) If asexual parasitemia is reduced by less than 75% during the first 48 hours or if it continues to rise, the parasites are resistant to the standard dose of the drug at the R3 level (4). A modified version of the "7-day" test, as presented by Rieckmann (1990), that uses blood films only from days 0, 2 and 7 was also assessed. Its field utility was evaluated by determining its predictive value.

Parasite densities were determined on Giemsa-stained thick films using capillary blood samples. Only asexual forms of the malaria parasite were counted per 100-600 leukocytes, depending upon slide quality, and parasite densities calculated per microliter. Following WHO standard methodology, we assumed an average patient leukocyte count of 8,000 leukocytes per microliter. After a pretreatment smear was made (day 0), daily smears were taken between 0800-0900 hours. While the hospital's laboratory staff performed the initial slide reading (using the 1+ to 4+ scale), all slides were subsequently reviewed by an experienced laboratory specialist present during this phase of the study.

Only patients initially placed on IV quinine/oral tetracycline (30 mg/kg/day) therapy, following national guidelines, were evaluated. Loading doses were not used, and patients who received mefloquine were excluded. Patients were switched to oral quinine at the discretion of the doctor/medical assistant to complete a standard 7 day course. IV bottles were checked during the night and counted the following day. Pill counts, however, were not done. Fever clearance time was not determined. As it was not possible to keep patients in hospital once they felt "cured," an adequate evaluation of treatment failure could not be made. Subsequent attempts to trace patients at home were severely limited.

The *in vivo* study on parasite clearance was started on 29 consecutive patients. Of these, one died, one was transferred, and two had missing day 0 slides, leaving 25 for evaluation. Among these 25, three had missing day 7 slides. Consequently, 22 out of 29 patients (76%) completed the study.

Statistical analysis

All data were analyzed using Epi Info (CDC, public domain). Reported p-values are for the

Yates corrected chi square value or Fisher exact test. All Odds Ratio estimates are provided with 95% confidence intervals.

RESULTS

KAP results

Sample description

There were 112 patients from six districts. Chuk 72%, DongTung 11%, Chum Kiri 10%, Angkor Chey 5%, Banteay Meas 1%, Tram Kak 1%. They came from 32 communes and 55 villages. The mean distance from the hospital was 10.6 kilometers (range 1-38 kms). There were two communes from which a significantly higher proportion of patients originated: Krang Snay 20 (18%) and Laboek 17 (15%). The age group distribution is shown in Fig 1. The mean age of participants was 28.4 years (range 1-72 years). Males made up nearly three-quarters of all cases: 73% male, 27% female.

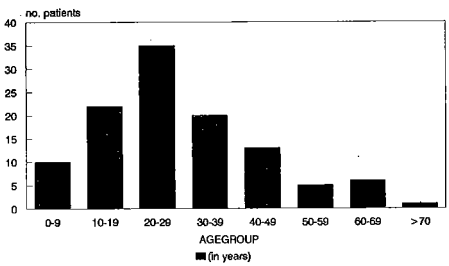

Fig 1–Malaria cases by age group (in years); n = 112.

Hospital transport

Patients used a variety of transport means to reach the hospital. Forty-two percent (n = 47) paid nothing. Of the 58% who did (n = 65), the mean cost was 702 riels (maximum = 10,000 riels @ 2,500 riels/1USD). A moto-remorque (motorcycle with attached wagon) was most commonly used and the most expensive (61%, 979 riels) followed by hammock (25%, 375 riels), roti/cart (8%; 0 riels) and other (6%; 0 riels). The mean transport time was 1.6 hours (range: 1-6 hours).

Admission characteristics, treatment and outcome

The most commonly recorded clinical state on admission (Table 1) was "delirium, agitation, somnolence (D:A:S)," noted in 60% of cases. As this is an imprecise symptom complex, it reflects someone who "looks sick." Other findings included: D:A:S with severe anemia, 28%; coma, 9%; jaundice, 2%; D:A:S with severe abdominal pain, 1%.

The majority of patients, 72%, were admitted with a high parasitemia load (3+/4+), while 9% presented with a minimal load (1+). The one patient in whom no *P. falciparum* trophozoites were found was admitted in coma with *P. falciparum* gametocytes (2+)/*P. vivax* (3+) on his smear. There was no correlation between the parasite level and prior treatment. Only six patients reported no self-medication while 15 reported using only non-malaria drugs. Comatose patients, small in number, did not differ from those without coma with regard to age, sex, duration of illness, work activities, nights spent in the forest, distance from hospital, prior treatment and history of malaria in the previous six months.

Despite hospital policy that only patients requiring IV quinine therapy be admitted, during the

Table 1

Diagnosis, treatment and outcome of malaria cases (n = 112).

	Frequency	Percent %
No. crosses		
1+	10	8.9
2+	20	17.9
3+	28	25.0
4+	53	47.3
none seen	01	0.9
Clinical state		
coma	10	8.9
D:A:S	67	59.8
D:A:S w/anemia	32	28.6
jaundice	02	1.8
D:A:S w/abdominal pain	01	0.9
Treatment		
quinine IV	65	58.0
quinine p.o.	37	33.0
mefloquine	08	7.1
mefloquine/quinine	02	1.8
Outcome		
survived	109	97.3
died (CFR)	03	2.7

survey period, 42% did not. This is a realistic reflection of the situation, which is influenced by socio-economic factors, patient demands, staff workload, distance from the hospital and season of the year. Those who received mefloquine (7%) were treated initially as outpatients and subsequently admitted after an observation period. The case fatality rate (CFR) was 2.7% (n = 3). Only one patient was transferred for an emergency transfusion. There were too few deaths for statistical analysis. Neither distance from hospital nor district/khum of origin appeared to be factors.

Patient knowledge of present illness

When asked "What sickness do you have?," not one patient answered with the Khmer word for malaria. Instead, patients used some combination of the words "fever, hot fever, hot body and fever with chills." These responses were made despite having had a blood smear positive for malaria and subsequent hospitalization for treatment. When asked how many times during the past six months they had experienced the combination of "fever + chills + headache," 85.7% reported their current illness as their first episode, 10.7% reported two prior episodes, 2.7% reported three and 0.9% reported four. Among the latter 2 groups (n = 4), none had a bednet.

The mean duration of illness before patients sought hospital care was 8.9 days (range: 2-90 days; sd = 10.2). The majority of patients, 93.8%, reported that their illness began at home; 3.6% noted the forest, 0.9% the ricefield and 1.8% "other." When asked how long they had been "very ill" before seeking hospital care, the mean time was 3.4 days (sd = 2.3).

Concerning the decision to come to the hospital (why hospital?), patients gave any combination of symptoms and physical complaints. These were tabulated by individual symptom and are presented in Table 2 where they are compared with their responses to "What are the symptoms of malaria?" Several points are worth noting. Fever, headache and chills were the most commonly reported malaria symptoms. While vomiting was more frequently given as a reason for seeking hospital care compared with its recognition as a malaria symptom (52% *vs* 36%), those who came to the hospital with vomiting were more likely to state it as a malaria symptom (27/58 *vs* 13/53; p = 0.03; OR = 2.7; 95% CI: 1.2, 6.0). Diarrhea was not well appreciated as a clinical malaria symptom and joint pains were not often stated as a reason for coming to the hospital. Perhaps more importantly, however, neither coma nor convulsions were recognised as a malaria sign/symptom.

Table 2

Symptoms (by percentage) noted by patients concerning why they came to the hospital (n = 112) compared with stated symptoms of malaria (n = 111).

Symptom	Why hospital	Symptom malaria
Fever	94.8	98.1
Headache	63.5	81.0
Vomiting	51.9	36.0
Chills	36.7	47.7
Diarrhea	6.3	0.9
Abdominal pain	6.3	7.2
Coma	3.6	0.0
Joint pains	1.8	8.1
Convulsions	0.0	0.0
Do not know	0.0	1.8

The primary reason for patient delay in seeking hospital care was self-treatment at home, with 91% (n = 102) reporting this. Only 5% (n = 6) cited distance as a factor and 3% (n = 3) came early during their illness without delay. In total, 95% (n = 106) of all patients purchased drugs for self-medication before seeking care at the district hospital. Six persons did not receive prior treatment. Most (90%; n = 95) sought home treatment within 3 days of falling ill (mean = 1.78 days; sd = 1.62): 69% on day 1, 13% on day 2, 7.5% on day 3, 3% on day 4, 4% on day 5, 2% on day 7, 2% after 7 days. The majority of patients (60%), however, could not name the type of medicine bought (Table 3). Since a pill chart was not used during the interview, the specific drugs taken were undereported.

Eighty percent of those who took drugs did so for 5 days or less, corresponding to a group mean of 4.95 days (sd = 8.93). All but one person (n = 105) reported buying their drugs through private sellers, which includes commune and district market sellers, private practitioners in the villages and people with small stocks of drugs in their

Table 3

Type of medicine used in self-treatment; n = 106.

Drug type	Frequency	%
Do not know	64	60.4
Non-malaria	15	14.2
Quinine, oral	11	10.4
Quinine, IV	7	6.6
Quinine, oral/IV	5	4.7
Quin/tetra, oral	2	1.9
Tetra, oral	1	0.9
Quinine oral/IV + tetra + chloroquine	1	0.9

houses. One person received drugs from another family member. The mean cost of drugs purchased was 14,429 riels (range: 300 to 200,000 riels). Only one person out of 106 reported an alternative treatment through a traditional Kru Khmer, who do not appear to play an important role in treatment of this disease/symptom complex.

Patient knowledge about malaria

In distinct contrast to patients' non-use of the word "malaria" in describing their current illness, 97% (n = 109) of them recognised "malaria" when asked directly. A majority, 57%, identified the forest/mountain as the place where you get malaria, 24% identified the home and 18% did not know. Their understanding of the actual source of malaria varies. While mosquito bite was mentioned most frequently (54%), a large proportion (37%) did not know. Other responses included water (6%) and mountain bathing (3%). Concerning the possibility of preventing malaria, 57% (n = 64) answered "yes" (21% no, 22% did not know). Multiple possibilities were noted by them (n = 64): use bednets, 72%; make fire/smoke, 50%; boil water, 25%; good hygiene, 13%; take medicines, 5%.

When asked (n = 112) whether one could get malaria from a mosquito, 69% said "yes," 29.5% did not know, and 2% said "no." Of those responding affirmatively (n = 77), 46% answered "no" when asked if all types of mosquitos gave malaria (14% yes; 40% did not know). Although people knew that mosquitos bit throughout the 24 hour day/night cycle (n = 79), they were less aware of "when" the malaria mosquito bit, indicated by the high "do not know" response rate (43%). Nearly half identified the early morning and/or early evening as the time when the malaria mosquito bit.

Forest behavior patterns

A total of 92 (82%) patients reported forest activity in the two months before falling ill. Twenty (18%) reported none. Their activities in and around the forest are shown in Fig 2. Those who reported visiting relatives mostly travelled through the mountains in order to reach the Cambodian-Thailand border region. On average, people went into the forest 2.2 times per month and spent a mean of 4.7 nights per trip, which varied by activity: soldier-10 (nights); ricefield work-6.7; cut wood-5.1; visit relative-4.3; collect firewood-1.7; pasture-0. While many activities were confined to certain geographic areas, patients identified 54 different work locations in and around the forest.

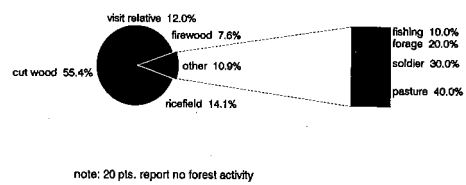

Fig 2–Patient activities in the forest and mountains-what the forest worker does; n = 92.

Of the 92 people working in the forest, 15 did not sleep there. They represent firewood collectors, foragers and people entering for fishing or cattle grazing. Of the 77 persons who reported sleeping in the forest, 91% slept at the same place of their work. For the most part, forest workers traveled into the forest with their neighbor (n = 50, 56%) or other villagers (n = 25, 28%). Less commonly, they went with family (n = 12, 13%) or as soldiers with other soldiers (n = 3, 3%). People who cultivated rice in the forest generally have small houses and slept on beds (17%). Otherwise, hammocks were most commonly used for sleep (40%), followed by plastic sheeting (18%), mats (16%) and other (9%). People prefer not to stay alone in the forest, and on average, slept together in groups of 5.7 persons.

When asked directly about mosquito net usage (n = 77) in the forest, 79% (n = 61) did not use them while 21% (n = 16) did. Of those using bednets,

37.5% (n = 6) used them "sometimes" and 62.5% (n = 10) used them "always." The reasons for not using nets were consistent. Either people found them difficult to carry into the forest (51%) or stated they did not have one (44%). The former group had an average of 1.6 nets per family, compared with a total group mean of 1.9, of whom 55% had only one net in the family. A few (3%) implied they did not want to use bednets, stating they were "not used to one;" 2% gave other reasons. Patients' use of mosquito nets in the forest was also evaluated relative to their habits at home. While only 21% (16/77) of forest workers used bednets in the forest, 48% (54/112) of all families reported sleeping with them at home. Among the 77 persons who slept in the forest, there was a significant association between forest and home usage, with those using bednets in the forest more likely to use them at home (13/38 *vs* 3/39; p = 0.01; OR = 6.2; 95% CI : 1.7, 29.2). There was also a strong association between forest activity (versus none) and awareness of malaria transmission in the forest/mountain (62/78 *vs* 3/14; p < .0001; OR = 14.2; 95% CI : 3.6, 67.4).

When all patients (n = 112) were asked about people who treat malaria in their area, 95% reported that treatment was available in the village. Only 2% mentioned the commune, and a very small proportion (3%) knew of no one. Treatment in villages was 99.9% "private." Patients were generally not able to distinguish a private nurse or pharmacist/medicine seller from other types of health workers or opportunists. The two commune-based practitioners were both identified as commune staff (representatives of the public health sector). Additionally, with regard to drug use for malaria prohylaxis, 97% of patients did not report using prophylaxis. Of the three who did, one took antimalarials, one antipyretics, and one did not know.

Mosquito net knowledge

Of the families (54/112) using mosquito netting at home, 70% stated that everyone used them. Among the remaining 30%, only certain family members did. While most (78%) used bednets in the rainy season, only 22% used them throughout the year. The mean number of nets for an average-sized family (n = 6) was 1.9. This number increased with increasing family size: 1 net for 5.1 persons; 2 nets for 5.8 persons; 3 nets for 6.7 persons. Everyone who used a bednet, however, did so incorrectly, sleeping with only part of their body under the net. The reasons given for not using bednets (58/112) were consistent: do not have, 69%; never used, 29%; unknown, 2%.

Length of hospitalization

The average number of days (Fig 3) spent in hospital per patient was 6.2 (sd = 2.4), meaning that people did not stay for the full 7 day treatment course. This number was not influenced by age, sex or distance from the hospital.

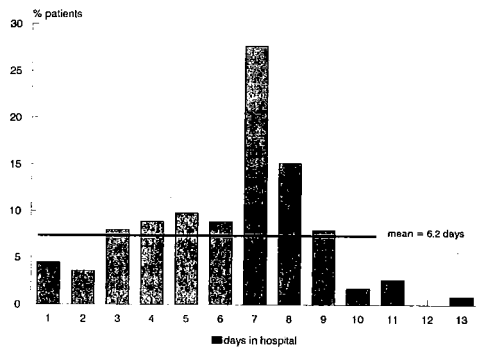

Fig 3–Length of hospitalization: the number of days spent in hospital; n = 112.

In vivo study results

The mean age of participants (n = 25) in this study phase was 30.9 years (range: 6-66 years). There were 16 men (64%) and 9 women (36%). Patients spent an average of 7.3 days in hospital and came from 13 different khums, the largest number coming from Laboek (n = 6; 24%) and Krang Snay (n = 5; 20%), district Chuk. All variables analyzed (clinical state on arrival, distance from hospital, history of prior malaria episodes) were similarly distributed as that for the whole group.

Of 25 exams done (Table 4) to evaluate parasitemia reduction by day 2 (48 hours after start of treatment), 17 (68%) showed a reduction to </= 25% of the day 0 pretreatment value. Among these 17 persons, day 7 results were not available for two patients, leaving 15 for evaluation. All but one (14/15) had a negative smear on day 7, giving a 93% negative predictive value for the modified 7-day test. For the 8 patients with >25% parasitemia on day 2, one did not have a day 7 blood smear, leaving

Table 4

Results of the modified seven-day field test using day 2 blood smear (exam) results to predict day 7 results. Day 2 calculations (</ = 25% *vs* > 25%) are based on the proportion of parasites (per microliter) remaining at day 2 compared with the initial blood smear (day 0).

Day 2 exam	Neg at D7	Pos at D7	Unknown D7	Total
</=25%	14	01	02	17
>25%	02	05	01	08
Total	16	06	03	25

7 for evaluation. Five of these 7 patients were positive at day 7, resulting in a positive predictive value of 71%. Among the 22 patients who completed the study, 6 (27%) had trophozoites found on day 7 (Table 5). Standard interpretation (4) of the WHO 7-day test yielded the following resistance pattern: S1/R1-73% (N = 16); R1-9% (N = 2); R2=0%; R3-18% (N = 4).

Of the eight patients who showed insufficient parasite reduction by day 2, five (63%) came from Laboek commune. These eight spent half (6,888 riels) the amount on drugs compared to the general study group (14,000 riels), reported being ill for 10.5 days compared to the group mean of 8.9, were mostly female (5/8; 63%) and younger (24.8 years). They also travelled a greater distance to the hospital (14.1 kms *vs* 10.6). Due to sparse data, it was not possible to evaluate these differences further.

DISCUSSION

The current study provides a better understanding of malaria patients' use of Chuk hospital and the numerous issues involved. It correlates a diagnosed disease (smear positive malaria) with prior patient behavior and health-seeking patterns (work activities, self-treatment), general malaria know ledge (awareness of both preventative measures and disease symptoms) and treatment outcome (clinical state on arrival, case fatality rate, and parasite response to therapy). While some factors are particular to the Chuk region, many may be generalizeable to other malarious areas within Cambodia.

The essential message from the KAP section is that the forest worker is at highest risk for disease and the use of a simple mosquito net is neither normal practice nor adequate for protection against disease. An equally important message is that private care in all forms, whether through self-treatment or private practitioner, predominates and the public sector is utilized only when patients have not been cured in the periphery. However, the population does subsequently make active use of

Table 5

Patient data (n = 6) for positive Day 7 cases. Parasite density is calculated per microliter.

Patient (A/S)	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
19 M	182,075	2,238	89,103	2,895	992	934	317	210
08 M	220	1,585	688	259	3,603	785	167	57
06 F	33,357	24,308	49,371	NA	51,529	2,629	2,202	65
20 M	1,246	14,169	2,868	832	462	0	0	82
47 F	228,143	99,670	101,257	1,737	246	45	26	85
47 M	55,292	NA	4,250	2,526	113	0	0	68

A/S = Age/Sex; NA = Not Available

hospital services. This health-seeking pattern in itself is not surprising, but the serious consequences of malaria clarifies the future task, namely that community education is essential. The need to emphasize preventive measures in addition to early diagnosis with appropriate treatment and referral demands a joint community-district hospital effort.

The essential message from the *in vivo* study is its confirmation of the predictive value of the modified 7-day WHO field test in rural Cambodia. Even though follow-up beyond the 7 day period was far from satisfactory, our results support the need to develop sentinel district hospital sites for periodic *in vivo* monitoring. The information is important in developing an infrastructure capable of adapting to future changes in the malaria parasite.

The reason for the high rate and degree of resistance found is not clear, especially given the low case fatality rate. It is probable that the R3 level group includes individuals resistant only at the R2 level as the actual day 2 slide may have been taken before a completed 48 hour treatment period. Under existing field conditions, it was not feasible to control for this possibility. It is reasonable to conclude, though, that there is a special problem in Laboek commune, the most isolated and forested area. Our results may also reflect differences in individual immunity to malaria in combination with some degree of quinine resistance. Since we cannot be sure that all tetracycline was taken appropriately, this may be another factor. Finally, as a quinine loading dose is not part of the national protocol, there may be an undetected failure among some patients to rapidly reach appropriate serum drug levels.

Several problems were identified that are particularly relevant to developing a malaria control strategy and message adapted to local circumstances.

Patient recognition of malaria as a disease of the forest - a socioeconomic pattern: While 94% of patients reported falling ill at home, 82% of them reported forest activity in the preceeding 2 months (mean visits per month = 2.2), most of them sleeping where they work. Subsequently, 57% of patients mentioned the forest as a source of malaria and most, 79%, did not use bednets in the forest. Also, patients came for treatment from 55 different villages. Given this information, it is clear that the malaria problem is predominately a matter of where people work rather than where people have their houses, and despite an awareness of where malaria is transmitted, most did not take appropriate precautions, either because they did not have a net (44%), or they did not want to be bothered to carry one (51%). Even those that used bednets did not appear to be protected from disease, and there is probably little natural immunity within the community as it was predominately adult males who presented ill. The forest worker, which is the group at highest risk for disease, should therefore be targeted by any intervention program in the area. It should also be recognized that the forest "worker" is not a homogeneous group but rather a diverse one with varying occupational exposure to and risk from the malaria parasite.

Patient failure to recognize important malaria signs and preference for treatment at home, using the hospital only late in their illness course: While no one used the word "malaria" in speaking about their current illness, patients failed to identify both coma and convulsion as a symptom/sign of malaria. All but six (95%) received treatment at home, and "private" practice was identified in every village but two. This behavior pattern occurred despite the fact that Chuk hospital is known within the region (patients from 55 villages/32 communes). While the use of traditional healers does not appear to be important, more than 60% of patients could not name the drugs bought. Patients waited an average of 8.9 days before seeking care in the public sector, although 90% started therapy at home within 3 days of falling ill. That people waited such a long time correlates with the finding that 47% of those admitted had 4+ parasites on their blood film. This high parasite density also implicates prior self-medication as inadequate and/or inappropriate. The confusion over symptoms combined with delays in seeking public sector treatment results in unnecessary morbidity and mortality.

Patient knowledge gaps about malaria and its prevention: Patients are primarily focused on specific symptoms and treatment for symptom relief, which is very tangible. Prophylaxis and prevention (*ie* bednets), on the contrary, represent vague and abstract concepts. Most people do not use bednets either at home or in the forest (52% and 79%, respectively). Even those that do use them do so incorrectly, sleeping with only part of their body under the net. Moreover, 78% of patients used bednets only during the rainy season, and only one person in ten knew that the malaria mosquito bit

during the night. These demonstrated knowledge gaps help to explain the confusion surrounding malaria and subsequent challenges for its prevention.

Low hospital case fatality rate and evolution of Chuk hospital as a regional malaria center-the need for additional services: Given existing constraints, the study case fatality rate of 2.7% is good and approaches the WHO objective of 2% at the district level. It is also consistent with the 2.6% rate for the preceding 10 month period, January-October (MSF data). This rate reflects the development of Chuk hospital as a regional malaria treatment center and its evolution as an efficient health care provider. Despite rising numbers of malaria cases diagnosed and treated at the hospital (790 slides per month; range: 416-1,623 over a seven month period), most are treated as outpatients. While approximately 25% of cases are admitted to hospital, the proportion of malaria patients (including outpatients) with high parasitemia levels (3+/4+) has significantly decreased over time relative to those with lower densities (1+/2+; MSF data). In our study, clinically diagnosed anemia, an underestimate of its true prevalence, was found in 29% of patients, underscoring the need for expanded district-based laboratory services that include the possibility of blood transfusion.

Hospital accessibility - a familiar picture: Only 5.4% of patients stated that they waited before coming to the hospital because of distance, 91% preferring self-treatment (3% came without delay). Comparing the amount of money spent on drugs used at home (14,429 riels) to that spent on transport to the hospital (702 riels; 42% paid nothing), and given a mean transport time of 1.6 hours, it appears that cost and distance are not the predominate barriers to treatment. The main barrier to hospital care observed in this study reflects insufficient patient awareness combined with a strong preference for home treatment, which is reasonable given the availability of private care in most villages. Additional socioeconomic factors and circumstances were found to play a role such as the availability of people to carry the patient to the hospital, to look after the house and animals, and to care for the children and the fields. This preference for home care despite high costs was documented for more general health complaints as well (van de Put, 1992).

It is important that national malaria control efforts recognize the complex interplay of cultural beliefs, local economic patterns, existence of a pervasive private sector and inadequate community education levels. It is also important to define essential basic services required of a district level referral hospital. As malaria in the Chuk area is predominately a disease of the forest/mountains and its edges, distribution of impregnated bednets should be targeted to those at greatest risk. Distributing mosquito nets to everyone in all villages is not feasible under current conditions. Any subsequent intervention should also include an evaluation plan that measures program effectiveness.

Equally important, a study of the private health sector/market is necessary. It should aim at understanding more precisely the processes of selling and dispensing drugs, private health workers' knowledge about malaria treatment and the attitudes of all drug sellers. Recognizing the fundamental economic motives involved, ways need to be explored to influence this "private" sector to deliver effective, quality care in coordination with the public sector rather than outside of it.

ACKNOWLEDGEMENTS

Special appreciation goes to team Kampot and Chuk district hospital, its staff and director, for their cooperation and support. Their efforts made this study possible.

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