Economic analysis of several types of malaria clinics in Thailand

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The costs of three types of malaria clinics in Maesot District, north-west Thailand, for a one-year period in 1985–86 were compared from the institutional, community and social (institutional plus community) perspectives. The greatest number of patients at the lowest average institutional cost per smear and per positive case diagnosed (US$ 0.82) were seen at the large central clinic in Maesot town. The peripheral clinic in Pophra, a subdistrict town, had moderate institutional costs per smear and per positive case (US$ 1.58). The periodic mobile clinic, which served five villages on a fixed weekly schedule, had low average institutional costs per smear, but the highest cost per positive case (US$ 3.53). Community costs (those paid by patients and their families) were lowest in the periodic clinic. Addition of a periodic clinic to a system of central and peripheral clinics increased the number of malaria cases treated, particularly those involving women and under-16-year-olds. Although the periodic clinic entailed a modest increase in institutional costs, it minimized social costs. The results of the study suggest that use of a combination of central, peripheral, and periodic clinics, which maximizes access to malaria treatment, minimizes the social costs of malaria.

Introduction

Case management—prompt diagnosis and effective treatment—has been recommended by a WHO Expert Committee as a major strategy for malaria control (1). Constrained by limited funds and personnel, public health officials have to determine how to maximize the number of malaria cases effectively managed. The cost–benefit study described in the present article shows how various kinds of outreach clinics have contributed to solving this problem in rural Thailand.

Throughout Thailand, Plasmodium falciparum is highly resistant to most antimalarial drugs, including those used for treatment of presumptive malaria by village health volunteers and in rural health posts (2). The prompt diagnosis and appropriate radical treatment offered free of charge by clinics of the Thai Antimalaria Programme have become a major factor in the control of malaria morbidity and mortality. During the last 10 years the system of clinics has been extended from the 33 zone office laboratories to over 450 facilities in small towns and villages in malarious areas. By 1985, malaria clinics identified approximately 60% of all cases reported by the programme (3).

In 1983, as part of a study to appraise the costs and performance of surveillance activities, Kaewsonthi reported that malaria clinics were the most cost-efficient method for the identification and treatment of malaria cases in east-central Thailand (4). Also noted were the effects of underuse of facilities on the costs of clinics per patient and per positive case. The results also indicated that the community cost to patients and their families was quite high relative to the institutional costs of the antimalaria programme. Kaewsonthi suggested the establishment of outreach clinics as a solution to both the underuse of facilities and the high travel costs incurred by patients.

In western Thailand, Hongvivatana & Hoontrakul have reported frequent (87% of those interviewed) patient self-medication or use of other inappropriate treatment before attending a malaria clinic. The time spent in pursuit of such activities often also causes lengthy delays in the receipt of treatment at the malaria clinic. Against a background of multidrug-resistant falciparum malaria, self-treatment is not only costly but harmful.

In 1984, the Thai Antimalaria Programme initiated a fixed-schedule mobile malaria clinic that made periodic visits as a supplement to the established clinics in one highly malarious area. The mobile clinic was expected to increase coverage and

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reduce patient expenditure on inappropriate treatment as well as on travel to the regular clinic. Its periodic presence in a village was intended to increase the accessibility of treatment and encourage early diagnosis of malaria. Villagers typically leave home quite early in the morning to travel to work in distant fields, and hence they needed to be assured that the clinic would open on the scheduled day if they were to put off going to work and attend it. The clinic’s fixed schedule, e.g., open every Monday in the same village, was designed to enable villagers to plan their use of services in advance.

Previous studies by Ettling et al. have evaluated epidemiologically this particular clinic model and described patterns of clinic use and individual patient expenditure and their determinants (5, 6). The present paper presents an economic analysis of the relative costs of selected fixed and mobile malaria clinics to the antimalaria programme and to the community of clinic attenders. For the economic evaluation of the clinics we adapted a previously reported method, and the investigation was carried out using routine resources from the programme.

**Background**

Three clinics that served the southern part of Maesot District, Tak Province, in north-west Thailand (Fig. 1) were evaluated from September 1985 to October 1986. The area is inhabited by both Karen and ethnic Thais, who are engaged in rice farming and small-scale enterprises; they frequently cross the border into Myanmar to visit family and tend their rice fields, which are typically at some distance from the village hamlets. In 1985, the average gross national product (GNP) per capita for Thailand was US$ 800 (8). The average household in the study area had 4.7 members and an income of 22 000 baht (US$ 183 per capita). Residents of villages served by the periodic clinic had an average household income of 16 000 baht.

In Maesot the central clinic is a large facility staffed on average by three microscopists and an assistant who records data and administers antimalarial drugs to malaria cases diagnosed by microscopy. The clinic occupies part of a rented building that also serves as sector office and accommodation centre for field staff. Since the clinic is located in the major market centre for the western border area, and its services are highly regarded among the district’s 90 000 residents, the patient load is large (about 100 per day), the majority being young men. Microscopists at the central clinic frequently participate in research projects, in addition to their regular duty of examining smears from the clinic, special surveys, or village voluntary collaborators. Maesot also has a large government hospital, many pharmacies, and several private clinics, all of which treat malaria cases. A number of traditional healers and persons performing injections also work in the area.

The peripheral malaria clinic in Popphra, a small subdistrict market centre, shares a building with the public health officer. Staffed by a single, usually unassisted microscopist, it serves patients from the approximately 15 000 residents of the surrounding countryside and handles smears from other parts of the area. The Maesot sector office provides a supervisory service, and the clinic in Popphra sometimes receives referrals from the small government hospital adjacent to it.

The periodic mobile clinic, which is staffed by a microscopist and an assistant who travel by motorcycle with portable equipment, serves a population of 2200 in five villages in the study area on a fixed weekly schedule. The clinic is set up in a local temple or other public place on the scheduled day, and patients for the most part come from the village itself. The day and site of the clinic are known by the villagers, and the schedule was maintained without fail throughout the period of evaluation reported here.

The clinics of the antimalaria programme routinely treat with antimalarial drugs only those cases positively diagnosed by microscopy or those with unequivocal clinical symptoms who have travelled such long distances as to jeopardize the chance of a repeat examination and subsequent treatment.

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Patients with a negative blood smear are referred to other sources of care or treated with paracetamol or vitamins, if these are available. At the time of the study the antimalarial drugs used in the clinics for treatment of falciparum cases were not available in the private market or from other facilities. Therefore, the clinics offered a distinct advantage in the radical treatment of malaria cases. In the clinics, treatment of malaria cases is standardized and does not vary with the severity of individual patient's illness; however, the very few pregnant patients or those with severe complications are referred to a hospital, if possible.

Materials and methods

Institutional costs

The institutional costs considered in this analysis were the financial costs to the antimalaria programme. These costs included manpower, rent, public services, transportation, and supplies such as glass slides and stains. Manpower costs were for both clinic staff and supervisors. Permanent employees of the antimalaria programme receive their regular salary, intermittent per diem allowances, and other benefits, such as payment of medical expenses and school fees. Manpower costs were determined from zone accounts, and were allocated to the clinics on the basis of activity logbooks kept by clinic staff during the study period and the proportion of clinic slides of the total number examined, weighted by the relative time required to assess positive and negative slides.

Rent and public services costs were determined from zone accounts and allocated proportionally, in the same way as manpower costs. Since the periodic clinic was held in temples, empty schools, or unused sheds, it incurred no rent or public services costs.

Transportation for the day-to-day operations and supervision of the clinics was provided by motorcycle. Vehicle fuel and maintenance costs were estimated at a daily rate and allocated to clinic operations from logbooks kept by all zone field staff during March 1986, depending on the number of days of mobile clinic and supervisory use. The daily operating costs included the amortized 1985 local purchase price of a motorcycle (US$ 784), assuming a 5-year life and a discount rate of 8% per annum.

Costs of supplies were calculated from headquarters and zone records by multiplying the cost per smear by the number of attendees at each clinic. Institutional costs did not include the cost of antimalarial drugs, since these were supplied free to patients with falciparum malaria as part of a field trial of mefloquine (Fansimef®, Hoffman–La Roche) carried out at the time of evaluation. The value of this drug supply constituted a subsidy to the clinics during the study period. The market value of all antimalarial drugs used by the clinics amounted to 40 baht per case (US$ 1.6), standardized to the average dose for the entire patient population in the study area.

Full economic costs, based on the opportunity costs of buildings, vehicles, supplies, drugs, and manpower, probably exceeded institutional costs (by no more than 10%) primarily because of the cost of pensions and drug subsidies.

Community costs

The costs to patients and family included direct expenditure on the treatment of the illness prior to arrival at the malaria clinic and on the round-trip transport to the clinic for both patient and accompanying family members. Treatment costs included expenditures on drugs, consultations, and traditional therapies made by the patient or family at either private or government facilities before attending a malaria clinic. For positive cases of malaria the treatment costs are included in the evaluation of clinic costs, even though they are not an explicit cost of attending the clinic since the choice of alternative treatment was closely related to the nature of and distance to a particular clinic. Indirect costs included earnings lost by patients and/or relatives who cared for them during the period of illness, as well as those lost by patients and family while travelling to and attending the clinic. In the analysis, malaria cases incurred all four types of community cost: prior treatment, travel, illness time, and attendance time. Patients not diagnosed to have malaria were considered to incur only the costs of travel and attendance since the costs of their treatment and time lost because of illness could not be ascribed to malaria.

Community costs were determined from interviews of a random sample of 1283 patients in the central clinic, 634 in the peripheral clinic, and 1382 in the periodic clinic. The average costs for a positive case and for a slide-negative case were calculated for each clinic and applied to its patient population. Lost earnings were valued at 25 baht per day, based on the average annual household income in the study area applied to 365 days for two adults per household. This was consistent with the standard agricultural wage during the study period of 40 baht for a 12-hour day. Days on which adult patients reported that they were ill and could not work were valued at the full 25 baht; lost earnings on days on which patients reported fever and/or headache, but not a total inability to work, were valued at 6.25 baht. Time lost by children was valued using the same rate as for adults, assuming that at least one adult relative had to tend a sick child and thereby forfeit their regular income or production.
Costs of episodes of illness for nonattendees at malaria clinics were estimated from bimonthly census surveys of 229 residents of one of the villages served by the mobile clinic. All 105 persons who reported a malaria-like illness in the preceding 2 months were interviewed employing a method similar to that used to interview the clinic patients. The methods used in all household and patient surveys have been described elsewhere (5, 6).

Economic analysis

The average institutional and community costs per smear test and per positive case identified were determined for each clinic during the study period. These costs indicate the level of institutional expenditure required to implement such clinics in areas where the epidemiology of malaria and individual behaviour resemble those in the study area. They also permit an examination of the relationship between institutional and community costs.

The social costs of each combination of clinics were determined using assumptions about patient's behaviour for each combination. The results of surveys in similar areas indicated that in a village served by a periodic mobile clinic, 63% of inhabitants with malaria attended a clinic, compared with only 10% of those in a village with no malaria clinic (6). It was assumed that 16% (i.e., 10%/63%) of malaria cases who attended a local (periodic or peripheral) clinic would have attended another, more central clinic (a clinic of resort) in the absence of a local clinic. For example, the combination of a central and peripheral clinic hypothesizes the absence of the periodic clinic; to determine the social cost of this combination, it was assumed that in the absence of the periodic clinic 16% of the malaria cases that would have attended it would instead attend a clinic of resort (the peripheral clinic). It was further assumed that the remaining 84% of cases from the periodic clinic did not attend a malaria clinic and had treatment and illness experiences that were similar to the non-attendees described above. The number of patients who did not have malaria, and in the absence of the periodic clinic would have attended a clinic of resort, is proportional to the 16% of malaria cases who attended the latter clinic. In practice, however, the proportion used was the ratio of negative to positive cases in the clinic of resort. It was assumed that the number of slides from activities outside the clinic of resort that were examined by the microscopists did not vary, since this number is determined by operational policy not directly related to the clinic's function.

In determining the social cost of the various clinic combinations, vehicle costs were taken to be fixed, because it was hypothesized that the use of vehicles by supervisors and mobile clinic personnel would not vary with the levels of clinic attendance. The unit cost of supplies per smear appears not to vary with the number of slides. Manpower costs do, however, vary with increased attendance at the clinics of resort under the various clinic combinations, in so far as the relative proportions of slides from the clinic and external sources change or additional overall microscopist's time is required. Rent and the cost of public services vary in the same manner.

The community cost elements used to estimate social costs also varied. The costs of travel and attendance time were calculated using the average values from the clinic of resort, since these costs were taken to be characteristics of a clinic. If anything, the values taken were conservative for patients from outlying areas. The costs of prior treatment and illness time were calculated using the average value from the original clinic (now absent), since such costs were held to be characteristics of particular patients and their community. Illness time for positive cases (3.5 days) varied little from one clinic to another; for all patients this averaged 3.1 days in the central and peripheral clinics, but was only 1.6 days in the periodic clinic, which was more frequently used as a screening facility by asymptomatic persons (6).

The social costs apply to the population of 6004 positive cases treated by the clinics in 1985–86. Additional costs were incurred by cases not treated by any of the clinics, but cannot be estimated since an accurate count of the total number of malaria cases in the area could not be made. However, the bimonthly surveys suggest that untreated cases constituted at least half of the number treated (6).

Results

The number of smears taken by each clinic varied markedly (Table 1). The central clinic dealt with 22,708 patients per year, by far the most, compared with only 3724 in the peripheral clinic and 12,977 in the periodic clinic. At the regular clinics, approximately a fifth of attendees were positive for malaria. The positivity rate for the periodic clinic was 5%, reflecting the large numbers of schoolchildren and asymptomatic persons screened there. This difference in patterns of use had a direct effect on costs.

Institutional costs

The total institutional operating costs for each clinic over the study period reflect the number of smears made. The costs for the central clinic (98,444 baht) were almost twice those of the periodic clinic (56,925 baht), and the latter was over twice as expensive as the peripheral clinic (26,176 baht).
The average institutional cost per smear taken (approximately 4.4 baht) was virtually the same in the central and periodic clinics. In the peripheral clinic the cost per smear was higher (7.03 baht). Although the periodic clinic was smaller and dealt with fewer patients than the central clinic, the efficiency of the use of manpower resources in the two clinics was remarkably similar.

The institutional costs per positive case showed a different pattern to the costs per smear. The highest average institutional cost per positive case (90.07 baht) was for the periodic clinic. These costs were considerably lower for the peripheral clinic (40.21 baht) and for the central clinic were only 20.85 baht. This pattern reflects the fraction of positive cases in each clinic. Although many patients were seen at the periodic clinic, proportionately fewer positives were found. The peripheral clinic, which was relatively inefficient as indicated by the costs per smear, was somewhat more efficient in terms of the cost per positive case, because of the high proportion of such cases and the smaller total patient load.

The marginal institutional cost per positive case (the extra institutional cost to identify an additional positive case) was 2.30 baht in the central clinic, and represented 11% of the average institutional cost per positive case. Under the study hypotheses, the total number of slides examined in the central clinic would not require additional staff, only a slight reorganization of microscopists' duties to increase the time spent on examining clinic slides. The standard number of slides examined by a malaria microscopist is 60 per day; even with the increase in slides predicted by the study hypotheses, this number would not be exceeded. However, the marginal institutional cost per positive case in the peripheral clinic was 15.22 baht, i.e., 38% of the average institutional cost per positive case. This higher proportion arises because the slides examined by the microscopist in the peripheral clinic was already greater than 60 per day. Therefore, the increased number of slides predicted would require an overall increase in microscopists' time, increasing the marginal cost.

**Community costs**

The community costs for each clinic are shown in Table 2. The costs per smear were highest in virtually all categories for the central clinic and lowest in the periodic clinic. This trend reflects the increasing ease of access to the smaller community-based clinics and the different patterns of use. In the central clinic the community cost per smear was 27.64 baht, i.e., 2% of the average monthly household income in the local villages, compared with 1% and 0.5% for the peripheral and periodic clinics, respectively.

Community costs per positive case follow the same order by type of clinic as the cost per smear, since the number of smears was the major factor for both these costs. The total community cost was lowest for the periodic clinic (55,285 baht), despite the relatively large number of patients; however, these low costs to the community were achieved at the expense of high institutional costs.

Low cost to patients and family is desirable not only as a saving of resources, but also because...
Expenditure on prior treatment indicates inappropriate medication and a delay in proper radical cure. Attendees of the periodic clinic reported the least improper prior treatment and the highest coverage of children (5, 6).

Nonattendees reported an average expenditure of 95.2 baht on treatment of their malaria-like illness and an average of 6.3 days on which they could not work—more than 4 days longer than among clinic attendees. An average untreated case therefore incurred a mean community cost of 252.70 baht, including direct expenditure and illness time.

### Social costs

Estimates of the total social cost of the various strategies of clinic implementation are shown in Table 3. For example, for the combination of central plus peripheral clinic, a total of 5473 positive cases will be treated; these consist of the original 4721 positive cases in the central clinic, the 651 original positive cases in the peripheral clinic, and an additional 101 positive cases originally treated in the periodic clinic who were subsequently treated in the peripheral clinic as the clinic of resort. These 101 positive cases

### Table 2: Annual community costs (in baht) of malaria clinics in Maesot District, Thailand, 1985–86

<table>
<thead>
<tr>
<th>Breakdown of costs (per smear)</th>
<th>Central</th>
<th>Peripheral</th>
<th>Periodic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct cost</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>2.63 (10)</td>
<td>0.93 (4)</td>
<td>0.06 (1)</td>
</tr>
<tr>
<td>Travel</td>
<td>11.56 (42)</td>
<td>5.10 (24)</td>
<td>0.05 (1)</td>
</tr>
<tr>
<td><strong>Indirect cost</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illness time</td>
<td>10.34 (37)</td>
<td>8.52 (39)</td>
<td>2.06 (49)</td>
</tr>
<tr>
<td>Attendance time</td>
<td>3.11 (11)</td>
<td>7.08 (33)</td>
<td>2.09 (49)</td>
</tr>
<tr>
<td>Total</td>
<td>27.64 (100)</td>
<td>21.62 (100)</td>
<td>4.26 (100)</td>
</tr>
</tbody>
</table>

**Aggregated data**

- **Total community cost**: 627,719
- **Direct cost per positive case**: 68.25
- **Total cost per positive case**: 132.96

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* Figures in parentheses are percentages.

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### Table 3: Annual social costs (in baht) of possible clinic combinations, Maesot District, Thailand, 1985–86

<table>
<thead>
<tr>
<th>Number of cases</th>
<th>Central</th>
<th>Central + peripheral</th>
<th>Central + peripheral + periodic</th>
<th>Central + periodic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive cases treated</td>
<td>4926</td>
<td>5473</td>
<td>6004</td>
<td>5457</td>
</tr>
<tr>
<td>Additional cases treated&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4826</td>
<td>547</td>
<td>531</td>
<td>—&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Positive cases untreated&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1078</td>
<td>531</td>
<td>0</td>
<td>547</td>
</tr>
</tbody>
</table>

**Social cost**

- **Institutional cost**: 98,910
- **Additional institutional cost<sup>a</sup>**: 98,910
- **Community cost (treated cases)**: 652,234
- **Community cost (untreated cases)**: 272,340
- **Total social costs**: 1,023,484
- **Added institutional cost per extra case treated**: 20.08

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<sup>a</sup> Social costs equal institutional costs plus community costs for the 6004 positive cases treated in existing clinics. 25.5 baht = US$ 1.

<sup>b</sup> Compared with the combination in the preceding column. For the central clinic only, the prior combination is the absence of all clinics.

<sup>c</sup> The central + periodic combination is not a cost-effective option.

<sup>d</sup> Equal to 6004 minus the number of positive cases treated.
were accompanied by 578 negative cases (ratio, 5.7:1) found in the peripheral clinic. This combination leaves 531 of the 632 original positive cases from the periodic clinic untreated.

The central clinic patients incur all costs as originally calculated, while the former peripheral clinic patients incur community costs as originally calculated. The additional peripheral clinic patients, formerly of the periodic clinic, incurred the same travel and attendance time costs as the peripheral clinic patients and the same prior treatment and illness time costs as in the periodic clinic. The increased number of slides in the peripheral clinic (679) requires additional microscopist’s time. For this combination, the central clinic has an institutional cost of 98,444 baht; and the institutional cost of the peripheral clinic rises to 27,713 baht, which gives a total institutional cost for the combination of 126,157 baht. The central clinic has a community cost of 627,719 baht for treated cases in this combination; while for the peripheral clinic the community cost is 101,407 baht, which gives a total community cost for treated cases of 729,126 baht. The 531 untreated cases incur community costs of 134,153 baht. Therefore, the total social cost of the central + peripheral clinic combination is 989,436 baht.

The institutional costs of the central + peripheral combination are 27,247 baht greater than those for the central clinic alone. The combined clinics treat 547 more positive cases than the central clinic alone; therefore, the additional institutional cost per additional positive case treated is 49.81 baht (27,247/547).

The central clinic alone incurs the lowest institutional costs but the highest community costs, and, therefore, the highest total social costs. The addition of the peripheral clinic to the available treatment settings, although it increases institutional costs, reduces the costs to the community of untreated cases. The combination of all three clinics has the highest institutional costs of the options considered but the lowest total social cost. The implementation of increasingly accessible clinics reduces community expenditures, largely on illness time and prior treatment of positive cases otherwise untreated by a clinic, and outweighs the added institutional costs of implementation.

A sensitivity analysis of the assumption that only 16% of positive cases will attend a clinic of resort was carried out using an alternative hypothesis—that 60% of peripheral clinic patients and 40% of periodic clinic patients would attend the central clinic if it alone existed, and that 60% of periodic clinic patients would attend the peripheral clinic under the central + peripheral clinic combination.

These rates are based on the finding that greater numbers of men attended clinics than women and children, although they have comparable levels of exposure (5). The percentages, which assume that all the adult male patients attend a clinic of resort and that women and children attend in the same proportions as they do the clinic of resort, provide the lowest estimates of additional cases treated by the periodic and peripheral clinics. Based on this conservative calculation of the numbers of untreated cases, the relative order of the various clinic combinations remains unchanged, although the absolute social costs of each clinic combination are different. The three-clinic combination remains the lowest social cost alternative, while the central + peripheral clinic combination is intermediate.

**Cost-effectiveness**

The incremental cost-effectiveness of each possible combination of clinics is based on the additional institutional cost per extra case treated. The results indicate that compared with the theoretical option of no clinics, the central clinic treats an extra 4926 positive cases at an additional institutional cost of 200.08 baht per case. The central + peripheral clinic combination treats an extra 547 cases at an additional institutional cost of 49.81 baht per case, while the three-clinic combination treats an extra 531 cases at 104.31 baht per case. Fig. 2 shows that the central + periodic clinic combination is dominated by the central + peripheral combination.

This increasing effectiveness as the central clinic is supplemented by the peripheral and then the

![Fig. 2. Incremental cost-effectiveness of possible clinic combinations, Maesot District. The slopes of line segments (figures above each segment) represent the extra institutional cost per additional case treated by each combination (25.5 baht = US$ 1).](image-url)
mobile clinic is reflected in the long-standing policy of Thailand’s Antimalaria Programme, which recognizes the effectiveness of peripheral clinics not only as loci for case identification and treatment but also as foci for other laboratory and supervisory activities. Similarly, the implementation of either the peripheral or periodic clinic alone is not considered here as a viable alternative. The central clinic serves as a resource for the entire district; and although the periodic clinic gives the most complete coverage, it serves less than 10% of the 58 villages in the district. The central clinic is considered the basis for implementation of other types of clinic.

Discussion

The social desirability of implementing peripheral clinics in the malarious study area is further strengthened by two additional considerations. First, these tax-supported clinics represent a progressive redistribution of resources. The average household income in the north of Thailand in 1986 was 89% of the national average (7), while for the study area, particularly in the five villages served by the periodic clinic, it was even lower. If community costs are weighted using this distribution factor, an approach that has been employed for weighted project appraisal (8), the relatively large community costs of centralized clinics and untreated cases increase. The saving in social cost is enhanced as the level of outreach increases.

Second, it is important that the population most affected by the accessibility of the periodic clinic is under-16-year-olds (6). The following benefits of rapid and effective treatment of malaria in this group were not explicitly evaluated in the present analysis: the reduction in an illness that can impair growth and development; reduction in the length of time infected children can serve as gametocyte carriers; minimization of the possible development of parasite resistance to the available antimalarial drugs; and reduction in the risk of serious side-effects from inappropriate treatment.

Our findings suggest that extension of malaria clinic services in areas of high transmission, such as Maesot District, can be accomplished at institutional costs of less than 10 baht (US$ 0.40) per patient examined. Despite higher institutional costs, the overall costs of cases to the community are reduced by as much as 34%. Outreach clinics, such as the fixed-schedule mobile clinic described here, can significantly increase the overall coverage of malaria cases.

In 1983 in eastern-central Thailand, Kaewsonthi found that the average cost for an outpatient with malaria who attended a government hospital was 127 baht and over 900 baht for an inpatient (4). A subsequent analysis estimated that the average cost in malaria clinics was 7–14 baht per slide and 103–130 baht per positive case. The minimum estimated cost was 4.4 baht per slide and 44 baht per positive case. Alternative case-finding techniques used in Kaewsonthi’s study show fully-allocated costs as high as 208 000 baht per positive case, by active case detection in a low transmission zone. Compared with these reliable data from an area of Thailand with a lower malaria incidence, the costs in the present study (4–7 baht per slide and 20–90 baht per positive case) appear reasonable.

The total budget for the antimalaria programme, averaged over the number of positive cases identified and treated in 1985, was greater than 900 baht per case (3). If only 50% of this budget were spent on case-finding activities, the expenditure per positive case in 1985 would still have been 450 baht—much higher than the 21–90 baht in the clinics examined here. Clinics operated by the programme in less malarious areas, which were evaluated using the same methods as the present study, had an average cost per case of 2500 baht. Thus, increasing access in highly malarious areas is more cost-effective than initiating services in low prevalence areas. Clinics that integrate malaria treatment with other services or that promote services on less than a daily basis might realize the same economies that many Thai vaccination programmes have achieved (9).

The institutional cost of the periodic clinic is approximately 26 baht per capita in the five villages it serves. Using Kaewsonthi’s findings for an area similar to Maesot in terms of the extent and organization of its antivector operations (4), we estimated the costs of antivector measures to be approximately 28 baht per capita of the affected population.

The unit institutional costs in the three clinics varied widely, indicating variations in efficiency. However, the greater efficiency of the central and periodic clinics probably occurred for different reasons. In the periodic clinic, the low cost per smear arose because of the number of patients seen. Maesot Clinic, which was located in the sector office, not only dealt with many patients but also had a flexible approach, assigning personnel to other tasks when the patient load was low. Manpower costs accounted for up to 86% of the total institutional costs. It is

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therefore likely that staffing patterns and overall patient loads will most affect the relative efficiency of the study clinics expressed as cost per smear taken.

Interpretation of the average institutional costs of clinics requires also comparison of the quality of their performance. In the malaria clinics studied here, many of the components of performance were rigidly standardized, including treatment, record-keeping, finger-prick techniques, and the staining and examination of slides. Furthermore, routine re-examination of all positive as well as a sample of negative slides at a central laboratory revealed no difference in the accuracy of diagnosis among the clinics, which was in any case high.

The larger, regular clinics, particularly those located in a sector office, are clearly more efficient because of the ease of supervising staff and their flexibility in assigning idle staff to other tasks within the clinic; however, to attend centralized clinics such as these, patients must commit more of their money and time. Some patients, especially busy adults who are caring for an ill child, choose instead to delay or resort to convenient but inappropriate self-medication. In areas such as Maesot District, with large hill-tribe populations, travel to a large clinic staffed by ethnic Thais may present cultural barriers, and in a sense, the three types of clinics described and evaluated here serve different populations and complement each other. For example, the central clinic in Maesot is accessible to mobile younger working persons, particularly men; the peripheral clinic in Popphra serves patients such as this who live nearby and also those women and older persons in the immediate vicinity who might not travel to Maesot; and the periodic clinic serves a large group of residents who would not travel outside the village for proper treatment of malaria illness.

Because of the limited availability of Fansimel®2, the clear advantage in terms of radical treatment of falciparum malaria that the clinics possessed at the time of the study clearly depends on changes in both access and resistance to antimalarial drugs. Since the study was carried out, mefloquine has become available on the private market to some extent. However, the following factors tend to maintain the treatment advantages of the malaria clinics. First, the choice of antimalarial drugs and doses in Thailand (whether chloroquine, Fansidar®2, quinine, or other antimalarial) in the private market has been notoriously inadequate; there is no reason to believe that mefloquine would fare any better under similar circumstances. Second, antimalarials bought privately are expensive, and this is particularly true of mefloquine. Finally, there are the following unquantifiable benefits: minimization of the development of resistance, reduction in illness time, and reduction in the presence of gametocytes in the population.

The analysis presented here strongly suggests that the combination of village-based clinics and a fixed-schedule mobile clinic can reduce the overall social cost of malaria in areas where transmission of the disease is high. The relative efficiency of the peripheral versus mobile clinic depends on factors such as the transport available to remote rural villages and the willingness of individuals to travel outside their village for treatment. The fixed-schedule mobile clinic offers a feasible means for identifying and treating individuals with malaria, particularly women and children, who would otherwise remain untreated.

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Résumé
Analyse économique de plusieurs types de dispensaires antipaludiques en Thailande
Les coûts associés à trois dispensaires antipaludiques dans le district de Maesot, en Thailande, ont été comparés sur une période d'un an en 1985-1986. Le grand dispensaire central de la ville de Maesot a examiné 22708 frottis sanguins et traité 4721 cas positifs de paludisme. Un dispensaire périphérique plus petit, dans une ville de sous-district, a examiné 3724 frottis et traité 651 cas. Enfin, un dispensaire mobile desservant cinq villages selon un schéma périodique (hebdomadaire) a examiné 12977 frottis et traité 632 cas.

Le coût institutionnel de chaque dispensaire, comprenant le coût du personnel, du transport, du loyer, du matériel et des fournitures, a été calculé d'après les registres généraux, les registres journaliers et les observations. Pour la période de 12 mois, le dispensaire central avait le coût institutionnel total le plus élevé (98444 baht; 25,5 baht = US$1), mais le coût par frottis le plus faible (4,37 baht). Le coût institutionnel pour le dispensaire périphérique était le plus faible (26176 baht) mais le coût par frottis était le plus élevé
(7,03 baht). Pour le dispensaire mobile, le coût institutionnel était élevé (56,925 baht) mais le coût par frottis était faible (4,38 baht). Ces coûts reflètent non seulement l’efficacité relative des trois dispensaires en ce qui concerne l’exécution des frottis et l’examen des lames, mais sont également fortement influencés par la proportion de cas positifs dans chaque établissement. Les coûts institutionnels par cas positif traité étaient de 20,85 baht pour le dispensaire central, 40,21 baht pour le dispensaire périphérique et 90,07 baht pour le dispensaire mobile.

Contrairement aux coûts institutionnels des trois dispensaires, les coûts communautaires du malade et de sa famille étaient les plus faibles pour le dispensaire mobile. Le coût communautaire inclut le coût direct du traitement de l’épisode paluste avant consultation d’un dispensaire et du voyage jusqu’au dispensaire (pour le malade et les membres de la famille qui l’accompagnent), ainsi que le coût indirect de la perte de revenu lors du séjour au dispensaire et lors de l’arrêt de travail dû à la maladie. Les coûts indirects ont été estimés en prenant 25 baht pour une journée de 12 heures, valeur du revenu moyen des ménages dans la zone étudiée.

Le coût direct pour la communauté par cas positif traité par le dispensaire mobile était de 2,26 baht, contre 34,45 baht pour le dispensaire périphérique et 68,25 baht pour le dispensaire central. Ces coûts reflètent l’accessibilité du dispensaire mobile, la dépense due au voyage étant alors nulle.

Les interrogatoires de villageois qui ne s’adressaient pas à un dispensaire antimaladique pour le traitement d’une maladie de type paluste ont montré que la dépense directe moyenne était dans ce cas de 95,2 baht par épisode, avec 6,3 jours de maladie.

Les coûts sociaux, qui comprennent à la fois le coût des cas traités et des cas non traités, ont été calculés pour diverses combinaisons de types de dispensaires. Les résultats indiquent que le dispensaire central seul traiterait 49,26 cas sur un total de 604 cas positifs à un coût social moyen de 5,023,484 baht. En ajoutant le dispensaire périphérique, on aboutirait au traitement de 5473 cas à un coût social de 989,436 baht. En ajoutant enfin le dispensaire mobile, on traiterait la totalité des 6004 cas à un coût social de 945,062 baht.

Le coût institutionnel supplémentaire par nouveau cas positif traité est de 20,08 baht pour le dispensaire central seul, 49,81 baht pour la combinaison dispensaire central/dispen sine mobile, et 104,31 baht pour la combinaison des trois types de dispensaires. Pour une dépense supplémentaire de US$4, un cas positif supplémentaire de paludisme, probablement une femme ou un enfant de moins de 16 ans, pourrait par conséquent être traité dans la zone étudiée.

References