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A comparison of cost – effectiveness between dipstick and thick blood film for malarial active surveillance

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Objective : *The purposes of this study were to analyze cost, effectiveness and cost – effectiveness of dipstick (OptiMal ®) method compared to thick blood film (TBF) method in malarial active surveillance.*

Setting : *The Vector Borne Disease Control Center 18 (Mae Sot)*

Research design : *Descriptive analysis, provider perspective.*

Methods : *The cost centers, transient and absorbing, were allocated by direct distribution and step – down methods.*

Results : *Of 9,114 collected blood samples from Thailand – Myanmar border areas, 1,878 (20.81 %) were positive by dipstick and 2,725 (29.90 %) were positive by the TBF. The full costs of both direct and indirect of the dipstick and the TBF were 2,771 baht, 784.77 baht and 2,226, 032.57 baht, respectively, in which most of them were direct cost (87.75 %). The unit cost of the dipstick and the TBF were 304.12 baht and 244.24 baht, respectively. Alternatively, in cost – effectiveness analysis (i.e., unit costs of any methods for malarial diagnosis – positive samples), the dipstick had the unit cost of 1,475.92 baht; whereas, the TBF was 816.89 baht. The sensitivity analysis of the cost – effectiveness showed that the TBF had its efficiency higher than the dipstick in all levels of the prevalence of malarial infection. However, the dipstick effectiveness would increase when the prevalence of infection was increased.*

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Conclusion : *These findings are beneficial to the public health administrators to allocate the limited resources with managerial, financial and technical supports in malarial active surveillance in the border areas.*

Keywords : *Cost – effectiveness, Dipstick, Thick blood film, Malaria.*

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ทศพร วิมลเก็จ, ยุทธพงศ์ หมื่นราษฎร์, บดี ธนะมั่น. การวิเคราะห์ต้นทุนประสิทธิผลของการเฝ้าระวังโรคไข้มาลาเรียเชิงรุก ด้วยวิธีการใช้ชุดน้ำยาสำเร็จรูปและฟิล์มโลหิตชนิดหนา. จุฬาลงกรณ์เวชสาร 2549 ก.ย; 50(9): 641 – 9

วัตถุประสงค์ : *เพื่อศึกษาต้นทุนประสิทธิผลของการเฝ้าระวังโรคไข้มาลาเรียเชิงรุก ด้วยวิธีการใช้ชุดน้ำยาสำเร็จรูปและฟิล์มโลหิตชนิดหนา*

สถานที่ทำการศึกษา : *ศูนย์ควบคุมโรคติดต่อนำโดยแมลงที่ 18 แม่สอด*

รูปแบบการวิจัย : *การศึกษาเชิงพรรณนา*

วิธีการศึกษา : *เป็นการเก็บข้อมูลย้อนหลัง จากหน่วยงานที่เกี่ยวข้องโดยแบ่งออกเป็นหน่วยงานต้นทุนชั่วคราวและหน่วยงานรับต้นทุน ใช้วิธีการกระจายต้นทุนแบบการกระจายโดยตรงและการกระจายต้นทุนแบบการกระจายตามลำดับขั้น*

ผลการศึกษา : *จำนวนที่ตรวจทั้งหมด 9,114 รายพบว่าให้ผลบวก 1,878 (20.81 %) ราย ด้วยชุดน้ำยาสำเร็จรูป และ 2,725 (29.90 %) ราย ให้ผลบวกด้วยฟิล์มโลหิตชนิดหนาพบว่าต้นทุนรวมทั้งหมดของการดำเนินงานเฝ้าระวังโรคไข้มาลาเรียเชิงรุกด้วยวิธีการใช้ชุดน้ำยาสำเร็จรูปเท่ากับ 2,771,784.77 บาท โดยเป็นต้นทุนทางตรงร้อยละ 87.75 และต้นทุนรวมทั้งหมดของการดำเนินงานเฝ้าระวังโรคไข้มาลาเรียเชิงรุกด้วยฟิล์มโลหิตชนิดหนาเท่ากับ 2,226,032.57 บาท โดยเป็นต้นทุนทางตรงร้อยละ 84.26 ต้นทุนเฉลี่ยต่อตัวอย่างที่ตรวจด้วยชุดน้ำยาสำเร็จรูป เท่ากับ 304.12 บาท ต่อราย และต้นทุนเฉลี่ยต่อตัวอย่างที่ตรวจพบเชื้อ เท่ากับ 1,475.92 บาทต่อราย ส่วนต้นทุนเฉลี่ยต่อตัวอย่างที่ตรวจด้วยฟิล์มโลหิตชนิดหนา เท่ากับ 244.24 บาทต่อราย และต้นทุนเฉลี่ยต่อตัวอย่างที่ตรวจพบเชื้อเท่ากับ 816.89 บาทต่อราย สำหรับ ต้นทุน - ประสิทธิผลพบว่าการดำเนินงานเฝ้าระวังโรคไข้มาลาเรียเชิงรุกด้วยฟิล์มโลหิตชนิดหนามีประสิทธิภาพสูงสุด (ต้นทุน – ประสิทธิผล ต่ำสุด) โดยมีต้นทุน – ประสิทธิผลเท่ากับ 816.89 บาท ส่วนการเฝ้าระวังโรคไข้มาลาเรียเชิงรุกด้วยวิธีการใช้ชุดน้ำยาสำเร็จรูปมีต้นทุน-ประสิทธิผลเท่ากับ 1,475.92 บาท เมื่อวิเคราะห์ความไวของ ต้นทุน – ประสิทธิผล พบว่า ถึงแม้ว่าจะมีการเปลี่ยนแปลงของอัตราการตรวจพบเชื้อมาลาเรียจากสถานการณ์ปัจจุบันทั้งเพิ่มขึ้นและลดลง ของวิธีการตรวจวินิจฉัยทั้ง 2 วิธี ก็ตาม วิธีการตรวจวินิจฉัยด้วยฟิล์มโลหิตชนิดหนาก็ยังคงมีประสิทธิภาพสูงสุดแต่มีแนวโน้มว่าหากอัตราการตรวจพบเชื้อมาลาเรีย ยิ่งเพิ่มสูงขึ้นก็จะทำให้ประสิทธิภาพของวิธีการตรวจวินิจฉัยทั้ง 2 วิธี ใกล้เคียงกันมากยิ่งขึ้น*

วิจารและสรุป : *ผลการวิจัยจากการศึกษานี้ สามารถเป็นข้อมูลพื้นฐานให้ผู้บริหารนำไปประกอบการวางแผนการดำเนินงานเฝ้าระวังโรคไข้มาลาเรียเชิงรุกและบริหารการใช้ทรัพยากร ในการดำเนินงานอย่างมีประสิทธิภาพสูงสุด*

คำสำคัญ : *ต้นทุนประสิทธิผล, ชุดน้ำยาสำเร็จรูป, ฟิล์มโลหิตชนิดหนา, มาลาเรีย*

Malaria, a mosquito – borne disease, remains a public health problem in Thailand, particularly in the Thailand – Myanmar border areas where most are forests and mountains. Also, in such areas, most of the affected persons have no timely access to health care; so, this catastrophic disease gives rise to death tolls enormously.[1] In fiscal year (Fy) 2001, for example, more than 68,000 malarial cases were reported nationwide, and from the cases, 23,821 (34.93 %)[2,3] were reported from Tak Province, a Thailand-Myanmar border area. In the province, both Falciparum and Vivax species have posed problems ahead with the divergence of geographical variations of the malarial parasites. Moreover, some cases are resistant to anti-malarial drugs and the mosquito vectors are also insusceptible to insecticides. The Malaria Division, Department of Communicable Disease Control, the Ministry of Public Health, has an effort in emphasizing on bilateral health services along the Thailand – Myanmar border by implementing new initiatives through the local health settings (i.e., early diagnosis and prompt treatment). The early diagnosis with the immunochromatographic dipstick tests is to efficiently and effectively clarify the malarial cases either asymptomatic or uncomplicated.[4,5] Such rapid diagnosis with the dipstick (OptiMal ®) is used for detecting simple infection with *P.falciparum*, *P.vivax* or mixed infections. It can be introduced in active surveillance for border areas in Thailand. In the regular diagnosis for malaria control program in most endemic countries, thick blood film (TBF) is recommended as a standard method. However, it has been more often considered unsuitable and unavailable in terms of costs both personnel and time for the remote health settings. Therefore, in active malarial surveillance in the border areas, early diagnosis and prompt treatment to reduce severity and suffering from malarial infection are essentials. There are no studies concerning cost analysis between the dipstick method and the TBF method. Thus, to solve the problem, we hereby describe a performance of both tests in a cost-effectiveness manner, using the patients' blood samples from the Malaria Control Sectors, Vector Borne Disease Control Center (VBDC) 18 (Mae Sot), Tak Province, as units of the study which are targeted to implement the active surveillance program in Fy 2002.

Materials and Methods

Population and samples

The population in this study was all 11 units that were conducting active malarial surveillance using the dipstick (OptiMal ®) and the conventional thick blood film (TBF) of the VBDC 18 Mae Sot in fiscal year 2002.

Samples

The samples were all 11 active malarial surveillance units using the dipstick (OptiMal ®) and the conventional TBF. Our samples were divided into two groups: absorbing and transient cost, and absorbing cost. The absorbing and transient cost group was comprised of 6 units: administrative, financial and accounting, procurement, vehicle, diagnostic and surveillance, of the study center. The absorbing cost group included 33 administrative, diagnostic and surveillance sub-units which were belonged to the 11 Vector Borne Disease Control Units under the provision of the VBDC 18 Mae Sot.

Methods

In this study, the cost centers were divided into two groups, namely: absorbing and transient. The

cost distributions were also classified into two groups. The first group was determined by personnel amount, working time and using the step – down distribution methods for distributing cost from transient cost centers to absorbing cost centers. The second group was determined by personnel amount, working time, working area, number of specimen, using the direct distribution methods for distributing cost within the absorbing cost centers.

In data collection concerning labor cost, material cost, investment cost and in analyzing cost, effectiveness and cost – effectiveness, recorded forms were used as the instruments.

Results

Of the 9,114 individual blood samples that were parasitologically and immunologically examined, 2,725 (29.90 %) were positive by the TBF and 1,878 (20.61 %) were positive by the dipstick.

The full costs both direct and indirect of the dipstick (OptiMal ®) were 243,236.66 and 33,945.10 baht or totally 2,771,784.76 baht; whereas, the TBF were 1,875,633.67 and 350,398.90, or totally 2,226,032.57 baht. Of these full costs, a similar of the direct costs between the dipstick (87.75 %) and TBF (84.26 %) was detected. On the other hand, when a total full cost of both diagnostic tests was separated into labor cost, material cost, and capital cost, the similar cost of the labor cost between the dipstick (61.31 %) and the TBF (78.79 %) was found.

The cost ratio of the labor cost: materials cost: capital cost when using TBF was 18.59: 4.00:1.00, which was lower than using the dipstick (26.00: 15.41: 1.00) .

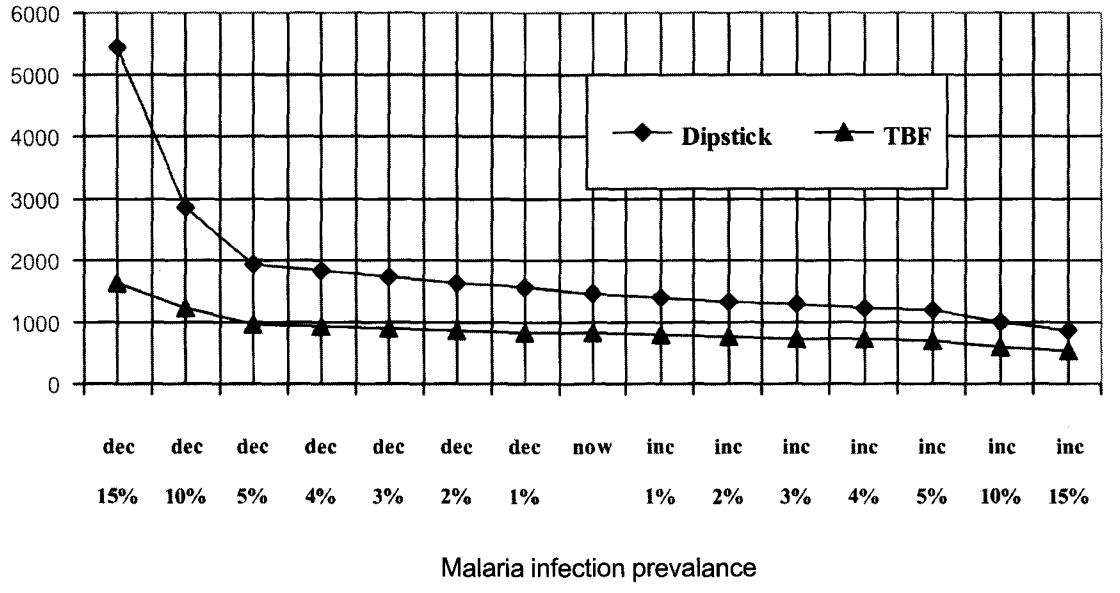
In cost - effectiveness analysis, the unit cost per sample of the TBF was 244.24 baht which was lower than that of the dipstick (304.12 baht). Similarly, the unit cost per malaria – positive sample of the TBF was 816.89, which was lower than that of the dipstick (1,475.92 baht) (Table1).

In the different prevalence of malaria infections, of both methods, the TBF had more sensitivity in diagnosis malaria than the dipstick (OptiMal ®). TBF gave the unit cost (in baht) per positive sample lower than that of the dipstick (OptiMal ®) at all levels of the prevalence of malaria infections. However, when the prevalence was increase, the cost-effectiveness of both methods was more close to each other (Figure 1).

Table 1. Unit cost of the Dipstick (OptiMal ®) and TBF.

Diagnostic test	Total full cost (Bahts)	Tested samples		Unit cost (Bahts)	
		Total	Positive	Per Sample	Per positive
Dipstick (OptiMal ®)	2,771,784.76	9,114	1,878	304.12	1,475.92
TBF	2,226,032.57	9,114	2,725	244.24	816.89

Cost – effectiveness



* dec = decrease

** inc = increase

Figure 1. Sensitivity analysis of cost-effectiveness of the Dipstick (OptiMal ®) and TBF with the differences in malarial infection prevalence.

Discussion

From malarial active surveillance of the study center, we found that 9,114 cases were totally diagnosed. Of these, 1,878 (20.61%) cases were positive by the dipstick method. Whereas the total positive samples of using the TBF were 2,725 cases or the positive rate of 29.90 %. By using both methods, the total positive rate of 18.94 % or 1,726 positive cases were detected. It can be seen that in malarial active surveillance of the center in the fiscal year 2002, the tested samples using both methods had quite high positive rate compared to the positive rate of active case finding of all units which were drawn a total samples of 390,077 cases, of these only 33,816 cases were positive or the positive rate was 8.67 %. [6] This higher positive rate might due to the screening processes that have absolutely followed the criteria in selection the cases for conducting such two diagnostic tests. Moreover, the current study has found that malarial diagnostic test by the TBF had a higher positive rate than that of the dipstick.

Total direct cost and total indirect cost: In our study, the total direct cost of the absorbing cost centers using both methods had more value than the total indirect cost of those transient cost centers. This finding is owing to the absorbing cost centers have more personnel and more proportion of working time than that for the transient cost centers. Therefore, the labor cost was higher, leading to a higher total direct cost. Moreover, the total direct cost was directly

changed by the number of personnel and the number of the diagnosed cases which are factors used in calculation of working proportion and costs.

Full cost and unit cost:

Our finding shows that the full cost of malarial active surveillance of the study center in the fiscal year 2002 using the dipstick and the thick blood film methods was mostly a total direct cost (88.75 % for the dipstick and 84.26 for the TBF). This is because the absorbing cost centers had many direct sub-units and the personnel were more than the indirect sub-units and personnel. So, the total direct cost was higher than the total indirect cost. Moreover, the results revealed that costs of malarial active surveillance using those two methods were mostly labor cost. Therefore, the centers which have more personnel will have more full cost because in estimating the labor cost, the number of concerning personnel and timing proportion are used. In malarial active surveillance of that study center, the ratio of labor cost, material cost and investment cost of dipstick were 26.00 : 15.41 : 1; whereas, of the TBF were 18.59 : 4.00 : 1. It can be seen that of those two methods used, most of the costs was labor cost. Thus, to reduce the costs of conducting this surveillance, the administrators should consider the labor cost. These may be done by reducing the number of workers per time, continuous training of the personnel to get more experience and more expertise in interpreting the results of the diagnostic tests accurately and timely. These affect the time used in the diagnostic tests and the efficiency of malarial detection, to finally reduce the full cost as less as possible.

Cost – effectiveness:

In the current study, the use of the thick blood film method had higher cost-effectiveness than that of the dipstick. The ratio of the cost-effectiveness was 816.89 baht. This means that the cost of TBF in detecting malarial cases was 816.89 baht per sample, whereas that of the dipstick was 1,475.92 baht.

Sensitivity analysis of cost –effectiveness:

Our results found that even the prevalence of malarial infections had changed to either increasing or decreasing, the TBF was more sensitive to the cost-effectiveness in every changed situation. However, when the prevalence of infection was high, the sensitivity of the cost-effectiveness of both methods moved toward each other. It means that if anyone resides in malarial high risk areas, such as, districts with high movement of foreign labors along the borders, having many hiding illegal workers, where they have proper ecology for breeding of the vectors and anti-malarial drug resistance, the use of dipsticks in conducting case finding is more appropriate, even it has lower positive rate compared to the TBF. This is because every positive case detected by the dipstick has more chance to be promptly treated and recovered with shorter duration of illness, suffering time, severity, and density and life cycle of the causative agents. They are less likely to be further spread because such agents were destroyed. Thus, in case of the limited resources, the use of dipsticks in malarial active case finding, the criteria for its using must be strictly and appropriately settled in order to achieve the highest benefit and cost-effectiveness.

In conclusion, our finding noted that the TBF had higher cost-effectiveness than that of the dipstick method. At the moment, Thailand itself cannot produce

dipsticks it has to be imported from overseas with high cost and consequently creating imbalance of trade deficit. Therefore, strict and appropriate criteria for the use of dipsticks in malarial active case finding must be established. Concerned personnel should be trained to prioritize and understand the necessary of the screening. Moreover, public relation should also be performed to targeted populations to increase their understanding of the differences between the two diagnostic methods.

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