



## CHAPTER 5

### DISCUSSION

Malaria vector control meets several problems. For example, *Anopheles* mosquito became resistant to DDT, and some *Anopheles* species have phenomenon of exophily and exophagy. Therefore, there is a the need for seeking an appropriate vector control measure. Permethrin treated bednet measure has shown a good effectiveness in preventing malaria disease, but until now there was no cost analysis of impregnated bednets in Vietnam. Malaria National Control Program with limited budget need information on the cost of this measure in different regions before using it in large scale. This study showed that Permethrin impregnated bednets program was more cost- effectiveness, cost - benefit in *some places* of coastal and forest regions.

#### *5.1 Effectiveness of Two Measures*

##### *5.1.1 Malaria Disease*

From the results, Permethrin treated bednets was found to be more effective in preventing malaria disease in some places in both Long An and Song Be provinces (Thong Nhat, Nghia Trung communes). The number of patients avoided from malaria disease in treated bednets are more than that in untreated bednets in both Long An and Song Be provinces (Thong Nhat, Nghia Trung communes).

Due to the fact that *An.dirus*, a main vector in the forest region, mainly feed outdoor, therefore Permethrin treated bednets only have good result in the forest area on condition that local people have the high rate of sleeping under bednets (90-100%), and the main occupation of the people in that area does not require to work outdoor at active of mosquitoes.

The study results of ThoSon, DakNhau communes (Song Be) showed that Permethrin treated bednet measure was less effective and the rate of disease in Permethrin treated bednet group did not decrease significantly comparing untreated bednets group. The reason may be large proportion of ethnic minority in these communes. The level of knowledge of these people was often low. They did not know much about how to prevent malaria. So the proportion of sleeping under bednets reached only 60% even they had bednets, but they did not use it. In an earlier study, we had zero effectiveness of the impregnation program when less than 40% of the population slept under impregnated nets

Besides, another study was conducted in Phu Rieng rubber company (Song Be). In this company, the worker must work outdoor at active time of mosquito, so

Permethrin treated bednets measure showed less effective and the rate of disease in Permethrin treated bednet group did not decrease significantly comparing untreated bednet group.

Permethrin treated bednet was effective in preventing malaria disease in Thong Nhat, Nghia Trung communes (Song Be province) because these two communes satisfied two conditions mentioned above (the sleeping habit under bednets is higher, and the main occupation of the people there is farmer who does not need to work outside at the active time of mosquitoes. The farmer often go to bed early at 8-9 PM and wake up at 5- 6 PM)

The number of patients avoided from malaria disease in Permethrin treated bednet group was significant higher than that in untreated bednet group with  $P < 0.01$ . The rate of children patient avoided from malaria disease was higher than that of adult group: 82.65% versus 72.8% in treated bednet group, 11.53% versus 14.24% in untreated bednet group (Long An) and 81.73% versus 72.23% in treated bednet group, 23.96% versus 9.79% in untreated bednet group (Song Be). This can be explained that the children were protected better than adult in the bednets. The children often go to bed earlier and wake up later than adults who sometimes are outside the bednets at active time of mosquitoes. It shows that the effectiveness of Permethrin treated bednet is strictly related to the biting time of the mosquito and the time people go to bed and wake up.

One more important thing is that after one year of using treated bednets, there was a change in parasite structure. The infective rate of *Plasmodium falciparum* (P.f) decreased in treated bednet group in both these places. For Long An province the rate of P.f was 43.58% before intervention, but after intervention, the rate of P.f is only 39.62%. In SongBe province (Thong Nhat, Nghia Trung communes), the rate of P.f before and after intervention was 81.7% and 59.3 %, respectively. The change in parasite structure is significant, because *Plasmodium falciparum* is resistant to some drugs and often cause severe illness and death.

But the rate of malaria disease in untreated bednet group in Long An and Song Be decreased a little too. This may be due to there was too many factors that affected malaria situation in Vietnam in recent years such as more urbanization, reduction in forest area, high living standard. In the past years, houses in the malaria area were mostly made of leaves. They create good conditions for mosquitoes to rest indoor and mosquitoes can contact human easily. But now due to increased income of local people, many houses were constructed by bricks, their houses become more bright ..., and it made some disadvantages for mosquito to rest and the knowledge of people in malaria areas are better, they know how and have more conditions to protect themselves. Besides, in recent years the Ministry of Health has emphasized to invest more for primary health services, so the quality of health services is better, they can detect disease earlier and give exact treatment.

### 5.1.2 Vector Indicator

In treated bednet group, there was a reduction in main vector density by indoor and outdoor human bait in both Long An (Tan Tap and Long Huu Dong) and Song Be (Thong Nhat and Nghia Trung) because Permethrin can kill mosquitoes and also has repellent characteristics. A reduction in Anopheles density will make the transmission of malaria decreased and so does the risk of getting new malaria case. But from above results, we also found that the density of Anopheles decreased but still present at low level. It means that Permethrin treated bednet cannot cut absolutely the transmission of disease and we understand that no measure can cut absolutely the presence of mosquitoes. Therefore to get a better improvement in malaria situation, we should prevent mosquito from feeding (using Permethrin treated bednet) and eliminate the malaria parasite in human together( see Figure 1.1)

Some Anopheles species like *An.sundaicus*, *An.minimus*, particularly *An.dirus* have a phenomenon of exophagy, so in case of people who must work outdoor in active time of mosquito especially in the forest area (*An.dirus*), this measure show less effective. If people only sleep outdoor but bring treated bednets with them and sleep in bednets, this measure still has a good result. This is an important point concerning impregnated measure because DDT cannot protect people as they sleep outdoor.

In addition, to ensure the success of Permethrin treated bednet measure, the first important thing is that the main vector in that areas must be sensitive to Permethrin. By using Bio-assays in Long An, Song Be provinces, the results showed that the main Anopheles species in Long An, Song Be provinces are still sensitive to Permethrin (Bioassay tests are presented in Appendix 7). The second important thing is that the densities of main Anopheles species are higher at the time people go to bed. By using outdoor and indoor human bait from 6 PM to 6 AM, it showed that the densities of *An.sundaicus*, *An.subpictus* (Long An province), and *An.dirus*, *An.minimus* (Song Be province) are highest from 9 PM to 3 AM.

## 5.2 Cost

### *Provider Cost*

The capital cost occupied small proportion as compared with recurrent cost (The capital cost in Long An and Song Be provinces was 7.4% and 6.37 %, respectively).The capital cost is low in this measure because no building or some complicated equipments are required just simple things like plastic bowls, buckets. Additionally, bednets can be treated with insecticide anywhere such as in the yard, garden...

### *Recurrent Cost*

The cost of treating bednets in Long An and Song Be provinces was 69.09% and 62.8%, respectively).With Permethrin impregnated bednets measure, although at first, the provider must pay the cost of treating bednets, but later the total provider cost was lower in treated bednets group in both Long An, Song Be provinces due to

more people protected by the measure from malaria and therefore some money can be saved from treatment of disease.

Of the cost of treating bednet, nearly 85% was cost of Permethrin in both Long An and Song Be provinces (84.79% in Long An province and 84.8% in Song Be province). Permethrin accounted for high proportion in treating bednet because the technique and the equipment required for this measure are very simple. These equipments are very cheap and the people can treat bednets on their own after they are introduced.

#### *Patient Cost*

The income loss due to illness occupied 34.08 %- 45.82% in both groups in Long An and Song Be provinces (34.08 %-35.92% in treated bednets group and 44.61%- 45.82% in untreated bednets group)

On this point, we have different opinions. Bonilla de Catro (1985) found in a area of Colombia that the work of ill member was virtually always taken over by non salary family members who continued the patient's activities. Mill (1989) also found that over 70% of households did not think household production would suffer as a result of malaria episode. On the other hand, the same data set suggested malaria may continue to reduce work time even after the patients felt completely recovered (Picard and Mill 1990). Amongst Gezira tenants in the Sudan, 62% of the loss of work hours due to malaria was compensated by family members, primarily women and children, though at the expense of household activities and schooling (Nur and Mahran, 1988).

### **5.3 Cost – Effectiveness and Cost - Benefit Analyses of Two Measures in Preventing Malaria Disease**

#### *5.3.1 Cost - Effectiveness Analysis*

**Effectiveness :** The clinical impact of this study was measured in term of malaria cases avoided

**Cost** was determined in the year 1994

**Cost - effectiveness analysis (CEA)**

The study in Long An (Tan Tap and Long Huu Dong communes) and Song Be (Thong Nhat and Nghia Trung communes) showed that Permethrin treated bednets measure was more cost - effectiveness than untreated bednet measure.

The cost - effectiveness ratio is lower in both provider and patient side in Permethrin treated bednet group comparing untreated bednets group in both Long An (Tan Tap and Long Huu Dong communes) and Song Be (Thong Nhat and Nghia Trung communes)

### 5.3.2 Cost - Benefit Analysis

When using Permethrin treated bednets measure, the benefit is higher than the cost of treating bednets: B/C was 6.48 and 7.7 in Long An (TanTap, Long HuuDong communes) and in Song Be (Thong Nhat, Nghia Trung communes), respectively.

The B/C in Song Be was higher than that in Long An province because the malaria rate in Song Be was higher. Therefore, more people can be protected from malaria disease in SongBe province than Long An province.

Besides, in order to get better calculation of benefit - cost, malaria episodes should be included instead of number of people affected, but due to the fact that there was no analysis of malaria cases by episodes in the record, we have to base on a study by Pirom Kamol Ratanakul and Chusak Prasittisuk (1988) to do assumptions. In the study of the benefit of Permethrin treated bednets against malaria for migrant workers in Eastern Thailand, the authors found that during 35 weeks of observation, 23 subjects with malaria in treated bednets group and 33 subjects with malaria in untreated bednets group developed 28 and 51 episodes of malaria, respectively. The migrants workers in Pirom Kamol Ratanakul's study were considered semi-immune for malaria meanwhile in our study local people who lived in malarious area got higher immunity. Therefore, the number of malaria episodes developed in Long An and Song Be provinces should be lower a compared with migrant worker groups. So, we have the number of malaria episodes in two provinces as follows :

In Long An province, 106 subjects with malaria in treated bednets group and 295 subjects with malaria in untreated bednets group developed 116 (*Plasmodium falciparum* 47, *Plasmodium vivax* 69) and 383 episodes of malaria (*Plasmodium falciparum* 157, *Plasmodium vivax* 226), respectively. In children group, 17 subjects with malaria in treated bednets group and 69 subjects with malaria in untreated bednets group developed 18 (*Plasmodium falciparum* 7, *Plasmodium vivax* 11) and 89 episodes of malaria (*Plasmodium falciparum* 37, *Plasmodium vivax* 52), respectively. In treated bednet group, episodes per person-time was 92/1000 person-year or 1.7/ 1000 person-week. In untreated bednet group, episodes per person-time was 285/1000person-year or 5.4/ 1000 person-week

In Song Be province, 123 subjects with malaria in treated bednet group and 350 subjects with malaria in untreated bednet group developed 147 (*Plasmodium falciparum* 87, *Plasmodium vivax* 60) and 455 episodes of malaria (*Plasmodium falciparum* 360, *Plasmodium vivax* 95), respectively. In children group, 21 subjects with malaria in treated bednet group and 92 subjects with malaria in untreated bednet group developed 24 (*Plasmodium falciparum* 14, *Plasmodium vivax* 10) and 119 episodes of malaria (*Plasmodium falciparum* 95, *Plasmodium vivax* 24), respectively. In treated bednet group, episodes per person time was 117/1000 person-year or 2.26/1000 person-week. In untreated bednet group, episodes per person-time was 341/1000 person-year or 6.57/1000 person -week

Base on number of episodod obtained to calculate the B/C ratio, we get the results of B/C ratios : 9.09 (in Long An province) and 10.58 (in Song Be

province). The benefit of Permethrin treated bednets measure when including the number of malaria episodes was higher than that in case of only the number of people affected mentioned.