CHAPTER 2

LITERATURE REVIEW

Malaria is still the most important parasitic disease in the world, but now the malaria control becomes more difficult due to the increasing resistance of vector to insecticides, and of parasite to drugs, while resources invested for malaria are scare, therefore the choices should be made. In recent years, most countries in the world have selected Permethrin treated bednets as their program's main form of vector control.

2.1 Effectiveness of Permethrin Impregnated Nets

Many studies on the effect of using Permethrin treated bednets on malaria disease as well as vector in different countries in the world have been done. Treated bednets with different dosages of Permethrin have been studied. A trial in Solomon Islands with Permethrin 0.5 g/m^2 showed 71% reduction in the vector-biting density over a one year period and the parasite rate in children under 10 years old dropped from 33% to 10%. And in a study in one isolated village in Malaita province, the crude parasite rate was 67%, of which 35% were *Plasmodium falciparum*, the parasite rate had dropped to zero 9 months after treament, and the density of *Anopheles koliensis* was also zero as comparing 27 per man-hour before treatment. The nets were highly effective against these relatively endophilic species where the more exophagic did not(WHO,1989).

In another study, Axel Kroeger (1991) tried to find out the effectiveness of Permethrin treated bednets in different regions. This study was conducted with Permethrin and Lambdacyhalothrin over a period of 9 months in each of 5 endemic malarious areas of Ecuador, Peruand Colombia. The effectiveness of the bednets, measured as a reduction of malaria incidence in intervention communities as against control communities, the results showed that Permethrin treated bednets measure made mortality, morbidity and disability decreased but they also showed large variation between and within the study areas. The protective efficacy ranged between 0% and 70% when looking only at the post- intervention differences between intervention and control groups.

More than 20 studies have been done in areas where malaria is endemic, including more than 12 in Africa. The results showed a reduction by 20-63% (median 45%) in malaria rate following introduction of treated nets (WHO,1996).

The effectiveness of Permethrin treated bednet measure on children group was emphasized. The study in children aged 6 months to 5 years in rural Gambia showed that sleeping under impregnated bednets was associated with overall reduction in mortality of about 60% in children aged 1-4 years. Episodes of fever associated with

malaria parasitaemia were reduced by 45% among children who slept under impregnated nets (Alonso, P.L.1987).

The effectiveness of Permethrin treated bednets on children groups changed according to different areas also. Four large scale were initiated in different ecological and socio-economic setting in Africa. The results showed a reduction in deaths among children under 5 years of age. All cause mortality was reduced by 25% in a country-wide program in the Gambia, by 33% in coastal Kenya and by 17% in Northern Ghana (Jacqueline Cattani,1997).

Carvnevale, P.(1988) analyzed the effectiveness of Permethrin treated bednets measure on mosquito. The results showed that this measure made the density of mosquito decreased and the sporozoite decreased also, particularly in species of mosquito that rest indoor.

Bozhao, X.U. (1994) conducted a study on the effectiveness of pyrethroid (labdacyhalothrin) treated bednets on differrent kinds of bednets in coastal Chiapas, Mexico. The results showed that bioassay mortality rates of *An.albimanus* exposed to treated nets for 3-5 min, rose from 40-55% to 90-100% for nylon nets 3-19 weeks after treatment, but were lower for treated cotton nets. Mortality rates of *An.albimanus* females existing overnight (22-6 hours) ranged 15-39% in houses with treated cotton and 16-46% with treated nylon nets, very significantly greater than control mean rates of 6-8% mortality with untreated nets.

2.2 Cost of Permethrin Treated Bednets

Many studies on the cost of Permethrin treated bednets have also been done. Those studies showed that the cost change widely. It depends on the life of nets and different countries have different reports on the durability of the nets. The price of nets varies according to conditions they are manufactured, domestic or imported from other countries. Besides, the cost of nets and the price for treating bednets can be influenced by tranportation to different areas, by the time requirement for re-treating in different malaria transmission pattern, and by the labor cost.

Brinkmann,U.(1995) studied changes in different countries in terms of various costs of insecticide bednet impregnation. (Table 2.1)

Table 2.1 Cost and Durability of Impregnated Bednets in Various Countries

Cost Item / Countries	Cost of nets (US$)	Cost of Impregnat - ion (US$/year)	Cost/household (US$ /year)	Frequency of Impregnation (times/year)	Durability of net (year)
Burundi	4.5 -6.0	0.5		1	
Cameroon (rural)	72.0	1.44	6.40		
Cameroon (Douala)	23.1				
Cameroon (Douala)	13.2-15.2	2.00			
Cameroon (Yaounde)	22.4-23.2		9.40-13.60		
China	3.0	0.10	3.66		3
Ethiopia	4.5 -6.0	0.60		2	
Gambia	9.0-10.5	0.30	6.00-10.00		6
Kenya	4.5 -6.0	0.30		2	
Malawi	14.9		2.98		3
Rwanda	4.5 -6.0	1.20		1.3	
Solomon Islands	1.35-2.71		9.85		5
Tanzania	15.0	0.25-0.40		6	
Thailand	3.5	0.83		1	1.3
Ugada	4.50-6.0	1.20		2	
Zaire	5.00		8.1		

Source : Bulletin World Health Organization (1995)

2.3 Cost - Effectiveness of Permethrin Treated Bednets and Untreated Bednets

Moses Kweku Aikins (1996) conducted a study on cost - effectiveness in Gambia in order to compare the costs and consequences of Permethrin treated bednets from the viewpoint of provider and community comparing the cost and consequences of the situation without treated bednets.

The *provider cos*ts are divided *capital and recurrent cost.* The main components of recurrent costs are insecticide, personnel, office supplies, services, transportation, and cost of treatment. The capital costs are vehicles, building, office equipments, furniture, equipment for impregnation.

On the *community* side, the *recurrent cost* are water, detergent, dipper's time, the cost of taking care of sick patients, the income loss due to looking after patients. The *capital cost* are plastic bowls, buckets. *Recurrent cost* in this study were valued at the rate of payment during this period: For example, personnel was valued at the rate at which salaries were paid, insecticide was valued at the rate at which it was imported with the official exchange rate at that time. Time loss was valued as an appropriate proportion of gross salaries. The value of dipper's time was based on the estimated farm work fee per hour. *Cost of capital* items were annualized over their expected useful life at a discount rate. Both cost and consequence were presented in term of total costs and consequences for the intervention and no impregnation. Further analyses consider the resources saved, as well as a range of cost - effectiveness ratios (cost per healthy life year gained, cost per child-year protected, cost per capita, cost per impregnated bednet) and net cost - effectiveness ratio. (These last ratios were calculated by subtracting the resources saved from the total implementation cost divided by the number of cases or death averted)

The result of this study showed that the capital cost took up 13%, the remaining 87% was recurrent cost; insecticide accounted for 69% of recurrent cost. The estimated number of deaths averted was 40.56. The net implementation cost - effectiveness ratio per death averted and discounted life years gained were US$ 471 and US$ 31.5, respectively.

Kamol - Ratanakul, P. (1998) carried out a study on cost - effectiveness, cost - benefit was conducted to compare the effectiveness of Permethrin treated bednets with that of untreated nets in migrant workers in Eastern Thailand. In this study, the experimental group received Permethrin treated bednets with a dosage of 0.5 g/m^2, while the control group received untreated bednets. In this study, the cost was divided to direct, indirect cost and assigned to provider, and worker. Direct cost consist of bednets, costs of impregnation of nets, cost of field services, costs of treatment for positive cases at malaria clinic. Indirect cost includes cost of absence from work. As calculating the effectiveness, the author mentioned the number of workers with malaria and number of malaria episodes also. The result showed that Permethrin treated bednet measure was more cost - effectiveness than untreated bednets. Net saving of using a treated net was US$ 1.17/worker in perspective of Malaria Division and US$ 1.61/worker in perspective of the migrant worker (Kamol Ratanakul, P.1988).