WORLD HEALTH ORGANIZATION
ORGANISATION MONDIALE DE LA SANTÉ

REGIONAL OFFICE FOR THE WESTERN PACIFIC
BUREAU REGIONAL DU PACIFIQUE OCCIDENTAL

Lecture Notes No. 50
7 December 1987

THE CURRENT STATUS OF COMMUNITY PERSONAL PROTECTION MEASURES IN THE WESTERN PACIFIC REGION[1]

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1. INTRODUCTION

The programme on disease vector control promotes the operational use of innovative, cost-effective vector control measures that can be used at the community level within the framework of primary health care. Health education and other community motivation mechanisms are used to overcome obstacles in achieving widespread use of simple environmental measures to prevent the breeding of dengue haemorrhagic fever and subperiodic bancroftian filariasis vectors. Personal protection measures, such as insecticide-impregnated mosquito nets, curtains and screens, are promoted in countries where malaria and Japanese encephalitis remain public health problems. Countries are encouraged to maintain preparedness against outbreaks of arboviral diseases and prevent the spread of vector insects and rodents in international travel.

2. PROBLEMS

Some common problems encountered in the programme are:

(1) Slow progress in improving housing, sanitation and socio-economic conditions in many endemic areas.

(2) Shortage of medical entomologists, public health inspectors and auxillary staff to carry out specific vector control tasks.

(3) Non-involvement of communities in controlling vectors.

(4) Ineffective health education programmes and the inability to disseminate information on technical matters which leads to effective community participation.

(5) Absence of effective legislation to obtain compliance of householders in controlling vectors.

(6) Non-involvement and lack of knowledge of non-governmental organizations in promoting community vector control activities.

(7) Lack of spray equipment and insecticides to combat epidemics.

(8) Lack of communication among quarantine personnel in sharing surveillance data in the reporting of diseases and vector introductions.

(9) Insufficient commitment in developing appropriate technology and new vector control measures suitable for community use.

3. EFFORTS TO OVERCOME PROBLEMS

Programme efforts dealing with the above problems have included:

(1) Identifying in precise, clear and simple terms the exact tasks required of individuals to control vectors.

(2) Disseminating above information to various categories of staff at national and intercountry training courses and workshops.

(3) Providing technical advisory visits and consultant services to promote multisectoral approaches to extend vector control coverage.

(4) Implementing large scale projects on new community approaches to control malaria and other vectors, using insecticide-impregnated mosquito nets and other innovative measures.

(5) Promoting emergency preparedness against arboviral outbreaks, involving surveillance, maintenance and storage of spray equipment.

(6) Disseminating guidelines, manuals, pamphlets, slides and other visual aids to facilitate country activities in health education and legislation.

(7) Seeking extrabudgetary funds from UNDP, Japan Government and other sources to support programme activities.

(8) Encouraging exchanges of information among quarantine staff through meetings, overseas visits and correspondence.

(9) Promoting operational research proposals on simple, innovative, cost-effective vector control measures.

4. PERSONAL PROTECTION MEASURES

4.1 Permethrin-impregnated mosquito nets and curtains

A community approach to the control of malaria vectors is being developed in practically all nine malarious countries of the Region, based on the use of mosquito nets impregnated with the pyrethroid insecticides, permethrin or deltamethrin. Mosquito densities and parasite rates have been reduced in small-scale projects where thepopulation under protection was less than 1500 persons.

A significant finding was a reduction in malaria incidence from 1.87% to 0.15% in Sichuan, China. In a highly endemic area in Sabah, Malaysia, the number of persons with positive blood films was reduced from 46.3% to 10.9%. Near Madang, Papua New Guinea, a noticeable reduction in malaria occurred only in the age group 1-4 years. These small-scale projects do not provide all the desired information, and the killing of mosquitos coming to bite or rest on treated nets would probably be of greater benefit to the community

if the projects covered a larger area. Large-scale projects involving at least 5000 persons are accordingly being planned against malaria vectors in the Lao People's Democratic Republic, Papua New Guinea and Viet Nam, and also against filariasis vectors in Samoa. About 25,000 mosquito nets and 200 litres of permethrin were recently sent to the Solomon Islands for malaria vector control.

The Solomon Islands malaria control programme have carried out small-scale trials with permethrin-treated mosquito nets, which is now being gradually expanded into –large-scale control operations. Approximately 25,000 nets will be treated beginning October 1987 in Eastern Province (Santa Cruz), Central Province (Florida Islands), and Malaita Province (northern and southern districts). Treated nets are also being used in Guadalcanal and Temotu Provinces. The promising preliminary net trials which commenced in 1986 provided a basis for expanding net usage to the present large-scale undertaking. For example, about 400 nylon mosquito nets were treated with permethrin at 0.5 g/m^2 in September 1986 and distributed to numerous small villages in the plain area of Guadalcanal Province. Female Anopheles farauti were released each month into the nets for a 15-minute period. Practically 100% of these mosquitos died up to 10 months after treatment. There also was a 71% reduction in vector biting density over a one-year period, and the parasite rate in children under 10 years of age dropped from 33% to 10%. Mass drug administration also was carried out for a 12-week period beginning in March 1987. Population movement probably accounted for achieving only a modest level of malaria control.

In December 1986, 140 treated nets were distributed to 45 houses in Belemanu village in the northern area of Malaita Province. The village was isolated and had a crude parasite rate of 67%, of which 35% were Plasmodium falciparum. In September 1987, nine months after treatment, the parasite rate for P. Falciparum was zero, and the density of A. Punctulatus and A. Koliensis was also zero as compared to 28 per manhour before treatment. The nets were highly effective against these endophilic species where A. Farauti did not occur. Mass drug administration also was carried out for a 12-week period commencing March 1987. The parasite rate would have been expected to rise again in absence of net treatment. The zero parasite rate observed for P. Falciparum could not have been obtained without the net treatments of other equally effective vector control measure.

Recently, it was observed that deltamethrin formulations irritated the skin and eyes of participants during mosquito net treatment and distribution in a workshop in Papua New Guinea. Adequate precautions need to be taken when this material is used. This mainly involves wearing gloves and immediate washing after net treatment. This shortcoming does not occur with suitable formulations of permethrin which is the insecticide of choice for the treatment of mosquito nets.

Mosquito net usage has been common in some urban areas experiencing dengue haemorrhagic fever outbreaks. Some indo-China countries are considering permethrin treatments for mosquito nets and curtains as a means of controlling Aedes aegyptis. This approach could have a very good chance of achieving some success if the net is left open during the day.

Also, impregnated with-mesh netting covers could be used to kill vectors entering water jars to lay eggs.

It should be noted that a cheap source of good-quality mosquito nets are available in the Philippines and Thailand. Nets have been exported to many countries at a cost of about US$1.75 per net. However, about 50% need to be added for air or shipping costs.

4.2 Permethrin/deet soap

The soap is produced by a company in Australia and contains 20% deet and 0.5% permethrin. Government malaria staff in some Indo-China countries have expressed great interest in using the soap to protect temporary workers in forest areas. They are exposed to the bites of Anopheles dirus (= balabacensis) and drug-resistant strains of Plasmodium falciparum.

Studies in Malaysia, Solomon Islands and Samoa indicate one application can provide about 6 hours o protection. One 20 gram bar, at a cost of 30 US cents, could protect one person for about one month, if the soap is used sparingly on the arms, lower legs and other exposed areas.

In Solomon Islands in January 1986, a permethrin/deet repellent soap was applied to the lower legs of 3 groups of collectors, 2 persons per group. The soap was applied once before the all-night mosquito collections began. The soap was not rinsed but left to dry on the skin. All mosquitos (A. Farauti) were collected only from below the knee. A general observation was that negligible numbers of mosquitos were found on the upper parts of the body. Since the initial all-night catch greatly reduced mosquito biting, a catch was carried out on the second night to determine residual effectiveness. The results were as follows:

	First Night		
Treatment	No. Per man night	No. Per man hour	24-hour %mortality
0.5% permethrin + 20% deet	8.5	0.71	23.5
1.0% permethrin + 20% deet	4	0.3	12.5
Control	137	11.4	12.5
	Second Night		
0.5 % permethrin + 20% deet	93	7.8	28.4
1.0% permethrin + 20% deet	50.5	4.2	22.8
Control	147	12.2	7.0

These results show that the repellent soap provided 12 hours of good protection from mosquito bites. The .5% permethrin deet mixture reduced biting by 94% and the 1.0% mixture by 97%. Appreciable mortality and residual activity were not readily apparent.

In Samoa, in October and November 1985, the repellent soap containing 0.5% permethrin and 20% deet routinely provided 6 hours of protection from the bites of Aedes polynesiensis and Aedes samoanus. The soap was applied for 17 consecutive days to 4 infants, 4 children and 5 adults. The soap was normally applied as a thin layer of suds and washed off. The soap was allowed to dry on some persons to observe any skin reactions which might have occurred before the soap was rinsed 8 hour later. The soap was applied to the arms, legs and face. Some slight skin irritation was observed in 3 infants, one 5 years old and one 18 years old. This test did not answer the question as to whether a build-up of permethrin occurred on the outside body surface to kill mosquitos that came to feed during the intervals when deet was not repelling. Based on the observations in Papua New Guinea and Solomon Islands, it is most likely that an unknown percentage of mosquitos were indeed killed during attempted feeding activity.

In Malaysia, a published report has shown that the permethrin/deet soap mixture repelled mosquitos for 4 hours after application. Additional tests are now in progress in Malaysia to obtain more information on repellency and also mortality using permethrin insecticidal soap without deet.

It is envisaged that in future trials with the permethrin insecticidal soap, an isolated population in a holo-endemic Indo-China village would use the soap in an attempt to control malaria mosquitos and malaria. For each 10-day period, the soap would be used for 3 days and withdrawn for one week. It would be interesting to determine residual effect after this one month cycle has been completed. Preliminary data on vector mortality and residual effect should be obtained in small scale tests before a village trial.

Malaria control staff in Indo-China countries also have expressed an interest in using the repellent soap to protect temporary migrant workers who travel to and from the plains to the forest. Such workers live in temporary shelters and are exposed to A. Dirus (=balabacensis) and drug resistant strains of P. Falciparum. Ideally, impregnated mosquito nets also would be used in combination with the repellent soap.

4.3 Permethrin insecticidal soap

Protocols have been developed for experimental use of the 1.5% permethrin soap in Indo-China and Solomon Islands. Small isolated villages have been identified where malaria problem is quite severe. In addition, laboratory and small-scale tests are being conducted in Malaysia, Solomon Islands and Papua new Guinea. The evidence is quite clear that mosquitos can be killed after feeding or contacting the skin or hair of persons using the soap.

Use of permethrin soap to kill anopheline mosquitos

a) Papua New Guinea tests

The following has been extracted from a report the writer prepared on a visit to Papua New Guinea in May 1987.

This village is located 5 km south of Madang near Umium village. The permethrin soap samples, which contained 1.5% permethrin, were obtained from Mr T. Simmons in Australia. The workshop participants and WHO staff were divided into 7 groups and given instructions on how to use the soap during a four-day period from 4 to 7 May 1987. The soap was briefly used in the laboratory in the morning and late afternoon and spread over the lower legs. Some were requested to rinse the soap off, while others left a dry film on the skin surface. About 24 participants and 4 WHO staff participated in this exercise.

The demonstration of a killing effect of the soap to mosquitos could have important implications in further developing a primary health care approach in reducing the risk of malaria transmission under village conditions. If one could achieve a short period of mortality at about two weeks intervals, the vectorial capacity of malaria vectors could be reduced. Under practical conditions, it is not envisaged that the soap would be used on a daily basis throughout the year but perhaps for 2 or 3 days about every two weeks only during the periods of peak malaria transmission.

Participants and WHO staff exposed to the soap carried out a night collection in Ord village from 6:15 to 8:15 pm on 7May 1987. The permethrin residue on the body did not repel mosquitos and many anophelines were attracted to the collectors. It was found that about 90% of the malaria vectors died within several hours after collection. However, high mortality also was observed in the control group, who probably were contaminated with permethrin and deltamethrin from the previous workshop exercises. Also, rough handling of the mosquitos in transferring them from collecting tubes to plastic cups was another possible factor contributing to high mortality.

There was however considerable evidence that the permethrin soap quickly killed many of the biting anopheline vectors. Some Culex specimens appeared to die during the process of feeding and it was difficult to remove them with the sucking tubes used for collection. The proboscis appeared to be stuck and the paralyzed or intoxicated females made no effort to fly when disturbed. The natural feeding position of a Culex mosquito places it in closer contact with the body surface than an Anopheles. One unfed, dead Armigeres mosquito was found entangled in leg hair, which undoubtedly contained a permethrin residue. Many culicine as well as anopheline specimens were immediately knocked down after being placed in the collection cups. Further tests need to be made to obtain more information on these promising results. A total of 292 female anopheline vectors were collected during this workshop exercise.

These workshop results however have to be interpreted with caution because many of the mosquitos from the control group also had died when detailed mortality counts were

recorded the following morning. They did not however, as mentioned above, die quickly like those from the soap treatments. Also, under the best of conditions, there is a likelihood of high mortality (20%) occurring within 24 hours after mosquitos are dislodged and collected from the body during the process of feeding or before feeding actually takes place. This is an area of entomological assessment in which more field data are needed.

Additional tests need to be conducted that do not depend upon collecting living (or dying) mosquitos off the body. For example, a person with permethrin on the body could be exposed in a large net that allow mosquitos to enter but not exit. Dead mosquitos could be collected from a white sheet on the ground, and living mosquitos from the net surface. This type of test could help confirm that mosquitos can be killed by feeding on persons using permethrin soap. Also, more information is needed on the method and frequency of use. If one uses the soap for 3 days, how long is she or he toxic to mosquitos? The ultimate goal is to proceed with a large-scale test under village conditions to access the effect of the soap in controlling malaria.

b) Solomon Islands tests

Preliminary trials with the permethrin soap also have been carried out in the Solomon Islands by the WHO entomologist stationed there. In July 1986, a 1.5 % permethrin soap was applied to the legs of 3 groups of collectors, 2 persons per group. One group rinsed, one did not rinse, and the last group was a control. Human bait collections were carried out from 6:30 to 8:30 p.m. in the Lungga area of Honiara, and the soap was applied shortly before the collecting period began. Mosquitos collected off the body were held for an additional 24 hours to determine % mortality. All the mosquitos collected were A. Farauti and the results were as follows:

Treatment	Females per manhour	24-hour % mortality
Non-rinse	7.5	90.7%
Rinse	11.1	41.3%
Control	9.3	16.6%

These results were similar to the observations in Papua New Guinea where it was found that about 90% of the anophelines coming to bite persons using the soap were killed. Some slight repellancy may have occurred when the soap was applied immediately before the collecting period began.

4.4. Mosquito Coils

Studies on mosquito coil effectiveness have been supported in Malaysia, Viet Nam and Papua New Guinea. Million of dollars are spent for coils in the Western Pacific Region. The pyrethroid coils reduce vector biting activity.

Support has been provided to the national programme in Viet Nam by providing pynamin for mosquito coil use. The “coil” sticks (joss sticks) are soaked in pynamin, dried and then burned inside houses to kill dengue vectors at times of outbreaks.

5. CONCLUSIONS

Health for all cannot be achieved without control of vectorborne diseases. Malaria and dengue haemorrhagic fever are the two most important vectorborne diseases in this Region. Identifying vector control activities that communities can carry out at a cost they can afford is given strong emphasis in the programme. This approach must rely upon primary health care activities involving training, health education and motivation of the community, involving sectors other than disease vector control.

Operational research proposals are required from scientists in the Region on innovative, cost-effective vector control measures that can be used within the framework of primary health care. In general, there has been a lack of research funds for desired development of this activity. A new study being promoted involves the methodology and application of temphos-impregnated coconut husks to breeding sites to control mosquito larvae.