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REGIONAL OFFICE FOR THE WESTERN PACIFIC
BUREAU REGIONAL DU PACIFIQUE OCCIDENTAL

MISSION REPORT

Subject	:	Strengthening PacELF country capacities for vector control
Place(s) visited	:	Fiji
Dates of mission	:	28 August-19 September 2004
Author(s) and designation	:	Dr Thomas R. Burkot WHO Consultant
Name of focus	:	Malaria, Vectorborne and Other Parasitic Diseases
Participating agencies	:	Government of Fiji World Health Organization
Source of funds	:	Extrabudgetary (Japan/WPR)

Key words

Elephantiasis, Filarial - drug therapy, transmission, prevention and control / Filariasis / Pacific Islands / Vector-borne diseases / Wuchereria bancrofti

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WORLD HEALTH ORGANIZATION
REGIONAL OFFICE FOR THE WESTERN PACIFIC

MISSION REPORT EXECUTIVE SUMMARY

Dr Thomas R. Burkot Author(s)	Fiji Place(s) visited	28 August-19 September 2004 Dates of mission
MR/2004/0554 Report series number	WP/ICP/MVP/1.2/002/XZ/04 Project identifier	01.02.01.SC.02 Activity code

Objectives of mission:

In collaboration with the national authorities in Fiji:

(1) to develop the strategic plan for a PacELF vector-control programme and future programme proposals; and
(2) to provide technical support to produce documents and publications on entomology for PacELF.

Summary of activities, findings, conclusions and recommendations:

The Pacific Programme to Eliminate Lymphatic Filariasis (PacELF) has two goals. The first is to interrupt transmission by 2010 by administering five annual mass drug administrations (MDAs) of combination therapy with diethylcarbamazine (DEC) and albendazole (ALB). The second goal is to alleviate the suffering associated with pathology due to infection with Wuchereria bancrofti. By the end of 2004, five (Samoa, French Polynesia, Niue, Vanuatu and Cook Islands) of the 16 endemic PacELF countries and territories will have completed five rounds of MDA. In order to prevent the re-emergence of lymphatic filariasis by residual pockets of infection or by reintroduction by migrants, it will be necessary to develop other strategies to suppress transmission.

One component of a filariasis-suppression strategy should be mosquito control. The particular mosquito-control strategy to be employed should be based on the biology of the known vectors in a country. In order to have an effective vector-control programme for filariasis, it will be necessary to develop country capacities in vector surveillance and control. At the present time, some Pacific island countries and areas (PICAs) have mosquito-control programmes in place for malaria and/or dengue. The vectors of filariasis in the Pacific are often dengue (Aedes polynesiensis) or malaria (Anopheles farauti complex) vectors. Therefore, integration of filariasis control with these established programmes will be both a logical and recommended approach. The goal of the work presented in this report is to support countries in implementing cost-effective vector-control strategies based on the known biology of the vectors.

Recommendations include the following:

(1) The elimination of lymphatic filariasis using MDA should continue. The authorities should strive to achieve and maintain 100% coverage of their eligible population with directly observed treatment. Coverage should be verified by sample surveys conducted by independent bodies.
(2) Countries, in collaboration with WHO and PacELF, should study the feasibility of DEC-fortified salt. This should be done by gathering information on local regulations, sources of salt, salt usage and cost implications of this alternative strategy in endemic countries.
(3) A network of vectorborne-disease-control experts should be identified. Mechanisms should be established to increase the capacity of countries to conduct vector-control activities. These should include vector identification, knowledge of biology and control strategies and their evaluation.
(4) A regional training workshop should be held to cover mosquito surveys, mosquito identification and control.
(5) Operational research should be conducted on the effectiveness of vector-control measures. This should include source reduction for Aedes (crab-hole and domestic-container breeding), use of impregnated materials for mosquito control, and the impact of vector control on LF infection.
(6) Social/behavioural studies should be undertaken and results incorporated into updated health communications as part of the country LF-elimination programme.

Key words : Elephantiasis, Filarial - drug therapy, transmission, prevention and control / Filariasis / Pacific Islands / Vector-borne diseases / Wuchereria bancrofti

1. PURPOSE OF MISSION

The writer visited Fiji from 28 August to 19 September 2004 with the following terms of reference:

In collaboration with the national authorities in Fiji:

(1) to develop the strategic plan for a PacELF vector-control programme and future programme proposals; and

(2) to provide technical support to produce documents and publications on entomology for PacELF.

2. BACKGROUND

The Pacific Programme to Eliminate Lymphatic Filariasis (PacELF) has two goals:

(1) to stop the transmission of lymphatic filariasis (LF) in the 22 Pacific island countries and areas (PICAs); and .

(2) to alleviate the pain and suffering caused by *Wuchereria bancrofti* by the year 2010.

Transmission interruption is based on five annual rounds of mass drug administration (MDA) of diethylcarbamazine (DEC) and albendazole (ALB). In 2003, Samoa completed five MDA rounds. Vanuatu, Niue, French Polynesia and Cook Islands will finish their fifth MDAs by the end of 2004.

Many of the PacELF countries are nearing the completion of their MDA programmes. Therefore the focus of PacELF has shifted to morbidity assessment and control, together with final prevalence and transmission assessments. Cessation of MDA programmes will require filariasis-suppression activities to be integrated into other programmes. These will include malaria, dengue and helminth-control programmes. A major issue to be addressed is what other measures may be needed both to eliminate transmission and to prevent the reintroduction of LF.

3. ACTIVITIES AND FINDINGS

3.1 Activities

3.1.1 Sixth Annual PacELF Meeting and evolution of the Pacific Regional Vector-Control programme

mosquitos that transmit filariasis differ in where their larvae live, how far the adults fly, as well as when, where and on what animals they will feed.

These characteristics of mosquito biology were then related to different control techniques to show why some control measures are effective for only some mosquito species. It was stressed that there were no proved control methods for all species of mosquitos. It was stated that some control measures worked well in certain areas, but perhaps not in others, if the biology of the mosquito differed in different geographic areas. Mosquito control has been very important in the elimination of filariasis in Solomon Islands, Australia, Japan and parts of Papua New Guinea. However, MDA will remain the most important tool for filariasis elimination in the Pacific. If everyone takes DEC and ALB every year, then mosquito control may only be needed in selected areas.

This information was presented to the PacELF country representatives via a 40-slide Powerpoint presentation, a copy of which was delivered to the PacELF home office.

3.1.1.3 Entomology practical on mosquito identification

Working with Dr Jeffrey Hii during the mosquito-identification practical, country managers learnt some of the key characters used to identify the major genera of mosquitos that can transmit filariasis and dengue. Mounted slides of *Aedes*, *Ochlerotatus* and *Culex* were examined. The participants learnt to differentiate between *Aedes aegypti* and *Aedes albopictus*, important dengue vectors, and *Aedes polynesiensis*, the most important vector of LF in Polynesia (also a dengue vector).

The technical skills needed for mosquito identification were introduced to the participants. In addition, during the demonstration, country managers asked specific questions about mosquito-control options appropriate to their PICA.

3.1.2 Strategic plan for PacELF Vector-Control programme and future programme proposals

The *PacELF handbook* and *PacMAN* book had included country-specific vector-control plans. Following on from these, a brief survey was undertaken to ascertain the present state of vector-control strategies, policies and capacities in the PacELF PICAs.

A questionnaire was distributed via e-mail to the PacELF country managers on entomological expertise and resources available to undertake mosquito control in PacELF countries. Nine of the PacELF PICAs responded to the survey. Seventy-eight per cent of responding PICAs said that routine mosquito-control measures were practised, with 67% of PICAs having undertaken larval surveys. The most commonly practised control measure was larval source reduction (67% of PICAs). Twenty-two per cent of the PICAs said that routine mosquito control involved one or more of the following strategies: insecticide spraying, draining breeding sites, oil application on breeding sites, use of bednets, and health communication through IEC materials. One country also reported aerial spraying. During malaria or dengue outbreaks, control measures included source reduction in five countries, truck-mounted insecticide spraying in four PICAs, and perifocal spraying in three PICAs. IEC messages were cited as part of the outbreak response in four countries. A total of 58 Ministry of Health personnel in the nine PICAs had received some training in mosquito biology and control. Two countries said that no one in their country had any vector-control training. A further two PICAs had only two trained individuals. Four out of nine PICAs had no backpack insecticide sprayers; a fifth PICA had only a single sprayer. One-third of the responding PICAs said they had truck-mounted sprayers (range: 1-3 sprayers per country). Permethrin/pyrethroid insecticides were the

4. Information sheets were produced on the following for the PacELF website:

   - filariasis vectors of the Pacific;
   - *Anopheles farauti* ;
   - *Aedes polynesiensis;*
   - *Culex quinquefasciatus;* and
   - *Ochlerotatus vigilax.*

5. Applications to the Peace Corps were made for volunteers to assist the Fiji LF Elimination Programme and the PacELF home office, with responsibilities to include assisting in the evaluation of vector control.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Some Pacific island countries and areas currently have mosquito-control programmes in place for malaria and/or dengue. Filariasis vectors are often the same species. Therefore, the integration of filariasis control with these established programmes is a logical approach.

4.2 Recommendations

(1) The elimination of lymphatic filariasis using MDA should continue. The authorities should strive to achieve and maintain 100% coverage of their eligible population with directly observed treatment. Coverage should be verified by sample surveys conducted by independent bodies.

(2) Countries, in collaboration with WHO and PacELF, should study the feasibility of DEC-fortified salt. This should be done by gathering information on local regulations, sources of salt, salt usage and cost implications of this alternative strategy in endemic countries.

(3) A network of vectorborne-disease-control experts should be identified. Mechanisms should be established to increase the capacity of countries to conduct vector-control activities. These should include vector identification, knowledge of biology and control strategies and their evaluation.

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(5) Operational research should be conducted on the effectiveness of vector-control measures. This should include source reduction for *Aedes* (crab-hole and domestic-container breeding), use of impregnated materials for mosquito control, and the impact of vector control on LF infection.

(6) Social/behavioural studies should be undertaken and results incorporated into updated health communications as part of the national LF-elimination programme.

ANNEX 1

KEY CONTACTS

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Dr Kazuyo Ichimori,	PacELF Team Leader, Suva, Fiji

ANNEX 2

ABBREVIATIONS

ALB	Albendazole
C	*Culex*
CD	Compact disk
CDC	Centers for Disease Control and Prevention
DEC	Diethylcarbamazine
DOT	Directl observed treatment
GSK	Glaxosmithkline
ICT	Immunochromatographic test
IEC	Information, education and communication
ITN	Insecticide treated bed net
JICA	Japan International Cooperation Agency
JOVC	Japanese Overseas Volunteer Cooperation
km	Kilometer
LF	Lymphatic filariasis
LLIN	Long-lasting impregnated bed nets
MDA	Mass drug administration
O	*Ochlerotatus*
PacCARE	Pacific Coordinating and Review Group
PacELF	Pacific Programme for the Elimination of Lymphatic Filariasis
PacMAN	Pacific Monitoring and Analysis Network
PNG	Papua New Guinea
PICA	Pacific island country or area
W	*Wuchereria*
WHO	World Health Organization

ANNEX 3

DETAILS FOR CARRYING OUT VECTOR CONTROL ACTIVITIES FOR FILARIASIS TRANSMISSION SUPPRESSION

SOURCE REDUCTION

One of the recommended strategies for reducing the transmission of filariasis (and dengue) vectors that lay their eggs in containers is to remove, destroy or make such containers unsuitable as places for mosquitos to lay their eggs. This is known as source reduction. Source reduction can be important for limiting filariasis transmission by *Aedes* and some *Culex* mosquitos. In theory, this strategy is both logical and straightforward. In practice source reduction can be difficult to accomplish, as it requires a number of different people to work together with communities to change people's behaviour. Source reduction requires identifying which types of containers are used by mosquitos for breeding, understanding why people have those types of containers and then making those containers unsuitable for mosquito breeding (either by removing the containers from households, protecting them from exposure to water or making them unsuitable for holding water).

Steps in the development of behavioural changes in individuals and communities to reduce larval breeding sites may have the following steps (Gary Clark, CDC, in press):

1. Identify the container types that produce the most adult mosquitos. To accomplish the step, a survey to find the containers with mosquito pupae must be undertake: containers with pupae must be found and counted, the number of pupae inside the containers must be counted and the adult mosquitos that emerge from them must be identified.

2. Determine why the containers producing most of the mosquitos are present. We need to determine the function and role of containers that produce a lot of mosquitos. Do people want and use these containers or is it that they just have not bothered to have them removed or destroyed.

3. Develop with the community solutions based on formative research. If the containers are of value to the owners, how can the owners keep and use the containers in a way that they will not produce mosquitos? This will require

Annex 3

When working in villages, please

- observe local customs (e.g. removal of shoes before entering houses)
- respect places of worship and shrine rooms
- respect the privacy of householders
- give any assistance you can to the villagers (e.g. provide advice on mosquito control and personal protection measures).
- do not make excessive noise or create disturbances
- do not enter properties without permission
- enter a bedroom unless the occupants are awake and dressed
- do not ask for personal favours or food (you may accept food only when it is given voluntarily)
- do not break anything.

Collecting mosquito larvae and pupae

The larvae and pupae of *Aedes* and *Culex* mosquitos that transmit filariasis may be found in water in man-made (e.g., domestic) containers or in rot holes in trees, in discarded coconuts, in leaf axils or in crab holes. During a survey we want to find where mosquitos are breeding. It is important to record the type and location of containers where mosquitos were found together with the number of pupae in the container and the species of mosquito found in the container.

Equipment needed for a larval/pupal survey should include:

- 5-10 ml pipette or medicine dropper
- Gravy needle or turkey baster (large pipette with squeeze bulb that holds 50-100 ml)
- White dipper

them into a white pan for collection. Individual larvae and pupae can then be sucked into a small pipette for transferring to a container to carry back to a laboratory for identification.

Small Containers

Water in receptacles can be emptied into a white tray. The larvae are collected with a pipette.

Discarded motor car tyres can be difficult from which to collect mosquitos. A small net or a large 30 ml pipette or gravy needle is needed to remove the water into a white pan so that immature can be seen and transferred the container that will be used to hold them in the laboratory.

Water in rot holes in trees can surveyed by siphoning or pipetting the water out of the tree hole with a 30 ml pipette/gravy needle. It may be necessary to add water to the tree holes to flush out larvae in the debris at the bottom of the hole.

Larvae that breed in the water collected by leaf axils can be removed using a pipet. When there is little water in the leaf axil, water may be added in order to enable any larvae in the leaf axil to be drawn up into the pipet.

Larvae and pupae in crab holes can be pumped out with a long hose attached to a pump. Some crab holes are more than a meter deep and may contain multiple chambers. It is impossible to know if all the chambers have been sampled.

Killing mosquitos

It is preferable not to kill immature mosquito stages in the field, however if you are not returning to the laboratory for a lengthy period it may be safer to transfer the larvae to 80% alcohol which will kill and preserve them. The preferred method of killing larvae in the laboratory is to transfer larvae to a container of water at approximately 60°C – boiling water may destroy much of the characters needed to identify larvae.

Adult mosquitos that have emerged from pupae collected in the field should be removed from the container using an aspirator and transferred to another container. Adults can then be frozen to kill them before identifying.

them or have them removed to a landfill. If the container is of value, the community and the environmental health officers must find ways that the container can be used in such a way that the container will not serve as a breeding site.

The community must be educated to understand that containers will breed mosquitos if not protected from the rain or other sources of water; however, the container can still be used, but in such a way that it will not support mosquito breeding.

INSECTICIDE TREATED BED NETS AND CURTAINS

Types of treated materials

Bed nets or mosquito nets are commonly used to protect people from night-time biting mosquitos (such as *Culex* or *Anopheles*). The Roll Back Malaria campaigns feature the use of bed nets to protect mosquitos from the *Anopheles* mosquitos that transmit malaria. Recently, it was discovered that if nets were treated with permethrin insecticides, then mosquitos would be killed by landing on the net while attempting to feed on the people sleeping inside. As importantly, it was discovered that the insecticide-treated nets would repel mosquitos. Studies in Africa have shown that if enough people use insecticide-treated nets, then not only would the people sleeping under the treated net be protected, but that other people in the house and even in neighbouring houses would be bitten less often by mosquitos.

More recently new insecticide-treated nets were developed. Unlike the first insecticide treated nets that lose their ability to kill mosquitos after they were washed, these new nets can be washed and will not lose their insecticide. The traditional bed nets treated with permethrin required retreatment with insecticide every 6-12 months to maintain their ability to kill or repel mosquitos. The new type of nets are known as long-lasting insecticide treated nets (LLINs). These nets will continue to kill or repel mosquitos without retreatment for 5-7 years. There are two basic kinds of these LLINs: the Olyset and the PermaNet. The differences between the two is the type of materials from which they are constructed, the insecticides with which they are treated and how they must be handled after washing in order to maintain the insecticidal properties of the nets. The PermaNets can be washed, dried and then hung in the house. In order for the Olyset net to regenerate its insecticidal properties after washing, the net must be "reactivated". This means that the damp net, after washing, Spraying operations are generally carried out in teams of at least 5 individuals (4 spray-men and a team leader). It is the responsibility of the team leader to talk to homeowners about the reasons for the operation and to explain the safety measures which the householders should follow (e.g., removal of food from the house, occupants to remain outside the house for the recommended period following spraying, etc). The team leader should maintain the records about household coverage and direct the individual spray-men. Generally for wall spraying, one spray-man should be able to treat 6-10 houses per day. Teams carrying out ULV spraying or fogging should be capable of treating a larger number of houses per day.

REPELLENTS AND COILS

Repellents containing DEET and mosquito coils with permethrin can be effective in preventing mosquito bites. Repellents and mosquito coils are available through many commercial sources. However, repellents and coils have only a short-lived effect and so are not felt to be cost-effective for routine mosquito control. During dengue or malaria outbreaks, however, their use should be encouraged as one option to prevent transmission of these diseases. For long-term suppression of filariasis transmission, control of mosquito breeding sites and the use of insecticide treated materials (nets and curtains) should provide more effective control.

ANNEX 4

RESEARCH PROPOSAL TO THE FIJI MINISTRY OF HEALTH TO EVALUATE LLINS ON *AEDES POLYNESIENSIS* AND *AEDES AEGYPTI*

Proposal: The Effectiveness of Long-Lasting Impregnated Materials on *Aedes polynesiensis* and *Aedes aegypti*

Hypothesis:

Insecticide treated bed nets have been shown to be highly effective in suppressing the transmission of malaria and filaria by anopheline mosquitos. We hypothesize that the repellent and insecticidal properties of long lasting insecticide impregnated bed nets and curtains will be effective in reducing the house entering and human feeding habits of the daytime biting vectors of lymphatic filarisis and dengue in Fiji.

<u>Objectives:</u>

Our objectives are:

1. To investigate the potential of long-lasting insecticide treated materials (LLIMs) in the form of bed nets and curtains to suppress the transmission of lymphatic filariasis and dengue

   Impacts will be measured in the mosquito population by

   a. Measuring the impact of these materials on house entering behaviour using resting collections and
   b. Oviposition indoors
   c. Filariasis infection rates in mosquitos

   Impact on transmission of lymphatic filariasis will be accessed by

   a. Immunochromatographic test (ICT) kits
   b. Serologic assays

2. To determine the acceptability of LLIMs to village populations through KAP surveys

BACKGROUND

Lymphatic filariasis (LF) and dengue are the two most important vector borne diseases in Fiji. LF in Fiji is caused by subperiodic *Wuchereria bancrofti* with circulating microfilariae (Mf) densities being greatest during the day. Fiji is home to the PacELF, the Pacific Programme for the Elimination of Lymphatic Filariasis, Home Office. The two

Annex 4

We propose to evaluate the effectiveness of LLIMs in reducing the potential for filariasis and dengue transmission in Fiji. Materials to be tested will be bed nets and curtains constructed from long-lasting impregnated materials.

PROPOSED STUDY DESIGN

The study design will be based on a cluster-randomized trial model. Each site will consist of approximately 500 households and all schools located in the study area, with some houses and schools in each site randomly allocated to receive the intervention and others randomly allocated to act as temporary controls. At the termination of the study, all control houses and schools will receive LLIMs. The study area will be a coastal area where *Aedes polynesisensis* is the primary vector of LF.

Meetings with the village chiefs and stakeholders will be held to inform them of the study and the potential benefits and risks to their community. Only upon receiving their consent to participate in the study will villages be enrolled.

Villages will be assigned randomly to one of the following two groups:

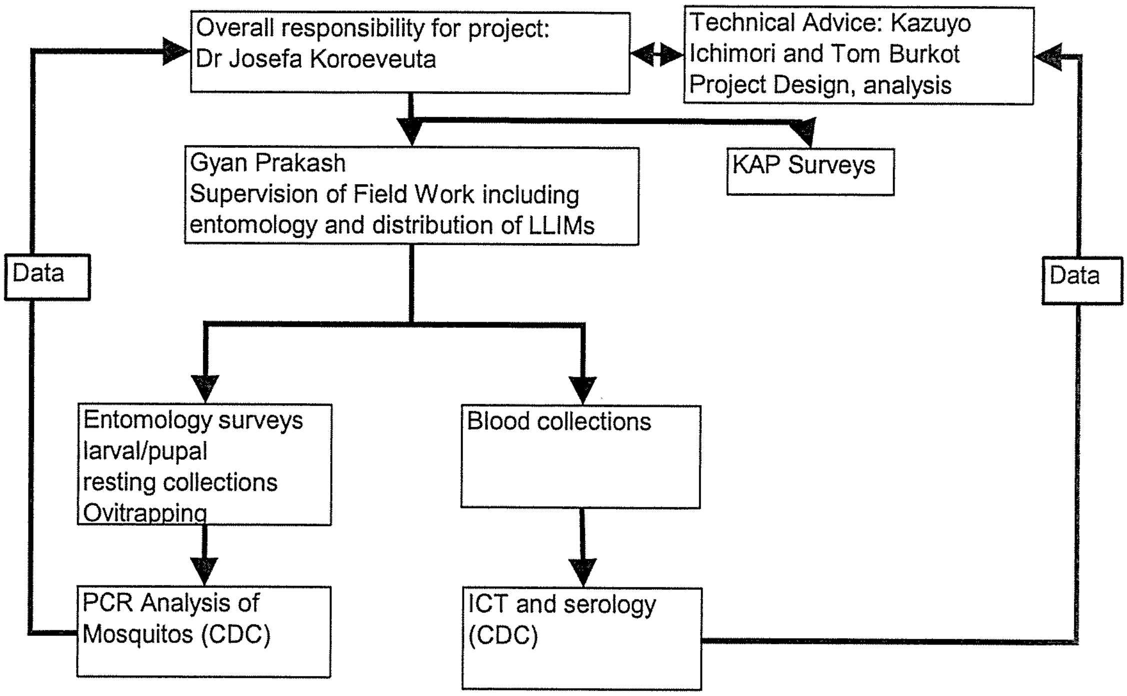
1. The intervention: houses provided with window curtain material made of PermaNet fabric and PermaNet bed nets
2. Houses to act as control

Houses selected for the intervention will be provided with one PermaNet bed net for each adult inhabitant as well as 10 m of PermaNet fabric per house for use as curtains. Control houses will receive equal numbers of PermaNet bed nets and curtain material at the conclusion of the experiment.

A workshop on mosquito survey and identification techniques will be held prior to the beginning of the study. The impact of LLIMs will be accessed on both the mosquito and the human populations.

During the baseline period, vector populations will be accessed through larval and pupal container surveys, ovitrapping and indoor resting collections. The treatments will be implemented and the entomological parameters assessed at 2 weeks, 4 months and 12 months

Flow Chart of Work Responsibilities



Budget:
Supplies:

5,000 meters of PermaNet fabric for curtains	(Vestergaard to provide)
2000 PermaNet Bed Nets	(Vestergaard to provide).
ICT tests: 8000	(PacELF to provide)
Reagent for PCR	(CDC to perform analysis)
Mosquito larval survey kits (n=4)	
Pumps for crab holes	
Aspirators	
Torches	
Curtain ties	
Containers for holding mosquitos	

Travel

Operational costs

Fuel

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