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EMERGENCY CONTROL OF AEDES-BORNE EPIDEMICS AND A REGIONAL PLAN OF ACTION FOR *AEDES ALBOPICTUS*

A Workshop Jointly Sponsored
by PAHO/WHO and USAID/VBC

May 11-15, 1987

CE-021

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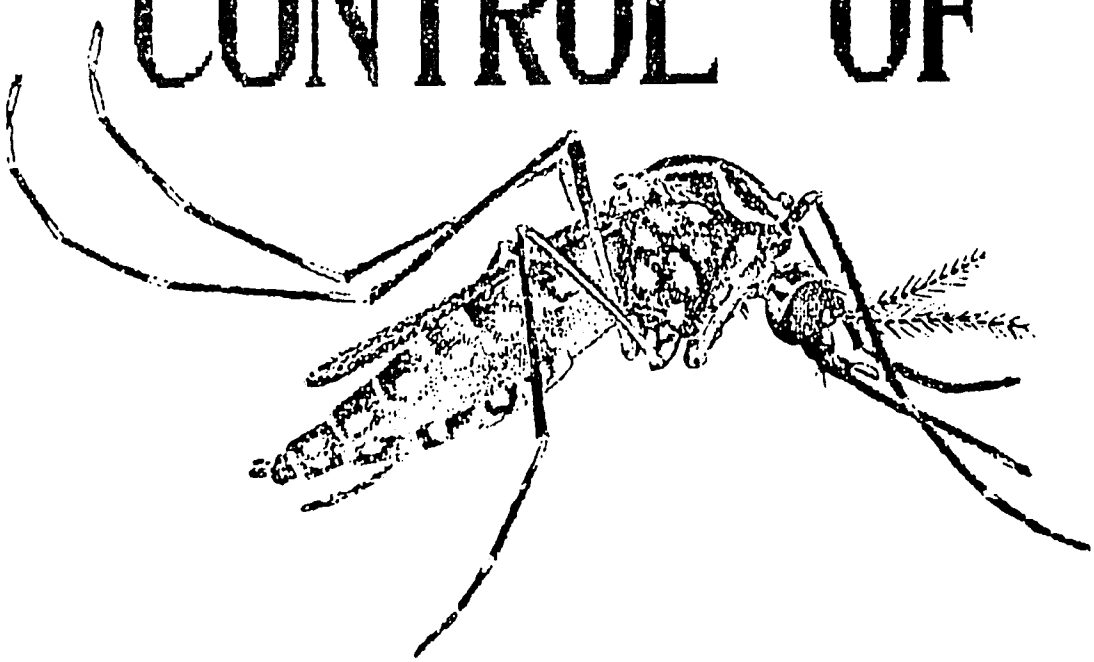

AEDES-BORNE EPIDEMICS

WORKSHOP
BARBADOS
11-15 MAY 1987

REPORT ON THE EMERGENCY CONTROL OF AEDES-BORNE EPIDEMICS AND THE

REGIONAL PLAN OF ACTION FOR AEDES ALBOPICTUS WORKSHOP

(JOINTLY SPONSORED BY PAHO/WHO AND USAID/VBC)
BRIDGETOWN, BARBADOS

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REPORT ON THE EMERGENCY CONTROL OF AEDES-BORNE EPIDEMICS AND THE REGIONAL PLAN OF ACTION FOR AEDES ALBOPICTUS WORKSHOP

(JOINTLY SPONSORED BY PAHO/WHO AND USAID/VBC)

BRIDGETOWN, BARBADOS

(11-15 MAY 1987)

I INTRODUCTION:

The workshop on the Emergency Control of Aedes-borne epidemics and the regional Plan of Action for Aedes albopictus was held in Bridgetown, Barbados, during the period of 11-15 May 1987. This activity, with its venue at the Caribbee Beach Hotel, Hastings, Barbados was jointly sponsored by USAID/VBC and PAHO/WHO

OBJECTIVES:

In light of the current dengue situation in the Caribbean, with three of four dengue serotypes, actively circulating in a number of countries, notably, Puerto Rico. In addition, with the advent of the more serious form of the disease being manifested there, with bleeding and shock, and in view of the basic inadequacies found in most country programs in terms of their capacity to deal with Aedes-borne epidemics. This workshop, was therefore organized to assist the countries in becoming better prepared for any contingency involving a dengue outbreak.

The basic purpose of the workshop was to provide: 1) the necessary information on the current status of Aedes (Stegomyia) species, including the distribution of both Aedes aegypti and Ae. albopictus; and 2) data on the prevalence of dengue, dengue hemorrhagic fever and dengue shock syndrome in the Caribbean. This was done to enable the various country representatives, to draft a national plan of action for the emergency control of Aedes-borne diseases.

In the Addendum is a list of 44 participants and resource persons who registered during the morning of the first day. Fourteen other individuals, sat in on the proceedings as observers from Ministry of Health, Public Health Service, and the Aedes aegypti Eradication Program, representing the countries five public health districts.

Of the 28 country representatives invited, 24 attended the workshop. Those countries absent included Haiti, Belize, Bermuda and French Guyana. Guyana and Trinidad and Tobogo were represented by PAHO/WHO Advisors. Among the participant present were, medical officers of health, directors of institutes, entomologists and senior

public health officers.

The workshop was enhanced by the presence of 13 resource persons, including six professionals from the PAHO/WHO secretariat (WDC, Barbados, Panama, Guyana and Trinidad), three from USAID or USAID/VBC (Washington, D.C., and Barbados), and three from CDC (Puerto Rico and Fort Collins, Colorado).

II SPONSORS:

The workshop was supported principally through two organizations, i.e., PAHO/WHO (Bridgetown and Washington, D.C.) and USAID/VBC (Virginia and Bridgetown). USAID/VBC Consultants, provided the grant which covered tickets and perdiem for all country representatives, as well as some of the conference related expenses at the venue.

The PAHO/WHO, Office of the Caribbean Program Coordinator, rendered technical support, and was the chief organizer of the workshop, providing all aspects of a logistical nature, made local conference arrangements, and provided secretarial, duplication (photocopy) and transportation, and administrative assistance. In addition, PAHO/WHO country funds were made available for representation from Guyana.

The host country's Ministry of Health, fully assisted in the opening and closing ceremonies, had liaison with the news, TV and radio media, permitted senior level public health officials to attend the complete workshop activities, provide transportation for one of the evening social activities. In addition, the local organizing committee was chaired by the Chief Public Health Inspector, Bridgetown.

III PROGRAM ORGANIZATION:

The Addendum also contains the amended version of the program, which basically reflects some minor changes, from that originally presented.

Formal opening and closing ceremonies were held at the venue, with official representations from the Ministry of Health, and the Caribbean Program Coordination Office, Bridgetown, and USAID, Bridgetown. The radio, TV and newspaper media were present during the opening ceremony, and adequate coverage resulted.

Formal presentations were given by the various resource persons, and from the respective country representatives present. Audio/visual equipment used, included the overhead transparency projector, 35 mm slide projector and VHS video equipment.

Each half day session had a chairperson and a rapporteur, who were responsible for summary reports covering the presentations made during their respective sessions. The final report for the workshop was the responsibility of the PAHO/WHO, Caribbean Program office.

The local organizing committee prepared, through the cooperation of several sources, a number of after hour social amenities, which provided the participants with exposure to a number of the host country's tourist attractions.

Six commercial exhibitors set up displays of their products, and equipment in a conference room located adjacent to the hotel's lobby, where during break time, and before and after workshop sessions, the participant could view various products which were applicable to the theme of emergency control of Aedes-borne disease.

A questionnaire was used on the final day to enable the participants to evaluate the workshop in terms of its overall objectives.

IV SESSION REPORTS:

From the eight sessions reports, general summaries, and tables were made to reduce the volume of the report. The summaries are presented in the order of their appearance in the program, i.e., In addition, this report includes abstracts of some reports, when available, as submitted by the resource individuals.

TOPICS:

The workshop topics were divided into four sections as follows:

1) The Aedes Program Country Reports
2) Components Necessary in Emergency Control
3) The Aedes albopictus Plan of Action and
4) The Development of Country Plans of Action for the Emergency Control of Aedes-borne Diseases.

SESSION SUMMARIES:

1. The Aedes Program Country Reports:

Twenty-six reports were presented by the individual country representatives, primarily addressing the following questions: 1) What is the present Aedes House Index; 2) Does the Aedes aegypti Eradication/Vector/Pest Control Program have adequate - staffing, insecticide, equipment, supplies, vehicles/transportation; 3) Has insecticide resistance been reported?, 4) Is there an active health education component; 5) Any dengue reported during the period of

1986/76; 6) Has Ae. albopictus surveillance commenced; and 7) Does the program have a biological control component?

Table 1 is an overview of the reports presented by each of the country representatives, in addition three country reports were given by PAHO/WHO advisor who were familiar with the country programs, in cases where no country representative were present or had not yet arrived during the sessions of the first day, i.e., Guyana, Trinidad and Tobago, and Grenada. The table was prepared from the rapporteurs summaries.

In reference to Tobago, it was reported that the sister island to Trinidad has been reinfested by Ae. aegypti, and the vector mosquito has not yet been eradicated. Grand Cayman Island has had eight reinfestations in the past two years, but each time, the mosquito has been successfully eliminated.

In summary, 14 (53.8%) of the countries indicated that their present staff strength was insufficient to meet the needs of their respective vector control programs. Fifteen (57.7%) countries stated that they felt they had sufficient or adequate stocks of insecticides (basically malathion and temephos) to meet the routine needs of their programs. Sixty-five percent (17 countries) stated that they had inadequate equipment (insecticidal and otherwise), and a similar number voiced concern for insufficient supplies.

Fourteen countries (53.8%) felt that their present transportation pool needed to be upgraded. Eight countries (30.7%) reported on some form of insecticide resistance, while another seven countries (26.9%) queried resistance in populations of Ae. aegypti.

Half of the countries reported having some form of health education program, related to vector control.

Six countries (23.1%) indicated that they had confirmed cases of dengue. Puerto Rico had an extensive outbreak of dengue types 1,2 and 4 during 1986, with an estimated 100,000 -200,000 cases, with confirmed case of dengue hemorrhagic fever (DHF) and/or dengue shock syndrome (DSS) with deaths. The epidemic continued into 1987. An additional 23/1% (six countries had unconfirmed/suspect dengue cases.

Some 17 countries (65.4%) have commenced some form of Ae. albopictus surveillance and monitoring, and only one country, Barbados, reported intercepting the Asian dengue vector, in the form of one first instar larva, reared to the 4th stage for identification, from a used tire shipment, received in January 1987, from Japan.

Nine countries (34.6%) reported that they were using larvivorous fish, as an alternative biological control measure, in their efforts to use integrated control in their respective programs.

TYPE OF ORGANIZATION STRUCTURE:

Presentations were made by Barbados and the PAHO/WHO Technical Advisors to Trinidad and Tobago on the type of organization structures which exist in the Aedes aegypti Eradication Programs of those two country program. The organization structure in the Barbados context had been changed from a strictly vertical program, to a horizontal one, which resulted in a lowering of the Aedes indices, but the length of the cycle increased, and the importance of constant monitoring recognized.

Trinidad's Program, which is the largest in the eastern Caribbean, is one of a horizontal nature, with both national and city council type operations. The program has still not achieved its goal of eradication of the dengue vector due principally to inadequate supervision in the field.

PLAN OF ACTION - AEDES AEGYPTI:

An overview was presented by the PAHO/WHO Entomologist from Panama of the PAHO document, Plan of Action - Aedes aegypti[1], with a historical review of campaigns aimed at eradication of the vector species, successes and failures, and the accounts of reinfestations, resulting now in only six countries in the region being free of the dengue vector, i.e., Chili, Uruguay, Argentina, Caymans, Costa Rica and Bermuda. Dengue epidemics have occurred in almost all of the countries formerly eradicated, due to the concept of eradication being modified to control programs only. Much of the reason for reinfestation is related to financial, political and technical constraints, in each country.

A more practical approach is needed in vector control, which can reduce vector populations (Ae. aegypti populations) to such minimal levels, that disease transmission is not possible. This conceivably can be accomplished by maximizing available resources, and by the identification of areas of greatest risk, and treating/controlling such areas with priority.

It was mentioned that the document is in its third draft, with moderate changes in phases of control terminology, i.e., subdividing the "Attack Phase" into early and late attack phases. The document places emphasis upon vigilance, surveillance and monitoring and the reduction of Ae. aegypti house densities to less than 1%. In addition it advocates the use of other indices indicators like, container, potential container, Breteau, adult landing and resting rates, ovitrap indices, etc.

[1]Each participant and resource person was given a copy of this document, which has been produced by PAHO/WHO, Division of HPD/HPT, Washington, D.C., which is a draft (PLANACC.AEG 09/May/87).

Additional suggestions arising from this presentation concerned the importance of using appropriate program stratification, identifying containers of greatest importance, enhancing health education to give emphasis to source reduction, the importance of community participation in vector control, having flexibility to use difference vector control approaches to suit different problems, and the need to link vector control with disease surveillance.

2. Components Necessary in Emergency Control:

Presentations were made concerning experiences which four countries (Jamaica, Cuba, Aruba and Puerto Rico) have had in dealing with emergency control measures during a dengue, DHF/DSS epidemics.

DENGUE EPIDEMIC REPORTS:

During this session, various reports were given on emergency control measures which have been experienced by several countries within the Caribbean within the past decade.

JAMAICA:

The Jamaican dengue type 1 (D-1) epidemic of 1977, is documented in a PAHO/WHO publication, entitled, "Dengue in the Caribbean, 1977", publication no. 375, published in 1979. Basic conclusions of this presentation were that the both ground and aerial ULV spraying with malathion were effective in reducing dengue transmission by Ae. aegypti in the Kingston area, but that the epidemic in rural areas had already peaked before control measures were instituted. A public health education campaign played a significant role in the success of the control measures, with information being disseminated via radio, TV and newspapers.

CUBA:

The Cuban dengue type 2, epidemic with DHF/DSS manifestations of 1981 is well documented, and has been thoroughly studied (344,203 cases and 158 deaths). The epidemic was brought under control as a result of a large scale ground and aerial ULV spraying, vehicle mounted aerosol generators applications and health education program. As a result the Ae. aegypti house index, in one year went from 10.0 to 0.01. The cost of the campaign was estimated to approximate 40 million US dollars.

ARUBA:

The Aruba outbreak of D-1 (November 1984-March 1985) affected an estimated 24,000 persons, out of a population of 70,000, with two deaths. The economic loss approximated three million guilders (1.6 million US dollars). Vector control measures included ground level

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ULV spraying and thermal fogging of the entire island, on one occasion and twice in high risk urban, resort and port areas, and focal and perifocal treatment at each suspect dengue foci.

PUERTO RICO:

The presentation on dengue in Puerto Rico, was given by the Head of the Dengue Laboratory, CDC, in which it was indicated that there have been repeated epidemics of dengue over the past ten years in Puerto Rico, each costing approximately US $25 million, and now totally over US $150 million. The 1986 epidemic involved three dengue serotypes, i.e., D-1, D-2, and D-4, with 10,659 reported cases (the probable number of cases may be as high as 200,000), and 129 hospitalized confirmed cases. The DHF attack rate was 29/1,000

Dengue by 1985 in the Caribbean, became hyperendemic endemic, and the sequence of events now unfolding are similar to those witnessed in Southeast Asia in 1950's, prior to the DHF/DSS epidemics which gradually hit every country of that region. Three or more Caribbean countries have now experienced some serious cases of dengue with DHF and or DSS.

The type of approach to dengue surveillance must be an active one, with entomological, virological, epidemiological, serological and clinical components, all working in harmony, and communicating together.

Entomological surveillance must include: identification of vector species present; species association; vector competence; geographical distribution; types of larval habitats; seasonal changes in population densities; and adult mosquito behavioral characteristics.

Virological surveillance must embrace: the monitoring of dengue virus during transmission, as well as, in interepidemic periods; plotting geographical distribution of the viruses; recognition of virus serotypes; and types of illness being manifested.

In conclusion, it was emphasized that the problem of recognizing dengue was related to low surveillance and inadequate reporting systems in the countries of the West Indies. The present strategies for the prevention and control of epidemic dengue and DHF/DSS call for: 1) targeting source reduction against the vector; 2) stressing community involvement and cooperation; 3) having strong vector control campaigns, which are capable of responding quickly with ground and aerial application of insecticides; and 4) having a strong epidemiological surveillance system.

DETECTION AND SURVEILLANCE:

During this presentation by the Senior Medical Officer of Health (Environment), Barbados, seven points were mentioned which needed to be addressed during a dengue outbreak: 1) recognition of cases of varying severity; 2) monitoring of case, to watch for rapid increase in numbers; 3) evaluating spread to new areas; 4) risk of introduction of cases by international travel; 5) risk of social and economic disruption; 6) possible inability of local authorities to deal with epidemic; and 7) public response leading to panic.

The importance of pre-epidemic planning and surveillance was emphasized to help anticipate and alleviate potential problems, should an epidemic develop. Cooperation between physicians, epidemiologists, virus laboratories and the health authorities is vital to detect such potential problems.

CONTINGENCY PLAN FOR A DENGUE EMERGENCY:

A guide[1], useful to the development of a contingency plan was presented for the emergency control of Ae. aegypti, which included the topics such as the selection of an emergency control committee, under whose direction the various phases of vector control activities would be operated. Those phases included: preparatory phase or pre-emergency phase; the alert phase; and the emergency phase. The hand was given to each participant which include important information for the formulation of such a plan, at the country level, which would become part of the country's national health plan.

It was emphasized that the most opportune moment for the solicitation of external assistance, when an outbreak is detected, was at the time of the actual declaration of a vector-borne epidemic, as at the commencement of an emergency.

SIMPLE INDICATORS OF DENGUE RISK:

In studies conducted in Vera Cruz, Mexico, certain indicators of risk relating to whether an individual potentially could experience dengue were reported. Three indicators where determined which identified correlations in the prevalence of dengue: 1) household members having previous dengue experience; 2) number of water storage containers (drums) per dwelling; and 3) number of years individuals resided in same dwelling. Mosquito indices like the Breteau, were not statistically related to these factors, as in some cases a few dwellings (12%) had 75% of all larval positive containers.

[1] This unofficial document was produced in house, by PAHO/WHO advisors at a workshop held in Panama during 1986, consisting of seven (7) pages of suggestions of value for each country to use in developing a POA.

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THE ROLE OF PAHO/WHO IN DISEASE CONTROL (DENGUE):

This presentation emphasized the role of PAHO/WHO in the development of programs for disease control, and specifically the surveillance of dengue. This key features included the enumeration of the basic activities undertaken by the organization, which were sub-headed into: 1) mobilization of resources; 2) dissemination of information; 3) the development of health policies; 4) promotion of research; and 5) direct technical cooperation.

With respect to dengue, parallels were mentioned between the present day situation in the Americas with those of Southeast Asia, and the status of DHF/DSS developing today. PAHO/WHO's contributions include the presence of seven full time entomologists, epidemiological surveillance, coordination of laboratory results, the dispersal of information and training and professional education.

THE ROLE OF CDC:

The role of the San Juan, Center for Diseases Control (CDC) Laboratory, Puerto Rico was discussed, in which an emphasis was placed upon the difference between the conventional approach to surveillance being "reactive", and that preferred by CDC, which is the "active" approach.

The reactive approach basically is the recognition of dengue based upon an increase in transmission rates, when they become apparent (after an inter-epidemic phase). Whereas the active surveillance requires early recognition by the medical community that dengue is an important disease and should be watched for in or during inter-epidemic periods, so that any change in disease transmission can be recognized immediately before an epidemic occurs.

Virus surveillance is the most important method for detecting dengue transmission as it enables viral serotypes, their geographic distribution and types of overt illness to be assessed. The new MAC-ELISA IgM test was described as a very useful tool in surveillance, which test did not depend upon paired samples from suspect dengue cases.

Entomological surveillance is less important in terms of disease prediction, as often indices are high even during inter-epidemic periods, without transmission. However, a knowledge of vector habitats, species distribution is of value.

The CDC, Dengue Laboratory, Puerto Rico, has trained 34 individuals from seven countries, from around the Caribbean since 1986 and is assisting in the upgrading of laboratories in the sub region. The ultimate goal is to create a network of regional surveillance, using standardized diagnostic techniques.

9'

THE ROLE OF CAREC:

The role of the Caribbean Epidemiological Center (CAREC), Port of Spain, Trinidad, with reference to dengue, and its vectors was presented. The center has as its objectives: 1) disease surveillance; 2) diagnostic service (virological, bacteriological, parasitological and entomological in nature); 3) training for surveillance and laboratory procedures; and 4) conducting research.

With reference to dengue specifically, CAREC examines diagnostic specimens, collects and disseminates information and is involved in mosquito taxonomy, and virus isolation from field specimens.

The importance of making adequate collections was stressed, utilizing the air link system with LIAT, the Caribbean airline to bring samples from the countries to CAREC, and the value of feedback to the countries, where the samples originated, was emphasized.

INTERNATIONAL COLLABORATION:

Dengue surveillance at the international level is dependent upon a flow of communication in both directions, therefore it is vital that quality surveillance data be accumulated at the national level and shared at the international level. This allows for the analysis and summary of data from several sources, permitting international trends to be recognized.

In addition, evaluations and results of studies testing new, more cost-effective methodologies in vector control, as carried out by international agencies or in the larger, better equipped countries, must be shared, to allow for rapid adoption, and increased standardization, as a collaborative effort, between countries.

INTEGRATED CONTROL TO PREVENT DENGUE EPIDEMICS:

In this presentation, it was clearly stated that integrated control methods were far more effective than a single method, i.e. insecticide, for preventing or reducing outbreaks of dengue, DHF/DSS.

This becomes especially important, when it is recognized that there is no capacity yet developed to predict dengue outbreaks, so that a knowledge of the characteristics of vector populations, and a country's capability to suppress indices to low levels is the most effectively means today to prevent transmission.

This approach is both ecological as well as one of habitat management, through the correct application of the principle of source reduction. This requires an understanding of breeding habitat, and the methods which can be employed to eliminate them, including solid waste management and good sanitation and hygiene.

Larvicides and adulticides can be effectively and properly used in both inter-epidemic as well as during epidemic periods, however, insecticide resistance continues to be problem and fewer new products are being introduced onto the market.

Biological control, through either fish or predaceous mosquito larvae such as Toxorhynchites can have an impact upon vector populations, but must be used in harmony with other integrated methods, such as insecticides and source reduction.

Enforced legislation, community participation, health education, as well as regular mosquito programs regime, make for an integrated approach which has and will continue to be successful as means for controlling populations of Ae. aegypti, and prevent dengue epidemics.

METHODS FOR EVALUATING ADULTICIDE SPRAYING:

An impromptu presentation was made, with several contributors regarding various methods for evaluating the efficacy of insecticides to reduce adult populations of Ae. aegypti, as either cold mist aerosols, or thermal fog applications. Such methods of evaluation included the recommendation to know dosage rates, droplet size, droplet densities, meteorological factors, time of application (as relates mosquito periodicity) vehicle application speed, number of applications, angle of nozzle, adult population densities, use of a variety of sampling methods to access population reduction, including ovitraps, adult collections, ovarian dissections, landing rates, wall bioassays, etc.

METHODS FOR DEALING WITH A DENGUE EPIDEMIC-GROUND ATTACK:

This presentation dovetailed in with the one above, and recommendations were presented, emphasizing the importance of applying adulticides, in a systematic, block by block manner, to ensure that houses were not missed. Frequency of the spraying was also mentioned, as a single application may only be effective upon a certain percentage of the population, which may be transmitting the disease. Therefore, multiple applications must be carried out, with repeated spraying cycles, at five to seven day intervals, in order to interrupt an outbreak.

It is not always easy to carry out evaluations, in terms of determining how effective spray applications are during an epidemic, but it is important to access whether the spray is reaching its targeted area. This can be done through the use of monitoring systems, such as caged adult mosquitoes, Intek paper, dye cards, ovitraps, adult landing rates.

It was emphasized that the results of caged mosquito kills could not be directly interpreted to spray results in wild mosquito popula-

tion. Also the use of the simple house index, is not an accurate evaluator as most adulticidal insecticides are not larvicidal in action. Therefore larvicidal activity through focal spray/granulating program are necessary, in conjunction with adult control activities.

AERIAL APPLICATIONS FOR CONTROLLING A DENGUE OUTBREAK:

Aerial ULV applications have an advantage of covering all areas from a height of 150-200 feet, combined with rapid coverage, is usually the method of choice, when faced with a large scale dengue epidemic. This method is also more cost effective, than a long term ground attack. Some countries do not have aircraft equipped with correct ULV spray nozzles, which necessitates having to possibly hire aircraft from outside resources or make emergency purchases of correct equipment to fit existing agriculture spray aircraft. Also in some countries, single engine aircraft are not permitted to fly over urban centers. In any event, any aerial application must be cleared with national aviation authorities.

THE US NAVY'S RAPID RESPONSE TEAM:

Although the representative from the U.S. Navy's, Jacksonville, Florida unit was unable to attend the workshop, several of the resource persons present were familiar with the Navy's capacity to respond to a request for vector control assistance during an emergency, such as a dengue outbreak.

It was clearly pointed out, that in order for the US Navy's team to come in and assist a country during an emergency, that the country must first have declared an emergency, and secondly, made an official request through normal government diplomatic channels, for the assistance. Such requests could be honored on fairly short notice.

An emphasis was made, that every effort should be made by the individual countries to adopt sufficiently strong control measures that Aedes-borne epidemics are prevented, rather than relying upon international organizations or agencies to help should an outbreak occur.

PREVENTION AND CONTROL OF EPIDEMIC DENGUE:

The prevention and control of epidemic dengue, specifically dealt with the 1986 epidemic of D-1,2 and 4, in Puerto Rico. The warning was clearly given, from the experiences there, that the only means of avoiding a repetition of the Southeast Asia DHF/DSS epidemics, in the Caribbean, was to eradicate the vector mosquito.

Special emphasis must be placed on prevention rather than upon emergency measures. These preventative measures include: 1) mosquito surveillance and control; 2) community wide participation; and 3)

health education at all levels, medical profession, layman, schools, civil organizations, etc.

EQUIPMENT MAINTENANCE:

The importance of maintaining insecticidal application equipment was emphasized in this presentation, including the care and servicing of perifocal pumps, ULV and fogging equipment, and the value of having spare parts on hand, to make repairs. Each individual operator should be trained in routine maintenance of hand operated pumps, etc.

THE ROLE OF THE COMMUNITY:

The representative from St. Lucia, gave a presentation on the PAHO/WHO funded community participation vector control project, which took place during 1986 in two villages. The major activity centered on health education, community volunteer health aids, and source reduction.

The success of the activity was seen in the reduction of the Ae. aegypti House Index from 16% to less than 1%. A clean up campaign resulted in the removal of much rubbish and abandoned appliances and vehicles in the villages, and the schools had very successful poster competitions, and the community ceremonies, included dances, songs, skits centering on the theme of vector control.

THE ROLE OF THE MOSQUITO RESEARCH AND CONTROL UNIT, CAYMAN ISLAND:

A report was given by the Director of the Mosquito Research and Control Unit (MRCU), Grand Caymans Island, regarding the role in which program could play in a dengue epidemic. Since the Cayman Islands are free of Ae. aegypti, albeit there have been repeated reinfestation of the vector during the previous several years. The unit can assist other countries in three basic ways: 1) through the loan of equipment; 2) the provision of consultants; and 3) through training.

It was emphasized that the unit's main strength lie in aerial application of adulticides in the control of Ae. taeniorhynchus, but are willing to be resource people for the control of epidemic dengue.

THE ROLE OF NON-GOVERNMENTAL AGENCIES IN HEALTH EDUCATION:

In Puerto Rico, the Rotary Club become involved in community service project to prevent dengue epidemics. Aspects of the broader concept of using non-government agencies in the prevention of dengue included community education, school programs, use of civic organizations, and the creation/writing of lesson plans for teachers to use in school curricula.

The program included a press conference featuring the topic, "Will history repeat itself" referring to the pattern of dengue and DHF/DSS in Southeast Asia; a dengue awareness week, the use of prominent citizens to participate in a trash removal campaign. Also included in the first phase of the health education movement was the use of TV and radio spots, and involvement of a student environmental association.

In the second phase, movie spots were used for the media, flyers used in shopping centers and on buses. Bumper stickers were distributed, a soap opera was developed with a DHF case featured, as well as the provision of free book covers, complete with dengue slogans.

In addition to involving the Rotary club, other resources within the community were approached. Of the US $300,000 spent, thus far all but $23,000 was donated. Even the Boy Scout program became involved and a merit badge program was created regarding mosquito control education. Finally, two video tapes were produced in Spanish and English on the clinical diagnosis of dengue.

THE ROLE OF RESEARCH DURING A DENGUE EPIDEMIC:

Although it is not always practical to carry out research during the time of dengue crises, it is however, important to keep careful records of all aspects of activities which take place during a dengue epidemic. Data such as space spraying information, type and amount of insecticide applied, areas covered, dates of various activities are necessary for future evaluations. It is also essential to properly store (refrigerate) blood sera, for either isolation attempts or serological tests, etc. This is vital to determine the strain/strains of virus which is/are circulating during the outbreak.

3. Aedes albopictus Plan of Action:

At the commencement of this session, each participant and resource individual was given a copy of the PAHO/WHO draft document, entitled: the "Ecology, Biology and Control of Aedes albopictus (Skuse)", consisting of 56 pages of text, and 27 pages of references. This is the most comprehensive document of its kind available on the subject. It was emphasized to those to whom the document was distributed, that the document was not yet official, but that it would be of considerable value in assisting the countries to better understand the bionomics and vector capacity of this new Asian vector of dengue, DHF/DSS.

This section commenced the topic of surveillance for Ae. albopicctus, from several select countries, as well as a discussion on the draft plan of action for the Americas for dealing with the monitoring and potential control of this Asian dengue vector.

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PRESENT SITUATION CONCERNING AEDES ALBOPICTUS DISTRIBUTION:

Aedes albopictus is now present 12 states (Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Louisiana, Mississippi, Missouri, Ohio, Tennessee and Texas) and 48 counties in the continental United States, from search carried out 16 states and 134 counties. The mosquito has been reported from Hawaii since the mid 1940's. In addition, the vector has been found in four Brazilian states.

The introduction of Ae. albopictus into the New World apparently was via shipment of containerized, used tires for Asia, which arrived in 20 and 40 foot containers from Japan, Korea, Taiwan and India, etc. From studies done at the University of Notre Dame, it has been shown that the Houston, Texas strain, where the infestation was first reported in Harris County, in August 1985, resembles that of the Japanese Ae. albopictus, which is cold hardy, whereas the Brazilian strain is related to the true tropical, non-cold hardy strains of Southeast Asia.

One of the problems related to the surveillance of tires into the USA is related to jurisdiction. The US Department of Agriculture has the responsibility, but they are basically concerned with the importation of insects of agricultural importance, so records of mosquito are not included. CDC spent $0.5 million US dollars in 1986/87 on Ae. albopictus surveillance. During tire surveillance programs carried out by CDC to detect importation of the Asian dengue vector, five exotic mosquito species have been intercepted from containerized cargo at American ports.

The introduction of Ae. albopictus into the Caribbean is plausible through importation of used tires. For example the Dominican Republic imported 1.8 million tires from Japan during the period of 1978-1985. Other possible methods of importation could include adult mosquitoes on board aircraft, cargo shipments, mosquito eggs on cut flower shipments, or larvae in tires or other large equipment which has been allowed to collect rainwater, in an Asian country.

Prevention of the introduction of Ae. albopictus included the development of international regulations, aimed at the exporters of tires at the country of origin, i.e., shipment arriving with a certificate that the tires in containers have not been exposed to water. It was emphasized that ports of entry must be maintained free of all Aedes (Stegomyia) spp.

Other suggestions for prevention included disinsection of containers, by fumigation, or the steam cleaning or flaming of tires, once they are removed. Any of those methods are labor intensive and expensive. Simple fogging was also voiced as a pragmatic solution, upon the first opening of the container, at the port of entry/consignee, to eliminate the possible introduction of adult mosquitoes.

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COUNTRY REPORTS ON AEDES ALBOPICTUS SURVEILLANCE:

At the commencement of this session, a CDC/USAID video film (28 minutes in length) was shown to the participants. The film reviewed the introduction of Ae. albopictus into the Americas, its spread, biology, behavior, and public health implications. In addition the film presented the common methods for collecting immatures and adult mosquitoes, surveillance methodologies, mosquito identification and the control of vector species.

It should be recognized that the monitoring and surveillance for Ae. albopictus, as reported during this workshop, in every instance, was done in conjunction with existing Aedes aegypti Eradication/Control programs, or as part of existing, broad pest/vector control campaigns.

Individual country reports were presented, enumerating the efforts made to monitor and conducted surveillance against the introduction of Ae. albopictus into the Caribbean.

The report from Barbados was the singular example where surveillance had resulted in a positive Ae. albopictus finding. A single first instar larvae was collected from a wet, used truck tire, imported into Barbados in January 1987, from Japan. The tire was among a shipment of 944 used car and truck tires. Subsequent soaking of approximately 30 tires in the shipment, yielded no additional Ae. albopictus larvae, but two Ae. aegypti immatures were obtained. In as much as Ae. aegypti is not found in Japan, a serious question was raised as to whether the used tires came from Japan, or whether that port was a transshipment point only.

Table 2 is an analysis of reports given by 25 countries on their respective surveillance attempts to monitor for the introduction of Ae. albopictus into their territories. The results are as follows:

Eighty-four percent (21 of 25 countries) indicated that their respective programs had adequate information on the biology, ecology and distribution of Ae. albopictus.

Twenty-one countries (84.0%) indicated that they had commenced some form of surveillance and monitoring with the intent of intercepting the importation of the new dengue vector into their respective territories. Four countries (16.0 %) had no programs yet implemented.

Seventy-six percent (19 countries) indicated that their surveillance activities were directed at both ports of entry (sea and air) as well as at tire importation.

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Only 24.0 % of the respondents indicated that they were utilizing, ovitraps ("little black jars" LBJ's) as part of their monitoring program. Seventy-six percent of the countries (19) felt that the public had been sufficiently informed about the importance of Ae. albopictus, in terms of its new distribution, medical importance and biting habits.

Seventeen countries (68.0%) had involved the customs/port authorities in their information dissemination system, to obtain cooperation in the surveillance for the Asian vector species at ports of entry.

Seventy-two percent of the countries (18) indicated that tires dealers had been alerted either personally or through correspondence regarding the threat of the introduction of Ae. albopictus through means of imported used tires.

Only 16.0 % (4 countries) had make contact with commercial flower importers, as a means of Ae. albopictus surveillance. Five countries (20.0 %) had an active system for the disposal of tires, i.e., land fill, burning, or use of tires in lime kilns.

Six of the countries had commenced their surveillance programs during 1986, through either the stimulus of PAHO/WHO or CDC alerts, or as a result of having attending a PAHO/WHO/CAREC workshop held in Trinidad in November 1986 on the topic. Fifteen countries began surveillance during the early part of 1987.

AIRCRAFT DISINSECTION:

This presentation gave ample and irrefutable evidence of the phenomena of vector and nuisance mosquitoes being transported worldwide by aircraft. Mosquitoes and other insects are being thus transported, and introduced into new countries as a result of inadequate and often poorly enforced international regulations pertained to the disinsection of aircraft. The 30 cases of airport area transmission of malaria, in European countries, were cited as evidence of the importance of enforcing this control method.

Various techniques for aircraft disinsectioning were described along with the list of WHO approved insecticides, with an emphasis place upon the use of aerosols, not only in passenger cabins, but in cargo holds as well, combined with the necessity of maintaining airports free from vectors.

4. The Development of Country Plans of Action: For the Emergency Control of Aedes-Borne Diseases:

During the final day of the workshop, each country representative was expected to develop a draft plan of action, for the emer-

gency control of Aedes-borne disease epidemic. An outline was provided for assistance in writing the of the contingency plan, which included guidelines for selecting members of the emergency control committee, the various phases of the plan, guides to aerial and ground applications in an emergency, different aspects of vector control operations, as well as a list of manufactures and distributors of pesticides, materials and equipment for vector control.

Following the development of the draft plans of action four countries were invited to make presentations of their proposed plans, which will be presented to their respective ministry's of health, and eventually be approved, and become part of their national health plans.

The countries which made the presentations included: St. Lucia, Barbados, St. Maarten and Martinique. Each country was requested to formalize their plans, and following approval of the plan of action, to send copies to PAHO/WHO, Bridgetown, Barbados.

END OF WORKSHOP QUESTIONNAIRE:

Tables 3 and 4 are the tabulated results of the end of workshop questionnaire, which were circulated among the participants and resource individuals during the afternoon of the final session.

A total of 34 questionnaires were passed out, and 26 (76.5%) responses were received. Twenty responses out of 26 came from participants and six out of eight resource persons[1] responded.

In general, according to the tabulation of the questionnaire (table 3) the over all purposes/goals of the workshop were met. One hundred percent of the respondents felt that the workshop was properly organized and was efficiently managed, 86.0 % were given proper advance knowledge, and 87.5% felt that the correct participants were invited to attend.

Eighty-five percent felt that their travel arrangements were sufficient, and 76.2% approved of their financial arrangements. As pertains to the hotel venue/room accommodations, 95.7% approved, 84.6% said that the conference room facilities/organization in terms of seating, sight and sound were suitable.

The secretarial support was given a 96.0 approval. Thus recognizing the extreme importance of this type of backup, as so many of the day to day workshop elements require absolute secretarial proficiency, i.e., having session minutes, notes and abstracts typed in draft and final form, travel reconfirmations, photocopying, messages

[1]There were 14 resource persons present, but six had already departed the country by the close of the workshop.

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delivery, etc.

As pertains to the actual content/topics of the various workshop presentations, 100.0 percent felt that the program adequately covered the theme of the seminar. Eighty-eight percent said that the topics were aimed at the correct audience, however, 58.3% said there were areas, within the topics in which they would like to receive more/additional information.

As pertains to the request for additional information, the areas requested included: how to properly organize cleanup campaigns; used tire control; more data on Ae. albopictus; a better understanding of insecticidal action; more information of vertical versus horizontal management concepts; greater information on dengue epidemics; help on using integrated control measures; how to involve communities in vector control; and a question on Ae. aegypti research.

Ninety-two percent said that the handouts, received (over 200 pages per participant) were sufficient, as supplementary materials to the various presentations. Another 92 percent stated that they felt the audio/visual aid equipment as used in/during the presentations was fine.

The overall agenda/workshop topics was given a 95.3% approval rating. However, some suggested that less emphasis should be placed on individual country reports, and the need for greater exchange of ideas, and problem solving between countries. As pertained to the panel discussions, it was recommended that each member of the panel should be given an opportunity to speak, before discussions were invited from the general audience.

Ninety-five percent also stated that they had received adequate information pertaining to the draft plan of action for the emergency control of Aedes-borne diseases. Sixty-six percent said they now had an adequate plan of action with which to present to their respective ministry of health, as a draft toward the development of a national strategy for the emergency control of an epidemic such as dengue, which eventually would become part and parcel of their national health plan.

Eighty-eight percent indicated that they would, upon their return home to their respective countries, increase their surveillance system for the monitoring of Ae. albopictus.

Sixty-two percent felt that the presence of the commercial exhibitors enhanced the overall purpose of the workshop, and 76.0% felt that there was no product endorsement involved in the presence of the companies.

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One hundred percent of those answering, felt that the local organizing committee had sufficiently prepared for the after hour social activities, and 96.2% indicated that there was no conflict with evening's activities and the workshop itself. This was clearly seen by the attendance each morning, when nearly every participant was punctually present at the opening of each session.

All the respondents indicated they did plan on holding a special staff training session, to report on the workshop upon their return home.

With respect to Table 4, which dealt with that element of the questionnaire, concerning whether the participants planned on trying to improve their respective country's capacity to prevent a dengue epidemic.

That portion of the questionnaire was very vital, as it indicated the degree of importance attached to each category and the intention of the head of the program to do something tangible to improve program conditions. Between 50.0 and 93.7% indicated that would try to improve staff strength, training, equipment maintenance, increase insecticide stocks, order better supplies and equipment, increase source reduction measures, and improve health education.

This resolve carried over in the area of increasing the integrated control measures used in their programs, as well as the involvement of non-governmental agencies to try and educate the public on their responsibility to help prevent a dengue epidemic. In addition, they felt that they would try and use community participation as a part of the strategy for vector control, as well as make better use of the media to spread the message about the eradication/elimination of the Aedes vectors of dengue, DHF/DSS.

V RECOMMENDATIONS:

1. The principal recommendation arising from this workshop was that each country participant/representative would carry back to their respective adminitistrative offices, the draft document of their own country plan of action, for the emergency control of an Aedes-borne epidemic.

Follow-up correspondences to permanent secretaries, in each of the countries, encouraged the final drafting of the plan of action, for submital to the minister of health, for the eventual acceptance of the document as part of the country's national health plan. This activity would include the designation of the emergency control committee, and clear designation of lines of authority, as pertains to all elements of the plan, and its potential application, should an emergency arise.

2. In addition, as a result of the depth and interest in the discussion on the efficacy of ULV and fogging, a suggestion was made by the USAID/VBC representative, to seek funds to support the evaluation of several adulticide trials in the Caribbean.

V ADDENDUM:

doc:emcagend 30/06/87

PROGRAM FOR THE WORKSHOP ON:

THE EMERGENCY CONTROL OF AEDES-BORNE EPIDEMICS
AND THE REGIONAL PLAN OF ACTION FOR AEDES ALBOPICTUS

A WORKSHOP JOINTLY SPONSORED BY PAHO/WHO AND
USAID/VBC

(CARIBBEE BEACH HOTEL, HASTINGS, BRIDGETOWN, BARBADOS)

BARBADOS, 11 - 15 MAY 1987

MONDAY 11 MAY 1987

8:00 AM	Registration	
9:00	FORMAL OPENING CEREMONY	
	Introduction	Dr. A. Bruce Knudsen Area Advisor-Scientist PAHO/WHO
	Welcoming Remarks	Mr. Ronald Williams Ag. Caribbean Program Coordinator, PAHO/WHO
	Remarks	Ms. Holly Wise Program Development Officer USAID, Barbados
	Feature Address	Mrs A. Haynes Ag. Permanent Secretary Ministry of Health
9:30	Break	
9:45	Introduction, Anouncements and Objectives of Workshop, Selection of Workshop Rapporteurs[1]	A. B. Knudsen

[1]General Workshop Chairman responsibilities for producing the final report, will be shared by Drs. M. J. Nelson and A. B. Knudsen.

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MONDAY 11 MAY 1987 (Continued)

TOPIC: AEDES PROGRAM COUNTRY REPORTS:

Session chairperson: Dr. M. Nelson

Rapporteur: Dr. Donald Elaison

10:00 Reports from Selected Countries on *Aedes* Program's State of Readiness to Deal with an Emergency. (8 minutes each.)

Anguilla	Caymans
Antigua	Cuba
Aruba	Curacao
Bahamas	Dominca
Barbados	Dominican Rep.
Bonaire	Grenada
BVI (Tortola)	

12:00 PM Lunch

Session chairperson: Dr. A. B. Knudsen

Rapporteur: Dr. Michael Nelson

1:15 Reports from Selected Countries on *Aedes* Program's and State of Readiness to Deal with an Emergency (Continued) (8 minutes each.)

Guadeloupe	St. Kitts
Guyana	St. Lucia
Haiti	St. Maarten
Jamaica	St. Vincent
Martinique	Suriname
Montserrat	Turks and Caicos
Puerto Rico	Trinidad and Tobago
St. Croix (AVI)	

2:30 Presentation on type of *Aedes aegypti* Program organization structure - Barbados — C. Brown

2:45 Presentation on type of *Aedes aegypti* Program organization structure - Trinidad — R. Aarons

3:00 Break

MONDAY 11 MAY 1987 (Continued)

	3:15	Presentation on type of *Aedes aegypti* Program organization structure - Grenada	C. Edwards
	3:45	Presentation on the Plan of Action *Aedes aegypti*	M. Nelson
a	4:30	Discussion on the *Aedes aegypti* Plan of Action	M. Nelson
	5:00	Close	

TUESDAY 12 MAY 1987

TOPIC: COMPONENTS NECCESSARY IN EMERGENCY CONTROL:

Session chairperson: Dr. F.J. Lopez-Antunano

Rapporteur: Dr. Francisco Pinheiro and Dr. Michael Nathan

8:30 AM	Presentations by countries who have had experience in dealing with emergency control measures during a dengue/dengue hemorrhagic fever (DHF), dengue shock syndrome (DSS) epidemic (30 minutes each.)	
	Jamaica - 1977 (Dengue 1)	T. Castle
	Cuba - 1981 (Dengue 2)	M. Nelson
	Aruba - 1985 (Dengue 1)	V. Krozendijk
	Puerto Rico 1986 (Dengue 2,4)	D. Gubler
10:30	Break	
10:45	Discussion/Questions	
11:15	Panel Discussion on: Organizational Structure: Structures: Vertical vs. Horizontal and How they Relate to the Capacity to deal with an *Aedes*-borne epidemic	Moderator: F.J. Lopez-Antunano Panel: M. Nelson E. Ferdinand R. Paul B. Knudsen M. Nathan D. Gubler

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TUESDAY 12 MAY 1987 (Continued)

12:00 PM	Lunch	

Session chairperson: Dr. Duane Gubler

Rapporteur: Dr. Paul Reiter

1:30	Detection and Surveillance of an *Aedes*-borne Disease Outbreak	E. Ferdinand
2:00	How to Prepare for an Emergency: Contingency Plans for Dealing with an *Aedes*-borne Disease Outbreak	M. Nelson
2:15	The Use of Simple Indicators of Risk in Stratification Areas of Cities in Allocating Resources in the Planning and Prevention of Epidemics	D. Elliason
2:30	The Role of PAHO/WHO in the Development of Programs for Disease Control	F. J. Lopez-Antunano
2:45	The Role of PAHO/WHO in Dengue Surveillance	F. Pinheiro
3:00 P.M.	Break	
3:15	Surveillance for Dengue: The Role of CDC	D. Gubler
3:30	Surveillance for Dengue: The Role of CAREC	E. Tikasingh
3:45	Surveillance for Dengue: The Importance of International Collaboration	A. Arata
4:00	Integrated Control Strategy as it Relates to the Prevention of Dengue Epidemics	A. Arata
4:30	Close	

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WEDNESDAY 13 MAY 1987

TOPIC: EMERGENCY CONTROL CONTINUED

Session chairperson: Dr. E. Tikasingh

Rapportuer: Mr. Joseph Lynch

8:00 AM	Discussion on ULV	M. Nelson
8:30	Methods for Dealing with an Outbreak of Dengue by Ground Attack	M. Nelson
9:15	The US Navy's Rapid Response Team - Deployment in Emergency Control of *Aedes* -Borne Outbreaks	Impromptu report by Nelson & Eliason
10:00	Break	
10:15	Prevention and Control of Epidemic Dengue in Puerto Rico	D. Gubler
10:45	The Importance of Maintaining Equipment for Routine and Emergency Operations	R. Aarons
11:15	Role of the Community in a Dengue Emergency	E. Poyette
12:00	Lunch	

TOPIC: EMERGENCY CONTROL CONTINUED

Session chairperson: Dr. A. A. Arata

Rapporteur: Dr. Michael Nelson

1:30	Role of the Mosquito Research and Control Unit in a Dengue Emergency	F. Burton
2:00	The Role of Non-government Agencies in the Prevention of Dengue Epidemics	D. Gubler
2:30	Does Research Play a Role During a Dengue Epidemic?	P. Reiter
3:00	Break	

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WEDNESDAY 13 MAY 1987 (Continued)

TOPIC: THE AEDES ALBOPICTUS PLAN OF ACTION

3:15	An overview of the introduction of *Aedes albopictus* into the Western Hemisphere with Notes on its Biology	P. Reiter
3:30	Approaches to the Prevention of International Transport of *Aedes albopictus*	D. Elliason
3:45	Methods of Disinsection of Containerized Tires	D. Elliason
4:00	Presentation on the Plan of Action: *Aedes albopictus*	M. Nathan
4:30	Discussion on the *Ae. albopictus* Plan of Action	B. Knudsen
5:00	Close	

THURSDAY 14 MAY 1987

TOPIC: AEDES ALBOPICTUS PLAN OF ACTION

Session chairperson: Dr. D. Ellaison

Rapporteur: Dr. Duane Gubler

8:30 AM	CDC/USAID Video on *Aedes albopicuts*	D. Eliason
9:00	Reports on *Ae. albopictus* Surveillance Program - CDC	P. Reiter
9:30	Reports on *Ae. albopictus* Surveillance Program-Barbados	R. Broomes
9:45	Reports on *Ae. albopictus* Surveillance Program - Trinidad	R. Aarons
10:00	Break	
10:15	Reports on *Ae. albopictus* Surveillance Program - Grenada	C. Edwards

THURSDAY. 14 MAY 1987 (Continued)

10:30	Reports on *Ae. albopictus* Surveillance Program - Martinique	A. Yebakima
10:45	Reports on *Ae. albopictus* Surveillance Program - Dominican Rep.	F. Paulino Menica
11:15	The Role of Health Education in the Surveillance of *Aedes albopictus*	P. Brandon
12:00	Lunch	

TOPIC: AEDES ALBOPICTUS PLAN OF ACTION CONTINUED

Session chairperson: Dr. M. Nathan

Rapporteur: Dr. Fred Burton

1:30	Reports on *Ae. albopictus* Surveillance Program - Tortola	O. George
1:45	Reports on *Ae. albopictus* Surveillance Progam - Guadeloupe	J.C. Artus
2:00	Reports on *Ae. albopictus* Surveillance Program - Curacao	S.P. Boekhoucdt
2:15	Reports on *Ae. albopictus* Surveillance Program - Guyana	M. Nathan
2:30	Reports on *Ae. albopictus* Surveillance Program - Jamaica	T. Castle
2:45	Reports on *Ae. albopictus* Surveillance Program - Bahamas	W. Sweeting
3:00	Break	
3:15	Reports on *Ae. albopictus* Surveillance Program - Suriname	N. Burgos
3:30	Discussion on Surveillance Reports	D. Elliason
4:00	Airscraft Dissinsection	G. D. White
4:30	Close	

FRIDAY 15 MAY 1987

TOPIC: THE DEVELOPMENT OF COUNTRY PLANS OF ACTION: FOR THE EMERGENCY CONTROL OF AEDES-BORNE DISEASES

Session chairperson: Dr. A. B. Knudsen

8:30 AM	Development of Individual Country Plans of Action for Emergency Control	
10:30	Break	
10:45	Continue Development of Ind. Country Plans of Action for Emergency Control	
12:00	Lunch	
1:00	Development of Country Plans of Action for *Ae. albopictus* Surveillance and Control	
3:00	Reports by Four Countries on Plan of Action -Emerg. Contr. (determined at that time)	St. Vincent Barbados St. Maarten Martinique
4:30	CLOSING CEREMONY	
	Chairperson	Dr. A. B. Knudsen
	Closing Remarks	Dr. E. Ferdinand SMOH (Envirnment Ministry of Health
	Comments by PAHO	Dr. Halmond C. Dyer Caribbean Program Coord. PAHO/WHO
	Comments by USAID	Dr. Andrew A. Arata Senior Technical Officer USAID/VBC Consultant
	Comments by Participant	Mr. T. Castle

EMERGENCY CONTROL OF AEDES-BORNE DISEASES

(WORKSHOP HELD IN BARBADOS 11-15 MAY, 1987)

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TABLE 1 REPORTS ON THE STATUS OF THE AEDES AEGYPTI/VECTOR CONTROL PROGRAMS, AS PRESENTED AT THE WORKSHOP FOR THE EMERGENCY CONTROL OF AEDES-BORNE DISEASES BARBADOS, 11-15 MAY 1987

COUNTRY	AEDES HOUSE IND.	DOES PROGRAM HAVE ADEQUATE: STAFF	INSEC.	EQP.	SUPL.	VEH.	RESIS.	HLTH ED.	DEN.	ALBO. SURV.	BIOCONTR.
ANGUILLA	11.0-17.0	NO	YES	NO	NO	NO	NO	NO	NO	YES	YES
ANTIG/BARB	10.70	YES	NO	NO	NO	YES	YES	YES	NO	NO	YES
ARUBA	7.40	YES	YES	YES	YES	NO	?	YES	NO	NO	YES
BAHAMAS	19.00	YES	YES	NO	YES	YES	NO	NO	NO	YES	YES
BARBADOS	0.68	NO	YES	NO	NO	NO	NO	YES	YES	YES	NO
BONAIRE	8.00	NO	YES	NO	NO	YES	NO	NO	NO	NO	NO
BVI(TORT.)	8.70	YES	YES	NO	NO	NO	YES	YES	NO	YES	YES
CAYMAN	0.00	YES	YES	YES	YES	YES	NO	YES	NO	YES	NO
CURACAO	9.0-42.0	YES	YES	YES	YES	YES	?	YES	?	YES	NO
DOMINCA	UNKNOWN	NO	NO	NO	NO	NO	NO	YES	NO	YES	YES
DOM.REPL.	20.0-77.0	NO	NO	NO	NO	NO	YES	YES	NO	YES	NO
GRENADA	5.50	YES	YES	NO	NO	NO	YES	NO	?	YES	YES
GUYANA	VARIES	NO	NO	NO	NO	NO	?	NO	YES	YES	NO
JAMAICA	2.0-55.0	NO	NO	NO	NO	NO	?	YES	?	YES	NO
MARTINIQUE	VARIES	YES	YES	YES	YES	YES	YES	YES	?	YES	NO
QUADELOUPE	VARIES	YES	YES	YES	YES	YES	YES	NO	YES	YES	NO
MONTSERRAT	5.5-10.5	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
PUERTO RIC	UNKNOWN	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO
ST. CROIX	UNKNOWN	NO	NO	NO	NO	YES	?	NO	YES	NO	NO
ST. KITTS	19.40	NO	NO	YES	NO	NO	?	NO	NO	NO	NO
ST. LUCIA	1.8-2.1	NO	NO	NO	NO	NO	NO	NO	?	YES	NO
ST.VINCENT	5.2-39.6	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES
ST. MAART.	UNKNOWN	NO	NO	NO	NO	NO	YES	NO	NO	NO	NO
TURK/CAIC.	20.0	NO	YES	NO	NO	YES	?	NO	NO	NO	YES
TRINIDAD &	5.00	YES	YES	YES	YES	YES	NO	YES	YES	YES	NO
TOBAGO	UNKNOWN	YES	YES	YES	YES	YES	NO	YES	?	YES	NO

EVALUATION

	YES	NO	? POSS.	ADEQUATE:
STAFF NO:	12/46.2	14/53.8	-	NO
INSECTICID	15/57.7	11/42.3	-	YES
EQUIPMENT	9/34.6	17/65.4	-	NO
SUPPLIES	9/34.6	17/65.4	-	NO
VEHICLES	12/46.2	14/53.8	-	NO
RESISTANCE	8/30.7	11/42.3	7/26.9	N.A
HLTH. ED.	13/50.0	13/50.0	-	YES/NO
DEN.86/87	6/23.1	14/53.8	6/23.1	N.A.
ALBO. SURV	17/65/4	9/34.6	-	YES
BIOCONTRL.	9/34.6	17/65.4	-	NO

TABLE 2 COUNTRY REPORTS ON THE SURVEILLANCE OF AEDES ALBOPICTUS DURING THE PERIOD OF 1986-87, IN THE CARIBBEAN

COUNTRY	ADEQ. INFORMATION	PROG COM.	SURV. TYPE SURV	USE LBJ	PUB. INFOM	PORT AUTH.	TIRE DLR	FLWR IMP.	TIRE DISP	DATE SURV. COM	FINDINGS TODATE:
BARBADOS	YES	YES	PORT	YES	YES	YES	YES	YES	NO	JAN. 87	1 LARVA
TRINIDAD	YES	YES	PORT	YES	YES	YES	YES	YES	NO	JAN. 87	NONE
GRENADA	YES	YES	PORT	NO	YES	NO	YES	NO	NO	FEB. 87	NONE
MARTINIQUE	YES	YES	PORT	NO	YES	YES	YES	NO	NO	MAY 86	NONE
DOM. REP.	YES	YES	PORT	NO	YES	YES	YES	NO	YES	FEB. 87	NONE
TORTOLA	YES	YES	PORT	NO	YES	YES	YES	NO	NO	MAR. 87	NONE
GUADELOUPE	YES/NO	YES	PORT	NO	YES	YES	YES	NO	NO	JAN. 87	NONE
CURACAO	YES	YES	PORT	YES	YES	YES	YES	NO	NO	MAY 87	NONE
GUYANA	YES/NO	NO	NONE	NO	NO	NO	NO	NO	NO	NO SURV.	?
JAMAICA	YES	YES	PORT	YES	YES	YES	-YES	YES	NO	NOV. 86	NONE
BAHAMAS	YES	YES	PORT	YES	YES	YES	YES	NO	NO	JULY 86	NONE
SURINAME	YES	YES	PORT	NO	YES	YES	YES	NO	YES	JAN. 87	NONE
CAYMANS	YES	YES	TIRE	YES	YES	NO	NO	NO	NO	JAN. 87	NONE
BONAIRE	YES	NO	NONE	NO	NO	NO	NO	NO	YES	NO SURV.	?
DOMINICA	YES	YES	PORT	NO	YES	YES	?	NO	NO	JAN. 87	?
TURKS/CAI	YES	YES	PORT	NO	YES	NO	YES	NO	NO	JAN. 87	NONE
ANGUILLA	YES	YES	PORT	NO	YES	YES	NO	NO	NO	MAR. 87	NONE
MONTSERRAT	YES	YES	PORT	NO	YES	YES	YES	NO	NO	DEC. 86	NONE
ST. LUCIA	YES	YES	PORT	NO	NO	YES	YES	NO	YES	MAR. 87	NONE
ANTIGUA	YES	YES	TIRE	NO	NO	NO	YES	NO	YES	MAY 87	NONE
ST. CROIX	NO	NO	NONE	NO	NO	NO	NO	NO	NO	NO SURV.	?
PUERTO RIC	YES	YES	PORT	NO	YES	YES	YES	NO	NO	AUG. 86	NONE
ST. KITTS	YES	YES	PORT	NO	NO	YES	NO	NO	NO	JAN. 87	NONE
ARUBA	YES	YES	PORT	NO	YES	YES	YES	YES	NO	NOV. 86	NONE
ST.MAARTEN	NO	No	NONE	NO	YES	NO	YES	NO	NO	NO SURV.	?

EVALUATION

	YES	NO	?	YES/NO	PORT/TIRES	TIRES	NONE
ADEQ. PROG INFORMAT.	21/84.0	2/8.0		2/8.0			
SURVEY COM	21/84.0	4/16.0		0			
TYPE SURV.					19/76.0	2/8.0	4/16.0
USE LBJ'S	6/24.0	19/76.0		0			
PUB.INFRMD	19/76.0	6/24.0		0			
PORT AUTH.	17/68.0	8/32.0		0			
TIRE DLRS.	18/72	6/24.0		1/4.0			
FLWR IMPTR	4/16.0	21/84.0		0			
TIRE DISP. SYSTEM:	5/20.0	20/80.0		0			
DATE COMM.	1986-6	1987-15		NO PROG-4			
FINDINGS:	1-B'DOS						

TABLE 3 RESULTS OF THE END OF WORKSHOP QUESTIONNAIRE

	QUESTION:	YES	NO	NOT APPLIC.	NO. RESPONSES
1.	WORKSHOP PROP. ORG.	26/100.0%	0	0	26/26
2.	ADVANCE NOTICE REGARDING WK. SHP.	21/84.0	4	1	26/26
3.	MET AT AIRPORT	16/76.2	5	5	26/26
4.	CORRECT PARTIC. INVITED	21/87.5	3	2	26/26
5.	TRAVEL ARR. OK	18/85.7%	3	5	26/26
6.	IND. SUFF. PREP. FOR WK. SHP. CONTENTS	20/76.9	5	1	26/26
7.	FIN. ARRANGE. OK	16/76.2	5	5	26/26
8.	HOTEL ACCOM. OK	22/95.7	1	3	26/26
9.	CONF. RM. ARRANGE. OK TO HEAR/SEE	22/84.6	4	0	26/26
10.	SECRETARY ADEQ.	24/96.0	1	1	26/26
11.	TOPICS ADEQ. COV.	26/100.0	0	0	26/26
12.	CORRECT AUDIENCE	22/88.0	2/3	1	26/26
13.	AREAS WHERE MORE INFO. NEEDED	14/58.3	10	2	26/26
14.	SUFFIC. HANDOUTS	24/92.3	1	1	26/26
15.	AV PRES. ADEQ.	24/92.3	2	0	26/26
16.	AGENDA COMPREH.	25/96.2	1	0	26/26
17.	ADEQ. INFO. TO DRAFT PLAN OF ACTION	20/95.3	1	5	26/26
18.	HAVE ADEQ. PLAN NOW TO PRESENT MOH	12/66.7	6	8	26/26
19.	PLAN TO INCR. SURV. FOR AE. ALBO.	16/88.9	2	8	26/26

TABLE 4 WORKSHOP QUESTIONAIRE (CONTINUED)

PLAN TO IMPROVE COUNTRIES CAPACITY TO PREVENT

DENGUE EPIDEMICS:

CATEGORY:	HIGHLY IMP.	IMP.	LITTLE	HAVE DONE	WILL TRY	MAY DO
STAFF STRENGTHING:	68.8%	18.8%	12.5	37.5%	50.0	0.0[1]
INCR. STAFF TRAIN.	53.3	40.0	6.7	31.3	56.3	6.7[2]
IMP. EQUIP. MAINT.	25.0	68.7	6.3	31.3	56.3	6.3[3]
ASSURE INS. STOCK	31.3	62.5	6.3	20.0	73.3	6.3[4]
BETTER SUPL./EQUIP.	25.0	62.5	6.3	26.7	73.3	0.0[5]
INCR. SOURCE RED.	87.5	12.5	0.0	18.8	81.2	0.0
IMP. HLTH ED. METH.	81.3	18.8	0.0	6.3	87.4	6.3
INCR. INTEG. CONTR. MEASURES	37.5	56.2	6.3	13.3	66.7	13.3[6]
INVOLVE NGO'S	50.0	37.5	12.5	12.5	50.0	31.3[7]
USE COMM. PARTICIP. IN VECTOR CONTR.	80.0	20.0	0.0	6.3	93.7	0.0
USE MEDIA BETTER	50.0	50.0	0.0	12.5	81.2	6.3

[1] Excludes 9.4% (one country) which stated they would not try or or had no need to try for staff strengthening.
[2] Does not include 6.3% (one country) which stated they did not need to increase staff training.
[3] Does not include 6.3% (one country) who stated they did not need to improve equipment maintenance.
[4] Excludes 6.3% (one country) who did not need to increase insecticide stocks.
[5] Doesn't include one country (6.3%) whose equipment and supplies are adequate.
[6] Exludes one country (6.7%) who does not feel it needs to employ a greater degree of integrated control measures.
[7] Doesn't include 6.3% (one country).

Abstract

Community-Based Mosquito Control Programs for Prevention of Epidemic Dengue/Dengue Hemorrhagic Fever

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Early *Aedes aegypti* control and eradication programs that placed emphasis on source reduction and environmental sanitation were generally very successful. With the advent of ultra low volume (ULV) application of insecticides in the late 1960s, however, emphasis was redirected towards adulticiding as the mainstay of most *Ae. aegypti* control programs. This, plus economic and political problems, caused many control organizations to die by attrition during the 1970s. In the past 15 years, *Ae. aegypti* has reinvaded nearly every country that had achieved eradication during the 1960s. Moreover, in many countries the current distribution is more widespread and the densities are higher than in pre-eradication days. This, combined with repeated introduction of dengue viruses of all serotypes by airplane travelers, has resulted in the emergence of epidemic dengue hemorrhagic fever (DHF) as a major public health problem in the Americas. Epidemiologic evidence that insecticides applied from vehicle-mounted ULV machines have little or no impact on dengue transmission has been accumulating for many years. This conclusion has recently been reinforced by spray trials in several countries that show no significant control of the natural *Ae. aegypti* populations. Collectively, the evidence suggests that effective, long-term mosquito control can only be achieved by implementing an integrated program with emphasis on source reduction. The economics of the 1980s, however, will not allow development of the high budget, government programs with adequate staffing to operate in manner even remotely similar to the old programs. In other words, the government agencies cannot do it alone in the 1980s. Successful programs in the future will depend upon community involvement, with emphasis on education of the people to understand the danger of DHF and make them accept the responsibility for controlling the environment and mosquitoes around their home. Successful programs will require innovative educational approaches, and help with funding from private sources. The approach used in Puerto Rico will be discussed and representative educational materials will be presented.

CDC's *Aedes albopictus* Surveillance Program, 1986

In 1986, CDC spent nearly $0.5 million on the *Aedes albopictus* problem:

A. Surveillance

1. Developed survey protocols for use by CDC, state, and local agencies.
2. Developed taxonomic keys for larvae and adults.
3. Conducted surveys in 134 counties in 16 states. Surveys revealed *Ae. albopictus* in 48 counties in the following 12 states: Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Louisiana, Mississippi, Missouri, Ohio, Texas and Tennessee.
4. Expanded routine ovitrap surveillance from 19 to 53 cities.
5. Demonstrated that *Ae. albopictus* can be imported from Asia in used tire casings: 11 (.07%) of 22,051 tires inspected in the Port of Seattle were positive for *Ae. albopictus* larvae.

B. Laboratory Research

1. Demonstrated transmission of dengue and yellow fever viruses by *Ae. albopictus*.
2. Improved the efficacy of diagnostic tests for viruses transmissible by *Ae. albopictus*.
3. Determined dosages of fumigants required to kill *Aedes* eggs and larvae in tires.

C. Information/Education

1. Convened two meetings of technical experts and outside consultants.
2. Conducted a training workshop for state and local public health and vector control specialists.
3. Assisted the Pan American Health Organization in preparing a surveillance and control strategy for Latin America, and in running a workshop at CAREC headquarters in Port-of-Spain, Trinidad.
4. Produced publications and presentations at local, regional, national and international meetings.
5. Prepared a videotape to train public health and vector control personnel.
6. Initiated a computerized bulletin board for rapid exchange of information on *Ae. albopictus*.

D. Prevention and Control

1. Demonstrated that fumigation and heat treatment are both effective against *Ae. albopictus* in containerized shipments of used tires.
2. Demonstrated that in the United States, *Ae. albopictus* is resistant to several insecticides commonly used in mosquito control. Identified several compounds to which it is susceptible.
3. Obtained direct evidence that intra- and interstate movement of used tires is a major means for dispersal of *Aedes* species.

Abstract

Epidemic Dengue/Dengue Hemorrhagic Fever in Puerto Rico, 1986

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The frequency of epidemic dengue in Puerto Rico has increased significantly in recent years. Since 1977, the island has experienced five major epidemics caused by all four dengue virus serotypes. The changing epidemiology of dengue in the past few years placed Puerto Rico at high risk for epidemic dengue hemorrhagic fever (DHF), and in 1986, severe and fatal DHF occurred for the first time in the islands history. The 1986 epidemic was caused by multiple virus serotypes with DEN-4 being the predominant virus transmitted, followed by DEN-1 and DEN-2, respectively. Peak transmission occurred in September-October with 10,659 cases reported. The illness was generally of the classical dengue fever type, but there were 31 laboratory confirmed cases of DHF that met the World Health Organization criteria. The majority of cases were children, although some adults were also affected. The highest risk group was infants. There were three deaths, one infant, one child and one adult. Of particular concern is that the dengue epidemic was predicted by the CDC-Puerto Rico Health Department (PRHD) surveillance system as early as May, 1986, two months prior to actual increased transmission. The medical community was alerted to the potential epidemic through periodic surveillance summaries and letters while the lay community was alerted via press releases and a variety of other educational materials. In addition to a community-based source reduction campaign, the PRHD increased malathion spraying activities using vehicle-mounted ULV machines. Data collected by the CDC-PRHD surveillance system, however, showed no evidence that the control measures had any impact on dengue transmission. The problems associated with currently used control methods will be discussed with emphasis on alternative approaches to *Aedes aegypti* control.

Abstract

Surveillance for Dengue and Dengue Hemorrhagic Fever: The Role of CDC

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There has been a marked increase in the frequency of epidemic dengue in the American region in recent years, caused mainly by circulation of multiple virus serotypes in most countries. This hyperendemicity has led to the emergence of dengue hemorrhagic fever (DHF) as a major public health problem in the Americas. One major epidemic has already occurred in Cuba (1981) and smaller epidemics have occurred in Mexico (1984), Nicaragua (1985), and Puerto Rico (1986). Moreover, many other countries in the region have reported sporadic cases of DHF with increasing frequency. The widespread occurrence of DHF in the Americas has reinforced the need for more effective, laboratory-based surveillance that will provide an early warning predictive capability for epidemic dengue. "Active" vs. "reactive" surveillance for DHF will be discussed, with emphasis on the advantages of a laboratory-based active surveillance system. The components that give the active system its predictive capability include virologic, serologic, epidemiologic, clinical and entomologic surveillance. All of these depend upon the availability of a good diagnostic laboratory which is critical to the successful operation of any effective surveillance system. The Centers for Disease Control, in collaboration with the Pan American Health Organization, has attempted to improve laboratory-based surveillance for DHF in most of the region by upgrading laboratories and training personnel. The Centers for Disease Control role in developing a regional surveillance system for DHF, has been to provide training in laboratory diagnosis of dengue, and to provide reagents, epidemiological evaluation, and quality control for other laboratories through reference services.

PAHO'S ROLE IN DENGUE SURVEILLANCE

Francisco P. Pinheiro
HPT/HPD

Summary

Dengue fever and dengue haemorrhagic fever are major causes of morbidity and mortality in tropical Asia and in certain Pacific islands. Dengue fever also occurs endemically in many areas of Central and South America and of the Caribbean Region where several millions of persons were infected in the past decades. Serious economic losses result of school and work absenteism and burden of medical care among others are reasons that make control of dengue viruses an imperative objective. The appearance of dengue hemorrhagic fever in Cuba in 1981, and the explosive and extensive outbreaks of dengue fever in Brazil in 1986-87 stress the need for implementation of control measures. Undoubtedly, the sharp increase of dengue activity observed in the past 25 years is greatly due to the increase and dissemination of Aedes aegypti populations. The recent introduction of Aedes albopictus in the USA and in Brazil and its possible spread to other countries of the Americas raised considerable concern because of the possible aggravation of the dengue problem in endemic areas.

Surveillance is an essential component of PAHO's program for the prevention of dengue. PAHO has cooperated with Member Countries in the implementation of epidemiologic and vector surveillance activities through several mechanisms of assistance. Epidemiologic surveillance includes monitoring of dengue fever and dengue hemorragic fever together with serological and virological surveillance. Several seminars have been sponsored by PAHO in recent years on the diagnosis, treatment and surveillance of dengue hemorrhagic fever. Considerable progress has been achieved in strengthening of dengue national laboratories through provision of training, diagnostic reagents and technical consultantship. The Caribbean Epidemiologic Center in Trinidad and the San Juan Laboratories, CDC, in Puerto Rico have played a major role in these activities and also in epidemiologic surveillance. Until recently, vector surveillance in the Americas focused on Aedes aegypti, however, it will be essential now to extend it also to Aedes albopictus. PAHO has seven entomologists assigned to country or regional projects who provide technical assistance to orient vector surveillance activities.

Presented at the Workshop "The Emergency Control of Aedes-Borne Epidemics and the Regional Plan of Action for Aedes albopictus", Barbados, 11-15 May 1987

ARUBA

An extensive outbreak of dengue fever occurred in Aruba from November 1984 to March 1985. An estimated 24,000 persons became infected during the epidemic and there were two fatalities. The economic losses were estimated in about 3 million guilders.

No epidemic of dengue had been recorded in Aruba prior to 1984, despite the wide curculation of dengue virus type 1, 2 and 3 in the Caribbean Region and in northern South America. This was possibly due to the existence of an effective *Aedes aegypti* control program in Aruba which began in 1970. Since 1983, however, the program experienced constraints and high densities of *Ae. aegypti* populations then developed. Further increase of the mosquito population was associated with the fall of heavy rains from October 1984 to March 1985. By late November 1984, the *Ae. aegypti* house index was abound 50%.

Although the first cases seem to have occurred in November 1984, the epidemic was not recognised until several weeks later. All age groups were affected and clinical manifestations were generally similar to those observed in other epidemics of dengue fever. Dengue Type 1 was isolated from several patients by CAREC and the San Juan Laboratory. Two fatal cases occurred

in adult siblings who exhibited hemorrhagic manifestations, jaundice, hepatorenal failure and shock. Dengue 1 infection was demonstrated in both siblings.

A house to house seroepidemiological survey conducted in March 1985 in Oranjestad and San Nicoles revealed that 35.8% of the persons interviewed had evidence of dengue infection. Based on this information an estimated 24,000 persons were infected during the epidemic.

Vector control measures consisted of the application of ULV spraying and thermal fogging control of houses of suspected dengue cases and its immediate vicinity. Focal and perifocal treatment was also carried out in each dengue case premises, and all premises within a 100 meter radius were inspected and sprayed internally. The whole island was sprayed at least once and in some high risk areas and port areas spraying was done twice.

SURVEILLANCE FOR DENGUE: THE IMPORTANCE OF INTERNATIONAL COLLABORATION

by Dr. A. A. Arata, Senior Technical Officer
Vector Biology and Control Project/USAID

Other participants have presented the role of PAHO/WHO, and the CAREC and CDC San Juan Laboratories in providing surveillance and viral surveillance in the Caribbean in respect to dengue and DHF. This paper presents several general topics which are inherent to international collaboration. These include:

1. The quality of international surveillance systems depends on the quality of the surveillance data collected at national levels. Therefore it is important that systems of data collection are standardized to facilitate summary and analysis to determine international trends and to enhance the reporting which is the responsibility of the international organizations.

2. Surveillance at an international level must be a "two-way" flow of information. It is essential that national authorities are able to review their activities, in a timely way, in relation to the activities of their neighbouring countries. Contrasts in efficacy, types of control measures employed, cost-effectiveness of different control strategies, etc., will allow more rapid adoption of regionally tested strategies and enhance the development of regional plans for action and collaborative effort. This is especially true in the Caribbean where so many small states lack the critical mass for research and testing new approaches to vector control.

3. Surveillance should be broadly defined and include clinical, virological, entomological and behavioural aspects as well as retrospective case reporting. By small additional effort ecological data on human life styles can be used to stratify vector breeding sites and enhance control measures.

4. Strengthening surveillance measures enhances evaluation of efforts, and generally enhances opportunities for international assistance by demonstrating the capability of the national authorities to identify their problems and the national commitment to improve the situation.

5. It is only through sound surveillance practices on an international level that we can move from retrospective case reporting to prediction of potential epidemic situations which permits prevention or reduction in their severity.

INTEGRATED CONTROL STRATEGY AS IT RELATES TO THE PREVENTION OF DENGUE EPIDEMICS

by Dr. A. A. Arata, Senior Technical Officer,
Vector Biology and control Project/USAID

In the absence of capability for long term prediction of disease epidemics, knowledge of the characteristics of local Aedes populations and the ability to maintain them at low levels is the most effective means of preventing or reducing the impact of dengue/DHF outbreaks. Our experience to date favours the use of integrated control systemsrather than the dependence upon a single method.

Integrated control is not so much as a single technique as it is an ecological approach, starting with habitat management (source reduction). This must start with understanding the human ecology as man creates the habitats (water shortage, waste containers, etc.) with which we are concerned. To do so efficiently health education and general community enterprise is required. Whenever possible Aedes control should be linked to overall improvement of sanitation.

The proper use of chemical insecticides can be effective, both as larvicides and as adulticides during peak periods when epidemics threaten. However resistance continues to develop and few new pesticides are reaching the market. Therefore we must conserve the effective use of those that we have through judicious use.

Biological control through the use of predators such as fish and Toxorhynchites can have an impact on reducing vector populations but generally require integration with other methods (insecticides and source reduction) to consistantly control populations at the low levels required. Control with the microbial insecticides (Bacillus theringiensis (S-14) and possibly B. sphaericus) may be an added approach but, although environmentally safe, should be examined for cost effectiveness along with other larviciding means.

An example of the control measures used in Singapore, relying heavily on source reduction, health education, community participation, and enforced legislation against household breeding of Aedes was presented.

As the WHO and major donors in the field of disease control (such as USAID) have emphasized the need to improve Primary Health Care (PHC) systems, it is suggested that Aedes control authorities take advantage of the increased opportunities for improving health education and the general health services in reinforcing their campaigns for control of Aedes vectors during the critical interepidemic periods.

SURVEILLANCE FOR DENGUE: THE ROLE OF THE CARIBBEAN EPIDEMIOLOGY CENTRE

BY ELISHA TIKASINGH
Parasitologist/Entomologist
The Caribbean Epidemiology Centre (PAHO/WHO)

The Caribbean Epidemiology Centre (CAREC) was established in 1975 by Bilateral and Multilateral Agreements between PAHO and 18 Commonwealth Caribbean Governments. Suriname joined later. Objectives of the Centre were:-

1. Disease Surveillance
2. Diagnostic service for virology and supportive referral services for bacteriology, parasitology and entomology.
3. Training for surveillance and laboratory personnel.
4. Conducting of operational research relevant to the basic programmes of the Centre.

When CAREC was established it incorporated the Trinidad Regional Virus Laboratory (TRVL). The TRVL itself was established in 1953 by the Rockefeller Foundation with later financial assistance by the Trinidad and Tobago and Commonwealth Caribbean Governments to study arboviruses of the region. Obviously, dengue was part of this study and the first isolation of Dengue virus type 2 in the Western Hemisphere was made in our laboratory.

CAREC's role in the Surveillance of dengue fever is threefold:-

1. Examination of diagnostic specimens
2. Collection and dissemination of information; and
3. Entomology.

Collection and dissemination of information

One of CAREC's function is to collect, analyze and disseminate information on communicable diseases to its member countries: dengue, dengue haemorrhagic fever and dengue shock syndrome form an important part of this activity. In times of epidemics however, and if there are politically sensitive aspects to an epidemic, information is forwarded to other countries only with the permission of the affected country and by confidential telex to the Designated Epidemiologists and/or Chief Medical Officer, who have been requested not to release information to the press.

Entomological

Entomological activities are limited to assisting countries with surveillance of vector populations by species identification and training of entomological technicians. CAREC has well trained staff and has maintained a large collection of mosquito reference specimens and is well equipped to perform these functions.

At the request of the Ministry of Health, Trinidad and Tobago, surveillance for *Ae. aegypti* at the airports in Trinidad and Tobago have been carried out over a 10- year period, 1977-1987. The Centre has also initiated surveillance at the Grantley Adams Airport and is presently being conducted by Vector Control Staff in Barbados.

CAREC has also initiated research studies on the control of the dengue vector *Aedes aegypti* using the predatory mosquito *Toxorhynchites moctezuma*. Releases of adult *Tox moctezuma* have just started at Diego Martin in conjunction with the Insect Vector Control Division of Trinidad and Tobago. CAREC has also received a grant from BOSTID (US National Research Council)to conduct trails in Union Is. St. Vincent and The Grenadines.

The Centre thus serves as a unique listening and action post for member countries.

AIRCRAFT DISINSECTION

by

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The International Health Regulations include guidelines on spraying aircraft with insecticides (Bailey,1977), as approved by all member Governments of WHO.

The Public Health objective of aircraft disinsection is to prevent international transportation of living insects, such as mosquitoes, houseflies, cockroaches, that may spread disease or become established as pests or vectors in new parts of the world. The presentation includes some important examples, notably the recent upsurge of airport malaria cases due to importation of infective Anopheles to European airports (White, 1985).

Four insecticides have been approved by WHO (1985) for spraying in the cabin of passenger aircraft in service. These are: resmethrin, bioresmethrin, d-phenothrin and permethrin.

The treatment rate should be 35g/100m^3 (=10g/100 ft^3) of specified 2% formulations of these insecticides, dispensed as 30-50μ VMD aerosol droplets from a special type of "one-shot" nozzle on a pressurized can. Application should be either in the sealed aircraft before take-off (at "blocks away") or immediately when doors of the plane are opened after landing.

Fogging with hand-held mist-blowers and other procedures are appropriate for treatment of cargo planes and baggage compartments of passenger planes, both before take-off and on arrival. In the Cayman Islands, for example, this is done for a fee of US$3-6 per plane on arrival as an obligation for which the pilot must pay on the spot. It is also appropriate to implement these procedures on flights within countries in some situations (e.g. against Ae. albopictus on flights from Hawaii to North America).

Interior residual treatment of planes with permethrin has also been advocated and applied especially for smaller short-range aircraft (e.g. Dale, 1982), but this procedure which also is beneficial against crawling pests and agricultural insects is not reliable as the only method of disinsection for control of flies and mosquitoes.

To prevent or minimize the risks of insects, rodents etc. getting onto planes, Airport Health Authorities should also implement stringent control measures (e.g. sanitation, larviciding, residual and space-spraying of insecticides) in all airport facilities and their environs. (WHO, 1972,1986).

REFERENCES

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G. B. White (1985). Airport Malaria and Jumbo Vector Control Parasitology Today, 1, 177-179

WHO (1972) Vector Control in International Health, WHO Geneva. 144pp.

WHO (1985) Recommendations on the disinsecting of aircraft. Weekly Epidemiological Record, 60, 45-52.

WHO (1986) Intercountry Seminar on Airport Vector Control in the South Pacific. Honiara, Solomon Islands, 12-15 May, 1986. WHO Regional Office for the Western Pacific. (WP) VBC/ICP/VBC/003-E. 44pp.

PLAN OF ACTION

STRATIFICATION

The Plan of Action for *Aedes aegypti* has been revised in draft form to include the concept of stratification in control programs. Where economic constraints prevent simultaneous coverage of the entire country, it may be possible to prioritize the localities, and the houses within each locality according to risk of dengue transmission, and use the scarce resources to optimal advantage by treating the high-risk areas first. This approach is being tried in Guatemala and Puerto Rico. In Mexico, several indicators of risk have been identified, including House Index, number of drums and tanks per 1000m^2, and length of residence in the same house.

INTEGRATED CONTROL

Routine control of *Aedes aegypti* should be based on an integrated program of souce reduction, health education and community involvement. Chemical control should be considered as a temporary, stop-gap measure only. Temephos (Abate 1% sand granules) gives good control for many weeks, but insecticide resistance is now emerging. Perifocal application with fenthion also results in long-lasting control, but may result in environmental contamination. Space spraying reduces adult populations of mosquitoes for a few days only and should be reserved for emergencies.

EMERGENCY CONTROL METHODS

Space spays of adulticides are applied as thermal fogs (high-volume, low concentration of insecticide mixed with diesel) or as aerosols (ultra-low-volume of concentrated insecticide applied as tiny droplets). Indoor application with portable, hand-held or backpack machines are highly effective. Applications from vehicle mounted aerosol generators and thermal foggers are less effective, depending on degree of openness of doors and windows of the houses, on accessibility by roads and on wind conditions.

- Field trials of ULV application at 4-6 oz per acre with vehicle-mounted aerosol generators in Thiland and Colombia have shown that the man-biting population is reduced 50-99% and recovers 3-14 days later. Recent tests in Puerto Rico at a lower dosage detected no reduction in ovitrap positivity after ULV vehicle application, although the mosquitoes in bioassay cages were killed. Further field trials are necessary to define the optimal operational parameters for this method.

ULV application from fixed-wing multi-engine and single engine aircraft has been shown to be as effective as ground vehicle application, and is much faster. When available, it is the method of choice for rapid response to dengue epidemics. It should <u>not</u> be done without expert technical assistance, because of the many operational parameters which must be carefully controlled or monitored, such as wind conditions, swath width, height of the aircraft over the roof tops, calibration of discharge rate and computation of dosage per acre. Some countries do not allow single-engine aircraft to fly over urban areas and have regulations as to the minimum height the aircraft may fly. The cost of aircraft application may be very high or may be less than ground application, depending on hourly charges for the aircraft. In some countries suitable aircraft are available from the armed forces or from crop-dusting companies.

SURVEILLANCE

The importance of epidemiologic surveillance must be emphasized. Dengue incidence with serological confirmation must be carefully monitored in order to detect any unusual increase in numbers of cases. Emergency control measures should be applied when an epidemic appears to be imminent. If you wait until the official declaration of an emergency, it is already too late. The outbreak will run its course, and by the time vector control measures are applied, the epidemic will have already peaked, and the measures will not have much effect on the course of the outbreak.

CONTROL EMERGENCY PLANS

During the workshop, each representative prepared an Emergency Plan for his country, following the guidelines prepared by the response personnel (Annex). The plans included provision for the naming of an emergency committee, gathering of information on present and required resources for the routine program and for emergency control, criteria to be used for determination of the existence of an emergency situation, and methodology to be used for emergency control. Emergency Plans were presented to the group by the participants from Barbados, Martinique, St. Lucia and St. Maarten.

DRAFT: CONTINGENCY PLAN: OUTLINE FOR EMERGENCY CONTROL OF AEDES AEGYPTI, THE VECTOR OF YELLOW FEVER AND DENGUE

I INTRODUCTION:

THE FOLLOWING OUTLINE IS SUGGESTED TO ENABLE PARTICIPANTS TO FORMULATE THEIR OWN CONTINGENCY PLANS AS PART OF THE TRAINING EXERCISE FOR THIS SEMINAR.

DIRECTIONS:

1. THE PARTICIPANTS WILL BE DIVIDED INTO FOUR DISCUSSION GROUPS, EACH WILL CHOOSE ITS OWN CHAIRMAN AND RAPPORTEUR, AND WRITE A CONTINGENCY PLAN FOR ONE COUNTRY ONLY.

2. THE DISCUSSION GROUPS WILL FOLLOW THE SUGGESTED OUTLINE WITH MODIFICATIONS AS THEY DEEM DESIREABLE AND NECESSARY.

3. SEE ANNEX, THIS INSTRUCTION SHEET, FOR HELPS AND REFERENCES FOR DEVELOPING SPECIFIC AREAS OF THE PLAN.

CONTINGENCY PLAN GUIDE:

I The Emergency Committee:

1. Appointment (by whom?)
2. Members
3. Center of Operations
   A) Location
   B) Requirements
      -Space
      -Telephones
4. Duties
   A) Write the plan
   B) Official declaration of emergency
   C) Coordinate emergency Activities
   D) Designate responsiblities during emergency
   E) Procurement of necessary resources

5. Meetings
   1) Frequency
   2) Purpose
6. Liaison

II The emergency Plan

A. The Preparatory Phase:

1. Analysis of risk: i.e. Preparation of tables, figures maps of:
   a. Disease
      1) Own country and neighboring countries.
      2) Dengue, DHF, DSS and YF.
      3) Historical, present and potential.
      4) Population at risk.

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b. vector
   1) Distribution
   b) Indices
   c) Susceptibility to insecticide
2. Analysis of Present Vector Control Programs
   a. Insititutions
      1) National (SNEM, DCV)
      2) Local
         a) General Health Service
         b) Solid waste management, etc.
   b. Inventory of Resources
      1) Human resources
      2) Equipment and Spare Parts
      3) Insecticides
      4) Vehicles
3. Emergency Requirements
   Based on estimation of risk.
   (see section II.C.5 and treatment scenario, section II.C.7.)
   a. Items now available
   b. Items to be stockpiled
   c. Items to be obtained upon entry into "Alert Phase" or "Emergency Phase".
      1) Local
      2) International
4. Procurement of Necessary Items
   a. The emergency budget
      1) Standing emergency reserve funds
      2) Provision for alotment of funds upon declaration of emergency.
   b. Sources of equipment
      1) Local
      2) International
   c. Sources of human resources
   d. Funding agencies
   e. Contigency contracts, for consultants, or equipment
5. Special training in preparation for an emergency
   a. Courses
   b. Simulations
   c. Pilot studies of new methodologies

B. The Alert Phase:

1. After a natural disaster
   a. Criteria
   b. Plan of action
2. Dengue, DHF, DSS or YF in a nearby country
   a. Criteria
   b. Plan of action
3. Dengue, DHF, DSS or YF in own country
   a. Criteria
   b. Plan of action

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C. The Emergency Phase:

1. Criteria for determination of an emergency
   a. Epidemiological
      1) Dengue, DHF, DSS or YF
      2) Clinical Cases
      3) Serological confirmation
      4) Isolation necessary ?
      5) Population at risk, and probability of an epidemic.
   b. Entomological
2. Declaration of an emergency
3. Responsibilities
   a. Coordination
   b. Vector Control and Surveillance
   c. Disease treatment and surveillance
4. Dissemination of information
   a. Media
   b. General public
   c. Bee keepers
5. Procurement,organization and budget for necessary manpower, equipment, insecticide and supplies.
6. Determination of areas to be treated
   a. Affected areas
   b. Areas at risk

7. Plan for Vector control operation:

   a. Adult control

      1) Ground application
         a) Type of machines
            (1) Vehicle mounted
            (2) Back pack
         b) Insecticides (based on susceptibility and previous trials)
         c) Dosage as determine by:
            (1) Discharge rate
            (2) Swath width
            (3) Speed of vehicle
            (4) Area treated
            (5) Total insecticide applied
         d) Droplet size
         e) Frequency of application
         f) Climatological limitations

      2) Aircraft application

         a) Type and source of aircraft and spray equipment
            (1) Single engine aircraft
            (2) Twin engine aircraft
            (3) Helicopter

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b) Time required to formalize contract
c) Configuration time and steps for installation of spray equipment
d) Federal aviation restrictions over urban areas
e) Center of operations at airport
f) Calibrations
g) Reconnaisance flights
h) Special staff
(1) Pilot
(2) Ground crew
i) Swath markers
j) Insecticide, dosage, droplet size, and climatological limitations
k) Height of flights during spraying

b) Larval control

1) Focal
2) Elimination of breeding containers
a) source reduction
b) destruction and removal

8. Evaluation of the emergency control measures (tables, graphs and maps)
a. Type
1) Operational
2) Entomological
3) Epidemiological
b. Frequency

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ANNEX THE FOLLOWING MATERIALS ARE FOR SUGGESTION ONLY:

1. SUGGESTED LIST OF MEMBERS OF COMMITTEE:

1) CHAIRMAN FROM MINISTRY OF HEALTH
2) EPIDEMIOLOGIST-GOVERNMENT
3) CHIEF OF NATIONAL PUBLIC HEALTH LABORATORY
4) CHIEF MEDICAL OFFICER OF HEALTH
5) CHIEF PUBLIC HEALTH INSPECTOR
6) MANAGER OF VECTOR CONTROL OR AEDES AEGYPTI OR MALARIA PROJECT.
7) SENTINEL PHYSICIAN REPRESENTATIVE
8) REPRESENTATIVE'S FROM OTHER GOVERNMENT AGENCIES INVOLVED.
   a) AGRICULTURE
   b) TOURISM/CHAMBER OF COMMERCE
   c) POSSIBLY MILITARY
9) PAHO REPRESENTATION

2. GUIDE - TO GROUND OPERATIONS:

A. AERIAL PHOTOGRAPHS (MAPS) OF COUNTRY BY AREAS
   1) FOR LATER DETERMINATION OF CASES, CLUSTERS, EXTENT OF EPIDEMIC ON MAPS WITH PINS, MARKERS,
   2) ABOVE AIDS IN DECISION MAKING REGARDING CHOICE OF TREATMENT METHOD.
      a) IF AREA IS EXTENSIVE, IN A HEAVILY POPULATED URBAN AREA - CONSIDERER AERIAL ULV.
      b) IF CASES ARE IN A SMALL CITY, OR IN A CONFINED AREA - CONSIDER USING VEHICLE MOUNTED MACHINES.
      c) IF CASES IN SLUMS, OR SCATTERED IN AREAS WITHOUT ROADS - CONSIDER USING PORTABLE KNAPSACK MISTBLOWERS OR FOGGERS.
      d) MANY AREAS WILL REQUIRE THE USE OF BOTH VEHICLE MOUNTED AND KNAPSACK PORTABLE EQUIPMENT.

3. VECTOR CONTROL OPERATION:

A. INVENTORIES:

   1) INSECTICIDE ON HAND, QUANTIFY, AGE, WHERE STORED.
   2) HOW TO ORDER ADDITIONAL SUPPLIES IN AN EMERGENCY.
      a) LOCAL SOURCES
      b) INTERNATIONAL SOURCES
   3) INVENTORY: HEALTH EQUIPMENT
      HAND SPRAYERS
      POWER SPRAYERS
      ULV VEHICLE MOUNTED
      ULV PORTABLE
      THERMAL FOGGERS
      - VEHICLE MOUNTED
      - PORTABLE

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OTHER EQUIPMENT
VEHICLES
- NUMBER AND TYPES
- CONDITION OF

4) INVENTORY: OTHER SOURCES
   a) MINISTRY OF AGRICULTURE
   b) MINISTRY OF TOURISM
   c) MINISTRY OF DEFENSE
   d) HOTELS/PRIVATE INDUSTRY
   e) PEST CONTROL AGENCIES
   f) PRIVATE SOURCES, I.E. DEALERS, ETC.

B. MAP OF CITY OR AREAS
1) DIVIDE AREA INTO ZONES, EACH ZONE WOULD CORRESPOND TO AN AREA THAT A VEHICLE MOUNTED FOGGER COULD COVER IN ONE DAY OF OPERATION (CONSIDERING TIME OF OPERATION WHICH MUST CONFORM TO MOSQUITO PEAK PERIODICITY.)
2) CAN DEVELOP A COLOR SCHEME WITH CORRESPONDING COLOR TO DESIGNATE TYPE OF APPLICATION.
3) COLOR FOR ZONE TREATED WITH A PARTICULAR MACHINE AND INCLUDE DATE OF TREATMENT, THIS ENABLES ONE TO VISUALLY FOLLOW THE PROGRESS OF:
   a) WHAT HAS BEEN TREATED
   b) WHAT HAS NOT BEEN TREATED
   c) WHERE INDIVIDUAL MACHINES ARE SPRAYING
   d) ZONES WHICH STILL REQUIRE TREATMENT/ RETREATMENT
   e) SMALLER ZONES FOR WHICH KNAPSACK OR COMBINATION TREATMENT CAN BE DESIGNATED.

4. WHERE TO OBTAIN EMERGENCY CONTROL INFORMATION FOR EQUIPMENT:

a) EMERGENCY VECTOR CONTROL AFTER NATURAL DISASTER (PAHO SCI. PUBL. NO.419) PP. 90-93.
   * LIST OF MANUFACTURES AND DISTRIBUTORS OF PESTICIDES, MATERIALS AND EQUIPMENT FOR THE CONTROL OF VECTORS, 8 PP, (UNPUBLISHED PAPER)
b) PROVISION OF TELEPHONE DIRECTORIES, AIRLINE SCHEDULES, LIST OF HAM RADIO OPERATORS, RADIO TELEVISON AND NEWSPAPER SERVICES.
c) INFORMATION ON BILATERIAL AGREEMENT FOR POSSIBLE PROVISION OF INSECTICIDE AND EQUIPMENT.
d) SOURCES FOR PARTS, I.E. LOCAL, INTERNATIONAL
e) LIST OF PARTS ON HAND IN MINISTRY STORES.

5. PRE-TREATMENT PLANNING FOR:

1) INFORMING PUBLIC AND OFFICALS IN OTHER GOVERNMENT AGENCIES, I.E. POLICE AND TEACHERS RE-OPERATIONS
2) BEE KEEPERS REQUIRE SPECIAL INFORMATION
3) THE READYING OF EQUIPMENT AND INSECTICIDE

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a) VEHICLES TO BE USED IN THE OPERATION SHOULD BE IN GOOD WORKING ORDER AS THERE IS A TENDENCY FOR TRUCKS TO OVERHEAT AT SLOW SPEEDS.

b) VEHICLES SHOULD HAVE BLINKING HAZARD LIGHTS AND FLASHING AMBER LIGHT INSTALLED ON TOP OF CAB.

c) EQUIPMENT SHOULD BE CALIBRATED:
I.E. OUTPUT PER ML. PER MINUTE
DROPLET SIZE
SWATH WIDTH

d) DRIVERS SHOULD BE FAMILIAR IF POSSIBLE WITH ZONES AND TREATMENT ROUTES, BEING SUPPLIED WITH ZONE MAPS WITH ARROWS INDICATING ROUTES.

e) IN AS MUCH AS HOURS OF WORK WILL BE IRREGULAR, LABOR UNION APPROVAL AND ADJUSTMENT IN PAY FOR OVERTIME MAY BE NECESSARY.

f) DRIVERS AND EQUIPMENT OPERATORS MUST BE INSTRUCTED ON THE PROPER USE OF EQUIPMENT, ETC.
SPEED OF VEHICLES
TEMPERATURE LIMITATIONS IF ANY
WIND LIMITATIONS
PRECAUTIONS IN HANDLING ULV FORMULATION OF INSECTICIDES

6. PRE TREATMENT ENTOMOLOGICAL EVALUATION:

a) DATA CONCERNING PRE SPRAYING INDICES
b) OVITRAP SURVEY DATA
c) ADULT MOSQUITO BIOASSAY (WHEN POSSIBLE)

7. TREATMENT DAY

a) TREATMENT WITH ULV AND THERMAL FOGGERS AGAINST AE. AEGYPTI IS IDEALLY DONE IN THE EARLY MORNING AND EVENING TWILIGHT HOURS. RESIDENTS OF THE ZONE OF TREATMENT SHOULD BE NOTIFIED REGARDING THE SPRAYING, A DAY PRIOR TO TREATMENT, WITH A REQUEST TO OPEN WINDOWS AND POSSIBLE DOORS AT TIME OF APPLICATION. INFORMATION SHOULD BE DESCIMINATED REGARDING THE COVERING OF FOOD, PET BIRDS, AND THAT HUMANS SHOULD AVOID DIRECT EXPOSURE TO THE SPRAY.

b) IN AS MUCH AS SPRAYING BY GROUND VEHICLE WILL BE AT HEAVY TRAFFIC PERIODS, AN ESCORT BY THE POLICE IS DESIRABLE.

c) PRIOR TO SPRAY ROUND THE VEHICLE SHOULD BE CHECKED FOR:
- SUFFICIENT PETROL (FULL TANK)
- RADIATOR FULL, WITH RESERVE WATER IF NECESSARY
- BATTERY WATER LEVEL
- OIL LEVEL
- TIRE PRESSURE
- READYNESS OF SPRAY EQUIPMENT
- WATER
- FUEL

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- OIL
- BATTERY
- DRIVE BELTS
- INSTRUMENT PANEL FUNCTIONS
- NOZZLES
- INSECTICIDE TANKS
- FLUSHING TANKS

d) A COPY OF EQUIPMENT INSTRUCTIONS MANUAL SHOULD BE IN THE VEHICLE.

e) SPRAYING OPERATION INSTRUCTIONS
START ENGINE AND CHECK INSTUMENT PANEL, AND SET DOSAGE RATE.
SET NOZZLE DIRECTION AND ANGLE
RECORD INFORMATION REQUIRED ON FORM
BEGIN OPERATIONS - IF WIND OR TEMPERATURE INCREASE ABOVE RECOMMENDATION..STOP
WHEN ZONE IS SPRAYED OR TIME PERIOD ENDS
RETURN VEHICLE TO OFFICE, RECORDING:
- MILEAGE
- INSECTICIDE
- EQUIPMENT PROBLEMS

THE EQUIPMENT MUST BE FLUSHED AND SERVICED.

8. POST SPRAYING ENTOMOLOGICAL EVALUATION

a) OVITRAP SURVEY RESULTS
b) SPOT CHECK SURVEYS IN SPRAY AREA FOR RESTING ADULTS
c) ADULT MOSQUITO BIOASSAY RESULTS

TABLE: CATEGORIES CONTAINING CORRESPONDING LEVELS OF THE THE THREE AEDES AEGYPTI LARVAL INDICES

DENSITY FIGURE	HOUSE INDEX	CONTAINER INDEX	BRETEAU INDEX
1	1-3	1-2	1-4
2	4-7	3-5	5-9
3	8-17	6-9	10-19
4	18-28	10-14	20-34
5	29-37	15-20	35-49
6	38-49	21-27	50-74
7	50-59	28-31	75-99
8	60-76	32-40	100-199
9	77<	41<	200<

TAKEN FROM: BROWN, A.W.A. 1973. SURVEILLANCE SYSTEM FOR AEDES AEGYPTI AND RELATED STEGOMYIA MOSQUITOS IN TERMS OF DENSITY. WHO/VBC/73.464.

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THE EMERGENCY CONTROL OF

AEDES-BORNE EPIDEMICS

WORKSHOP
BARBADOS
11-15 MAY 1987