A network of collaborating academic institutions throughout the Americas should be established to make health promotion skills development a part of the professional preparation of many types of health workers. Similarly, participatory approaches in community-based education need to become an integral part of in-service and continuing education of personnel at the regional, national, and local levels. A priority area for skills development is sensitization of health services personnel to the priorities, needs, practices, and cultural values and expressions of the community.

To facilitate intersectoral action, basic health promotion concepts should be taught to personnel at all levels in such fields as education, agriculture, and labor, and to the general population.

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*Source:* Pan American Health Organization; Health Promotion, Health Education, Community Participation: Relationships and Relevance for the Americas; Preliminary Report of a Technical Workgroup; Washington, D.C., 1988.

# UPDATE ON *AEDES ALBOPICTUS*: STATUS AND CONTROL IN THE AMERICAS

Established infestations of *Aedes albopictus*, a mosquito native to Asia and a proven vector of dengue and other arboviral diseases, were first found in the United States in 1985 and in Brazil in 1986. Noting the potential seriousness of this new threat to public health in the Americas, in 1986 the XXII Pan American Sanitary Conference adopted a resolution recommending that Member Countries initiate or continue surveillance activities for *A. albopictus* and measures to prevent its further spread, or that they eradicate it if possible; it also urged the Director to prepare a plan of action to combat *A. albopictus* in the Region, support detection, surveillance, and control activities, and promote research to improve control measures. The plan of action was approved in 1987 by the PAHO Executive Committee and the Directing Council. (See the *Bulletin of PAHO*, 21(3), 1987, pages 314–324, for a discussion of the public health implications of *A. albopictus* and an outline of the plan of action.)

## Status of the Infestation

*Aedes albopictus* has spread within the two countries at an alarming rate, displacing *Aedes aegypti* in many areas where that vector was present. By October 1986, *A. albopictus* had been found in 12 states in the United States and four in Brazil. The expanding infestations in Brazil are still confined to the same four states (Espírito Santo, Rio de Janeiro, São Paulo, and Minas Gerais), but in the U.S. the mosquito has subsequently been discovered in five more states. In that country *A. albopictus* has become established principally in the South, East, and Midwest. The northernmost infestation is in downtown Chicago, Illinois.

Eight U.S. cities known to be infested with *A. albopictus* were surveyed in detail in 1987 to determine how far the mosquito has spread from the original foci of introduction and the manner in which it is spreading. Preliminary data suggest that *A. albopictus* is not yet well established in the more northerly cities, but it is a prominent *Aedes* species in all of the southern cities surveyed, with the exception of Jacksonville, Florida. Attempts by state and local agencies to eliminate or reduce focal infestations have had mixed results.

## Modes of Introduction

Following the discovery of the first *A. albopictus* infestation in Houston, Texas, in August 1985, the U.S. Centers for Diseases Control (CDC) began to investigate possible routes of entry of the mosquito. Since *Aedes albopictus* and other container-breeding *Aedes* species commonly breed in water found in tire casings stored outdoors, and since *A. albopictus* had previously been found in shipments of used tires from Asia *(1, 2)*, this route was immediately suspected.

Between 18 May and 4 December 1986, 79 seagoing containers and their contents of 22,051 used tire casings entering the United States were inspected for the presence of mosquitoes. Of the total inspected, 5,507 tires (25%) contained water. No adult mosquitoes or eggs were found, but 15 tires contained mosquito larvae that were identified as *Aedes albopictus, Aedes togoi, Tripteroides bambusa, Uranotaenia bimaculata*, and a member of the *Culex pipiens* complex *(3)*. *Aedes albopictus* larvae were the most frequently collected, occurring at a rate of 20 larvae per 10,000 tires containing water. The overall infestation rate was 6.8 tires per 10,000 inspected. At these rates, 1,000 to 2,000 infested tires per year could be expected to arrive at U.S. ports from Asian countries.

The vector has been discovered in tire shipments in widely scattered localities where it has not yet become established. In 1986, *A. albopictus* was collected from large-equipment tires shipped from Hawaii to an Oakland, California, tire dealer, but no additional specimens have been recovered from the Oakland site. In 1987, *A. albopictus* larvae were found in a cargo of used tires arriving in Barbados from Japan. The larvae were identified at PAHO's Caribbean Epidemiology Center and represent the first collection of this species from the Caribbean area *(4)*.

The international trade in used tires from Asia is large and well documented. It appears to have been the most likely route of entry of *A. albopictus* into the U.S. and will be a principal factor in the mosquito's spread to other countries in the Americas.

## Implications of Further Introductions

The introduction of *Aedes albopictus* into the U.S. and Brazil illustrates the increasing vulnerability of countries or regions to the spread of vector species through modern shipping practices. Tires are a mode of transport ideally suited not only to the introduction of *A. albopictus* but of other exotic mosquitoes that breed in similar habitats, presenting the danger that different species of disease vectors will become established in places they do not now occupy. But of additional concern is that other strains of already-present vector species may be introduced in the future, and with them new viruses, insecticide resistance, and, at the least, a more diverse gene pool with greater adaptability.

**Possible introduction of arboviruses.** It has been demonstrated that a number of important arboviruses, including dengue, yellow fever, and the La Crosse virus, can be transmitted vertically by *Aedes albopictus*; that is, infected adult females lay infected eggs. In this way, a virus may be introduced in cargo such as used tires by means of eggs that produce infected mosquitoes at the shipment's destination.

**Insecticide resistance.** *Aedes albopictus* from many Asian countries are known to be resistant to one or more insecticides commonly used in vector control. Insecticide susceptibility tests conducted by the New Orleans Mosquito Board, Rutgers University, and the CDC have shown that this species has increased tolerance to malathion, temephos, and bendiocarb, among the limited number of insecticides evaluated to date. Should resistant strains be introduced, they would undoubtedly quickly replace existing susceptible strains if the insecticide to which they are resistant remained in use, making their control very difficult and creating an especially dangerous situation during epidemics.

**Genetic diversity.** *Aedes albopictus* occurs in a very large area of the world, living in greatly varied habitats and conditions. Introduction of strains from those diverse areas increases the genetic diversity and potential adaptability of existing populations and carries the risk that the populations may become better able to expand into new areas. For example, the strain of *Aedes albopictus* that presently occurs in the United States apparently is unable to spread southward from the temperate zone into the tropics. Introduction into the southern U.S. of a strain adapted to the tropics would likely result in a rapid spread of this vector into Mexico and beyond.

## Control of Introductions

Unless efforts are made to control the situation, there will likely be further introductions of strains of *Aedes albopictus* as well as introduction and establishment of other exotic species. However, the means of spread has been demonstrated and is preventable, and measures taken to prevent the spread of *Aedes albopictus* via tires will also be effective against other vectors imported in the same way.

To this end, on 1 January 1988 the U.S. Public Health Service implemented a regulation requiring that all used tires from Asian countries arrive at U.S. ports dry and with a certificate attesting to their having been treated in a manner ensuring that they are insect-free. Disinsection and certification are to be carried out by the exporter using one of the following methods:

1) Clean, dry tire casings are fumigated with at least two pounds of methyl bromide fumigant per 1,000 cubic feet for 24 hours. The container must be opened following fumigation to allow desorption of the fumigant, which requires two to four days depending upon ambient temperature. The methyl bromide concentration in a container closed for 12 or more hours must be less than 5 ppm before the container is released.

2) Clean, dry tire casings are subjected to dry heat at a temperature of 120°F (49°C) for more than 30 minutes (the heat and time necessary to kill *A. albopictus* eggs). Various methods may be used to raise the temperature to this level. Thermocouples or other devices placed in several locations within the container (including the point farthest from the heat source) should be used to verify that minimum effective heat treatment has been achieved.

3) Clean, dry tire casings are subjected to steam or a pressurized spray of hot water (190°F, 88°C) containing detergent. Care must be taken to treat the entire inside surface of each tire. Water remaining after treatment must be removed.

After tires have been disinsected they must be kept dry. The exporter must sign a certificate specifying the method of disinsection used and the date the tires were treated. The U.S. Customs Service will ensure that all shipments of used tire casings from Asia are accompanied by a valid CDC Disinsection Certificate before releasing the cargo. The CDC will make site visits to the major exporting countries to verify disinsection capabilities, will perform periodic inspections of shipments of used tire casings to monitor compliance, and will receive copies of the disinsection certificates from the U.S. Customs Service.

## Response by PAHO

PAHO's plan of action to achieve the elimination of *Aedes albopictus* from the Americas called for preparation of national action plans, with PAHO regional activities in support of them. Once national plans of action are in force, bilateral and multilateral agreements can be made between Member Countries for joint surveillance and control activities.

It is recognized that appropriate legislation is required to prevent importation and exportation of the vector. In addition to legislation, such as the new U.S. regulations outlined above,

there is a need for surveys of the tire casings trade, investigation of containerization procedures in the countries of origin of exported tires to determine if they comply with disinsection recommendations, *ad hoc* task force meetings of public health officials and industry representatives, and expansion of the network for rapid exchange of scientific information and surveillance data.

In this regard, PAHO will continue to disseminate available scientific and technological information to Member Countries. The CDC guidelines for certification of mosquito-free cargo and alternative methods for treatment of tire casings have been circulated to the countries. In addition, WHO's Vector Biology and Control Division has incorporated the CDC specifications into the upcoming edition of its publication *Vector Control in International Health*. PAHO has already included these norms in all medical entomology and vector control courses and seminars in the Region and is providing the necessary technical cooperation at the country and subregional levels.

PAHO considers the U.S. Public Health Service regulations and CDC specifications on the importation of used tires technically sound and operationally feasible. A resolution drafted at the 101st Meeting of the Executive Committee in June and recommended to the XXXIII Meeting of the Directing Council, to be held in September, encourages Member Countries to adopt legislation appropriate to local conditions to prevent importation and exportation of *Aedes albopictus*.

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*Sources:* (1) Pan American Health Organization, *Aedes albopictus*: A Proposal for Action by the Pan American Health Organization (Document CE101/28), Washington, D.C., 29 June 1988; (2) World Health Organization, *Aedes albopictus* infestation: update, *Wkly Epidemiol Rec* 63(17):123–124, 1988; (3) PAHO, Provisional Summary Record of the Seventh Plenary Session, 101st Meeting of the Executive Committee (Document CE101/SR/7), Washington, D.C., 30 June 1988, pp. 25–29.