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SPECIAL TECHNICAL PROBLEMS IN MALARIA ERADICATION IN LATIN AMERICA

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Introduction

Problem areas in the Americas have been found usually to be due to a combination of factors. While double resistance (to both DDT and dieldrin) is the most important single factor, DDT usually continues to exert considerable suppression of transmission, although not sufficient to halt it entirely, even in the presence of resistant vectors. This may be due to irritability, repellency, or merely to a low or moderate level of resistance.

The chief factors found operating in problem areas are:

(a) resistance of the vector to insecticides;

(b) irritability of the vector;

(c) incomplete or highly perforated walls, usually serious only when combined with irritability to DDT;

(d) mud walls which rapidly absorb, or inactivate, residual insecticides - almost never serious except in the presence of resistant strains;

(e) agricultural redevelopment areas - usually found in low, poorly drained land; much new housing between cycles, much housing of poor quality;

(f) movement of people in pursuit of work, resulting in living in temporary shelters of poor construction, without walls, often unsprayed;

(g) a predominantly outdoor biting and resting habit of the vector.

While technical problems have caused delays in achieving eradication, and increased the financial burden for a number of countries, they involve only a small fraction of the hemisphere programme. Until spraying is applied at maximum efficiency, it is not possible to predict the size of problem areas or the amount of supplementary attack that will be needed.

Physiological resistance of anophelines to insecticides. Most countries have been shifting the emphasis of entomological work away from routine insecticide susceptibility testing due to the now considerable accumulation of knowledge and the very slight changes that occur from year to year.

There has been very little recent change in the levels of resistance shown or in areas showing DDT resistance, except for a few small localities in El Salvador, Guatemala and Nicaragua where land was recently converted to cultivation of cotton or rice. Here, resistance increased in degree, from 5 or 10% to 25 or 35% and, in a few localities in Guatemala, to about 50%.

Substitute insecticides have been found which are highly effective against DDT- and dieldrin-resistant mosquitos and two are now ready for field trial. Unfortunately, they are rapidly lost on sorptive muds (see below).

Irritability. Irritability may be either present or absent in susceptible vectors, and likewise in resistant ones. Like resistance, it may be either partial or total in any population. When vectors are susceptible, irritability favours their survival. Vectors can and do escape from houses before receiving a lethal exposure as has been demonstrated in window-trapped houses. When vectors are resistant, two or three beneficial effects may result from irritability: (1) many of those which enter houses leave without feeding; (2) those which would normally rest in houses while digesting their blood-meals are driven out from their preferred environment into a more adverse one that tends to shorten their life; (3) if repellency accompanies irritability, a smaller number of vector enter the sprayed house, reducing the human biting potential.

A. albimanus, long resistant to both DDT and dieldrin in parts of Nicaragua, has become non-irritable in some districts and this strain shows no effects of any kind even on fresh applications of DDT. It is feared that this strain is spreading into nearby Honduras and El Salvador.

A. pseudopunctipennis is susceptible to and not irritated by DDT in South America and programmes are progressing well in those countries. In western Mexico, the same species is irritated, does not rest in sprayed houses and constitutes a stubborn problem.

Dieldrin has been found to be non-irritating in both A. albimanus and A. pseudopunctipennis and a change to this insecticide is under trial where the vectors are irritated by DDT and susceptible to dieldrin.

Sorption of insecticides. The remaining technical problem which is causing some difficulty with DDT, and much more with malathion and other newer insecticides proposed as replacements for DDT, is the problem of sorption presented by certain types of mud walls. It was demonstrated by AMRO-196 that on non-sorptive surfaces DDT at 1 g/m^2 may last much longer than six months but on many mud walls DDT at 2 g/m^2 may scarcely last six months, even after several applications, while 1 g fails completely in less than six months.

Studies of malathion at 1 g/m^2 show very rapid loss on sorptive muds, while at 2 g/m^2 residues become very attenuated in six to 10 weeks as determined by bio-assay. In a small study in El Salvador, new cases of malaria appeared about eight weeks after 2 g/m^2 applications, indicating only four or five weeks of effectiveness of malathion in sprayed villages whose houses are predominantly of mud. Because most of the other substitutes for DDT also are rapidly lost on sorptive mud walls, WHO and PAHO are now studying the possibility of applying an inexpensive sealer to such walls before spraying.

Types of construction of houses. All that is feasible is to try to install continuous spraying schedules where there are continuous building programmes, as is done in problem areas in Guatemala. People can sometimes be induced not to wash, repaint or reconstruct newly-sprayed surfaces.

Migration. Movement of people is a serious problem in many areas with persistent transmission. This is more properly considered a complication of the failure to halt transmission in one area rather than a basic cause of failure. Total eradication in the whole region under the influence of migration is the best answer.

Solutions to problems of continuing transmission. One solution to the problem of persistence of transmission is to change to an alternate insecticide where insecticide resistance is the cause but satisfactory substitutes for dieldrin and DDT have not yet been found. Two other methods of attack are being applied in problem areas as rapidly as funds and personnel allow. Because of their high cost and the difficulty of achieving 100% coverage, they are used only as supplementary attack methods as long as DDT continues to exert a profitable degree of reduction of transmission. These supplementary attack methods are mass drug treatment and anti-larval measures. They could be used alone but it is advantageous to lower the transmission rate as much as possible by spraying before and while using them. Their duration and the areas that must be treated can thus be reduced considerably.

(1) Mass drug administration. Mass drug administration programmes using the combined tablet of chloroquine (or amodiaquine) plus primaquine were expanded during 1962 after the orientation field trial in El Salvador in 1961.

In El Salvador, a simplified type of organization was field tested during 1962. Each drug distributor had to live in the locality for which he was responsible and work without transport. This programme was employed in the most highly infected localities of the 1961 study area in a total of 2500 permanent residents and an average of 300 workers in a hacienda. The percentage treated averaged 77% but many of those absent probably were treated in the workers treatment line in the hacienda. The incidence of malaria was reduced from 110 per 1000 persons in a two-week period in July 1961 to four per 1000 for the corresponding period of 1962 and to nought per 1000 in October and November 1962. The experience in this type of work is being applied in an expanded programme among 70 000 persons, April to December 1963, in the problem area of the western quarter of the country. It is anticipated that it will be applied to the rest of the problem area as soon as funds permit.

Pilot drug projects were also initiated in 1962 in Mexico (80 000 persons), Guatemala (14 000 persons) and Nicaragua (6000 persons) and much valuable experience was gained. The Mexican programme was entirely supported by PAHO and was intended to determine feasibility and costs in one of the most difficult problem areas in the country. In Guatemala, drug administration was not pressed with sufficient

determination and acceptance fell to about 60% with a consequent persistence of new cases at a low level. The Nicaraguan campaign will be expanded to about 30 000 persons in an area of very high resistance in 1963.

In Costa Rica, PAHO is joining in a mass drug treatment campaign being undertaken to clean up the final foci in six problem areas of the Pacific coastal region with about 30 000 people.

Venezuela has had extensive experience with various mass drug treatment programmes since 1957 in the western states bordering on Colombia. It appears that these have been transiently successful but re-importation of malaria from Colombia has usually prevented lasting benefits.

(2) Chloroquinized salt programmes. These are a special form of mass drug administration, not often usable. The Amazon Valley chloroquinized salt programme was terminated in December 1961. An evaluation of this programme was undertaken in the field during the last four months of that year and the data subjected to analysis during 1962. It is clear that several factors contributed to its failure; a high percentage of "leaching" of chloroquine resulted after the salt was delivered and possibly there was some chemical deterioration caused by impurities in the salt. It has since been proved that in several areas a significant proportion of cases of P. falciparum either fail to clear up or else relapse very soon after taking 1500 mg of chloroquine base and some after 2500 mg or more. It is believed that under these conditions chloroquinized salt is doomed to fail.

In British Guiana, in January 1961, the government began adding 0.4% chloroquine base to all salt destined for the interior. The results were excellent in two districts and very poor in a third one. In three months after the start of the programme, among 28 000 persons, cases dropped from about 500 a year (mixed P. falciparum and P. vivax) to nil and have remained there for the two years since that time. But in a third district, the Lethem sector of the Rupununi district, among 4000 persons cases dropped to one or two per month in the first year but rose to 236 during the second year, all but one due to P. falciparum. This sector was close to the Brazilian border and received much non-medicated salt from Brazil as well as importation of chloroquine-tolerant strains of P. falciparum. Chloroquine-tolerant strains have been found in this sector but the situation is being brought under control by house spraying.

(3) Anti-larval work. Larviciding operations have proved a very valuable adjunct in the city of Guayaquil, Ecuador and constitute the only antimosquito operation in the centre of that city. Transmission has been halted and the programme is about to be terminated. Larviciding by various means has been tried in Managua, Nicaragua, with good but not completely successful results as yet due to dependence on hand methods in terrain of very difficult access. It is considered that aircraft dispersal of larvicides will be more effective and economical, based on studies of the Insecticide Testing Team, AMRO-196.

Conclusion. In overcoming problem areas, the malariologist must be ready to use any combination of means of attack that promises the most rapid reduction of transmission for the least money, using supplementary attack methods only to the extent necessary in place and time to achieve eradication. This selection requires more epidemiological knowledge of individual localities and sound judgment than does routine spraying operations. Fortunately, problem areas involve smaller areas and smaller numbers of people than those areas which respond reasonably well to simple spraying.

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