

WORLD HEALTH  
ORGANIZATION

a 60500

ORGANISATION MONDIALE  
DE LA SANTÉWHO/Mal/96 ✓  
10 August 1953

ORIGINAL: ENGLISH

The Secretary of the Expert Committee on Malaria  
has the honour to communicate hereunder  
the following note:

INTERRUPTION OF RESIDUAL SPRAYING AFTER SEVERAL YEARS OF  
ACHIEVED MALARIA CONTROL IN THE UNITED STATES

by

Dr. Justin M. ANDREWS,  
Bureau of State Services,

and

Jean S. GRANT,  
Communicable Disease Center  
US Public-Health Service.

On 1 July 1947, the National Malaria Eradication Programme was commenced in the United States. This was the logical development of the co-operative antipaludic efforts of the US Public-Health Service and certain State and local health agencies during and immediately after World War II. These activities had been aimed at preventing malaria in military trainees and industrial war workers in the malarious sections of the country at the time of mobilization, and later at protecting the civilian population from malaria imported by service personnel returning from malarious areas abroad. That these had been successful undertakings is indicated by morbidity and mortality statistics for that period. The trend of reported malaria incidence from 1942 to 1947 shows a steady decline with a slight temporary increase in the late war years (1944 and 1945) resulting from the repatriation of thousands of infected servicemen (Fig. 1). In 1942, totals of 58,781 cases and 861 deaths from malaria were reported; by 1947 these numbered only 16,203 and 214 respectively, a decrease of about 75 per cent to.

the lowest reported incidences on record. It was believed by United States malariologists that the continuation of this co-operative control programme for five years more would eliminate endemic paludism from the country. The proposal for the National Malaria Eradication Programme was submitted to the Congress and was approved. Thus, what was expected to be the final drive against malaria in the United States was launched.

Control operations reached their maximal level in 1948. In that year \$5,048,886 were spent, of which 39 per cent were State and local funds and the remainder Federal. DDT residual spray was applied to 1,364,950 dwellings in 360 counties covering 13 States (Table 1). This required 1,405,813 pounds of DDT (1). Reported morbidity decreased to 9,797 and mortality to 170. Entomologic evaluation of the programme revealed that 98.9 per cent of sprayed houses and 91.2 per cent of unsprayed ones were free of Anopheles quadrimaculatus, an indicated percentage of control of 88.5 (2).

Starting in 1949 Congressional appropriations for the National Malaria Eradication Programme were reduced each year. This resulted in an over-all decrease in funds expended for the programme but in relative increases in State and local contributions during each of the years concerned (Fig. 2). In 1950, Federal support of operations was withdrawn from the six States located on the outer edge of the malarious area (Florida, Kentucky, Missouri, North Carolina, Oklahoma, and Tennessee). In 1951, the Public-Health Service ceased active participation in operational phases of the eradication programme in the remaining seven States (Alabama, Arkansas, Georgia, Louisiana, Mississippi, South Carolina, and Texas), but continued to give technical guidance to States and localities when requested.

Coincident with the curtailment of Federal participation in the residual spray programme, State health departments were given Federal support in activating malaria surveillance and prevention programmes designed to safeguard gains which had been achieved, and to complete the task of eradicating endemic malaria from the United States. This entailed the assignment of teams usually consisting of an epidemiologist (either physician or nurse), an engineer or operational specialist, and an entomologist. The epidemiologist investigates and tries to verify

parasitologically all malaria reports, both official and non-official. Where a case is accepted as malaria, the entomologist appraises the local mosquito vector potentialities and recommends the necessary control measures. These are effected by the engineer within a one-mile radius of the patient's home. The teams assist practitioners in making differential diagnoses of questionable cases, supply information about new antimalarial drugs, and promote better reporting by physicians by explaining the uses to which morbidity and mortality statistics are put.

By 1950 only 2,227 cases\* of malaria were reported to the National Office of Vital Statistics. Criteria to determine when malaria ceases to be an endemic disease in the United States were established by the National Malaria Society at the request of the Public-Health Service (3). It was believed that the eradication goal was in reach. But in June of 1950 American troops entered the Korean conflict. By 1951 thousands of servicemen were being returned to this country from the combat zone and a substantial number were infected with malaria. Antimalarial prophylaxis in Korea had not been adequately administered. The Korean strain of malaria exhibited the same long incubation period as do other temperate zone malarias (4-8); therefore, many of these infected troops experienced their primary attacks in the United States either before discharge, when the military authorities could take the necessary precautions to prevent further transmission, or after separation, when it was difficult if not impossible to institute the proper preventive measures for all cases. In 1951, 5,600 cases\*\* were reported. Of the 1,874 appraised, 14 were believed to be the result of local transmission, probably from Korean veterans (10). This influx of potential sources for the reintroduction of malaria to this country caused much concern among both civilian and military authorities.

---

\* More than two-thirds of these were contributed by a single State, the only one which does not require identification of patient and physician for each communicable disease report.

\*\* This is an incomplete figure since it is known that over 12,000 malaria attacks (new cases and relapses) occurred among Army personnel during that year (9).

Studies on antimalarial drugs had demonstrated the value of primaquine in preventing clinical attacks of malaria (4) (11-13). Therefore, in January 1952 a programme of mass prophylaxis with this compound of all troops returning from Korea aboard ship was instituted, but it was June 1952 before it reached full effectiveness. During this period large numbers of service personnel who received little or no primaquine entered the United States. Consequently morbidity statistics for 1952, 7,630 reported cases,\* do not reflect the expected benefits of this programme.

During 1952, expenditures for vector control on the co-operative programme in 13 States amounted to \$2,574,000, about 84 per cent being State and local funds (14). However, starting in 1951, these operations had been expanded to multi-purpose programmes for vector control in general and were not directed solely against malaria; but they provided a reservoir of trained personnel and equipment which would be readily available should the need arise for intensified malaria control activities. Both DDT and Chlordane were used as residual sprays (Table 1). Entomologic evaluations of these programmes were less extensive in 1952, but available data indicate that 99.5 per cent of sprayed houses were maintained free of vector anophelines, as compared to 89.9 per cent of unsprayed ones, an indicated control of 94.5 per cent.

As of 25 April 1953, 2,252 malaria reports for 1952 have been appraised. Of these, 33 were adjudged primary indigenous cases, 27 probably having been transmitted from Korean veterans and six having occurred in Mexican Nationals. All but one, a Plasmodium malariae infection, were vivax malaria. For the most part, these cases were unrelated in time and space. There has been to date only one epidemic, a small one but the first in the United States since 1945 (10). This occurred at a Camp Fire Girls' summer camp in California, in a region where malaria had been unreported since 1939. Nine campers came down with Malaria between 2 August and 3 September 1952. Epidemiologic investigation revealed that a Korean veteran who camped nearby over the 4 July week-end had experienced, during that period, a relapse of an infection acquired overseas. Anopheles freeborni, the malaria vector in California,

---

\* Preliminary figures

were abundant in the area during that summer. Current information on this outbreak lists 22 cases of malaria among girls attending the encampment. Thirteen primary attacks occurred between 29 March and 25 May of this year, with indicated incubation periods of 226 to 312 days. Seven of the original nine cases have relapsed, one in December 1952 and the others between 13 March and 5 April 1953, with latent periods of between 127 and 244 days from primary attack to first relapse. One of the non-relapsing cases had been on continuous suppression (Chloroquine 0.5 gm weekly) since her primary attack. Considerable control activities have been carried out in this area this year and it is improbable that there will be a recurrence of malaria transmission.

Up to 25 April 1953, a total of 70 cases was reported from civilian sources and 64 from military ones for the current year. Of these, 32 have been appraised; 28 are considered positive, 13 being of local origin and 15 of foreign.\*

It is difficult to measure accurately the influence of Federal participation on the development of State and local vector control activities. In six States, programmes existed prior to World War II. In these States it is felt that advances made since 1942 in developing permanent vector control organizations were greatly accelerated through the assignment of personnel and equipment, and the development of better control materials and techniques by the Public-Health Service. Two States have established mosquito abatement districts in the most critical areas. Programmes are continuing on a county- or community-wide basis in five States. Two other States, California and Virginia, not regularly included in the group of 13 "malarious" States, have active vector control programmes which were stimulated by Federal sponsorship.

From the facts noted above it can be seen that while widespread insecticidal operations directed against malaria mosquitos alone have been discontinued, more selective antianopheline activities have been incorporated into broader vector control and prevention programmes. The development of DDT-resistance among some

---

\* We are indebted to Mr. Roy F. Fritz of the Epidemiology Branch, Communicable Disease Center, for the latest information available concerning malaria prevalence in the USA.

anophelines has made health authorities cautious of indiscriminate applications; therefore, residual spraying is being carried out only in a few isolated areas. However, the surveillance-and-prevention teams assigned to the States have at hand the organization, personnel, and equipment which can be made rapidly available if and when malaria transmission either threatens to or does become established in areas not being sprayed regularly.

In spite of the influx of infected Korean veterans, it is not believed that perennial malaria transmission has been re-established in the United States even though residual spraying has been greatly de-emphasized. Only one outbreak of related cases has been detected so far. Careful surveillance and the prompt institution of antimalarial measures have served to prevent imported malaria from seriously impeding the diminishing incidence of primary indigenous cases in this country.

REFERENCES

1. ANDREWS, Justin M. 1951 Nation-Wide Malaria Eradication Projects in the Americas. I. The eradication program in the U.S.A. J. Nat. Mal. Soc. 10: 99-123.
2. BRADLEY, George H., and LYMAN, F. Earle. 1950 Discussion of five years' use of DDT residuals against Anopheles quadrimaculatus. J. Nat. Mal. Soc. 9: 113-118.
3. HINMAN, E. Harold. 1951 Criteria of malaria eradication, Committee Report. J. Nat. Mal. Soc. 10: 195-196.
4. ALVING, Alf S., ARNOLD, John, and ROBINSON, Donald H. 1952 Status of Primaquine. 1. Mass therapy of subclinical vivax malaria with primaquine. J. A. M. A. 147: 1558-1562.
5. deBUCK, A. 1936 Some results of six years' mosquito infection work. Am. J. Hyg. 24: 1-18.
6. HACKETT, L.W. 1937 Malaria in Europe, an ecological study. Oxford Univ. Press, London. 336 pp.
7. COATNEY, G. Robert, and COOPER, W. Clark. 1948 Recrudescence and relapse in vivax malaria. Proc. 4th Int. Cong. Trop. Med. and Mal. 1: 629-639.
8. COATNEY, G. Robert, COOPER, W. Clark, RUHE, David S., YOUNG, Martin D., and BURCESS, Robert W. 1950 Studies in Human Malaria. XVIII. The life pattern of sporozoite-induced St. Elizabeth strain vivax malaria. Am. J. Hyg. 51: 200-215.
9. MYERS, Lt. Col. Donald S. 1952 Official Communication.
10. FRITZ, Roy F., and ANDREWS, Justin M. 1953 Imported and indigenous malaria in the United States, 1952. Am. J. Trop. Med. & Hyg. 2: 445-456.
11. CLAYMAN, Charles B., HOCKWALD, Robert S., YOUNT, Ernest H., Jr., EDGCOMB, John H., and ALVING, Alf S. 1952 Toxicity of primaquine in Caucasians. J. A. M. A. 149: 1563-1568.
12. GARRISON, Paul L., COKER, Walter G., DONOVAN, William N., JUSTREMSKI, Bruno, COATNEY, G. Robert, ALVING, Alf S., and JONES, Ralph, Jr. 1952 Cure of Korean vivax malaria with pamaquine and primaquine. J. A. M. A. 149: 1562-1563.
13. HOCKWALD, Robert S., ARNOLD, John, CLAYMAN, Charles, and ALVING, Alf S. 1952 Toxicity of primaquine in Negroes. J. A. M. A. 149: 1568-1570.
14. CDC Activities, 1950-1951. Public Health Service Publication Number 204, U. S. Government Printing Office, Washington: 1952.

TABLE 1  
Insecticidal Spraying Accomplishments and Data during National Malaria Eradication Programme in USA, 1947-1952.

Fiscal Year	Number Counties	Number House Spray Applications	Pounds DDT Used	Man-Hours		Lbs. DDT Per Application	Man-Hours Per Application	Man-Hours Per Lb. DDT
				CDC	Local			
1947	297	1,277,989	1,046,000	2,070,342		0.82	1.62	1.89
1948	360	1,364,950	1,405,813	688,642	1,173,735	1.03	1.36	1.32
1949	361	1,060,395	1,262,283	1,434,084		1.20	1.36	1.14
1950	332	842,509	946,386*	284,726	785,079	1.12	1.27	1.13
1951	243	457,064	423,005*	287,113	561,369	1.16#	2.43	2.07#
1952	185	268,913	162,299*	6,386	236,094	0.74#	0.90	1.22#

N.B. In 1947, "Local Contribution 26%", unidentified.  
 In 1948, 39% of total expenditures local funds.  
 In 1949, 41% of total expenditures local funds.  
 In 1950, 48% of total expenditures local funds.  
 In 1951, 62% of total expenditures local funds.  
 In 1952, 84% of total expenditures local funds.

\* In 1950, 30,526 lbs Chlordane used also.

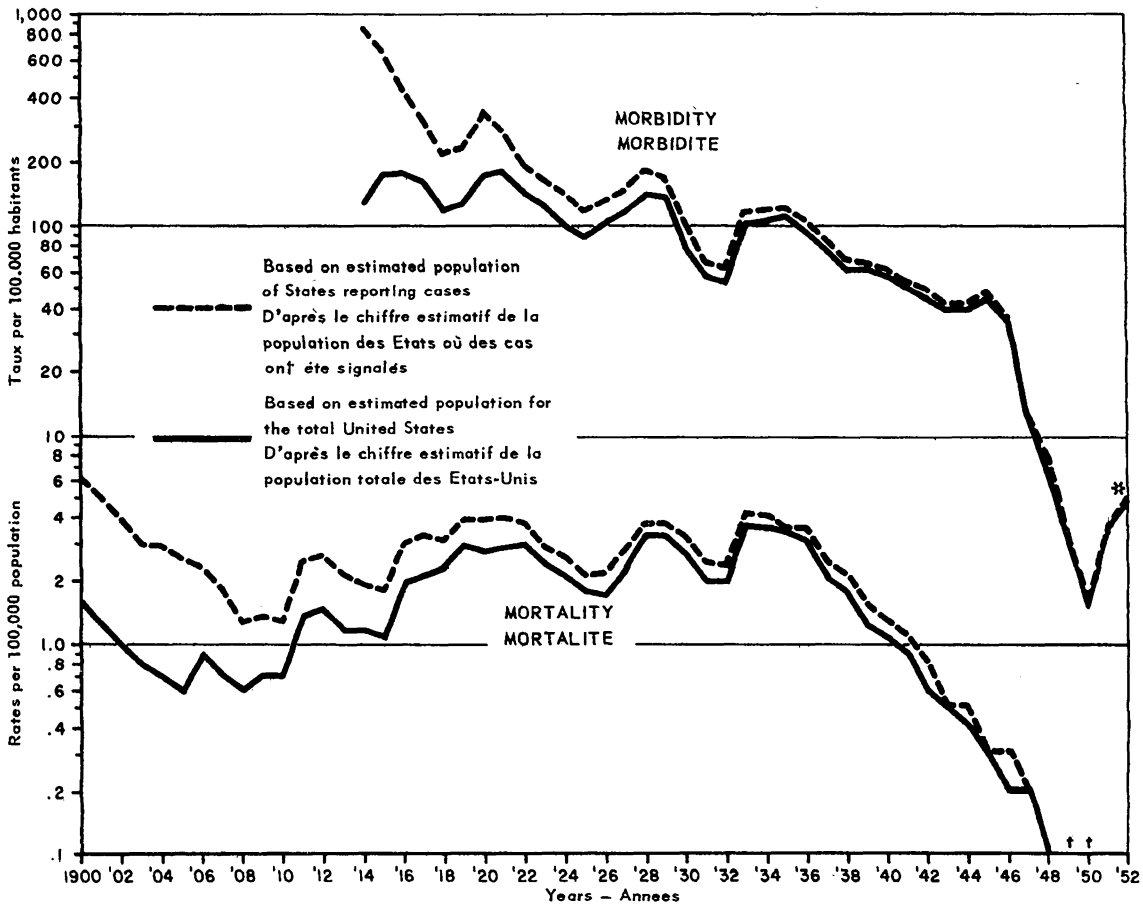
In 1951, 62,745 lbs Chlordane used also.

In 1952, 36,141 lbs Chlordane and 339 lbs of other unidentified insecticide also used.

# These figures represent all insecticides, not DDT alone.

FIG. 1

REPORTED MALARIA MORBIDITY AND MORTALITY FOR THE UNITED STATES  
 STATISTIQUES DE LA MORBIDITE ET DE LA MORTALITE DUES AU PALUDISME  
 AUX ETATS-UNIS D'AMERIQUE



Morbidity data: The notifiable diseases supplemented by State reports.  
 Données concernant la morbidité: statistiques des maladies soumises à déclaration obligatoire, complétées par les rapports des divers Etats.

Mortality data: Annual summaries. "Vital Statistics" of the United States.  
 Données concernant la mortalité: résumés annuels publiés dans les "Vital Statistics" of the United States".

\*Preliminary figures  
 \*Chiffres provisoires

† 1949, 1950 rates less than 0.1  
 † Pour 1949 et 1950, les taux ont été inférieurs à 0,1

FIG. 2

