MALARIA CONTROL IN PUERTO RICO*

(A Summary of Accomplishments)
1924–1954

INTRODUCTION

Puerto Rico is the smallest of the Greater Antilles with an area of 3,500 square miles lying East of the Island of Hispaniola between latitudes 17° 52′N and 18° 32′N. It is a Commonwealth associated with the United States of America.

Until a few years ago malaria was a serious public health problem, being one of the leading causes of death in Puerto Rico. In 1931 it was responsible for 3,208 deaths and 47,656 cases in a population of 1,575,578. Due to intense control measures and improvement in the economic structure of the country this has ceased to be a problem and is now in the process of disappearing completely.

THE PROBLEM AND ITS SOLUTION

Although malaria was prevalent throughout the entire Island, the highest incidence was in the south coast, as shown in the accompanying map. Transmission took place during the entire year. The vector of malaria was *Anopheles albimanus*, one of the three anopheline species found in Puerto Rico. Table I shows the incidence of the disease from 1928 to 1954, and Table II shows the results of parasite surveys in malarious areas.

The first malaria control program was started in 1924 and was sponsored by the Rockefeller Foundation. Later this program was expanded and transferred to the Bureau of Malarial Control of the Department of Health. Control measures consisted of the application of paris green as a larvicide, drainage and treatment of cases. In one area screening of houses was used as a control measure.

Major drainage played an important role in malaria control particularly during and immediately after World War II. This was due to the establishment of various military installations in the island. During the period 1944–49, approximately $1,500,000 was spent in drainage operations alone.

Another important aspect of the control work was the search and treatment of malaria cases. Blood smears were taken from all suspected cases and an initial dose given. In case the smears were positive the treatment was completed. Treatment consisted in .75 grams quinine sulphate or atabrine in capsules for 5 consecutive days, either one followed by 0.2 grams of plasmochin one week afterwards: Table III is a summary of this phase of the control work.

Although used in Puerto Rico in 1944, the DDT residual spraying program first became a part of the activities of the Bureau of Malaria Control in 1954. At the beginning spraying operations were limited to the malarious areas and houses were sprayed twice during the year. During and after 1950 this method was changed and there was only one annual spraying. Thus, it was possible to cover other areas. A summary of the work accomplished is shown in Table IV.

Since 1952 DDT residual spraying of houses has been used as an aid to the *Aëdes aegypti* eradication program instead of using this method solely as a malaria control measure. An effort was made to spray all houses in the Island at least once. At present this program has been cut down and is limited to places with insect problems or where any malaria case is reported.

ACCOMPLISHMENTS

Malaria is on the verge of being eradicated from Puerto Rico. During the past four years the number of cases and deaths reported has diminished notably. All cases and

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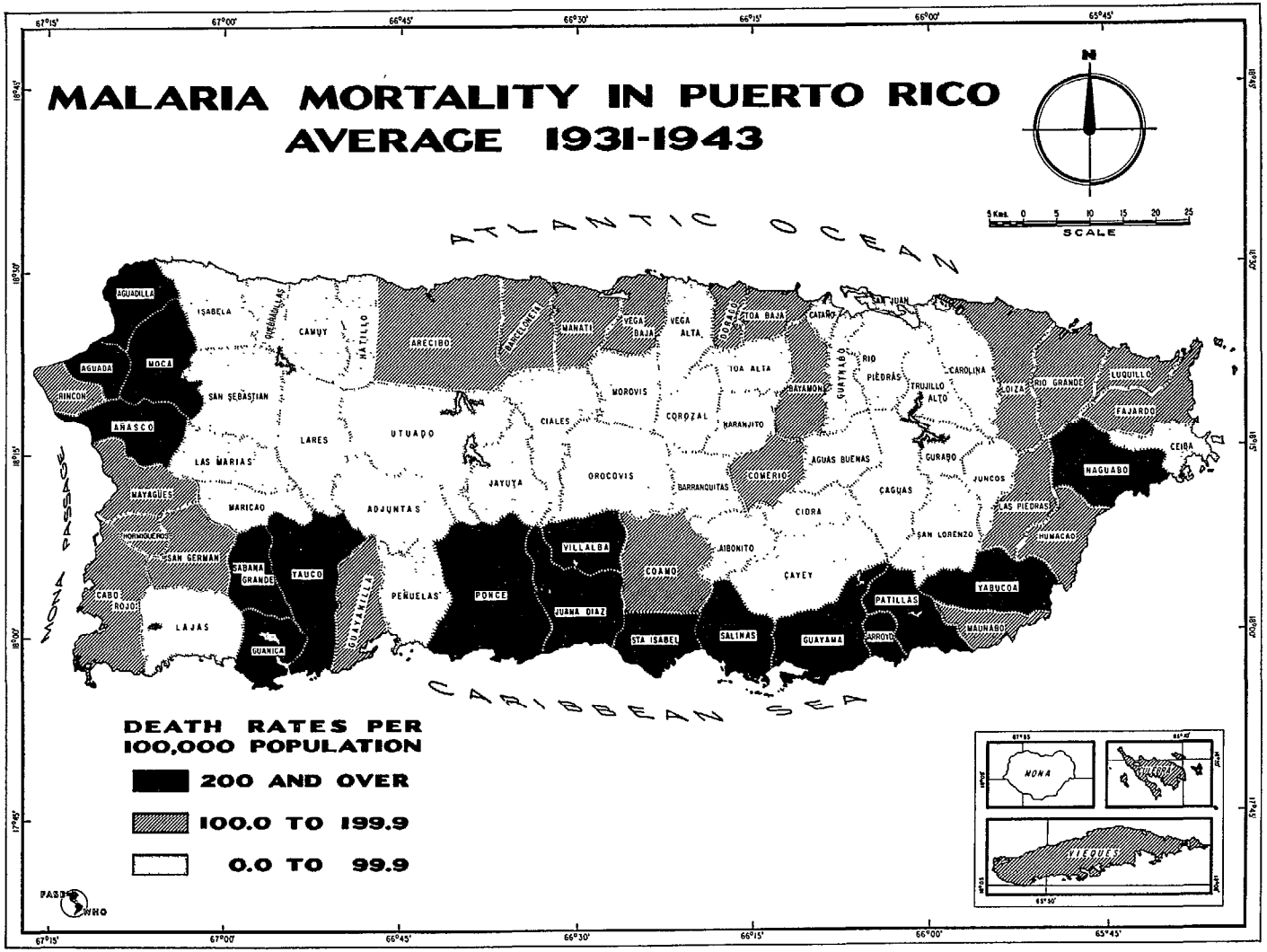

MALARIA MORTALITY IN PUERTO RICO
AVERAGE 1931-1943
N
5 Kms. 0 5 10 15 20 25
SCALE
ATLANTIC OCEAN
CARIBBEAN SEA
MONA PASSAGE
AGUADILLA
ISABELA
CAMUY
HATILLO
ARECIBO
BARCELONETA
MANATI
VEGA BAJA
VEGA ALTA
DORADO
TOA BAJA
CATAÑO
SAN JUAN
AGUADA
MOCA
RINCON
AÑASCO
SAN SEBASTIAN
LARES
UTUADO
CIALES
MOROVIS
COROZAL
NARANJITO
TOA ALTA
BAYAMON
GUAYNABO
RIO PIEDRAS
TRUJILLO ALTO
CAROLINA
LOIZA
RIO GRANDE
LUQUILLO
FAJARDO
CEIBA
NAGUABO
LAS MARIAS
MAYAGUEZ
HORMIGUEROS
MARICAO
ADJUNTAS
JAYUYA
OROCOVIS
BARRANQUITAS
COMERIO
AGUAS BUENAS
CAGUAS
CIDRA
GURABO
JUNCOS
LAS PIEDRAS
HUMACAO
SAN LORENZO
SAN GERMAN
SABANA GRANDE
TAUCO
CABO ROJO
LAJAS
GUANICA
GUAYANILLA
PEÑUELAS
PONCE
VILLALBA
JUANA DIAZ
COAMO
AIBONITO
CAYEY
STA ISABEL
SALINAS
GUAYAMA
ARROYO
PATILLAS
YABUCOA
MAUNABO
DEATH RATES PER
100,000 POPULATION
200 AND OVER
100.0 TO 199.9
0.0 TO 99.9
PASB
WHO
MONA
VIEQUES

TABLE I.—*Reported malaria cases and deaths in Puerto Rico—1928–1954.*

Year	Morbidity		Mortality	
	Cases	Rate*	Deaths	Rate*
1928	29,888	1989.6	2,166	144.2
1929	17,471	1144.9	2,105	137.9
1930	21,733	1402.1	1,887	121.7
1931	47,656	3027.6	3,208	203.7
1932	46,045	2879.4	2,797	174.9
1933	45,613	2089.2	3,259	200.7
1934	24,049	1459.0	2,518	152.8
1935	13,975	835.4	2,112	126.2
1936	14,415	849.2	2,401	141.4
1937	26,045	1468.2	2,296	129.5
1938	35,659	1975.6	1,962	108.7
1939	24,101	1312.2	1,637	89.1
1940	23,759	2168.9	1,817	97.0
1941	23,471	1228.7	2,382	124.6
1942	21,391	1099.8	1,933	99.4
1943	16,032	810.3	1,166	58.9
1944	11,209	557.1	1,004	49.9
1945	6,168	301.5	881	43.1
1946	5,583	268.5	672	32.3
1947	3,915	185.3	423	20.0
1948	1,299	60.5	253	11.8
1949	353	16.2	92	4.2
1950	73	3.3	57	2.6
1951	88	3.9	33	1.5
1952	134	5.9	15	0.7
1953	28	1.2	2	0.1
1954	13	0.6	3	0.13

*Rate per 100,000.

deaths are subject to a thorough epidemiological investigation. A large number of the cases come from returning soldiers from Korea. None of the deaths, during these years, were confirmed by laboratory diagnosis.

TABLE II.—*Results of parasite surveys in Puerto Rico—1941–1950.*

Year	No. of blood smears	No. parasite positive	% Positive
1941	6,589	337	5.1
1942	7,043	227	3.2
1943	7,951	180	2.3
1944	5,601	96	1.7
1945	4,966	40	0.8
1946	4,864	73	1.5
1947	4,973	32	0.6
1948	5,061	5	0.1
1949	4,984	0	0
1950	602	0	0

TABLE III.—*Summary of work done by field aides showing persons examined and treated.*

Year	Persons Examined	Positive cases treated	% positive
1941–42	14,229	3,227	22.7
1942–43	51,374	8,008	15.6
1943–44	46,156	5,622	12.2
1944–45	41,386	5,165	12.5
1945–46	25,202	3,041	12.1
1946–47	26,867	2,906	10.8
1947–48	23,864	1,461	6.1
1948–49	18,495	480	2.6

The malaria rates in Puerto Rico had been going down since 1931. (See Graph) However this downward trend was rather slow until the introduction of DDT. From here on there was a sharp decline. Following is a breakdown of the cases reported from 1951 to 1954.

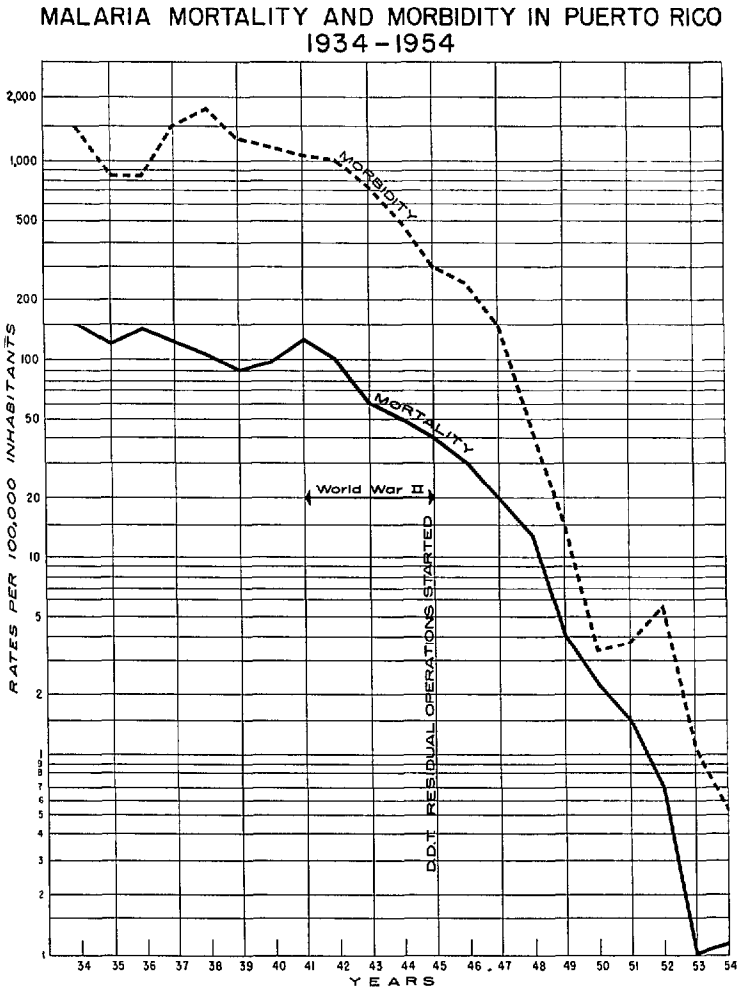
Year	Total cases reported	Civilian	Military (a)
1951	88 (b)	84	4
1952	134 (c)	18	116
1953	28 (d)	10	18
1954	13 (e)	8	5

(a) Korean veterans
(b) Includes 33 deaths
(c) " 13 "
(d) " 2 "
(e) " 3 "

In 1954, as shown above, only 13 cases were reported. Of these, 5 were Korean

TABLE IV.—*Summary of DDT residual spraying operations—1945–1954.*

Year	Houses sprayed	Gals. 5% DDT used	Cost (U.S. $)
1945–46	2,499	—	$3,731.00
1946–47	76,339	85,967	52,419.00
1947–48	100,682	117,433	71,736.00
1948–49	93,424	119,763	78,730.00
1949–50	172,955	206,946	113,113.00
1950–51	171,964	236,285	130,214.00
1951–52	167,852	226,932	130,059.00
1952–53	128,751	168,829	96,812.00
1953–54	132,116	190,152	140,826.00



veterans, 3 were merchant marines in transit, 3 were deaths and 2 were other cases. Only one case was confirmed by the laboratory: *P. malariae* in a 34 year old lady, which upon investigation was found to have been a relapse. The other case was reported as *P. vivax* but was not confirmed. Thus, no primary indigenous case was reported in that year and so far in 1955, only 2 cases have been reported, both of them imported (a Korean veteran and a merchant marine).

The death rate in Puerto Rico has been reduced from 18.4 in 1941 to 7.5% per 1,000 in 1954 while life expectancy has risen from 46 years in 1940 to 61 years in 1950.

CONTROL DE LA MALARIA EN PUERTO RICO (*Resumen*)

La malaria fué una de las enfermedades de mayor importancia en Puerto Rico hace algunos años. Fué una de las principales causas de muerte siendo responsable por 3,208 muertes y 47,566 casos en un solo año (1931). El transmisor de la enfermedad en la isla lo era el *Anofeles albimanus*.

El control de la malaria en Puerto Rico comenzó en 1924 bajo los auspicios de la Fundación Rockefeller. Posteriormente se estableció un Negociado de Control de Malaria en el Departamento de Salud. Los métodos de control durante varios años consistieron en la aplicación de verde paris como larvicida, desagüe de terrenos pan-

tanosos y tratamiento de enfermos. Con el tiempo estos trabajos fueron intensificados hasta 1944 cuando se introdujo el rociamiento de casas con DDT.

Con la introducción del DDT se redujeron las otras actividades anti-maláricas hasta que finalmente el único método de control era la dedetización de casas. En un principio se hacían dos aplicaciones de DDT al año pero luego se cambió a solamente una aplicación.

Como resultado de los trabajos de control así como otros factores de índole económica y social se ha logrado reducir la incidencia de la malaria notablemente. Actualmente la enfermedad ha desaparecido y se considera que la misma ha sido erradicada de la isla. En 1954 solamente se informaron 13 casos de los cuales luego de investigados los mismos no hubo ninguno que pudiera considerarse como caso primario indígena.