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## 1. MALARIA ERADICATION IN PAKISTAN

In July 1961 the Government of Pakistan signed the plan of operations for a malaria eradication programme covering the whole country with a population of 90 million.

It would be opportune to give a summary of an address made by Colonel M. K. Afridi, Vice-Chancellor of the University of Peshawar, at a Symposium on Malaria held in Delhi earlier in the year. The address was reported in the National Malaria Eradication News of India in their June 1961 issue.

Colonel Afridi said that much of the basic parasitological and entomological studies in Pakistan had been carried out by officers of the Malaria Institute of India in the first half of the century, and many of the problems to be faced were the same as those India was facing at present. Over the entire Indo-Gangetic plain, surveys had shown that there was a uniform character of malaria and A. culicifacies was the main vector. In the Quetta region of West Pakistan, A. superpictus is the vector, but it does not appear to have moved east of the River Indus. Although A. stephensi and A. fluviatilis occur in many areas in West Pakistan, thousands of dissections of these two species had not revealed a positive mosquito. In East Pakistan, the vectors are more varied, the proved ones being A. minimus in the foothill areas, A. philippinensis in the plains and A. sundaicus in the coastal zone.

Referring to the transmission season of malaria, Colonel Afridi pointed out that this varies from north to south according to the climatic conditions and the timing of spraying will also have to vary to suit the circumstances best. In the Punjab, on the mud walls of houses, DDT appeared to be effective for only six weeks to two months, and the greatest care will have to be taken to ensure that spraying operations coincide with the peak malaria season. On the other hand, in East Bengal 2 g/m<sup>2</sup> DDT would appear to last for a full twelve months.

The malaria eradication programme of Pakistan is controlled by a semi-autonomous body - The Central Malaria Eradication Board, which was instituted by Ordinance in June 1961. The whole country is divided into four regions and thirty-five zones in the west, and three regions and thirty-one zones in the east. The attack phase of

the programme has started in two zones in Lahore region and one zone in the western region (Rajshali Division) of East Pakistan, covering a population of two-and-a-half million. All three of these zones border on India to the mutual benefit of both countries. The peak of the operations will occur in 1969 and they are planned to terminate in 1974.

The total estimated cost over the years from 1961-1974 is 520 million rupees (or about US \$ 110 million) - a little over US \$ 1 per head of the population. This is a large sum, but Colonel Afridi pointed out that on the average there are 20 million cases of malaria in Pakistan each year, and if it is considered that 25 per cent. of these are wage-earners losing ten days a year at a pay of two rupees a day (all of which he considered to be very low figures) and the annual loss to the country due to malaria alone could be estimated at 100 million rupees (or about US \$ 20 million). Apart from this direct economic loss there was the immeasurable loss of human energy in the people resulting in weakness and apathy.

## 2. THE MEDICATED SALT PROJECT IN BRITISH GUIANA

British Guiana introduced a systematic DDT residual spray campaign in January 1947 and within four years had virtually eradicated malaria from the coastal belt in which 90 per cent. of the population lived.

However, similar operations in the sparsely populated mountainous hinterland did not meet with such complete success, as total coverage of the scattered settlements was extremely difficult and costly to achieve.

In a report by Dr G. Giglioli and Mr H. A. van Seventer on a malaria reconnaissance in the Rupununi Savannah, it is stated that in 1959-1960 case reports of malaria became more frequent than in previous years; in one district with a population of 6100 there were 235 confirmed cases in 1960 including 28 positives from 126 notified clinical cases and 207 positives found in the course of systematic surveys during which 3797 persons were examined.

The success of the campaign in the coastal belt was considerably influenced by the almost exclusively anthropophilic and endophilic behaviour of A. darlingi but in the sparsely inhabited Rupununi district, A. darlingi was not as exclusively anthropophilic as it was on the coast, it being found in the forest where only temporary camps existed.

It was considered that in the savannah areas, very favourable conditions existed for the distribution of medicated salt and the control of malaria by this method, provided that equally effective provisions were made by neighbouring states. The numerous well-frequented schools distributed throughout the area provided widely scattered centres for the systematic collection of slides and of other surveillance data.

It was therefore decided to employ medicated salt as an antimalaria measure in the hinterland areas of British Guiana covering a population of about 65 000.

During 1959 and 1960 investigations were made into the salt-consuming habits of the people and tests were conducted on the excretion of salt.

All importers, wholesalers and retailers of salt were listed, and the channels of supply to the hinterland studied. It was found that the majority of salt imported came from one manufacturer; this simplified the mixing and distributing procedures. In July 1960, regulations were made under the Public Health Ordinance to provide for the mixing of common salt with an antimalarial drug, for the distribution of such salt and for the supervision of the process within certain districts of the country. These regulations are appended to this note as they may provide guidance for other countries embarking on a medicated salt project.

Every opportunity has been taken to explain the purposes of the programme to the people - by means of radio talks, leaflets and posters - and the Minister of Housing, Health and Labour, officially launched the programme on 20 January 1961.

The operations of mixing and distribution have been simplified as much as possible. Medicated salt is prepared first as a pre-mix of chloroquine-diphosphate, calcium-triphosphate and common salt in the proportion 1:1:5. This pre-mix is stored in plastic bags containing 4.8 kg. One bag of 4.8 kg (10.56 lb) is added to 90.7 kg (200 lb) of common salt to give a "final mix" of 95.5 kg (210.56 lb) with a concentration of 0.716 per cent. chloroquine-diphosphate or 0.43 per cent. of chloroquine base (i.e. 43 mg chloroquine base per 10 g medicated salt).

The medicated salt is then put up in 2 lb plastic bags which are sealed and these in turn are packed in fibre-board boxes which are closed with metal strips; the boxes contain 25 bags and are suitable for areas where man portorage is needed.

BRITISH GUIANA

REGULATIONS

Made under

THE PUBLIC HEALTH ORDINANCE

(Chapter 145)

UNDER SECTIONS 48 AND 157 OF THE PUBLIC HEALTH ORDINANCE THE FOLLOWING REGULATIONS HAVE BEEN MADE BY THE CENTRAL BOARD OF HEALTH AND APPROVED BY THE GOVERNOR-IN-COUNCIL:

- |   |   |
|---|---|
| 1. These Regulations may be cited as the Public Health (Malaria Eradication) Regulations, 1960.   | Short title                             |
| 2. In these Regulations, unless the context otherwise requires -<br><br>"district" means any administrative district or part thereof as shown in the schedule I to these Regulations.<br><br>"master" means person in charge.<br><br>"medicated salt" means dry ground salt containing anti-malarial drug prepared under the direction or with the approval of the Director of Medical Services.<br><br>"salt" means chloride of sodium or commonsalt.<br><br>"vessel" means steamship, motor ship, motor boat, sail boat, row boat, ballahoo, canoe or other floating craft or raft. | Interpretation                          |
| 3. It shall be lawful for the Director of Medical Services to cause all dry ground salt intended to be sent or taken to any district to be mixed with anti-malarial drug, and to establish a mixing plant for the processing and packaging of medicated salt.   | Mixing of dry ground salt with drug     |
| 4. It shall be the duty of the Officer in Charge of the medicated salt mixing plant -<br><br>(i) to process medicated salt according to such formulation as is approved by the Director of Medical Services;<br><br>(ii) to package the medicated salt in appropriate plastic or other containers of standard type or types, as are approved by the Director of Medical Services;   | Mixing and packaging of medicated salt. |

- (iii) to mark clearly all containers with the amount of salt in them and the official stamp, showing the letters "m.s.", after checking that the quantity, quality and packaging of the medicated salt are in order.

No person shall tamper with seal or mark. 5. No person shall tamper with or break any seal or obliterate, erase or modify any mark on any bag or packet containing medicated salt unless authorised in that respect by or on behalf of the Director of Medical Services.

No salt other than medicated to be taken to district. 6. No salt in any form whatsoever other than ground salt medicated in accordance with the provisions of these Regulations shall be shipped, despatched or taken by any person or carried by the master of any vessel, aircraft or vehicle or otherwise to any district.

Requisition of medicated salt by merchants or other parties. 7. (1) Every merchant, wholesaler, retailer or other person who desires to send or carry any quantity of medicated salt to any district shall make a requisition for the quantity of medicated salt required to the Officer in Charge, Central Medical Stores - Medicated Salt Mixing Plant - Georgetown, and shall deliver in exchange to this officer an equivalent amount of dry ground salt.

Form of Requisition. (2) Every requisition shall be on a form as shown in schedule II to these Regulations and shall state the quantity of medicated salt required, the name and address of the person who ordered the salt, and the place of destination and the mode of transport thereto.

Offence. 8. It shall not be lawful for any person in any district to sell, barter or give free of charge any dry ground salt unless such salt is medicated in accordance with the provisions of these Regulations.

9. The Director of Medical Services shall appoint persons for the enforcement of the provisions of these Regulations to be designated as "Malaria Control Officers".

Malaria Control Officers. 10. It shall be the duty of the Malaria Control Officers to -

- (a) supervise the removal of unmixed dry ground salt to the mixing plant and the return of the medicated salt to the wholesaler, retailer or other person.
- (b) check from time to time the shipment of medicated salt to any district and when necessary examine cargoes and passengers' luggage.
- (c) check records kept by shipping agents, wholesalers, retailers or other persons relating to the shipment, sale, storage or disposal of medicated salt.
- (d) check from time to time the distribution of medicated salt at retail dealers and at unloading points, the transportation of medicated salt by canoes, and boats, and make inquiries into the use of medicated salt in any district.

- (e) take samples for examination or analysis of dry ground salt at shipping or despatch points or at any place of sale or storage of such salt, or at any dwelling-house, or from any consignment of such salt in course of delivery.
- (f) submit a monthly and yearly summary report on the shipment and use of medicated salt in any district.
- (g) enforce generally the provisions of these Regulations.

11. (1) It shall be lawful for any registered medical officer, govern- Powers of  
ment dispenser, malaria control officer, or any person authorised by entry.  
the Board to enter and inspect any place including any wharf, shipping  
centre, bond, store, shop, vessel, aircraft or vehicle, and to examine  
therein any medicated or other salt and to check any records kept at  
any place in relation to medicated salt for the purpose of enforcing  
any of the provisions of these Regulations.

(2) Any person who in any way obstructs such entry, inspection,  
examination or checking shall be guilty of an offence under these Regu-  
lations.

12. Any person who contravenes any of the provisions of these Regu- Penalty.  
lations or who fails, neglects or refuses to do anything which he is  
required to do by virtue of any of the provisions of these Regula-  
tions or who fails to permit any person to execute any of the  
provisions of these Regulations shall be guilty of an offence and  
liable to a penalty of fifty dollars.

Made by the Central Board of Health on the Twenty-seventh day of  
July 1960.

#### SCHEDULE I

##### DISTRICTS:

North West District.

Mazaruni-Potaro District (including Bartica).

Rupununi District.

The Pomeroon Area in the Essequibo District.

SCHEDULE II

REQUISITION

No \_\_\_\_\_

MALARIA ERADICATION CAMPAIGN - BRITISH GUIANA

NAME OF SUPPLIER . . . . .

ADDRESS . . . . .

OFFICER IN CHARGE, CENTRAL MEDICAL STORES  
MEDICATED SALT MIXING PLANT  
GEORGETOWN

I herewith apply for . . . . . lbs of medicated ground salt.\*  
This amount has been ordered by:

Mr/Mrs . . . . .

Address . . . . .

An equivalent amount of dry ground salt shall be delivered in exchange.  
The medicated salt will be shipped by: \* (B.G. Airways Plane.  
(Transport & Harbours Dept. Steamer.  
(Sloop, boat, etc.

on the . . . . . 19 to . . . . .  
. . . . . at . . . . .

SIGNATURE . . . . .

DATE . . . . .

\* Orders should be for 50 lbs or multiples of 50 lbs.  
\* Strike out words not required and give name of steamer, sloop or boat, etc.

MALARIA ERADICATION CAMPAIGN - BRITISH GUIANA

No \_\_\_\_\_

Received from the Medical Department

. . . . . lbs of medicated salt for shipment to:

Mr/Mrs . . . . .

Address . . . . .

by \* (B.G. Airways Plane.  
(Transport & Harbours Dept. Steamer.  
(Sloop, boat, etc. on . . . . .

SIGNATURE . . . . .

DATE . . . . .

\* Strike out words not required and give name of steamer, sloop or boat, etc.

EXPLANATORY NOTE

(This is not part of the Regulations, but it is intended to indicate their general purport.)

These Regulations provide for the processing of common salt with an anti-malarial drug and for the distribution of such salt and supervision thereof in certain districts of the colony.

### 3. THE EFFECTS OF MALARIA ON THE PRE-SCHOOL CHILD IN AFRICA

A report by Dr G. J. Glynn, Regional Adviser in Maternal and Child Health, WHO Regional Office for Africa, on the conference dealing with infectious diseases of the pre-school child held under the auspices of the West African Council for Medical Research at Lagos in January 1961, contains extracts from a number of papers dealing with investigations into the effect of malaria on the pre-school child.<sup>1</sup>

Dr H. M. Gilles of the University College of Ibadan, dealt with the natural history of "stable" falciparum malaria in the pre-school child in the Gambia. He reviewed the various theories put forward to explain the relative insusceptibility of infants under three months of age to malarial infection. This seems most likely to be due to the existence of a passive immunity derived from immune mothers. He found that the milk/PABA theory did not adequately explain discrepancies in three groups of children investigated by him, all of whom were breast-fed. A relationship between the rate of disappearance of foetal haemoglobin and the rise in the rate of malarial infection in infants did seem to exist.

It is during the period from six months to about three years that malaria inflicts the bulk of its damage, disrupting the normal pattern of growth, and producing profound anaemia. From the third year onwards, the Gambian child acquired the first phase of active immunity, characterized by a rapid decline in the severity and frequency of clinical infections despite the persistence of a relatively dense parasitaemia.

By the twenty-fourth month of life, malarious children exhibited significantly higher concentrations of serum gamma-globulin than their counterparts in whom parasitaemia had been prevented. An interesting case was mentioned of uni-ovular twins aged five years, brought up in the same house, by the same mother, and receiving an identical diet. One had prophylactic drug treatment from birth continuously against malarial infection. The other was treated only when clinical illness occurred. This latter had well-marked hepatosplenomegaly, but at the age of five years the twins were practically equal in height, weight, and general physique.

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<sup>1</sup> The proceedings of this conference have now been published in the West African Medical Journal 1961, 10, No. 4

A further paper was presented by Dr I. R. McGregor and his colleagues of the Medical Research Council Laboratories in Gambia on growth and mortality in children in a rural African village. The observations were made in the village of Keneba, Gambia, where since 1949 the staff of the MRC Laboratories have studied the health of Africans. Most infants here are exclusively breast-fed for four to six months after birth. The earliest food supplements are paps, usually made of rice, but sometimes of millet or sorghum. To this fish and sauces of groundnuts and green leaves are gradually added. A base-line survey in April-May 1950 established that malaria was hyper-endemic, with a crude parasite rate for all ages of 54.7 per cent. Approximately 36 per cent. of villagers were carriers of microfilariae (W. bancrofti) while 33 per cent. showed Acanthocheilonema perstans. Trypanosomiasis affected 2.5 per cent. of the population, while hook-worm and ascaris infestations were rampant. Against this background, a recurrent shortage of harvested cereals was noted.

While the combined use of insecticides and the mass administration of antimalarial drugs at intervals of two to three months over the wet period of each year failed to eradicate malaria, more intensive measures adopted subsequently were more successful. From May 1957 to April 1958, pyrimethamine was given fortnightly to all inhabitants, and this achieved virtual eradication of malaria, the crude parasite rate in April 1958 being less than 1 per cent. After April 1958, antimalarial drugs were discontinued in all save some 80 subjects. The crude parasite rate rose in April 1959 to 34.5 per cent. and in April 1960 to 37.3 per cent.

Of 187 children born alive in the village, 81 (43 per cent.) died before reaching seven years of age. Nearly two-thirds of the deaths occurred during the wet months. Initial death rates were high, with a neonatal rate of 64 per 1000. During the age period three to nine months, the death rate was low, rising subsequently to a sharp peak at ages nine to fifteen months. The rate then fell abruptly, followed by a slow, steady rise up to two-and-three-quarters to three-and-one-quarter years. The lowest rates were obtained in the four-and-three-quarters to six-and-three-quarter year age period.

Clinical and laboratory evidence in this survey showed that there was an intense transmission of a wide variety of infectious and parasitic diseases which, in the main, bear most severely on young children, so that the child is likely to

encounter infection early in life, and, if he survives, to show a high level of immunity. New-born infants, children, and adults in the Gambia, exhibit serum gamma-globulin levels well above those of Europeans. The pattern of malaria in the Gambia supports a theory of changing levels of immunity. The high mortality of children in the wet months corresponds to the peak period of insect-borne disease. Malaria was probably an important cause of mortality in babies and toddlers from Keneba, but it was by no means the only one.

Dr C. C. Draper of the West African Council for Medical Research described the effects of malaria control on growth and other health indices in the Taveta-Pare area in East Africa during the period 1954-1959. Following a period of eighteen months' observation for the collection of basic data, malaria control by the spraying of all huts with dieldrin was started in the latter part of 1955. Although complete arrest of transmission was never achieved, a dramatic fall in parasite rates and other conventional malaria indices occurred during the period of observation. Through special clinics mean values for attained weight were calculated for each month of age, and this was done for one year before, and three years after, the start of malaria control. The means were calculated from between 40 and 100 observations for each month of age. While the well-recognized deviation from English weight curves occurred from the sixth month onwards, no significant differences were found between the malarious and malaria-free years.

A longitudinal anthropometric survey was also done six monthly throughout the course of the scheme on a group of about 2000 children and adults. Measurements included weight, height, sub-cutaneous fat and other somatic indices. No effects of the successful malaria control could be found. There was, however, a significant rise in the mean haemoglobin levels of all age-groups, most apparent in the infants and younger children. Serum gamma-globulins were lower in the non-malarious infants, when compared with a group suffering from malarial infection. Other positive findings included a fall in the frequency of liver enlargement, coincident with, but not as great as, the fall in splenomegalic manifestations.

A vital statistical survey was also made, based on regular house to house questioning of a sample of some 10 000 people, with additional retrospective information obtained through maternity histories. Comparison of the years before malaria control

with the last year of the control scheme showed the following changes. The birth-rate rose from between 30 and 40 to almost 50 per 1000. (It should be noted that the crude birth-rate is a satisfactory index only when comparison is being made of communities whose populations are known to be nearly, if not quite, similar in their age, sex and marital composition.) The crude death rate fell from between 20 and 30 to almost 20. The infant mortality rate fell from over 200 to about 100. The changes in fertility and in infant and young child mortality were considered to be well shown by the changes in the fertility ratio (i.e. number of live children aged 0-4 years per 1000 females aged 15-49). This was found to have increased from 400 to over 500.

The statistics quoted above, and the anthropometric data are, of course, subject to the influence of many factors other than malaria control. However, when one considers the nutritional handicap caused by any febrile disease in the tropics characterized by vomiting and anorexia, the multiplication of malarial parasites takes place at the expense of red cell proteins with an effect also on the vitamin economy of the body, and the fact that in malarious animals protein utilization falls by 50 per cent., the results of the anthropometric survey may at first sight appear disappointing. In addition to the influence of other variables on the data, the question of survey techniques and the difficulties in the tropics of maintaining continuous surveys are very relevant. Difficulties usually experienced include inadequate supervision of auxiliary staff, lack of standardized weighing techniques, difficulties in measuring heights of young infants, inadequate clinical assessment, difficulties in obtaining accurate age data, population movement, problems of transport, including impassable roads during rainy seasons, and difficulties in selecting comparable samples.

#### 4. POTENTIAL HAZARDS OF RE-INTRODUCTION OF MALARIA

The following notes may be of interest in countries in the late consolidation or maintenance phases of malaria eradication. Although the two events were separated by fourteen years and occurred in different continents they illustrate that vigilance cannot be relaxed while malaria exists elsewhere in the world.

In an article entitled "Epidemiological Annual Review of 1958 for the Federal Republic of Germany and West Berlin" by Anders & Meier, appearing in the "Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene" 1961, (0.181.339) the authors discuss the possibility of the re-establishment of malaria in Northern Europe in the late nineteen-forties.

After the Second World War, there appeared to be a danger of the re-establishment of malaria in the Federal Republic of Germany, especially in Berlin. An indication of the danger is shown in the first three years of the following table which covers the twelve years 1947-1958:

MALARIA INFECTIONS IN THE FEDERAL REPUBLIC OF GERMANY AND WEST BERLIN  
1947-1958 (ABSOLUTE FIGURES)

| Year | No. of infections | Year | No. of infections |
|------|-------------------|------|-------------------|
| 1947 | 1272              | 1953 | 14                |
| 1948 | 2351              | 1954 | 16                |
| 1949 | 1600              | 1955 | 11                |
| 1950 | 193               | 1956 | 12                |
| 1951 | 30                | 1957 | 15                |
| 1952 | 23                | 1958 | 12                |

In the diagnosis no differentiation is made between indigenous and relapsing cases.

Most of the infections were due to P. vivax, both among the indigenous and relapsing cases. P. falciparum and P. malariae were rarely found but those diagnosed occurred mainly in the relapses. Gametocyte carriers were found in prisoners-of-war and in personnel of the occupation armies.

Although the vector mosquito (A. atroparvus) was widespread in the area, malaria did not re-establish itself in spite of the continual importation of gametocyte carriers. As there was previously an endemic area in Emsland there was considered to be a constant danger of an epidemic of malaria occurring up to 1950, but after that date it was no longer a public health problem.

In March 1961 a similar situation occurred in the Province of Taiwan (China) which is well advanced in the consolidation phase. According to reports received from the Commissioner of the Taiwan Provincial Health Administration and the Director of the Taiwan Provincial Research Institute there was an influx of immigrants from Burma, many of whom were parasite carriers. Of the first 3536 who arrived, 7.5 per cent. were found to be infected, and of these, 26 per cent. were gametocyte carriers.

A special committee was set up and arrangements were made prior to the arrival of these immigrants to spray their camps and all habitations within one kilometre radius. Anopheline surveys were carried out within a two kilometre radius but no A. minimus minimus were found; these surveys will be continued for a further six months. All health centres and stations and medical personnel were alerted to the dangers. Curative chemotherapy was planned for all immigrants.

At this stage it was suddenly realized that there were insufficient primaquine tablets in the country to treat adequately all those expecting to require full curative therapy. Fortunately, the Director of the Malaria Eradication Division of WHO, Geneva, was in Taiwan at the time and he immediately cabled his Headquarters at Geneva; within twenty-four hours 200 000 tablets of primaquine were dispatched by air to Taiwan from pharmaceutical firms in France who had to put on a special night-shift to clear the procurement request.

These two examples of dangers of the influx of a number of infected persons into a country should be kept in mind by all countries where there is a potential malaria hazard. Malaria eradication does not necessitate vector eradication and similar situations may arise in any country in the consolidation or maintenance phases. It behoves the public health authorities or the national malaria eradication service to have a plan prepared to combat such a situation.