NAVY MEDICAL DEPARTMENT GUIDE TO MALARIA PREVENTION AND CONTROL

NAVY MEDICAL DEPARTMENT GUIDE TO MALARIA PREVENTION AND CONTROL

FIRST EDITION
1984

PUBLISHED BY
THE NAVY ENVIRONMENTAL
HEALTH CENTER
NORFOLK, VIRGINIA 23511

ACKNOWLEDGEMENTS

EDITORS

This publication was compiled and edited by:

LCDR Stephen O. Cunnion, MC, USN, Head, Epidemiology Service, Navy Environmental and Preventive Medicine Unit Number Six, Pearl Harbor, HI.

CDR Tim H. Dickens, MSC, USN, Head, Medical Entomology Division, Navy Environmental Health Center, Norfolk, VA.

CDR Douglas A. Ehrhardt, MSC, USN, Professional Assistant, Navy Disease Vector Ecology and Control Center, Alameda, CA.

LT James T. Need, MSC, USNR, Medical Entomologist, Navy Environmental and Preventive Medicine Unit Number Six, Pearl Harbor, HI.

LT John G. Wallace, MSC, USN, Microbiologist, Navy Environmental and Preventive Medicine Unit Number Six, Pearl Harbor, HI.

TECHNICAL REVIEW

The authors wish to thank the following reviewers whose comments and suggestions contributed in a very significant way to the production of this guide:

CAPT Fred L. Baker, MC, USN, Epidemiologist, Navy Environmental and Preventive Medicine Unit Number Five, San Diego, CA.

CDR Herbert T. Bolton, MSC, USN, Professional Assistant, Navy Disease Vector Ecology and Control Center, Jacksonville, FL.

LCDR Thomas P. Breaud, MSC, USN, Medical Entomologist, Second Field Service Support Group, Second Marine Division, Camp Lejeune, NC.

LCDR Richard Buck, MC, USN, Malariologist, Naval Medical Research Unit Number Two, Manila, RP.

CDR Paul E. Campbell, MSC, USN, Head, Preventive Medicine Service, Naval Hospital, Camp Lejeune, NC.

LCDR David E. Conwill, MC, USN, Head, Epidemiology and Infectious Disease Control Division, Navy Environmental Health Center, Norfolk, VA.

LT Wayne Gale, MSC, USN, Entomologist, Defense Personnel Support Center (DSR-PAC), Alameda, CA.

CDR Richard R. Hooper, MC, USN, Officer in Charge, Navy Environmental and Preventive Medicine Unit Number Six, Pearl Harbor, HI.

CDR Stanley R. Husted, MSC, USN, Officer in Charge, Navy Disease Vector Ecology and Control Center, Alameda, CA.

CDR Jay M. Lamdin, MSC, USN, Officer in Charge, Navy Disease Vector Ecology and Control Center, Jacksonville, FL.

LCDR Henry B. Lewandowski, MSC, USN, Medical Entomologist, Third Field Service Support Group, Third Marine Division, Okinawa, Japan.

CDR Larry A. Lewis, MSC, USN, Executive Secretary, Armed Forces Pest Management Board, Forest Glen Section, Walter Reed Army Medical Center, Bethesda, MD.

LCDR Kenneth A. Love, MSC, USN, Environmental Health Division, Navy Environmental Health Center, Norfolk, VA.

CAPT William B. Mahaffey, MC, USN, Head, Preventive Medicine Department, Navy Environmental Health Center, Norfolk, VA.

CDR Alan E. Mataldi, MSC, USN, Head, Environmental Health Division, Navy Environmental Health Center, Norfolk, VA.

LCDR Donald M. McCroddan, MSC, USN, Navy Environmental and Preventive Medicine Unit Number Two, Norfolk, VA.

LCDR David E. Morton, MSC, USN, Head, Planning and Analysis Department, Navy Environmental Health Center, Norfolk, VA.

LCDR H.G. Potter, MC, USN, Epidemiology and Infectious Disease Control Division, Navy Environmental Health Center, Norfolk, VA.

CDR L. Lance Sholdt, MSC, USN, Head, Preventive Medicine Section, Naval Medical Command, Washington, D.C.

CDR Fred Santana, MSC, USN, Officer in Charge, Defense Pest Management Information Analysis Center, Armed Forces Pest Management Board, Washington, D.C.

LT H.R. Stevenson, MSC, USN, Medical Entomologist, Preventive Medicine Service, Naval Hospital, Subic Bay, RP.

LCDR Richard A. Thomas, MC, USN, Outservice Training in Preventive Medicine, John Hopkins University, Baltimore, MD.

LT Mark T. Wooster, MSC, USN, Medical Entomologist, Naval Medical Research Unit Number Two, Manila, RP.

LCDR John Zimmerman, Medical Entomologist, Navy Medical Research Unit Number Three, Cairo, Egypt.

Mrs. Rose Morrisette, Head, Editorial Services Division, Navy Environmental Health Center, Norfolk, VA.

The Staffs of the Navy Environmental and Preventive Medicine Units, Navy Disease Vector Ecology and Control Centers and Navy Medical Research Units Numbers Two and Three.

PRODUCTION

Special thanks are due HM1 Terry R. Beagle, USN, Medical Entomology Division, Navy Environmental Health Center, who collated the numerous review comments on the first draft and proofed, assembled, and distributed the second and third drafts. Special thanks are also extended to Mrs. Barbara Stanley, Typist, Administrative Support Division, Navy Environmental Health Center, for her timely and excellent production of the second and third drafts.

PREFACE

Malaria is a vector borne disease which threatens the sustainability of the Operating Forces. A major concern of the Medical Department is providing optimum support to the field commander in the prevention and control of malaria. The most important steps in preventing malaria include proper training and education of susceptible personnel augmented by direct operational support in vector control.

This guide may be used as both a comprehensive reference source and training aid. The information contained in it is intended to help reduce the potential for malaria transmission among United States military personnel.

Intended Audience

This guide has been prepared for use by all Medical Department personnel—hospital corpsmen, preventive medicine technicians, environmental health officers, entomologists, and medical officers—who are involved in the prevention and control of malaria to help promote combat sustainability in Navy and Marine Corps personnel. It contains information on the pathophysiology of malaria infection, geographic areas of malaria risk, responsibilities of military personnel in controlling the disease, guidelines for use of chemoprophylactic medication, and the principles of malaria discipline.

How to Use the Guide

Medical Department personnel are encouraged to use the guide to familiarize themselves with malaria and to help indoctrinate others on recommended measures to prevent its transmission to operational Navy and Marine Corps units. A world map showing some geographic areas of risk and a chart detailing some country by country risks is provided.

Medical Department personnel who support individuals or units deploying to geographical locations outside CONUS should refer to the map/chart for planning antimalarial training and chemoprophylactic drug regimens. Additional information should be obtained from the area Navy Environmental and Preventive Medicine Unit (NEPMU) and the area Disease Vector Ecology and Control Center (DVECC). Local sources such as Environmental Health Officers should also be consulted.

Frequency of Issue

The Medical Department Guide to Malaria Prevention and Control will be revised as needed to ensure the availability of the most up-to-date world map and chart detailing malaria risk by country. Additionally, changes in nomenclature and National Stock Numbers (NSNs) where applicable, or chemoprophylactic drugs or vector control equipment and chemicals will be published as necessary. Users of the guide are encouraged to submit information, comments, or recommendations for needed changes to the Commanding Officer, Navy Environmental Health Center, Naval Station, Building X-353, Norfolk, VA 23511.

PART ONE
INTRODUCTION

TABLE OF CONTENTS

PART ONE—INTRODUCTION

PART TWO—ETIOLOGY OF MALARIA

PART THREE—MALARIA PREVENTION AND CONTROL IN THE MILITARY

FIGURES AND TABLES

STATEMENT OF THE PROBLEM

For centuries, military campaigns have been compromised seriously when malaria occurred in operational units. Malaria is a hazard to personnel deployed ashore or near shore in malaria-risk areas of the world. It is of particular importance to Marine Corps units, Naval Construction Battalions and shore support activities. Aviation personnel transiting some malaria transmission areas may be at risk, as are Naval Operating Forces whose missions require deployment on short notice to malarious parts of the world. For shipboard personnel, a hazard may be present in ports where malaria transmission occurs.

Malaria is a very debilitating and an occasionally fatal disease. Unfortunately, many persons are unaware of the risks of acquiring this disease, the severity of its complications, or the protection afforded by malaria chemoprophylaxis. Malaria attacks can be minimized by the use of relatively safe, convenient, and inexpensive prophylactic medication which is available for military personnel from their unit medical department. Additionally, there are many things that individuals can do to lessen their exposure to Anopheles mosquitoes, the only vectors of human malaria.

MALARIA IN THE MILITARY

Advances in malaria prevention and control have been accelerated by military or quasi-military needs. This is partially a result of the movement of susceptible troops into areas of high risk for infectious disease.

World War I

It was estimated that over 2 million man days were lost to the debilitating effects of malaria during World War I. Malaria control was still in its infancy at that time, restricted for the most part to therapeutic and prophylactic use of quinine and the control of mosquito larvae.

World War II

Malaria was the most serious health hazard encountered by American troops in the South Pacific during World War II. An estimated 85% of U.S. forces serving there became infected

with malaria. Malaria contributed greatly to the unhappy termination of the courageous defense of Bataan in the Philippines. Among units which saw the most combat, over five times as many casualties were due to malaria as were caused by battle related incidents. The Japanese occupation of Indonesia eliminated the Allies main source of quinine. This created a serious military problem, as Allied forces were engaged in some of the most malarious areas of the world. Consequently, research in synthetic anti-malaria drugs was given a very high priority.

The Germans were also attempting to find newer and better antimalarials, and they synthesized compounds as early as 1934. The French obtained samples of some of the drugs in 1941 and tests confirmed their high activity against malaria parasites. This information was transmitted to the U.S. where an extensive program of chemotherapeutic research had already begun. The drug screening program of the U.S. has been coordinated by the Walter Reed Army Institute of Research. Since its inception, more than 250,000 compounds have been screened in primary tests. This included screening of available compounds, as well as the synthesis of new materials.

Korea and Vietnam

During the Korean war U.S. forces reported 390,000 cases of malaria. More recently, during the Vietnam conflict more than 50,000 cases occurred among U.S. military personnel with additional complications due to multidrug resistant strains of *Plasmodium falciparum* malaria.

Current Situation

In each of these military situations and continuing today, malaria control involves the elimination of parasites in man by means of drugs, the use of personal protective measures, direct attack on the bloodsucking *Anopheles* female with adulticides, and control of mosquito larvae.

One exciting new area of research which may revolutionize the future of malaria control is a malaria vaccine. Recent breakthroughs in laboratory development of malaria parasites has increased the potential for development of a malaria vaccine. However, field trials for a human malaria vaccine are probably 10 years away.

MALARIA WORLDWIDE

Brief History

From time immemorial malaria has been one of the most prevalent of human diseases affecting primarily the populations of tropical and subtropical regions of the world. More people have died from malaria than from any other infectious disease in human history. It is especially common among impoverished people wherever a high incidence of biting by Anopheles mosquitoes is characteristic. Outbreaks may also develop whenever major displacements of people occur such as during military conflicts, social upheavals, or natural disasters.

According to the World Health Organization (WHO), 2.35 billion people were living in malaria risk areas of the world in 1979, representing 65% of the world population of 3.29 billion (excluding China). Except in areas endemic for P. falciparum malaria, the disease is insidious rather than dramatic. It causes chronic suffering, results in an increased number of deaths from other causes, and lowers life expectancy. For centuries malaria has had a profound impact in curbing economic activities and social progress throughout the world. From 1965 to 1976, governments, international organizations, and bilateral agencies spent in excess of $2 billion to combat malaria.

In 1971 a Pan American Health Organization (PAHO) Advisory Committee on medical research sponsored a symposium on the recrudescence of vector borne disease with hopes that their discussions would stimulate research and lead to better methods of prevention and control. Unfortunately, the situation is worse now than it was in the 1970s. Due to insecticide resistance by mosquitoes, drug resistance by the parasite, and financial resistance by governmental agencies (compounded by oil prices), there has been a resurgence of malaria. Annual statistics show that malaria is responsible for the death of over 1 million children (newborn-five years of age) worldwide, especially in rural communities.

Geographic Areas of Risk

General information on the geographic areas of risk for malaria transmission is contained in the Appendices. Appendix I shows the principal regions of malaria transmission as well as the severity of the threat. Appendix II details the country-by-country

status of malaria transmission. This chart also includes information on the local areas of risk, seasonal occurrence and areas with known P. falciparum choloroquine resistance. Remember that these are only general guidelines and specific information should be obtained from the area NEPMU and DVECC.

Practically all malaria risk areas of the world are situated within areas having a mean summer temperature of at least 16°C (60.8°F). These conditions may be determined by latitude or, as in the tropics and subtropics, by altitude. Temperature affects both the development of the plasmodium in mosquitoes and the longevity of the vector. (The geographic distribution of malaria occurs between 45°N and 40°S latitude.)

Africa

Some parts of northern and southern Africa are naturally non-malarious, whereas others became malaria free as a result of eradication programs. For example, only 5% of the population of the Republic of South Africa live under a malaria risk. In tropical continental Africa however, all countries are malarious, including Madagascar. The parasite rate in children exceeds 50% in many areas. Plasmodium falciparum is responsible for 80-90% of the cases reported.

North America

Only Canada has been naturally free of malaria. Malaria has been eradicated from the USA but still exists in Mexico. The USA maintains a malaria free status in spite of frequent importation of cases from abroad mostly by tourists, business people and missionaries.

Central America and the Caribbean

Malaria risk still exists in all Central American countries, Haiti, and parts of the Dominican Republic. Malaria has been eradicated from Cuba, Jamaica and Puerto Rico. The major problem of malaria control in Central America is insecticide resistance in mosquitoes.

South America

In South America, malaria has been eradicated from Chile, and

parts of Argentina, Brazil and Venezuela. Uruguay is naturally free from malaria. The situation in South America is aggravated by chloroquine resistant Plasmodium falciparum.

Asia

Kuwait and Mongolia are the only naturally malaria free countries in Asia. Brunei, Hong Kong (including Macao), Israel, Japan, Lebanon, Taiwan and apparently North Korea have achieved and maintained malaria eradication. Considerable reduction was obtained in Asia Minor, Iran, Pakistan, India, Nepal, Bangladesh, Thailand and the Philippines following intensive eradication or control operations in these countries. However, political and military events have led to a serious deterioration of malaria control in many parts of Asia.

Many countries in eastern Asia are afflicted with chloroquine resistant Plasmodium falciparum, and the frequency and degree of resistance are higher than in South America. The highest levels of drug resistance are in Burma, Thailand, Laos, Kampuchea and Vietnam, but the Philippines, Malaysia, and southern China are also widely affected.

Europe

Except for Greece and European continental Turkey, all countries in Europe are now free of malaria. However, Europe is exposed extensively to imported malaria due to increased business, tourist, and student travel. This may be related to the rising malaria incidence in India and Pakistan.

Australia

Australia has achieved and maintained malaria eradication, although the country is exposed to the importation of many cases for the same reasons as Europe and the United States.

WHO SUMMARY

In 1955 and 1956, the eighth and ninth World Health Assemblies adopted a policy of malaria eradication and the Expert Committee on Malaria of the World Health Organization prepared appropriate technical guidelines. Table 1 shows that since this was undertaken, 37 (26%) of the 143 countries originally considered malarious have achieved and maintained malaria eradication.

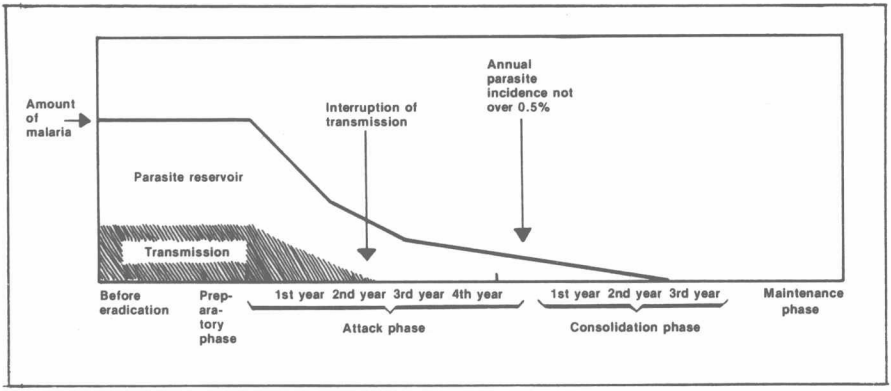
TABLE 1. STATUS OF MALARIA ERADICATION IN THE WORLD (1978)

Status	Africa	North and South America	Asia	Europe	Australia and Oceania	Total
No. of countries and territories	54	49	45	38	23	209
No. of nonmalarious countries (1950)	05	16	04	21	20	66
No. of malarious countries (1950)	49	33	41	17	03	143
No. of countries freed from malaria	02	12	06	15	01	37
No. of countries still malarious (1978)	47	21	35	02	02	106

Countries that eradicated malaria between 1950 and 1978: Africa: Mauritius and La Reunion; America: Chile, Cuba, Dominica, Grenada and Carriacou, Gaudeloupe, Jamaica, Martinique, Puerto Rico, St. Lucia, Trinidad and Tobago, United States of America, U.S. Virgin Islands; Asia: Brunei, Lebanon, Taiwan, Hong Kong, Japan, Israel, Macao; Europe: Ablania, Bulgaria, Byelorussian SSR, Czechoclovakia, Cyprus, France, Hungary, Italy, Netherlands, Poland, Portugal, Romania, Spain, Ukrainian SSR, Yugoslavia; Australia and Oceania: Australia.

Eradication programs designed to end transmission of malaria and eliminate the reservoir of infective cases were launched in numerous countries. The steps that effectively permit malaria eradication are shown in Figure 1.

FIGURE 1. DIAGRAM OF MALARIA ERADICATION. In the attack phase, the mosquito population is lowered so that transmission ceases; thereafter, annual parasite incidence shows a slow decline. (Courtesy of WHO).



In many countries, the morbidity and mortality caused by malaria and the prevalence of the disease were reduced to a low level. However, the initial success of eradication efforts has been followed by the maintenance of important active foci or by a resurgence of the disease. At the end of 1979 some 2.35 billion were living in areas where the transmission of malaria had not ceased. At least one sixth of these people live in places where no organized anti-malaria measures have been undertaken, especially in Africa south of the Sahara. Today, malariologists and public officials are once again working to establish "control" over the transmission of malarial parasites while the more desirable goal of "eradication" appears, unfortunately, to be slipping from our grasp.