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BY THE U.S. GENERAL ACCOUNTING OFFICE
REPORT TO THE ADMINISTRATOR,
AGENCY FOR INTERNATIONAL
DEVELOPMENT

**Malaria Control In Developing Countries:
--Where Does It Stand?
--What Is The U.S. Role?**

Malaria is still a major public-health problem in many developing countries. The World Health Organization recently estimated that 214 million people were infected with the disease. Since the early 1950s, the United States has contributed nearly \$1 billion to combat this problem.

GAO recommends that the Agency for International Development re-examine existing program guidelines in light of changes since the last agencywide statement. These changes involve a resurgence of malaria, emphasis on general health services to counter this threat, and a decline in U.S. financial and technical support.

U.S. assistance has generally been successful in meeting the immediate needs of many anti-malaria activities, but continued progress has been hampered. GAO makes recommendations which could result in a more effective use of U.S. assistance.



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ID-82-27
APRIL 26, 1982

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UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

INTERNATIONAL DIVISION

B-206909

The Honorable M. Peter McPherson
Administrator, Agency for International
Development

Dear Mr. McPherson:

This report discusses U.S. support of anti-malaria activities in developing countries. We did not obtain formal agency comments. We did, however, discuss the report with agency officials and made the necessary changes.

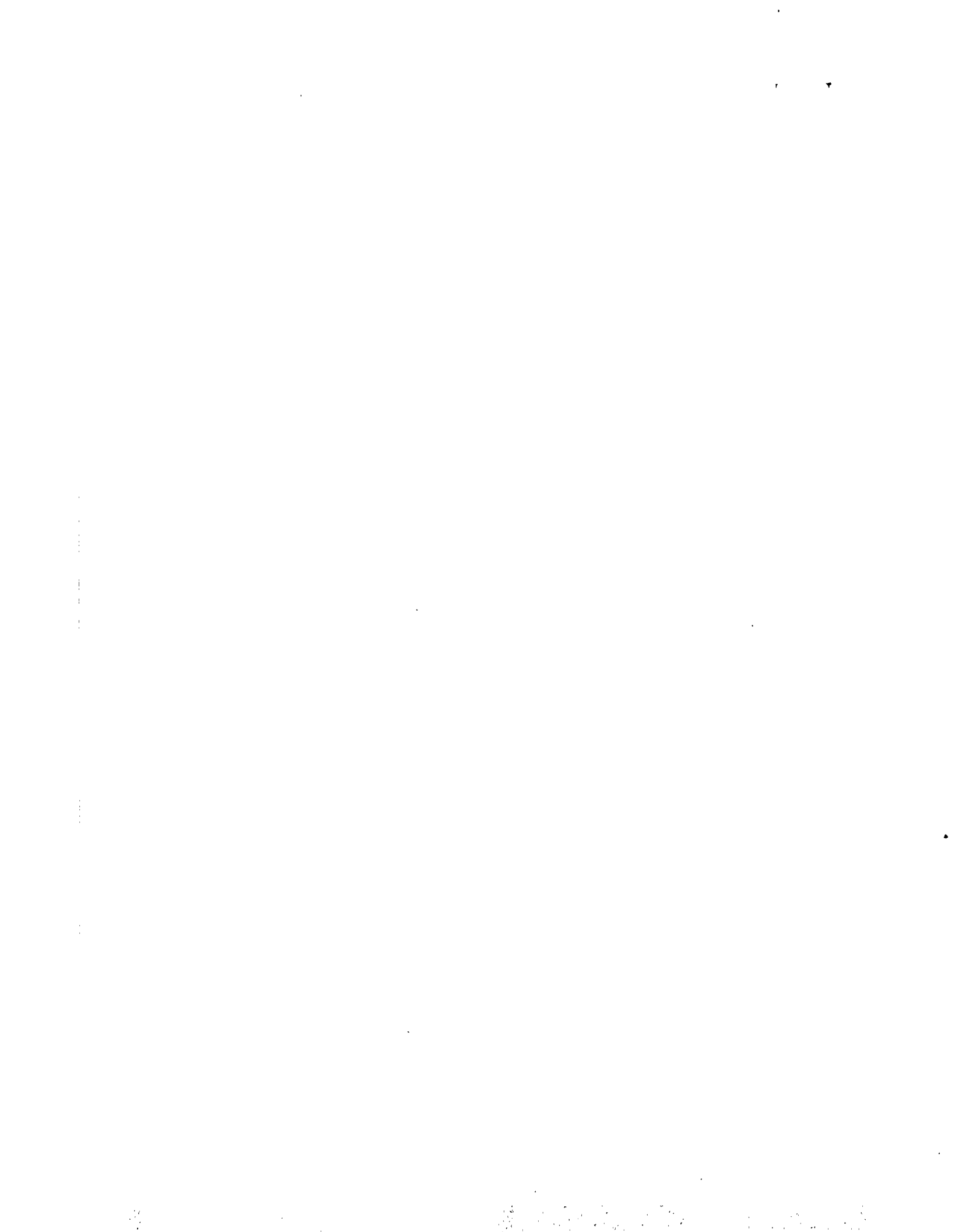
This report contains recommendations to you on pages 18 and 36. As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the Senate Committee on Governmental Affairs and to the House Committee on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Director, Office of Management and Budget, and to appropriate congressional committees.

Sincerely yours,

A handwritten signature in cursive script that reads "Frank C. Conahan".

Frank C. Conahan
Director



GENERAL ACCOUNTING OFFICE
REPORT TO THE ADMINISTRATOR,
AGENCY FOR INTERNATIONAL
DEVELOPMENT

MALARIA CONTROL IN DEVELOPING
COUNTRIES:
--WHERE DOES IT STAND?
--WHAT IS THE U.S. ROLE?

D I G E S T

Malaria is one of the most widespread diseases prevalent in developing countries. Previous gains in combating the disease have not been sustained, and economic and social progress continue to be impeded. The World Health Organization (WHO) estimates that 1.8 billion people are at risk, and that about 214 million are infected with malaria.

The Agency for International Development (AID) is the principal U.S. agency providing assistance to anti-malaria activities in developing countries. Since the 1950s, the United States has provided almost \$678 million in bilateral assistance to combat the disease. In addition, \$131 million has been contributed to international organizations concerned with the problem. Several U.S. agencies also support research to develop vaccines, drugs, and other measures to more effectively deal with the disease. Total U.S. support has exceeded \$989 million.

GAO did this review to (1) obtain an overview of the U.S. investment in combating malaria and (2) examine current program activities in light of existing policies, strategies, and the prevalence of malaria. GAO believes the issues discussed in this report represent the progress and difficulties AID has experienced in combating malaria. Although the results of this review cannot be generalized in a statistical sense, they are typical of the problems AID is experiencing in assisting developing countries to control malaria. Official agency comments were not obtained but the findings, conclusions, and recommendations were discussed with AID program officials. Their comments were incorporated in the report.

ID-82-27
APRIL 26, 1982

AID MALARIA GUIDELINES
SHOULD BE UPDATED

The last AID guidance dealing specifically with malaria was issued in 1973. Since then, several regional bureaus have issued separate guidance for their overseas missions. Also, the agency's 1980 health-sector policy addresses anti-malaria activities, but only in terms of those project components the agency is willing to support. Several events have occurred since the last agencywide statement was issued in 1973.

There has been a serious resurgence of the disease in the last 10 years. Between 1972 and 1980, the number of reported cases outside Africa doubled to almost 7.8 million. In Africa, the widespread prevalence of malaria and the lack of health facilities to diagnose, treat, and report the incidence of the disease, render available statistics meaningless.

Emphasis is now being placed on primary health care as a means of providing a level of health to permit all people to lead productive lives. Where malaria is a major public-health problem, such as in Africa, the disease becomes a focus of these general health-delivery services. WHO now promotes efforts to prevent and reduce mortality and morbidity by providing anti-malaria drugs through these systems.

In addition, there has been a relative decline in the level of U.S. assistance to anti-malaria activities. Between the early 1950s and 1970, AID provided about \$522 million in bilateral support. Between 1970 and 1981, only about \$151 million in grant and loan assistance was approved--mostly for the import of commodities for five countries. AID also no longer provides the technical and management assistance to its overseas projects from its own personnel resources. As of the end of 1981, the agency had only two direct-hire advisers overseas and three program managers in Washington. (See ch. 2.)

CONSTRAINTS TO REDUCING MALARIA
SHOULD BE FULLY CONSIDERED

In 1973, AID established criteria to identify activities which merit U.S. assistance. Support can be considered when a country demonstrates its own concern for the problem by providing an adequate budget and staff, a viable plan, and arranges for available resources. There should also be a need to protect a substantial U.S. investment in terms of gains already achieved, or prevent the disease from becoming a detriment to other development programs. WHO has also identified the constraints to long-term malaria control. In addition to mosquito and parasite resistance to insecticides and drugs, these include increased costs of commodities; shortages of trained and experienced personnel; inadequate general health-delivery services; and human behavioral patterns and development projects which help spread the disease. Some of these constraints--such as the lack of adequate host-country financial resources and trained and experienced personnel--are inherent and the proper aim of AID assistance. Other constraints--such as inadequate general health-care delivery services, human behavioral patterns, and development programs which promote the spread of the disease--are external and the proper objective of other types of assistance or host-country responsibilities.

GAO found that the projects included in this review are successfully meeting the immediate needs of the programs--commodities, training, equipment, and technical assistance usually provided by contract personnel. Some of the projects, however, did not meet the criteria for U.S. assistance, and all were experiencing constraints to long-term success. Progress was being hampered by the lack of resources and commitment on the part of some countries; people carrying the disease across national borders; development programs, such as irrigation projects which create breeding areas for mosquitos to spread the disease; and inadequate general health-care delivery systems to deal with the problem. In some cases, the inherent constraints were not adequately considered during the project-design process. In other cases, the external constraints were also not

adequately considered and threaten continued progress. However, the projects do serve a humanitarian purpose and provide one element of a serious public-health need. (See ch. 3.)

RESEARCH FOR MORE EFFECTIVE ANTI-MALARIA WEAPONS

Several U.S. agencies are involved in efforts to develop vaccines, drugs, and other measures to effectively combat malaria. AID has established and continues to support a network of scientists to develop a vaccine to protect populations from getting the disease. The agency also supports field research and testing of environmentally acceptable alternatives to DDT and comprehensive measures of mosquito control. The Army and Navy support research and development of drugs and vaccines to maintain the effectiveness of their forces having a potential requirement of operating in areas where malaria is prevalent. The National Institute of Allergy and Infectious Diseases supports research intended to provide a broader scientific understanding of the mechanisms of malaria and immunity to the disease. The Centers for Disease Control, often in cooperation with AID, are developing methods for evaluating potential vaccines; artificially cultivating additional strains of the malaria parasite; testing the effectiveness of various drugs; developing more effective mosquito-control procedures including integrated approaches to the problem; conducting epidemiological evaluations; and developing specifications for insecticides and insuring that the products meet AID and WHO standards. The United States also contributes to WHO vaccine, drug, and field research. (See ch. 4.)

CONCLUSIONS AND RECOMMENDATIONS

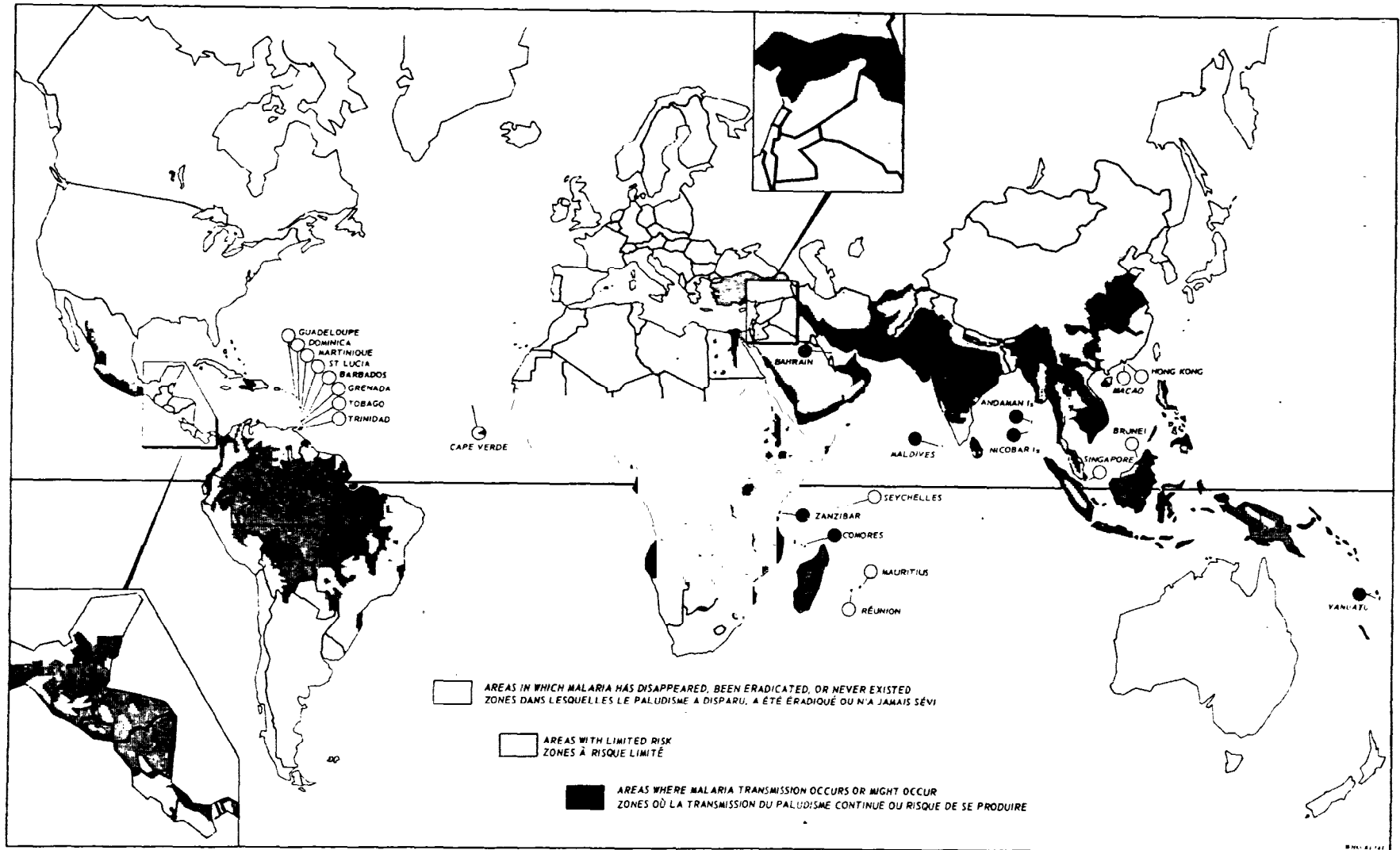
GAO believes that changes since 1973--involving a resurgence of malaria, new approaches involving general primary health-care services to provide drugs to combat the disease, the initiative of several AID bureaus to develop regional approaches to the problem, and the relative decline of U.S. financial and technical assistance--warrant a re-examination of the previous agencywide malaria program guidance.

GAO also believes that the constraints to effective anti-malaria activities must be fully considered to ensure efficient use of limited foreign assistance resources. The agency should avoid those situations where the inherent constraints cannot be resolved by the design of the projects and where external constraints preclude long-term effectiveness. At the same time, AID should maintain some flexibility to meet humanitarian needs on a case-by-case basis.

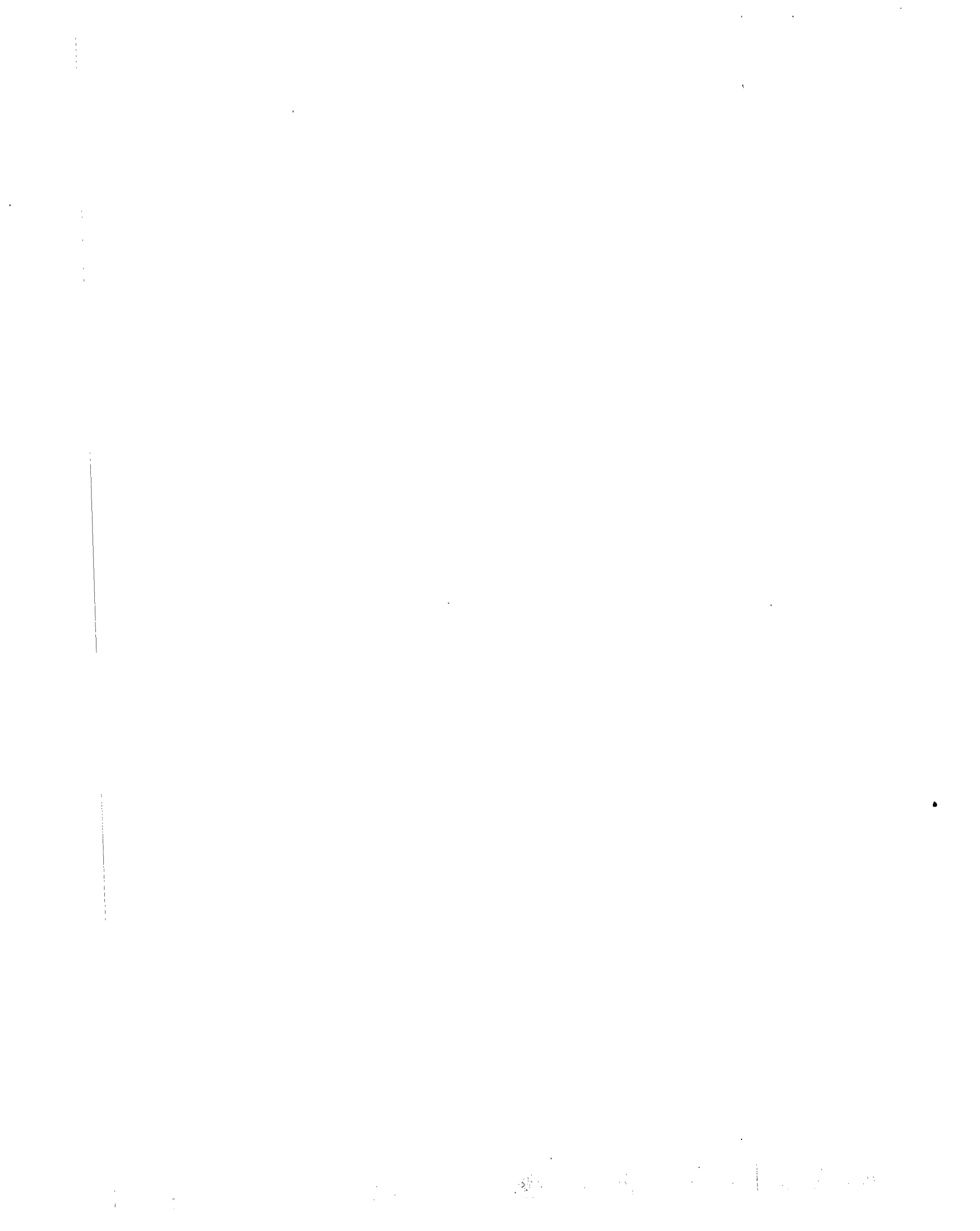
GAO therefore recommends that the Administrator, AID, direct a re-examination of the existing agencywide malaria guidance to consider changes which have occurred since 1973, and alert program managers about

- situations where assistance will be considered appropriate,
- what the assistance should accomplish,
- the circumstances where anti-malaria activities can be incorporated into general health-care services, and
- where anti-malaria activities stand in relation to other development opportunities and priorities.

GAO further recommends that the Administrator, AID, direct that project designs fully address the inherent constraints to successful anti-malaria activities and realistically assess the external constraints to long-term effectiveness. The project review and approval processes should also ensure that constraints do not preclude progress.

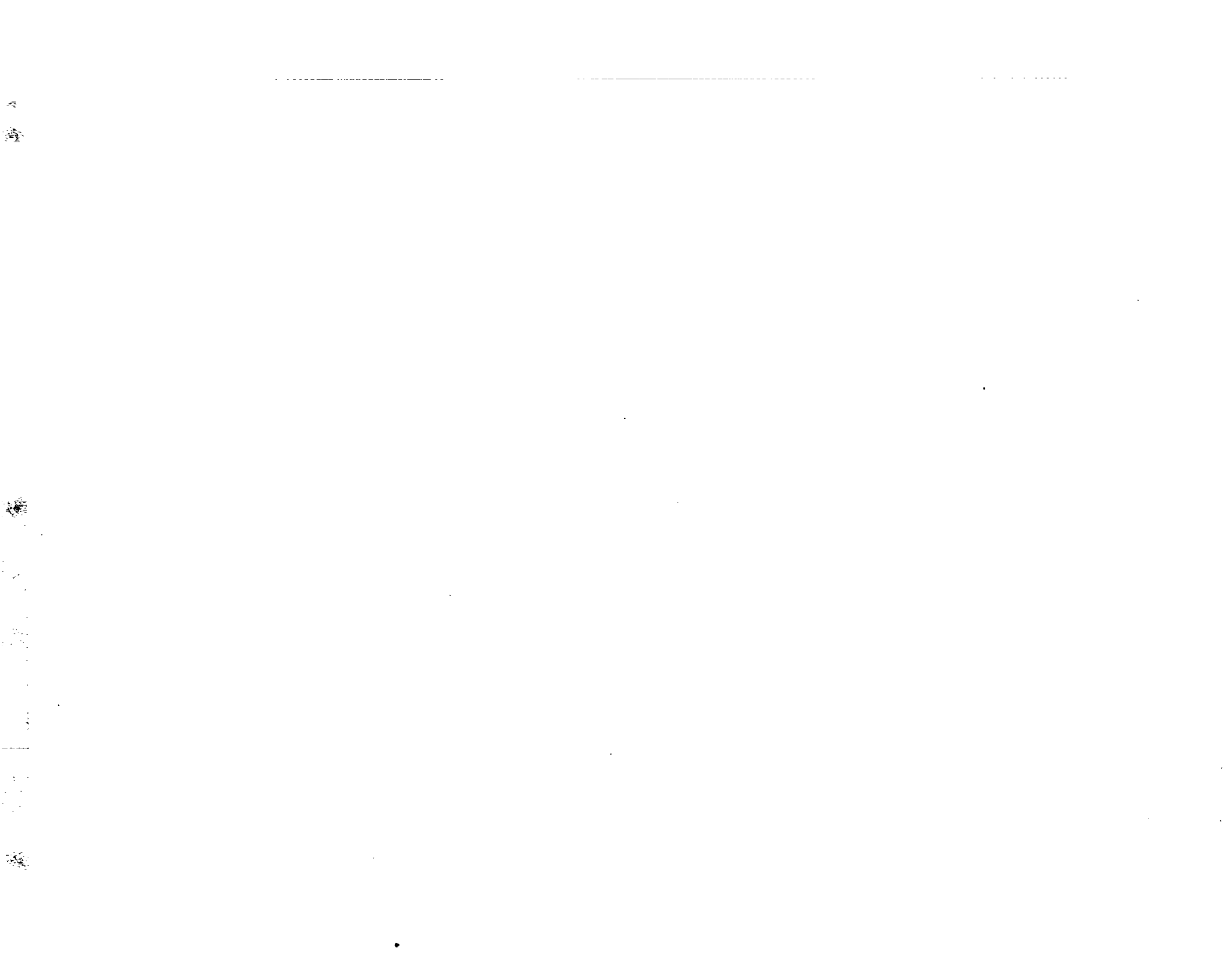


Source: The World Health Organization.



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ABBREVIATIONS

AID	Agency for International Development
CDC	Centers for Disease Control
GAO	General Accounting Office
NIAID	National Institute of Allergy and Infectious Diseases
PAHO	Pan American Health Organization
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
WHO	World Health Organization



Photo by GAO Staff

A worker in a government dispensary in Sri Lanka takes a blood sample to test for malaria. Workers also dispense drugs to combat the disease.

CHAPTER 1

INTRODUCTION

Malaria is one of the most widespread of the parasitic diseases and, in some countries, it is the primary public-health problem. Recently, the World Health Organization (WHO) estimated that 1.8 billion people living in 107 countries were at risk to the disease. The WHO study noted that approximately 214 million people were infected. A smaller figure was officially reported, however, because not all victims have access to facilities which diagnose, treat, and record prevalence of the disease.

Four types of malaria affect humans. The milder form of a common strain of the disease causes periodic chills and fever, an enlarged spleen, anemia, abdominal pain, headache, and lethargy. The fatality rate is low, but the disease is debilitating and lowers the victims' resistance to other health problems. A more serious form produces the same symptoms, but also causes fluid to accumulate in the brain and lungs, and blockage of the kidneys. The fatality rate for this form is high if not promptly treated.

Malaria is a complex disease. It begins when the female Anopheles mosquito, referred to as the vector, injects parasites into the bloodstream of the victim. These eventually mature in the liver and attack red blood cells. The parasites multiply until the cells in the bloodstream burst, bringing about the physical signs of the disease. Some parasites develop into male and female forms of the organism. When the victim is again bitten at this stage, the organisms enter the mosquito, fertilize, multiply, and become capable of infecting another victim--thus continuing the cycle. (See diagram p. 40.)

The objective of malaria eradication is to break the cycle, eliminate any source of infection, and prevent the reintroduction of the disease into the population. It is a time-limited strategy that requires careful implementation. Malaria control has a more modest objective. It is intended to reduce mortality and morbidity and contain the disease to a level where it is no longer a serious public-health problem. Malaria control has no time limit. Appendix I shows the major differences between malaria eradication and control programs.

Efforts to control malaria in the early 1950s were highly successful and led some authorities to believe that the disease could be eradicated. In 1955, the goal of eradication was endorsed by the members of WHO, including the United States. Many programs failed to achieve that goal--even though a vast number of people were freed from risk of the disease. Later programs, with the aim of at least reducing the disease to an acceptable level, have not been able to sustain earlier gains. During the last 10 years, a dramatic resurgence of malaria has occurred that now

threatens past program successes--between 1972 and 1980, the number of reported cases outside Africa more than doubled.

U.S. SUPPORT OF
ANTI-MALARIA ACTIVITIES

Except for a short period in the late 1960s and early 1970s, the Agency for International Development (AID) and its predecessor agencies have managed U.S. bilateral support of anti-malaria activities. In addition, the United States contributes to international organizations which are concerned about malaria and funds research to develop effective vaccines and drugs to combat the disease. Since the early 1950s, total U.S. assistance has exceeded \$989 million, as shown below. Over the past 10 years, however, U.S. support has not kept pace with the prevalence of malaria.

<u>U.S. SUPPORT OF ANTI-MALARIA ACTIVITIES</u> <u>(1950-81)</u>	
<u>Type</u>	<u>Amount</u> <u>(in millions)</u>
Bilateral	\$677.3
Multilateral	131.0
Research and development	<u>181.2</u>
Total	<u>\$989.5</u>

Bilateral assistance
to developing countries

The United States has provided over \$677 million in grant and loan assistance to bilateral anti-malaria activities. Appendix II lists the countries which have received U.S. bilateral assistance. This assistance has provided developing countries with commodities, such as drugs and insecticides; vehicles, sprayers, and spare parts; laboratory equipment; research; technical advisers and training. The number of programs receiving U.S. support and technical advisers has steadily decreased, particularly over the last several years.

At the peak of the worldwide malaria eradication campaign in the 1960s, AID provided almost 70 full-time advisers in 26 countries and provided commodity assistance to 10 other countries. At the end of 1981, AID had two direct-hire, four contract, and two local-hire personnel overseas; and three program managers in Washington working directly on anti-malaria activities. Financial support and technical assistance were being provided to eight projects: one in Africa; one in the Caribbean; and six in Asia.

In 1976, the AID Auditor General (now the Inspector General) reviewed U.S. bilateral assistance to combat malaria and concluded that " * * * the program machinery to combat malaria on a global basis has largely been disassembled." The reasons cited were (1) increasingly tight overall AID budgets, (2) assumptions that the downward trend of malaria outbreaks/epidemics would continue, and (3) new program priorities for the diminishing AID funds and manpower.

Multilateral assistance to international organizations

The United States has been a major contributor to the overall operations of the international organizations now or previously interested in anti-malaria activities--WHO, Pan American Health Organization (PAHO), United Nations Development Program (UNDP), and United Nations Children's Fund (UNICEF). We estimate that between 1955 and 1980, the United States contributed almost \$89 million to the anti-malaria activities financed from the general operating budgets of these organizations. In addition, WHO sponsors a special malaria fund financed by voluntary contributions of member governments, including the United States. Previously, PAHO also operated such a fund, but it was discontinued in 1970 when the United States withdrew support. Since 1955, the United States has also contributed over \$42 million to these special funds. Therefore, the United States has assisted a wider range of anti-malaria activities than indicated solely by bilateral assistance.

Assistance supporting malaria vaccine and drug research

Several U.S. civilian and defense agencies are involved in research and development of vaccines, drugs, and other measures to more effectively combat malaria. The vaccine development programs depend on the target populations; people in developing countries with a history of exposure to malaria; or U.S. military personnel never exposed to the disease, but with a potential requirement to operate in infected areas. Drug research and development is intended to overcome the increasing problem of parasite resistance to available compounds. Other research has been directed at finding better ways to control the vector. Since 1965, various U.S. agencies have invested about \$179 million in these programs.

In 1975, WHO established The Special Program for Research and Training in Tropical Diseases with the assistance and co-sponsorship of UNDP and the World Bank. The purpose of the program is to develop new methods to control malaria and five other tropical diseases. The program is also intended to strengthen the research capabilities of developing countries. As of 1981, the United States contributed an estimated \$2 million to the anti-malaria activities.

MALARIA IMPEDES DEVELOPMENT

Malaria deserves particular attention because of its prevalence in temperate and tropical climates and its effect on the social and economic development of individuals and communities. In terms of social impact, malaria can retard the mental development of infants, increase the absences of children from school, result in lost workdays for the labor force, and shorten life expectancies. When combined with other diseases which are common in many developing countries, malaria raises the morbidity and mortality rates above that normally expected.

The economic impact of malaria can be considered in terms of lost income to the victims, reduction in productivity, effects on tourism and development, and expenditures to combat and treat the disease. An important point is that the malaria vector and parasite are becoming more resistant to insecticides and drugs, respectively. As the disease spreads, greater quantities of more effective and increasingly expensive commodities are now required to combat the problem or reduce it to previous levels.

Over the years, malaria eradication or control has been a goal of many developing countries, international organizations, and U.S. humanitarian assistance. The types of programs vary from vertical programs organized to directly attack the disease, to efforts integrated within a country's general-health services. At one time, nearly 90 countries had national programs to combat malaria.

Resurgence of malaria

By 1970, eradication or control programs had freed about 727 million people from malaria--almost 53 percent of the affected population. During the last 10 years, however, malaria has reappeared in many areas, and the possibility now exists that the disease will reinfect regions once cleared.

Between 1972 and 1980, the number of malaria cases reported to WHO for all regions except Africa increased from about 3.1 million to nearly 7.8 million. Outside Africa, the most serious problems are in Asia and the Western Pacific where in 1980 about 90 percent of the reported cases were located. Africa has historically been unable to deal with malaria; outbreaks of the disease are not even systematically reported.

Social and economic costs of malaria

The health of a population affects social and economic development. Areas where diseases are prevalent are not able to develop at the same pace as areas with healthy populations. In some countries, malaria is a continuing cause of poverty.

A recent PAHO study of the effects of malaria on the availability of labor and agriculture production in a Latin American country shows that groups most severely infected with the disease worked fewer days or at a slower pace and cleared less land. Groups having more malaria victims produced fewer crops and were limited to growing food mostly for personal consumption at the expense of crops for market. This resulted in depleted food stocks, poor diets, and the accumulation of debt.

As resistance to widely used insecticides and drugs increases, more costly commodities will be necessary. This will further limit the ability of many developing countries to combat the disease.

OBJECTIVES, SCOPE, AND METHODOLOGY

This report concerns U.S. participation with developing countries and international organizations in combating malaria, and efforts to develop effective vaccines and drugs. Our primary objective was to assess the current level of U.S. support, in relation to the previous investment in eradication and control programs, and the serious resurgence of the disease during the last 10 years. Another objective was to examine how well ongoing projects receiving U.S. assistance are overcoming the constraints to long-term control of the disease.

At the beginning of this review, we examined AID's overall involvement in disease control that includes immunization against common communicable diseases and separate control programs for specific diseases--malaria, schistosomiasis (snail fever), and onchocerciasis (river blindness). We narrowed the scope of our review to malaria because of the (1) worldwide prevalence of the problem, (2) impact on social and economic development, (3) long history of U.S. involvement, (4) support going to both in-country programs and research for effective vaccines and drugs, and (5) number of U.S. agencies involved in the research.

Over the last 30 years, AID has been involved in nearly 70 malaria eradication or control projects. During 1981, AID provided financial and technical assistance to projects in eight developing countries. We made a preliminary review of information at AID headquarters and discussed the status of current projects with agency officials. The programs varied in stages of implementation, methods of financing, purpose, and AID mission involvement. To obtain a broad perspective, we selected four projects to illustrate a variety of these considerations. For example, one AID-grant project represents a substantially completed effort which was intended to develop a malaria-control capacity within the host government. Another project represents a long-term commitment to a country's malaria-control program. A third project is partially integrated into the country's primary health-care

system. A fourth project illustrates a country's serious commitment to deal with the malaria problem. Geographical considerations were also incorporated into our selection--we examined projects in Africa, Asia, and the Caribbean.

We did fieldwork in Zaire, Haiti, Thailand, and Sri Lanka. In addition to reviewing relevant documents, including previous AID evaluations, and visiting project sites, we held extensive discussions with many AID and host-government officials. We spoke with WHO headquarters officials in Geneva and held discussions with WHO representatives in the Southeast Asian, Western Pacific, and African regional offices. We also met with WHO country representatives in Zaire, Thailand, and Sri Lanka. We met with PAHO officials in Washington and Haiti. Basic information on the projects we visited is provided in Appendix III.

We believe the issues which we identified in the projects we reviewed represent the difficulties AID has experienced in combating malaria. These issues also confirm previous AID evaluations of the projects we visited. In addition, our observations confirm that similar problems, which AID pointed out in evaluations of previous programs (in India, Nepal, and Pakistan, for example), still exist.

Our inquiry of vaccine and drug research was limited to identifying the major activities of the U.S. agencies involved, the level of financial support, and examples of progress. A detailed assessment of the value of all the individual research projects was beyond the scope of this review.

We did not obtain official agency comments. However, we discussed the draft report with program officials and included their comments into the report.

This review was conducted in accordance with the General Accounting Office "Standards for Audit of Governmental Organizations, Programs, Activities, and Functions."

CHAPTER 2

AID GUIDANCE AND STRATEGIES TO COMBAT MALARIA

SHOULD BE UPDATED

AID malaria-program guidelines have generally followed WHO eradication and control strategies intended to combat the disease; however, the last agencywide statement was issued in 1973. Since then, three AID regional bureaus have provided guidelines for their overseas missions. The recent health-sector policy only concerns malaria as part of general disease-control concerns.

The availability of the insecticide DDT after World War II appeared to be the means of overcoming malaria. In 1955, the goal of time-limited eradication was adopted by WHO. This strategy worked in a number of countries. In others, the programs did not succeed. After almost 15 years, it became evident that worldwide eradication was an unrealistic objective. Another strategy to control the disease was endorsed in 1969. The aim was to protect areas cleared of malaria, reduce the prevalence of the disease to a manageable level in areas where it had not been eliminated and, where possible, eventually eradicate the disease.

WHO now promotes the prevention and reduction of mortality and morbidity by providing anti-malaria drugs and other basic control measures through primary health-care systems. Our recent review of primary health-care projects receiving AID support shows that health-service delivery must be a host-country priority, requires long-term financial support, good leadership, and sound management. We believe AID should apply these lessons when considering support for malaria-control activities in the framework of primary health-care systems.

We believe that, considering the (1) anti-malaria worldwide resurgence of malaria, (2) emphasis now being given primary health care, (3) absence of current agencywide malaria guidelines, and (4) relative decline in U.S. anti-malaria assistance--AID should restate its position on support of anti-malaria activities. Such a restatement could alert program planners and managers to the types of projects AID is willing to support and what the programs should accomplish.

RESURGENCE OF MALARIA

Although some regions have successfully eradicated malaria and a reduction of morbidity and mortality has occurred, the overall objective of controlling the disease has not been achieved. In 1979, WHO reported on the malaria situation. Of 143 countries or areas where malaria was originally endemic, 37 had been freed of the disease while the risk was minimal in 16 countries. In the remaining 90 countries, the risk was still moderate to high.



Photo by GAO Staff

Workers spraying outside of house with insecticides to combat malaria in Sri Lanka.



Photo by GAO Staff

Although improvement had been achieved--over 400 million people had been freed from risk to malaria--there were still 1.7 billion people at risk to infection.

In an analysis on the number of reported cases between 1972 and 1979, WHO stated that the overall recent decline after 1977 was greatly influenced by the improved situation in three countries: India, Sri Lanka, and Turkey. The reduction was a result, according to WHO, of increased spraying and drug distribution, rather than a change in the methods of malaria control. According to one WHO expert, the repeated use of traditional anti-malaria measures is not likely to further improve the situation. This could even lead to another resurgence of the problem that would be more difficult to control than the increase that took place in the 1970s. The following table shows the number of malaria cases reported to WHO between 1972 and 1980.

<u>NUMBER OF REPORTED MALARIA CASES</u> (in thousands)									
<u>WHO Region</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Americas	285	280	269	357	379	399	469	515	599
South-East Asia	1,816	2,686	4,162	6,105	7,304	5,540	4,790	3,658	3,371
Europe	13	9	7	13	41	119	93	34	38
Eastern Mediterranean	830	746	480	429	348	227	162	125	130
Western Pacific	171	201	179	188	211	4,457	3,422	2,706	3,621
Total	<u>3,115</u>	<u>3,922</u>	<u>5,097</u>	<u>7,092</u>	<u>8,283</u>	<u>10,742</u>	<u>8,936</u>	<u>7,038</u>	<u>7,759</u>

Source: The World Health Organization.

The table does not include Africa because available statistics do not represent the magnitude of the problem. Relatively few people have access to hospitals or health centers which report the prevalence of the disease. However, malaria is recognized as a major health problem facing most of these countries, and the situation has not changed significantly over the last generation. Of 19 African countries reporting on the incidence of disease in 1975 and 1976, malaria led by a wide margin. In 1977, WHO estimated that of the 342 million people living in Africa, 291 million were in areas where the risk of the disease was moderate to high. Annually, 1 million children under the age of 5 years die from malaria. Survivors are subject to repeated attacks.

PRIMARY HEALTH CARE

In 1978, the governing body of WHO endorsed the objective of providing a level of health that will permit all people to live socially and economically productive lives by the year 2000. Primary health care is being promoted as the key to that objective.

The approach includes the prevention, control, and treatment of common diseases. Where malaria is endemic, the disease necessarily becomes a focus of these general health services. In some areas, particularly in Africa, the prevalence of malaria and the lack of even minimum health-care services renders the hope of "health for all * * *" a formidable objective.

To resolve this dilemma, WHO identified a series of inter-related goals for anti-malaria activities which match the prevalence of the disease with available resources. The goals range from the prevention and reduction of mortality, to wide-scale malaria control and eventual eradication of the disease. The limited goal of prevention of mortality is considered appropriate in areas of high prevalence of malaria, severe illness, scarce resources, and limited experience in anti-malaria program management. The more optimistic goal of control and even eradication is considered appropriate only in cases where a national commitment and community involvement, adequate resources, and experienced and capable anti-malaria program management exist. Between these extremes, countries can aim at reducing both mortality and morbidity or reducing the prevalence of the disease with drugs, insecticides, and other vector-control measures. The prevention and reduction of mortality and morbidity are "holding actions" which provide only short-term measures for malaria. They rely heavily on anti-malaria drugs supplied to selected, high-risk target populations through primary health-care systems. Wider control and prevention of the disease must await the further economic and social development in affected countries or better control methods--such as the development of a malaria vaccine.

The WHO goals and the primary health-care approach to malaria have implications for AID. The agency gives priority to primary health care in its health-sector assistance program. AID health-delivery projects in Zaire and Honduras, for example, support anti-malaria activities.

In 1981, we reviewed AID assistance to primary health-care programs.^{1/} We believe our observations--particularly those dealing with the lack of host-country support, inadequate supplies of medicine, and poor project management--are relevant to efforts to provide anti-malaria drugs through this mechanism. We found that many projects were achieving their intermediate objectives--such as training health workers, building facilities, administering immunizations, and providing initial stocks of medicine--but most projects were overly optimistic in what they planned to accomplish. Problems evident in most projects involved logistic

^{1/}"Management Problems With AID's Health-Care Projects Impede Success," (ID-81-24, April 28, 1981).

support, project management, evaluation, and shortages in essential medicine. Host-country resources were inadequate to replenish initial stocks supplied through AID assistance.

U.S. ANTI-MALARIA STRATEGIES AND GUIDANCE

The last AID guidance specifically dealing significantly with malaria was promulgated almost 9 years ago. Since then, three AID regional bureaus have initiated individual strategies to guide their respective missions. The agency's 1980 health-sector policy also addresses anti-malaria activities, but only in the context of AID's overall disease-control program.

AID guidance for assistance

The last AID guidelines dealing specifically with malaria were issued in 1973 and maintain the option of supporting control activities, but retain eradication as the ultimate objective if projects meet minimum conditions. The major elements provide for

- assistance on an individual basis when countries demonstrate interest and concern about malaria;
- commodity support, local costs, and cooperation with WHO on evaluations; and
- interim advisers to assist with supply procurement and use and program management.

According to the guidelines, WHO would be relied on for scientific advisory services and technical assistance. AID also intended to establish regional malaria adviser positions for Asia and Africa to assist the overseas missions and coordinate activities between AID, WHO, and other donors. Although the positions for Asia were staffed, they have recently been eliminated. The adviser for Africa was never appointed. (The criteria which the guidelines established to identify projects meriting U.S. assistance is discussed in ch. 3.)

Regional guidelines

AID's regional bureaus for Asia, Latin America and the Caribbean, and Africa have promulgated the following anti-malaria strategies to guide program planning and implementation.

Bureau for Asia

In 1977, the bureau formed a group of experts to (1) assess the results of past and present programs, (2) review the technical problems interfering with the progress and identify training and

research needs, and (3) review the various approaches to combating the disease. The resulting strategy proposes

- support of malaria-control projects, preferably in conjunction with other donors, and efforts to ensure long-term host-country support when external assistance ends;
- establishment of ways to bring potential donors together to support programs which need assistance;
- support of training centers 1/; and
- continued participation in appraisals of malaria-control programs.

Bureau for Latin America and the Caribbean

Because of the resurgence of malaria in many countries, a restatement of the bureau's position was issued in 1980. The policy directs that support must be (1) considered in the context of rural health-care delivery goals, (2) proven competitive with other options for assistance, and (3) meet the AID criteria for identifying projects which merit U.S. assistance. Support will normally be provided as a component of multidonor operations.

Bureau for Africa

More recently, AID initiated a comprehensive review of malaria in Africa, concluding that it is possible to implement anti-malaria activities there, depending on the goal. However, it is improbable that most countries can combat the disease without external assistance. The strategy identifies two approaches which would be particularly useful in Africa:

- reducing mortality by distributing curative doses of anti-malaria drugs to all suspected severe cases, and
- reducing both mortality and morbidity by distributing drugs to protect, as well as cure, groups most vulnerable to the disease--children under 5 years of age and pregnant women.

The strategy recommends that residual spraying be limited to the few cases where it is cost effective. Where feasible, more comprehensive control measures may be considered for urban and semi-urban areas.

1/AID now supports an international malaria training center in Malaysia.

The AID health-sector policy

The AID 1980 health policy concentrates on four areas: primary health care; improved water and sanitation; health planning; and selected disease-control programs. The agency places priority on primary health care, but still believes that constructive attempts can be made to control diseases which are common in many developing countries. AID favors immunization as part of primary health-care programs, recognizing that separate measures are sometimes necessary for specific diseases of major public-health importance--including comprehensive malaria-control projects. Support for such programs is limited, however, by the current state of technology and other competing priorities. The 1980 policy continues to support anti-malaria training, commodities, applied field research, and health education. The AID policy also recognizes that commodities constitute a significant recurring cost, and that countries should aim at self-reliance in the long-term.

Beyond the types of anti-malaria program components the agency is willing to support, however, the policy is silent about (1) the conditions where assistance would be appropriate, (2) what the assistance should accomplish, (3) where malaria stands as a priority among public-health and communicable disease problems, and (4) the conditions where malaria programs can be incorporated with primary health-care programs. In this respect, the 1973 guidance is still the only agencywide statement available to serious anti-malaria program planners.

DECLINE IN U.S. SUPPORT OF ANTI-MALARIA ACTIVITIES

The United States has contributed an estimated total of \$808 million to eradication and control programs in developing countries, technical assistance, and the anti-malaria activities of international organizations. The following table summarizes the types of assistance.

U.S. ASSISTANCE TO ANTI-MALARIA ACTIVITIES
(1950-81)

<u>Type of assistance</u>	<u>Number of projects</u>	<u>Amount</u> (in millions)
<u>Bilateral a/</u>		
Asia	24	\$ 536.9
Latin America and Caribbean	26	96.6
Africa	7	30.2
Near East	7	7.2
Other technical assistance and training b/	<u>12</u>	<u>6.4</u>
Total	<u>76</u>	\$ <u>677.3</u>
<u>Multilateral c/</u>		<u>131.0</u>
TOTAL		\$ <u>808.3</u>

a/Includes grants, loans, and U.S.-owned, foreign currency contributions.

b/Represents centrally funded technical assistance and five training/technical assistance activities funded by regional bureaus.

c/U.S. contributions to WHO, PAHO, UNICEF, and UNDP.

Bilateral support

Excluding centrally funded technical assistance, AID and its predecessor agencies have contributed an estimated \$672.2 million in bilateral grants and loans to almost 70 projects in 37 countries. By the time the United States joined the worldwide eradication campaign in 1957, \$114.7 million had already been channeled to 13 programs in 12 countries. During the eradication era, between 1957 and 1969, an additional \$407 million in grants and loans were approved for 44 programs in 37 countries. Between 1970 and 1981, only 12 new projects in 9 countries were approved--representing \$150.5 million in assistance.^{1/} Over \$125.6 million of the amount allocated during this latest period, however, was to finance mostly commodity imports in five Asian countries--Nepal,

^{1/}Not including two projects approved at the end of fiscal year 1981 for \$12.8 million.

Sri Lanka, Indonesia, Pakistan, and India. A limited number of primary health-care projects containing anti-malaria components were also approved.

During 1981, there were eight ongoing anti-malaria projects. During that year, three ended. Three are scheduled to terminate during 1982; the others will end by 1985.

Technical assistance

At the peak of U.S. support to malaria eradication activities, full-time advisers were assisting programs in many countries, however, the ability of AID to now provide such assistance has declined. In 1965, program administration was transferred from AID to the Centers for Disease Control (CDC) to make better use of health resources located elsewhere in the Government. AID continued to be responsible for program funding, but 39 technical advisers were transferred to CDC. However, a 1968 Presidential directive to limit the number of U.S. employees overseas, balance-of-payment concerns, and reduced foreign assistance appropriations affected the program. At that time, there were 65 U.S. advisers working on projects overseas, and a staff of 22 people in the United States provided additional technical assistance, training, evaluation, research, and procurement services. AID, however, could not support the minimum number of personnel CDC considered necessary to manage the projects.

In 1970, AID decided to rely on the international organizations to implement U.S. development programs. WHO had already expressed a willingness to provide technical assistance and training for the U.S. projects. CDC agreed to provide interim support until WHO could assume the increased responsibilities. However, WHO failed to provide the advisers and actually reduced the number of approved positions from 121 to 91. Only two U.S. advisers were transferred to WHO; many U.S. experts in combating malaria were therefore lost.

In 1972, AID was notified that CDC would terminate the interim assistance during the following year. By that time, there would be only five U.S. advisers in three countries. All program responsibilities eventually reverted to AID.

The following shows U.S. project personnel assigned overseas.

<u>Year</u>	<u>Number of direct-hire personnel overseas</u>	<u>Number of countries</u>
1955	13	7
1960	45	14
1965	62	13
1970	41	11
1975	3	3
1980	<u>3a/</u>	2

a/Does not include four contract and two local-hire personnel.

As of the end of 1981, AID assigned five direct-hire personnel to the malaria program: two overseas and three in Washington (of which one was primarily involved in the malaria vaccine research program). Further reductions of the staff are expected during 1982.

Contract personnel are now assisting projects in Zaire, Haiti, and Indonesia. Contract advisers could be a resource for any future program activities. Experienced and qualified individuals are difficult to find, especially if there is a foreign language requirement. For example, 1 year elapsed before an epidemiologist could be obtained for the project in Zaire.

Multilateral support

WHO establishes anti-malaria policies, provides technical assistance, and promotes cooperation among member countries. PAHO, the regional organization of WHO, has a similar but limited, scope of activity. Until 1973, UNICEF provided commodity support to host-country programs. The United States has indirectly supported the anti-malaria activities of these organizations through contributions to general operating budgets, and in the past, also directly contributed to special malaria accounts of WHO and PAHO. (See the following table.)

U.S. SUPPORT OF ANTI-MALARIA ACTIVITIES
OF INTERNATIONAL ORGANIZATIONS
(1955-80)

<u>Organization</u>	ACCOUNT TYPE		<u>Total</u>
	<u>General budget a/</u>	<u>Special malaria fund</u> (millions)	
WHO	\$ 37.5 b/	\$ 17.8	\$ 55.3
PAHO	8.7	24.5	33.2
UNICEF	<u>42.5</u>	<u>-</u>	<u>42.5</u>
Total	<u>\$ 88.7</u>	<u>\$ 42.3</u>	<u>\$131.0</u>

a/Represents an estimate of the portion of the U.S. contribution to the general operations of the organizations allocated, on a pro-rata basis, to anti-malaria activities.

b/Includes \$2.5 million in allocations of U.S. contributions to UNDP which supported WHO's Technical Assistance Budget.

The anti-malaria activities of PAHO were mainly supported by voluntary contributions to the special malaria fund. The United States was a major contributor, but withdrew support in 1970 because of budget limitations. Because the organization relied heavily on U.S. participation, activities had to be significantly curtailed.

PREVIOUS AID REVIEW OF
ANTI-MALARIA ACTIVITIES

During 1975, the AID Inspector General conducted a comprehensive review of U.S. support of anti-malaria activities since 1972. The resulting report noted that (1) the policy of relying on WHO to provide technical assistance to U.S. programs resulted in a decrease in needed technical advisory assistance to affected countries, (2) the overall attack on malaria dropped to a very low level, and (3) the potential for re-emergence of the disease as a major hindrance to development was again a significant possibility. The report concluded that the AID program machinery to combat malaria on a global scale had largely been dismantled.

The Inspector General recommended that AID assemble a task force to: review the prevalence and seriousness of malaria, determine the ability of the affected countries to plan malaria programs, and make recommendations concerning the most feasible approach to combating the disease. According to AID officials, such a task force was never formed. The Bureaus for Asia and

Africa, however, have relied on panels of experts to develop their regional strategies.

CONCLUSIONS AND RECOMMENDATIONS

A number of strategies have been adopted to combat malaria. Early attempts to eradicate the disease were not entirely successful. As a result, a more modest objective--controlling malaria and eventually eradicating the disease if feasible--was adopted in 1969. Shortly after the endorsement of the malaria-control strategy, the number of reported cases increased. As late as 1980, the number of cases outside Africa was more than twice that reported in the early 1970s.

The endorsement of primary health care as the means of achieving "health for all * * *" has implications for anti-malaria activities, especially where the disease is a major public-health problem, such as in many African countries. WHO is now promoting the use of general health-care systems to provide anti-malaria drugs to prevent mortality and reduce morbidity. Our review of AID-assisted primary health-care projects shows that the goals of these systems are often over optimistic. Host countries are unable to replenish medicine initially provided through AID assistance.

The United States has traditionally supported anti-malaria activities in developing countries. However, the last agencywide guidance that specifically addresses these programs was issued in 1973. Since then, guidance has been issued by several AID regional bureaus. The AID 1980 health-sector policy reaffirms which project components the agency is willing to support. However, this latest statement is silent as to (1) the conditions where assistance would be appropriate, (2) what the assistance should accomplish, (3) where malaria stands as a priority among public-health and communicable disease problems, and (4) the conditions where malaria projects can be incorporated with primary health-care programs. The 1973 policy is still the only specific agencywide guidance for program planners and managers.

We believe that changes since 1973--including the increased prevalence of malaria, new approaches to combating the disease using primary health-care systems, and the initiatives of several bureaus to develop regional approaches to the problem--warrant a re-examination of the 1973 guidelines. The United States has invested \$808 million in bilateral support of anti-malaria activities and contributions to concerned international organizations. However, the level of support, the number of programs, and the ability of AID to provide technical assistance from agency resources have declined. We believe that the 1975 observation of the AID Inspector General--that the machinery to combat malaria on a global scale had largely been dismantled--is still valid today.

We, therefore, recommend that the Administrator, AID,

- direct a re-examination of the existing anti-malaria program guidelines by a panel of experts representing AID, other U.S. agencies, such as the Centers for Disease Control, the international health community, and other appropriate sources to consider the increased prevalence of the disease, new approaches to health-service delivery, the particular concerns of the regional bureaus, and the extent the agency should support such activities; and
- alert program managers to situations where assistance would be considered appropriate, what the assistance should accomplish, the circumstances where anti-malaria activities can be incorporated with primary health-care programs, and where anti-malaria activities stand in relation to other development opportunities and priorities.

CHAPTER 3

PROGRAMS SHOULD BE DESIGNED TO ACHIEVE

LONG-TERM REDUCTION OF MALARIA

WHO identified the constraints to effective anti-malaria programs in 1979. The problems range from increasing costs of commodities for combating the disease to inadequate training and research support.

AID recognizes that U.S. support of malaria programs cannot be maintained at previous levels. In 1973, criteria was adopted to identify those situations where such limited assistance could be considered. We reviewed four current programs and evaluations of three other recently completed projects to determine the extent the impediments identified by WHO are being overcome. We also reviewed how well the AID criteria is identifying programs which merit U.S. assistance. Of the seven projects, the earliest was initiated in 1975, and the latest is now planned to terminate in 1984. Cumulatively, the projects total \$115 million in grant and loan assistance from the United States. We found that AID assistance has successfully met the immediate needs of the anti-malaria programs we reviewed. However, other problems threaten long-term success. We believe, therefore, that AID should seriously consider these problems when planning and designing future projects.

ONGOING PROJECTS ARE ACHIEVING INTERMEDIATE OBJECTIVES

The current anti-malaria projects we reviewed have an ultimate, long-term goal of institutionalizing the mechanisms for improving the health of target populations. To achieve this, AID finances commodities and equipment and provides training and technical assistance. In most cases, the projects we reviewed are achieving the intermediate steps to better health. The following relates some program accomplishments.

Zaire

Malaria control is part of a larger disease-control project partially financed through an AID grant. The program is intended to reduce mortality and morbidity by strengthening the government's institutional capacity to monitor and control the disease. AID provides technical assistance, training, and commodity support. The project has successfully established an organization capable of monitoring malaria, and it has demonstrated the feasibility of reducing the prevalence of the disease, using DDT in a limited geographic area.



Photo by GAO Staff

Examples of buildings and insecticides for the malaria control program in Sri Lanka.

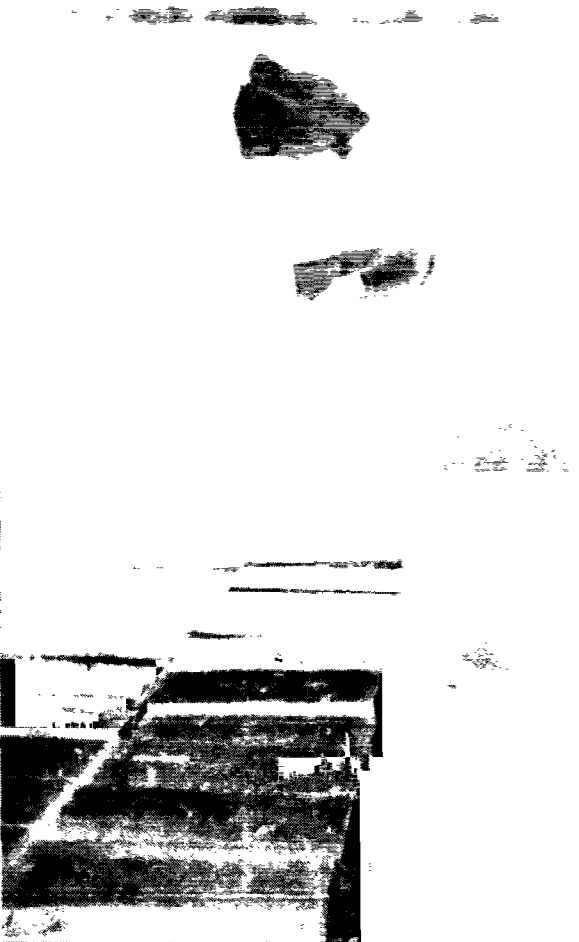


Photo by GAO Staff

Thailand

AID partially supports the multidonor project in Thailand with loan and grant assistance. The aim is to improve the health of Thailand's people by maintaining long-term malaria control in the border and mountainous regions and eradicating the disease in the remaining areas. This will be accomplished if (1) there is a significant reduction in general mortality and morbidity, (2) malaria mortality is reduced to approximately five deaths per 100,000 population, and (3) malaria is eradicated in designated areas. Representatives from Thailand, AID, WHO, and other consultants evaluated the program during July 1981 and observed that "It is evident that at this time there is little likelihood of the project achieving these goals * * *." Malaria increased from about 303,000 reported cases in 1979 to over 395,000 reported cases in 1980. The most serious strain of the disease was identified in almost 70 percent of the cases. In 1979, the malaria death rate was over eight cases for each group of 100,000 people.

The project, however, has accomplished many of its intermediate objectives, such as

- technical assistance for training, procurement of commodities, administration, and monitoring;
- contracts for commodities and equipment;
- opening malaria treatment centers and other facilities;
- training and commodity support for village volunteers;
- research for proper drug treatment regimens; and
- delivery of equipment and maintenance of vehicles.

Some project components, particularly construction and training, will probably not be fully completed until after the project ends.

Sri Lanka

The Sri Lanka project is a large-scale multidonor effort to reduce the annual incidence of the disease to one case for each group of 1,000 people--countrywide. The program is divided into three phases (1) intensive spraying, (2) selective spraying and monitoring, and (3) monitoring with phased integration into the general-health service. The principal purpose of the project we reviewed is to finance the import of insecticides and drugs, and to a lesser extent, provide short-term training, research, and operational equipment over a 5-year period. Our review of selected sites showed ample supplies of commodities in adequate

storage facilities. Government officials also assured us that there were sufficient commodities to support the program.

Most of the projects we reviewed are successfully meeting the immediate needs of organized anti-malaria campaigns. However, the projects are also facing other constraints, discussed below, which threaten long-term success. If these constraints cannot be overcome, then the projects will (1) be stopgap measures which do not meet the long-term health needs of the population they are intended to assist and (2) not meet the objectives of U.S. foreign assistance.

WHO ANALYSIS OF CONSTRAINTS TO LONG-TERM MALARIA CONTROL

In 1979, WHO reported that of 143 countries where malaria was originally endemic in all or part of the territory, 90 countries still had a moderate to high risk of the disease. In addition to vector and parasite-resistance problems, WHO identified constraints to controlling the disease, including

- increased costs of material and equipment and global inflation;
- inadequate support from other government entities, such as public works and other elements of the public-health network;
- shortages of trained and experienced personnel;
- human behavioral patterns which increase vector contact, assist in spreading the disease, or hinder ongoing control measures;
- natural or security problems which prevent control measures from reaching malarious areas;
- other programs, such as irrigation and agriculture development, which contribute to the spread of the disease; and
- inadequate research and insufficient knowledge of the cost-effectiveness of various control measures.

Some of the constraints--such as the lack of host-country resources, shortages of trained personnel, and an inadequate understanding of the cost-effectiveness of various control measures--are properly within the scope of U.S. assistance to anti-malaria activities. However, other impediments--such as inadequate general-health services, lack of cooperation from other host-government organizations such as public works, rural development, and personal or religious customs of the target population--are host-country responsibilities or the proper objective of other

development programs. The projects we visited, particularly in Zaire and Haiti, but also in Thailand and Sri Lanka, were experiencing many of these constraints to effective malaria control.

CRITERIA FOR U.S. ASSISTANCE

The resources needed to control malaria exceed the capacity of the affected countries or the donor community. AID, however, believes constructive attempts can be made to control the disease. According to the AID 1973 criteria, assistance can be considered when

- "the country demonstrates its own interest and concern * * * through the provision of an adequate budget and staff to carry out the program;
- there is a critical need to protect a substantial U.S. investment in terms of gains already made or a need to prevent malaria from becoming a deterrent to other country development programs;
- the country provides a malaria plan which is technically, administratively, and financially sound and is based on an AID review of the recommendations of a joint WHO/LDC [developing country] evaluation team; and
- available resources within the country have been mobilized and available external sources of assistance have been explored."

We found that using the criteria AID developed was not effectively identifying those programs which merit U.S. assistance. Considering the number of constraints to malaria control, we doubt that existing criteria can be effectively used to identify projects which merit U.S. assistance. We do believe, however, that a standard is required to prevent the commitment of scarce foreign assistance resources to projects which offer little hope of sustained progress. Such a standard should include recent changes to the methods of malaria control, which have become necessary because of the increased difficulties in controlling the disease.

Programs need long-term assistance

Using the budget and staff that host countries target for anti-malaria activities can indicate a national concern for the problem. However, the countries we visited rely heavily on external assistance to finance their health services, including anti-malaria programs.

The rapidly rising cost of commodities for anti-malaria programs causes a continuing, long-term need for external assistance.

For example:

--The cost of DDT tripled between 1972 and 1981. In areas where the vector has developed resistance to this insecticide, more costly products must be applied, at more frequent intervals; and

--In 1978, WHO estimated that it would cost \$45,000 to protect a million people with a single dose of the anti-malaria drug chloroquine. By 1981, it cost \$54,000 to protect the same number of people. In endemic areas, the drug should be continually available if the population is to be protected.

The malaria programs discussed below probably could not continue at the current level without substantial assistance from the United States.

Zaire

Malaria is considered a major health problem in Zaire--the primary cause of morbidity and a leading cause of mortality. The disease in the capital city of Kinshasa at least contributes to the death of half the children under 1 year of age.

The overall goal of the AID project is to reduce the mortality and morbidity caused by communicable diseases--specifically measles and malaria. Part of the \$2.3 million AID grant was to demonstrate the feasibility of controlling malaria by using DDT to spray houses in 3 of 24 zones in the capital and 1 nearby rural community. Although spraying reduced the incidence of malaria, the cost of the insecticide has made this tactic too expensive for Zaire to replicate on a broad scale. Between 1978 and 1981, the price of DDT for the project increased from \$0.44 to the equivalent of \$0.65 a pound. An AID Public Health Officer in Zaire told us that the feasibility of a wide-scale spraying campaign should have been questioned at the initial stage of the project. An AID team recently visited the project and concluded, "The enormity of the socio-economic and logistical problems of Zaire makes the possibility of creating an effective, nation-wide anti-malaria program very remote at present."

Zaire has not demonstrated a national commitment to combating malaria. It contributes office, laboratory, and warehouse space and only about \$10,000 a year for the salaries of project personnel. The funds for the salaries are generated by the U.S. Public Law 480 agriculture program because no specific provisions for the program exist in the national budget.

Haiti

Although previous programs to control malaria in Haiti achieved impressive results--only about 2,500 cases were reported in 1968--setbacks have occurred. During 1980, almost 48,400 cases were reported. AID officials estimate that this is about 20 percent of the actual number of cases. The resurgence has been attributed to several causes, including resistance of the vector to DDT.

Between 1960 and 1981, Haiti, AID, UNICEF, and PAHO contributed almost \$43 million to the anti-malaria program. Of this amount, Haiti contributed nearly \$7 million and AID contributed over \$32 million. Although Haiti has contributed almost 57 percent of the total public health budget to malaria-control activities since 1978, both host-country and AID officials told us that it would be impossible to continue the program without outside assistance. AID is now considering a follow-up grant for another malaria-control program.

Japan has donated a large quantity of the most effective insecticide now being used in the Haiti project; however, it is four times as expensive as DDT and must be applied more frequently. In 1981, the joint Haiti, AID, WHO, and PAHO evaluation team estimated that it would cost about \$14.2 million a year to spray a million dwellings with the insecticide being donated by Japan. Adding the cost of evaluation, logistic support, and general management, a nationwide program would require an estimated \$60 million for a 3-year plan of operation. This exceeds the total resources that both Haiti and the donor community have historically been willing to commit to the problem.

As an alternative, the joint evaluation team recommended a more modest approach of spraying limited areas, providing drugs to fever patients, controlling outbreaks, and additional surveys to determine which control measures could be most effectively implemented. However, to finance the limited spraying operations alone would require about \$8 million a year--more than Haiti has contributed to the program since 1960. Annual support from all sources would have to quadruple just to provide the insecticide for such a plan.

Considering (1) the threat Haiti's malaria problem poses to the region, (2) a \$32-million U.S. investment over the last 20 years to control the disease in the country, and (3) the estimated cost of continuing to combat this major public-health concern, AID faces a difficult decision concerning future program support.

Thailand

In fiscal year 1979, AID approved \$4.5 million in grant and loan assistance to the current project we reviewed in Thailand. The host country agreed to contribute an additional \$28 million over the 4-year life of the program.

Funding for anti-malaria activities by Thailand has not kept pace with other public-health programs. In 1965, Thailand allocated 4.7 percent of the public-health budget to combat malaria. In 1980, the country allocated only 3.8 percent to anti-malaria activities. Inflation has also constrained the program. During the same period (1965-80), the country experienced a 275-percent inflation rate. Therefore, the 1980 appropriation of \$8.7 million represents only about \$3.2 million at constant 1965 prices. This is less than half the amount actually allocated for malaria during the base year.

In 1980, AID reviewed the program and reported " * * * support has not been adequate during the current project due to budgetary limitations and competing priorities." In 1981, another evaluation confirmed the inadequate budget as a recurring problem.

Sri Lanka

The Sri Lanka program was evaluated in 1981 by representatives from the government and donor organizations. The report noted that malaria-control activities represented over 9 percent of the health budget for 1980. Because health programs receive about 4 percent of the national budget, the team considered this financial commitment supportive of the program. However, about 55 percent of the 1980 anti-malaria program budget represented foreign assistance. The U.S. contribution represented about 50 percent of that donor support. Sri Lanka, therefore, depends heavily on foreign assistance to finance such activities.

All the programs we reviewed relied to varying degrees on external assistance from the United States and other donors. These programs either could not exist, or would be seriously curtailed if such assistance were terminated.

Shortages of qualified personnel limit effectiveness

Malaria-control activities require trained and experienced personnel at all levels of the health service to ensure long-term success of the program. The effectiveness of many national anti-malaria programs has been limited because of insufficient qualified personnel. The availability of adequate staff is another element of the AID criteria to indicate a country's concern about malaria control.

Zaire

One project objective is to strengthen the institutional capacity of Zaire to monitor and control vector-borne diseases, especially malaria. From the onset, however, AID stressed that the project was to provide "seed money" to establish an effective, responsive health-service system.

Fully qualified operational and administrative personnel have been impossible to find. As a result, AID project officials told us that they have had to provide formal training and daily on-the-job instructions for people at all organizational levels. WHO also contributed to training.



Photo by GAO Staff

Laboratory workers in Zaire reviewing blood samples under microscopes.

At the time of our review, all critical staff positions had finally been filled; however, the government probably will not continue the project when U.S. assistance terminates. One U.S. official told us that the laboratory and trained technicians which the project established to diagnose malaria would probably continue to operate for only about 6 months after U.S. assistance ends.

Haiti

A lack of qualified health personnel exists at all levels of Haiti's health-care system. An assessment of health-care personnel was attempted as part of the design of the current anti-malaria project. The project proposal noted that the data needed for planning is not routinely collected.

An indepth evaluation by an international team of anti-malaria experts was conducted in 1979. Their review, almost 2 years after the AID project was approved, noted that the country needed to create a capacity to conduct, monitor, and evaluate an anti-malaria program. The report also identified the need for long-, medium-, and short-term technical assistance. The evaluation team also commented on the lack of formal training within the host-government organization responsible for the program. People did, however, receive informal instruction. The 1979 report also recommended a formal training program. By 1981, we noted that a training organization had been established and was beginning to contribute to the program.

Thailand

A shortage of qualified personnel has adversely affected the program. Joint evaluations by AID, WHO, and Thailand officials in 1974, 1979, and 1981, all recommended personnel improvements in the research and training areas. The most recent study determined that their understanding of the vector's habits is inadequate. A U.S. official told us that, as a result, insecticide spraying techniques have not changed since 1948. The project needs additional qualified personnel because these tasks are being neglected.

Problems also exist at the operational level. Spray personnel are hired on a temporary basis, so a complete turnover takes place after each spray cycle; therefore, there is no accumulation of experience. Consequently, the effectiveness of the spray operations is hampered.

Sri Lanka

As in many developing countries, skilled medical personnel are reluctant to locate in rural areas. In Sri Lanka, only about one-half of the Regional Medical Officer positions were staffed by fully qualified individuals at the time we reviewed the project. Although community participation is high, rural program management has been inadequate. A Ministry of Health official told us that program management needs improvement, and progress could be jeopardized by the lack of qualified individuals.

Relationship of malaria projects and other U.S. assistance

The 1973 AID malaria guidance established a criteria that there be (1) a critical need to protect a U.S. investment in terms of gains already made or (2) a need to prevent malaria from becoming a deterrent to other development programs. Current AID health-sector policy recognizes that other activities, such as agriculture development or rural resettlement projects, should work to inhibit malaria. Our review of four projects shows that these guidelines are not being fully considered. We did observe, however, that the projects are attempting to provide the anti-malaria element of the total health-care needs of the countries we visited.

The projects in Zaire, Haiti, and Thailand are not intended to protect U.S. investments in terms of gains already achieved or prevent malaria from becoming a deterrent to other development programs. The primary project purpose is humanitarian--to directly address a serious public-health problem by providing needed assistance to the affected people.

Sri Lanka, however, does seem to address the criteria. The project was amended in 1979 to provide an additional \$4 million to support malaria-control efforts for a new development and resettlement program. The objective is to protect people moving into the area and the transient laborers who are building dams and irrigation channels. The labor force is considered a serious threat to malaria control because the workers could carry the disease from the resettlement site to cleared areas. AID mission officials in Sri Lanka also said that the expanded malaria program will protect an agriculture project in the resettlement area that also receives U.S. support.

Effective programs need adequate planning

Host-country governments should choose an anti-malaria strategy appropriate to their resources and the specific problems of eradicating or controlling the disease. According to WHO, such a plan should (1) identify appropriate objectives; (2) consider the prevailing social, economic, and operational constraints within which a program is expected to succeed; and (3) be feasible with respect to the available personnel and financial resources.

Zaire

When the agreement for the Zaire project was signed in 1976, Zaire had no anti-malaria plan, policy, or organization to carry out such activities. According to documents we reviewed at the AID mission, the project was developed as a result of (1) the AID 1973 anti-malaria statement, (2) a review of the country's malaria problem by an AID adviser in 1973, and (3) the influence of the



Photo by GAO Staff

Stagnant water is an ideal proven breeding place for mosquitos which transmit malaria. Such is the case as seen around a well (above) and in an inoperable irrigation canal (below).



Photo by GAO Staff

special medical adviser to the President of Zaire. In early 1981, Zaire developed a national strategy for malaria control and submitted it to WHO for approval. According to an AID official, "it is little more than a statement of general goals and some estimated costs, for which the GOZ [Government of Zaire] expects external donors to provide the lion's share."

Haiti

In 1978, Haiti began using a new, relatively toxic and expensive insecticide. At that time, the effectiveness of the insecticide under local conditions was not known. In essence, the strategy was changed from malaria control to eradication of the disease. The 1979 evaluation noted that neither the program executive committee nor Haiti public-health officials approved this change. A 1981 study recommended that another plan be developed to include financial, personnel, and material support; a realistic timeframe for operations; and goal setting. The study also recommended that the plan be approved by the Executive Committee.

The program in Haiti is hampered by an inadequate understanding of the effectiveness of various anti-malaria measures. Program officials are aware of vector resistance to DDT, but more information needs to be obtained about locations where it still can be effectively applied. No investigation has been made concerning the failure of the mass distribution of anti-malaria drugs to reduce the prevalence of the disease. The effectiveness of other control measures such as fogging, larviciding, biological control, and source reduction has not been evaluated under local conditions. There is insufficient information to determine if transmission of the disease can be interrupted by traditional insecticide spraying techniques. This type of information is essential to ensure the effective use of scarce host-country and donor resources.

Thailand and Sri Lanka

Anti-malaria activities in Thailand have been carried out for many years through a series of operating plans. WHO endorsed the first plan in 1965. The plan was based on a 1963 joint assessment conducted by representatives of Thailand, AID, and WHO. Since that time, similar joint assessments by the same organizations have guided anti-malaria activities.

In Sri Lanka, WHO assisted the government in preparing a detailed plan to accomplish the objectives of the anti-malaria activities. Yearly plans provide specific guidance. In addition, AID has reviewed the plan and found it to be sound.

Other problems limit effectiveness

The projects we reviewed are experiencing other problems which the AID criteria does not address. Many of these are beyond the scope of problems donor assistance to anti-malaria activities can reasonably be expected to overcome. Impediments, such as inadequate health-care systems and general support services, may logically be the concern of other categories of assistance. Problems, such as difficulties of access to malarious areas because of security reasons, and personal and religious customs which interfere with anti-malaria measures, are host-country responsibilities. Taken together, however, they indicate the types of situations AID should consider if scarce resources are to be used effectively for malaria control.

Zaire

With AID support, a group of experts recently advised the agency on an anti-malaria strategy for Africa. The group noted that the problems encountered in many parts of the world are particularly severe in Africa. In the past, the impediments to effective anti-malaria activities had not been fully recognized, were taken too lightly, or were ignored. As a result, the pattern of failure has caused many countries in tropical Africa to be pessimistic about malaria control.

As part of the effort to develop a strategy for Africa, the group noted that in Zaire, the constraints to malaria control are enormous and include

- a very poor economic situation indicated by a weak local currency, heavy dependence on imported commodities, and high inflation;
- a vast country coupled with poor roads and grossly inadequate maintenance of government vehicles; and
- insufficient malaria-control expertise at all levels of the government.

In addition, the group's report noted a chronic, nationwide shortage of therapeutic drugs; widespread malnutrition that makes malaria a fatal disease; and inadequate involvement of other departments of the government in the program. Our discussions with government and AID mission officials and our review of other reports and documents confirmed the continuing seriousness of these conditions.

Thailand and Sri Lanka

Both Thailand and Sri Lanka are experiencing problems in implementing their anti-malaria projects beyond the purely technical and management aspects of such programs. Some of these problems involve the people whom the projects are intended to protect including (1) widespread resistance to insecticide spraying, (2) migration, and (3) other economic pursuits. Resistance to spraying the interior of the houses has limited the effectiveness of anti-malaria activities in both countries. In Thailand, it is a continuous problem. People dislike the intrusion and inconvenience. Complete coverage has recently declined to between 40 and 60 percent in some regions. According to authorities, it is probable that less than 60-percent coverage will not stop transmission of the disease. In Sri Lanka, widespread popular resistance to spraying, sometimes involving religious customs, has limited the coverage. In 1977, almost 71 percent of the houses were sprayed; only 61 percent were sprayed in 1981. The AID malaria adviser said that further reductions could jeopardize the program.

Migrant workers have spread the disease. It is particularly serious in Thailand, where some bordering countries have no anti-malaria programs. Migrant workers are now introducing malaria into areas where spraying was discontinued because the disease was no longer considered a serious problem.

Plantation workers, seasonal agricultural workers, and illegal gem miners also spread the disease. In Thailand and Sri Lanka, miners and seasonal agriculture laborers work in areas away from their villages. Sometimes they live in temporary shelters which afford no protection from the vector. The workers can become infected, return to their villages, and then provide sources of the disease which can infect entire areas. Mining leaves areas where water can accumulate and create vector breeding sites. Further, some plantation employees work at night, the peak period of vector activity. Thus, these people are more subject to infection.

The above constraints are representative of the conditions under which anti-malaria projects are expected to succeed. These problems impede the success of projects now receiving U.S. assistance. When designing and approving future projects which will compete for scarce foreign assistance resources, these factors must be considered.

OTHER AID-ASSISTED PROJECTS

We also reviewed AID evaluations of recently completed projects in Nepal, Pakistan, and India to confirm that the problems we observed in current projects also hindered past programs. Problems ranged from the need for assistance to obtain commodities and vector resistance to insecticides; to the spread of malaria

within countries and across national borders, and the inability of general health services to contain the disease. They demonstrate further that the impediments to effective malaria control can only be overcome with sustained, long-term efforts.

Nepal

AID provided about \$4 million for a 5-year project that was approved in 1975. In addition to Nepal and AID, WHO, UNDP, and Great Britain also assisted the program. The objective was to reduce the nationwide incidence of malaria. A 1979 evaluation of the program noted (1) the import of a significant number of malaria cases from India, (2) increasing case rates where malaria-control measures were integrated into the general health services, and (3) increasing vector resistance to DDT.

People frequently cross the border between India and Nepal. Approximately 30 percent of the malaria cases in Nepal came from India. In addition, irrigation, settlement, road, and forestry projects increased the possibility of malaria transmission and caused outbreaks of the disease.

The project proposed that a mechanism be developed within the general health services to control malaria. At the time of the 1979 evaluation, only 6 of 42 districts had been integrated. Of the six integrated districts, three were unable to maintain a satisfactory level of control, and the number of malaria cases increased.

The rapid spread of vector resistance to insecticides in one area of the country required major operational changes and additional financial resources. Nepal took steps to obtain the necessary foreign exchange for the project's last year of operation. In addition, parasite resistance to drugs appeared to be controlled at the time of the evaluation. The source of the drug-resistant parasite was concentrated in several bordering regions of India. The effect of India's measures to contain the problem was evident in Nepal by a decreased number of such reported cases.

Pakistan

The Pakistan project, started in 1975, provided a \$24-million loan for commodities and equipment and a \$18.8-million grant to help meet the local costs of the 5-year program. Since 1963, AID has provided almost \$91 million to Pakistan's anti-malaria programs. Japan, UNICEF, and WHO have also contributed to the program.

In 1961, almost 7 million cases of malaria were reported. The number of cases dropped to 9,500 in 1967 as a result of control efforts. The disease spread in 1974, however, claiming 10 million victims. The 1975 AID project assisted a program of

insecticide spraying, surveillance, and drug distribution. The program made progress even though problems occurred with insecticide resistance, increased costs, and procurement delays. A 1981 end-of-project evaluation reported that the goal of achieving 500 cases of malaria for each group of 1 million people was met.

Malaria is still a long-term health problem in Pakistan, where development projects have increased the threat of the disease. Nomads help spread the disease, and refugees from Afghanistan also require malaria-control services. Further, rapid urbanization has increased the problem, and the integration of control activities into the general health service was not well coordinated, according to the last AID report.

India

The AID project in India provided \$38 million to finance the import of insecticides for the 1979 and 1980 program. AID officials originally expected that additional loans would be necessary through 1983, but this has not occurred because of an increase in India's domestic production of insecticides.

Initially, delivery of the insecticides to India was delayed, and spraying operations reached only about half of the target population. Nonetheless, malaria declined from 6.5 million reported cases in 1976 to about 3.0 million cases in 1979. According to a 1980 AID evaluation, a major factor was the increased participation of community volunteers and the establishment of drug distribution and treatment centers. Progress has continued toward the program objective of two malaria cases or less for each group of 1,000 people. In its fiscal 1980 budget, India allocated \$94 million for malaria control. This amount represents almost 75 percent of the total health-sector support.

CONCLUSIONS AND RECOMMENDATIONS

Recently completed and current projects are generally achieving their intermediate objectives--delivery of commodities and equipment, training, and technical assistance. However, the impediments to implementing effective long-term, malaria-control programs are still a formidable challenge to AID. Programs have been implemented in countries which range from those with inadequate national commitment or resources for combating the disease to others willing to support a massive effort through a broader public-health program. At the time the AID project in Zaire was approved, the country had no malaria budget or staff to carry out such a program; there was no plan for what the country hoped to accomplish; and resources had not been marshalled to combat the disease. The malaria-control measures started by this project will probably not continue when AID support ends.

In contrast, India has demonstrated concern about malaria. That country channels substantial resources to the program and has organized other government entities, volunteers, and a network of treatment centers to combat the problem. Other countries recognize the threat of the disease, but lack the financial, technical, and other personnel resources to sustain effective campaigns. Malaria control in these countries probably could not operate at the current level without the support of the United States. Countries such as Haiti, Thailand, and Pakistan previously experienced a serious resurgence of the disease.

Generally, the anti-malaria programs we reviewed were not designed to protect a U.S. investment in terms of gains already achieved or other development programs. Some are humanitarian efforts to provide a needed public-health service. In many instances, the United States is the only donor willing to commit substantial resources to this type of program. Without such assistance, many more people would continue to be either infected or at risk to the disease.

We also observed that projects must not only overcome problems which are inherent to malaria control, but they must also operate in an environment of external constraints which are beyond the scope of problems these projects are intended to resolve. Inherent problems such as the lack of host-country resources, trained personnel, and even a basic understanding of the appropriate methods of malaria control in a particular setting, are complicated by external constraints, such as inadequate general-health services, popular resistance to control measures, and human behavioral patterns which help spread the disease. As many of these constraints as possible must be considered in the project design and approval process.

In 1973, AID adopted criteria to identify those situations in which assistance can be considered. In addition to the need to protect the U.S. investment in terms of gains already achieved and other development programs, the AID criteria focuses on the host-country's concern for combating the disease--expressed in terms of an adequate budget and staff, a feasible plan, and the mobilization of available resources. Our review of the malaria-control projects approved after 1973, but before the AID 1980 health-sector policy statement, shows that this criteria has not been helpful in identifying programs which merit U.S. assistance. Considering the number and types of problems these projects are expected to overcome, and the environments in which they are expected to succeed, any checklist approach to malaria control will be of little value. However, we believe that a standard is still required to prevent the commitment of scarce foreign assistance resources to projects which offer little hope of sustained progress.

We therefore recommend that the Administrator, AID, direct that (1) project designs fully address the inherent constraints to successful anti-malaria activities, and also realistically assess the external constraints to long-term effectiveness; and (2) the review and approval processes ensure that the constraints do not preclude continued progress. At the same time, AID needs the flexibility to meet humanitarian needs on a case-by-case basis.

CHAPTER 4

MALARIA VACCINE AND DRUG RESEARCH

Malaria is caused by a parasite that undergoes a complicated development process. (The diagram on the following page illustrates the development of the malaria parasite.) Based on what is now known about the disease, a vaccine could be developed to induce an immune response at any stage of the life cycle, depending on the target group--either later in the life cycle of the parasite for those who already have malaria or at the point of infection for those never exposed to the disease.

Developing a malaria vaccine involves (1) identifying and isolating the antigens 1/ which produce immunity, (2) demonstrating that the antigens are effective and maintain immunity, and (3) producing adequate amounts of the antigens for the large-scale manufacture of vaccines. The first two steps are now underway. Antigens are being identified and isolated using the latest scientific technology, and they are being tested for effectiveness in laboratory animals. Once immunity is achieved in an animal model, safe and effective vaccines are expected to be developed and tested for malaria in humans.

Different populations intended to benefit from a vaccine present different requirements. In developing countries where people have a history of malaria, the vaccine should

- be suitable for mass production;
- not require special handling, such as refrigeration; and
- not require frequent revaccinations.

In contrast, a vaccine for those never infected with the disease, such as U.S. military personnel, has other requirements. It should (1) induce an immune response at the point of infection, (2) need not be produced in such relatively large quantities, and (3) need not be effective for extended periods of time.

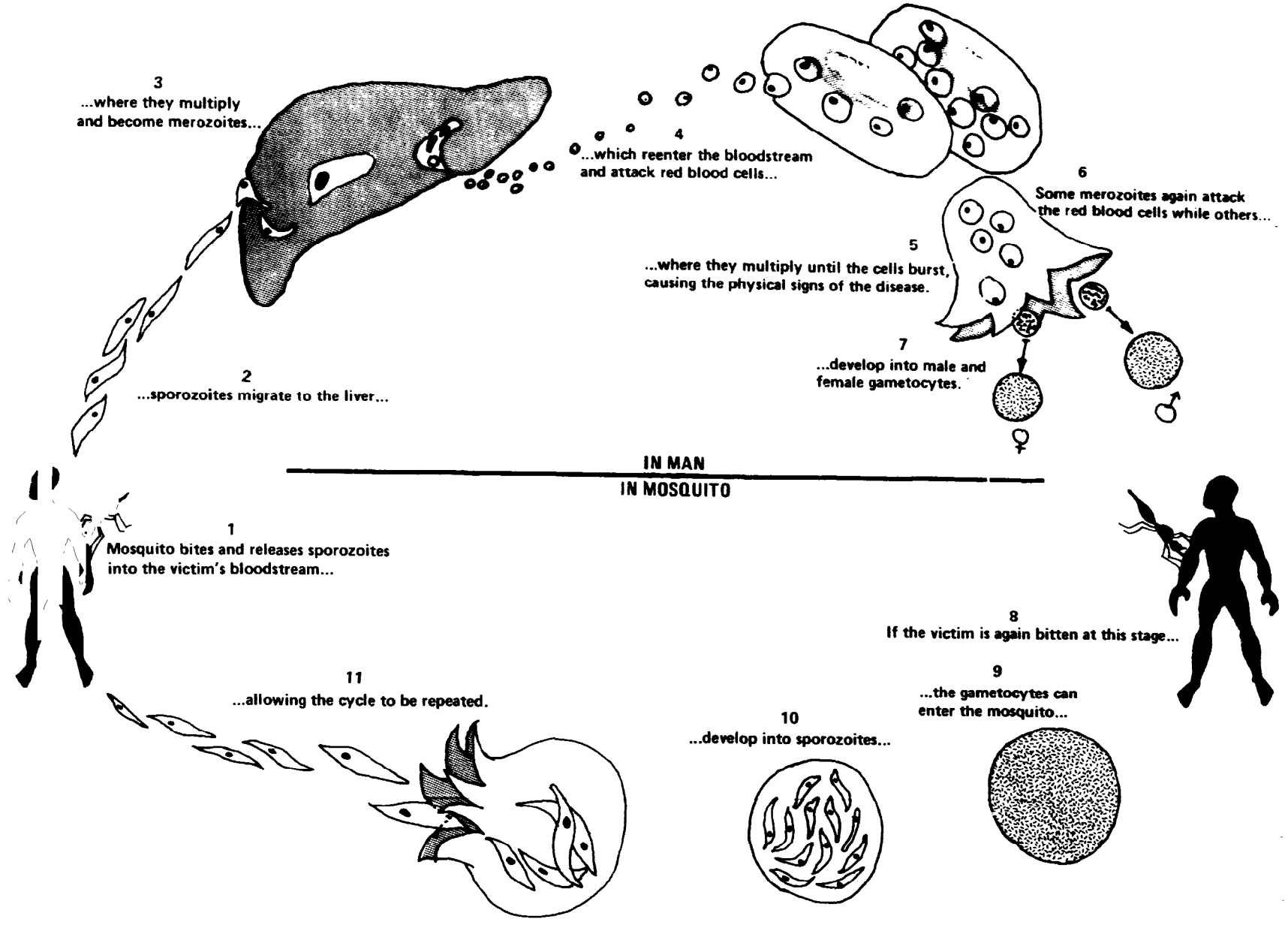
The development of new anti-malaria drugs is also of concern. Although most drugs are still effective in many areas, the parasite has developed a resistance in some parts of the world to such drugs.

Several U.S. agencies are involved in research and development of vaccines and drugs to more effectively combat malaria.

1/Antigens stimulate the production of antibodies which, in turn, produce immunity to diseases.

LIFE CYCLE OF THE MALARIA PARASITE

40



AID, the National Institute of Allergy and Infectious Diseases (NIAID), and CDC are primarily interested in protecting people with a history of the disease and basic research concerning the mechanism of malaria. The Departments of the Army and Navy are concerned with protecting those military personnel never exposed to malaria, but who must be prepared to operate in tropical areas where the disease presents a threat. The United States also contributes to the WHO Special Program for Research and Training in Tropical Diseases which focuses on six diseases, including malaria. Based on information made available to us, we determined that at least \$170.1 million has been allocated to malaria vaccine and drug research and development by the United States.

Despite predictions in the 1970s that an effective malaria vaccine would be possible within the next 10 to 15 years, today authorities are still speaking in terms of the next 10 years, and beyond. Even if such vaccines were now available, they would not solve the malaria problem.

This chapter describes the activities of the organizations receiving U.S. support for malaria research and development, estimates of what has been invested in these programs, where available, and examples of progress.

AGENCY FOR INTERNATIONAL DEVELOPMENT

AID supports research for a vaccine for effective use in developing countries. Since 1966, \$17.4 million in contracts have been awarded to a network of public and private institutions. Although the goal of a vaccine for victims with a history of the disease has not yet been achieved, many technical questions have been answered. For example, the feasibility of producing a malaria vaccine was proven when animals were successfully protected against a normally fatal strain of the disease.

Also, another AID project resulted in the development of a method to produce large quantities of needed malaria parasites outside living organisms in artificial environments (in vitro cultivation). Subsequent contracts were awarded to improve this technique and identify the antigens which can be used to produce a vaccine.

Candidate malaria vaccines require additional substances to increase their effectiveness. At one time, these produced undesirable side effects such as abscesses and tumors. AID supported efforts to resolve these problems in laboratory animals.

Because vaccines alone will not overcome malaria, AID also supports efforts directed at improving methods to control the mosquitos which transmit the disease. For example, the agency

supports a project to identify environmentally acceptable alternatives to DDT. Two insecticides have been evaluated and found acceptable; others are now being tested. Another project, just getting underway, will attempt to develop comprehensive methods of vector control. The project will involve (1) laboratory research to improve known methods and develop new methods of vector control, (2) field research to test the improved and newly developed techniques, and (3) demonstration projects combining a variety of methods in an integrated program under local conditions. In addition, the agency has supported research for better methods of diagnosing malaria and workshops to coordinate activities with other interested organizations. A total of about \$9.1 million has been allocated to these activities. Therefore, we estimate that AID has invested about \$26.5 million in vaccine research, improved vector-control techniques, diagnosis of malaria, and related activities.

DEPARTMENT OF DEFENSE

Historically, infectious diseases have incapacitated more military personnel than combat. Most U.S. servicemen are particularly vulnerable because they have never been exposed to the diseases prevalent in many developing countries. Malaria is of special interest because of the prevalence, growing resistance to available drugs, and the prolonged effects of the disease. The Army and Navy support malaria drug and vaccine research to maintain the effectiveness of their forces.

Department of the Army

Since 1965, over \$128 million has been allocated to research and development of malaria vaccines and drugs. We found that at least \$68 million of this amount has supported the anti-malaria drug program. Vaccine research originally focused on the initial stage of infection. However, because others were involved in the effort, emphasis has shifted to the later stage of infection.

Research for effective drugs has involved the testing and screening of over 300,000 potential anti-malaria compounds. Some have qualified for further clinical testing, and others have been submitted to the Food and Drug Administration for review. Other achievements have been the development of the first animal model useful in the study of human malaria, and the development of the only new effective anti-malaria drug being considered for large-scale production.

Department of the Navy

Since 1965, about \$6 million has been allocated to the development of a malaria vaccine for the initial stage of infection. The approach involves the artificial production of large quantities of the malaria parasite to provide antigenic material for

purification, analysis, and testing. Most of the research is conducted at Navy facilities, although contracts totaling about \$930,000 have been awarded for specific phases of the program. The program has been partially successful in developing a vaccine for human malaria. However, it produced undesirable side effects and provided protection for only a short period of time.

Both the Army and Navy conduct research at laboratories in the United States and overseas. Together, about 70 military and civilian scientists and technicians are involved in these programs.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

A broad range of malaria vaccine and drug research projects are supported by the Department in the interest of improving international health. Currently, NIAID funds research intended to contribute to the basic understanding of the malaria parasite and vector, and the response of humans to the disease. It also supports the work of outside investigators to study immunology and vector control. CDC supports research aiding vaccine development and better ways to deal with parasite resistance to drugs.

National Institute of Allergy and Infectious Diseases

Because of a reorganization and changes in accounting methods, we were unable to determine the long-term funding for malaria research. However, according to available records, over \$8.6 million was channeled to these activities between fiscal years 1978 and 1981.

Projects concern the identification of malaria antigens and the development of the parasite in the vector. The objective is to provide a broader scientific basis for the development of vaccines which are effective for both the initial and later stages of infection and better approaches to vector control.

Other projects are concerned with determining how malaria organisms induce immunity to the disease and identifying the antigens which induce protective antibodies in animal models. Grants have also been awarded to outside scientists who are interested in the development of malaria vaccines and the biological regulation of the vector.

Centers for Disease Control

Malaria vaccine and drug research activities are only one part of the CDC tropical disease program. Costs are not accumulated by specific disease. However, according to CDC estimates, about \$1 million a year has been allocated to these activities since 1972.

CDC has accumulated over 40 years experience in anti-malaria activities, mostly in the epidemiology of the disease and vector control, often in cooperation with AID. Current laboratory work centers on identifying animal models to evaluate potential malaria vaccines and developing methods to test and treat drug-resistant strains of the disease. CDC has successfully cultivated additional strains of malaria parasites in artificial environments and has successfully produced sufficient quantities of antigens for immunization tests and other studies. The program also involves the development of effective vector-control techniques, including integrated approaches to the problems and epidemiologic evaluations. In addition, they have demonstrated immunity to human malaria in an animal model. New techniques have been developed to monitor and test the response of the disease to various drugs. CDC also develops specifications for insecticides and ensures that the products meet AID and WHO standards.

WHO-SPONSORED RESEARCH

In response to the major health problems of developing countries, WHO initiated the Special Program for Research and Training in Tropical Diseases. The program is co-sponsored by UNDP and the World Bank and is intended to develop new and improved tools to combat six tropical diseases--including malaria. The program has received more than \$80 million in contributions. As of the end of 1981, the United States has provided about one-half of a \$20.5-million pledge. U.S. institutions have been awarded more than \$3 million for malaria research projects, compared to an estimated \$2 million of the U.S. contribution channeled to the area.

Anti-malaria drug development efforts have included collaboration with the U.S. Army in field trials of a new drug, studies to develop drugs which will protect those at risk to the disease for longer periods of time, and efforts to reduce the harmful side effects of currently available compounds. Examples of vaccine research include: the artificial cultivation of malaria parasites, new techniques to isolate antigens, studies of the immune response of the host to malaria, and tests to evaluate potential vaccines.

PROGRAM COORDINATION

Since the early 1970s, AID has initiated and participated in a series of workshops and conferences which have included representatives of WHO and other U.S. agencies involved in vaccine development. The purpose has been to identify research priorities and needs, develop strategies, and share information. The agencies which use outside investigators sponsor committees which independently review research proposals for relevancy and merit. In addition, U.S. officials are members of the scientific working groups and committees of WHO, therefore, promoting a cooperative

effort. The relatively small community of scientists working on vaccine development also facilitates coordination and the exchange of information. We spoke with representatives of all these organizations about duplication and overlap of the various programs, and were repeatedly told that this has not been a significant problem. We did not assess the extent of coordination and the relative value of individual research projects.

CONCLUSIONS

If vaccines are eventually developed, they will probably, by themselves, not be the answer to the malaria problem. Rather, they will be important components of a strategy for more effective control and perhaps eventual eradication of the disease. However, much will depend on the type of vaccine produced--whether it is directed at the initial stage of infection and prevents illness, or the later stages, thus preventing future transmission. Other factors concerning effectiveness include special handling and storage requirements, such as refrigeration, mass production, period of coverage, effectiveness and the need for revaccination, and resistance and adaptability of the parasites.

In areas with low malaria transmission, the impact of vaccines could be great. In endemic areas such as tropical Africa, however, the combination of vaccines, vector-control measures, and drugs will be necessary to effectively contain the disease.

MAJOR DIFFERENCES BETWEEN MALARIA ERADICATION AND CONTROL PROGRAMS

<u>PROGRAM ELEMENT</u>	<u>TYPE OF PROGRAM</u>	
	<u>Eradication</u>	<u>Control</u>
Objective	End transmission of malaria and eliminate the source of infection in man	Reduce mortality and morbidity to the lowest possible level
Coverage	All malarious areas	Limited by available resources and feasibility of reaching objective
Duration	Limited	No limit
Cost	Large investment	Depends on resources
Case detection	Essential	Secondary importance
Optimal implementing organization	Vertical	Integrated with general health services where feasible

AID CONTRIBUTIONS TO ANTI-MALARIA PROJECTS IN DEVELOPING COUNTRIES
(1950-81)

<u>Region/Country</u>	<u>Number of projects</u>	<u>CONTRIBUTIONS</u>		
		<u>Loans</u>	<u>Grants</u>	<u>Total U.S. dollar value</u>
		U.S.-owned foreign currency		
		-(in thousands)-		
<u>ASIA</u>				
Cambodia	1	\$	772	772
India	3	38,000	83,269	300,441
Indonesia	3	28,300	37,643	65,943
Korea	1		68	68
Laos	1		1,052	1,151
Nepal	2		6,770	18,617
Pakistan	5	38,200	8,168	91,345
Philippines	1		8,974	8,974
Sri Lanka	2	16,000	1,004	17,603
Taiwan	1		167	450
Thailand	2	4,000	18,985	22,985
Vietnam	2		8,596	8,596
Total	24	\$124,500	175,468	536,945
<u>AFRICA</u>				
Ethiopia	4	22,500	5,607	28,107
Liberia	1		509	509
Libya	1		222	222
Zaire	1		1,352	1,352
Total	7	\$ 22,500	7,690	30,190
<u>LATIN AMERICA/CARIBBEAN</u>				
Bolivia	1	\$		931
Brazil	3	16,584	14,115	32,395
Columbia	1		1,762	1,762
Costa Rica	2	1,600		1,600
Ecuador	3	2,000	2,892	4,916
El Salvador	2	2,665	10	2,675
Guatemala	1	1,550	3,541	5,191
Haiti	3		32,096	32,096
Honduras	2	2,673	2,474	5,147
Jamaica	1		71	71
Mexico	1		27	27
Nicaragua	2	3,934	2,125	6,059
Panama	1	1,421		1,421
Paraguay	2	1,900	272	2,172
Peru	1		169	169
Total	26	\$ 34,327	59,554	96,632
<u>NEAR EAST</u>				
Afganistan	1		44	44
Iran	2		4,446	4,446
Iraq	1		31	31
Jordan	1		1,923	1,923
Tunisia	1		534	534
Turkey	1		200	200
Total	7		7,178	7,178
Total for regions	64	\$181,327	249,890	670,945
Technical assistance and training	12	\$	6,408	6,408
TOTAL	76	\$181,327	256,298	677,353

AID MALARIA-CONTROL PROJECTS
REFERRED TO IN THIS REPORT

ZAIRE: Endemic Disease Control

Purpose:

To strengthen institutional capabilities for monitoring and controlling endemic diseases and integrating these capabilities into health-delivery systems.

Goal:

To reduce morbidity and mortality caused by endemic diseases.

Estimated life of project: Fiscal years 1976-81

Estimated cost of project: (malaria component - as originally approved)

AID grant	\$1,352,000
Host country	1,600,000
Other	<u>1,356,000</u>
Total	<u>\$4,308,000</u>

HAITI: Strengthening Health Services II

Purpose:

To establish within the Ministry of Health the ability to support the planning, administrative and operational tasks for expanding preventive and curative health services and to reduce the incidence of malaria to allow integration of the malaria-control program into the rural health-delivery system.

Goal:

To improve the quality of life for the rural people of Haiti by reducing health-sector constraints to development.

Estimated life of project: Fiscal years 1977-82

Estimated cost of project:

AID grant	\$ 7,525,000
Host country	5,600,000
Other	<u>852,000</u>
Total	<u>\$13,977,000</u>

THAILAND: Anti-MalariaPurpose:

To develop the institutional capability for providing rural inhabitants continuing malaria control services at a level and quality sufficient to minimize the occurrence of the disease and to provide timely and proper treatment to those who do contract the disease.

Goal:

To improve the health status of the rural population and contribute to their social, physical and mental well being.

Estimated life of project: Fiscal years 1979-82

Estimated cost of project:

AID loan	\$ 4,000,000
AID grant	500,000
Host country	28,000,000
Other	<u>1,000,000</u>
Total	<u>\$33,500,000</u>

SRI LANKA: Malaria ControlPurpose:

To assist in strengthening Sri Lanka's institutional capabilities for monitoring and controlling malaria within an integrated health-service system by the most effective and efficient means.

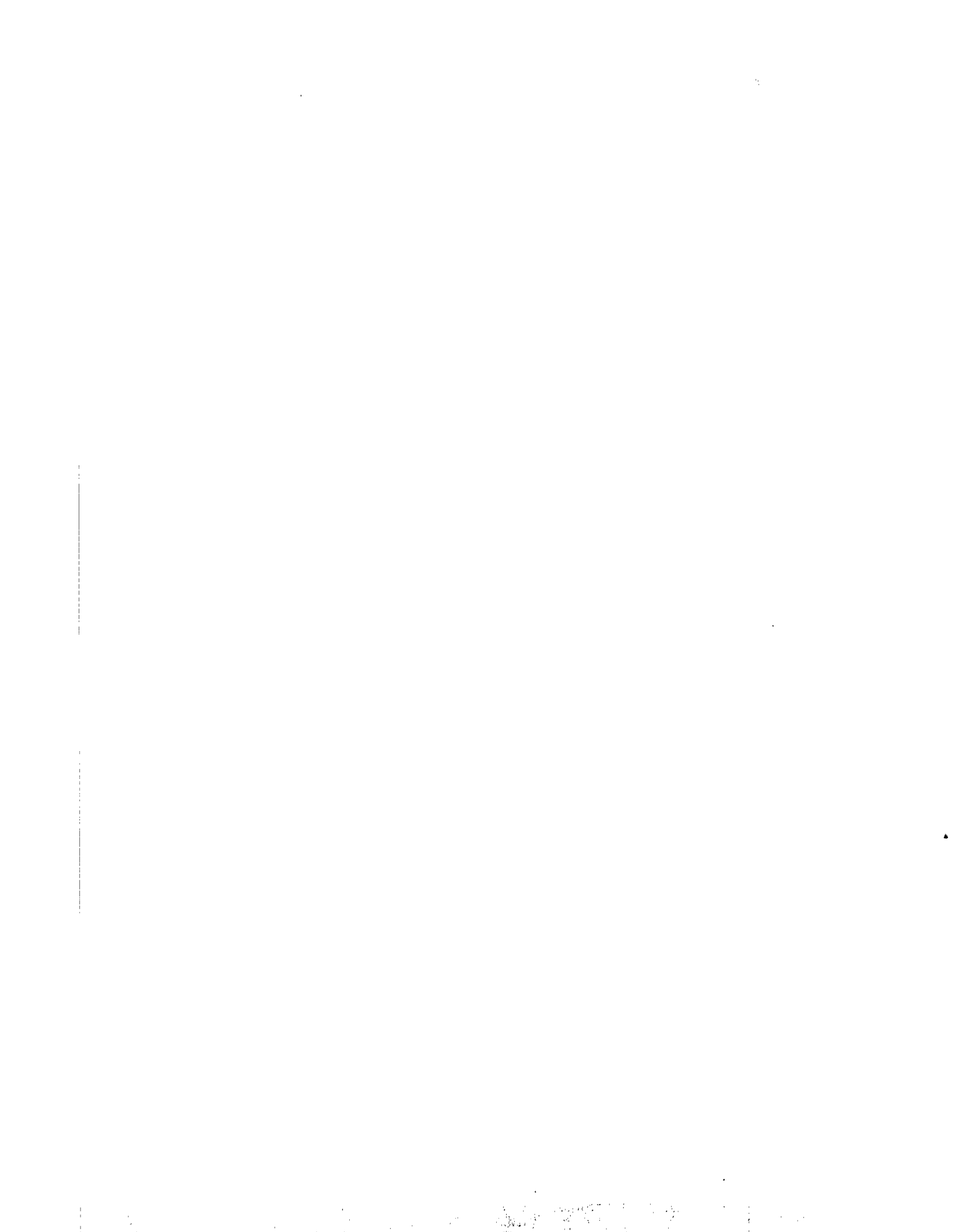
Goal:

To reduce morbidity and mortality from endemic diseases through the establishment of a responsive, effective, and efficient nationwide health service and facilitate economic and social development.

Estimated life of project: Fiscal years 1977-85

Estimated life of project:

AID loan	\$16,000,000
Host country	31,853,000
Other	<u>8,800,000</u>
Total	<u>\$56,653,000</u>



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