

Funding of Tropical Disease Research

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Funding of Tropical Disease Research

INTRODUCTION

This chapter presents an analysis of funding of biomedical research in the tropical diseases of interest in this assessment—namely, malaria, schistosomiasis, trypanosomiasis, leishmaniasis, filariasis, leprosy, tuberculosis, diarrheal diseases, acute respiratory infections (ARIs), and diseases caused by arboviruses.

The chapter describes the major funding sources and levels of funding for tropical disease research. It also discusses the types of research (by disease and by research goals) that the funding sources support. The concluding section of the chapter presents information about the types of organizations that actually conduct the research.

The analysis in this chapter represents the *first* attempt in over 20 years to review all major funding sources for tropical diseases. The information in this analysis was obtained from various sources that do not report according to a common set of definitions or in a common format. Every attempt has been made to take account of variations and to identify assumptions and accommodations that have been made. Even so, the data presented in this chapter should be regarded as indicative rather than definitive. Additional information about the limitations of the data is presented in appendix B.

FUNDING SOURCES

The sources of tropical disease research funding considered in this analysis are as follows:

- the Special Program for Research and Training in Tropical Diseases (TDR) and the World Health Organization (WHO);
- U.S. Government agencies, specifically, the Department of Health and Human Services (DHHS), the Agency for International Development (AID), and the Department of Defense (DOD); and
- U.S. private foundations.

Private pharmaceutical companies are discussed separately.

Each source of tropical disease research funding considered in this analysis is profiled below. Data made available by the funding sources themselves are analyzed to show the level of funding, historical trends, and the allocation of funding across the tropical diseases of interest.

Special Program for Research and Training in Tropical Diseases (TDR)

TDR was planned and initiated by WHO, with the assistance and cosponsorship of the U.N. Development Program (UNDP) and the World Bank. The program was initiated in 1974, and between that date and the end of 1982, nearly \$120 million had been contributed to the program by 25 governments, other organizations, the World Bank, UNDP, and WHO. The U.S. contribution alone was about \$15 million, and by fiscal year 1983, the United States had contributed a total of about \$20 million over a 7-year period (351,353).

TDR has two interdependent objectives (353):

- to develop new and improved tools to control six tropical diseases: malaria, schistosomiasis, trypanosomiasis, leishmaniasis, filariasis, and leprosy; and

- to strengthen the biomedical research capabilities of developing countries.

TDR is organized into four program areas: 1) Administrative and Technical Bodies; 2) Research and Development; 3) Research Capability Strengthening; and 4) Program Management.

TDR's Research and Development program area has 10 components: one component for each of the six specific tropical diseases and four additional components that cut across disease lines. The four transdisease components of TDR's Research and Development program area are biomedical sciences, vector control and biology, epidemiology, and social and economic research. Scientific working groups make recommendations about program direction and the allocation of research funding.

Table 3-1 presents information about the overall growth of the disease-specific components of TDR's Research and Development program area from 1977 through 1981. (These components of the program area **comprised about 85 percent of the program area's total expenditures from 1977 to 1981.**) The data in table 3-1 show that the disease-specific components of TDR's Research and Development program area grew from 128 projects amounting to \$2,791,000 in 1977 to 374 projects amounting to \$10,377,000 during 1981.

From 1977 through 1981, TDR allocated a total of some \$43,767,000 to investigations into the six diseases (351). The percentage of this research funding allocated to specific diseases from 1977 to 1981 was as follows: malaria, 30 percent; schistosomiasis, 14 percent; trypanosomiasis, 22 percent; leishmaniasis, 6 percent; filariasis, 16 percent; and leprosy, 13 percent. The percentage of funding for research on specific diseases remained fairly constant each year, with the exceptions of a decline for schistosomiasis from 16 percent in 1979 to 10 percent in 1981 and an increase for leprosy from 11 percent in 1979 to 16 percent in 1981.

World Health Organization (WHO)

Research on two groups of diseases discussed in this report —ARIs and diarrheal diseases—is funded through separate WHO programs.

In the biennium 1980-81, WHO allocated a total of \$2,389,000 for biomedical research pertaining to tropical diseases of interest in this assessment (see table 3-2). This research falls in the broad category of communicable disease prevention and control. The data in table 3-2 were collected by a combination of budget review and personal interviews and should be regarded as approximations (108). Sixty-six percent of the funding for such research came from regular budgetary sources.

The United States contributes 25 percent of the regular WHO budget, just under \$400,000 for the 1980-81 period. The United States (as do other countries and organizations) makes additional allocations on a program-by-program basis (extrabudgetary contributions), bringing the total annual contribution of the United States to between \$250,000 and \$500,000 for 1980-81. An example of other extrabudgetary WHO funds in 1980-81 was \$600,000 for research into leprosy, much of which was a gift from the Japan Shipbuilders Association.

WHO Program in Acute Respiratory Infections

In 1980-81, WHO spent a total of \$381,000 for research in ARIs and tuberculosis, 45 percent of which was from regular budgetary sources (see table 3-2). In 1983, ARI was identified as a distinct WHO program area. Since then, while ARIs have been receiving greater attention within the WHO regular budget, support from extrabudgetary sources has been relatively modest. The Pan American Health Organization (PAHO) reports that in 1983 its program for ARIs received only \$31,000 in direct support funds from WHO, and a further \$45,000 for tuberculosis (207).

WHO Program in Diarrheal Diseases

WHO's Program for Control of Diarrheal Diseases (CDD) was initiated in 1978. Its objectives are to reduce the mortality and morbidity caused by acute diarrheal diseases and to promote the self-reliance of individual countries in the delivery of health and social services for the control of diarrheal diseases (427).

Table 3.1.—TDR’s Research and Development Program Area: Distribution of Projects^{a,b} and Budget Amounts for Specific Tropical Diseases, 1977-81

Table 3-2.—WHO Funding for Selected Biomedical Research Pertaining to Tropical Diseases, 1980=81 Biennium

Type of research	Amount of funding (000s)		
	Regular budget	Extra-budgetary	Total budget
Malaria	\$ 222	\$ 11	\$ 233
Other parasitic diseases	335	0	335
Bacterial diseases, plague, meningitis and mycotic diseases.	105	0	105
Leprosy	66	600	666
Tuberculosis and acute respiratory infections (ARIs)	170	211	381
Viral diseases	250	0	250
Vector biology and control	419	0	419
Total	\$1,567	\$822	\$2,389

SOURCE: Data presented in V. Elliott and P. Contacts, "A Profile of Selected Biomedical Research Efforts Into Diseases of Major Public Health importance to People of Developing Countries;" typescript, prepared for the US. Agency for International Development Washington, DC, November 1982.

Support for CDD is predominantly from extra-budgetary WHO sources. In the biennium 1980-81, CDD resources totaled \$6,879,018, of which \$5,004,840 (73percent) came from extrabudgetary sources. In 1982, total resources were \$7,857,429 of which \$6,932,352 (88 percent) were extrabudgetary. The contribution of the United States was \$157,400 in 1980-81 and \$78,800 in 1982.

CD Obligated a total of \$5,654,423 during 1980-81 and unestimated \$14,373,600 during 1982-83. Of these obligations, 33 percent in 1980-81 and 39 percent in 1982-83 were set aside for research. The research component of CDD includes both biomedical and operational activities. In 1980-81, \$1,060,095 (56percent) of CDD's research budget was allocated

to biomedical research; estimates for 1982-83 are \$3,814,700 (67percent) (427). These figures include funds for planning, coordination, and support of collaborating centers as well as direct support of research projects.

Table 3-3 shows that between 1980 and 1983, CDD provided \$3,035,000 in funds for a total of 149 biomedical research projects. Bacterial enteric infections were the focus of 63 of these research projects and accounted for \$1,150,000 (38percent) of research project funds over the period. Drug development and the management of acute diarrheas accounted for 25 percent of these funds and viral diarrheas for somewhat less (23 percent) (425).

Table 3-3.—WHO Program for the Control of Diarrheal Diseases (CDD) Funding for Biomedical Research Projects, 1980-83

Type of research	Number of projects 1980-83	Budget amount (000s)			Total 1980-83 budget amount (000s)	Percent of total budget 1980-83 amount
		1980-81	1982	1983		
Bacterial enteric infections.	63	\$222	\$312	\$ 616	\$1,150	38%
Parasitic diarrheas	8	0	10	111	121	4
Viral diarrheas	36	61	256	390	707	23
Drug development and acute diarrhea management	31	109	159	497	765	25
Other	11	25	119	148	292	10
Total by year.	149	\$417	\$856	\$1,762	\$3,035	100%

SOURCE: Derived from World Health Organization, *Program for Control of Diarrheal Diseases*, DCC/TAG/84.2A (Geneva: WHO, February 1984).

U.S. Department of Health and Human Services (DHHS)

Three organizational units within DHHS fund research in the tropical diseases of interest in this assessment:

- the National Institute of Allergy and Infectious Diseases (NIAID) of the National Institutes of Health (NIH);
- the Centers for Disease Control (CDC); and
- the Fogarty International Center for Advanced Study in the Health Sciences of NIH.

The activities of these organizations are discussed below.

National Institute of Allergy and Infectious Diseases

NIAID has primary responsibility for tropical medicine research at NIH. In fiscal year 1981, the total NIAID budget accounted for \$232 million

(or 6 percent) of the total NIH obligations of \$3,572 million (383). That year, as shown in table 3-4, NIAID awarded about \$26,865,000 in extramural and intramural grants for research activities in tropical diseases, general parasitology, and general tropical medicine (379). These grants represented about 12 percent of NIAID funds and less than 1 percent of all NIH funds in fiscal year 1981.

Table 3-4 shows that overall NIAID funding for tropical disease research increased from a level of almost \$27 million in fiscal year 1981 to a little more than \$33 million in fiscal year 1983 (379, 380,381). This NIAID-funded research can be classified under three general headings: 1) tropical diseases (malaria, schistosomiasis, trypanosomiasis, leishmaniasis, filariasis, and leprosy); 2) general parasitology (cestodes, nematodes, protozoa, and trematodes); and 3) general tropical medicine (ricketsia, bacteriology, mycology, virology, and vector pathogens). As shown in table 3-4, the percentage of funds allocated to research under the

Table 3.4.—NIAID Funding for Tropical Disease Research, Fiscal Years 1981-83

Fiscal year and program area	Amount of funding (000s)		Combined extramural and intramural funding	
	Extramural	Intramural	Amount (000s)	Percent
Fiscal year 1981:				
Tropical diseases	\$ 9,101	\$4,187	\$13,288	490/0
General parasitology	3,551	1,163	4,714	18
General tropical medicine	7,660	1,203	8,863	33
Total	\$20,312	\$6,553	\$26,865 ^a	100%0
Percent of combined funding amount.	760/o	240/o	100 %/0	
Fiscal year 1982:				
Tropical diseases	\$10,042	\$5,627	\$15,670	51 0/0
General parasitology	3,502	1,854	5,356	17
General tropical medicine.	7,659	1,991	9,650	31
Total	\$21,203	\$9,472	\$30,676 ^b	100 %/0
Percent of combined funding amount.	690/o	31 %	100 %/0	
Fiscal year 1983:				
Tropical diseases	\$16,211	\$5,182	\$21,393	650/o
General parasitology	2,908	1,245	4,153	13
General tropical medicine.	6,182	1,430	7,612	23
Total	\$25,301	\$7,857	\$33,158 ^c	100 %/0
Percent of combined funding amount.	760/o	240/o	100%	

^aIn fiscal year 1981, \$40,000 of this amount was for research into acute respiratory infections (ARIs) and \$106,000 for research into diarrheal and enteric infections.

^bIn fiscal year 1982, \$930,000 of this amount was for research into ARIs and \$2,464,000 for research into diarrheal and enteric infections.

^cIn fiscal year 1983, \$3,019,863 of this amount was for research into arboviruses, \$1,080,000 for research into ARIs, and \$2,850,000 for research into diarrheal and enteric infections.

SOURCE: U.S. Department of Health and Human Services, National Institutes of Health, "International Cooperation by the National Institute of Allergy and Infectious Diseases, FY 1981, FY 1982, FY 1983," mimeo, Bethesda, MD, no date.

tropical diseases heading rose from 49 percent in fiscal year 1981 to 65 percent in fiscal year 1983, while the percentage allocated to general tropical medicine declined from 33 percent in fiscal year 1983 to 23 percent in fiscal year 1983. About three-quarters of NIAID funding for tropical disease research was awarded through extramural grants and contracts in fiscal years 1981 and 1983 and a slightly smaller proportion in fiscal year 1982. There were no major differences in the proportion of extramural awards between the three categories of research.

Table 3-5 shows the allocation of NIAID funds for research under the heading of tropical diseases—i.e., on the six TDR diseases—for fiscal years 1981, 1982, and 1983. Funds for research into each of these diseases increased over the 3-year period, with the exception of funds for leprosy research, which were substantially reduced in fiscal year 1982, but increased again in fiscal year 1983. Over the 3-year period, trypanosomiasis research accounted for 26 percent of NIAID funding for research on the six TDR diseases; schistosomiasis research, 22 percent; malaria research, 20 percent; leishmaniasis research, 18 percent; filariasis research, 9 percent; and leprosy research, 5 percent. The same relative level of NIAID research funding among the six diseases is seen for each year for which data are presented, with the exception of fiscal year 1983, when funding for leishmaniasis research slightly exceeded that for research in malaria.

Table 3-6 shows NIAID funding for research on diarrheal and enteric diseases and ARIs, through grants awarded under the headings of general

parasitology and general tropical medicine, for fiscal years 1981, 1982, and 1983. Most NIAID funding for research in diarrheal and enteric diseases and ARIs is considered domestic research for reporting purposes, but the share allocated to tropical medicine has increased. In fiscal year 1981, only 1 percent of NIAID funds for research in diarrheal and enteric diseases and ARIs came under the heading of tropical medicine; in 1982, 16 percent; and in 1983, 15 percent (263).

The data presented in table 3-6 show that NIAID funded research on ARIs at more than twice the funding level for research on diarrheal and enteric infections during the 3-year period 1981-83. The distribution of funding between extramural and intramural research for these two disease classes varied during the 3-year period, ending with a slight shift toward extramural research in fiscal year 1983.

Centers for Disease Control

CDC conducts research in all of the categories of tropical diseases of interest in this assessment. Table 3-7 shows the levels of CDC funding of such research during fiscal years 1981, 1982, and 1983. Overall, CDC'S tropical disease research funding grew from \$3,877,000 in fiscal year 1981 to \$4,929,000 in fiscal year 1983 (288). This growth is reflected in each of the categories of disease shown in the table. Overall, about 44 percent of CDC'S tropical disease research funding from 1981 to 1983 was allocated to research on the six TDR diseases; 22 percent was allocated to research on diarrheal diseases; 29 percent to research on ARIs; and 4 percent to research on arboviral infections.

Table 3-5.—NIAID Funding Specifically for Research on the Six TDR Diseases, Fiscal Years 1981-83

Disease	Fiscal year 1981		Fiscal year 1982		Fiscal year 1983		Fiscal years 1981-83	
	Amount ^a (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent
Malaria	\$ 2,426	180/0	\$3,567	230/0	\$3,950	180/0	\$9,943	20%
Schistosomiasis	2,984	22	3,550	23	4,598	21	11,132	22
Trypanosomiasis	3,783	28	3,889	25	5,308	25	12,980	26
Leishmaniasis	1,927	15	2,883	18	4,107	19	8,917	18
Filariasis	1,189	9	1,452	9	2,051	10	4,692	9
Leprosy	979	7	330	2	1,379	6	2,688	5
Total by year	\$13,288	100%	\$15,670	100/0	\$21,393	100%	\$50,351	100%

SOURCE U S Department of Health and Human Services, National Institutes of Health, "International Cooperation by the National Institute of Allergy and Infectious Diseases, FY 1981, FY 1982, FY 1983," mimeo, Bethesda, MD, no date

Table 3-6.—NIAID Funding for Research on Diarrheal and Enteric Infections and Acute Respiratory Infections (ARIs), Fiscal Years 1981-83

	Extramural funding amount (000s)	Intramural funding amount (000s)	Combined funding amount (000s)
Fiscal year 1981:			
Diarrheal and enteric infections	\$4,459	\$2,497	\$6,956
ARIs	11,819	4,442	16,261
Total	\$16,278	\$6,939	\$23,217
Percent of combined funding amount	70 % ⁰	30 % ⁰	100 % ⁰
Fiscal year 1982:			
Diarrheal and enteric infections	\$4,195	\$2,984	\$7,179
ARIs	10,194	4,293	14,487
Total	\$14,389	\$7,277	\$21,666
Percent of combined funding amount	66%	34%	100%
Fiscal year 1983:			
Diarrheal and enteric infections	\$5,452	\$2,731	\$8,183
ARCS	14,689	3,944	18,633
Total	\$20,141	\$6,675	\$26,816
Percent of combined funding amount	75%	25%	100%

SOURCE J E Nutter, Chief, Office of Program Planning and Evaluation, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, MD, personal communication, April 1984.

Table 3-7.—CDC Funding for Tropical Disease Research, Fiscal Years 1981-83

	Fiscal year 1981		Fiscal year 1982		Fiscal year 1983		Fiscal years 1981-83	
	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent
TDR diseases ^a	\$1,722	44%	\$1,927	45%	\$2,160	44%	\$ 5,809	44%
Diarrheal diseases	859	22	976	23	1,113	23	2,948	22
ARIs	1,130	29	1,261	29	1,397	28	3,788	29
Arboviral infections	166	4	166	4	259	5	591	4
Total by year	\$3,877	100%	\$4,330	100%	\$4,929	100%	\$13,136	100%

^aMalaria, schistosomiasis, trypanosomiasis, filariasis, leishmaniasis, and leprosy

SOURCE J G Randolph, Budget Analyst Financial Management Office, Centers for Disease Control, Atlanta, GA, personal communication, April 1984

Table 3-8 shows the amount and distribution of CDC funds among the six TDR diseases for fiscal years 1981-83. Over that 3-year period, research in malaria received more than **60 percent of this funding**. Schistosomiasis research funding increased from 15 percent of the funds in 1981 to 21 percent in 1983, while filariasis research funding declined from 6 percent of the funds in 1981 to 4 percent in 1983.

Fogarty International Center for Advanced Study in the Health Sciences

FIC is the focal point within NIH for scientific exchange and collaboration at the international level. The FIC budget was \$5.1 million in fiscal year 1979, \$4.5 million in fiscal year 1980, and

\$4.3 million in fiscal year 1981 (382). Most of the activities of FIC fall outside the biomedical research concerns that are the subject of this analysis.

A major exception, however, is FIC'S responsibility for transmitting the U.S. Government's care support to the Gorgas Memorial Institute of Tropical and Preventive Medicine. The operating unit of the institute is the Gorgas Memorial Laboratory, located in Panama. Neither FIC nor any other U.S. agency has programmatic control over the activities at the laboratory. Gorgas received \$1.7 million in core support through FIC in fiscal year 1980, \$1.8 million in fiscal year 1981, \$1.692 million in fiscal year 1982, and \$1.8 million in fiscal year 1983 (360). These amounts con-

Table 3-8.—CDC Funding for Research on the Six TDR Diseases, Fiscal Years 1981-83

Disease	Fiscal year 1981		Fiscal year 1982		Fiscal year 1983		Fiscal years 1981-83	
	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent
Malaria	\$1,127	650/o	\$1,208	630/o	\$1,290	600/0	\$3,625	620/o
Schistosomiasis.	250	15	352	18	461	21	1,063	18
Trypanosomiasis	40	2	48	2	58	3	146	3
Leishmaniasis.	66	4	66	3	98	5	230	4
Filariasis	101	6	101	5	86	4	288	5
Leprosy	138	8	152	8	167	8	457	8
Total by year.	\$1,722	100 %/0	\$1,927	100 %/0	\$2,160	100 %/0	\$5,809	100 %/0

SOURCE: J G Randolph, Budget Analyst, Financial Management Office, Centers for Disease Control, Atlanta, GA, personal communication, April 1984

stitute between 64 and 74 percent of all support received by the institute. Other agencies of the U.S. Government also provide funds to Gorgas Memorial Institute through grants and contracts. Further information about Gorgas is presented in OTA'S technical memorandum entitled *Quality and Relevance of Research and Related Activities at the Gorgas Memorial Laboratory (360)*, which was published in August 1983 as part of this assessment.

U.S. Agency for International Development (AID)

AID's Bureau for Science and Technology supports a variety of biomedical research activities pertaining to tropical diseases. Table 3-9 presents information for fiscal years 1979 through 1984 about projects that are classified by AID as "Dis-

ease Control—Research" (152). This category includes AID's support for TDR and for the International Center for Diarrheal Disease Research, Bangladesh. In addition to providing this institutional support, AID funds research through grants and contracts. The research activities funded by AID in the past have been primarily concerned with malaria immunology and vaccine development, but AID is planning to expand its tropical disease research agenda (110).

Since 1981, the Office of the Science Advisor of AID has also been supporting biomedical research through AID's Program in Science and Technology Cooperation (PSTC) and through the complementary Research Grants Program of the National Academy of Sciences' Board on Science and Technology for International Development (BOSTID). These programs administer grant funds which are intended to stimulate investiga-

Table 3-9.—AID's Bureau for Science and Technology: Funding for Disease Control Research Projects, Fiscal Years 1979-84

Project title	Amount of funding (000s)					
	Fiscal year 1979	Fiscal year 1980	Fiscal year 1981	Fiscal year 1982	Fiscal year 1983	Fiscal year 1984
Malaria immunity and vaccine research	\$1,773	\$2,679	\$ 4,203	\$3,000	\$ 5,787	\$3,900
Comprehensive methods of vector control	0	0	0	40	200	500
Alternatives to DDT	0	198	281	300	0	0
Antischistosomal drug testing	0	0	100	0	0	0
Tropical diseases research ^a	1,500	4,000	4,000	4,000	3,000	2,000
International Center for Diarrheal Disease Research (Bangladesh)	2,060 ^b	1,900	1,900	1,900	2,217	0
Diarrheal disease research	0	0	0	0	0	1,900
Total	\$5,333	\$8,777	\$10,484	\$9,240	\$11,204	\$8,300

^aThis project provides support to the U.N. Development Program/World Bank/WHO TDR program.

^bIn fiscal year 1980, AID support for the International Center for Diarrheal Disease Research (Bangladesh) came from the Asia Bureau (\$1,400,000) and from the Bureau for Science and Technology (\$660,000). In other fiscal years, the support was from the Bureau for Science and Technology.

SOURCE: F. R. Herder, Deputy Director for Health and Population, U.S. Agency for International Development, Washington, DC, personal communication, March 1984.

tion of problems that confront developing countries. The Research Grants Program administered by BOSTID provides funds only to developing country institutions. PSTC gives priority to proposals received from developing countries, but also funds activities in the United States.

PSTC has concentrated on five areas of research. One of these relates to tropical diseases—namely, biotechnology/immunology and biological control of human schistosomes and associated snail vectors (73).

The BOSTID program concentrates on six areas of research. Three of these areas—field studies of the mosquito vector, rapid epidemiologic assessment, and the diagnosis and epidemiology of ARIs in children—fall within the broad rubric of biomedical research in tropical diseases.

Table 3-10 shows AID funds committed to PSTC and the BOSTID program for research relevant to this analysis. The data show that AID has committed about \$8 million of research funding for investigations into these areas of interest since

the AID-funded programs began in 1981. The duration of any single project may be from 1 to 4 years (73,255).

U.S. Department of Defense (DOD)

In fiscal year 1982, DOD obligated \$233 million for biomedical research and development (383). Of this amount, \$21 million (9 percent) was for research on about 30 infectious diseases. Almost \$13.5 million of the latter amount was for research pertaining to the tropical diseases of interest in this analysis (140). That \$13.5 million represents 64 percent of DOD's infectious disease research funding and 6 percent of DOD's total biomedical research funding.

Table 3-11 shows the levels of DOD funding for research pertaining to the six TDR diseases, diarrheal diseases, and arboviral diseases for fiscal years 1981, 1982, and 1983. DOD does only a small amount of research in ARIs. The figures in table 3-11 are for activities of the Army Medical Research and Development Command, which

Table 3-10.—Total AID Funds Committed Since 1981 for Research on Selected Diseases by the Program in Science and Technology Cooperation (PSTC) and the Board on Science and Technology for International Development (BOSTID)

	PSTC		BOSTID	
	Number of awards ^a	Amount (000s)	Number of awards ^b	Amount (000s)
Parasitic tropical diseases	21	\$3,058	14	\$1,575
Diarrheal diseases	6	851	0	0
ARIs and tuberculosis	2	271	4	598
Other	10	1,688	0	0
Total	39	\$5,868	18	\$2,173

^aAs of March 1984. The duration of each award may be from 1 to 4 years.

^bAs of January 1984. Awards are made three times each year.

SOURCES: PSTC: I. Asher, Office of the Science Advisor, U.S. Agency for International Development, Washington, DC, personal communication, March 1984
BOSTID: National Research Council, Board on Science and Technology for International Development, "Grants Approved Through January 1984," mimeo, 1984

Table 3.1 I.—DOD*Funding for Tropical Disease Research, Fiscal Years 1981-83

Disease	Fiscal year 1981		Fiscal year 1982		Fiscal year 1983		Fiscal years 1981-83	
	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent
TDR diseases ^b	\$ 7,115	57% ^o	\$ 7,797	58% ^o	\$ 8,190	58% ^o	\$ 23,102	58% ^o
Diarrheal diseases	1,558	12	1,635	12	1,717	12	4,910	12
Arboviral infections	3,815	31	4,004	30	4,204	30	12,023	30
Total by year	\$12,488	100%^o	\$13,436	100%^o	\$14,111	100%^o	\$40,035	100%^o

^aThese figures are for the U.S. Army, which manages the great majority of DOD research.

^bMalaria, schistosomiasis, trypanosomiasis, filariasis, leishmaniasis, and leprosy.

SOURCE: M. Groves, U.S. Army Medical Research and Development Command, Ft. Detrick, MD, personal communication, March 1984

manages almost all DOD tropical disease research efforts. The percentage of DOD funds for research in the specific categories of diseases remained almost constant from fiscal year 1981 to fiscal year 1983, with 58 percent of funds allocated to the six TDR diseases, 12 percent allocated to diarrheal diseases, and 30 percent allocated to arboviral diseases. The actual amounts available rose by approximately \$1 million each year.

Table 3-12 shows the level and distribution of DOD funding for investigations in the six TDR diseases for fiscal years 1981 through 1983. As shown in that table, DOD conducts no research in filariasis or leprosy. About 58 percent of the DOD funding shown in table 3-12 is concerned with malaria; 19 percent with leishmaniasis; 17 percent with trypanosomiasis; and 7 percent with schistosomiasis.

Private U.S. Foundations

A number of private foundations in the United States fund activities in health, but do not report supporting biomedical research in the tropical diseases of interest in this analysis. These include the National Science Foundation, the Lasker Foundation, the Kellogg Foundation, the Ford Foundation, and the Carnegie Foundation. The paragraphs below describe the objectives and funding levels of the three U.S. foundations that do support these activities: the Edna McConnell Clark Foundation, the Rockefeller Foundation, and the MacArthur Foundation.

Edna McConnell Clark Foundation

The Edna McConnell Clark Foundation reports assets of \$225 million in 1982 and makes grants of approximately \$14 million annually (105). Grantmaking procedures suggest that applicants write a brief letter describing the program, which is reviewed by the appropriate program officer. If the request seems to fit the program's goals, more information and a proposal is requested. In reviewing proposals, the Clark Foundation's officers look for sound strategy and staff with the skills to accomplish work central to the aims of a particular program. Proposals are reviewed by trustees and a committee of outside experts and acted upon by the trustees.

The Clark Foundation makes grants in four program areas: 1) children in foster or institutional care, 2) jobs for the disadvantaged, 3) improvements in the criminal justice system, and 4) tropical disease research. Recently, the foundation made a decision to broaden support and include research on preventable causes of blindness. The tropical disease research program is currently concerned mainly with schistosomiasis, supporting research in immunology for vaccine development, the metabolism and biochemistry of schistosomes, and studies of the epidemiology of schistosomiasis.

The grants payable by the Clark Foundation's tropical disease program were \$3,174,651 on September 30, 1980; \$2,433,047 on the same date in 1981; and \$2,238,369 in 1982 (106). These amounts

Table 3-12.— DOD^a Funding for Research on the Six TDR Diseases, Fiscal Years 1981-83

Disease	Fiscal year 1981		Fiscal year 1982		Fiscal year 1983		Fiscal years 1981-83	
	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent
Malaria	\$4,259	600/0	\$4,471	57 %	\$4,694	57%	\$13,424	580/0
Schistosomiasis ^b	270	4	611	8	644	8	1,525	7
Trypanosomiasis	1,224	17	1,285	16	1,350	16	3,859	17
Leishmaniasis	1,362	19	1,430	18	1,502	18	4,294	19
Filariasis	0	0	0	0	0	0	0	0
Leprosy	0	0	0	0	0	0	0	0
Total by year	\$7,115	100 %	\$7,797	1000/0	\$8,190	100 %	\$23,102	100 %

^aThese figures are for the U.S. Army, which manages the great majority of DOD research.

^bIn fiscal year 1982 and fiscal year 1983, the Army and Navy schistosomiasis research programs were consolidated.

SOURCE: M. Groves, U.S. Army Medical and Research Development Command, Ft. Detrick, MD, personal communication, March 1984

constitute about 30 percent, 25 percent, and 20 percent of total grants awarded by the foundation in each of these years.

Rockefeller Foundation

The Rockefeller Foundation's Health Sciences program began in 1977 and has three components: 1) the Great Neglected Diseases of Mankind, 2) the Health of Populations, and 3) Coping With Biomedical and Health Information. Since these components were put in place, the foundation has allocated about \$12 million, \$3 million, and \$676,000 to the respective components (293).

The Rockefeller Foundation's Great Neglected Diseases program seeks to improve the knowledge, the means of treatment, and the control of these diseases by attracting outstanding scientists. The diseases included under the program are those such as malaria, schistosomiasis, hookworm, and diarrheal diseases. The objectives of the Rockefeller Foundation's efforts have been to establish and support research units of excellence, to establish collaboration in clinical investigation and field research among research institutions in developed and developing countries, and to maximize collaboration among these researchers through an annual meeting.

Funds for the Great Neglected Diseases program were \$1.6 million in 1980, \$1.9 million in 1981, and \$1.9 million in 1982. By 1980, there were 14 research units established, 3 of which are located in the developing world, and collaboration had been established with 22 developing countries. Foundation funding for each research unit is \$150,000 at most, and this support is about 30 percent of the support received by the units from all sources.

In addition to supporting these research units, the Rockefeller Foundation awards some grants related to tropical disease research to institutions not included under its program of institutional support. In 1981, such grants supported investigations in malaria, schistosomiasis, trypanosomiasis, and leprosy, as well as an investigation by the Center for Public Resources of ways in which the pharmaceutical industry might be encouraged to expand its role in improving health in developing countries.

MacArthur Foundation

In 1983, the board of the MacArthur Foundation decided to devote \$20 million over the next 5 years to the support of centers of excellence to apply the techniques of modern biology to parasitic diseases (282). The MacArthur Foundation is particularly interested in supporting research by scientists who have not previously studied parasitic diseases and in fostering collaboration among scientific disciplines. Accordingly, it has invited proposals from a selected group of individuals and institutions and made its first awards under this program in late 1984. The MacArthur Foundation has also recently made a grant of \$1 million to TDR.

Pharmaceutical Companies

Detailed information about the money spent by U.S. pharmaceutical companies to conduct biomedical research in tropical diseases is not available. Neither individual firms nor the industry publish comprehensive data about research expenditures because such information is considered proprietary. The discussion below summarizes relevant facts and conjectures about research on tropical diseases being undertaken by private companies.

Overview

The Pharmaceutical Manufacturers Association (PMA) reported in 1979 that its 132 U.S. members spent \$1.3 billion each year on research. About one-fifth of the companies conduct 80 percent of the research and development in drugs. A PMA survey published in 1979 found that 21 companies had done, or were doing, research relevant to tropical diseases. PMA estimated that this research accounted for about 5 percent of the overall research and development effort of the industry (306).

Another report indicates that the U.S. pharmaceutical industry spends more than 50 percent of its net income on research and development (165). The report notes, however, that these activities are extremely concentrated within the industry. Only 14 of the 26 companies that spend more than \$1 million a year on research and development

actually spend at the industry average rate of 50 percent. The four most research-intensive companies account for 37 percent of the industry's research and development, but produce only 21 percent of industry sales. The next four most research-intensive companies account for 23 percent of the industry's research and development and 24 percent of its sales. The next 12 companies represent 33 percent of total research and development, but 47 percent of industry sales (165).

A survey of 15 research-oriented European pharmaceutical companies in 1977 found that 7 of these firms were engaged in tropical disease research. These companies allocated approximately \$40 million to tropical disease research (387).

An analysis of the leading U.S. and European pharmaceutical companies in the area of research in tropical diseases suggests that seven companies spent a total of \$22,327,000 on research in parasitology during fiscal year 1979 (73).

The data cited above should be reviewed in relation to the costs of developing new drugs. One study found that the average cost to a U.S.-owned pharmaceutical firm for developing a new chemical entity (NCE) to the point of marketing approval in the United States was \$54 million in 1976 dollars. The average length of time from initiation of clinical testing to market approval for all NCEs approved in 1976 was more than 6 years. During the period 1963-76, approximately 900 NCEs were studied in humans by U.S.-owned firms. Of these 900, 20 (2 percent) were candidates primarily for tropical or parasitic diseases. These NCEs came from 11 U.S.-owned pharmaceutical firms (95).

Examples of Pharmaceutical Company Activities

In the past 25 years, a number of pharmaceutical companies have conducted biomedical research related to *malaria*, often in collaboration with the public sector. During the period 1960-69, for example, Parke-Davis invested about \$16 million in antiparasite research, much of which was concerned with malaria (a disease for which Parke-Davis developed seven drugs). Furthermore, Parke-Davis reported in 1979 that, with AID support, it was engaged in studies of an

immunological approach to malaria (20). Research in malaria by Roche led to the development of Fansidar, a prophylactic and chemotherapeutic drug marketed in 1970 (20). Since then, Roche has been collaborating with TDR and Walter Reed Army Institute of Research to conduct clinical trials of derivatives of the natural alkaloid quinine (20). A 1979 PMA survey found 14 U.S. companies and 4 of the 7 European firms surveyed were conducting research in malaria (306,387).

The PMA survey reported 11 American companies and 4 of the 7 European firms were engaged in *schistosomiasis* research (306,387). Pfizer's major work has been in schistosomiasis. Roche has been engaged in schistosomiasis research for more than 20 years and, after screening tests, has focused attention on two compounds, one of which has now been selected for clinical trials (20). Wellcome has worked on schistosomiasis for 30 years, but without commercial success (20). Bayer and E. Merck/Darmstadt began intensive research in schistosomiasis about 10 years ago (20).

Three of the 7 European firms surveyed by the PMA work in *trypanosomiasis* (387). Roche has given high priority to investigations into Chagas' disease (American trypanosomiasis), and reports that once the company succeeds, it will emphasize investigations pertaining to African trypanosomiasis (20). Bayer discovered the first effective drug against African trypanosomiasis in 1916, and after more than 30 years of research, Bayer introduced the first drug to treat the acute and chronic phases of Chagas' disease in 1972 (20). E. Merck/Darmstadt also has an active program in trypanosomiasis (20).

Research in *leishmaniasis* was stopped by many companies about 10 years ago because the market was small and a drug was available (20). However, TDR has provided some stimulus to new efforts, and six U.S. companies and two European companies are engaged in leishmaniasis research (306,387). Among these, Squibb was reported to be collaborating with TDR in supplying a compound to be tested in Africa (306). Burroughs-Wellcome is currently testing allopurinol, an existing drug used for gout, which was found to have antileishmanial activity.

Various companies have spent some \$20 million on *filariasis* research, and there is as yet no satisfactory drug. Roche, Bayer, and Ciba-Geigy have been particularly active in this research effort, and Janssen has also been having good results (20). Seven members of the PMA reported research projects in filariasis, including Parke-Davis which was under contract to WHO for the synthesis of antifilarial drugs (306). Four of the seven European firms questioned in the PMA survey reported research in filariasis (387).

Leprosy is under investigation by two of the European firms and six members of the PMA (306,387). Ciba-Geigy and Lepetit have drugs on the market and are doing further research to try to reduce treatment costs by requiring a less frequent application (20).

Information about research into other diseases of interest to this analysis is not readily available. However, Lederle, Sterling, and Merck are reported to be conducting research in tuberculosis (306). The WHO program concerned with diarrheal diseases reports that during 1981-82, it col-

laborated with eight pharmaceutical companies, none of which were American (427).

The Rockefeller Foundation has sought to expand the role of the pharmaceutical industry in developing products for tropical diseases by making a series of grants to the Center for Public Resources. The center organized a task force of leaders from the pharmaceutical industry, the developing countries, academe, and assistance agencies following a 1979 conference at the Institute of Medicine. This task force designed a number of projects, but in 1981 and 1982, the pharmaceutical industry determined that it did not wish to match the Rockefeller Foundation's commitment to the cooperative effort and the individual projects, and the project was terminated. The Rockefeller Foundation points out that the outspoken support of Senators Jacob Javits, Richard Schweiker, and Edward Kennedy during the 1979 conference was not reflected in the political atmosphere of 1980, and suggests that industry cooperation may have been discouraged as a result (293).

TYPES OF RESEARCH FUNDED

Types of Tropical Diseases

Table 3-13 summarizes annual funding from WHO, TDR, and from U.S. Government and private foundation sources for research pertaining to the six TDR diseases, diarrheal diseases, ARIs, and arboviral diseases, for roughly the period 1979-81. Combined WHO/TDR and U.S. funding for biomedical research on these diseases was a little over \$109 million per year. Less than \$100 million came from U.S. sources.

Combined funding for research in the six TDR diseases—malaria, schistosomiasis, trypanosomiasis, leishmaniasis, filariasis, and leprosy—was almost \$55 million, or about 50 percent of the total \$109 million per year. Malaria research alone was funded at \$22.8 million per year (21 percent of the total \$109 million). TDR, AID's Bureau of Science and Technology, and DOD allocated a greater portion of their research funding for malaria research than for research in any of the other

categories of tropical diseases considered in OTA's analysis. As shown in table 3-13, the distribution of combined annual funding for biomedical research on the other TDR diseases was as follows: schistosomiasis, \$9.2 million (8 percent of the total \$109 million); trypanosomiasis, \$9 million (8 percent); leishmaniasis, \$6.3 million (6 percent); filariasis \$3.7 million (3 percent); and leprosy, \$3.8 million (4 percent).

Research in diarrheal diseases was funded at an annual level of \$14.5 million (or about 13 percent of the total \$109 million per year); research in ARIs was funded at \$20.7 million (19 percent of the total); and research in arboviral diseases was funded at \$7.5 million (7 percent of the total). Combined annual funding for research that is related to the diseases of interest in this analysis but for which data were not available in sufficient detail to allocate the funding by disease (the "unspecified category in table 3-13) amounted to \$11.5 million (11 percent of the total).

Table 3.13.—Summary of Annual Funding by U.S. Sources^a and WHO/TDR Sources^b for Biomedical Research on Selected Tropical Diseases, Various Years^c

Disease	U.S. sources ^b (000s)	WHO/TDR ^c (000s)	Combined WHO/TDR and U.S. sources	
			Amount (000s)	Percent
Malaria	\$19,354	\$ 3,435	\$22,789	21 %
Schistosomiasis	8,136	1,044	9,180	8
Trypanosomiasis	6,716	2,335	9,051	8
Leishmaniasis	5,707	614	6,321	6
Filariasis	2,137	1,548	3,685	3
Leprosy	1,546	2,299	3,845	4
Subtotal	\$43,596	\$11,275	\$54,871	500%
Diarrheal diseases	\$14,081	\$ 417	\$ 14,498	130%
Acute respiratory infections	20,301	381	20,682	19
Arboviral diseases	7,482	NA	7,482	7
Subtotal	\$41,864	\$ 798	\$ 42,662	39 %
Unspecified	\$10,359	\$ 1,109	\$ 11,468	11 %
Total by source	\$95,819	\$13,182	\$109,001	100%
Percent of combined funding amount.	880%	12 %		

^aThis category includes U.S. Government agencies and private foundations shown in previous tables.

^bThis category includes TDR and WHO funds as shown in tables 3-1, 3-2, and 3-3.

^cData are presented for most recent years available, as noted on previous tables.

SOURCE: Compiled from data presented in previous tables in this chapter and the 1981 reports of the Rockefeller Foundation and the Edna McConnell Clark Foundation

These data are affected by the fact that not all agencies define diarrheal diseases and ARIs as tropical diseases. Research funds for these diseases from NIAID sources other than those that fall under tropical medicine are included, but it is likely that WHO and other institutes of NIH, in particular, fund biomedical research in these diseases which is not included in this analysis.

Furthermore, information about the contribution of pharmaceutical companies to research in these diseases is not available. Although the PMA suggests that tropical disease research receives some percent of the \$1.3 billion spent by all U.S. industry on biomedical research and development, this figure cannot be substantiated.

Types of Research Objectives

Recently, AID attempted to classify TDR research projects according to four research objectives: diagnostic methods, chemotherapy, immunology and vaccination, and vector control (108). AID compiled a matrix of research projects by looking at a list of TDR project titles and, using the opinion of a small number of experienced

scientists, allocated each research project to one disease category and one research objective category. The matrix that was developed by AID cannot be construed as comprehensive or definitive, but it does give some indication of the relative attention paid to each objective as research funds were allocated among diseases and disease types.

Table 3-14 is an expansion of AID's matrix for the six TDR diseases. The figures in table 3-14 include projects funded by NIAID, AID, DOD, the Rockefeller Foundation, and the Edna McConnell Clark Foundation, as well as those funded by TDR.

In the data presented in table 3-14, the research projects included under TDR include relevant projects funded under both the disease-specific and transdisease components of TDR's Research and Development program area. Thus, in table 3-14 (unlike in table 3-1 concerned with TDR as a funding source), a research project funded under one of the four transdisease components of the program area (i.e., biomedical sciences, vector control and biology, epidemiology, or social and economic research) was included if it seemed to relate directly to one of the six TDR diseases.

Table 3-14.—Distribution of Funding for Biomedical Research on the Six TDR Diseases^a by Research Objective, 1981

Disease	Diagnostic methods		Chemotherapy		immunology/vaccination		Vector control		Other		Total	
	Number of projects	Amount (000s)	Number of projects	Amount (000s)	Number of projects	Amount (000s)	Number of projects	Amount (000s)	Number of projects	Amount (000s)	Number of projects	Amount (000s)
Malaria	2	\$ 118	47	\$3,819	67	\$8,128	16	\$1,166	27	\$ 2,797	159	\$16,028
Schistosomiasis	6	310	35	1,748	48	2,800	15	446	31	2,400	135	7,704
Trypanosomiasis	4	245	15	1,027	37	2,397	6	156	40	3,145	102	6,970
Leishmaniasis	6	409	11	728	11	917	4	106	13	1,532	45	3,692
Filariasis	3	156	18	1,237	15	971	3	136	10	716	49	3,216
Leprosy	5	164	22	785	19	693	NA	NA	15	1,052	61	2,694
Total by research objective	26	\$1,402	148	\$9,344	197	\$15,906	44	\$2,010	136	\$11,642	551	\$40,304
Percent ^b of total number of projects	5 %		27 %		36 %		8 %		25 %		100 %	
Percent of total funding		3 %		23 %		39 %		5 %		29 %		100 %

^aNumbers of projects and funding amounts are totals for research funded by the following: TDR, NIAID, AID, DOD, the Rockefeller Foundation, and the Edna McConnell Clark Foundation.

SOURCES: J. Elliot and P. Contacos, "A Profile of Selected Biomedical Research Efforts Into Diseases of Major Public Health Importance to People of Developing Countries," typescript prepared for the U.S. Agency for International Development, Washington DC, November 1982; M. Groves, U.S. Army Medical Research and Development Command Ft. Detrick, MD, personal communication, March 1984; J.E. Nutter, Chief Office of Program Planning and Evaluation, NIAID, personal communication, April 1984; and J. Erickson, Division Chief Office of Health, U.S. Agency for International Development, personal communication, March 1984.

Although the data in table 3-14 are not comprehensive and are only an indication of research objectives, they do show that immunology/vaccination was the objective of 39 percent of the total \$40.3 million funding and 35 percent of the 551 projects. Research in malaria immunology and vaccination accounted for \$8.1 million (20 percent of the total funds shown). Research in chemotherapy amounted to \$9.3 million (27 percent of the total); vector control, \$2 million (8 percent); and diagnostic methods, \$1.4 million (3 percent). Biomedical research in other aspects of the TDR diseases amounted to \$11.6 million, which is 29 percent of the total \$40.3 million.

RECIPIENTS OF RESEARCH FUNDING

The organizations receiving funds for biomedical research in tropical diseases are predominantly universities and research institutes. Table 3-16 presents information about the distribution of extramural biomedical research funds from various sources to institutions in the United States, in other industrialized countries, and in less developed countries.

Table 3-16 suggests that about one-third of TDR biomedical research funding in 1981 was awarded to institutions in the United States. The *Country Profile: USA*, published by TDR, reports that between 1975 and mid-1982, \$15,103,228 (20 percent) of the \$77.3 million obligated by the program was in support of research and training by U.S. institutions. During this same period, the United States contributed \$15,372,912 to TDR (352).

CDD, the WHO program in diarrheal diseases, awarded \$214,000, or one-quarter of its biomedical research funds, to U.S. institutions during 1982 (see table 3-16). In 1982, the United States contributed less than \$80,000 to CDD, about 1 percent of the total CDD budget (427).

NIAID research in tropical medicine and international health is concentrated at U.S. institutions (see table 3-16), though these institutions often work in close collaboration with scientists in the developing world. In addition, NIAID has a role

Table 3-15, presenting data on NIAID-funded research concerned with diarrheal and enteric infections and ARIs, shows that in fiscal year 1981, research projects with the objective of immunology/vaccination accounted for over \$9 million, or 39 percent of the \$23.2 million funding NIAID provided. Research projects with objectives other than diagnostic methods, chemotherapy, or immunology and vaccination accounted for \$12.8 million, or 55 percent of the total \$23.2 million.

in bilateral programs for scientific exchange and collaboration with Egypt, Israel, and India, which are funded by other agencies. On occasion, NIAID makes grant and contract awards to institutes outside the United States, usually in other industrialized countries. The distribution of NIAID funding for intramural and extramural (U.S. and foreign) research in tropical diseases during fiscal years 1981, 1982, and 1983 is shown in table 3-17.

In fiscal year 1983, AID's Bureau of Science and Technology allocated almost three-quarters of its biomedical research funds to U.S. institutions (see table 3-16) (110). Many of these institutions collaborate with organizations in less developed countries. The remaining biomedical research funding is in the form of support to the International Center for Diarrheal Disease Research in Bangladesh. AID's Research Grants Program administered by the Science Advisor's Office and by BOSTID has allocated 45 percent of its resources to American institutions (11,255). The BOSTID portion of this program makes grants only to institutions in developing countries.

The DOD biomedical research program allocates about three-quarters of its extramural funds to organizations in the United States (see table 3-16). A further 18 percent is allocated to organizations in less developed countries and 5 percent to organizations in industrialized countries other

Table 3-15.—NIAID Funding for Biomedical Research on Diarrheal and Enteric Infections and ARIs by Research Objective, Fiscal Year 1981

	Diagnostic methods		Chemotherapy		Immunology vaccination		Other		Total
	Number of projects	Amount (000s)	Number of projects	Amount (000s)	Number of projects	Amount (000s)	Number of projects	Amount (000s)	Amount (000s)
Diarrheal and enteric infections	0	\$ 0	0	\$ 0	17	\$1,657	51	\$5,299	\$6,956
ARCS	7	749	6	487	48	7,443	76	7,582	16,261
Total by research objective	7	\$749	6	\$487	65	\$9,100	127	\$12,881	\$23,217
Percent of total amount for all research objectives		30/0		2%		39 %/0		550/0	100 %/0

SOURCE J. E. Nutter, Chief, Office of Program Planning and Evaluation, NIAID, National Institutes of Health, Bethesda, MD, personal communication, April 1984

Table 3-16.—Distribution of Extramural Biomedical Research Funds by Various Funding Sources to Recipient Organizations in the United States, Other Industrialized Countries, and Less Developed Countries, Various Years

Funding source	United States		Other industrialized countries		Less developed countries		Total
	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)
TDR (1981)	\$ 4,003	320/0	\$4,313	340/0	\$4,386	350/0	\$12,702
WHO/CDD (1982)	214	25	205	24	438	51	857
NIAID (fiscal year 1982) ^a	24,346	96	1,039	4	0	0	25,385
AI D/Bureau of Science and Technology ^b (fiscal year 1983)	5,987	73	0	0	2,217	27	8,204
AID/Science Advisor ^c	3,608	45	0	0	4,433	55	8,041
DOD (fiscal year 1983)	3,984	76	285	5	952	18	5,221
Edna McConnell Clark Foundation (1981)	1,667	77	436	20	76	3	2,179
Rockefeller Foundation (1981)	995	52	579	30	345	18	1,919
Total by recipient country	\$44,804		\$6,857		\$12,847		\$64,508
Percent of total for all recipient countries		69%		11%		20%	100%

^aInvestigations undertaken by U.S. institutions and funded by NIAID are often carried out in close collaboration with institutions in less developed countries. These data include funds for training in biomedical research and exclude intramural research projects. The data are for NIAID's tropical disease research only.

^bDoes not include \$3 million contribution to TDR.

^cResearch funds committed as of March 1984.

SOURCES: Derived from: TDR, Rockefeller Foundation, Clark Foundation: V. Elliott and P. Contacos, "A Profile of Selected Biomedical Research Efforts Into Diseases of Major Public Health Importance to People of Developing Countries," typescript, prepared for the U.S. Agency for International Development, Washington, DC, November 1982. WHO/CDD: World Health Organization, *Program for Control of Diarrheal Diseases*, DCC/TAG/84.2A (Geneva: WHO, 1984). NIAID: U.S. Department of Health and Human Services, National Institutes of Health, "International Cooperation by the National Institute of Allergy and Infectious Diseases, FY 1982," mimeo, Bethesda, MD, no date. AID: J. Erickson, Division Chief, Office of Health, U.S. Agency for International Development, Washington, DC, personal communication, March 1984. AID: I. Asher, Office of the Science Advisor, U.S. Agency for International Development, Washington, DC, personal communication, March 1984. DOD: M. Groves, U.S. Army Medical Research and Development Command, Ft. Detrick, MD, personal communication, March 1984.

Table 3-17.—NIAID Funding for Tropical Medicine and International Health by Type of Recipient, Fiscal Years 1981-83

	Fiscal year 1981		Fiscal year 1982		Fiscal year 1983		Fiscal years 1981-83	
	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent
Intramural	\$ 6,553	21%	\$ 9,472	27%	\$ 7,856	23%	\$ 23,881	24%
Extramural U.S. ^a	23,542	75	24,346	70	25,576	74	73,464	73
Extramural foreign ^b	1,155	4	1,039	3	963	3	3,157	3
Total ^c	\$31,250	100%	\$34,857	100%	\$34,395	100%	\$100,502	100%

^aThe extramural program includes grants and contracts.

^bForeign recipients of extramural grants or contracts are predominantly organizations in other industrialized countries.

^cThese figures include funds for training in biomedical research.

SOURCE: U.S. Department of Health and Human Services, National Institutes of Health, "International Cooperation by the National Institute of Allergy and Infectious Diseases, FY 1981, FY 1982, FY 1983," mimeos, Bethesda, MD, no dates.

than the United States. The distribution of DOD funding, both U.S. and foreign, in fiscal years 1981, 1982, and 1983 is shown in table 3-18.

In 1981, the majority of research funds of both the Rockefeller Foundation and the Edna McConnell Clark Foundation was awarded to U.S. institutions (see table 3-16). The Rockefeller Foundation awarded 52 percent of grants in the United States, 30 percent to other industrialized countries, and 18 percent to less developed countries (293).

The comparable figures for the Edna McConnell Clark Foundation are 77 percent, 20 percent, and 3 percent (105).

Institutions in the United States received \$44.8 million (69 percent) of biomedical research funds from the funding sources identified in table 3-16. Institutions located in other industrialized countries received \$6.7 million (11 percent); and those in less developed countries received \$12.8 million (20 percent).

Table 3-18.—DOD^a Funding for Biomedical Research on Tropical Diseases by Type of Recipient, Fiscal Years 1981-83

	Fiscal year 1981		Fiscal year 1982		Fiscal year 1983		Fiscal years 1981-83	
	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent	Amount (000s)	Percent
Intramural	\$ 7,867	630/o	\$8,431	630/o	\$8,890	63 ^{oo}	\$25,188	63
Extramural U. S.	3,244	26	3,554	26	2,984	28	10,782	27
Extramural foreign ^b	1,377	11	1,450	11 %/0	1,237	9	4,064	10
Total by year.	\$12,488	100 %/0	\$13,436	100 %/0	\$14,111	100 %/0	\$40,034	100 %/0

^aThese figures are for the U.S. Army, which manages the great majority of DOD research.

^bAbout 21 percent of extramural funding of foreign organizations is received by organizations in other industrialized countries, the remainder by organizations in less developed countries.

SOURCE: M. Groves, U.S. Army Medical Research and Development Command, Ft. Detrick, MD, personal communication, March 1984.

SUMMARY

Several departments and agencies of the U.S. Government support biomedical research on tropical diseases. The important players are DHHS, AID, and DOD. The U.S. Government also supports international programs in tropical disease research. Of greatest consequence are TDR and WHO's various research programs. A small number of U.S. foundations support research in tropical diseases. The Rockefeller Foundation and the Edna McConnell Clark Foundation have a long history of involvement in this field, and the MacArthur Foundation has become active more recently. A handful of pharmaceutical companies also invest in research to develop products for tropical diseases, but funding levels are *un-*documented.

Actual dollar amounts for funding of tropical disease research are difficult to assemble for a variety of reasons. The figures presented in this report represent the best efforts of the public and private bodies to provide this information, and

OTA believes that the totals are sufficiently accurate to give a rough estimate of U.S. spending for tropical disease research. OTA estimates that U.S. public and private organizations (excluding pharmaceutical companies) have spent somewhat less than \$100 million per year on tropical disease research. This figure includes contributions to international programs.

A high proportion of U.S. tropical disease research funds is awarded to U.S. investigators. About 96 percent of NIAID extramural research funds for this purpose goes to Americans. Perhaps more surprising, U.S. research institutions and investigators have been awarded at least as much as the U.S. Government has contributed to TDR and the WHO programs. Only one program—the AID-supported Research Grants Program administered by the National Academy of Sciences' BOSTID—is specifically designed to make grants only to institutions in developing countries.