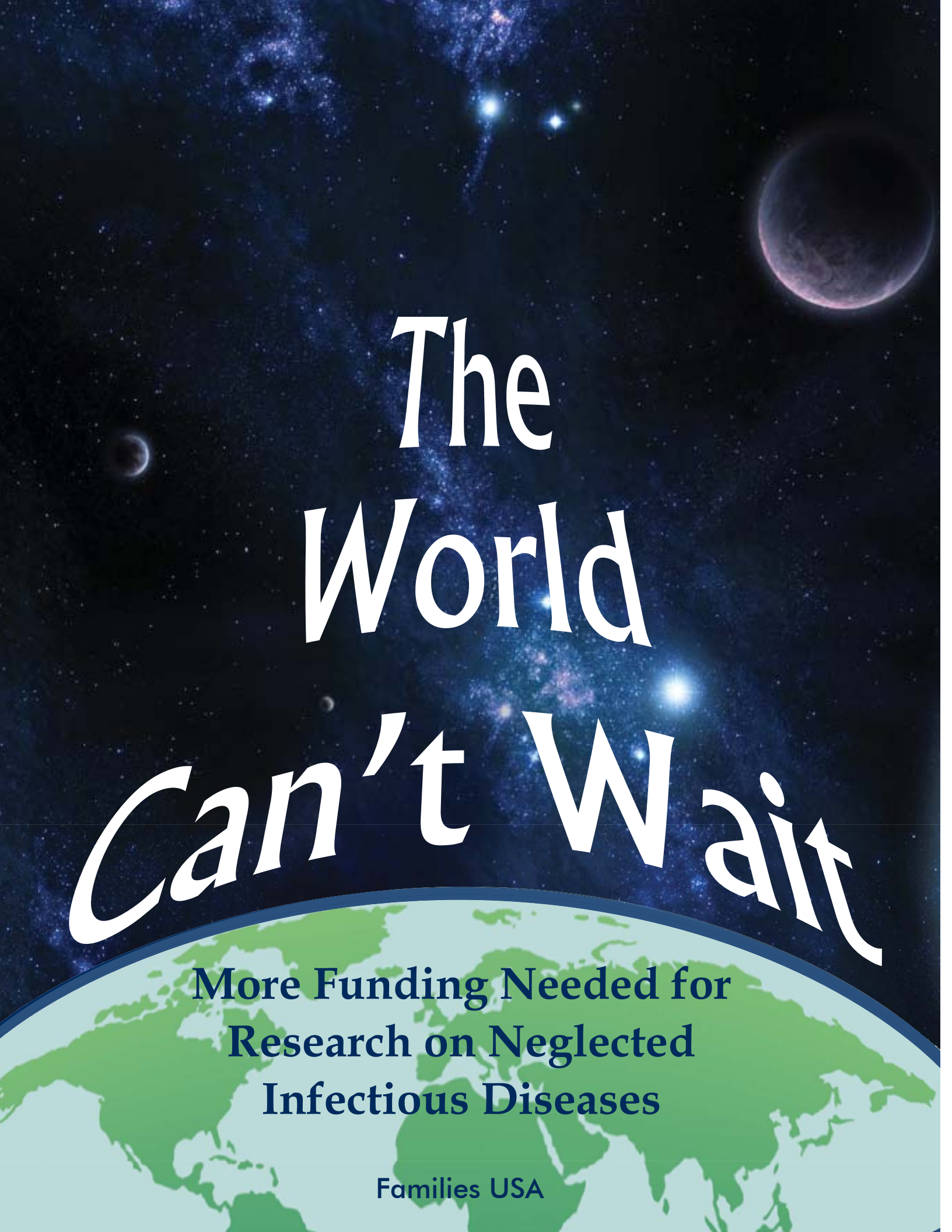

The World Can't Wait

More Funding Needed for Research on Neglected Infectious Diseases

Families USA

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Families USA's
Global Health Initiative

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INTRODUCTION

America's investment in medical research has led to astounding scientific advances that have improved the health and extended the lives of millions of people worldwide. The past 60 years have seen the development of vaccines for infectious diseases like polio, measles, and rubella—diseases that were once common in the United States but that are no longer prevalent in North America. And thanks to medical research, deaths from cardiovascular disease and stroke have declined considerably in the last decade.[1]

Unfortunately, medical research and its associated advances have not been evenly spread across all disease categories. For many infectious diseases that disproportionately affect people in developing countries, the pace of medical advance has been slow. Although diseases like malaria, tuberculosis (TB), dengue, and Chagas disease take a heavy toll in low-income countries—and even occur in the United States[2]—there have been few advances in treatments, diagnostics, and vaccines for these diseases over the last few decades.[3] What is more, the research funding that these diseases have received from governments and the pharmaceutical industry has historically been so meager that these diseases are among a group that has been classified as "neglected infectious diseases" by leading global health research agencies.[4]

Many factors have led to this lack of investment. Drug companies have focused their research and development efforts on the diseases that are most prevalent in affluent countries, where the potential profits are much higher.[5] In addition, because neglected infectious diseases do not affect large numbers of people in wealthier nations that have substantial government-sponsored research and development (R&D) capacity, there are no powerful constituency groups demanding government action.

Since 2000, however, heightened public attention and an influx of funding from philanthropies have prompted some increases in government funding of research on neglected infectious diseases, as well as greater industry activity on them.[6] Unfortunately, these funding increases have not been sufficient, and they may now be at risk: The global economic crisis may lead drug companies to retrench. And recent reductions in U.S. government funding for medical research threaten progress in all research areas, but particularly in areas that have been historically underfunded, such as neglected infectious disease research.[7]

Any loss in the momentum that has been slowly building would be tragic, because experience has shown that, when there is investment in research on global diseases, astounding progress can be made. For example, as mentioned above, our investment in

research has led to the development of effective vaccines against polio and measles, and now neither disease is endemic in the Americas. Today, worldwide polio eradication is a real possibility. And cases of measles have been reduced significantly: Global vaccination efforts have resulted in a 68 percent decrease in cases since 2000. Global health experts have set a goal of a 90 percent reduction in measles by 2010.[8] Investments in research made this progress against these diseases possible.

The U.S. government is one of the world's largest sponsors of medical research. This study evaluates the U.S. government's commitment to research on neglected infectious diseases that have a global impact. In this report, Families USA examines how much money the U.S. government invests in research on neglected infectious diseases, focusing on funding for the four major U.S. agencies that are engaged in this research: the Centers for Disease Control and Prevention (CDC), the Department of Defense (DOD), the National Institutes of Health (NIH), and the U.S. Agency for International Development (USAID). (See "U.S. Agencies' Roles in Conducting Global Infectious Disease Research" for a quick summary of the work that these agencies do, and see Appendix II on page 41 for a more detailed description of their work pertaining to global health.) We analyzed funding levels for the following eight diseases:

U.S. Agencies' Roles in Conducting Global Infectious Disease Research

NIH
Leads U.S. government efforts in conducting and supporting biomedical research.

CDC
Conducts disease tracking, rapid response, prevention, and control, as well as research that serves these goals.

USAID
Assesses local health conditions, develops and adapts appropriate health products and interventions (including supporting their field testing and introduction), and strengthens local health systems.

DOD
Develops new medical tools to protect U.S. personnel, including civilians stationed overseas, against naturally occurring infectious diseases.

1. African sleeping sickness (African trypanosomiasis),
2. Buruli ulcer,
3. Chagas disease (American trypanosomiasis),
4. cholera,
5. dengue,
6. leishmaniasis,
7. malaria, and
8. tuberculosis (TB).

All of these diseases are classified by the World Health Organization (WHO) as neglected infectious diseases because of their high prevalence in impoverished and marginalized populations in the developing world and because of the limited funds that are allocated to research on them.[9] (See "A Snapshot of the Diseases That Are Included in This Report" and Appendix III on page 43 for more information on each of the diseases included in this study.)

A Snapshot of the Diseases That Are Included in This Report

	African sleeping sickness (African trypanosomiasis)	Buruli ulcer	Chagas disease (American trypanosomiasis)	Cholera
What It Is	A parasitic disease spread by the tsetse fly or blood transfusions. Can be chronic or acute. Eventually leads to mental confusion and neurological damage.	A bacterial infection caused by the same bacteria family that causes TB, transmission not well understood. Causes skin and soft tissue destruction, large ulcers.	Parasitic disease transmitted by the assassin bug or blood transfusions. Initially, few symptoms; later stage causes heart and digestive tract damage.	Acute intestinal infection caused by ingesting food or water contaminated with *Vibrio cholerae* bacterium. Severe cases rapidly lead to shock.
Where It Occurs	Endemic in regions of sub-Saharan Africa covering 36 countries, with an estimated 60 million people at risk.	Tropical areas, including Central and South America, Australia, parts of Africa, southeast Asia, and New Guinea.	Mexico, Central and South America, rare cases in the U.S. U.S. blood supply is now screened.	Occurs worldwide, particularly where sanitation is poor or following disasters that affect water systems.
Rate of Occurrence[a]	50,000 to 70,000 cases.	No accurate estimate, but incidence is rising. Third most common mycobacterium infection after TB and leprosy.	Estimated 9 million infected.	236,000 new cases in 2006.
Treatments/ Prognosis	Fatal without treatment. Treatments are highly toxic. No vaccine.	Treatments are highly toxic. In later stages, surgery or amputation may be necessary. No vaccine.	Medications to treat infections that are not detected early have as low as a 60% cure rate and are not medically suitable for many of those infected. When these medications do not work, surgery–including heart transplant–may be required. No vaccine.	Hydration therapy. Fatal if not treated rapidly. Existing vaccine has limited efficacy.

[a] For short-term infections, occurrence is measured in incidence rates, or the number of new cases per year. For long-term diseases, occurrence is measured in prevalence, or the total number of people with the disease measured at a point in time.

Sources: See Appendix III on page 43, which has more detailed information on the diseases, including information on sources.

A Snapshot of the Diseases That Are Included in This Report (continued)

	Dengue	Leishmanaisis	Malaria	Tuberculosis (TB)
What It Is	Parasitic infection spread by mosquitoes. Causes high fever, severe muscle pain. Dengue hemorrhagic fever is a fatal complication.	Parasitic disease spread by sandflies. Two forms: 1) cutaneous, causes skin lesions; 2) visceral, damages internal organs.	Parasitic disease transmitted by mosquitoes. Causes fever, chills, vomiting.	Bacterial infection (mycobacterium) spread through the air when infected people cough, sneeze, or breathe. Usually pulmonary, can affect other systems.
Where It Occurs	Tropical and subtropical areas worldwide, mostly in cities. Southern U.S. at risk for dengue emergence.	88 countries worldwide. Cases have been reported in Texas.	Endemic in Mexico, Central and South America, Africa, south and southeast Asia.	Occurs worldwide. Is particularly prevalent in sub-Saharan Africa and southeast Asia.
Rate of Occurrence[a]	50 million new cases/year. Two-fifths of the world's population at risk of infection.	12 million currently infected.	247 million new cases/year. 40 percent of the world's population at risk of infection.	14,052,000 new cases of active TB in 2005. More than 13,000 cases reported in the U.S. in 2007. One-third of the world's population is infected, but most do not develop active TB.
Treatments/ Prognosis	No treatment. Milder cases usually resolve over several weeks; serious cases can be fatal. No vaccine.	Antibiotics or surgery for cutaneous form. Treatments for visceral form are highly toxic. Cutaneous forms are severely disfiguring; visceral form can lethal.	Treatment exists, but drug resistance is a problem. Can be fatal, especially in children. No vaccine.	Treatment exists but is difficult and long-term. Drug resistance is a growing problem. Diagnostics need improvement. Existing vaccine is not very effective.

[a] For short-term infections, occurrence is measured in incidence rates, or the number of new cases per year. For long-term diseases, occurrence is measured in prevalence, or the total number of people with the disease measured at a point in time.

Sources: See Appendix III on page 43, which has more detailed information on the diseases, including information on sources.

Although AIDS is one of the most devastating global infectious diseases, because of the level of worldwide funding for HIV/AIDS research, it is no longer classified as a "neglected infectious disease." Consequently, U.S. spending on HIV/AIDS research is not part of our study on U.S. funding for neglected infectious disease research. It is important to note, however, that in spite of current spending levels, much remains to be done in HIV/AIDS research, and it is essential that we maintain our current efforts. It is essential because of the global magnitude of the epidemic and because of the way that the epidemic affects our ability to fight other diseases, such as TB. See "HIV/AIDS, Neglected Diseases, and the Research Imperative" for a more detailed discussion of HIV/AIDS research and its link to making progress against neglected infectious diseases.

HIV/AIDS, Neglected Diseases, and the Research Imperative

In 2007, there were approximately 2.7 million people who were newly infected with HIV and 33 million people who were already living with HIV/AIDS.[a] Of all communicable diseases, only lower respiratory infections cause more deaths globally, and that category includes multiple widespread diseases, such as pneumonia and influenza.[b]

HIV/AIDS has taken—and continues to take—a colossal toll on humanity. This is particularly true in developing countries. In 2007, more than two-thirds of all people infected with HIV lived in sub-Saharan Africa, a region that accounted for more than three-quarters of AIDS-related deaths that year.[c] The impact of HIV/AIDS is so staggering that, in the minds of many, HIV/AIDS has become synonymous with the term "global health."

We did not include HIV/AIDS in our study of U.S. spending on neglected infectious disease research, however, because it is technically not a neglected infectious disease in terms of research spending. In 2007, NIH, which is just one of the agencies profiled in this report, spent $2.9 billion on HIV/AIDS research.[d]

It is important to note that, while overall spending on HIV/AIDS research is considerable, much work remains to be done. Furthermore, the prevalence of HIV/AIDS in developing countries has an enormous impact on the progression and treatment of all of the diseases that we included in this study.

Making progress against neglected infectious diseases is intertwined with making progress against HIV/AIDS because the AIDS epidemic is so sweeping in its scope and because the immune system suppression that is caused by HIV/AIDS increases susceptibility to, and progression of, other infectious diseases.[e] Developing effective medical tools to fight neglected infectious diseases will require a better understanding of how HIV/AIDS interacts with these diseases and becomes more deadly.[f] By the same token, developing medical advances to fight HIV/AIDS will support efforts to combat neglected infectious diseases more broadly.

Although the U.S. government has made substantial progress against HIV/AIDS, much more needs to be done. We do not yet have a cure, resistance to existing medications is increasing rapidly, and there is no vaccine. We need research on HIV/AIDS that is tailored to the conditions that are found particularly in developing countries, including high rates of co-infection with neglected infectious diseases.[g]

Given the funding that is allocated to HIV/AIDS research, some might say that the way to solve the problem of low funding levels for neglected infectious disease research would be to take some of the research money that is devoted to HIV/AIDS and redirect it to those other diseases. That would be akin to the adage "robbing Peter to pay Paul": It would be extraordinarily short-sighted, and it would diminish our efforts to address neglected infectious diseases overall. If we are to make real progress in improving health globally, it is imperative that we maintain our level of HIV/AIDS research funding.

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[a] United Nations AIDS Programme, *UNAIDS 2008 Report Executive Summary* (Geneva: UNAIDS, July 2008), available online at http://data.unaids.org/pub/GlobalReport/2008/JC1511_GR08_ExecutiveSummary_en/pdf.

[b] World Health Organization, *Revised Global Burden of Disease, 2002 Estimates, World Mortality Estimates* (Geneva: World Health Organization, 2002), available online at http://www.who.int/healthinfo/statistics/gbdwhoregionmortality2002.xls.

[c] United Nations AIDS Programme, *Key Facts by Region: 2007 AIDS Epidemic Update* (Geneva: UNAIDS, November 2007), available online at http://data.unaids.org/pub/EPISlides/2007/071118_epi_regional%20factsheet_en.pdf.

[d] National Institutes of Health, *Estimates of Funding for Various Diseases, Conditions, Research Areas* (Bethesda, MD: NIH, February 2008), available online at http://www.nih.gov/news/fundingresearchareas.htm. NIH funding of HIV/AIDS research, as is the case with all NIH reported disease-specific funding, includes full funding for studies that address co-infection research.

[e] D. Boraschi, M. Abebe Alemayehu, A. Aseffa, F. Chiodi, J. Chisi, et al., "Immunity against HIV/AIDS, Malaria, and Tuberculosis during Co-Infections with Neglected Infectious Diseases: Recommendations for the European Union Research Priorities," *PLoS Neglected Tropical Disease* 2, no. 6: e255.

[f] Fred Hutchinson Cancer Research Center, "Malaria May Fuel Spread of HIV in Sub-Saharan Africa," *Science Daily* (December 7, 2006), available online at http://www.sciencedaily.com/releases/2006/12/061207161148.htm.

[g] Medecins Sans Frontiers, *IGWG Booklet: Is AIDS a Neglected Disease?* (Geneva: Medecins Sans Frontiers), available online at http://www.accessmed-msf.org/main/medical-innovation/igwg-page/igwg-booklet-is-aids-a-neglected-disease/, accessed on September 12, 2008.

STUDY OBJECTIVE

The objective of our study was to measure U.S. government research and development (R&D) funding for the eight diseases listed on page 2, focusing on spending by the four leading agencies that are engaged in this research. Families USA estimated the total, unduplicated fiscal year (FY) 2007 U.S. government research funding that was allocated to the target diseases and then classified that funding by type of research activity. (Appendix IV on page 47 provides information on the research process and the categories we used to classify research activities for each disease in this study.)

An accounting of the amount of unduplicated funding is a good measure of the U.S. government's commitment to research across the spectrum of neglected infectious diseases. Funding duplication becomes an issue when tracking research spending on diseases that frequently occur together or that are caused by organisms that have similar biology, as is the case with many of the diseases in this study. For example, African sleeping sickness and Chagas disease are both caused by trypanosomes, so research on trypanosomes may lead to scientific advances for both African sleeping sickness and Chagas disease. Likewise, many of the diseases in this study frequently occur in conjunction with diseases that are not part of this study. For example, HIV/AIDS increases susceptibility to TB.

Researching co-infections is critical to advancing both science and medical practice, as diseases often occur together in the real world. However, when reporting disease-specific spending, agencies often do not separately account for spending that addresses multiple diseases.[10] For example, funding for a research project that addresses TB and HIV/AIDS might be reported, in full, for both diseases. Similarly, research on trypanosomes may be reported, in full, for both Chagas disease and African sleeping sickness. This is appropriate when measuring research spending that advances the fundamental science that underlies each of the individual diseases. However, counting full project funding more than once overstates the total research dollars that are spent across diseases.

Because this report looks at funding for multiple diseases and makes adjustments to account for duplications in funding across diseases, our disease-specific numbers are different from those reported in studies that look at a single disease or that do not make similar adjustments.[11] Those studies would appropriately count all funding for projects that advance the science related to that disease, including co-infection studies. For similar reasons, our numbers are also different from those reported by NIH on its Web site, where the agency notes: "(f)unding included in one area may also be included in other areas."[12] In this study, when research projects addressed multiple diseases, we asked the agencies to split the project funds among the diseases, as appropriate, because our goal was to measure the amounts spent on each disease included in this study while attempting to ensure that there was no redundancy in counting. Both approaches are acceptable ways to evaluate spending—the differences in methodology are appropriate for achieving different objectives.

METHODOLOGY

Using an online survey, Families USA asked each of the four agencies to report FY 2007 spending on each of the eight diseases listed on page 2 and to classify that spending by type of research activity. To ensure that the data represented only government-funded research for FY 2007 and did not include duplicated funds, the agencies were asked to:

- Report only funds that their agency had received through federal appropriations. Agencies were asked to exclude any non-federal funding and also to exclude projects that were funded through transfers from other agencies.
- Report FY 2007 actual spending not only by disease, but also by research activity (e.g., basic research, clinical trials, epidemiology research, etc.) and, when applicable, by type of product (diagnostic, treatment, vaccine, etc.). We provided disease-specific definitions that outlined all of the relevant research activity categories. (Appendix IV on page 47 contains more detailed information on the definitions that we provided to the agencies. The full definitions for each disease are available on Families USA's Web site at www.familiesusa.org/resources/publications/reports/world-cant-wait.html.)
- Ensure that dollars for grants that covered multiple diseases were reported only once. We asked respondents to report studies that covered multiple diseases under a separate heading for "co-infections." Respondents were asked to allocate funding for those studies across the target diseases as they deemed appropriate and to exclude funding that was allocated to diseases that were not part of this study.
- Provide funding at the award level (e.g., grants, contracts, projects, etc.).

Families USA obtained data from CDC, DOD, and USAID for all of the diseases in our study that they research. DOD provided award-level data, but CDC and USAID did not. For research involving multiple diseases, we asked CDC, DOD, and USAID to prorate funding by disease in a way that most closely matched the research activities undertaken. There were some multi-disease awards that these three agencies did not prorate, and, in those cases, we divided the dollars evenly among the diseases studied.

Our process for obtaining NIH data was somewhat different, as explained below.

Process for Gathering NIH Data

NIH did not provide data on the eight diseases in this study, except for select NIH intramural projects. However, NIH officials, including staff from the NIH Office of Budget, suggested a process for using official databases to compile the agency's spending data. Families USA, in consultation with NIH personnel, developed database search terms specific to each disease to identify federal funding awards (e.g., grants, contracts, intramural projects, etc.) to include in this analysis.[13]

Our database search yielded 1,200 NIH-funded projects across the eight diseases in this study. Working with an outside consultant, and using the same definitions for research activity categories that we had provided to the other agencies, we reviewed the abstracts for each of those awards (i.e., project summaries that researchers are required to submit to NIH). We classified each award by disease and research activity based on our review of the abstracts. Use of different search terms and/or different research definitions will yield different results than those reported in this study. (Appendix I on page 33 contains a complete Methodology, including definitions for our research activity categories. Appendix V on page 51 contains detailed tables that break down spending by disease, agency, research activity, and intervention type.)

Addressing Double-Counting of NIH Funding

For the 1,200 NIH projects, we used the project numbers assigned by NIH plus a review of project abstracts to do the following:

- Identify those projects that appeared more than once under our disease-specific searches, e.g., an epidemiology project that appeared under both Chagas disease and African sleeping sickness. For those double-counted projects, we apportioned project funding across the diseases and research activities covered by the study based on a review of the project abstract.
- Identify those projects that also covered diseases that were outside the scope of our study, e.g., a project that involved basic research for both TB and cancer or TB and HIV/AIDS. Again, for such projects, we apportioned funding by disease and research activity based on a review of the abstract and included only the funding portion allocated to the disease we included (in these examples, TB).

For research that advances multiple diseases, it is impossible to allocate funds across each of those diseases with absolute scientific accuracy. Experts might therefore make different decisions from those we made regarding how to allocate funds to one category or another. However, in a study that examines multiple diseases, reporting funding twice overestimates our investment in research, as does inclusion of funding that is largely directed to diseases not included in our study. The process outlined above is an effort to control for such overestimates. The Findings section of the report includes a discussion of the magnitude of adjustments we made to control for double-counting. Appendix I on page 33 discusses our Methodology in greater detail.

FINDINGS

We analyzed U.S. government FY 2007 research funding by CDC, DOD, NIH, and USAID on African sleeping sickness, Buruli ulcer, Chagas disease, cholera, dengue, leishmaniasis, malaria, and tuberculosis (TB). We evaluated agency-specific spending across diseases and by research activity. Data were adjusted to ensure that funding for projects that involved multiple diseases was counted only once. This section discusses the impact of that adjustment.

Total Spending across Agencies

- **Total spending across all study areas was approximately $366 million (see Table 1).**
  - NIH accounted for approximately 78 percent of total spending.
  - Of the remaining agencies, DOD accounted for 12 percent of total spending, CDC for 6 percent, and USAID for approximately 4 percent.
- **Research funding exceeded $100 million for only two of the eight diseases (see Table 1).**
  - Research on TB and malaria was funded at nearly the same level, with TB receiving nearly $133 million and malaria receiving about $130 million.
  - Research funding was less than $50 million for each of the remaining six diseases.
  - Malaria and TB each received about 36 percent of the total funding. Dengue received 12 percent. The remaining five diseases, African sleeping sickness, Buruli ulcer, Chagas disease, cholera, and leishmaniasis, each received less than 10 percent of total funding.
- **All of the agencies were involved in research on multiple diseases, particularly diseases with the greatest level of funding. However, for half of the diseases in this study, NIH was the only agency engaging in research on that disease (see Table 1).**
  - All agencies funded research on malaria.
  - NIH and CDC funded research on dengue, leishmaniasis, and TB. USAID funded research on TB but not dengue and leishmaniasis. DOD funded research on dengue and leishmaniasis but not TB.
  - NIH was the only agency conducting research on African sleeping sickness, Buruli ulcer, Chagas disease, and cholera.

Spending by Type of Research Activity

- **Overall Spending by Research Category**

  While there was some activity in all research categories, earlier stage research received the largest portion of funding by far (see Table 2).

- "Basic Research" was the activity that received the most funding (about 35 percent), with "Product Discovery and Preclinical Product Development" receiving the next largest percentage (approximately 33 percent).
- No other research area received more than 10 percent of funding.
  - "Clinical Product Development and Related Clinical Research" received just over 8 percent of funding.
  - The remaining areas, "Implementation/Operational Research," "Epidemiology Research," and "Education, Training, and Capacity Building" each received between 4 and 6 percent of funding.
  - 7.5 percent of total funding could not be classified. All of that funding was from NIH and could not be placed into a research category because there was insufficient information available to permit classification (for example, if an abstract was missing and the project title was not descriptive enough to permit classification). This represented about 5.8 percent of all of the NIH projects that we reviewed.

Table 1.

Fiscal Year 2007 U.S. Government Research Spending on Eight Neglected Infectious Diseases[a] (dollars in thousands)

Disease	CDC	DOD	NIH	USAID	Total by Disease*	
					Dollars	Percent
African sleeping sickness	$0	$0	$5,742	$0	$5,742	1.6%
Buruli ulcer	$0	$0	$656	$0	$656	0.2%
Chagas disease	$0	$0	$11,131	$0	$11,131	3.0%
Cholera	$0	$0	$15,679	$0	$15,679	4.3%
Dengue	$2,800	$14,384	$26,788	$0	$43,972	12.0%
Leishmaniasis	$2,800	$6,245	$16,750	$0	$25,795	7.0%
Malaria	$6,500	$23,123	$90,637	$10,000	$130,260	35.6%
Tuberculosis (TB)	$9,949	$0	$117,334	$5,373	$132,656	36.3%
Total by Agency *						
Dollars	**$22,049**	**$43,752**	**$284,717**	**$15,373**	**$365,891**	
Percent	**6.0%**	**12.0%**	**77.8%**	**4.2%**		**100.0%**

* Totals may not add due to rounding.

[a] Data in this table are from the four federal agencies that are responsible for the vast majority of all U.S. government funding for global infectious disease research. Data for the Food and Drug Administration and the Department of Veterans Affairs are not included.

Sources: Data for CDC, DOD, and USAID were reported by the agencies. NIH data were compiled using NIH sources and a process recommended by the agency.

Spending estimates were adjusted to control for projects that address co-infections and that were counted under multiple diseases.

Table 2.

Fiscal Year 2007 U.S. Government Research Spending on Neglected Infectious Disease Research, by Research Category and Agency[a] (dollars in thousands)

Research Category	CDC		DOD		NIH		USAID		Total*	
	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent
Basic Research	$4,345	19.7%	$2,637	6.0%	$122,289	43.0%	$0	0.0%	$129,271	35.3%
Product Discovery And Preclinical Product Development	$0	0.0%	$29,096	66.5%	$88,326	31.0%	$4,503	29.3%	$121,925	33.3%
Clinical Product Development and Related Clinical Research	$694	3.1%	$10,410	23.8%	$10,200	3.6%	$8,388	54.6%	$29,692	8.1%
Implementation/ Operational Research	$13,439	61.0%	$0	0.0%	$1,616	0.6%	$1,003	6.5%	$16,058	4.4%
Epidemiology Research	$2,210	10.0%	$0	0.0%	$18,751	6.6%	$570	3.7%	$21,531	5.9%
Education, Training, And Capacity Building	$1,361	6.2%	$1,609	3.7%	$16,202	5.7%	$909	5.9%	$20,081	5.5%
Unclassified	$0	0.0%	$0	0.0%	$27,333	9.6%	$0	0.0%	$27,333	7.5%
Total *	**$22,049**	**100%**	**$43,752**	**100%**	**$284,717**	**100%**	**$15,373**	**100%**	**$365,891**	**100%**

* Totals may not add due to rounding.

[a] Data in this table are from the four federal agencies that are responsible for the vast majority of all U.S. government funding for global infectious disease research. Data for the Food and Drug Administration and the Department of Veterans Affairs are not included.
Sources: Data for CDC, DOD, and USAID were reported by the agencies. NIH data were compiled using NIH sources and a process recommended by the agency.

Funding relates to research spending on eight diseases: African sleeping sickness, Buruli ulcer, Chagas disease, cholera, dengue, leishmaniasis, malaria, and tuberculosis (TB).

Spending estimates were adjusted to control for projects that address co-infections and that were counted under multiple diseases.

- **Spending by Research Category within the Agencies**

  The allocation of each agency's spending by research category to some extent reflected the unique strengths of each agency.

  - NIH was the only agency that provided funding for all research activities. "Basic Research" was the most heavily funded and accounted for 43 percent of total NIH spending (see Table 2).
  - DOD and USAID spent the majority of their research funds on "Product Discovery and Preclinical Product Development" and "Clinical Product Development and Related Clinical Research."
    - About 67 percent of DOD research spending was classified as "Product Discovery and Preclinical Product Development," and almost 24 percent was classified as "Clinical Product Development and Related Clinical Research."

- About 29 percent of USAID research spending was classified as "Product Discovery and Preclinical Product Development," while nearly 55 percent was classified as "Clinical Product Development and Related Clinical Research."
- Of the four agencies, CDC spent the largest percentage on "Implementation/ Operational Research," which accounted for 61 percent of total CDC spending.

- **Spending by Research Category across the Agencies**

  Although NIH allocated the largest amount of money to research on the diseases included in our study, looking at all the agencies, it did not account for the largest percentage of spending in all categories (see Table 3).

Table 3.

Fiscal Year 2007 U.S. Government Spending on Neglected Infectious Disease Research & Development across Agencies, by Research Category[a]

Research Category	CDC	DOD	NIH	USAID	Total *
Basic Research	3.4%	2.0%	94.6%	0.0%	100.0%
Product Discovery and Preclinical Product Development	0.0%	23.9%	72.4%	3.7%	100.0%
Clinical Product Development and Related Clinical Research	2.3%	35.1%	34.4%	28.3%	100.0%
Implementation/ Operational Research	83.7%	0.0%	10.1%	6.2%	100.0%
Epidemiology Research	10.3%	0.0%	87.1%	2.6%	100.0%
Education, Training, and Capacity Building	6.8%	8.0%	80.7%	4.5%	100.0%

* Totals may not add due to rounding.

[a] Data in this table are from the four federal agencies that are responsible for the vast majority of all U.S. government funding for global infectious disease research. Data for the Food and Drug Administration and the Department of Veterans Affairs are not included.

Sources: Data for CDC, DOD, and USAID were reported by the agencies. NIH data were compiled using NIH sources and a process recommended by the agency.

Funding relates to research spending on eight diseases: African sleeping sickness, Buruli ulcer, Chagas disease, cholera, dengue, leishmaniasis, malaria, and tuberculosis (TB).

Spending estimates were adjusted to control for projects that address co-infections and that were counted under multiple diseases.

- Across research categories, NIH accounted for by far the largest percentage of funding for four of the six categories: "Basic Research" (accounting for nearly 95 percent of the total spending in that category); "Product Discovery and Preclinical Product Development" (about 72 percent); "Epidemiology Research" (about 87 percent); and "Education, Training, and Capacity Building" (nearly 81 percent).
- Funding for "Clinical Product Development and Related Clinical Research" was the most evenly distributed across the agencies, with DOD, NIH, and USAID each funding more than 25 percent of the research in that category.
- "Implementation and Operational Research" was heavily concentrated at CDC, which accounted for nearly 84 percent of research funding in that category.

- **Spending by Disease**

  Spending varied tremendously across diseases. The widest range of research activities was performed on those diseases that had the greatest total funding (see Table 4).

  - Only four diseases had funded activity in all research categories: dengue, leishmaniasis, malaria, and TB.
  - For the remaining four diseases, activity was heavily concentrated in early stage or epidemiological research.
    - For African sleeping sickness, Chagas disease, and cholera, at least 50 percent of funding was classified as "Basic Research."
    - Almost 58 percent of the funding for Buruli ulcer was classified as "Epidemiology Research."
  - For all but two of the diseases studied, leishmaniasis and malaria, less than 10 percent of spending was classified as "Clinical Product Development and Related Clinical Research."
  - "Implementation/Operational Research" and "Education, Training, and Capacity Building" accounted for less than 10 percent of funding for all diseases.

Table 4.

Fiscal Year 2007 U.S Government Research Spending on Eight Neglected Infectious Diseases, by Research Category and Disease[a] (dollars in thousands)

Research Category	African sleeping sickness		Buruli ulcer		Chagas disease		Cholera	
	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent
Basic Research	$3,581	62.4%	$99	15.1%	$5,563	50.0%	$11,492	73.3%
Product Discovery And Preclinical Product Development	$2,137	37.2%	$178	27.2%	$4,460	40.1%	$831	5.3%
Clinical Product Development and Related Clinical Research	$0	0.0%	$0	0.0%	$0	0.0%	$163	1.0%
Implementation/ Operational Research	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
Epidemiology Research	$0	0.0%	$379	57.8%	$331	3.0%	$348	2.2%
Education, Training, And Capacity Building	$24	0.4%	$0	0.0%	$127	1.1%	$67	0.4%
Unclassified	$0	0.0%	$0	0.0%	$650	5.8%	$2,778	17.7%
Total *	**$5,742**	**100%**	**$656**	**100%**	**$11,131**	**100%**	**$15,679**	**100%**

* Totals may not add due to rounding.

[a] Data in this table are from the four federal agencies that are responsible for the vast majority of all U.S. government funding for global infectious disease research. Data for the Food and Drug Administration and the Department of Veterans Affairs are not included.

Sources: Data for CDC, DOD, and USAID were reported by the agencies. NIH data were compiled using NIH sources and a process recommended by the agency.

Spending estimates were adjusted to control for projects that address co-infections and that were counted under multiple diseases.

Table 4 (continued).

Fiscal Year 2007 U.S Government Research Spending on Eight Neglected Infectious Diseases, by Research Category and Disease[a] (dollars in thousands)

Research Category	Dengue		Leishmaniasis		Malaria		Tuberculosis (TB)		Total*	
	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent
Basic Research	$8,460	19.2%	$6,299	24.4%	$36,548	28.1%	$57,229	43.1%	$129,271	35.3%
Product Discovery And Preclinical Product Development	$23,626	53.7%	$6,229	24.1%	$53,257	40.9%	$31,207	23.5%	$121,925	33.3%
Clinical Product Development and Related Clinical Research	$2,315	5.3%	$4,601	17.8%	$14,866	11.4%	$7,747	5.8%	$29,692	8.1%
Implementation/ Operational Research	$1,840	4.2%	$1,840	7.1%	$6,820	5.2%	$5,558	4.2%	$16,058	4.4%
Epidemiology Research	$2,447	5.6%	$947	3.7%	$6,641	5.1%	$10,438	7.9%	$21,531	5.9%
Education, Training, And Capacity Building	$3,327	7.6%	$2,528	9.8%	$6,153	4.7%	$7,855	5.9%	$20,081	5.5%
Unclassified	$1,957	4.5%	$3,351	13.0%	$5,975	4.6%	$12,622	9.5%	$27,333	7.5%
Total *	**$43,972**	**100%**	**$25,795**	**100%**	**$130,260**	**100%**	**$132,656**	**100%**	**$365,891**	**100.0%**

* Totals may not add due to rounding.

[a] Data in this table are from the four federal agencies that are responsible for the vast majority of all U.S. government funding for global infectious disease research. Data for the Food and Drug Administration and the Department of Veterans Affairs are not included.

Sources: Data for CDC, DOD, and USAID were reported by the agencies. NIH data were compiled using NIH sources and a process recommended by the agency.

Spending estimates were adjusted to control for projects that address co-infections and that were counted under multiple diseases.

Adjustments for Double-Counting

All agencies except NIH provided directly to us data that were already adjusted for double-counting of multi-disease research.[14] For NIH data, we made adjustments for double-counting based on a review of NIH projects (see our abridged Methodology on page 7 and the full Methodology in Appendix I on page 33 for more details about this process.) This section outlines the impact of those adjustments to the NIH data.

Table 5 shows the extent of our adjustments for double-counting for multi-disease projects by comparing unadjusted funding (i.e., total spending when double-counting of multi-disease awards was not taken into account) to adjusted funding (i.e., total spending after subtracting double-counting of multi-disease awards). Our adjustments of NIH data for double-counting of multi-disease research reduced the total amount spent on all eight diseases by more than $110 million, which is 28 percent of unadjusted funding.

- For all diseases except Buruli ulcer and cholera, controlling for multi-disease projects reduced research funding by between 25 and 50 percent.
- TB had the largest dollar adjustment—nearly $45 million, or nearly 28 percent of unadjusted TB spending. Malaria was second, with just under $30 million, or nearly 25 percent of unadjusted spending.

Table 5.

Fiscal Year 2007 NIH Spending on Eight Neglected Infectious Diseases, Adjusted for Double-Counting (dollars in thousands)

Disease	Unadjusted Dollars (includes double-counting of multi-disease projects)	Adjusted Dollars (excludes double-counting of multi-disease projects)	Double-Counted Amount	
			Dollars (unadjusted minus adjusted)	As a Percentage of Unadjusted Dollars
African sleeping sickness	$10,420	$5,742	$4,678	44.9%
Buruli ulcer	$656	$656	$0	0.0%
Chagas disease	$22,232	$11,131	$11,101	49.9%
Cholera	$16,687	$15,679	$1,008	6.0%
Dengue	$36,959	$26,788	$10,171	27.5%
Leishmaniasis	$25,765	$16,750	$9,015	35.0%
Malaria	$120,306	$90,637	$29,669	24.7%
Tuberculosis (TB)	$162,283	$117,334	$44,949	27.7%
Total	**$395,308**	**$284,717**	**$110,591**	
Average Percent				**28.0%**

- Chagas disease and dengue had more than $10 million in double-counted multi-disease research. Leishmaniasis had slightly less—around $9 million.
- African sleeping sickness and cholera had, respectively, nearly $5 million and about $1 million in double-counted multi-disease research.
- The U.S. government is funding only $656,000 in research on Buruli ulcer, and none of this funding is related to multi-disease research.

DISCUSSION

While the diseases included in this study do not comprise all neglected infectious diseases, they represent a large percentage of the neglected diseases that lack effective diagnostics, treatments, or vaccines.[15] U.S. R&D spending on these eight diseases is therefore a good measure of our investment in research on neglected infectious diseases overall. Our Findings show that this investment is inadequate.

The diseases included in this study affect more than a quarter of the world's population and take a heavy toll both economically and socially.[16] Yet, in FY 2007, the U.S. government (the world leader in medical R&D) invested only $366 million in research to find new diagnostics, vaccines, and cures. The amount spent on these eight diseases by NIH, the largest agency that conducts biomedical research, is about $285 million—less than 1 percent of its total research budget of $29 billion.[17]

Advancing global health helps hundreds of millions of people around the world, and it is in our best interest as well. One way to make such advances is investing in medical R&D to accelerate the development of new interventions that target global infectious diseases.

Fighting Global Infectious Diseases Advances Our Interests

The United States has a long history of providing humanitarian relief to other nations. Addressing the world's critical global health challenges, of which neglected infectious diseases are a major component, would fit well within that tradition. But aside from humanitarian reasons, making progress against global infectious diseases is in our health, economic, and international interests as well.[18]

- **Our Health Interest**

  Throughout history, infectious diseases have moved from one part of the world to another, often with disastrous effect.[19] Despite the many advances in medical science, that trend continues today. As more people are traveling more rapidly around the globe, we are at greater risk than ever before. This fact was made clear in 2003, when sudden acute respiratory syndrome (SARS) spread from China to 30 countries in just eight weeks and nearly caused a worldwide pandemic.[20]

International travel and trade create opportunities for global infectious diseases to turn up here at home. People carry diseases with them from one place to another. Through trade, diseases move around the globe in multiple ways, from contaminated food, to exotic pets, to water in scrap tire shipments.[21] Over the last decade, both trade and travel have increased. In 2007, U.S. citizens made more than 41 million trips abroad by air, including more than 17 million trips to developing regions where neglected infectious diseases are most prevalent.[22] Also that year, there were about 56 million international arrivals in the United States.[23] Total imports have more than doubled over the last decade.[24] These activities create opportunities for infectious diseases to spread. Investing in research on those diseases strengthens our health security.

- **Our Economic Interest**

  Increased trade has linked our economic health to the economic health of other nations, including many developing countries. In 2007, U.S. exports in goods to Africa and South and Central America totaled $131 billion. Imports from those regions were valued at more than $226 billion.[25] These countries are important trade partners, and what happens to the economies of our trade partners matters to us.

  Infectious diseases hurt our trade partners by slowing economic growth. In a World Economic Forum survey of more than 8,000 business leaders worldwide, nearly a quarter reported that their business had been hurt by malaria or TB.[26] Diseases like TB and HIV/AIDS are damaging entire economies and indirectly increasing political instability.[27] A recent study estimated that, over a 12-month period, TB cases cause approximately $12 billion to disappear from the world economy due to lost productivity and deaths.[28]

- **Our International Interest**

  President-elect Obama has listed restoring America's global leadership as one of the key agenda items for his Administration.[29] Part of that effort includes the United States embracing the Millennium Development Goal of cutting extreme poverty around the world by 2015.[30] New and more effective medical interventions to fight and control global infectious diseases would be valuable tools in the fight against global poverty. Such new tools would help advance health and thereby foster economic growth in the world's weakest nations.

  Investing in neglected infectious disease research makes sense. It advances our public health and economic interests, and it strengthens our standing in the world.

Research on Global Infectious Diseases Can Have Direct Economic Benefits at Home

Investments in science and technology are economic drivers that allow us to better compete in the global marketplace. Government investments in biomedical research are part of that, and continuing those investments is critical if we are to continue our leadership in developing technology and in medical innovation. Government-funded biomedical research is crucial to the work of our nation's public health programs; to leading research universities and teaching hospitals; and to institutions that draw scientists, medical practitioners, and students from around the globe. Investing in research on neglected infectious diseases strengthens our biomedical research engine while bolstering our global leadership role.

Investing in research creates jobs and promotes economic growth across the country. That is easiest to see with the research grants that are awarded by NIH. NIH sends 80 to 85 percent of its funding into communities across the country and around the world in the form of research grants or contracts with universities, medical centers, and other research organizations. These grants and contracts provide new money that flows into communities, generating business growth and creating jobs. On average, in FY 2007, each dollar of NIH funding generated more than twice as much in state economic output. NIH grants and contracts created and supported more than 350,000 jobs that generated wages in excess of $18 billion in the 50 states.[31] Some of that NIH funding was for research on neglected infectious diseases, such as a $7.8 million grant to Texas A&M University to research TB drugs, and a $4.8 million grant to the University of North Carolina's Carolina Vaccine Institute to research vaccines for dengue fever.[32] The money from these projects goes to work immediately, fueling economic growth and creating jobs in the communities where the research is taking place. Research that is funded by the other agencies examined in this report has a similar economic benefit.

Will Spending More Make a Difference?

Medical research can be a lengthy process. Discoveries are not made immediately—they take time, and sometimes there are many setbacks. Even so, medical research is a good investment: Increased medical research spending has been found to lead to improvements in health in both high- and low-income countries.[33] For example, NIH-funded researchers have developed treatments that delay or prevent diabetic retinopathy, a leading cause of blindness. This, in turn, saves the United States an estimated $1.6 billion annually.[34] The SARS pandemic referred to earlier was averted because scientists funded through CDC, NIH, and the World Health Organization (WHO) were ready to act collaboratively and quickly. [35]

A push to speed discoveries can make a real difference in people's lives.

- From 1986 to 2007, NIH increased its investment in HIV/AIDS research from less than $250 million to more than $2.9 billion.[36] Without that funding commitment, we would not have the more than 30 approved antiretroviral drugs that are available today—drugs that have been essential to improving HIV/AIDS treatment and that have been credited with saving an estimated 3 million life years in the United States.[37]
- In the late 1980s, there was a political mandate to accelerate the development of a childhood vaccine that was safer than the whole-cell pertussis vaccines that were then in use. Congress set aside funding for that purpose. By 2000, four acellular pertussis vaccines (vaccines composed of cell fragments) had been licensed in the United States.[38]

The fruits of research may not be immediate (we still lack an AIDS vaccine, for example). And there will undoubtedly be failures along the way. But in science, failures add to the body of knowledge from which successes are derived. Government-funded research is a critical part of the equation to achieve medical progress, and it is particularly critical to neglected disease research, where the private industry has historically been less engaged.

Our findings support the link between government investment and advances in research. Among the diseases included in this study, higher total research funding for a given disease was associated with more research across the spectrum of research activities (see Table 4).[39] Research is cumulative in nature, with new projects building on the results of prior research. This means that, when more research is done on a particular disease, it quickens the progress toward advances in the prevention and treatment of that disease. Investing in research today does not guarantee success tomorrow, but without investments, discoveries certainly will not come.

What the Numbers Show: We Need a Larger Funding Base

The Findings in this report confirm that we need a larger funding base to make real progress in fighting neglected infectious diseases. A U.S. government commitment of only $366 million for research on eight diseases that affect more than 1 billion people is inadequate.

Several international organizations have made recommendations regarding the levels of research spending that are needed to make real progress against these diseases. For example, the estimated annual R&D spending needed for malaria is $1 billion, and for TB, the need is $900 million.[40] (Studies show that current global R&D spending on TB and malaria is less than half of the estimated need.[41]) Meeting those funding recommendations is a shared global responsibility. The countries that are hardest hit by these diseases should participate in the research process to the extent that they can. However, most of them lack the research capacity and essential infrastructure. Therefore, developed countries must take the lead in such research. That leadership is also a shared responsibility. But as the world leader in medical research, the United States should play a primary role—a role that includes stepping up government funding for medical research for these diseases.

Currently, the U.S. government does fund a large share of research on neglected infectious diseases. The most recent studies of global spending show that the U.S. government funds 41 percent of TB research and 38 percent of malaria research.[42] While those are large percentages of the global total, they are not high compared to the U.S. government's share of medical research spending in other areas. For example, in cancer research, we spend nearly seven times as much per person as the European Union.[43] Providing similar leadership in terms of funding research on neglected infectious diseases would be an investment in our economy, and it could yield progress against several major causes of death and disease worldwide (see "U.S. Leadership in Medical Research").

U.S. Leadership in Medical Research

Global health is an issue that requires a global response. In that context, what role should the United States play?

In the area of biomedical research, on any of several measures, the United States is the global leader. Over the last decade, 15 of the 24 Nobel Laureates in Medicine conducted their research in the United States.[a] In the scientific literature, articles from U.S. publications are cited more frequently than articles from publications in any other country.[b] The United States was responsible for seven of the 10 new drugs that were introduced into European markets in 2002.[c]

Investment in research drives much of the creativity that leads to the kinds of achievements noted above, and the United States is a world leader there, as well. The U.S. leads the world in scientific research and development (R&D), accounting for 40 percent of global R&D spending, and our leadership extends to medical research, too.[d] For example, in the field of cancer research, average per-capita spending in the United States in 2002-2003 was $22.76, compared to only $3.30 per capita in the European Union (EU). Our spending was nearly seven times the spending by the EU.[e]

All of these measures point to the United States as the world leader in medical research, in terms of creativity, innovation, and funding. In the areas of global health and research on neglected infectious diseases, the United States should show the same level of leadership that it does in other areas of biomedical research. This means that we should increase our investment to meet the estimated global R&D funding needs for these diseases. Doing so might mean we end up spending seven times as much as other countries. We spend that much more in other research areas—we should do no less for global infectious diseases.

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[a] The Nobel Foundation, *All Nobel Laureates in Medicine*, available online at http://nobelprize.org/nobel_prizes/medicine/laureates/, accessed on September 10, 2008.

[b] L. Philipson "Medical Research Funding, Activities, and Creativity in Europe: Comparison with Research in the United States," *JAMA* 294, no. 11 (September 2005):1,394-1,398.

[c] Ibid.

[d] Titus Galama, et al., *U.S. Competitiveness in Science and Technology* (Santa Monica: RAND Corporation, 2008), available online at http://www.rand.org/pubs/monographs/2008/RAND_MG674.pdf.

[e] S. Eckhouse and R. Sullivan, "A Survey of Public Funding of Cancer Research in the European Union," *PLoS Medicine* 3, no. 7 (July 2006): e267.

Increased Funding Is Needed across the Spectrum of Research Activities

While increased spending is important, it is also important to spread that funding across all research categories. Generally, government plays a large role in the funding of earlier stage research, such as basic research and product discovery.[44] Therefore, it is not surprising that we found that nearly 70 percent of government funding for neglected infectious disease research fell into those research categories (35.3 percent of government spending was for basic research, and 33.3 percent of government spending was for product discovery and preclinical product development, see Table 2). Private industry tends to become more involved at later stages of product development, particularly in clinical trials.[45, 46] But for diseases with a smaller paying market, private industry's interest is limited, even in the later stages of research.[47] To make advances in fighting neglected infectious diseases, substantial government commitment is needed across the entire development cycle.

There are key points in the development cycle where promising products for neglected diseases are likely to be dropped: moving from basic to preclinical research, and moving into clinical trials.[48] Strong government support in all stages of research, particularly the costly later stages of clinical research and clinical trials, is needed to ensure that promising products move all the way through the development pipeline. Without such support, discoveries may languish, as is happening now.

It is difficult to increase pharmaceutical companies' interest in moving technologies for neglected infectious diseases forward—so difficult that, for these diseases, NIH maintains a public list of inventions that are available for licensing from NIH, the FDA, or nonprofit organizations. (NIH maintains a similar list for rare diseases, which have also generated limited commercial interest.) The NIH neglected disease technologies list includes 53 technologies at various stages of development that are related to the diseases covered in this report. These technologies generally require additional studies and clinical testing.[49]

While the government already plays a role in clinical research, with neglected infectious diseases, it needs to do more. Looking at research on all diseases (i.e., the diseases included in this study and all other diseases for which the government funds research), the government funds a substantial amount of clinical research. In FY 2007, approximately 31 percent of the *overall* NIH budget was allocated to clinical research, and about a third of that (10 percent of the total NIH budget) was allocated to clinical trials.[50] However, for the diseases studied in this report, only 8 percent of funding was for clinical product development and clinical research. There was also little funding for operational research and for education, training, and capacity building (see Tables 2 and 4).

Without question, later-stage research can take place only when there is early stage research to build upon. Particularly in the case of the most neglected diseases—African sleeping sickness, Buruli ulcer, Chagas disease, and cholera—funding patterns may reflect the lack of ability to move to later stages of research, rather than a failure to fund particular areas of research. For those diseases, substantial early stage research may be needed. However, to ensure that discoveries for neglected diseases move forward, policies and funding priorities must support strong government involvement in, and funding of, all phases of research.

Engagement of Multiple Agencies

We found that there were two factors that were correlated with increased spending across the full range of research categories: higher levels of overall funding and the involvement of multiple agencies (see Tables 2 and 4). This indicates that both more funding and cross-agency engagement in research might best accelerate the development of new interventions across the spectrum of neglected infectious diseases.

In addition, for these diseases, the research agenda within each agency should be structured to expedite movement of discoveries through the research process and into global use.[51] Successfully moving products into global use requires research into the broader areas of implementation and capacity building. It is not enough to develop a product—the product needs to be appropriate for the physical and cultural setting in which it will be used.[52] Furthermore, there must be supporting health systems (the capacity) to ensure ongoing, in-country research and to track the intervention's adoption and use. These are areas where government leadership is essential and where funding is often inadequate.

To achieve sustained control of these infectious diseases, funding must not only increase—it must also span the range of research activities, including issues related to product adoption.

Government Funding Can Spur Non-Government Research

Government funding of neglected disease research can also increase private-sector innovation and investments. One way that government can help is through supporting the research initiatives of relatively new groups of private-sector, not-for-profit, product development organizations that are engaged in research on neglected infectious diseases. Referred to as public-private "product development partnerships" (PDPs), these are comparatively small entities that are funded by philanthropic organizations, as well as by the public and private sectors.[53] These organizations have made significant contributions in moving forward research on a host of neglected infectious diseases.[54]

PDPs represent an innovative and important new approach to filling a market void, but they do not obviate the need for increased government funding of medical research. While PDPs do receive some public and industry funding, they rely to a large extent on funding from

foundations, and many are facing funding gaps, especially for costly Phase III clinical trials. Increased government funding of PDP-sponsored research would enable them to expedite their efforts in product discovery and development.

Increasing government funding could also stimulate broader industry involvement and growth among PDPs. Statistical data show that private-sector research investments increase with greater federal R&D spending.[55] Recent events seem to indicate this might be true for research on global infectious diseases as well. Even though drug companies have historically not invested in this area of research, an influx of philanthropic and public funds since 2000 has helped lead several drug companies to get involved in neglected disease research, particularly through partnerships with PDPs.[56] By investing more in neglected infectious disease research—and investing across all stages of research—the government might stimulate private-sector investment in this research.

U.S. Government Research Funding: Heading in the Wrong Direction

Before agencies like NIH and CDC can spend more on neglected disease research, they need to have the money to spend. In recent years, government funding for these agencies has not kept pace with biomedical research inflation, which rose by a sizable 15.8 percent between 2004 and 2007. This has left these agencies unable to fund existing research programs, much less to expand research on neglected infectious diseases.

- Although NIH funding rose from $27.9 billion in 2004 to $29.0 billion in 2007, the agency needed $31.6 billion in 2007 to have the same purchasing power that it did in 2004. This means that, in 2007, the agency needed an additional $2.6 billion just to keep up with biomedical research inflation over those four years.[57] This erosion in purchasing power not only limited the agency's ability to finance ongoing research and to expand into areas where new health threats have emerged, it also limited the ability of NIH to simply maintain existing programs.
  - Between 2004 and 2007, funding for non-biodefense research at the NIH National Institute of Allergy and Infectious Diseases (NIAID) increased from $2.38 billion to $2.55 billion.[58] However, NIAID needed $3.295 billion in 2007 to keep up with biomedical research inflation. This left a funding shortfall of $745 million. (NIAID is the lead NIH institute that focuses on infectious disease research.)
  - From 2004 to 2007, funding for the NIH Fogarty International Center also fell far behind rising biomedical research inflation. During that time, the agency's budget increased from $65.4 million to $66.4 million. This represented an increase of only 1.6 percent, resulting in a funding shortfall of nearly $15 million (14.2 percent) since 2004.[59] (The Fogarty International Center is the lead center within NIH that is focused on global health research training and capacity building.)

- From 2004 to 2007, the budget for CDC's global health programs increased from $286 million to $307 million, but the agency needed $353 million to keep up with biomedical research inflation.[60]
- From 2004 to 2006, USAID funding was decimated, cut from about $12.6 billion to just $9.2 billion.[61] (USAID research funding for 2007 is not available on the agency's Web site.)
- The research budget for the Department of Defense Military Infectious Diseases Research Program (MIDRP) has also been on the chopping block. The annual budgets from 2004 to 2007 were anywhere from $43,000 to $3.6 million lower than the 2003 budget level of $43.7 million (without taking into account the rise in biomedical research inflation since 2003).[62]

If strapped for research funds, these agencies will be hard-pressed to expand research into new areas—or even to maintain existing programs that target infectious diseases. Our government needs to provide these agencies with both a directive regarding infectious disease research and the funds to move that research forward.

What's Needed: A Roadmap for Action

A U.S. government commitment to increase its funding for neglected infectious disease research, with the goal of playing a leadership role in bringing global research funding to needed levels, could pave the way for global action. The United States could start this process by increasing its funding over several years, with its percentage of the global community's need estimate remaining constant, until it had reached a particular long-term target. For example, the U.S. government share of current TB R&D spending is 41 percent, and the estimated global need is $1 billion annually. Under our proposal, the U.S. government would have an eventual funding target for TB research of $410 million, or 41 percent of the global need. Such a commitment would obviously require increasing funding across the agencies that conduct this research. And as we increase our research efforts, we should encourage other countries, particularly those with well developed research capacity, to increase their investments in neglected disease research as well.

Funding increases should be part of a comprehensive approach that is designed to advance medical interventions for neglected infectious diseases. A comprehensive strategy should ensure coordinated involvement of all relevant agencies. Each of the four agencies included in this report brings different strengths to the research enterprise, and all are critical if we are to discover, develop, and appropriately move products into low-resource settings. (See Appendix II on page 41 for a description of the agencies.) A comprehensive strategy should ensure funding along the entire research and development continuum and should support involvement and partnerships with the private sector, including PDPs.

CONCLUSION

Improving global health is in our national interest. One way to improve global health is to invest in research to accelerate the development and availability of new medical interventions that will curb the impact of global infectious diseases. As the world leader in biomedical research, the United States is in a unique position to lead this research. Doing so would not only provide a global benefit, but it would also advance our national interests on a variety of fronts.

Increased funding for neglected infectious disease research is needed across all of the agencies involved, and across the spectrum of research activities. This will require a public commitment to greater funding for all of the agencies that are engaged in this research, as well as a commitment to making research in these areas a priority. We have succeeded before by building on government investments in medical research. For example, we have all but eliminated pertussis and rubella by developing and using vaccines. We can have the same success with other diseases. The world cannot wait.

ENDNOTES

[1] A short list of accomplishments is available on the NIH Web site under "About NIH" at http://www.nih.gov/about/NIHoverview.html.

[2] Peter Hotez, "Neglected Infections of Poverty in the United States of America," *PLoS: Neglected Tropical Diseases* 2, no. 6 (June 25, 2008): e256, available online at http://www.plosntds.org/article/info:doi%2F10.1371%2Fjournal.pntd.0000256.

[3] Families USA's Global Health Initiative, *Investing in Global Health Research: Government Should Play a Larger Role* (Washington: Families USA, February 2007).

[4] The National Institutes of Health Office of Technology Transfer lists 20 diseases that are classified as "neglected" based on the World Health Organization's (WHO) evaluation, available online at http://ott.od.nih.gov/licensing_royalties/NegDis_ovrvw.asp, accessed on November 17, 2008. All of the diseases listed are infectious diseases that are classified as viral, bacterial, helmithic (transmitted by worms), or protozoan (typically spread by mosquitoes, flies, or other "vectors").

[5] P. Trouiller, et al., "Drug Development for Neglected Diseases: A Deficient Market and a Public-Health Policy Failure," *The Lancet* 359, no. 9,324 (2002): 2,188-2,194.

[6] M. Moran, et al., *The New Landscape of Neglected Disease Drug Development* (London: The Wellcome Trust, 2005).

[7] See the section of the Discussion titled "U.S. Government Research Funding: Heading in the Wrong Direction," and Families USA's Global Health Initiative, *President's Budget Delays Medical Progress* (Washington: Families USA, January 2008), available online at http://www.familiesusa.org/assets/pdfs/nih-cdc-budget-2008.pdf.

[8] Information on the global progress against polio is available on the Web site of The Global Polio Eradication Initiative at http://www.polioeradication.org/history.asp. Information on the progress against measles is available on the Web site of the Measles Initiative at http://www.measlesinitiative.org/mip.asp.

[9] See National Institutes of Health, Office of Technology Transfer, for a list of diseases classified as "neglected," available online at http://ott.od.nih.gov/licensing_royalies/NegDis_ovrvw.asp. All of the diseases listed are infectious diseases, classified as either viral, bacterial, helmithic (transmitted by worms), or protozoan (typically spread by mosquitoes, flies, or other "vectors").

[10] On its Web site, which reports disease-specific funding, NIH acknowledges this, noting: "(f)unding included in one area may also be included in other areas." NIH disease-specific spending data are available online at http://www.nih.gov/news/fundingresearchareas.htm.

[11] Excellent studies that provide comprehensive, global assessments of research funding that focuses on a single disease include the following: Malaria R&D Alliance, *Malaria Research and Development: An Assessment of Global Investment* (Geneva: Malaria R&D Alliance, 2005); Cindra Feuer, *Tuberculosis Research and Development: A Critical Analysis, 2nd edition* (New York: Treatment Action Group, 2006); and Treatment Action Group, *2008 Pipeline Report* (New York: Treatment Action Group, July 2008), available online at http://www.aidsinfonyc.org/tag/tx/2008pipeline.pdf.

[12] Of the diseases in this report, NIH reports spending on malaria, malaria vaccines, tuberculosis, and tuberculosis vaccines. The amounts reported do not control for "double-counting" of projects across diseases. NIH disease-specific funding is available online at http://www.nih.gov/news/fundingresearchareas.htm.

[13] Searches conducted using different terms will yield different results. NIH employs an internal process when calculating disease-specific spending, reported on its Web site at http://www.nih.gov/news/fundingresearchareas.htm. Because NIH did not provide its data directly to us, our data did not go through this internal process. As a result, findings from our NIH data searches vary somewhat from the amounts that NIH reports on its Web site. Our adjustments for double-counting further increased the difference between our NIH funding numbers and those that appear on the NIH Web site.

[14] CDC, DOD, and USAID provided data that were adjusted for duplicated counting related to co-infection research.

[15] This assessment was based on a review of the medical literature, looking at treatments available for the 20 diseases listed as "neglected diseases" on the Web site for the NIH Office of Technology Transfer, plus a discussion with a lead infectious disease researcher at the NIH National Institute of Allergy and Infectious Diseases (NIAID). The infectious diseases that we excluded from our study include the childhood cluster diseases of diphtheria, pertussis, polio, measles and tetanus; meningitis; hepatitis; intestinal nematode infections; trachoma; Japanese encephalitis; leprosy; shistosomiasis; lymphatic filariasis; onchocerciasis; trachoma; and diarrheal diseases other than cholera. Effective vaccines or treatments exist for many of the excluded diseases.

[16] Populations affected live in areas that place them at risk for acquiring the disease. For example, half the world's population is estimated to be at risk for malaria. World Health Organization, *World Malaria Report 2008* (Geneva: World Health Organization, 2008)..

[17] These calculations are based on the NIH neglected infectious disease funding figures that are presented in the Findings of this report as a percent of the NIH 2007 budget of $29.1 billion. The 2007 NIH budget numbers are from NIH, *Summary of the FY 2009 President's Budget* (Bethesda, MD: NIH, February 4, 2008), available online at http://officeofbudget.od.nih.gov/ui/2008/Summary%20of%20FY%202009%20Budget-Press%20Release.pdf.

[18] Institute of Medicine, Board on International Health, *America's Vital Interest in Global Health: Protecting Our People, Enhancing Our Economy, and Advancing Our International Interest* (Washington: National Academy Press, 1997). This report outlines the many reasons why global health matters to the United States, and its broad findings are the basis for our analysis. The Institute of Medicine is in the process of conducting a new study on the U.S. interest in global health, which is due to be published in early 2009.

[19] The Black Death arrived in Italy via ships from the East in 1348. Smallpox spread throughout the Americas with the arrival of the first European explorers, decimating the native population. Michael Drancourt and Didier Raoult, "Molecular Insight into the History of Plague," *Microbes and Infection* 4, no. 1 (January 2002):105-109, available online at http://www.macalester.edu/~cuffel/molecularplague.htm; Charles C. Mann, *1491: New Revelations of the Americas before Columbus* (New York: Alfred A. Knopf, 2005).

[20] T. F. Leung, G. W. K. Wong, K. L. E. Hon, and T. F. Fok, "Severe Acute Respiratory Syndrome (SARS) in Children: Epidemiology, Presentation and Management," *Paediatric Respiratory Reviews* 4, no. 4 (December 2003): 334-339.

[21] L. Kahn, "Viral Trade and Global Health," *Issues in Science and Technology*, Winter 2003, available online at http://www.issues.org/20.2/kahn.html. Notable examples of trade and the movement of disease include the arrival of Asian tiger mosquitoes, a known vector for dengue fever, in the U.S. in the mid-1980s via a tire shipment from Japan, as well as an outbreak of monkey-pox in the Midwest in 2003 that was traced to a Gambian rat, which was imported to Chicago by an exotic pet dealer.

[22] Based on U.S. citizen international air travel statistics (U.S. citizens' outbound flights, based on final flight destination) for 1997 and 2007, compiled by the Office of Travel and Tourism Industries, International Trade Administration, U.S. Department of Commerce. The office tracks travel by region. "Developing region" trips included the Caribbean, South and Central America, Mexico, Africa, and the Middle East. Because of the mix of developed and developing countries, trips to Asia, Oceania, and the Far East were excluded. Calculations were made by Families USA using data available online at http://tinet.ita.doc.gov/research/monthly/departures/index.html, accessed on August 5, 2008.

[23] Department of Commerce, International Trade Administration, *2007 International Arrivals to the United States* (Washington: Department of Commerce, June 2008), available online at http://www.tinet.ita.doc.gov/outreachpages/download_data_table/Analysis_2007YTD_Arrivals.pdf, accessed on August, 14, 2008; Department of Commerce, International Trade Administration, *1991 International Arrivals* (Washington: Department of Commerce, 1997), available online at http://tinet.ita.doc.gov/view/m-1997-I-001/Tcy1297.txt_data_file.csv.

[24] We calculated the increase in imports (goods and services) from 1997 to 2007 based on trade data from the U.S. Census Bureau, *U.S. Trade in Goods and Services, Balance of Payments (BOP) Basis, 1960-2007* (Washington: U.S. Census Bureau, 2008), available online at http://www.census.gov/foreign-trade/statistics/historical/gands.pdf.

[25] Ibid.

[26] David Bloom, et al., *Business and Malaria: A Neglected Threat* (Geneva: World Economic Forum, June 2006), available online at http://www.weforum.org/pdf/MalariaReport.pdf. This report outlines the business impact of malaria. See also Global Health Council, *Impact of Disease, Child Development in Developing Countries* (Washington: Global Health Council), available online at http://www.globalhealth.org/child_health/impact/, accessed on September 12, 2008.

[27] P. Ndeboc Fonkwo, "Pricing Infectious Disease: The Economic and Health Implications of Infectious Diseases," *Science and Society* 9, Special Issue, 2008.

[28] Ibid.

[29] On the Obama transition Web site, http://change.gov, "Renewing American Global Leadership" is listed among the five agenda items on the site's home page, accessed on November 17, 2008.

[30] See "Agenda: Foreign Policy," available online at http://change.gov/agenda/foreign_policy_agenda/, accessed on November 17, 2008. In 2000, delegates to the United Nations Millennium Summit adopted the *U.N. Millennium Declaration*, which committed their nations to work toward the overarching goal of reducing extreme poverty by 2015. The Declaration sets out eight "Millennium Development Goals" that have been deemed essential to development and the eradication of poverty. "Combating global disease" is among those goals. Further information is available on the U.N. Millennium Project Web site at http://www.unmillenniumproject.org/index.htm.

[31] Kudzai Makomva, *In Your Own Backyard: How NIH Funding Helps Your State's Economy* (Washington: Families USA, June 2008).

[32] These grants were found using the National Institutes of Health Research Portfolio Online Reporting Tool, which has a state-by-state listing of 2007 grants by institute and grant description, available online at http://report.nih.gov/award/State/state07.cfm, accessed on November 11, 2008.

[33] Global Forum for Health Research, *Monitoring Financial Flows for Health Research 2007* (Geneva: Global Forum for Health Research, June 2008), available online at www.globalforumhealth.org.

[34] Research!America, *Investment in Research Saves Lives and Money: Facts about Vision and Blindness* (Alexandria, VA: Research!America, 2008), available online at http://www.researchamerica.org/uploads/factsheet16vision.pdf.

[35] Mayo Clinic, *Infectious Disease Fact Sheets: SARS* (Mayo Foundation for Medical Education and Research, 2006), available online at http://www.mayoclinic.com/health/sars/DS00501; Research!America, op. cit.

[36] National Institutes of Health, *Estimates of Funding for Various Diseases, Conditions, and Research Areas* (Bethesda, MD: NIH, February 2008), available online at http://www.nih.gov/news/fundingresearchareas.htm, accessed on November 18, 2008; and Dr. Anthony Fauci, Statement during the Field Hearing on AIDS, Senate Appropriations Committee, Subcommittee on Labor, HHS, and Education: NIH HIV/AIDS Funding Slide, July 9, 1999, available online at http://www3.niaid.nih.gov/About/Directors/Congress/1999/0709/9.htm.

[37] David Metzner, "Economic Approaches to Valuing Health Research," chapter 7 in *Disease Control Priorities in Developing Countries, 2nd edition* (Washington: Disease Control Priorities Project, 2006), available online at http://files.dcp2.org/pdf/DCP/DCP07.pdf; Presentation of Dr. Anthony Fauci, Director of the NIH National Institute of Allergy and Infectious Diseases (NIAID), at Families USA's Health Action Conference 2008, available online at http://www.kaisernetwork.org/health_cast/hcast_index.cfm?display=detail&hc=2471; U.S. Food and Drug Administration, *Drugs Used in the Treatment of HIV Infection* (Washington: FDA, January 2008), available online at http://www.fda.gov/oashi/aids/virals.html.

[38] David Klein, "From Pertussis to Tuberculosis: What Can Be Learned?", *Clinical Infectious Diseases* 30, Supplement (June 2000): S302-308, available online at http://www.journals.uchicago.edu/doi/abs/10.1086/313879.

[39] The second factor was involvement of multiple agencies in research activities. This is addressed later in the Discussion.

[40] Roll Back Malaria Partnership, *Global Advocacy Framework to Roll Back Malaria: 2006-2015* (Geneva: World Health Organization, March 2006), available online at http://rbm.who.int/globaladvocacy/docs/GlobalAdvocacyStrategy.pdf; Stop TB Partnership, *The Global Plan to Stop TB, 2006-2015* (Geneva: World Health Organization, 2006), available online at http://www.stoptb.org/globalplan/assets/documents/GlobalPlanFinal.pdf.

[41] Calculation of spending as a percent of global need by Families USA based on global spending estimated from the Malaria R&D Alliance, op. cit.; and, Cindra Feuer, op. cit.

[42] Calculations of U.S. government spending as a percent of total spending by Families USA based on data from Treatment Action Group, *Funding Trends in TB Research & Development: 2005-2007, Preliminary Report* (New York: Treatment Action Group, October 2008); and Malaria R&D Alliance, op. cit.

[43] S. Eckhouse and R. Sullivan, "A Survey of Public Funding of Cancer Research in the European Union," *PLoS Medicine* 3, no. 7 (July 2006): e267.

[44] Congressional Budget Office, *Federal Support for Research and Development* (Washington: Congress of the United States, June 2007); National Science Board, *Research and Development: Essential Foundation for US Competitiveness in a Global Economy, a Companion to Science and Engineering Indicators 2008* (Arlington, VA: National Science Board, January 2008), available online at http://www.nsf.gov/statistics/nsb0803/start.htm.

[45] Although industry is the largest R&D funder in the U.S., the federal government is the primary source of basic research support, funding more than 59 percent of basic research. Industry funds only about 3.8 percent of basic research. In contrast, industry funds a large percentage of clinical research. For example, in 2003, industry funded an estimated 41 percent of Phase I through Phase III clinical trials. Sources: Congressional Budget Office, op. cit.; National Science Board, op. cit.; and Hamilton Moses III, et al., "Financial Anatomy of Biomedical Research," *JAMA* 294, no. 11 (September 2005):1,333-1,342.

[46] World Health Organization Commission on Intellectual Property Rights, Innovation, and Public Health, *Public Health: Innovation and Intellectual Property Rights* (Geneva: WHO, 2006).

[47] Several studies of global investment in neglected infectious diseases research show that, in the clinical trial stage, industry spending is far below the investments made by the public or philanthropic sectors. See HIV Vaccines and Microbicides Resource Tracking Working Group, *Sustaining the HIV Prevention Research Agenda: Funding for Research and Development of HIV Vaccines, Microbicides and Other New Prevention Options, 2000 to 2007* (New York: AIDS Vaccine Advocacy Coalition, August 2008); and Treatment Action Group, *Tuberculosis Research and Investment: A Critical Assessment, 2nd edition* (New York: Treatment Action Group, October 2006).

[48] Angela Fehr, et al., "Editorial: Drug Development for Neglected Diseases: A Public Health Challenge," *The European Journal for Tropical Medicine and International Health* 11, no. 9 (2006): 1,335-1,338, available online at http://www3.interscience.wiley.com/cgi-bin/fulltext/118598838/HTMLSTART?CRETRY=1&SRETRY=0. The author notes a third, post-development point where products often fail to move forward due to registration issues (e.g., government approvals) or fail to reach the target population due to cost, production, or distribution issues.

[49] National Institutes of Health, Office of Technology Transfer, *Neglected Diseases, Technologies Available for Licensing from NIH/FDA and Non-Profit Institutions* (Bethesda, MD: NIH Office of Technology Transfer), available online at http://ott.od.nih.gov/licensing_royalties/NegDis_ovrvw.asp, accessed on September 12, 2008.

[50] National Institutes of Health, *Estimate of Funding for Various Diseases, Conditions, and Research Areas*, op. cit.

[51] A detailed analysis of agency operations is outside of the scope of this report. However, such an agenda should address cross-agency communications and coordination and funding opportunities for new entities (product development partnerships).

[52] D. Sanders and A. Haines, "Implementation Research Is Needed to Achieve International Health Goals," *PLoS Medicine* 3, no. 6 (June 2006): e186.

[53] M. Moran, op. cit. In Dr. Moran's study, the public sector accounted for 16 percent of PDP funding.

[54] For an in-depth discussion of product development partnerships, see M. Moran, op. cit.

[55] Congressional Budget Office, op. cit.

[56] M. Moran, op. cit.

[57] Numbers for disease-specific spending for NIH for 2007 are available online at http://www.nih.gov/news/fundingresearchareas.htm. Total numbers for NIH spending for 2007 are available online at http://www.hhs.gov/budget/08budget/2008BudgetInBrief.pdf.

[58] These amounts are in real dollars, without any adjustment for biomedical research inflation, and they reflect NIAID's non-biodefense funding, when money that is passed through to the Global Fund to Fight AIDS, TB, and Malaria is excluded from calculations. (The United States' charitable contribution to the Global Fund is financed through NIAID's budget as an accounting mechanism. While this funding is necessary and important, it does not support any of NIAID's work.) National Institutes of Health, *History of Congressional Appropriations 2000-2008* (Bethesda, MD: NIH, 2008), available online at http://officeofbudget.od.nih.gov/UI/2008/Congressional%20Approps.pdf. NIH biodefense data were obtained from C. Franco, "Billions for Biodefense: Federal Agency Biodefense Funding, FY 2008-FY 2009," *Biosecurity and Bioterrorism* 6, no. 2 (2008).

[59] National Institutes of Health, *Mechanism Detail* (Bethesda, MD: NIH), available online at http://officeofbudget.od.nih.gov/PDF/Mechanism%20Detail%20by%20IC,%201983%20-%202006%20WEB%20PDF.pdf, accessed on March 24, 2008.

[60] Centers for Disease Control and Prevention, *Budget Documents*, available online at http://www.cdc.gov/fmo/fmofybudget.htm, accessed on March 24, 2008.

[61] U. S. Agency for International Development, *Summary of FY 2007 Budget and Program Overview* (Washington: USAID, June 2006), available online at http://www.usaid.gov/policy/budget/cbj2007/summary.html.

[62] Numbers provided by the Military Infectious Diseases Research Program in Fort Detrick, Maryland. Note that these numbers might vary slightly if adjusted for congressional special interest funding.

APPENDICES

Appendix I:
Methodology

Appendix II:
Agency Descriptions

Appendix III:
Background on the Diseases Covered in This Report

Appendix IV:
Research Categories

Appendix V:
Tables: Research Funding For Individual Diseases

APPENDIX I.
Methdology

Many staff members at the CDC, DOD, NIH, and USAID, as well as those at several other organizations, helped us collect, evaluate, classify, and analyze the data we present in this report. They either directly provided spending data, or they helped direct us in our collection and evaluation of data we obtained ourselves. Many of those who helped in this process are noted on page 60 of this report. Reviewing and analyzing the data were substantial tasks. In addition to Families USA staff, we retained an epidemiologist, Jennifer Tujaque, to assist with data collection and the review and classification of scientific abstracts.

Our methodology included several phases, with each successive phase building on the previous phase. First, we chose the U.S. government agencies from which we would seek funding data. Next, we selected the diseases and interventions to include. Then, for each disease selected, we defined the research activities that fell into each research category, which was the basis for data collection. Finally, we collected and analyzed the data. We discuss each phase of the process in greater detail below.

Agencies Included in the Study

To measure the U.S. government's investment in research and development related to the eight diseases included in this study, we collected spending data from the four leading U.S. government agencies that directly conduct or fund research on neglected infectious diseases. Those agencies are as follows:

- The Centers for Disease Control and Protection (CDC), which conducts disease surveillance and research worldwide;
- The Department of Defense (DOD), which conducts research to develop products (vaccines, therapeutics, diagnostics, insect repellants, etc.) to protect U.S. personnel and those of U.S. allies from infectious diseases that they may encounter while deployed;
- The National Institutes of Health (NIH), the primary federal agency that conducts and supports medical research; and
- The U.S. Agency for International Development (USAID), which conducts health research as part of its mission to provide economic, development, and humanitarian assistance worldwide.

There are other agencies that conduct a very limited amount of research on neglected infectious diseases. The Food and Drug Administration (FDA) funds a small number of research projects. The Department of Veterans Affairs (VA) also conducts related research, although much of

that is funded through NIH. In addition, some of the multilateral organizations that the U.S. government helps fund, such as the World Health Organization (WHO) and the Pan American Health Organization, use a portion of their funding for research. However, the four agencies profiled in this report represent the vast majority of U.S. government funding for neglected infectious disease research. (See Appendix II for more information on each of the four agencies.)

Selecting Diseases for Analysis

A multitude of infectious diseases pose global health threats—many more than the eight that we analyzed in this report. We selected the diseases we would evaluate based on their global burden, available treatments for them, the level of scientific knowledge about them, their global impact, and how they were classified by the World Health Organization.[1] For some diseases, we weighted one criterion more heavily than the others, but we considered all five criteria for each disease.

Our assessment of these factors led to the inclusion of African sleeping sickness (African trypanosomiasis), Burili ulcer, Chagas disease (American trypanosomiasis), cholera, dengue, leishmaniasis, malaria, and tuberculosis (TB) in the study. (See Appendix III for brief descriptions of these diseases.)

Although our weighing of these criteria led us to exclude HIV/AIDS, we nevertheless provide some publicly available funding information for this disease to highlight how global health progress can be made through investment in medical research.

- **Criteria**
  - **Global Burden of the Disease**: We evaluated the "global burden" of each disease, defined as the global mortality and morbidity costs associated with that disease. We measured this in terms of the total number of cases, the deaths caused, and the economic impact related to lost productivity.
  - **Treatments Available for the Disease**: We evaluated existing treatments in terms of their effectiveness, toxicity, cost, issues of resistance, and potential for long-term use in a resource-poor environment (such as a low-income country). For all of the diseases we selected, the available treatments are inadequate.
  - **Level of Scientific Knowledge about the Disease**: Developing baseline scientific knowledge about a disease is necessary for the discovery of medical interventions that are safe, effective, and suitable for use in the target populations. We read the scientific literature and spoke with an infectious disease expert to determine whether the science for specific diseases had advanced to the point where additional research funding could result in advances in treatment. We were most interested in including those diseases for which added research funding might lead to improved interventions.

- **Global Impact of the Disease:** All of the diseases included in this study have a tremendous global impact. They affect people in numerous countries, move across international boundaries, and have health and economic effects that are felt worldwide. Four of the eight diseases have already invaded the United States (Chagas disease, dengue, malaria, and tuberculosis), and a fifth (cholera) poses a substantial threat of doing so via bioterrorism.
- **World Health Organization Classification:** A complete list of WHO-classified neglected diseases was compiled by the NIH Office of Technology Transfer, available online at http://ott.od.nih.gov/licensing_royalties/NegDis_ovrvw.asp. This list includes 20 viral, bacterial, helmithic (transmitted by worms), and protozoan (typically spread by mosquitoes, flies, or other "vectors") diseases.

Definitions of Research Activity Categories

We worked with scientists, members of the research and advocacy community, and members of our Global Health Initiative Advisory Board to define, for each of the diseases selected, the research activities that would fall into each stage of the research process. (The organizations that are represented on our Advisory Board are listed on page 60). We developed research definitions not only for each stage of research, but also for the different types of interventions, including drug/therapeutics development, diagnostics, vaccines, and other preventives (e.g., vector control for diseases that are transmitted by insects). These definitions form the basis for our classification of spending data.

Draft definitions were shared with NIH scientists for review and comment because NIH receives the bulk of the U.S. government's funding for infectious disease research. Since agencies were asked to classify disease spending by research category, this review allowed us to ensure that the research categories we developed were categories that NIH could work with in terms of data reporting (see "Data Collected from Agency Sources by Families USA" on page 36).

Appendix IV on page 47 contains brief descriptions of the research categories we developed for each disease. The disease-specific definitions can be viewed in their entirety on our Web site at www.familiesusa.org/resources/publications/reports/world-cant-wait.html.

Our Data Request

We worked with APCO Worldwide, a global public relations and communications firm, to develop an online survey for collecting data from each of the agencies. APCO was selected because of their experience with similar research projects, having developed a comparable online survey for the Malaria R&D Alliance's November 2005 report, *Malaria Research and Development: An Assessment of Global Investment*.[2]

The online survey was sent to contacts at the Centers for Disease Control and Prevention (CDC), the Department of Defense (DOD), the National Institutes of Health (NIH), and the U.S. Agency for International Development (USAID). We asked these agencies to report the following:

- **Spending by Disease and Research Category:** We asked for fiscal year (FY) 2007 actual spending (outlays) by disease and by research category. We provided the agencies with the disease definitions we had developed. The online survey instrument included sections for online data entry by disease category and spreadsheets that the agencies could use to enter their funding data, if preferable. We asked the agencies to apportion spending across research categories if a project covered multiple research categories.
- **Direct Government Funding:** Our objective was to measure federal research funding. Therefore, we asked the agencies to report only dollars that they had received directly through the federal appropriations process. To avoid double-counting of funds, the agencies were instructed to exclude interagency transfers.
- **Funding Used for Multi-Disease Studies:** We asked the agencies to report any funding that involved more than one disease separately, to prevent double-counting of funds, and, if possible, to apportion study spending across each of the diseases addressed by the multi-disease study.
- **Award-Level Data:** We asked the agencies to provide data at the grant/project/contract level (i.e., awards of federal funding).

Data Used in the Analysis

- **Data Provided by the Agencies**
  - CDC, DOD, and USAID all provided FY 2007 outlay data (funds that were actually spent in FY 2007) on the diseases they study.
  - CDC and USAID provided aggregate data, classified by research category based on Families USA's definitions, adjusted for double-counting.
  - DOD provided grant-level data, classified by research category based on Families USA's definitions, adjusted for double-counting.
- **Data Collected from Agency Sources by Families USA**

  NIH did not provide data, except for a small number of intramural (in-house) projects. However, their Office of Budget suggested a process for using official NIH data sources to compile the agency's spending data. These sources include information on research awards for specific diseases and award amounts. NIH staff were available to answer questions about this process as they arose.

Using the data sources that NIH recommended, we were able to identify relevant awards and determine their related spending. For each award identified, we reviewed the scientific abstract to determine which research activity categories the project fit within and to identify research that involved multiple diseases. The dollars for each award were apportioned according to the relevant research categories and diseases studied. Below, we outline the process for identifying relevant projects and determining spending by disease and by research category.

- **Searching the NIH CRISP Database**: For each disease, we searched NIH's public database, Computer Retrieval of Information on Scientific Projects (CRISP), for FY 2007 awards. We included all NIH institutes, centers, and offices in the search. The CRISP database provided information on extramural and intramural projects, grants, contracts, and cooperative agreements (awards) funded by NIH for the diseases of interest. (Extramural funding supports research that is performed by anyone other than intramural NIH scientists.)
- **Identifying Search Terms**: CRISP conducts searches based on keywords. The keywords used for all of the disease-specific searches are listed above. We discussed keyword selection with NIH staff, who offered some guidance but did not recommend a list of keywords as search terms (see "Limitations of the Data" on page 39).

Disease	CRISP Search Terms Used
African sleeping sickness	African trypanosomiasis, sleeping sickness, African sleeping sickness
Burili ulcer	Buruli ulcer
Chagas disease	Chagas, American trypanosomiasis
Cholera	Cholera, Vibrio cholerae
Dengue	Dengue
Leishmaniasis	Leishmaniasis, Kala-azar
Malaria	Malaria
Tuberculosis (TB)	Tuberculosis

In addition to our own internal checks and reviews, we used NIH reported spending as a guide to help us determine whether the search terms we used were overly inclusive or not inclusive enough. NIH reports its spending on malaria and TB (unadjusted for double-counting), but it does not report spending for the other diseases evaluated in this study.[3] Since basic research can sometimes be quite broad in nature, we also needed to determine cut-off points for inclusion of NIH basic research projects in our study.[4]

- **Finding Funding Amounts for Each Grant**: The CRISP searches on the keywords listed above yielded 1,200 awards. CRISP reports the award identification number assigned by NIH, the principal investigator, and the award title. CRISP also provides abstracts for each award, but it does not report award funding. To obtain FY 2007 funding for each award, we used a spreadsheet prepared by NIH that lists all extramural awards provided by NIH in that fiscal year. This spreadsheet is available on the NIH Web site at http://report.nih.gov/award/trends/AggregateData.cfm?Year=2007.

Since the NIH extramural awards spreadsheet cannot be sorted by disease, we located each award generated through our CRISP searches and then matched the dollar amounts presented in the spreadsheet with the results of our abstract reviews.

- **Evaluating Awards for Relevance:** Families USA reviewed each of the 1,200 CRISP summary reports to determine whether the research was relevant to our study. We identified 238 projects that were not relevant and, therefore, excluded them from our analysis. This left a total of 962 projects to classify by research activity.
- **Classifying Spending by Research Category**: We reviewed all of the 962 relevant award abstracts to classify them by research category. For projects that involved multiple research activities, we prorated funds according to the goals and tasks identified by the principal investigator in his or her abstract. As explained below under "Limitations of the Data," we could not categorize some of these 962 awards because the CRISP summary report was missing an abstract, because NIH did not report a dollar amount, or both.
- **Adjusting for Multi-Disease Research Awards:** Some awards offer the potential to generate information that will enhance our knowledge about, and improve the diagnosis, treatment, and prevention of, multiple diseases. Such awards might show up under multiple CRISP searches (e.g., a search on "American trypanosomiasis" might yield many of the same awards as those listed under a search on "African trypanosomiasis").

  To achieve our objective of measuring research funding across diseases, we controlled for double-counting so that each dollar of funding was reported only once. We did this by reviewing all of the scientific abstracts for African sleeping sickness, Buruli ulcer, Chagas disease, cholera, dengue, leishmaniasis, malaria, and tuberculosis (TB), as well as the awards for each of these diseases that we had obtained from our CRISP data searches. Whenever any of these awards involved multiple diseases, we apportioned that award's dollars evenly by disease and by research category according to the objectives and tasks identified in each scientific abstract.[5] This ensured consistency in our analysis and avoided the impracticality of contacting each award's investigator.

- **Adjusting for Awards Outside the Scope of This Study:** In addition, we identified those projects that also covered diseases that were outside the scope of our study, e.g., a project that involved basic research for both TB and cancer. For such projects, we apportioned funding by disease and by research activity based on a review of the abstract and included only the funding portion allocated to the disease we included in our study (in this example, TB).

Limitations of the Data

- **CDC, DOD, and USAID Data**

  Communications with staff at CDC, DOD, and USAID indicated that these three agencies sometimes relied on NIH funds to conduct research. We asked each agency to report only the research funded directly by their agency, as opposed to interagency transfers of funds, to avoid double-counting across agencies. As a result, the funding numbers presented in this report do not completely reflect the extent of the research activities that are conducted by these three agencies. Our study did not seek to quantify interagency transfers of funds.

- **NIH Data**

  We collected and analyzed NIH data with guidance from NIH in developing the data collection process. We collected the data from official NIH sources. However, NIH did not certify the results. Their official disease-specific spending numbers come from special, coordinated reviews of all awards within their portfolios that are conducted by each institute, center, and office, rather than from CRISP searches, and they are not controlled for double-counting.

  Decisions regarding search terms, classification of grants by research category, and allocation of spending for awards that covered multiple diseases were based on our analysis and that of our consultant. The data were subject to the additional limitations outlined below. Note that, in spite of these limitations, we are confident that our findings are sufficiently accurate to support the conclusions outlined in this report.

  - **Search Terms**: As noted earlier, we determined the search terms for each disease. We consulted with NIH regarding our suggested terms, but they did not provide specific terms. We used official NIH spending numbers as a guide for assessing whether our search terms were too broad or too narrow.
  - **Division of Multi-Disease Awards**: The process we used to control for double-counting was the most consistent method of allocating funds, absent in-depth interviews with each investigator. Our Findings report adjusted and unadjusted NIH funding for double-counting in order to provide insight into the difference between funds that are allocated to specific diseases and the large volume of funds that address multi-disease research.
  - **Classification by Research Activity Category**: We classified funding by research category based on our review of the abstracts obtained through CRISP searches. In a large percentage of cases, there would be little disagreement among scientists regarding our classification of specific projects. However, there were projects that were difficult to classify, and our judgment was required. In these instances, some scientists may disagree with our classifications.

- **Awards for Which Spending Data Were Unavailable:** For NIH extramural data, there were 28 awards that lacked funding information, and an additional 28 awards that lacked both funding information and abstracts (or sufficiently descriptive titles to permit classification by research activity). NIH was unable to provide information on these awards. For the awards that were missing abstracts but for which funding information was available, whenever possible, we used the award title to determine the research category. For intramural projects, NIH provided funding data for all but three projects. Funding data on intramural projects were not available through NIH public data sources.

Many of the limitations that we have outlined above are the result of fragmented reporting at NIH. NIH is in the process of transferring its data to a new automated system, which is scheduled to take effect within the next few months. This system may address many of the gaps in the current NIH public databases. The new system may also increase transparency and provide easier access to information regarding NIH spending and priorities.

We were pleased to learn about the new reporting system in our discussions with NIH staff during completion of this project. It should be noted, however, that we do not know the search terms and research definitions that NIH will use to code data in its new system. As a result, if the new system incorporates 2007 data, results from searches using that system may vary somewhat from the findings in this report.

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[1] See the U.S. Department of Health and Human Services, National Institutes of Health, Office of Technology Transfer, available online at http://ott.od.nih.gov/licensing_royalties/NegDis_ovrvw.asp, accessed on August 14, 2008. The NIH Office of Technology Transfer compiled a list of the diseases that WHO classifies as neglected and also provides links to WHO's background information on each of these diseases.

[2] Malaria R&D Alliance, *Malaria Research and Development: An Assessment of Global Investment* (Seattle: Program for Appropriate Technology in Health, 2005), available online at http://www.malariaalliance.org/PDFs/RD_Report_complete.pdf.

[3] NIH does not report spending data on the other diseases included in this analysis. Official spending numbers reported by NIH were not obtained through CRISP searches. However, we used NIH official spending numbers for malaria and TB as a check to help us determine whether our CRISP search terms were too broad or too narrow.

[4] We came up with the following cut-off points for NIH basic research projects, which were reviewed and/or approved by a scientist on our Advisory Board who works for the Drugs for Neglected Diseases Initiative:

- For dengue, we included basic research grants that addressed flaviviruses (but not RNA viruses generally);
- For TB and Buruli ulcer, we included basic research grants that addressed Mycobacterium generally;
- For malaria, we included basic research grants that addressed Plasmodium generally (but not sporozoans generally);
- For African sleeping sickness, Chagas disease, and leishmaniasis, we included basic research grants that addressed the family Trypanosomatidae/Trypanosoma generally, and also basic research grants that addressed kinetoplastids generally (but not flagellates); and
- For cholera, we included basic research grants that addressed Vibrio generally.

[5] This means that there could be, for example, a grant that involved only TB and malaria research. If the grant had five goals/tasks to accomplish, and four of those goals/tasks related to TB and only one goal/task related to malaria, we would not split the dollars as one-half TB and one-half malaria. The same would be true for splitting up a grant by research categories. For example, if a grant involved four goals/tasks related to vaccine development and only one related to epidemiology, we would prorate the dollars as four-fifths vaccine development and one-fifth epidemiology (not one-half vaccine development and one-half epidemiology).

APPENDIX II:
Agency Descriptions

Almost all federal funding for global health research is provided by the U.S. Department of Health and Human Services (HHS), the U.S. Department of State, and the U.S. Department of Defense (DOD). We obtained our funding data from the following sources within those agencies:

- The two HHS agencies that are most focused on global health research are the **National Institutes of Health (NIH)** and the **Centers for Disease Control and Prevention (CDC)**.
- Within the Department of State, the **United States Agency for International Development (USAID)** is the main agency that is involved in global health research.
- The **Department of Defense (DOD)** data came from the Military Infectious Diseases Research Program (MIDRP), which is a combined service (multi-force) program that is executed through the U.S. Army Medical Research and Materiel Command, with oversight provided by the Armed Services Biomedical Research Evaluation and Management Committee.

  Infectious disease research is also funded by DOD within the Deployed Warfighter Protection Program (which is managed by the U.S. Armed Forces Pest Management Board) and the U.S. Uniformed Health Services (USUHS), which includes an Infectious Diseases Clinical Research Program. However, because these other programs did not fund any research for fiscal year (FY) 2007 for the diseases we evaluated, we did not include them in our study.

Below we provide brief descriptions of these agencies' activities relating to global health.

- **NIH** is the largest U.S. government agency that conducts biomedical research. Within NIH, the National Institute of Allergy and Infectious Diseases (NIAID) takes the lead in researching the infectious diseases that are relevant to global health. The Fogarty International Center takes the lead in building domestic and international capacity to conduct global health research.
- **CDC**'s international network of public health experts provides the infrastructure that is crucial for the rapid detection of, and response to, disease outbreaks here and around the world. CDC's public health and scientific experts also conduct global health research and facilitate the efforts of other U.S. agencies and the governments of other nations.

- **USAID** is the principal U.S. agency whose mission is to extend assistance to countries that are recovering from disaster, trying to escape poverty, and engaging in democratic reforms. USAID works to confront global health challenges and improve global health by improving the quality, availability, and use of essential health services. USAID research focuses on assessing local health conditions, developing and adapting appropriate health products and interventions and supporting their field testing and introduction, as well as strengthening local health systems.
- **DOD** conducts medical research to develop drugs, vaccines, diagnostics, and vector control products that will protect U.S. personnel, including civilians stationed overseas, against naturally occurring infectious diseases.

Notes

Further information on these agencies can be found online.

- **NIH**: http://www.nih.gov.
- **CDC**: http://www.cdc.gov.
- **USAID**: http://www.usaid.gov.
- **DOD-MIDRP**: https://www.midrp.org.

APPENDIX III.
Background on the Diseases Covered in This Report

All of the eight diseases included in this report affect large numbers of people globally, take a devastating social or economic toll in the areas where they are endemic, and are most prevalent in developing countries. For each disease, current medical interventions are inadequate.

The information below provides an overview of each disease. Incidence refers to the number of new cases per year; prevalence refers to the total number of cases measured in a year, including both newly acquired and existing infections. We provide the incidence rates for shorter-term infections, such as malaria, because one person might have multiple re-infections and courses of a disease in a single year. We provide prevalence rates for chronic infectious diseases, such as Chagas disease, because they do not involve repeated infections in a given year and can require lengthy courses of treatment that often last many years. We also provide general information on each of the diseases and a brief description of existing medical interventions.

African sleeping sickness (African trypanosomiasis)

Incidence or Prevalence: 50,000-70,000 cases

Background Information: Spread by the tsetse fly, African sleeping sickness occurs in sub-Saharan Africa. There are two forms. Ninety percent of cases involve a chronic infection that can be present for years before symptoms appear. By then, the person has advanced central nervous symptom involvement (e.g., confusion, sleep disturbances). The less common form involves an acute infection. Without treatment, it is fatal.

Current Medical Interventions: Existing treatments are highly toxic. There is no vaccine.

Buruli ulcer

Incidence or Prevalence: No accurate estimates. It is the third most common mycobacterium infection after TB and leprosy.

Background Information: Buruli ulcer is caused by a bacterium. It leads to disfiguring lesions and disability. Buruli ulcer has been reported in 30 countries in Africa, the Americas, Asia, and the Western Pacific. It occurs in poor, rural areas where surveillance and reporting are often inadequate. There is evidence that its incidence and geographic range are increasing. Because the disease is not well understood, there is a lack of the basic data needed to help plan effective control activities.

Current Medical Interventions: Aggressive surgery, amputation. There is no vaccine.

Chagas disease (American sleeping sickness or American trypanosomiasis)

Incidence or Prevalence: 9 million currently infected

Background Information: Chagas disease occurs in the Americas and is transmitted by triatomine ("assassin") bugs, through blood transfusions, or from a mother to her fetus. The initial phase is short and may cause illness or death in infants. After the initial phase, the parasite invades many organs of the body, causing heart, intestinal, and esophageal damage. In 32 percent of those infected, there is fatal damage to the heart and digestive tract.

Some cases have been reported in the United States. The United States blood supply is now screened.

Current Medical Interventions: Medications for treatment of infections that are not detected early have as low as a 60 percent cure rate and are not medically suitable for many of those infected. When these medications do not work, surgery, including heart transplant, may be required. There is no vaccine.

Cholera

Incidence or Prevalence: 236,000 new cases in 2006

Background Information: Cholera is an acute intestinal infection caused by ingesting food or water that is contaminated with the *Vibrio cholerae* bacterium. It occurs worldwide. Almost every developing country experiences cholera outbreaks.

Cases of cholera were suspected in New Orleans in the immediate aftermath of Hurricane Katrina.

Current Medical Interventions: Hydration therapy is available, but there are no drugs to shorten the course of the illness. There is a vaccine, but it has many side effects and limited efficacy.

Dengue

Incidence or Prevalence: 50 million new cases each year

Background Information: Dengue (sometimes called "break bone fever") is a mosquito-borne infection. The first time someone contracts dengue, he or she typically experiences a high fever, headaches, and severe pain in the muscles, joints, and bones. A second infection can cause a very serious, highly lethal complication called dengue hemorrhagic fever. Dengue occurs in tropical and sub-tropical climates worldwide, mostly in urban areas. About two-fifths of the world's population is now at risk for the disease, and the number of global incidences has grown in recent decades.

Cases have been reported in Hawaii and in the southern continental United States. The mosquito that carries dengue has been found in the southern United States.

Current Medical Interventions: No treatments are available at this time. There is no vaccine.

Leishmaniasis

Incidence or Prevalence: 12 million currently infected

Background Information: Leishmaniasis is caused by the bite of an infected sandfly. There are two forms of the disase: 1) cutaneous and 2) visceral. The first form causes severe, disfiguring skin lesions. The second form damages internal organs, particularly the liver, spleen, and bone marrow, and can be fatal. Leishmaniasis is endemic in 88 countries. More than 90 percent of visceral leishmaniasis cases occur in five countries: Bangladesh, Brazil, India, Nepal, and Sudan.

A few rare cases of cutaneous leishmaniasis have been reported in Oklahoma and Texas.

Current Medical Interventions: Antibiotics can treat cutaneous leishmaniasis, but surgery is often also needed. Treatments for visceral leishmaniasis are highly toxic. There is no vaccine.

Malaria

Incidence or Prevalence: 247 million new cases each year

Background Information: Malaria is transmitted by a mosquito bite. Symptoms include high fever, severe chills, and vomiting. Without treatment, it can be fatal, especially in children. Forty percent of the world's population, mostly those living in the poorest countries, is at risk of contracting malaria.

Malaria, once a major U.S. public health threat, is no longer endemic in the United States. However, cases have been reported near international airports in a phenomenon known as "airport malaria," which is presumably caused by mosquitoes that are brought by planes from regions where malaria is endemic.

Current Medical Interventions: Treatment exists, but it has increasingly become ineffective due to drug resistance. There is no vaccine.

Tuberculosis (TB)

Incidence or Prevalence: 14,052,000 new cases of active TB in 2005

Background Information: TB is a contagious disease that is spread from person to person through the air when infected people cough, sneeze, or breathe. About one-third of the world's population is infected with the bacterium that causes TB, but most will not develop active TB disease. People with weakened immune systems are more likely to develop active TB. If left untreated, half of those with active TB will die. Each person with active TB disease will infect, on average, between 10 and 15 people every year.

There were more than 13,000 active cases of TB in the United States in 2007.

Current Medical Interventions: Diagnostic tests take a long time to complete and have poor accuracy. Treatments exist but take months or sometimes years. Treatment resistance is a growing problem. Treatments may not work at all for multi- and extenstively drug resistant strains (MDR-TB and XDR-TB). The existing vaccine is ineffective.

Notes

The information in this appendix came from the following sources:

African sleeping sickness: World Health Organization, *African Trypanosomiasis Fact Sheet* (Geneva: WHO, August 2006), available online at http://www.who.int/mediacentre/factsheets/fs259/en/.

Buruli ulcer: World Health Organization, *Buruli Ulcer Disease Fact Sheet* (Geneva: WHO, March 2007), available online at http://www.who.int/mediacentre/factsheets/fs199/en/index.html.

Chagas disease: World Health Organization, The Special Programme for Research and Training in Tropical Diseases, *Chagas Disease: Disease Information* (Geneva: WHO, 2004), available online at http://www.who.int/tdr/diseases/chagas/diseaseinfo.htm; Centers for Disease Control and Prevention, "Blood Donor Screening for Chagas Disease, United States 2006-2007," *Morbidity and Mortality Weekly* (Atlanta: CDC, February 23, 2007), available online at http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5607a2.htm; and Centers for Disease Control and Prevention, *Chagas Disease: Detailed Fact Sheet,* available online at http://www.cdc.gov/chagas/factsheets/detailed.html, accessed on November 20, 2008.

Cholera: World Health Organization, *Health Topics: Cholera* (Geneva: WHO, 2008), available online at http://www.who.int/topics/cholera/about/en/index.html; Sydney Spiesel, "Sick City: The Diseases That Katrina Unleashed," *Slate* (September 2005), available online at http://www.slate.com/id/2125757/.

Dengue: World Health Organization, *Dengue and Dengue Haemorrhagic Fever Fact Sheet* (Geneva: WHO, May 2008), available online at http://www.who.int/mediacentre/factsheets/fs117/en/; CDC Division of Vector Borne Infectious Diseases, *Dengue Fever*, available online at http://www.cdc.gov/ncidod/dvbid/dengue/, accessed on November 20, 2008.

Leishmaniasis: World Health Organization, *Leishmaniasis: Background Information* (Geneva: WHO, 2008), available online at http://www.who.int/leishmaniasis/en/; CDC Division of Parasitic Diseases, *Leishmaniasis Infection*, available online at http://www.cdc.gov/ncidod/dpd/parasites/leishmania/factsht_leishmania.htm#get_us, accessed on November 20, 2008.

Malaria: World Health Organization, *World Malaria Report 2008* (Geneva: WHO, September 2008), available online at http://www.who.int/malaria/wmr2008/malaria2008.pdf; World Health Organization, *Malaria Fact Sheet* (Geneva: WHO, May 2007), available online at http://www.who.int/mediacentre/factsheets/fs094/en/; American Society for Tropical Medicine and Hygiene, "Airport Malaria: A Cause for Concern in the U.S.," *Biology News Net*, November 11, 2008, available online at http://www.biologynews.net/archives/2008/11/11/airport_malaria_cause_for_concern_in_the_us.html.

Tuberculosis (TB): World Health Organization, *Tuberculosis Fact Sheet* (Geneva: WHO, March 2007), available online at http://www.who.int/mediacentre/factsheets/fs104/en/; CDC Division of Tuberculosis Elimination, *Fact Sheet: Trends in Tuberculosis, United States 2007* (Atlanta: CDC, October 2008), available online at http://www.cdc.gov/tb/pubs/tbfactsheets/TBTrends.htm.

Additional information on Chagas disease and dengue is from Peter J. Hotez, *Forgotten People, Forgotten Diseases: The Neglected Tropical Diseases and Their Impact on Global Health and Development* (Washington: American Society for Microbiology Press, 2008).

APPENDIX IV:
Research Categories

In this report, in addition to classifying research funding by disease, we also classified research funding according to different categories of research activity. This appendix defines the research categories used in the report and explains how each category fits into the research and product development process.

Research that is designed to discover and develop improved medical interventions to treat, prevent, and diagnose diseases includes a broad range of activities. The process starts with basic research, which is followed by product discovery, preclinical research, clinical trials, and post-market studies. All of these steps are essential to the process of translating a scientific discovery into an effective, safe, usable product. In addition, several other activities, such as epidemiology research, implementation research, and capacity building, are vital to the success of research that is designed to develop new medical interventions

From the Lab to the Masses

Basic research refers to early stage investigation that is designed to expand the general knowledge base regarding a disease and its effect on humans. It lays the foundation for the discovery and development of new treatments by cultivating our understanding of living organisms, as well as disease-causing agents and their effects on the body. It produces fundamental knowledge that may be applied to the development of new drug or vaccine candidates. And although it may not be immediately clear how research performed at this stage has an impact on a particular disease, the knowledge that is accumulated through this research generates new ideas about methods of controlling, preventing, and treating disease.

Product discovery follows basic research. The findings from basic research regarding biological mechanisms, pathogen (disease-causing agent) biology, and disease progression lead to ideas about potential ways to diagnose or treat the disease, or, in the case of vaccines, how to prevent infection. Researchers apply these ideas to the process of screening numerous substances and/or molecules that might produce a desired immunological or therapeutic effect in humans, or that might accurately diagnose a disease. This process can last several years. Only a handful of the most promising product candidates proceed to the next stage of research, preclinical product development.

Product development starts with preclinical research, in which a few candidate products that are thought to have a specific therapeutic, preventive, or diagnostic effect go through rigorous safety and efficacy testing before they can be tested on human subjects. Research at this stage is initially conducted in the laboratory and then expanded to animal testing. The end goal of

this stage is to ensure that the candidate product is safe for testing in humans, and that the anticipated medical benefit outweighs the potential risks. The evidence from preclinical studies must be thoroughly documented. It is submitted to a national regulatory authority, such as the U.S. Food and Drug Administration (FDA), to obtain permission to proceed with clinical testing in human subjects.

Clinical trials are conducted on human subjects. Because the products (drugs and vaccines) are tested on humans, researchers must comply with strict regulatory standards in all phases of clinical testing. Clinical trials that evaluate drugs are designed to verify that a candidate drug is safe and effective. In the case of vaccines, researchers must verify the candidate vaccine's safety and ability to induce the desired immune response. Typically, clinical trials for drugs and vaccines proceed in three phases, and each successive phase involves more human subjects. (Diagnostics also undergo clinical testing, but generally not in the same sort of phased process as is the case for drugs and vaccines.)

Clinical trials are the most expensive and the longest stage of the research process. For drugs and vaccines, completion of all phases of clinical testing can take many years.

- In **Phase I** of clinical trials, the candidate drug or vaccine is administered to a small number of healthy human subjects, primarily to test for safety and to further understand how the drug or vaccine affects the human body.
- In **Phase II**, a candidate drug is administered to a larger number of people (about 30 to 100) who suffer from the disease for which the drug is being tested. Researchers evaluate the safety and efficacy of the drug for a particular condition and seek to gain insight into the common side effects and risks in patients. Phase II vaccine trials involve administration of a candidate vaccine to people who are not infected by the disease being studied in order to determine whether the vaccine appears to work in humans and to identify side effects and risks.
- **Phase III** involves expanded, more rigorous testing to satisfactorily demonstrate the effectiveness of the drug or vaccine as a medical intervention, to determine the most appropriate dosage or concentration, and to determine the range of potential side effects. This phase of clinical research is also designed to show whether the medical benefits of the drug or vaccine outweigh the risks. Thousands of human subjects are evaluated in this extremely expensive stage of development.
- If the results from all stages of a clinical trial demonstrate that a drug or vaccine is safe and effective, and that the medical benefits of the drug or vaccine outweigh any potential risks, the makers of the product candidate can submit an application to the FDA for a license to commercially manufacture and market their product.

- After a drug or vaccine has been marketed and sold commercially, post-marketing studies, also referred to as **Phase IV** studies, may be conducted to continue to evaluate any side effects that occur in the larger population and to develop different formulations for different types of patients.

Complementary Activities

There are several other research activities that complement the medical product development process.

Epidemiology research provides information about disease trends and the disease burden in different populations. It is essential for determining when, where, and why new interventions are needed.

Implementation research, sometimes called operational research, refers to research that is conducted to evaluate the implementation of public health interventions and medical advances in the field. It also includes research that is conducted to develop an understanding of the economic, cultural, and sociological barriers to the use of public health interventions and existing medical technologies. Implementation research is needed to determine whether existing interventions are being used by the intended populations, and if not, why not.

Education and training: Of course, research cannot happen unless there is a cadre of competent scientists ready to conduct that research. Therefore, education and training are essential to product development as well.

Capacity building: Finally, it is essential to build the human capabilities and institutional capacity to conduct research, otherwise known as capacity building, especially in the countries that are most affected by the diseases covered in this report. Capacity building ensures that research can take place and that the results of that research can be translated into clinical practice. It is essential to ensuring that research happens.

APPENDIX V:
Tables: Research Funding for Individual Diseases

The summary tables that follow show detailed spending by agency and research area for each of the eight diseases that we evaluated.

Data for CDC, DOD, and USAID were provided by the agencies. NIH provided data for its intramural research (research that is conducted in-house by NIH scientists). We compiled NIH extramural data (research funded by NIH that is performed by non-NIH scientists) using NIH sources and a process recommended by the agency.

The four agencies that we studied in this report represent the vast majority of U.S. government funding for neglected infectious disease research. Other agencies that conduct a very limited amount of research in this area include the Department of Veterans Affairs (VA) and the Food and Drug Administration (FDA). However, the related research that those agencies fund is extremely minimal compared to the amount of research that is funded by the four agencies on which we focused.

CDC, DOD, and USAID adjusted their funding data to account for double-counting of research that applied to multiple diseases. This ensured that funding for projects that addressed multiple diseases was counted only once. Families USA adjusted NIH data using the process outlined in the Methodology (Appendix I) to control for double-counting.

Each agency was asked to report only appropriations-funded research for the categories and diseases that we evaluated in this study. The agencies may conduct additional research that is funded by other agencies or outside sources. In addition, the agencies may conduct additional appropriations-funded scientific research and public health activities that were not evaluated by our study. For instance, CDC may detect and respond to outbreaks of dengue, Chagas disease, leishmaniasis, African sleeping sickness, cholera, and Buruli ulcer through its Emerging Infections appropriated funds. However, these outbreak response activities would not fit cleanly within the research categories of our study, which focus on the research and development of improved tools, as opposed to outbreak detection and response.

It is also important to note that the agencies' own internal research categorization systems may not match the research categories we used in this study. For example, DOD considers product discovery to be the same as basic research. In contrast, our study splits basic research and product discovery into two separate categories. DOD reported its data according to the categories that we requested for the purposes of our study, so different reports of DOD spending may not be comparable to ours.

Appendix Table 1: Fiscal Year 2007 Funding for Research on African Sleeping Sickness (dollars in thousands)

Research Category		CDC		DOD		NIH		USAID		TOTAL*
		Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	
Basic Research		$0	0%	$0	0%	$3,581	62.4%	$0	0%	$3,581
Product Discovery and Preclinical Product Development	**Vaccines TOTAL**	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Product Discovery									
	Preclinical Development									
	Drugs TOTAL	$0	0%	$0	0%	$2,085	36.3%	$0	0%	$2,085
	Product Discovery					$2,085	36.3%			$2,085
	Preclinical Development					$0	0.0%			$0
	Diagnostics TOTAL	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Product Discovery									
	Preclinical Development									
	Vectors TOTAL	$0	0%	$0	0%	$52	0.9%	$0	0%	$52
	Product Discovery					$52	0.9%			$52
	Preclinical Development					$0	0.0%			$0
	TOTAL: Vaccines, Drugs, Diagnostics, and Vectors	$0	0%	$0	0%	$2,137	37.2%	$0	0%	$2,137
Clinical Product Development	**Vaccines TOTAL**	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Phase I									
	Phase II									
	Phase III									
	Drugs TOTAL	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Phase I									
	Phase II									
	Phase III									
	Phase IV									
	Diagnostics Clinical Development	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Vector Field Research	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Clinical Research (Not Phased Trial)	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	TOTAL: Vaccines, Drugs, Diagnostics, Vectors, and Clinical Research	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
Implementation/ Operational Research		$0	0%	$0	0%	$0	0.0%	$0	0%	$0
Epidemiology Research		$0	0%	$0	0%	$0	0.0%	$0	0%	$0
Education, Training, and Capacity Building	Education					$24	0.4%			$24
	Capacity Building					$0	0.0%			$0
	TOTAL	$0	0%	$0	0%	$24	0.4%	$0	0%	$24
TOTAL*		$0	0%	$0	0%	$5,742	100%	$0	0%	$5,742

* Totals may not add due to rounding.

Appendix Table 2: Fiscal Year 2007 Funding for Research on Buruli Ulcer (dollars in thousands)

Research Category		CDC		DOD		NIH		USAID		TOTAL*
		Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	
Basic Research		$0	0%	$0	0%	$99	15.1%	$0	0%	$99
Product Discovery and Preclinical Product Development	**Vaccines TOTAL**	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Product Discovery									
	Preclinical Development									
	Drugs TOTAL	$0	0%	$0	0%	$178	27.1%	$0	0%	$178
	Product Discovery					$178	27.1%			$178
	Preclinical Development					$0	0.0%			$0
	Diagnostics TOTAL	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Product Discovery									
	Preclinical Development									
	TOTAL: Vaccines, Drugs, and Diagnostics	$0	0%	$0	0%	$178	27.1%	$0	0%	$178
Clinical Product Development	**Vaccines TOTAL**	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Phase I									
	Phase II									
	Phase III									
	Drugs TOTAL	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Phase I									
	Phase II									
	Phase III									
	Phase IV									
	Diagnostics Clinical Development	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Clinical Research (Not Phased Trial)	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	TOTAL: Vaccines, Drugs, Diagnostics, And Clinical Research	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
Implementation/ Operational Research		$0	0%	$0	0%	$0	0.0%	$0	0%	$0
Epidemiology Research		$0	0%	$0	0%	$379	57.8%	$0	0%	$379
Education, Training, and Capacity Building	Education									
	Capacity Building									
	TOTAL	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
TOTAL*		$0	0%	$0	0%	$656	100%	$0	0%	$656

* Totals may not add due to rounding.

Appendix Table 3: Fiscal Year 2007 Funding for Research on Chagas Disease (dollars in thousands)

Research Category		CDC		DOD		NIH		USAID		TOTAL*
		Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	
Basic Research		$0	0%	$0	0%	$5,563	50.0%	$0	0%	$5,563
Product Discovery and Preclinical Product Development	**Vaccines TOTAL**	$0	0%	$0	0%	$1,301	11.7%	$0	0%	$1,301
	Product Discovery					$1,301	11.7%			$1,301
	Preclinical Development					$0	0.0%			$0
	Drugs TOTAL	$0	0%	$0	0%	$2,020	18.1%	$0	0%	$2,020
	Product Discovery					$1,458	13.1%			$1,458
	Preclinical Development					$562	5.0%			$562
	Diagnostics TOTAL	$0	0%	$0	0%	$215	1.9%	$0	0%	$215
	Product Discovery					$215	1.9%			$215
	Preclinical Development					$0	0.0%			$0
	Vectors TOTAL	$0	0%	$0	0%	$924	8.3%	$0	0%	$924
	Product Discovery	$0	0%	$0	0%	$372	3.3%			$372
	Preclinical Development	$0	0%	$0	0%	$552	5.0%			$552
	TOTAL: Vaccines, Drugs, Diagnostics, and Vectors	$0	0%	$0	0%	$4,460	40.1%	$0	0%	$4,460
Clinical Product Development	**Vaccines TOTAL**	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Phase I									
	Phase II									
	Phase III									
	Drugs TOTAL	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Phase I									
	Phase II									
	Phase III									
	Phase IV									
	Diagnostics Clinical Development	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Vector Field Research	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Clinical Research (Not Phased Trial)	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	TOTAL: Vaccines, Drugs, Diagnostics, Vectors, and Clinical Research	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
Implementation/ Operational Research		$0	0%	$0	0%	$0	0.0%	$0	0%	$0
Epidemiology Research		$0	0%	$0	0%	$331	3.0%	$0	0%	$331
Education, Training, and Capacity Building	Education					$112	1.0%			$112
	Capacity Building					$15	0.1%			$15
	TOTAL	$0	0%	$0	0%	$127	1.1%	$0	0%	$127
Unclassified						$650	5.8%			$650
TOTAL*		$0	0%	$0	0%	$11,131	100%	$0	0%	$11,131

* Totals may not add due to rounding.

Appendix Table 4: Fiscal Year 2007 Funding for Research on Cholera (dollars in thousands)

Research Category		CDC		DOD		NIH		USAID		TOTAL*
		Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	
Basic Research		$0	0%	$0	0%	$11,492	73.3%	$0	0%	$11,492
Product Discovery and Preclinical Product Development	**Vaccines TOTAL**	$0	0%	$0	0%	$472	3.0%	$0	0%	$472
	Product Discovery					$210	1.3%			$210
	Preclinical Development					$262	1.7%			$262
	Drugs TOTAL	$0	0%	$0	0%	$224	1.4%	$0	0%	$224
	Product Discovery					$0	0.0%			$0
	Preclinical Development					$224	1.4%			$224
	Diagnostics TOTAL	$0	0%	$0	0%	$135	0.9%	$0	0%	$135
	Product Discovery					$0	0.0%			$0
	Preclinical Development					$135	0.9%			$135
	TOTAL: Vaccines, Drugs, and Diagnostics	$0	0%	$0	0%	$831	5.3%	$0	0%	$831
Clinical Product Development	**Vaccines TOTAL**	$0	0%	$0	0%	$162	1.0%	$0	0%	$162
	Phase I					$111	0.7%			$111
	Phase II					$51	0.3%			$51
	Phase III					$0	0.0%			$0
	Drugs TOTAL	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Phase I									
	Phase II									
	Phase III									
	Phase IV									
	Diagnostics Clinical Development	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	Clinical Research (Not Phased Trial)	$0	0%	$0	0%	$0	0.0%	$0	0%	$0
	TOTAL: Vaccines, Drugs, Diagnostics, And Clinical Research	$0	0%	$0	0%	$162	1.0%	$0	0%	$162
Implementation/ Operational Research		$0	0%	$0	0%	$0	0.0%	$0	0%	$0
Epidemiology Research		$0	0%	$0	0%	$348	2.2%	$0	0%	$348
Education, Training, and Capacity Building	Education					$67	0.4%			$67
	Capacity Building					$0	0.0%			$0
	TOTAL	$0	0%	$0	0%	$67	0.4%	$0	0%	$67
Unclassified						$2,778	17.7%			$2,778
TOTAL*		$0	0%	$0	0%	$15,678	100%	$0	0%	$15,678

* Totals may not add due to rounding.

Appendix Table 5: Fiscal Year 2007 Funding for Research on Dengue (dollars in thousands)

Research Category		CDC		DOD		NIH		USAID		TOTAL*
		Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	
Basic Research		$0	0.0%	$630	4.4%	$7,830	29.2%	$0	0%	$8,460
Product Discovery and Preclinical Product Development	**Vaccines TOTAL***	$0	0.0%	$10,193	70.9%	$6,913	25.8%	$0	0%	$17,106
	Product Discovery			$3,586	24.9%	$1,799	6.7%			$5,385
	Preclinical Development			$6,607	45.9%	$5,113	19.1%			$11,720
	Drugs TOTAL	$0	0.0%	$0	0.0%	$3,528	13.2%	$0	0%	$3,528
	Product Discovery					$3,403	12.7%			$3,403
	Preclinical Development					$125	0.5%			$125
	Diagnostics TOTAL	$0	0.0%	$461	3.2%	$1,544	5.8%	$0	0%	$2,005
	Product Discovery			$0	0.0%	$0	0.0%			$0
	Preclinical Development			$461	3.2%	$1,544	5.8%			$2,005
	Vectors TOTAL	$0	0.0%	$0	0.0%	$988	3.7%	$0	0%	$988
	Product Discovery			$0	0.0%	$988	3.7%			$988
	Preclinical Development			$0	0.0%	$0	0.0%			$0
	TOTAL: Vaccines, Drugs, Diagnostics, and Vectors	$0	0.0%	$10,654	74.1%	$12,973	48.4%	$0	0%	$23,627
Clinical Product Development	**Vaccines TOTAL**	$0	0.0%	$1,800	12.5%	$515	1.9%	$0	0%	$2,315
	Phase I			$0	0.0%	$515	1.9%			$515
	Phase II			$1,800	12.5%	$0	0.0%			$1,800
	Phase III			$0	0.0%	$0	0.0%			$0
	Drugs TOTAL	$0	0.0%	$0	0.0%	$0	0.0%	$0	0%	$0
	Phase I									
	Phase II									
	Phase III									
	Phase IV									
	Diagnostics Clinical Development	$0	0.0%	$0	0.0%	$0	0.0%	$0	0%	$0
	Vector Field Research	$0	0.0%	$0	0.0%	$0	0.0%	$0	0%	$0
	Clinical Research (Not Phased Trial)	$0	0.0%	$0	0.0%	$0	0.0%	$0	0%	$0
	TOTAL: Vaccines, Drugs, Diagnostics, Vectors, and Clinical Research	$0	0.0%	$1,800	12.5%	$515	1.9%	$0	0%	$2,315
Implementation/ Operational Research		$1,840	65.7%	$0	0.0%	$0	0.0%	$0	0%	$1,840
Epidemiology Research		$480	17.1%	$0	0.0%	$1,967	7.3%	$0	0%	$2,447
Education, Training, and Capacity Building	Education	$0	0.0%			$187	0.7%			$187
	Capacity Building	$480	17.1%	$1,300	9.0%	$1,360	5.1%			$3,140
	TOTAL	$480	17.0%	$1,300	9.0%	$1,547	5.8%	$0	0%	$3,327
Unclassified						$1,957	7.3%			$1,957
TOTAL*		$2,800	100%	$14,384	100%	$26,789	100%	$0	0%	$43,973

* Totals may not add due to rounding.

Appendix Table 6: Fiscal Year 2007 Funding for Research on Leishmaniasis (dollars in thousands)

Research Category		CDC		DOD		NIH		USAID		TOTAL*
		Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	
Basic Research		$0	0.0%	$234	3.7%	$6,065	36.2%	$0	0%	$6,299
Product Discovery and Preclinical Product Development	**Vaccines TOTAL**	$0	0.0%	$0	0.0%	$2,126	12.7%	$0	0%	$2,126
	Product Discovery					$1,804	10.8%			$1,804
	Preclinical Development					$322	1.9%			$322
	Drugs TOTAL	$0	0.0%	$482	7.7%	$1,742	10.4%	$0	0%	$2,224
	Product Discovery					$1,105	6.6%			$1,105
	Preclinical Development			$482	7.7%	$637	3.8%			$1,119
	Diagnostics TOTAL	$0	0.0%	$908	14.5%	$0	0.0%	$0	0%	$908
	Product Discovery			$0	0.0%					$0
	Preclinical Development			$908	14.5%					$908
	Vectors TOTAL	$0	0.0%	$896	14.3%	$75	0.4%	$0	0%	$971
	Product Discovery			$265	4.2%	$0	0.0%			$265
	Preclinical Development			$631	10.1%	$75	0.4%			$706
	TOTAL: Vaccines, Drugs, Diagnostics, and Vectors	$0	0.0%	$2,286	36.6%	$3,943	23.5%	$0	0%	$6,229
Clinical Product Development	**Vaccines TOTAL**	$0	0.0%	$0	0.0%	$0	0.0%	$0	0%	$0
	Phase I									
	Phase II									
	Phase III									
	Drugs TOTAL	$0	0.0%	$1,370	21.9%	$400	2.4%	$0	0%	$1,770
	Phase I			$0	0.0%	$0	0.0%			$0
	Phase II			$1,370	21.9%	$400	2.4%			$1,770
	Phase III			$0	0.0%	$0	0.0%			$0
	Phase IV			$0	0.0%	$0	0.0%			$0
	Diagnostics Clinical Development	$0	0.0%	$1,469	23.5%	$0	0.0%	$0	0%	$1,469
	Vector Field Research	$0	0.0%	$762	12.2%	$151	0.9%	$0	0%	$913
	Clinical Research (Not Phased Trial)	$0	0.0%	$0	0.0%	$449	2.7%	$0	0%	$449
	TOTAL: Vaccines, Drugs, Diagnostics, Vectors, and Clinical Research	$0	0.0%	$3,601	57.7%	$1,000	6.0%	$0	0%	$4,601
Implementation/ Operational Research		$1,840	65.7%	$0	0.0%	$0	0.0%	$0	0%	$1,840
Epidemiology Research		$480	17.1%	$0	0.0%	$467	2.8%	$0	0%	$947
Education, Training, and Capacity Building	Education	$0	0.0%			$375	2.2%			$375
	Capacity Building	$480	17.1%	$124	2.0%	$1,549	9.2%			$2,153
	TOTAL	$480	17.1%	$124	2.0%	$1,924	11.5%	$0	0%	$2,528
Unclassified						$3,351	20.0%			$3,351
TOTAL*		$2,800	100%	$6,245	100%	$16,750	100%	$0	0%	$25,795

* Totals may not add due to rounding.

Appendix Table 7: Fiscal Year 2007 Funding for Research on Malaria (dollars in thousands)

Research Category		CDC		DOD		NIH		USAID		TOTAL*
		Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	
Basic Research		$0	0.0%	$1,773	7.7%	$34,775	38.4%	$0	0.0%	$36,548
Product Discovery and Preclinical Product Development	**Vaccines TOTAL**	$0	0.0%	$10,099	43.7%	$20,494	22.6%	$4,503	45.0%	$35,096
	Product Discovery			$4,014	17.4%	$5,125	5.7%	$0	0.0%	$9,139
	Preclinical Development			$6,085	26.3%	$15,369	17.0%	$4,503	45.0%	$25,957
	Drugs TOTAL	$0	0.0%	$3,954	17.1%	$10,621	11.7%	$0	0.0%	$14,575
	Product Discovery			$2,939	12.7%	$9,466	10.4%			$12,405
	Preclinical Development			$1,015	4.4%	$1,155	1.3%			$2,170
	Diagnostics TOTAL	$0	0.0%	$380	1.6%	$122	0.1%	$0	0.0%	$502
	Product Discovery			$105	0.5%	$122	0.1%			$227
	Preclinical Development			$275	1.2%	$0	0.0%			$275
	Vectors TOTAL	$0	0.0%	$1,723	7.5%	$1,361	1.5%	$0	0.0%	$3,084
	Product Discovery			$0	0.0%	$1,361	1.5%			$1,361
	Preclinical Development			$1,723	7.5%	$0	0.0%			$1,723
	TOTAL: Vaccines, Drugs, Diagnostics, and Vectors	$0	0.0%	$16,156	69.9%	$32,598	36.0%	$4,503	45.0%	$53,257
Clinical Product Development	**Vaccines TOTAL**	$0	0.0%	$1,514	6.5%	$1,934	2.1%	$1,988	19.9%	$5,436
	Phase I			$1,494	6.5%	$1,570	1.7%	$1,988	19.9%	$5,052
	Phase II			$20	0.1%	$364	0.4%	$0	0.0%	$384
	Phase III			$0	0.0%	$0	0.0%	$0	0.0%	$0
	Drugs TOTAL	$0	0.0%	$2,635	11.4%	$364	0.4%	$1,700	17.0%	$4,699
	Phase I			$0	0.0%	$0	0.0%	$0	0.0%	$0
	Phase II			$2,635	11.4%	$364	0.4%	$750	7.5%	$3,749
	Phase III			$0	0.0%	$0	0.0%	$750	7.5%	$750
	Phase IV			$0	0.0%	$0	0.0%	$200	2.0%	$200
	Diagnostics Clinical Development	$0	0.0%	$0	0.0%	$80	0.1%	$0	0.0%	$80
	Vector Field Research	$0	0.0%	$860	3.7%	$639	0.7%	$0	0.0%	$1,499
	Clinical Research (Not Phased Trial)	$0	0.0%	$0	0.0%	$3,152	3.5%	$0	0.0%	$3,152
	TOTAL: Vaccines, Drugs, Diagnostics, Vectors, and Clinical Research	$0	0.0%	$5,009	21.7%	$6,169	6.8%	$3,688	36.9%	$14,866
Implementation/ Operational Research		$4,850	74.6%	$0	0.0%	$1,070	1.2%	$900	9.0%	$6,820
Epidemiology Research		$1,250	19.2%	$0	0.0%	$5,391	5.9%	$0	0.0%	$6,641
Education, Training, and Capacity Building	Education	$200	3.1%	$0	0.0%	$3,484	3.8%	$0	0.0%	$3,684
	Capacity Building	$200	3.1%	$185	0.8%	$1,175	1.3%	$909	9.1%	$2,469
	TOTAL	$400	6.2%	$185	0.8%	$4,659	5.1%	$909	9.1%	$6,153
Unclassified						$5,975	6.6%			$5,975
TOTAL*		$6,500	100%	$23,123	100%	$90,637	100%	$10,000	100%	$130,260

* Totals may not add due to rounding.

Appendix Table 8: Fiscal Year 2007 Funding for Research on Tuberculosis (TB) (dollars in thousands)

Research Category		CDC		DOD		NIH		USAID		TOTAL*
		Dollars	Percent	Dollars	Percent	Dollars	Percent	Dollars	Percent	
Basic Research		$4,345	43.7%	$0	0%	$52,884	45.1%	$0	0.0%	$57,229
Product Discovery and Preclinical Product Development	**Vaccines TOTAL**	$0	0.0%	$0	0%	$7,630	6.5%	$0	0.0%	$7,630
	Product Discovery					$3,133	2.7%			$3,133
	Preclinical Development					$4,497	3.8%			$4,497
	Drugs TOTAL	$0	0.0%	$0	0%	$19,165	16.3%	$0	0.0%	$19,165
	Product Discovery					$18,319	15.6%			$18,319
	Preclinical Development					$846	0.7%			$846
	Diagnostics TOTAL	$0	0.0%	$0	0%	$4,412	3.8%	$0	0.0%	$4,412
	Product Discovery					$2,937	2.5%			$2,937
	Preclinical Development					$1,475	1.3%			$1,475
	TOTAL: Vaccines, Drugs, and Diagnostics	$0	0.0%	$0	0%	$31,207	26.6%	$0	0.0%	$31,207
Clinical Product Development	**Vaccines TOTAL**	$0	0.0%	$0	0%	$1,298	1.1%	$0	0.0%	$1,298
	Phase I					$467	0.4%			$467
	Phase II					$174	0.1%			$174
	Phase III					$657	0.6%			$657
	Drugs TOTAL	$0	0.0%	$0	0%	$0	0.0%	$3,185	59.3%	$3,185
	Phase I							$0	0.0%	$0
	Phase II							$473	8.8%	$473
	Phase III							$2,712	50.5%	$2,712
	Phase IV							$0	0.0%	$0
	Diagnostics Clinical Development	$0	0.0%	$0	0%	$1,055	0.9%	$0	0.0%	$1,055
	Clinical Research (Not Phased Trial)	$694	7.0%			$0	0.0%	$1,515	28.2%	$2,209
	TOTAL: Vaccines, Drugs, Diagnostics, And Clinical Research	$694	7.0%	$0	0%	$2,353	2.0%	$4,700	87.5%	$7,747
Implementation/ Operational Research		$4,909	49.3%	$0	0%	$546	0.5%	$103	1.9%	$5,558
Epidemiology Research		$0	0.0%	$0	0%	$9,868	8.4%	$570	10.6%	$10,438
Education, Training, and Capacity Building	Education	$0	0.0%			$4,867	4.1%			$4,867
	Capacity Building	$1	0.0%			$2,987	2.5%			$2,988
	TOTAL	$1	0.0%	$0	0%	$7,854	6.7%	$0	0.0%	$7,855
Unclassified						$12,622	10.8%			$12,622
TOTAL*		$9,949	100%	$0	0%	$117,334	100%	$5,373	100%	$132,656

* Totals may not add due to rounding.

Organizations That Assisted with the Development of This Report

Families USA's Global Health Initiative Advisory Board

Below we list the organizations and their representative staff who serve on Families USA's Global Health Initiative Advisory Board. Advisory Board members, and, in many cases, others working with their organization, provided invaluable assistance with developing the research definitions and reviewing and commenting on the online survey used for data collection. While board members were generously available for consultation throughout the process, they did not participate in abstract review or certify our results.

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- Alliance for Microbicide Development (Polly Harrison, Executive Director)
- Drugs for Neglected Diseases Initiative (Jana Armstrong, Director, DNDI North America, and Els Torreele, Senior Project Manager)
- Family Health International (Kate MacQueen, Senior Scientist)
- Global Health Council (Maurice Middleberg, Vice President for Public Policy, and Nicole Bates, Director, Government Relations)
- Medicines for Malaria Venture (Anna Wang, Vice President, Public Affairs)
- RESULTS (John Fawcett, Legislative Director)

Other Organizations

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