

# Improving Health R&D Financing For Developing Countries: A Menu Of Innovative Policy Options

New financing mechanisms could speed up development of health technologies for neglected diseases.

by Robert Hecht, Paul Wilson, and Amrita Palriwala

**ABSTRACT:** New drugs, vaccines, and diagnostics for the diseases of the developing world could save millions of lives and prevent enormous suffering and economic loss. Despite substantial new funding from the Gates Foundation and other donors, financing for the development of these new health technologies remains inadequate. New approaches are needed to generate more resources, make funding more stable and flexible, and further engage the expertise of the pharmaceutical industry. Several new financing mechanisms have been launched recently, and others are being proposed. This paper summarizes some of the most promising new ideas and offers a framework for evaluating them. [*Health Affairs* 28, no. 4 (2007): 974–985; 10.1377/hlthaff.28.4.974]

**D**ESPITE PROGRESS IN RECENT YEARS, the world still urgently needs new and improved health technologies—drugs, vaccines, and diagnostic tests—to prevent and treat the diseases that take a heavy toll on people in the developing world. These new technologies could save millions of lives annually and promote faster economic and social progress.

■ **Need for vaccines.** New vaccines are required to lower the burden of infectious diseases, including AIDS, TB, malaria, and other tropical illnesses. The potential of these vaccines is enormous. For each million people in malaria-endemic countries of Africa, a partially effective malaria vaccine could avert 10,000 deaths and 16,000 severe cases of malaria over a twenty-year period.<sup>1</sup> A vaccine to prevent dengue fever, a mosquito-borne viral disease that causes tens of millions of cases of illness and thousands of deaths annually in all regions of the tropics, could reduce the

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burden of mortality and morbidity of the disease by 82 percent.<sup>2</sup> A million HIV infections could be avoided annually if we had a 50 percent effective first-generation AIDS vaccine.<sup>3</sup> An improved typhoid vaccine could help to reduce the estimated 216,000 deaths that occur annually, mostly in school-age children and young adults.<sup>4</sup>

■ **Need for Improved drugs.** Better drugs are also required to replace existing treatments, which are complex, costly, and sometimes ineffective. The drug regime currently used for TB, introduced more than fifty years ago, demands that patients take a complex combination of drugs daily for more than six months. The drugs recommended for Chagas disease and leishmaniasis, widespread illnesses caused by a class of protozoae, are expensive and have frequent toxic side effects. New tools for diagnosis are also needed to replace existing methods and help inform sound treatment decisions and curb the emergence of resistance.

■ **Need for new R&D investment.** New vaccines, drugs, and tests for these and other diseases could bring huge benefits to developing countries. But the people who most need these new technologies have few resources to pay for them, and the resulting small and uncertain markets have deterred investment by the private pharmaceutical industry in their development. The public-sector agencies in high-income countries that fund much of basic biomedical research have also focused primarily on diseases that are important in their own countries. The result is the often-cited "90/10 gap": only 10 percent of health research and development (R&D) spending is devoted to the health problems of 90 percent of the world's population.<sup>5</sup>

To redress this imbalance and accelerate the R&D process, from basic and applied research through clinical trials and initial manufacturing, the Bill and Melinda Gates Foundation, the U.S. National Institutes of Health (NIH), and others have made large investments in R&D over the past decade. As in other areas of development finance, there has also been much new thinking about the best ways to channel these resources, to encourage involvement of the private sector, and to make the global health innovation system more responsive to the needs of the poor. The World Health Organization's (WHO's) Intergovernmental Working Group on Public Health, Innovation, and Intellectual Property, which concluded its work in 2008, provided a vital forum for discussion of these issues and led to the establishment of an Expert Working Group on R&D Financing.<sup>6</sup>

In this paper we survey the range of financing and other incentive measures that could help accelerate the development of new technologies for the most pressing health problems of the developing world. We propose a framework for classifying and assessing these measures and illustrate its use by applying it in a preliminary way to two potential financing mechanisms. We suggest that the most promising proposals be analyzed in greater depth, using a robust and consistent assessment framework. This would help donor- and developing-country governments, philanthropic organizations, and pharmaceutical companies make sound decisions on these proposals.

## The Current System For Financing Health R&D

Traditionally, the bulk of financing for health R&D has come from two sources: (1) public funding through medical research councils such as the NIH in the United States, the Medical Research Council in Great Britain, and the Agence Nationale pour la Recherche Scientifique in France, awarded primarily to academic researchers through competitive grants programs. Promising health technologies that emerge from publicly funded research are then transferred to drug companies, which use (2) private financing to carry out additional research and to translate research results into commercially viable products. This private financing is derived from a combination of shareholder equity, debt issued by the company (bonds), and internally generated revenues from sales of other products.<sup>7</sup>

Although this system has produced many new drugs and vaccines, it has not worked well to deliver health technologies for the diseases of the developing world. Private investment in these technologies has been weak. Public and philanthropic funding has partially filled the gap, but new financing mechanisms and additional incentives for private-sector investment are needed for several reasons.

■ **Inadequate volume of R&D funding.** Most fundamentally, current funding, especially for applied research and product development, remains insufficient. Good ideas and projects are not being supported. A recent study suggests that R&D on new drugs for neglected diseases of the poorest countries requires an additional \$6–\$10 billion over the next ten years.<sup>8</sup> Only about 40 percent of the funding that is estimated to be required to develop safe and effective TB vaccines by 2015 has actually been committed.<sup>9</sup>

■ **Funding mismatched with R&D processes.** But inadequate volume of funding is not the only problem. The characteristics of conventional funding streams often leave them poorly matched to the kinds of R&D activities they fund. Drug and vaccine development is lengthy and uncertain, and R&D organizations therefore require stable long-term financing. Instead, grants from public sources tend to be short term (less than five years, often shorter) and unpredictable. This makes it difficult for grant recipients to plan and commit to long-term R&D investments.<sup>10</sup> Moreover, funding is often insufficiently flexible, preventing funds from flowing rapidly to the best R&D organizations and most promising projects. Grants often contain earmarks stipulating that they may be used only for certain purposes—for example, for a specific product design or clinical trial. These restrictions can tie the hands of researchers who, by the nature of the R&D process, often reach dead ends or come across entirely new leads to pursue. Such earmarking leads to inefficiencies in the R&D organization itself, by limiting its flexibility in portfolio management. Moreover, while the efficient structuring of R&D increasingly argues for collaboration among the best scientists, companies, and trial sites in the United States, Europe, and emerging economies such as Brazil, China, and India, funds from national medical research budgets must often be spent within national boundaries.

■ **Insufficient incentives for private investment.** Finally, existing financing mechanisms and other policies aimed at stimulating private-sector involvement do not provide sufficient incentive to overcome the scientific and commercial risks that companies face in considering whether to invest in R&D for a drug or vaccine aimed primarily at low-income countries. It is difficult for companies to forecast demand or project prices in these markets because of lack of information and uncertainty about subsidies from the donor organizations that support drug and vaccine purchase by the poorest countries. At the same time, the opportunity cost of capital to the firms is high, given the large returns they can obtain from alternative investments in the development of new products for affluent-country markets.

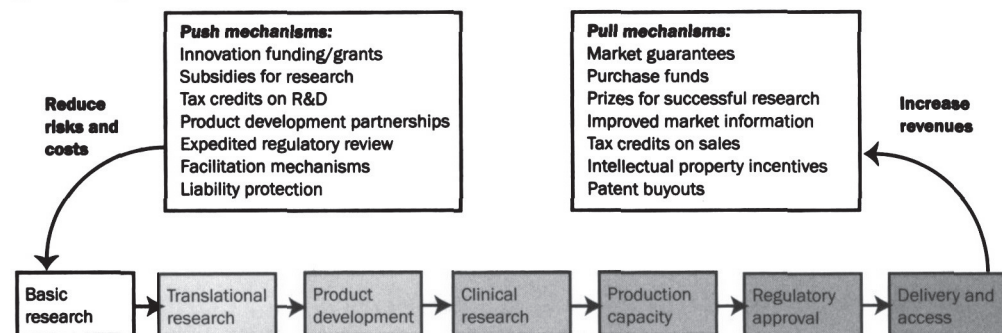
### Financing For Global Health R&D: General Considerations

Funders and advocates for global health R&D have considered solutions of two types: “push” mechanisms, which pay for R&D up front, and “pull” mechanisms,” which offer the prospect of a financial reward once the product has been developed and thus encourage private investment in R&D (Exhibit 1). Given the constraints described above, both push and pull mechanisms are needed.

■ **Push mechanisms.** Push measures act directly on the different stages of the R&D process. Grants from governments and foundations to the nonprofit product development partnerships (PDPs), which may in turn use the funds to subsidize product development by biotech or drug company partners, are an important example. Government R&D tax credits are another push mechanism that can help drug companies lower their costs. A drawback of push financing is that funders (governments, foundations) pay for inputs (research projects, clinical trials), not outputs (new drugs and vaccines), so they may ultimately spend on R&D activities that lead nowhere. Faced with the challenge of picking “winners,” donors rely on expert peer-review panels (which have been criticized for review bias) and specialized interme-

#### EXHIBIT 1

#### “Push” And “Pull” Mechanisms For Health Research And Development (R&D)



SOURCE: International AIDS Vaccine Initiative.

diaries such as PDPs to guide their investment decisions.<sup>11</sup>

■ **Pull mechanisms.** Pull mechanisms act indirectly by raising the potential rewards for investment in R&D and thus shifting the risk-reward equation for product developers. An example is the offer of a multimillion-dollar prize or market guarantee for a new drug for a neglected tropical disease, which increases the possible financial return to firms for developing, licensing, and marketing the drug in low-income markets. Since pull mechanisms pay for outputs rather than inputs, they avoid the difficulty of picking winners, but they introduce another problem: how to set the financial reward at the right level. At a minimum, the reward must be sufficient to cover the R&D costs incurred by product developers; at the most expansive, it would also provide a rate of return comparable to what the developer could earn from alternative uses of its investment capital. If the reward is too small, product developers will not be motivated to invest in the R&D; if it is too large, funders will have “overpaid,” losing taxpayer or foundation money that could have been used for other purposes. To address this problem, designers of pull funding mechanisms try to estimate likely R&D costs and model expected returns to private firms, to choose a reasonable and effective level of reward.

Another problem with pull mechanisms is specifying the characteristics of the end product—a major challenge for products in the early stages of R&D. If a funder specifies a target product profile too narrowly, innovation may be limited and potentially valuable options may be overlooked. A target product profile that is too general can lead to a product that does not serve the intended purpose—for example, a new drug or vaccine that cannot be used in resource-poor settings. To address this issue, both the sponsors of the pull mechanism and interested R&D organizations may have to accept the judgment of an independent expert or committee that can progressively interpret and redefine the target profile over time.

### **Recent Innovations In Health R&D Financing**

Over the past decade, important new forms of financing for health R&D for the developing world have begun to emerge. These include the following.

■ **Grants for PDPs (push).** PDPs have appeared over the past decade as an important vehicle for advancing R&D into new health technologies for a wide range of neglected diseases. They are funded largely by grants from public-sector and philanthropic sources. Most PDPs focus on taking new health products from design through pre-clinical and clinical testing, so that efficacy and the feasibility of large-scale manufacturing are demonstrated to both biopharmaceutical companies and those demanding the products, including developing-country governments, donors, and international purchasing agencies. Examples of PDPs include the Medicines for Malaria Venture (MMV), the Global Alliance for TB Drug Development, the International AIDS Vaccine Initiative (IAVI), the Aeras Global TB Vaccine Foundation, and the Institute for One World Health (iOWH). Typically, PDPs collaborate with drug and biotech companies, subsidizing R&D costs in return for commitments to

make the resulting drugs or vaccines affordable in developing countries. In recent years, some PDPs have moved into applied research, while others have turned their attention to licensure and early adoption. In 2004, PDPs were managing more than three-quarters of the sixty neglected-disease drug development projects identified in one study, and they have since added more projects to their portfolios.<sup>12</sup> In 2007, the eight largest PDPs together spent about \$380 million on R&D.<sup>13</sup>

■ **Government grants to small and medium-size companies (push).** Government grants to develop new vaccines and drugs are becoming an important part of financing from national medical research bodies to private firms. In 2006, for example, \$20.9 million in NIH funds for AIDS vaccines went to contracts with seven biotech and drug companies, and a sizable fraction of the \$67 million in government funds spent by the HIV Vaccines Trial Network was used to test products manufactured by Merck and others.<sup>14</sup> In emerging markets such as India and China, the government is also subsidizing R&D by biotech companies in an effort to make them competitive with North American and European firms.<sup>15</sup>

■ **Advance market commitments (AMCs—pull).** The AMC concept was developed during 2004–2006 as a way to accelerate R&D by creating a secure market for new drugs and vaccines, using legally binding commitments from developed countries to subsidize the prices of these new health products when they are ordered by low-income-country governments. AMCs are intended to motivate firms to develop and supply new products tailored to the needs of developing countries.<sup>16</sup> A pilot AMC for vaccines against pneumococcal disease is about to be launched to encourage manufacturers to develop vaccines that would cover the pneumo viral strains most prevalent in low-income countries and to scale up manufacturing rapidly for these markets.<sup>17</sup> A group of donors has agreed to pay \$1.5 billion to support sales of the vaccine for an initial period in return for promises from manufacturers to offer a lower long-run price to developing countries.<sup>18</sup> Although the pneumo AMC aims to stimulate the last stages of R&D, a next-generation AMC might target a product still in early stages of development, such as a malaria vaccine.<sup>19</sup>

■ **FDA priority review vouchers (PRVs—pull).** The Food and Drug Administration (FDA) PRV was voted into law by the U.S. Congress in September 2007. Under this law, the FDA will award a transferable voucher to the manufacturer of a novel drug or vaccine targeted at neglected diseases of the developing world. The voucher will entitle the holder to expedited FDA review of another product with major market potential, allowing the holder to bring this lucrative product to market nine to twelve months earlier than under normal FDA review procedures. The entity obtaining the voucher could keep it or sell it to another company that has a product ready for licensure. Because saving even a few months can mean big additional profits for a blockbuster drug, the vouchers are expected to have major monetary value—estimated at \$100–\$300 million—which could pull important investments into R&D for neglected disease drugs and vaccines.<sup>20</sup> In April 2009, the first priority review voucher was awarded to Novartis for Coartem tablets to treat malaria.<sup>21</sup>

## The Next Wave Of Innovative Ideas

Other ideas for innovative financing of health R&D have also been proposed.

■ **R&D windows in existing global health funds (push).** The existing global funding instruments for health, including the Global Fund to Fight AIDS, TB, and Malaria; the GAVI Alliance; and UNITAID (which generates revenues through a solidarity tax levied on air ticket purchases in nine countries) have thus far focused their resources on grants to developing countries for the purchase of already licensed drugs, vaccines, mosquito bednets, and so forth. The mandate of these organizations could be expanded to include funding for R&D, including grants to PDPs and grants or loans to biopharma organizations. This may be difficult to achieve, however, because there are already many competing claims on these organizations' resources. Because they are international institutions, the Global Fund and GAVI Alliance could also help support transnational collaborations and thereby address the problem of nationally restricted R&D funding. To implement an R&D window effectively, these health funds would need to strengthen their expertise in R&D, while not losing their current focus on product and service delivery.

■ **R&D bonds for PDPs (push).** Funds for R&D carried out by PDPs could be raised through the sale of government-backed bonds, which could eventually be repaid either from future donor grants or from sales revenues of PDP products purchased in industrialized and developing countries. In the first scenario, a stream of promised future grant payments by donors would be used to secure bond financing, thus "front-loading" this funding for R&D. The International Financing Facility for Immunization (IFFIm), which has generated additional resources to pay for vaccines that are already on the market but are underused in poor countries, works in this way.<sup>22</sup> In the second approach, royalties from future rich-world sales (and from a possible premium on donor-backed sales in low-income countries) could contribute to repaying the bonds. Because these revenues would be uncertain and might not fully cover R&D costs, formal government guarantees would be required to reduce risk to bondholders and ensure low interest rates. In either case, such bond financing would be predictable and long-term, and—depending on the institutional arrangements and rules for its allocation—could support a coalition of several PDPs, partnerships between PDPs and research institutions, and R&D projects for neglected diseases undertaken directly by private firms.

■ **Innovation funds (push).** Special "innovation funds" have been proposed to stimulate new ideas, attract researchers from other fields (for example, cancer vaccines, computational biology), and support high-risk projects. These new funds would be managed by individuals or groups that combine scientific and industrial expertise with venture-capital approaches to the allocation of financial resources and a high tolerance for risk. In 2007 IAVI established a fund, in part supported by the Gates Foundation, to encourage innovative science proposals from biotech companies.<sup>23</sup> The resulting IAVI Innovation Fund is yielding interesting lessons in how

to identify, motivate, and support the biotech companies with creative but untapped ideas and technologies to drive the development of new drugs and vaccines. In 2008 the Gates Foundation also made 104 small awards for "bold new ideas for global health solutions," mostly to academic groups, under its Grand Challenges Explorations program.<sup>24</sup> Building on lessons from these first initiatives, innovation funds could be extended to a wider range of health R&D challenges.

■ **Prizes (pull).** Cash rewards, or prizes, for the development of new drugs, vaccines, and diagnostic tests are another idea now receiving renewed attention. For example, \$100 million could be offered to a firm or group that designs a rapid diagnostic test or a new generation of drugs for TB.<sup>25</sup> Prizes could also be used to reward substantial progress toward the solution of a scientifically challenging problem (for example, proof of concept for an AIDS vaccine). Such an "interim milestone" prize could be especially attractive to biotech firms that need cash quickly and cannot wait the ten years or more required to bring a product to market and benefit from a final product prize or AMC. An even more ambitious alternative to one-time prizes is the idea of regularly replenished prize funds, which would reward developers of useful new health technologies with large payments in proportion to the social benefit of their inventions, in return for public access to the new technologies.<sup>26</sup>

These and other possible financing mechanisms for health R&D differ in a number of ways, including mechanism of action (push or pull); initial source of financing; intermediary institution for channeling funds (if any); type of R&D organization using the funds; and financing mode (Exhibit 2).

### Evaluating Financing Options

We believe that these new and proposed financing and incentive measures should be assessed and compared using a consistent framework along the lines of the evaluation framework developed under the Gates-sponsored Innovative Financing for Health Project.<sup>27</sup> Although the choice of assessment criteria is inevitably subjective and requires balancing the perspectives of donors, developing countries, PDPs, and industry, this project has demonstrated how this can be done in a systematic and transparent manner.<sup>28</sup>

We suggest that the criteria for assessing R&D financing mechanisms should include (1) quantity of additional financial resources generated; (2) sustainability and "automaticity" of resource generation (will it continue over the long run with little or no need for reauthorization by governments and others?); (3) predictability and flexibility of resources from the point of view of the recipient R&D organizations; (4) costs, including the financial and political cost of designing and launching the mechanism and running any new institutions required to manage it; and (5) in the case of industry pull mechanisms, the strength of the resulting incentives (will it persuade firms to reallocate resources to neglected diseases?).

Although a complete assessment of the existing and proposed R&D financing options is beyond the scope of this paper, we hope that a brief consideration of

**EXHIBIT 2  
Innovative Financing For Health Research And Development (R&D): Examples**

<b>Financing mechanisms: traditional</b>	<b>Push or pull</b>	<b>Initial source</b>	<b>Intermediary</b>	<b>R&amp;D user organization</b>	<b>Financing modality</b>
Public funding	Push	National budgets	Medical research councils	Mainly academic researchers	Grants
Private funding (pharma investments)	Push	Private capital markets, revenues	Not applicable	Pharma, biotech	Internal transfers, bonds, equity
<b>Financing mechanisms: recent</b>					
Grants for product development partnerships (PDPs)	Push	Donor governments, foundations	PDPs	PDP R&D units, industrial and academic partners	Grants
Government grants to private companies	Push	National budgets	NIH and other federal agencies (in U.S.)	Pharma, biotech	Grants through SBIR, STTR, other programs
Advance market commitments (AMCs)	Pull	Donor governments, Bill and Melinda Gates Foundation	GAVI Alliance	Pharma, biotech	Commitment to subsidize purchase price
FDA priority review vouchers (PRVs)	Pull	No direct funding	FDA and voucher holders	Pharma, biotech	None; expedited FDA review of another product
<b>Financing mechanisms: proposed</b>					
R&D window in existing global health funds	Push	Donor governments	GAVI Alliance, Global Fund, other bodies, perhaps PDPs	PDPs, pharma, developing-country researchers	Grants, low-interest loans
R&D bonds for PDPs	Push	Bondholders, ultimately purchasers from affluent countries, donors	PDP "bank" or international financial institution	PDP R&D units and their R&D partners	Bonds, proceeds used to make grants or loans
Innovation funds	Push	Bill and Melinda Gates Foundation	Directly, or through PDPs	Biotech, academic institutions	Grants
Prizes	Pull	Governments, foundations	Directly, or through PDPs	Academic institutions, biotech, pharma	One-time cash awards

**SOURCE:** This table was created by the authors.

**NOTES:** SBIR is Small Business Innovation Research. STTR is Small Business Technology Transfer. FDA is Food and Drug Administration (U.S.). NIH is National Institutes of Health (U.S.).

two proposed financing mechanisms—a new R&D funding window in an existing health fund and a PDP bond fund—will illustrate the value of this kind of comparative analysis.

■ **R&D funding window.** An R&D funding window could generate significant resources (in the tens or hundreds of millions of dollars annually, depending on the budget of the parent institution and the share assigned to R&D) and would be moderately sustainable once established, as long as the parent institution (for example, the GAVI Alliance or the Global Fund) remained operational. On the other hand, funding through such a window would not be automatic and predictable or provide

stable long-term funding for the R&D organizations, as it would require regular (annual or every few years) approval by the board of the parent institution. The start-up and operating costs could be relatively low, as no new institutions would have to be established, but the political obstacles could be significant, especially in the current economic environment, because the new window would compete directly with other uses of international health aid. In addition, a new R&D window would offer little or no additional incentive to R&D organizations, because payments would be tied to inputs rather than resulting outputs (new products).

■ **R&D bond fund.** An R&D bond fund would have a quite different set of advantages and drawbacks. By using government guarantees to access private capital markets, a bond fund could also generate major resources for R&D—several billions of dollars, disbursed over a decade or more, would be its minimum viable size from the perspective of the financial markets. Once established, it would provide the PDPs and other R&D organizations with predictable long-term financing, because donor guarantees would back long-term borrowing. By linking the repayment of the bonds to revenues from sales of new vaccines and drugs, the bond fund mechanism could also give the R&D organizations a new incentive to bring useful products to the market. Although bond investors would be the immediate source of funds, the money would ultimately come from a diverse set of sources—developed-world purchasers of new drugs and vaccines, donors who subsidize sale of these technologies to developing countries, and potentially the donors who guaranteed the bonds. One drawback to such a scheme is that potential revenues from commercial sales of neglected disease products are uncertain and may turn out to be insufficient to repay the bonds. Furthermore, bond funding is potentially more expensive than conventional grant funding, and the political and administrative costs of creating such a distinctly new mechanism could also be substantial and thus a major deterrent to its adoption.

### **Advancing The Global Health R&D Financing Agenda**

Several factors favor innovative financing mechanisms for health R&D for the developing world. Over the past decade, there has been growing public interest and political support for global health, fueled by attention focused on the Millennium Development Goals and the AIDS pandemic and the response to it (including the President's Emergency Plan for AIDS Relief [PEPFAR], and the Global Fund). More than a billion dollars a year in health R&D funding from the Gates Foundation has been another key factor. Other innovations in financing for health product delivery—including the IFFIm, the airline solidarity tax for UNITAID, and the AMC—are being implemented or readied for launch, stimulating interest in adopting similar approaches to accelerate R&D.<sup>29</sup>

At the same time, further experimentation with innovative financing for health R&D faces a number of obstacles. The current global financial crisis and economic slowdown may impair development assistance, reducing the financial resources

and political will available for innovative approaches to health and development. Some rich-country governments might not be prepared to make the long-term commitments that many of the new measures would require, because their own budgeting rules make this difficult or because it may be politically unpopular to obligate future tax revenues from their own citizens to research that will mainly benefit people in other countries. Furthermore, if new financing schemes require new institutions with complex management and governance arrangements, donors' enthusiasm may be blunted by the prospects of high transaction costs and slow implementation. Finally, there is some danger that the effort expended on launching IFFIm, the pneumo AMC, and other new initiatives may result in at least temporary "innovative financing fatigue" among donors and advocates.

Given the variety and complexity of proposals for innovative financing for health R&D, we suggest that there may be value in creating a neutral assessment center, supported by a number of R&D funders, where these proposals could be debated and evaluated. This could help build a shared understanding of these new ideas and shed light on their potential benefits as well as their pitfalls. Ultimately, by informing decision making and speeding implementation of better ways to finance R&D, these evaluations could accelerate the development and adoption of life-saving drugs, vaccines, and other health technologies.

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**NOTES**

1. N. Maire et al., "Predictions of the Epidemiologic Impact of Introducing a Pre-Erythrocytic Vaccine into the Expanded Program on Immunization in Sub-Saharan Africa," *American Journal of Tropical Medicine and Hygiene* 75, no. 2 Supp. (2006): 111–118.
2. D.S. Shepard et al., "Cost-Effectiveness of a Pediatric Dengue Vaccine," *Vaccine* 22, nos. 9–10 (2004): 1275–1280.
3. J. Stover et al., "The Impact of an AIDS Vaccine in Developing Countries: A New Model and Initial Results," *Health Affairs* 26, no. 4 (2007): 1147–1158.
4. World Health Organization, *Diarrhoeal Diseases*, February 2009, [http://www.who.int/vaccine\\_research/diseases/diarrhoeal/en/index.html](http://www.who.int/vaccine_research/diseases/diarrhoeal/en/index.html) (accessed 14 April 2009).
5. Commission on Health Research for Development, *Health Research: Essential Link to Equity in Development* (New York: Oxford University Press, 1990).
6. WHO Expert Working Group on R&D Financing, <http://www.who.int/phi/1stmeeting/en/index.html> (accessed 4 March 2009); and WHO, *Global Strategy and Plan of Action on Public Health, Innovation, and Intellectual Property*, Sixty-First World Health Assembly, 24 May 2008, [http://www.who.int/gb/ebwha/pdf\\_files/A61/A61\\_R21-en.pdf](http://www.who.int/gb/ebwha/pdf_files/A61/A61_R21-en.pdf) (accessed 4 March 2009).
7. P. Wilson, S. Post, and S. Srinivas, "R&D Models: Lessons from Vaccine History," Policy Research Working Paper no. 14, June 2007, <http://www.iavi.org/viewfile.cfm?fid=45872> (accessed 12 January 2009).
8. Dalberg Global Development Advisors, "Initiative for Sustainable Funding for R&D for Neglected Diseases," 8 November 2007, [http://www.ifpma.org/pdf/2007\\_11\\_08\\_Soren\\_Peter\\_Andreasen.pdf](http://www.ifpma.org/pdf/2007_11_08_Soren_Peter_Andreasen.pdf) (accessed 6 January 2009).
9. Stop TB, "Strategic Plan of the Stop TB Partnership Working Group on New TB Vaccines, 2006–2015," [http://www.stoptb.org/wg/new\\_vaccines/assets/documents/Strat%20Plan%20New%20Vaccines.pdf](http://www.stoptb.org/wg/new_vaccines/assets/documents/Strat%20Plan%20New%20Vaccines.pdf) (accessed 4 March 2009).
10. P.A. Wilson and R. Hecht, "Financing of Vaccine R&D—Gaps and Opportunities," *Global Forum Update on*

- Research for Health* 4 (2007): 88–93.
11. A. Gawrylewski, "Tackling Peer Review Bias," *TheScientist.com*, 28 July 2008, <http://www.the-scientist.com/blog/display/54893> (accessed 14 April 2009).
  12. London School of Economics and Political Science, *The New Landscape of Neglected Disease Drug Development* (London: Wellcome Trust, September 2005).
  13. George Institute for International Health, *Neglected Disease Research and Development: How Much Are We Really Spending?* February 2009, [http://www.thegeorgeinstitute.org/shadomx/apps/fms/fmsdownload.cfm?file\\_uid-409DIEFD-BF15-8C94-E71C-288DE35DD0B2&rsiteName=iih](http://www.thegeorgeinstitute.org/shadomx/apps/fms/fmsdownload.cfm?file_uid-409DIEFD-BF15-8C94-E71C-288DE35DD0B2&rsiteName=iih) (accessed 4 March 2009).
  14. Based on NIH data analyzed by Kevin Fisher, AIDS Vaccine Advocacy Coalition, personal communication, September 2008.
  15. S.E. Frew, H.E. Kettler, and P.A. Singer, "The Indian and Chinese Health Biotechnology Industries: Potential Champions of Global Health?" *Health Affairs* 27, no. 4 (2008): 1029–1041.
  16. Brookings Institution, "Advance Market Commitments for Vaccines," 2008, <http://www.brookings.edu/projects/global-health/-/media/Files/Projects/globalhealth/healthsnapshots/vaccines.pdf> (accessed 6 January 2009); and O. Barder, M. Kremer, and R. Levine, *Making Markets for Vaccines: Ideas to Action*, 2005, <http://www.cgdev.org/doc/books/vaccine/MakingMarkets-complete.pdf> (accessed 12 January 2006).
  17. Because these vaccines are already in very late-stage development, the main aim of the pneumo AMC will be to ensure adequate supply to developing countries at an affordable price.
  18. GAVI Alliance, "Saving Lives with New Vaccines: Advanced Market Commitments," 2007, [http://www.vaccineamc.org/files/AMC\\_FactSheet\\_v2.pdf](http://www.vaccineamc.org/files/AMC_FactSheet_v2.pdf) (accessed 6 January 2009).
  19. World Bank and GAVI Alliance, *Framework Document: Pilot AMC for Pneumococcal Vaccines*, 9 November 2006, <http://www.vaccineamc.org/files/Framework%20Pneumo%20AMC%20Pilot.pdf> (accessed 14 April 2009).
  20. BIO Ventures for Global Health, "About PRVs," 2008, <http://prvinfo.org/about> (accessed 14 April 2009); and IAVI, "U.S. FDA Priority Review Vouchers: An Effective Incentive to Develop Drugs and Vaccines for Neglected Diseases?" 2008, <https://www.iavi.org/viewfile.cfm?fid=47963> (accessed 6 January 2009).
  21. U.S. Food and Drug Administration, "FDA Approves Coartem Tablets to Treat Malaria," 8 April 2009, <http://www.fda.gov/bbs/topics/NEWS/2009/NEW01989.html> (accessed 7 May 2009).
  22. Brookings Institution, "International Finance Facility for Immunization," 2008, <http://www.brookings.edu/projects/global-health/-/media/Files/Projects/globalhealth/healthsnapshots/iffim.pdf> (accessed 6 January 2009).
  23. IAVI, "IAVI's Innovation Fund to Bring Novel Early-Stage Technologies to AIDS Vaccine Research," 2007, <http://www.iavi.org/viewfile.cfm?fid=46894> (accessed 6 January 2009).
  24. Bill and Melinda Gates Foundation, "Gates Foundation Invests in 104 Novel Ideas for Global Health," Press Release, 22 October 2008, <http://www.grandchallenges.org/about/Newsroom/Pages/GCERound1Grants.aspx> (accessed 6 January 2009).
  25. J. Love, "The Role of Prizes in Developing Low-Cost, Point-of-Care Rapid Diagnostic Tests and Better Drugs for Tuberculosis," *Medicins sans Frontiers Expert Meeting*, 11 April 2008, Geneva, Switzerland, [http://www.keionline.org/misc-docs/Prizes/prize\\_tb\\_msf\\_expert\\_meeting.pdf](http://www.keionline.org/misc-docs/Prizes/prize_tb_msf_expert_meeting.pdf) (accessed 14 April 2009).
  26. J. Love and T. Hubbard, "The Big Idea: Prizes to Stimulate R&D for New Medicines," *Chicago-Kent Law Review* 82, no. 3 (2007): 1519–1554; and A. Hollis and T. Pogge, *The Health Impact Fund: Making New Medicines Accessible for All*, 2008, [http://www.yale.edu/macmillan/igh/hif\\_book.pdf](http://www.yale.edu/macmillan/igh/hif_book.pdf) (accessed 12 May 2009).
  27. D. de Ferranti et al., "Innovative Financing for Global Health: Tools for Analyzing the Options," August 2008, [http://www.brookings.edu/papers/2008/08\\_global\\_health\\_de\\_ferranti.aspx](http://www.brookings.edu/papers/2008/08_global_health_de_ferranti.aspx) (accessed 14 April 2009).
  28. There has also been a recent attempt to examine the range of possible innovative development financing mechanisms by the Leading Group on Solidarity Levies. See "Invitation: The Second Plenary Meeting of the Leading Group," 18 December 2006, <http://www.innovativefinance-oslo.no/hjem.cfm> (accessed 14 April 2009).
  29. See, for example, OECD Global Forum on Development, "Innovative Financing in Health," 7 October 2008, [http://www.oecd.org/document/12/0,3343,en\\_21571361\\_37824719\\_41467532\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/12/0,3343,en_21571361_37824719_41467532_1_1_1_1,00.html) (accessed 12 May 2009).