



Vaccinators transporting polio vaccines in cold boxes during an Ethiopian polio immunization campaign.

#### ABOUT THE AUTHORS:

**Oliver Sabot** is the Executive Vice President for Global Programs at the Clinton Health Access Initiative (CHAI). He joined CHAI in 2006 to develop and launch a new malaria program, leading the program's expansion and major operations in Africa and Asia to increase access to effective malaria treatment and malaria control and elimination programs. Mr. Sabot also serves as the Chair of the Market Dynamics Committee of the Board of the Global Fund to Fight AIDS, Tuberculosis and Malaria.

**Prashant Yadav** is Senior Research Fellow and Director of Health Care Delivery Research at the University of Michigan's William Davidson Institute and also serves on the faculty at both the Ross School of Business and the School of Public Health at the University of Michigan. He is also Co-Chair of the Procurement and Supply Chain Management Working Group of the Roll Back Malaria Partnership. Previously, Dr. Yadav was

## Maximizing Every Dose and Dollar: The Imperative of Efficiency in Vaccine Delivery

Oliver Sabot, Prashant Yadav, Michel Zaffran

It is painful for us to witness developing countries struggle to secure financing to expand childhood immunization. Immunization is one of the best investments to improve lives around the world, and the total cost of fully vaccinating every child in developing countries is a small fraction of the amount that our own home countries spend on coffee or on cruise missiles every year. Yet while we urge rich nations to increase their investments in global vaccination, we recognize that we cannot rely solely on additional funding to realize the tremendous potential of expanded immunization. We must also maximize the number of children that we protect with every committed dollar and dose of vaccine that we purchase.

*“High rates of vaccine wastage were tolerable in the past when vaccines cost a few cents per dose, but wastage will be a major drain on resources once vaccines that are as much as 50 times more expensive are introduced.”*

Nearly 80% of children in the world are now vaccinated every year, with even some of the most troubled countries, such as the Democratic Republic of the Congo, reaching the majority of their children.<sup>1</sup> As a result, there is a common misconception in the global health community that the delivery of vaccines in most countries functions optimally, requiring little additional attention and resources. The architects and implementers of existing vaccine delivery systems certainly deserve praise, and their efforts are largely adequate for the demands of current vaccines.

But we cannot be complacent.

An unprecedented wave of new vaccines capable of dramatic impact on health outcomes, including for malaria and TB, will likely be launched over the next decade. Many of the new vaccines will be substantially more expensive and bulkier than traditional antigens and will place accumulative strain on delivery systems. Total vaccine costs and volume in many developing countries will leap over the next two years to as much as 20 times greater than before recent vaccine introductions began, with further dramatic increases as additional vaccines are introduced later in the decade (Fig. 1).

>>

<sup>1</sup> WHO Vaccine-Preventable Diseases: Monitoring System - 2010 Global Summary, Section 2: Reference - Country Immunization Profiles, [http://whqlibdoc.who.int/hq/2010/WHO\\_IVB\\_2010\\_eng\\_p32-R242.pdf](http://whqlibdoc.who.int/hq/2010/WHO_IVB_2010_eng_p32-R242.pdf).



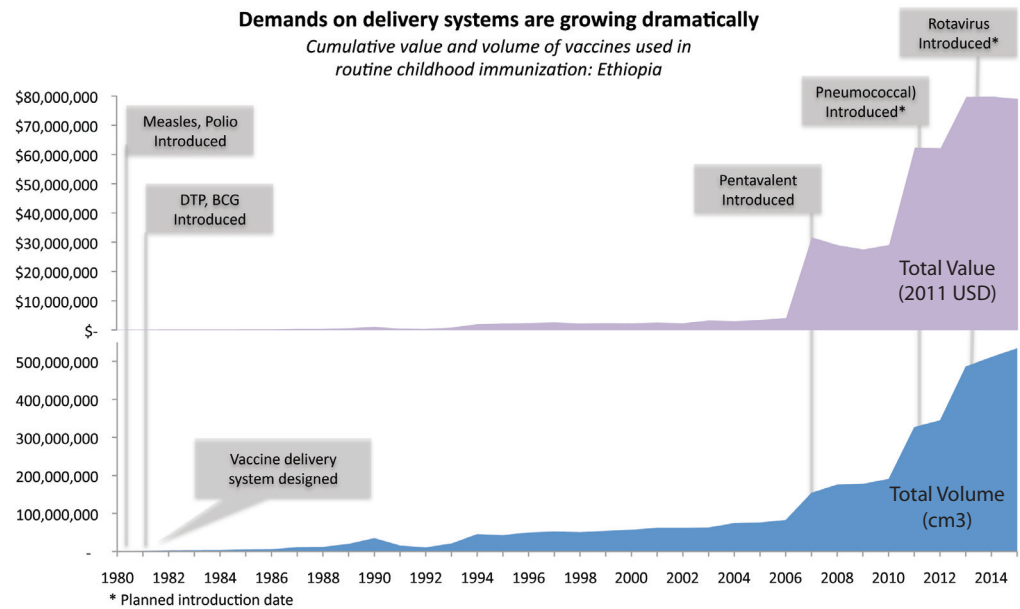
A frozen vaccine vial. Exposure to freezing temperatures during storage can reduce the potency of vaccines.

About the Authors, continued

Professor of Supply Chain Management at the MIT-Zaragoza International Logistics Program.

**Michel Zaffran** is Director of Project Optimize, a WHO-PATH collaboration aimed at catalyzing a shared vision of the future logistics of health programs. He is also Senior Advisor to the Director of the WHO Department of Immunization, Vaccines, and Biologicals. Previously, Dr. Zaffran was the WHO Representative on the Working Group that designed and contributed to the launch of the Global Alliance for Vaccines and Immunization (GAVI Alliance). He later served as Deputy Executive Secretary for Technical and Policy areas on the GAVI Alliance.

Figure 1: Demands on vaccine delivery systems are rising dramatically.<sup>2, 3, 4, 5</sup>



Many countries have introduced at most one new vaccine over the past 30 years, and their vaccine delivery systems are not currently designed to accommodate this impending wave of change. Nevertheless, many developing countries plan to introduce two new vaccines in the next three years. Beneath their relatively well-functioning surfaces, vaccine delivery systems have weaknesses that will be seriously exacerbated by the introduction of each new vaccine. In some countries, as many as 50% of vaccine doses are wasted by not being administered, and many more doses are exposed to freezing temperatures that can reduce their potency.<sup>6</sup>

Some waste is inevitable when immunizing children in the most remote areas of the world, as it is in any system that delivers heat sensitive or perishable products. In many countries, however, wastage and freezing far exceed the necessary levels.<sup>7, 8</sup> High rates of vaccine wastage were tolerable in the past when vaccines cost a few cents per dose, but wastage will be a major drain on resources once vaccines that are as much as 50 times more expensive are introduced. Even if the prices of new vaccines fall substantially in the coming year, every one percent of vaccine that is wasted or frozen across countries supported by the GAVI Alliance will represent millions of dollars annually – millions that we cannot afford to lose in the current constrained financing environment.

<sup>2</sup> "Vaccine Price Data," Supply Division of UNICEF, [http://www.unicef.org/supply/index\\_57476.html](http://www.unicef.org/supply/index_57476.html).  
<sup>3</sup> WHO Vaccine-Preventable Diseases: Monitoring System - 2010 Global Summary, *WHO-UNICEF Estimates of DPT3 Coverage*, [http://apps.who.int/immunization\\_monitoring/en/globalsummary/timeseries/tswucoveragedtp3.htm](http://apps.who.int/immunization_monitoring/en/globalsummary/timeseries/tswucoveragedtp3.htm).  
<sup>4</sup> "Vaccine Volume Calculator," Immunization Service Delivery and Accelerated Disease Control Program of WHO, [http://www.who.int/immunization\\_delivery/systems\\_policy/logistics/en/index4.html](http://www.who.int/immunization_delivery/systems_policy/logistics/en/index4.html).  
<sup>5</sup> "WHO Prequalified Vaccines," Immunization Standards of WHO, [http://www.who.int/immunization\\_standards/vaccine\\_quality/PQ\\_vaccine\\_list\\_en/en/index.html](http://www.who.int/immunization_standards/vaccine_quality/PQ_vaccine_list_en/en/index.html).  
<sup>6</sup> "Monitoring Vaccine Wastage at Country Level: Guidelines for Programme Managers," Department of Vaccines and Biologicals of WHO, May 2005, <http://www.who.int/vaccines-documents/DocsPDF05/www811.pdf>.  
<sup>7</sup> Divya Parmar, Elaine M. Burwa, Patrick Zuber, and Souleymane Kone, "Impact of Wastage on Single and Multi-Dose Vaccine Vials: Implications for Introducing Pneumococcal Vaccines in Developing Countries," *Human Vaccines* 6, no. 3 (March 2010): 270-78.  
<sup>8</sup> Stephane Guichard, Karen Hymbaugh, Brent Burkholder, et al, "Vaccine Wastage in Bangladesh," *Vaccine* 28, no. 3 (January 28, 2010): 858-63.



Jacqueline M. Koch (©2006)

Aceh Besar, Aceh Province, Indonesia. A year after the 2004 tsunami, Aceh's health system is still ailing and requires substantial reconstruction and rehabilitation support to fulfill basic primary care needs. Near her village, midwife Putri Marinda runs a mobile maternal and child health care clinic, ensuring all infants are immunized.

## ACKNOWLEDGEMENTS

The authors are grateful to Rose Martin-Weiss, Ian McConnell, Yann Le Tallec, Justin Yarrow, and Kate Sabot for their support in the conception of and research and analysis for this article.

Published in the United States of America by The National Bureau of Asian Research (NBR)  
 1414 NE 42nd Street, Suite 300  
 Seattle, Washington 98105  
 United States of America  
 +1-206-632-7370 Phone  
 +1-206-632-7487 Fax  
 nbr@nbr.org E-mail  
 http://www.nbr.org

© 2011 by The National Bureau of Asian Research

We thus need a paradigm shift in our approach to the delivery of new and existing vaccines. Maximizing the value we get from every dollar that we invest in immunization and every vaccine vial that we procure must be an equal priority to expanding coverage and accelerating new vaccine introduction, with the design and execution of delivery systems correspondingly receiving as much attention as the development of new technologies. If the hundreds of millions of dollars that have been invested in vaccine development are to be translated into the desired transformation in disease burden, vaccine delivery systems must themselves be transformed.

*“Revamping deeply rooted systems in time to meet the demands of the next decade will require commitment, creativity, and investment from all actors involved in the global vaccine enterprise, most notably the governments of developing countries themselves.”*

Revamping deeply rooted systems in time to meet the demands of the next decade will require commitment, creativity, and investment from all actors involved in the global vaccine enterprise, most notably the governments of developing countries themselves. In recent years, several leading vaccine organizations<sup>9</sup> have been the vanguard of pursuing this transformation, identifying, testing, and promoting innovative approaches to more effectively and efficiently delivering vaccines.

But these organizations cannot achieve large-scale change on their own. Every actor in the global vaccines community should pursue a number of priorities to create that change, adapting solutions to the specific needs of each country. The priorities include:

- *Redesign delivery channels* – Many countries can cut out entire layers of the delivery chain, better utilize innovative cold chain technologies, and/or contract the expertise of the private companies that successfully deliver heat sensitive products to the most remote areas;
- *Leverage true vaccine stability* – Some vaccines can survive at controlled temperatures above the traditional range for substantial periods. Manufacturers, regulators, and countries should exploit this stability to more efficiently reach remote areas;
- *Align incentives for efficiency* – Countries should ensure that all staff in the delivery system are accountable for minimizing waste while maximizing coverage;
- *Transform information* – Countries and their partners should pursue a vision in which a national manager or a remote nurse can view vaccine usage and coverage of children at the click of a button. The technology to do so exists – we just need the will and creativity to use it;
- *Invest in people* – Countries can no longer rely on a handful of appropriately trained individuals to distribute vaccines worth tens of millions of dollars. Any improvement to vaccine delivery will require a substantial increase in the number, training, and retention of logistics staff.

Scientific ingenuity and investment is providing the world with a historic portfolio of new vaccines. Governments, donors, researchers, companies, and NGOs must now mobilize similarly exceptional ingenuity and modest additional investment (a small fraction of the cost of purchasing new vaccines) in supply chain management to ensure that those vaccines are delivered to all children around the world as rapidly and efficiently as possible.

<sup>9</sup> The World Health Organization and PATH via Project Optimize.