



HOW THE RESEARCH-BASED
VACCINE MANUFACTURERS
ARE CONTRIBUTING TO THE
DECADE OF VACCINES GLOBAL
VACCINE ACTION PLAN

INNOVATION FOR A HEALTHIER WORLD



IFPMA

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Foreword

Vaccination is one of the most important public health initiatives that has saved millions of lives over the years. The pharmaceutical industry is proud to play a key part in developing vaccines for the global community. The world counts on an array of stakeholders to fully achieve disease elimination and vaccination coverage targets, develop and introduce new and improved vaccines and technologies, and reduce child mortality. This collaboration has led to the near elimination of polio and is winning the fight against diseases such as diphtheria, pneumonia, meningitis, hepatitis B and diarrhoea. It is this joint ongoing effort that will contribute to make such goals a reality at all levels.

“Today, the strides being made in the fight against polio demonstrate that with a joint effort and continuous dialogue we can make ambitious goals like this a reality.”

The research-based vaccine manufacturers are committed to the goals set by the Decade of Vaccines (DoV) Global Vaccine Action Plan (GVAP) adopted by the World Health Assembly in 2012. Our industry believes in the value innovation can bring in improving lives of millions of children and adults alike as well as reducing health inequities so that all people can achieve their full potential.

No government or policy maker can doubt today that immunization is indeed one of the most effective public health interventions. Vaccines have been proven beneficial to the health, wealth, and well-being of people across the globe. They have generated tremendous value by preventing and controlling diseases and ultimately sustaining healthier societies.

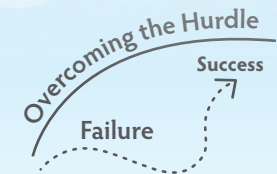
In this report the International Federation of Pharmaceutical Manufacturers and Associations (IFPMA) shows how research-based vaccine manufacturers continue to invest and innovate in the discovery, development, manufacture, and delivery of high-quality vaccines.

Yet, innovation doesn't happen in a vacuum. There are vital components that are required if the benefits are to be brought to society. The strength of partnership, collaboration, and coordination along the journey of vaccine development can only contribute to the global immunization community's success. Together with our partners, we are working to strike the right balance between sustainable innovation and the effective roll-out of vaccines to all. This is essential in avoiding missed opportunities and reaching those one-in-five children who are still not picked up by the radar of local healthcare systems.

We hope that our readers get a glimpse of how exciting the vaccines journey is to finally reach those people for whom they are destined, men and women, girls and boys, no matter where they live.

Eduardo Pisani
Director General, IFPMA

The Exciting Journey of Vaccines



Innovation is critical

- Supply Chain Development
- Changing Demographics

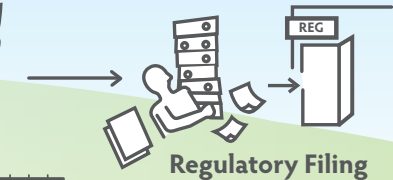
- Efficacy Studies
- Scalability for Production
- Clinical Trials

What will work?

A Lot of Work & Time

Consider all Factors

HIV Example
Decades



Regulatory Filing

2 From Lab to Regulatory Approval

Bring Diverse Groups and Perspectives

Let's Develop a Vaccine

An Extremely Important Journey!

Where to invest?

~ 5 years & ~ 600 mill. US \$ for a new biological manufacturing
(The Right One!)



6% Chance of Market Entry for an Average Vaccine Taken from the Pre-clinical Phase

Investing in A means not investing in B
→ Priorities

Development of Innovative Vaccines

Local Identify the Need

A Global Look:
Local → National → Regional



Determining the Burden of Disease

- Is a vaccine needed? → Measurement of Epidemiology
- Does a vaccine exist?

R&D Prioritization

Communication Challenges

Informing National Leaders

Includes education & communication

1 From Unmet Need to Vaccine Concept





Every report on vaccines starts with the same story: vaccines save lives. To be more specific, vaccines save three million lives every year.ⁱ But the Decade of Vaccines (DoV) Global Vaccine Action Plan (GVAP) has encouraged us as a global health community to consider not only how many lives we have saved, but how many lives we could save if current and new vaccines and technologies were fully adopted around the world, particularly in low-income countries (LICs) and lower-middle income countries (LMICs).

According to the GVAP, if we achieve five of their immunization-specific goals, we have the ability to prevent hundreds of millions of cases of disease and millions of deaths.ⁱⁱ This will reduce childhood mortality and in turn lead to healthy people who can contribute billions of dollars of productivity to their economies.

Research-based vaccine manufacturers have been major contributors to this important call to action. From vaccine development with partners around the globe to ensuring sustainable access, we are deeply committed to preventing diseases and saving lives. Through the Decade of Vaccines Global Vaccine Action Plan, we have renewed our commitments to:

1. Ensure availability to and support affordability for our vaccines;
2. Continue investment in innovation where it counts most;
3. Provide the highest quality vaccines possible; and
4. Collaborate wherever and whenever possible.

In this report, we highlight a few examples that illustrate our passion for innovation, although innovation is rarely possible in isolation. Our work often begins in laboratories and manufacturing facilities, but it does not end there. Our advances in technology are also helping us deliver and administer vaccines in ways we never thought possible.

ⁱ Ehreth, J. Vaccine 2003; 21:4111

ⁱⁱ The DoV GVAP lists these goals as: eradicate polio; meet vaccination targets in every region, country and community; exceed the Millennium Development Goal 4 for reducing childhood mortality; meet global and regional elimination targets; and develop and introduce new and improved vaccines and technologies. Page 28: <http://www.dovcollaboration.org/action-plan/>



“Vaccines already save and improve millions of lives in developing countries. Innovation will make it possible to save more children than ever before.”

- Bill Gates, Founder,
Bill & Melinda Gates Foundation

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Our Key to Success: Partnerships

The old proverb, “Two heads are better than one,” has never been truer than in the global health community. Each of us plays an important role in preventing disease, but when the global community works together we can dramatically advance our development and delivery of vaccines.

Research-based vaccine manufacturers have a long history of partnership. From research and development programs to delivery and storage, we are constantly seeking new ways to share information and technology to save lives. Some of our most important programs include academic facilities, non-governmental organizations and other manufacturers all working together toward the same goals. Some of our groundbreaking collaborations include:

- Gavi Alliance: Gavi was founded in 2000 by the Bill & Melinda Gates Foundation, the World Bank, the World Health Organization (WHO), UNICEF and vaccine manufacturers, including Sanofi Pasteur, Pfizer, MSD, GSK, Novartis, and Janssen. Together, we are working to vaccinate the remaining 20% of children around the world who do not yet have access to new vaccines.

Our unique contributions include the development of new vaccines and enhanced global vaccine manufacturing capacity, including facilities in developing countries. We are also helping to educate healthcare providers and develop technologies to facilitate vaccine distribution.

- Aeras: Tuberculosis (TB) is still a public health crisis. Each year, more than 8.5 million people contract TB and 1.3 million will die as a result. The rise of multi-drug resistant TB is making treatment particularly difficult and the current vaccine, Bacille Calmette-Guérin (BCG), is not optimal. Aeras was founded in 1997 to meet this challenge head-on. GSK, Janssen and Sanofi Pasteur have all partnered with Aeras to develop new TB vaccines that are accessible to all, improve the efficacy of BCG, and develop an improved TB vaccine that can either boost or replace BCG.
- International AIDS Vaccine Initiative (IAVI): The most vulnerable and impoverished people in the world continue to bear the heaviest burden of HIV: sub-Saharan Africa accounted for 70% of new HIV infections in 2012. The best long-term solution to the global AIDS epidemic is a vaccine. GSK, Novartis, Sanofi Pasteur, and Janssen are among numerous partners working to move a vaccine from the academic bench to clinical testing in the developing world in



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“Public and private partnership is critical to the rapid development and deployment of life-saving vaccines. Industry plays a central role in vaccine development and manufacture, bringing products from idea to reality. Working together, we seek to protect children and adults – no matter where they live – from life-threatening, vaccine-preventable diseases.”

- Katie Taylor, Deputy Assistant Administrator,
Global Health, USAID

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a safe, efficient manner. We are committed to working together to defeat this merciless disease.

- **Global Health Innovative Technology (GHIT) Fund:** The GHIT Fund was established to advance the development of new health technologies in LICs and LMICs by three key partners -- the Government of Japan and a consortium of the Bill & Melinda Gates Foundation and five leading Japanese companies: Astellas Pharma Inc.; Daiichi Sankyo Co., Ltd.; Eisai Co., Ltd.; Shionogi & Co., Ltd.; and Takeda Pharmaceutical Co., Ltd. Initial work has advanced our understanding of malaria, TB, Chagas disease and many neglected tropical diseases.
- **MSD Wellcome Trust Hilleman Laboratories:** The Wellcome Trust and MSD joined together in 2009 to create Hilleman Laboratories, a non-profit R&D venture in India to develop affordable vaccines optimized for use in developing countries. Their current efforts are focused on the development of a thermostable rotavirus vaccine as well as novel vaccine candidates for cholera and enterotoxigenic *Escherichia coli* (ETEC) mediated infection, leading causes of diarrheal disease in LICs and LMICs.
- **Novartis Vaccines Institute for Global Health (NVGH):** Novartis has partnered with 20 academic and research institutes around the world to develop vaccines for: Typhi and Paratyphi A, invasive non-typhoidal salmonella in Africa, Shigella, and African bacterial meningitis. One of the NVGH's scientific programs, GENDRIVAX (GENome-DRIVEN Vaccine), focuses on understanding the selection pressure bacteria face in order to develop vaccines that minimize the risk of creating resistant diseases.

These are just a small sample of the collaborations that happen each day to advance our ability to combat infectious diseases; many more are showcased throughout this report. Strong partnerships are, and will continue to be, our keys to success in ensuring sustainable access to life-saving vaccines.



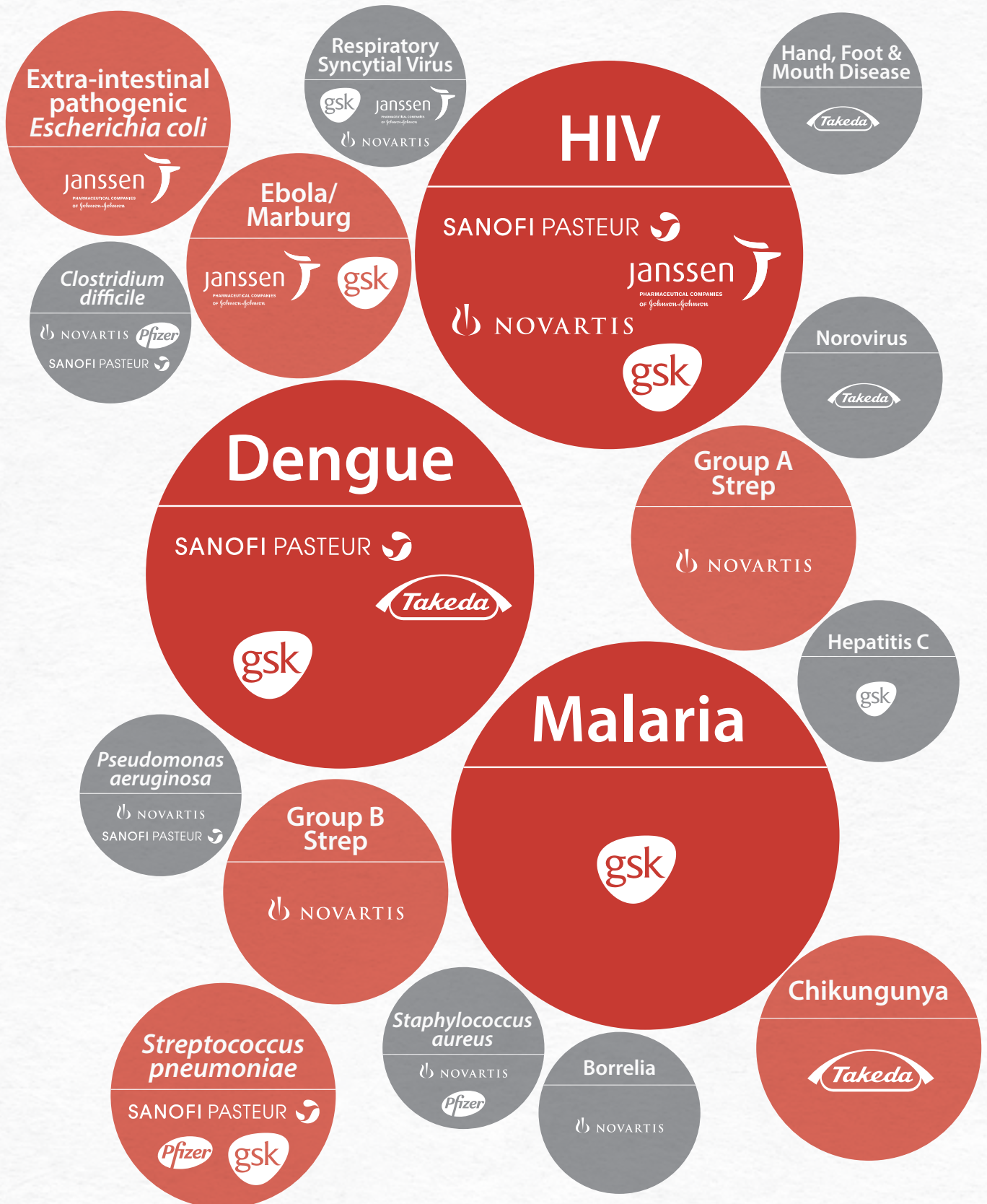
Innovation from Lab to Regulatory Approval

A sustainable regulatory, policy, market, and investment environment is critical for innovation in this field to happen: development and introduction of new and improved vaccines and technologies.

Today, research-based vaccine manufacturers and our partners are testing and developing over 300 vaccines, including potential preventative and therapeutic vaccines, to tackle some of the toughest diseases threatening the world.^{i, ii, iii} Not all will become vaccines that can successfully reduce disease, but each will teach us something important about the specific disease we are studying, or vaccine technology generally, that we can apply to our future work.

Developing vaccines is not an easy process. It often takes more than a decade to develop a vaccine, so we carefully consider vaccine candidates based on epidemiological trends and our best interpretations of the evolving burden of disease. We value input from our partners and the broader global health community when making these decisions. Sometimes, the choice of candidates is made easier when we make a technological breakthrough such as the development of recombinant DNA technology or when we gain an unexpected understanding of the underlying mechanism of a disease such as the connection between human papillomavirus and cervical cancer.

Continuing to Invest in Innovation to Address Unmet Needs



Continuing to Improve and Expand Current Vaccines

In addition to the many vaccines in development to tackle new diseases, we also continue to improve upon existing vaccines. While all of the vaccines currently available are safe and effective, new technologies mean we can reformulate many to include new, desirable qualities such as temperature stability which enables us to reach more people whose clinics may have limited refrigeration capabilities. We also now have the ability to combine multiple vaccines into one vial or delivery device, further limiting the number of vaccines and doses that must be shipped around the world and enhancing cold chain capacity to deliver even more vaccines to LICs and LMICs.

Improving current formulations also means improving adjuvants, the parts of a vaccine that enhance the body’s immune response to a vaccine. By developing more effective adjuvants, we can not only improve the effectiveness of vaccines, but also use less vaccine per dose, thus stretching our supply further and vaccinating more people at once. GSK has four Adjuvant System families: AS01^{iv} (used in its malaria vaccine candidate); AS03 (used in its pandemic flu vaccines); AS04 (used in its cervical cancer vaccine); and AS15^v (used in its candidate cancer therapeutic vaccines). Novartis MF59 adjuvant, which has been successfully used for more than 15 years in seasonal influenza vaccines for the elderly, is being tested to improve the potency of various additional vaccines such as HIV and respiratory syncytial virus (RSV).

A Selection of Current Vaccine Improvements		
Disease	Clinical Phase	Company
Human papillomavirus (HPV)	Discovery	Janssen
	Regulatory approval phase	Merck
Measles, mumps, rubella (MMR)	Phase III	GSK
Meningococcal disease serogroups A, C, W, and/or Y	Phase II	Novartis
	Phase II	Sanofi Pasteur
	Approved (Europe) Phase II (US)	GSK
Meningococcal disease serogroup B	Phase III	Pfizer
Polio	Pre-clinical	Janssen
Rabies	Phase II	Sanofi Pasteur
Rabies (monoclonal antibody combination)	Phase II	Janssen
Rotavirus	Phase III	Sanofi Pasteur
Tuberculosis	Phase I	Sanofi Pasteur
	Phase II	GSK
Varicella zoster virus	Phase III	GSK

ⁱ IFPMA infographic on vaccine research and development (2013) <https://www.flickr.com/photos/ifpma/8630947948/>

ⁱⁱ PhRMA Report Medicines in Development for Vaccines (2012) <http://www.phrma.org/sites/default/files/pdf/vaccines2012.pdf>

ⁱⁱⁱ BIO Ventures for Global Health (BVGH). Developing new drugs & vaccines for neglected diseases of the poor. The Product Developer Landscape; March 2012 <http://www.bvgh.org/LinkClick.aspx?fileticket=h6a0cJK9drg%3D&tabid=91>

^{iv} Contains QS-21 Stimulon® adjuvant licensed from Antigenics Inc, a wholly owned subsidiary of Aegenus Inc. (NASDAQ: AGEN), MPL and liposomes

^v A novel immunostimulant AS15 (a combination of QS-21 Stimulon® adjuvant, monophosphoryl lipid A, and CpG7909, a TLR-9 agonist, in a liposomal formulation)



Tackling the World's Most Challenging Infectious Diseases: Malaria, Dengue, Diarrheal Diseases, Ebola

Research-based vaccine manufacturers are leading the way in R&D for neglected conditions, particularly those prevalent in the developing world. More than 20 of the vaccines currently in development target diseases such as HIV, tuberculosis, bacterial pneumonia, meningitis and leishmaniasis.^{i,ii} Four diseases that have particularly disrupted the developing world's progress to better health are malaria, dengue, diarrheal diseases, and Ebola.

Putting an End to Malaria

Each year there are approximately 207 million cases of malaria globally, equivalent to the population of Brazil, and 627,000 malaria deaths, mostly in children in Africa under the age of five.ⁱⁱⁱ Although existing interventions have helped to reduce malaria deaths significantly over the past decade, a successful vaccine is a needed component for malaria control.

The PATH Malaria Vaccine Initiative (MVI) is the leading convener of efforts to develop a vaccine against malaria. Recently, the organization has partnered with both GSK and MSD to pursue promising vaccine candidates.

- For the past 30 years, GSK scientists have been working with others around the world to develop a vaccine against malaria. A vaccine candidate — RTS,S— is being developed in partnership with PATH MVI with more than USD 200 million in grant monies from the Bill & Melinda Gates Foundation. More than 200 experts are involved in this crucial R&D program. GSK takes the lead in the overall development of RTS,S; it has invested more than USD 350 million to date and expects to invest over USD 260 million more until development is completed.
- Currently in phase III, the latest clinical trial results (October 2013) showed that RTS,S reduced malaria cases by almost half over 18 months of follow-up in young African children 5-17 months of age, and by around a quarter in infants aged 6-12 weeks over the same time period. RTS,S had an acceptable safety and tolerability profile. The phase III program covers 13 African research centers in eight African countries (Burkina Faso, Gabon, Ghana, Kenya, Tanzania, Mozambique, Malawi, and Nigeria). With 16,685 infants and young children participating, it is the largest malaria vaccine trial program conducted in Africa to date.
- In July 2014, GSK announced that it had submitted a regulatory application to

the European Medicines Agency (EMA) for RTS,S. The EMA submission is the first step in the regulatory process toward making the RTS,S vaccine candidate available as an addition to existing tools currently recommended for malaria prevention. If this regulatory review concludes with a positive scientific opinion, GSK will subsequently apply for Marketing Authorizations to national regulatory authorities (NRAs) in sub-Saharan Africa. Furthermore, if the EMA issues a positive opinion following its regulatory assessment and if the required public health information, including safety and efficacy data from the phase III program, is deemed satisfactory, WHO has indicated that a policy recommendation for the RTS,S malaria vaccine candidate is possible by the end of 2015. This would pave the way for local regulatory submissions and decisions by African nations and large-scale implementation of the vaccine through their national immunization programs.

- GSK has committed that the eventual price of RTS,S will cover the cost of manufacturing the vaccine together with a small return of around 5% that will be reinvested in research and development for second-generation malaria vaccines or vaccines against other neglected tropical diseases.
- MSD's collaboration with PATH MVI and the New York University Langone Medical Center focuses on creating a vaccine that prevents an essential early stage of malaria infection: the invasion of the parasite into a person's liver. The researchers working on this project are focusing on a new approach that targets a region of the circumsporozoite protein (CSP) important to a critical function of the protein. By blocking this function, researchers hope the invasion can be prevented.

Although this vaccine approach is intended primarily for use in children younger than one year of age, it could be used to help prevent disease in all populations vulnerable

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“If we are to defeat malaria, new interventions that complement our existing tools like bed nets are needed. For the last 30 years, we have been striving to unlock the malaria parasite's secrets and develop a vaccine that could protect young children in Africa. Now we are closer than ever to fulfilling that goal and – we hope – helping to end the deadly cycle of malaria.”

– Dr. Sophie Biernaux, Head of the Malaria Vaccine Franchise at GSK

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to *Plasmodium falciparum*, the most deadly species of the parasite, and could potentially be adapted to prevent *Plasmodium vivax* as well.

Stopping Dengue in its Tracks

Among the most devastating potential disease outbreaks in the world is dengue; 40% of the world's population — a total of 2.5 billion people — is at risk from dengue. Global trade, air travel, urban crowding, ineffective vector (mosquito) control, and climate change have contributed to a 30-fold increase in incidence and geographic expansion of the disease over the past 50 years. WHO estimates that there may be 50-100 million dengue infections worldwide each year, resulting in an estimated half a million hospitalizations and 12,500 deaths. Many research-based vaccine manufacturers are working to develop a vaccine.

- Takeda is developing a tetravalent, recombinant chimeric candidate vaccine (currently in phase II) based on a live attenuated dengue 2 virus (DENV-2), which provides the genetic “backbone” for all four vaccine serotypes, with the intent of providing broad protection against this disease.
- GSK is also working to develop a dengue vaccine, expanding a long and growing manufacturing partnership with the Oswald Cruz Foundation (Fiocruz) in Brazil to collaborate on vaccine development. The alliance fosters the cross-fertilization of ideas and technology, as scientists from GSK and Fiocruz work across facilities in Brazil and Belgium.
- Sanofi Pasteur has been working to develop a live attenuated tetravalent vaccine against dengue for 20 years. The results of the two large phase III clinical studies conducted in five countries in Asia-Pacific and five in Latin America, have shown a favorable safety profile with an efficacy against all four serotypes. The overall efficacy in these studies was 56.5% and 60.8% respectively. To date, the company has invested EUR 350 million in the production of the vaccine, including a new dedicated vaccine manufacturing center in Neuville-sur-Saône, France. This R&D program is not occurring in isolation. Sanofi Pasteur is partnering with institutions and leading academics to better understand dengue disease, the corresponding virology and immunology, and support surveillance systems and laboratory capacity.

Developing a vaccine is the first part of the puzzle. The second part is effectively deploying it. In partnership with the French National Centre for Space Studies (CNES), Sanofi Pasteur has developed dynamic spatio-temporal high resolution maps in

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“Dengue threatens over 40% of the world’s population, and yet we have few tools to prevent it. We intend to change this picture, by bringing a safe and effective vaccine to the people who need it, wherever they may live.”

Rajeev Venkayya, MD, President, Takeda Vaccine Business Unit

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Martinique that can pinpoint exact locations where dengue-carrying larvae may grow in order to improve dengue control efficiently. Using a combination of satellite images and environment and weather conditions, epidemiologists can determine daily whether there are areas at risk of dengue and test those at-risk locations in real time. Currently, the study is using individual residential homes as its experimental unit.

Dengue vaccines and their strategic use may soon see the reduction of this debilitating disease.

Continuing Progress on Diarrheal Diseases

According to WHO, diarrheal disease kills 760,000 children around the world each year, making it the second leading cause of death in children under the age of five.^{iv} Rotavirus is one of the leading causes of diarrhea in children globally, but the introduction of vaccines to combat the disease, by MSD and GSK, is a giant step forward in reducing these deaths. The next step will be a vaccine for norovirus.

Norovirus is a leading cause of acute gastroenteritis (AGE) worldwide and impacts all ages.^v While the vast majority of norovirus cases are endemic, there are less frequent but highly visible outbreaks among people living in close proximity. Children under five years of age and older adults are particularly vulnerable, being more at risk from severe or fatal complications.^{vi}

The societal and economic impact of norovirus-related disease in industrialized countries is substantial and can cause significant disruptions for healthcare providers. In the developing world, norovirus is believed to be responsible for more than 200,000 deaths each year among children under five.^{vii}

Norovirus is highly contagious, with only a pinhead of virus particles being enough to infect more than 1,000 people.^{viii} Transmission is primarily from person to person, often through projectile vomiting and diarrhea.^{ix} The virus

has also been shown to remain infectious on contaminated surfaces for at least two weeks (compared with 8 to 48 hours for influenza) and for over two months in water.^{xi,xii,xiii} Classic hygiene measures are, therefore, largely ineffective to prevent the spread of the disease and contain outbreaks.

Immunization against norovirus presents an attractive future public health intervention, especially among populations where the morbidity and mortality of AGE have the greatest impact. As vaccines against rotavirus are introduced, preventing the next most important viral cause of diarrheal deaths is a logical next step.

No vaccine against norovirus disease is currently available. Takeda’s norovirus candidate vaccine is the most advanced in clinical development worldwide and will soon enter phase III trials, covering a range of age groups in industrialized, developing and middle-income countries, to assess safety, immunogenicity, and efficacy.

To secure recommendations for widespread vaccine usage, further assessments of the impact of norovirus-related disease on morbidity and mortality as well as socio-economic costs will be needed. Takeda seeks collaborations with private, national, and global public health institutions in order to strengthen the evidence defining the burden of disease.

Halting Ebola

Ebola is one of the world’s most virulent diseases. It is a severe, often fatal illness that is transmitted to humans from wild animals and spreads among people by direct, physical contact with bodily fluids of an infected person or a person who has died from the disease.^{xiv} Until 2014, the number of people affected each year and the overall disease burden of Ebola was small in comparison to other diseases and outbreaks tended to be sporadic and quickly controlled. Perhaps for this reason, compared to the attention paid to WHO’s 17 neglected tropical diseases, and malaria, HIV and TB which also affect poor countries, Ebola was not prioritized by the international community as an area for research and vaccine development given the focus on other diseases with greater impact on global public health. As a result, no licensed anti-viral treatment or vaccine had been approved against this terrible disease. However, in August 2014, alarmed by a significant outbreak of Ebola in West Africa, WHO developed a comprehensive road map including measures against disease spread, disease diagnosis and care, new health centers, social mobilization, and safe burials, as well as fast-tracking access to experimental treatments and vaccines.



As part of the response to this unprecedented crisis, companies including Janssen and GSK accelerated preventative vaccine development programs.

Johnson & Johnson announced that it was making a commitment of up to USD 200 million to accelerate and significantly expand the production of its Ebola vaccine program. The company is fast-tracking the development of a monovalent combination vaccine regimen specifically against the Ebola Zaire virus. It consists of two vaccine components that are based on AdVac® technology from Janssen and the MVA-BN® technology from Bavarian Nordic. It is targeting production of more than one million doses of the vaccine regimen in 2015, 250,000 of which are expected to be released for broad application in clinical trials by May 2015. The program has received direct funding from the National Institute of Allergy and Infectious Disease (NIAID), part of the US National Institutes of Health (NIH), and is also utilizing NIAID vaccine pre-clinical services. Janssen is bringing this development program forward, in close collaboration with Bavarian Nordic and the NIAID, to allow for initiation of a phase I clinical trial of this combined regimen in humans in early 2015. The collaboration between Janssen and Bavarian Nordic potentially allows for a faster and significant production of the doses required to ultimately halt the spread of Ebola in West Africa, since each company focuses on producing their own respective part of the vaccine combination.

Janssen is also working on the development of a preventive adeno-based multivalent vaccine against Ebola and Marburg viruses. The vaccine is currently in the pre-clinical stage. This development project is financed by the Division of Microbiology and Infectious Diseases (DMID), part of the NIAID.

Through the acquisition of a Swiss/Italian biotechnology company, Okairos, in May 2013, GSK acquired a pre-clinical

vaccine candidate for Ebola (including the Zaire strain responsible for the current outbreak), which had been co-developed by Okairos and the US National Institutes of Health's Vaccine Research Center (VRC). In collaboration with the VRC, this vaccine candidate has been evaluated in pre-clinical studies, the results of which appear promising.

Development of the vaccine candidate is progressing at an unprecedented rate, with first phase I safety trials underway in the USA, UK, Mali, and Switzerland as of November 2014.

As part of an international initiative, funding from partners that include the Wellcome Trust, the UK Government, the Medical Research Council, the Bill & Melinda Gates Foundation, and the European Union aims to help accelerate development of the vaccine candidate in response to the WHO-declared Public Health Emergency. GSK is supporting the accelerated development process. This Ebola outbreak is an unusual and rapidly changing situation with a unique risk/benefit scenario requiring a unique response that needs to be guided by the WHO and others.

With support from the various stakeholders, GSK will be able to manufacture doses of the vaccine candidate so that, if it is shown to have an acceptable safety and immunogenicity profile in phase I trials, it can begin accelerated phase II and phase III assessments. GSK is working with WHO and other partners to explore any feasible ways that the vaccine may be useful to contribute to the control of this or future Ebola outbreaks.^{xv}

Together, these programs are aimed at making a significant contribution to the control of the Ebola outbreak in West Africa, and at providing solution against future potential Ebola outbreaks in endemic areas.

ⁱ G-FINDER report 2013: http://www.policycures.org/downloads/GF_report13_all_web.pdf

ⁱⁱ IFPMA Pharmaceutical R&D Projects to Develop New Cures for Patients with Neglected Conditions: http://www.ifpma.org/fileadmin/content/Publication/2014/IFPMA_Status_Report_Neglected_Conditions_2013.pdf and infographic http://www.ifpma.org/fileadmin/content/Publication/2014/IFPMA_Infographic_NTDs_Jan2014.pdf

ⁱⁱⁱ Dr Margaret Chan, Page v, World Malaria Report 2013, WHO. Available at: http://www.who.int/malaria/publications/world_malaria_report_2013/report/en/

^{iv} "Diarrhoeal disease." World Health Organization. <http://www.who.int/mediacentre/factsheets/fs330/en/>

^v Sharia M Ahmed, et al. *Lancet Infectious Diseases* 2014, Aug; 14 (8): 725-30

^{vi} Mattner F, et al. *Clin. Microbiol. Infect.* 2006

^{vii} Hall AJ, et al. *EID* 2013

^{viii} Population estimate from UNPFA

^{ix} Koopmans M, *Journal of Hospital Infection* 2009

^x Lopman B, et al. *Current Op. Virol.* 2012

^{xi} Ibid

^{xii} *Am J Infect. Control.* 2014 Apr; 42(4): 423-513 13 Kim et al. *Food Environ. Virol.* 2014

^{xiii} Kim et al. *Food Environ. Virol.* 2014

^{xiv} "Ebola: What You Need to Know." World Health Organization. <http://www.who.int/csr/disease/ebola/en/>.

^{xv} For the most up to date information please visit <http://www.gsk.com/en-gb/our-stories/health-for-all/our-contribution-to-the-fight-against-ebola/>

A close-up photograph of a laboratory tray filled with numerous small glass vials, each with a green cap. The vials contain a golden-brown liquid. In the foreground, a pipette is shown dispensing a small amount of the same liquid into a vial. The background is slightly blurred, showing more of the laboratory environment.

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**“A vaccine that sits on the shelf
is useless.”**

- Albert Sabin, the developer of the oral polio vaccine

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Optimizing Production to Meet Growing Demand

Beyond the creation of new vaccines and formulations, research-based vaccine manufacturers are working to save millions of lives by supporting unique programs to increase vaccine availability globally.

Our pursuit of new technologies means we can manufacture more vaccine doses, more quickly than ever before while maintaining the topmost quality. We constantly seek ways to improve our manufacturing facilities and technologies to ensure we can efficiently meet the growing demand.

Manufacturing vaccines requires much more than a simple assembly line. The culture of the biological materials that form the basis of each vaccine can take weeks and even months. This process, as well as the mixing, vial filling, packaging, and labelling processes, must be done in a completely sterile environment, according to fully documented and controlled processes. Tens of thousands of tests are run and recorded by our scientists each month to ensure each process has been perfectly carried out. These standards are set by WHO and individual countries in what are known as Good Manufacturing Practices (GMPs). We follow them to guarantee the constant quality and safety of the vaccines we produce.

We view each step in the manufacturing process as an opportunity for innovation. If we can develop higher-yield cell lines, or identify new, stronger immune-boosting antigens, we can make more vaccine doses available more quickly for the people who need them. Similarly, if we can speed up the process of testing the potency of our vaccines or identify new, time-saving sterility practices, we can accelerate vaccine delivery.

In addition to identifying new technologies to meet demand, we are also expanding capacity by increasing the number of manufacturing facilities. This process can take time as we are committed to meeting the strict GMPs imposed by multiple countries. Where appropriate, we are partnering to build local facilities and identify technology transfer opportunities. Technology transfer and regional production can be an effective and sustainable solution if the necessary economies of scale can be achieved.¹

Once a vaccine has left our manufacturing facilities, our work continues to ensure the vaccine retains its safety and potency all the way through its journey to the person who needs it, up to and including the “last mile” to the vaccination clinic, even in remote areas.

¹ IFPMA infographic – a checklist for transferring technologies: <https://www.flickr.com/photos/ifpma/9149125051/>

Innovation in Vaccine Production

Companies are using the latest technological breakthroughs to improve manufacturing processes and make vaccine doses available more quickly and effectively for the people who need them. Below are a few examples of how Janssen and Novartis are applying these new possibilities.

Creating a High Yield Manufacturing Platform

Janssen is developing a production platform based on the PER.C6[®] human cell line, a comprehensive package of tools designed to facilitate the large-scale production of safe and affordable biopharmaceutical products, including vaccines. PER.C6[®] technology offers major advantages over other platforms including the ability to produce larger volumes of product more quickly and cost-effectively, while meeting increasingly stringent safety requirements and regulations. This intensified process, called the PIN process, can result in very high viral titers and is applicable for several viral vectors and viruses. The company's scientists are continuously working on the further development and optimization of this technology in order to enable the production of affordable vaccines in sufficient quantities.

Novartis has developed an MDCK cell line for production of influenza and other vaccines to eliminate the need for eggs in the manufacturing process, and has implemented this technology for commercial manufacturing of vaccines in Germany and the US. To facilitate a rapid response to newly emerging pathogens, Novartis has developed a process utilizing reverse genetics and cell culture vaccine production to enable the rapid generation of vaccine seeds and significantly reduce the time from declaration of an outbreak to availability of vaccine.

Developing an Adeno-based Platform for Recombinant Vaccine Candidates

Janssen's AdVac[®] technology involves the development and manufacturing of gene transport vehicles ("vectors") made from rare adenoviruses, which are harmless cold viruses. Genetic material from viruses, parasites or bacteria can be inserted into these transport vehicles to make new vaccines against a broad range of diseases. Adenoviral vector-based vaccines have shown the potential to prevent infectious diseases for which current vaccines are not yet perfected or for which licensed vaccines are not available. This adeno-based platform also allows for new manufacturing processes that are capable of reliably delivering large numbers of vaccine doses in a cost-efficient manner. Vaccine development projects based on the AdVac[®] technology are currently in pre-clinical or in clinical testing.

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“When you consider how far vaccine technology has come in the past ten years, it is truly astounding. In university, I could never have imagined our ability to turn human cells into infection-fighting powerhouses. The possibilities to relieve populations from incapacitating and deadly diseases have become endless. At Janssen, we are proud to contribute to the global partners’ efforts in fighting infectious diseases.”

- Johan Van Hoof, Global Therapeutic Area Head, Infectious Diseases and Vaccines, Janssen

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Manufacturing When and Where It Is Needed Most

The demand for vaccines is growing, particularly in LICs and LMICs. As part of our commitment to access, we are developing state-of-the-art manufacturing techniques and sites to ensure vaccine supply meets demand.

Responding Quickly to a New Supply Demand

Pfizer is striving to increase the speed by which it can formulate its pneumococcal conjugate vaccine, Prevenar 13[®]. A collaboration with Jacobs Engineering marries Pfizer's aseptic manufacturing expertise with Jacobs' capabilities in modular engineering, fabrication, and testing to create a Rapid Deployment Module (RDM) that integrates modular equipment, fully-automated control systems, and single-use technology for bags, mixers, sterile connectors, manifolds, and filters. The portable system is scalable for different batch sizes, adaptable for various products, and offers significant cost and schedule advantages compared to large manufacturing facilities with fixed equipment and limited flexibility.

The RDM has been installed in Russia and Argentina for the manufacture of Prevenar 13, with in-country licensure expected in 2015. The RDM provides a fast, safe, and cost-effective means of transferring the complex Prevenar 13 manufacturing process to these markets.

Building Facilities to Support Demand

The Japan International Cooperation Agency (JICA) asked Kitasato Daiichi Sankyo Vaccine, Co., Ltd. (KDSV), a subsidiary of Daiichi Sankyo Co., Ltd., to transfer manufacturing technology of the measles-rubella (MR) vaccine to the Center for Research and Production of Vaccines and Biologicals (POLYVAC) in Hanoi, Vietnam. Globally, more than 20 million people are still affected by measles each year; 95% of measles deaths occur

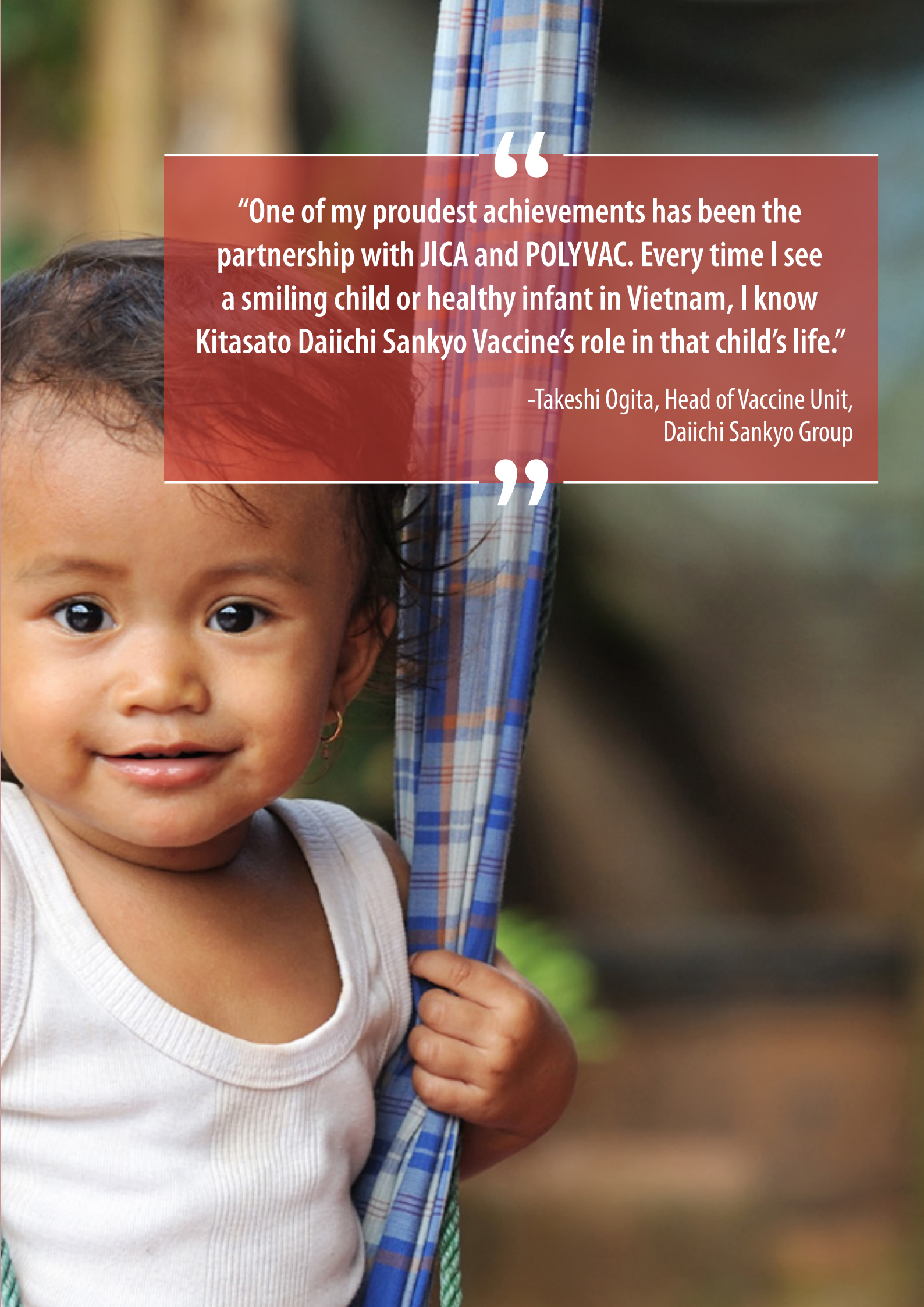
in countries with low per capita incomes and weak health infrastructures, such as Vietnam. Rubella does not only affect the health of infants; when contracted by pregnant women, it can cause risk of congenital disorders in newborns. Therefore, WHO recommends each country to introduce rubella immunization. Rubella incidence rates in Vietnam are also high.

The project was started in May 2013 as part of the Official Development Assistance (ODA) Agreement between Japan and Vietnam the year before. KDSV's MR vaccine project in Vietnam will be completed by the end of 2018 by which time POLYVAC should acquire the capability to manufacture vaccines within the guidelines of WHO's GMPs. This accomplishment is expected to contribute to the lowering of the infection rate of measles and rubella cases in Vietnam, prevent future disease outbreaks, and improve the quality of life for children across Vietnam.

Answering the Need of the Poorest Countries

Sanofi Pasteur and its affiliate Shantha Biotechnics have made significant investments to develop and produce Shan5[®], a pediatric combination vaccine, in order to give more children around the world access to the latest high-quality, fully-liquid, 5-in-1 vaccine and help secure the supply of pentavalent vaccine in over 70 countries emerging and low-income countries.

Shan5[®], which contains diphtheria, tetanus, whole cell pertussis, recombinant hepatitis B, and *Haemophilus influenzae* type b antigens, benefits from the company's 50 years of experience with whole-cell pertussis and combination vaccines, ensuring robust processes and guaranteeing international quality standards.




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“One of my proudest achievements has been the partnership with JICA and POLYVAC. Every time I see a smiling child or healthy infant in Vietnam, I know Kitasato Daiichi Sankyo Vaccine’s role in that child’s life.”

-Takeshi Ogita, Head of Vaccine Unit,
Daiichi Sankyo Group

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“Infectious diseases can change course in the blink of an eye—and in doing so, change the course of a child’s life. Why should a child suffer needlessly from a serious yet vaccine-preventable disease? This is why we must act quickly to ensure that children around the world have access to life-saving vaccines.”

- Susan Silbermann, President
and General Manager, Pfizer Vaccines

Traveling the “Last Mile”

Vaccines face many challenges as they travel from the initial point of delivery to the people who need them. This journey is particularly difficult in what is known as the “last mile”: the final step to reach every child, adolescent or adult who needs to be immunized.

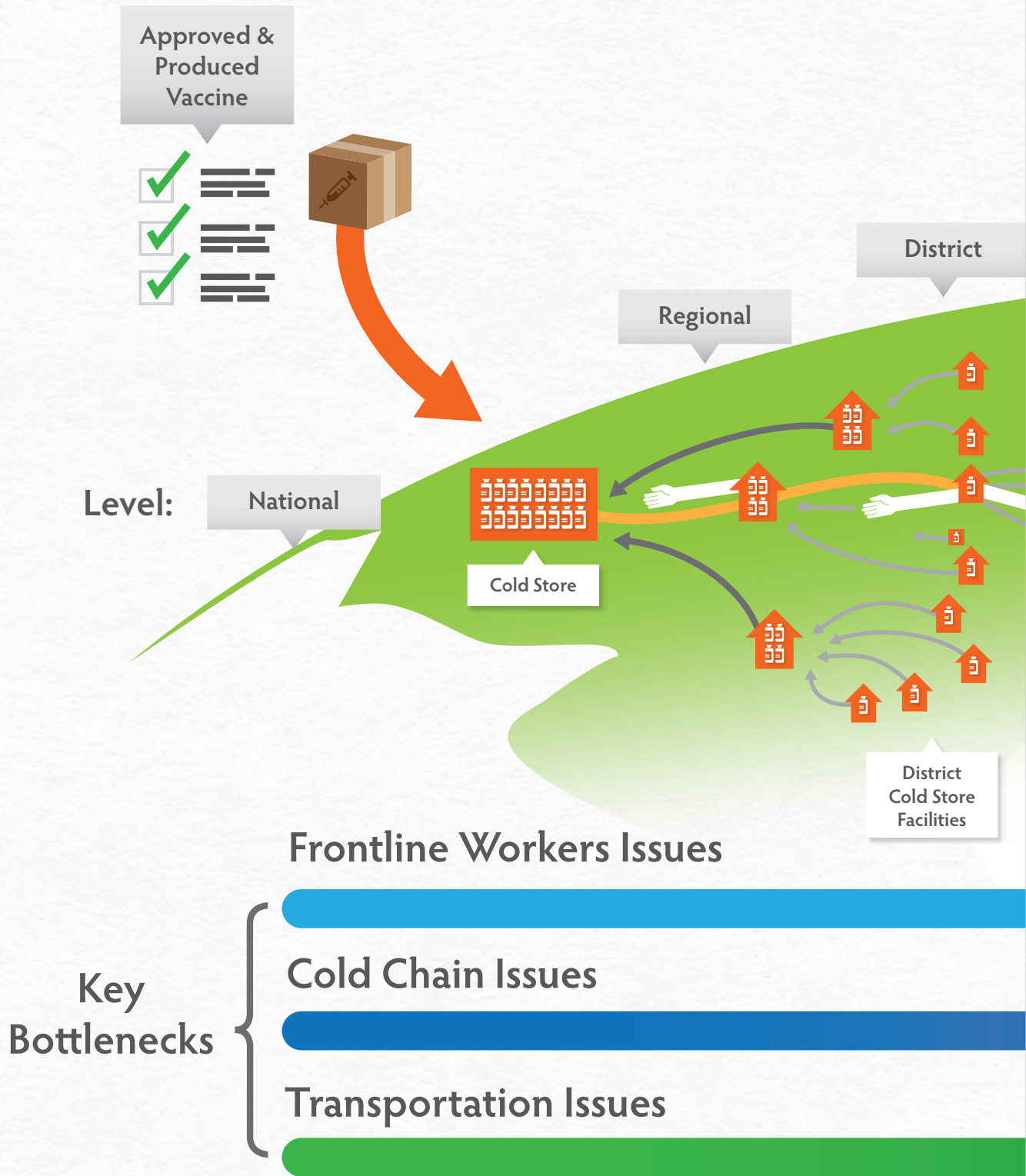
The last mile poses many challenges, such as lack of large transportation vehicles to carry vaccine doses and limited refrigeration. We are working extensively with our partners to ensure that no one is denied immunization protection due to a “roadblock” on this final part of the journey.

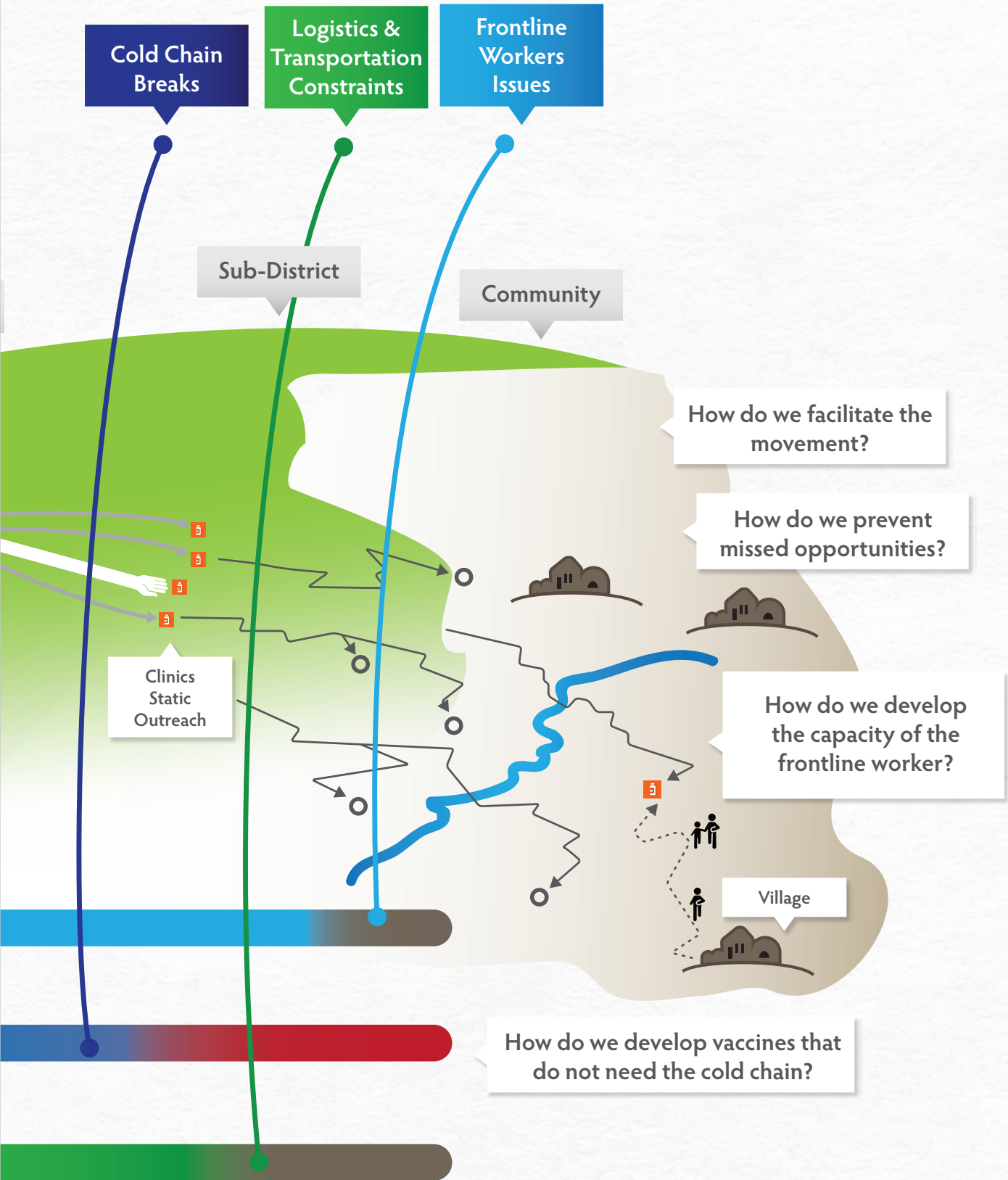
We have focused our attention on three potential issues that can impact vaccine supply: storage temperature, transportation, and availability of suitable formulations.

First and foremost, we are literally creating vaccines that can “take the heat.” Vaccines must stay within a specific temperature range to ensure that they are still effective when they reach their final destination. Therefore, most vaccines have traditionally been refrigerated, a major delivery challenge for countries where resources are limited. Many of these vaccines have not been tested at room temperature. We are therefore applying extensive resources to test the potency of our existing vaccines when they are left outside the refrigerator for a few days and preparing the regulatory submissions in order to obtain a label change. Then, if they are not able to withstand the heat for short periods of time, we are developing critical reformulations as well as incorporating temperature stability as a key component of new vaccines. Here are just a few examples of the crucial vaccines that will soon be available for use in a controlled temperature chain (CTC):

- Cholera: Sanofi Pasteur is upgrading the labeling of its cholera vaccine SHANCHOL® to enable its use in CTC during the last mile in vaccine delivery. A big step in facilitating outreach administration, data has been approved by the national authority and a WHO review is underway.
- Hepatitis B: Janssen is working to qualify its monovalent hepatitis B vaccine, Hepavax-Gene, with a change to its indications for use, enabling it to be kept in extended controlled temperature chain (ECTC) conditions prior to being administered.
- Human papillomavirus (HPV): MSD is teaming up with the Bill & Melinda Gates Foundation and PATH to assess the stability and potency of GARDASIL, MSD’s

Eliminating Roadblocks Along the Delivery Route





Concept developed by Dr. Joan Awunyo-Akaba, CSO Board member, Gavi Alliance & Eunice Peregrino-Dartey, Gavi Alliance CSO Special Advisor; Funded by IFPMA, Gavi CSO Steering Committee; Visual by: www.visualfacilitators.com

quadrivalent HPV vaccine, at temperatures up to 42°C. The company will seek regulatory approval and WHO pre-qualification when the studies are completed. GSK has created a new presentation of Cervarix® designed to reduce its storage space requirements.

- **Malaria:** GSK has entered into a Vaccine Discovery Partnership collaboration with the Bill & Melinda Gates Foundation, which aims to drive advances in vaccine R&D that have the potential to transform global health. In the first project that was initiated under the partnership, GSK and the Foundation are investing a combined USD 1.8 million in early-stage research into vaccine thermostability, with the particular aim of making a key component of GSK's malaria vaccine candidate, the adjuvant system, more thermostable.
- **Pneumococcal Disease:** Pfizer is addressing the need for enhanced temperature stability of its pneumococcal vaccine, Prevenar 13, for cold chain storage and distribution. The company wants to demonstrate that the single dose vials can be removed from refrigeration and remain safe and efficacious at temperatures as high as 40°C for up to three days. GSK has also created a new presentation of its pneumococcal vaccine (Synflorix®) designed to reduce its storage space requirements.

In addition to finding cold chain solutions, we are also addressing transportation space concerns while remaining mindful of the ultimate needs of frontline healthcare workers. They need multi-dose vials for vaccination campaigns, but also single doses for children who come into their clinics for other reasons. Our goal is to make choices available that are easy to transport and administer so that we never miss an opportunity to vaccinate. Through conversations with these workers and other delivery partners, we are anticipating their needs and proactively finding solutions, bridging the gap between global manufacturing and local dispensing.

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“We need to avoid every missed opportunity to immunize the child. Hence the time is long overdue to introduce single doses of all the life-saving vaccines to the GAVI eligible countries, so that children in hamlets/ villages/ remote scattered communities can be reached and immunized. Presently, frontline health workers avoid opening and administering multi-dose vaccines to immunize the ‘remote identified child,’ to avoid vaccine wastage.”

Dr. Mrs. Joan Awunyo-Akaba (Ph.D), Executive Director, Future Generations International (FUGI), Ghana, & GAVI The Vaccine Alliance CSO Board Member.

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Potential Solutions For Common Clinic Needs	
Clinic Need	Sample Solution
<p>Supply of Large Numbers of Vaccine Doses for Mass Vaccination Campaigns</p>	<p>Multi-dose vials facilitate the transportation of large numbers of doses for mass vaccination campaigns, particularly in LICs and LMICs. As an example, Pfizer is currently engaged in the development of a multi-dose vial with preservative for Prevenar 13. In addition to increasing the amount of pneumococcal conjugate vaccine available to the Gavi program, the multi-dose vial presentation will also reduce the cold chain requirements by 75% and still comply with the WHO open container policy. The presentation will be available in all Gavi markets.</p>
<p>More Easily Transported Single-Use Presentations for Clinic Use</p>	<p>Difficult-to-reach areas often struggle with vaccination coverage due to the many extra challenges they face. Therefore, developing vaccine presentations to overcome these difficulties aims to improve local, and thereby, overall vaccination coverage. Pre-filled single-dose injection systems have been specifically designed to overcome these challenges. For example, Janssen, along with partners, has developed a compact pre-filled auto-disable (cPAD) injection systems for its fully liquid pentavalent vaccine (DTwP-HepB-Hib, co-developed in partnership with Novartis).</p> <p>The new presentation within its innovative secondary packaging holds several advantages that can facilitate use, and reduce wastage and contamination risks. Its key features are: compact and lightweight design, the all-in-one injection system, ease of use through the reduction of manipulations required and, of course, the single dose and auto-disable primary packaging. However, the most important benefit lies in its expected improvement of vaccination coverage in these difficult-to-reach areas.</p>
<p>Easier Administration</p>	<p>The easier a vaccine is to administer, the more quickly healthcare workers can vaccinate an entire community. In 2013, GSK entered into a joint venture agreement with Biological E, the Indian biotechnology company, to develop a completely liquid combination vaccine, containing inactivated polio vaccine (IPV), which is intended for the post-polio eradication phase in the developing world. Liquid vaccines both make administration easier and require less storage space.</p>
<p>Track Vaccine Deliveries and Reduce Wastage</p>	<p>Currently, vaccines are not fully traceable along the delivery chain. This can result in patient safety concerns at the point of administration and wastage caused by counterfeit vaccines and expired product. In conjunction with the Gavi Alliance, UNICEF, WHO, and the Vaccine Presentation and Packaging Advisory Group, manufacturers are working to implement an innovative 2D barcode project in all of the Gavi markets. 2D barcodes will support a safe and stable supply of medications and vaccines by bridging the gap between global manufacturing and local dispensing.</p>

We welcome the opportunity to continue working with country-wide and local delivery partners to remove any barriers to vaccinating children, adolescents, and adults. Only by creating sustainable pathways around the world, and in remote communities in particular, can we ensure everyone has access to vaccines for generations to come.



Supporting Strong National Commitments to Vaccination

Key partners in these sustainable pathways are the countries themselves. Ultimately, it is up to governments to prioritize vaccination programs for the people they serve among the many health issues competing for their time and attention. As an industry, we are prepared to support that decision-making process.

We understand that developing an effective vaccination program can be challenging. The research-based vaccine manufacturers, along with supra-national partners such as WHO, UNICEF, and the Bill & Melinda Gates Foundation, are in a unique position to help as we have had an opportunity to view the implementation of many vaccination programs around the world. We are therefore able to lend insights from our experiences to help countries identify ways to maximize the impact of national and local programs, drawing from lessons learned in other countries.

Halting Cervical Cancer

With the stunning discovery that cervical cancer was caused by a virus, specifically human papillomavirus (HPV), scientists rushed to develop a vaccine to prevent the infection. We now have the opportunity to help protect more young girls against cervical cancer thanks to the introduction of MSD's GARDASIL® and GSK's Cervarix® vaccines.

In order to do so, countries must find ways to implement national vaccination programs; 85% of HPV cases occur in less developed regions. Without changes in cervical cancer prevention and control, projected global estimates of deaths are expected to rise to 416,000 by 2035.

Implementing a Strong National Vaccination Program

Eliminating diseases requires strong, locally-run immunization programs. Shortly after the approval of its HPV vaccine, MSD instituted a grant program to assist selected localities design, implement, and evaluate HPV vaccination programs.

The GARDASIL Access Program (GAP) was established to help enable organizations and institutions in eligible LICs to gain operational experience designing and implementing HPV vaccination projects, with the goal of supporting the development of successful child and adolescent immunization models.

Grantees have the assistance of leading experts to navigate barriers as they arise, as well as access to free HPV vaccine donated by MSD. To date, MSD has donated over 1.3 million doses to 25 participants in 21 countries. As the projects near completion, MSD is compiling lessons learned to disseminate for use in other HPV immunization programs and to avoid unnecessary

delays in protecting girls and boys from this cancer-causing virus.

These Programs Work

MSD established a comprehensive cervical cancer prevention program in Rwanda that includes HPV vaccination for girls and HPV screening for women. The program was created in 2011 and allowed for a national HPV vaccination program in grade levels Primary 6 through Senior 3. Rwanda successfully completed a national roll-out of a school-based vaccination program that year, achieving greater than 90% vaccine coverage in the first year. It is projected that Uganda will be the second country to roll out HPV vaccines nationally by the end of 2014.

Since 2013 many Gavi-eligible countries have applied for HPV demonstration programs to pave the way for countries to vaccinate their young girls against cervical cancer. The experience of the GARDASIL Access Program, Rwanda, and Gavi-supported demonstration programs has shown that through their efforts countries are making great strides in building strong programs to ensure their adolescent girls and young women grow up to live healthy and prosperous lives, free of the scourge of cervical cancer.



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“We’re on the brink of realizing a world free of cervical cancer with comprehensive screening, treatment and prevention programs. With the availability of HPV vaccines, we now have important tools to help prevent most cervical cancers, and it’s essential that every young girl and woman has access to these vaccines no matter where they live.”

- Dr. Julie Gerberding, President, Merck Vaccine

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Overcoming Communication Challenges

The standard approach to low immunization rates is to provide the public and healthcare providers with more information on why they should vaccinate; however, evidence shows that this does not work. Companies are tackling this problem by researching the root causes of sub-optimal vaccine coverage.

Understanding the Root Causes of Vaccine Gaps

Janssen is working to determine how, why, and in what direction the vaccine field is evolving by providing an analytical overview of recent developments from the perspective of economic sociology. The project was divided into four parts:

- 1) Historical development of vaccine sector
- 2) New stakeholders in the vaccine sector and international relations
- 3) Investors in the vaccine sector
- 4) Prevention and vaccination perception

Collaborating sociologists and researchers are going beyond existing specialties and focusing on how human interdependencies evolve. This project will contribute to a better understanding of vaccination and society interactions, taking into account different stakeholder perspectives. It may help to develop better approaches for vaccination communication and education, leading to improved vaccination access and coverage for all communities, countries, and regions.

Developing a Framework to Identify and Address Coverage Gaps

Sanofi Pasteur is developing a comprehensive diagnostic and implementation framework that may be applied to any vaccination program that has sub-optimal coverage.

The objective of this program is to understand and diagnose the coverage gap in a vaccination program. This information is then used to develop an evidence-based approach to optimize the impact of vaccination programs. The framework incorporates a novel approach to understanding sub-optimal coverage, called the 5As:

- Access
- Affordability
- Awareness
- Acceptance
- Activation

The vaccine manufacturer has ongoing collaborations with behavioral and social scientists that are informing both the diagnostic and implementation phases of the project with robust measurement of attitudes, intentions, and beliefs, and the subsequent application of this formative research in communication and public engagement initiatives.

Getting the Word Out

GSK has formed a partnership with Vodafone, a telecommunications company, to harness innovative mobile technology to help vaccinate more children in Africa. The increasing use of mobile phones in developing countries offers an opportunity to create innovative and cost-effective ways to address barriers to vaccination. The initiative is designed to encourage mothers to take up vaccination services, support health workers, improve record keeping, and enable better management of vaccine stocks. The partnership project is creating a model in Mozambique that can be replicated and scaled across Africa to reach thousands more children with life-saving vaccinations.





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“We are fully committed to the advancement and adoption of new vaccines and technologies throughout the world. Our collaborations with academic institutions, international groups, and non-governmental organizations have allowed us to accelerate life-saving vaccine development and deliveries in ways we never thought possible. Our ultimate goal is to continue this spirit of collaboration and innovation for generations to come.”

- Eduardo Pisani, Director General, IFPMA

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Controlling, Eliminating, and Eradicating Diseases

The ultimate goal is to control, eliminate, and eventually eradicate vaccine-preventable diseases. Eradication of polio and elimination of measles and rubella are within our reach. Yet eradication or elimination of any disease is a highly complex undertaking that requires the full commitment of not only the global health community but also governments and their citizens.

No one should be denied a vaccine because of where they were born, who they are, or where they live. Only through sustained investment in new vaccine technologies and their effective introduction and roll-out can the global health community have the potential to save millions more of these young lives.

Eradicating Polio

Polio is a disease that has nearly disappeared from the collective consciousness, yet it continues to trigger epidemic outbreaks in certain countries of sub-Saharan Africa, as well as in the Middle East. Although the number of cases has dropped by over 99% since 1988, polio remains a devastating disease for the people it strikes. Polio is still endemic in three countries (Nigeria, Afghanistan, and Pakistan) and the infection has reappeared in several more. That is why, since 2003, annual case numbers have fluctuated between 1,000 and 2,000 and why between 12 and 23 countries report polio cases due to imported polioviruses every year.

Sanofi Pasteur has a longstanding commitment to the global eradication of polio using both live attenuated polio vaccine (OPV) and inactivated polio vaccine (IPV), which it has manufactured since 1964 and 1983, respectively. In partnership with the Global Polio Eradication Initiative (GPEI), Sanofi Pasteur has contributed proactive manufacturing investments to produce high volumes of the vaccine, along with the company's immunization expertise.

Sanofi Pasteur has led and supported the adoption of IPV, for children all around the world, at affordable prices, in multiple partnerships:

- **Making the vaccine in high quantities and in the frame of future eradication:**

A new Sanofi Pasteur manufacturing unit doubling the current manufacturing process lines was designed and built, opening new frontiers in the concept of a building able to manufacture at a high biocontainment level. This conceptualization and design of a high capacity building was done in collaboration with WHO. The manufacturing unit has already been validated and approved by worldwide regulatory agencies and the process scale-up

to the final manufacturing scale validated and implemented. Manufacturing ramp-up is ongoing right now to reach the targeted capacity, with optimal biosafety conditions for personnel and the environment.

- **Getting IPV licensed to allow its deployment within very short timelines:**

WHO faces an immense challenge to get IPV vaccines registered in over 100 countries to allow introduction of this vaccine as part of routine immunization. To achieve this ambitious goal Sanofi Pasteur has partnered with WHO's polio and prequalification teams as well as experts in the French national authorities (ANSM) to rise to the challenge.

- **Offering IPV to support rapid and widespread adoption:**

Sanofi Pasteur and the Bill & Melinda Gates Foundation have developed a joint price support mechanism, including a financial contribution from both organizations. This mechanism allows Sanofi Pasteur to offer IPV at a price of EUR 0.75 per dose (approximately USD 1) to 73 of the world's poorest countries. UNICEF, with support from the Gavi Alliance, will make IPV available for inclusion in routine immunization schedules in these countries.

These commitments and partnerships underscore Sanofi Pasteur's dedication to offer unparalleled volumes of high-quality IPV across a broad range of countries at differential prices in an unprecedented, global rollout. These actions have the potential to remove the remaining obstacles on the road to a world where polio is a disease of the past.



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“Poliomyelitis is the second disease affecting humankind that is on its way to be eradicated. We have been at the forefront of this fight since the seventies, and following many steps and major industrial milestones, now, not only can we imagine a world without polio, but we can make it happen.

- Emmanuel Vidor, Medical Affairs,
Sanofi Pasteur

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Ensuring Healthy Communities for Generations to Come

Vaccination begins and ends in the community: it begins with the emergence of a disease and ends only when the community is protected against it through immunization.

The steps in between – developing a vaccine, manufacturing enough doses to meet demand and ensuring it is administered safely and effectively – are immense, complicated undertakings. Vaccinating a community therefore requires its own network of public health advocates to overcome barriers, including in-country organizations, research-based vaccine manufacturers, and governments.

This ecosystem for vaccine innovation and delivery ensures people have sustainable access to life-saving vaccines while maintaining an environment in which the research, development, and delivery of vaccines can continue for many generations. Only with policies in place that recognize and share respect for the contributions of each partner can we continue to develop life-saving vaccines for every child, adolescent, and adult throughout the world.

Working together, we can defeat some of the most challenging diseases we face today. It requires persistence, creativity, and a continued joint effort to ensure we are not only overcoming the diseases of today, but are also prepared to meet the infections of tomorrow.

Additional Resources

Delivering the Promise of the Decade of Vaccines, IFPMA, 2012 http://www.ifpma.org/fileadmin/content/Publication/2012/IFPMA_Delivering_the_Promise_of_the_DoV_NewLogo.pdf

Delivering the promise of the Decade of Vaccines: Opportunities and challenges in the development of high quality new vaccines, J. Keith et al Vaccine 2013 315 B184-B193 http://www.ifpma.org/fileadmin/content/Global%20Health/Vaccines/Elsevier-Delivering_the_promise_of_the_Dicade_of_Vaccines.pdf

Infographic on Innovative Vaccines Companies and the Decade of Vaccines <https://www.flickr.com/photos/ifpma/8629853047/>

IFPMA World Immunization Week 2014 webpage – Are you up to date about the amazing journey of vaccines and the value they bring along <http://www.ifpma.org/events/ifpma-in-external-events/view/article/world-immunization-week.html>

IFPMA Global Vaccine and Immunization Research Forum event page <http://www.ifpma.org/events/ifpma-in-external-events/view/article/global-vaccine-immunization-research-forum.html>

IFPMA 2014 interview series with Susan Silbermann http://www.youtube.com/watch?feature=player_embedded&v=ybnG_julp30

Charles River Associates Report on Assessing the Value of Biopharmaceutical Innovation in Key Therapy Areas in Middle-Income Countries Key Findings http://www.ifpma.org/fileadmin/content/Publication/2014/CRA_-_2013_key_findings_web.pdf and Full Report http://www.ifpma.org/fileadmin/content/Publication/2013/web_Brochure_CRA_IFPMA.pdf

IFPMA infographic on vaccine research and development (2013) <https://www.flickr.com/photos/ifpma/8630947948/>

IFPMA Pharmaceutical R&D Projects to Develop New Cures for Patients with Neglected Conditions: http://www.ifpma.org/fileadmin/content/Publication/2014/IFPMA_Status_Report_Neglected_Conditions_2013.pdf and infographic http://www.ifpma.org/fileadmin/content/Publication/2014/IFPMA_Infographic_NTDs_Jan2014.pdf

IFPMA case study IFPMA case study Dengue April 2014: http://www.ifpma.org/fileadmin/content/Publication/2014/IFPMA-Case_Study_Dengue_FINAL.pdf

IFPMA infographic – a checklist for transferring technologies: <https://www.flickr.com/photos/ifpma/9149125051/>

About IFPMA

IFPMA represents the research-based pharmaceutical companies and associations across the globe. The research-based pharmaceutical industry's 1.3 million employees research, develop and provide medicines and vaccines that improve the life of patients worldwide. Based in Geneva, IFPMA has official relations with the United Nations and contributes industry expertise to help the global health community find solutions that improve global health.

www.ifpma.org

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