



Draft 3 of the Global Vaccine Action Plan To be presented at the 2012 World Health Assembly

This is a working draft of the Global Vaccine Action Plan (GVAP) that is being submitted to SAGE to seek SAGE recommendations. A revised version that includes SAGE feedback will be shared with the member states missions in Geneva in early March. The final version of the GVAP will be submitted for endorsement to the 2012 World Health Assembly.

1. Introduction

Immunization is, and should be recognised as, a core component of the human right to health and a personal and community responsibility. Vaccination prevents 2.5 million deaths each year.¹ Protected from the threat of vaccine-preventable diseases, immunized children have the opportunity to thrive and stand a better chance of realising their full potential. These advantages are further increased by vaccinations in adolescence and adulthood. As part of a comprehensive package of interventions for disease prevention and control, vaccines and immunization are an essential investment in a country's—indeed, the world's—future.

Now is the time to commit to achieving immunization's full potential. The collective recognition of this opportunity has led the global health community to call for a Decade of Vaccines (DoV).

Decade of Vaccines Vision

The vision for the DoV is a world in which all individuals and communities enjoy lives free from vaccine-preventable diseases. Its mission is to extend, by 2020 and beyond, the full benefits of immunization to all people, regardless of where they are born, who they are, or where they live.

Like any vision, the DoV needs a concrete plan and commitment from all stakeholders to make it a reality. In May 2011, the Sixty-fourth World Health Assembly (WHA) noted the DoV vision and called for the development of a Global Vaccine Action Plan (GVAP). This plan will build on the success of the Global Immunization Vision and Strategy² (GIVS), launched in 2005 as a first-ever ten-year strategic framework to realise the potential of immunization.

Developing the GVAP has brought all stakeholders involved in immunization—including governments and elected officials, health professionals, academia, manufacturers, global agencies, development partners, civil society, media and the private sector—together to define collectively what the immunization community wants to achieve over the next decade. The GVAP identifies concrete actions to make change happen and defines indicators to monitor and evaluate progress. Translating the GVAP actions into results will require that country, regional and global stakeholders identify targets appropriate to their context, customise and prioritise actions, and mobilise resources in order to contribute to shared goals.

This document includes an overview of the immunization landscape, guiding principles for the GVAP, a vision of success for the decade, actions and stakeholder responsibilities required to achieve this vision, estimated resource requirements, and indicators for monitoring and evaluating progress to ensure the DoV vision becomes a reality.



2. The immunization landscape today

Strong progress has been made in the last decade

In the last ten years, great advances have been made in developing and introducing new vaccines and delivering existing ones. More people are being reached than ever before, and the utilisation of existing and new vaccines by age groups other than infants is expanding. As a result of immunization combined with other healthcare interventions, improved access to clean water and sanitation, and better hygiene, the number of children under five years of age who die annually fell from 9.6 million in 2000 to 7.6 million in 2010.³

Immunization has helped drive this reduction in child mortality through expanded coverage of vaccines that have been in use for a long time as well as through the introduction of new ones. Hepatitis B and *Haemophilus influenzae type b* vaccines have become part of national immunization schedules in 177 and 173 countries, respectively⁴; polio is nearing eradication, and a large number of deaths due to measles are being averted every year. Deaths caused by traditional vaccine-preventable diseases (diphtheria, tetanus, pertussis, polio, measles) have fallen from 1.5 million in 2000 to 0.6 million in 2008.^{5,6}

New and increasingly sophisticated vaccines that became available in the last decade—including the pneumococcal conjugate vaccine, the human papillomavirus (HPV) vaccine and the rotavirus vaccine—are currently being rolled out globally.

Efforts are being made to shorten the time lag that has historically existed in the introduction of new vaccines between high- and low-income countries. For example, the 13-valent pneumococcal vaccine was introduced in a low-income country a little more than a year after it had been introduced in a high-income country. Through an innovative international collaboration, an affordable conjugate vaccine against *Neisseria meningitidis* serogroup A was developed and used in the meningitis belt of Africa. There are now licensed vaccines being used to prevent, or contribute to the prevention and control of, 25 diseases (Table 1).

Table 1: Vaccine-preventable diseases

<ul style="list-style-type: none"> • Anthrax • Cholera • Diphtheria • Hepatitis A • Hepatitis B • Hepatitis E • <i>Haemophilus influenzae</i> type b • HPV • Japanese encephalitis 	<ul style="list-style-type: none"> • Measles • Meningococcal disease • Mumps • Pertussis • Pneumococcal disease • Poliomyelitis • Rabies • Rotavirus gastroenteritis 	<ul style="list-style-type: none"> • Rubella • Influenza • Tetanus • Tuberculosis • Typhoid fever • Tick-borne encephalitis • Varicella and herpes zoster (shingles) • Yellow fever
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The rising immunization coverage rates inherent in this progress have resulted from the strengthening of country programmes and improved coordination among local, national, regional, and international partners. Funding from domestic budgets allocated to immunization programmes has risen over the past decade, as has the flow of international resources dedicated to immunization.⁷ According to 2010 WHO immunization programme data, 153 of the world's 193 countries report having a specific budget line item for immunization and 147 have developed multiyear national plans to sustain the gains



achieved, further enhance performance to reach desired goals, and introduce appropriate new vaccines.⁸

Global immunization initiatives have supported countries in building up their systems and introducing new vaccines. Global goals and milestones, established through the GIVS, the United Nations (UN) Millennium Declaration⁹, the UN World Summit and General Assembly Special Sessions on Children and, more recently, the UN Global Strategy for Women's and Children's Health¹⁰ have provided direction to and stimulated action within national immunization programmes. In low- and middle- income countries these have been supported by initiatives such as the GAVI Alliance, the Polio Eradication Initiative, the Measles Initiative, the vaccine procurement scheme of the United Nations Children's Fund (UNICEF) and the Pan American Health Organisation (PAHO) Revolving Fund.

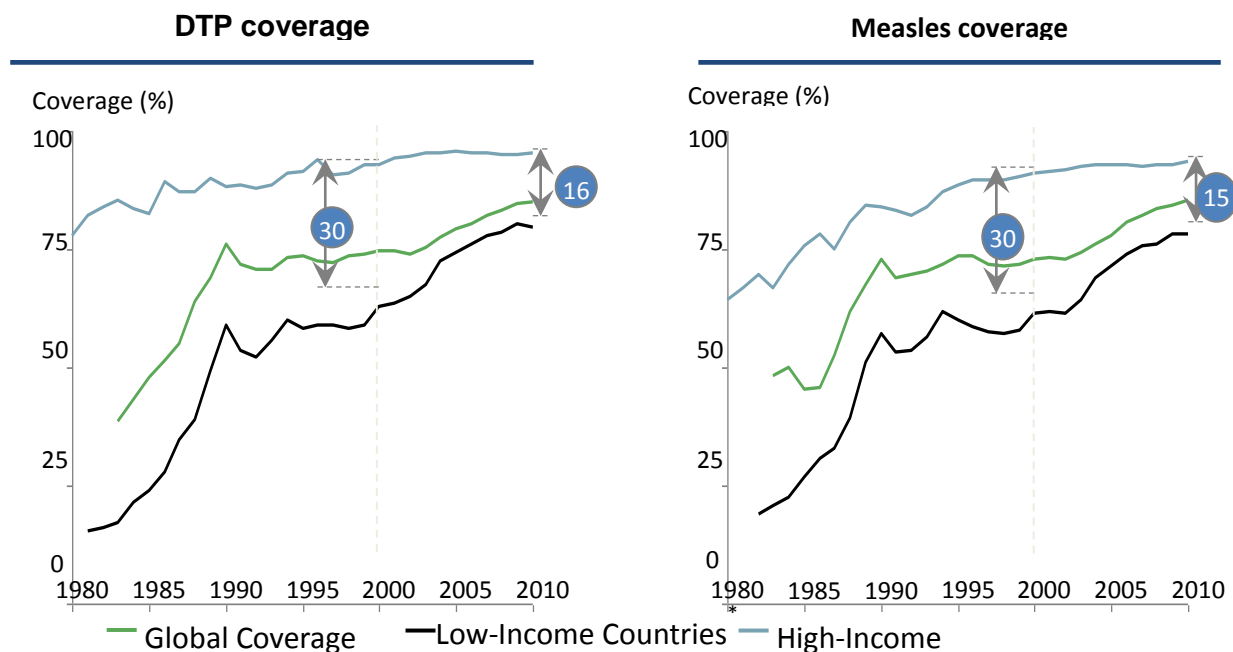
And yet, there are significant unmet needs

In spite of this great progress, vaccine-preventable diseases remain a major cause of morbidity and mortality. An estimated 2 million child deaths each year are caused by infections for which licensed vaccines currently exist and a sizeable proportion of these deaths could be averted through universal access to these vaccines.¹ Adoption of new vaccines by low- and middle-income countries (where disease burdens are often the highest) has been slower than in high-income countries. For example, in 2010 18 percent of high-income countries but only 6 percent of low-income countries had introduced the rotavirus vaccine.⁴

Coverage gaps persist among high-, middle-, and low-income countries, as well as within countries, often varying within populations according to income level and geographic location. The average coverage of the DTP and measles vaccines in low-income countries was 16 and 15 percentage points below that of high-income countries in 2010, respectively.¹¹ However, there is a positive trend if one looks at the coverage gap in the year 2000, which was 30 percentage points lower for DTP and measles, respectively.



Figure 1: Comparison of DTP and measles vaccine coverage rates in low- and high-income countries



* Country income categories (defined by World Bank) as of 2009.
Source: World Bank aggregates based on WHO and UNICEF data.

In the rural areas of some countries, coverage by the measles vaccine is 33 percent lower than in urban areas. Similarly, the measles vaccine coverage rate for the richest 20 percent of the population in some countries is up to 58 percent higher than for the poorest 20 percent.¹² Coverage can also be very low in settlements of the urban poor, especially in cities with transitory migrant populations, and in indigenous communities.

Low coverage does not always correlate with geographic distance from health centres; inequities are also associated with income, age, gender, race, religious beliefs, physical attributes and other causes of social isolation. A special geographic focus is needed on large-population, lower-middle-income countries, where the majority of the unvaccinated live. Reaching underserved populations will be especially challenging, but inequities must be addressed because these populations often carry a heavier disease burden, may also lack access to medical care and basic services, and have severe disease-related impact on their fragile economies.

This decade will bring new opportunities and challenges

Individuals and communities, governments and health professional have the primary responsibility to take advantage of the opportunities and confront the challenges that this decade will bring. New and improved vaccines are expected to become available during this decade, given the robust vaccine pipeline that includes a number of products for diseases that are not currently preventable through vaccination. The introduction of new vaccines targeted against important, but not all pathogens, of major killer diseases such as pneumonia, diarrhoea and cervical cancer, can be used as a catalyst to scale up complementary interventions. Beyond the mortality gains, these new vaccines will prevent morbidity



with resulting economic returns, even in low and middle income countries that have achieved low child mortality.

Innovations in existing vaccines will bring additional benefits, such as greater effectiveness, thermostability, easier administration, and lower cost. At the same time, the development of vaccines and other immunization innovations are facing increasing complexity of manufacturing and regulatory processes, as well as rising research, development, and production costs. As new vaccines (for example, dengue, hookworm, leishmaniasis, malaria, and improved TB) become available and underutilised vaccines (for example, those against HPV, cholera, typhoid, rotavirus, rabies and rubella) are applied more widely, already stressed supply-and-logistics systems will face an even greater need for innovations in vaccine delivery. Finally, with the increasing number of vaccines and the complexity of delivering them in a timely manner, the number, knowledge and skills of health workers in immunization programmes will need to be enhanced, better coordinated and better supervised.

Immunization funding needs for research and development, procurement and delivery are expected to grow markedly in the coming decade. New and more complex vaccines will bring new funding requirements, and countries will confront difficult decisions in dealing with competing health priorities. Resources will need to be allocated more efficiently and guided by national priorities, capacity, clear information on the costs and benefits of choices, and improved financial management. Also, it will be critical to ensure and increase national and international financial commitments to immunization while promoting greater country ownership. At the same time, the economic gains from immunization must be appreciated by all stakeholders.

As the economies of many low and middle income countries continue to grow, so will their potential to fund immunization. Countries that have relied on development assistance will be able to fund an increasing proportion of their immunizations programmes and eventually fully sustain them. Some will be able to extend new financial and technical support to global immunization projects. At the same time, vaccine manufacturers in some of these countries are expected to make an even more significant contribution to the supply of high-quality, affordable vaccines, spreading the sources of production more widely, and increasing competition.

In addition, the growing availability of information, penetration of mobile phone coverage and expanding social networks will play an essential role in boosting public demand for immunization and ensuring that people are made aware of both the benefits derived from vaccines and the possible associated adverse events. This information will be based on scientific evidence and will be disseminated widely, enabling intended vaccine recipients to make informed decisions. Through the use of new communication technologies, quality information will be shared more widely and efficiently. The immunization community needs to learn to use social networks and the electronic media more effectively to allay fears and create awareness and trust.

The last century was in many aspects the century of treatment, with dramatic reductions in morbidity and mortality due to antibiotics and chemotherapy. This century promises to be the century of prevention. Ensuring that the DoV vision becomes a reality is a first powerful step in that direction.



3. Guiding principles

Six principles have guided the formation of the GVAP. These six principles should be the cornerstones of GVAP implementation throughout the Decade and beyond:

- **Country ownership:** Countries have primary ownership and responsibility for establishing good governance and providing effective and quality immunization services for their citizens. This means ownership by all stakeholders within a country, not just governments.
- **Shared responsibility and partnership:** Maintaining active immunization against vaccine-preventable diseases is a personal and community responsibility that transcends borders.
- **Equitable access:** Equitable and affordable access to immunization is a core component of the right to health.
- **Integration:** Strong immunization systems, which are part of the broader health systems and closely coordinated with other primary health care delivery programmes, are essential for achieving immunization goals.
- **Sustainability:** Informed decisions and implementation strategies, appropriate levels of financial investments, and improved financial management and oversight are critical to ensure the sustainability of immunization programmes.
- **Innovation:** The full potential of immunization can be realised only through learning, continuous improvement, and innovation in R&D and across all aspects of immunization.

Although the GVAP will need to be translated into specific country and community contexts, these guiding principles should be upheld in all settings and under any circumstances.

4. Measures of success at the end of the decade

Success at the end of the decade means the following goals are achieved by 2020:

- **Certification of Poliomyelitis eradication;**
- **Neo-natal tetanus is eliminated;**
- **Measles is eliminated** in at least five WHO regions **and an eradication date is defined;**
- **Rubella and congenital rubella syndrome are eliminated** in at least two WHO regions¹³;
- **Currently available and underutilized vaccines are scaled-up, growing the average coverage to at least 90% nationally and at least 80% in every district or equivalent administrative unit;**
- **One or more new vaccines that are currently in advanced stages of clinical development for diseases currently not vaccine preventable** (such as dengue, hookworm, leishmaniasis, malaria, and improved TB) are developed, licensed and introduced;
- **Under 5 mortality rates declines significantly** when compared to 2010 levels.

During this decade, hundreds of millions of cases and millions of future deaths will be averted by expanding access to immunization, through increased coverage of existing and rapid scaling up of appropriate new vaccines. For example, with the envisioned scaling-up of nine¹ currently available and underutilised vaccines **XX to XX million future deaths could be averted**, which will in turn result in **up to \$XXX billion of productivity gained** through the power of immunization (this estimate only accounts for

¹ Nine vaccines include HepB, Hib, Pneumo, Rota, HPV, Yellow Fever, MenA, JE, and Rubella.



the economic impact of the deaths averted, the full impact would be higher given morbidity reductions and impact in health care costs).

To advance progress towards these goals, the outcomes of a successful Decade will include the following:

- **Outcome 1—All countries commit to immunization as a priority.** This translates into good governance, human and financial resources, robust decision-making, planning and ownership that are prerequisites for sustainable progress towards the above mentioned goals.
- **Outcome 2—Individuals and communities understand and demand immunization as both their right and responsibility.** This will empower individuals and communities to demand their entitlement, value the benefits of immunization and help reduce vaccine hesitancy. As new and stronger advocates at the community level demand immunization services, they will hold their governments accountable, reinforcing country commitment to increase coverage rates.
- **Outcome 3—The benefits of immunization are equitably extended to all people.** An equity approach will increase coverage among underserved populations with existing and appropriate new vaccines, and also include new risk groups across the life-course. Equity is essential to achieve the goals of morbidity and mortality reduction, as well as elimination and eradication.
- **Outcome 4—Strong immunization systems that are an integral part of a well functioning health system.** A strong immunization programme, as part of a strong health system, will ensure coordinated delivery between preventive and curative interventions to maximize impact on morbidity and mortality, particularly for diseases where vaccines target some but not all pathogens that cause disease syndromes such as pneumonia and diarrhoea.
- **Outcome 5—Immunization programmes have sustainable access to long-term funding and quality supply.** This will ensure that the necessary funding and supplies (vaccine and non-vaccine) are available to generate and meet demand, reach underserved populations and strengthen health systems.
- **Outcome 6—Country, regional, and global R&D efforts maximise the benefits of immunization.** Continued R&D efforts will allow for other major causes of morbidity and mortality to become vaccine preventable. R&D conducted during this decade will also enable cost-effective vaccines, efficient delivery systems and monitoring and evaluation tools for immunization.

Achieving the DoV vision will require that all stakeholders involved in immunization are accountable for adhering to these DoV guiding principles and align their efforts towards achieving these goals and outcomes. Progress over the course of the decade should be monitored and evaluated on the basis of increasingly robust and timely data, leveraging indicators being proposed by the GVAP. Individual responsibilities of the different stakeholders, including the overall monitoring and progress tracking will be defined through an accountability framework.



5. Required actions to achieve desired outcomes

Outcome 1: All countries commit to immunization as a priority.

Committing to immunization as a priority first and foremost means recognizing the importance of immunization as a critical public health intervention and the value that immunization represents in terms of health and economic returns. It means setting ambitious but attainable country-specific targets and allocating adequate financial and human resources to programs to achieve these targets. It also means having a national immunization plan formulated with the participation of all major stakeholders in the country and with the necessary political and administrative endorsement. National immunization plans should be part of national health plans and accompanied by an appropriate budget for immunization, a mechanism for stakeholder coordination, and a mechanism for monitoring and evaluating progress. Country commitment to immunization as a priority should under no circumstances come at the expense of other health programmes.

Convincing evidence is important to build consensus and to facilitate the establishment of appropriate legislation, and policies and allocation of the requisite financial resources. Different models should be explored (for example, formation of a portal or network) to promote collaboration between the technical experts who generate the evidence and champions of immunization who construct context-specific messages that highlight the importance of immunization within health and social services. In particular, collaborations between technical experts and champions should help better articulate and highlight the ways in which immunization supports equity and economic development.

Independent bodies (for example, National Immunization Technical Advisory Groups, NITAGs) that guide country policies and strategies should be created or strengthened, thus reducing dependency on external bodies for policy guidance. These bodies need to be supported by institutions or individuals charged with collating and synthesizing information required for informed decision-making. Regional support systems and initiatives, such as the PAHO ProVac initiative^{2, 14}, should be established to support countries in strengthening their decision-making.¹⁵

It is important that decision-making bodies (for example, NITAGs) engage with academia, professional societies, the national medicines and vaccine regulatory agencies (NRAs), health-sector-coordination committees (HSCCs), and interagency coordination committees (ICCs) to ensure a cohesive and coordinated approach to achieving national health priorities. Strong links between Ministries of Health, Education³, Finance, Human Resources and elected officials are also essential for efficient programme implementation.

Support and formal endorsement of national policies and plans by the highest political and administrative levels both nationally and sub-nationally is essential to ensure the sustainability of commitments. Governments and elected officials are responsible for putting in place needed legislation, budgets, and programme improvements. Elected officials should scrutinize, defend and more closely follow immunization budgets and immunization program activities, both at the national level as well as

² ProVac is a package of tools for generation of cost-effectiveness, epidemiological and economic impact of new vaccines and for training and strengthening national infrastructure for decision-making

³ Especially important for delivering immunization to older children and adolescents through school health programmes and for monitoring school entry requirements with immunization.



within their respective constituencies. Civil society organisations (CSOs) should advocate for increased commitments and hold governments accountable to commitments once they are made. Governments, elected officials and CSOs should all proactively engage the media. For high income countries and countries with emerging economies, commitment to immunization should include maintaining or assuming the role of development partners. Together with global agencies, development partner countries can coordinate the sharing of information and best practices among countries, help bridge temporary funding gaps, and support capacity building by working with local stakeholders.

Table 2: Summary of recommended actions for Outcome 1

All countries commit to immunization as a priority	
Establish and sustain commitment to immunization.	<ul style="list-style-type: none"> • Ensure up-to-date vaccine legislation in all countries, including provisions for public funding and for monitoring and reporting. • Develop comprehensive national-immunization plans that are part of overall national-health plans through a bottom-up process including all stakeholders. • Set ambitious but attainable country-specific targets within the context of morbidity and mortality reduction goals. • Scrutinise, defend, and more closely follow immunization budgets and immunization program activities.
Convince decision makers of the value of immunization.	<ul style="list-style-type: none"> • Explore models to promote collaboration between evidence generators and evidence users • Articulate and highlight equity arguments for immunization. • Articulate and highlight economic arguments for immunization. • Include immunization in the agendas of governing body meetings at all levels and in other social, health and economic forums
Strengthen local decision-making.	<ul style="list-style-type: none"> • Create or strengthen independent bodies that guide country decision-making (for example, NITAGs). • Develop more effective ways for national regulatory agencies (NRAs), health-sector-coordination committees (HSCCs), and interagency coordination committees (ICCs) to support immunization programmes. • Create regional forums and peer-to-peer exchange of information, best practices, and tools. • Create expanded, more transparent mechanisms for aggregating, sharing, and using information to monitor commitments.

The strength of each **country's commitment to immunization** over the course of the decade will be monitored by tracking the following indicators:

- *Presence of up to date legislation that includes establishment of a national immunization plan for effective delivery of vaccines*
- *Presence of independent technical advisory group that meets defined criteria*
- *Number of WHO recommended vaccines in national immunization schedule*
- *% of target population immunized with 3 doses of DTP containing vaccine*
- *% of target population immunized with other WHO recommended vaccines*
- *% of routine immunization costs financed through government budgets*
- *% of immunization financing gap (as projected in cMYP) met by development partner countries*
- *For GAVI-supported countries: % of co-financing requirements met and % of supported vaccines that continue to be funded post-graduation (Note: selected to reflect the unique circumstances of GAVI countries)*



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Outcome 2: Individuals and communities understand and demand immunization as both their right and responsibility

Significant improvements in coverage and programme sustainability are possible if individuals and communities understand the benefits and risks of immunization, are empowered to demand their entitlements, and provided the space to participate in the planning and implementation of programmes within their local communities. Generating demand has the potential to transform immunization at both programmatic and political levels. At the programmatic level, demand generation means promoting participation in immunization activities, thereby increasing coverage of currently underserved populations or well-served populations where there is rejection of immunization. At the political level, demand generation means mobilising advocates to hold governments and programmes accountable for their immunization commitments. Thus, generating individual and community demand reinforces country commitment to vaccines and immunization (Outcome 1). Activities to generate demand for vaccines and immunization should build on the broader movement to help people hold their governments and private sectors accountable for access to health services.

In order to generate individual and community demand, new strategies are needed to promote the benefits of immunization. Strategies should use social media tools and tactics from commercial and social marketing efforts, not just to promote immunization but also to counter misinformation often spread through the electronic media. New mobile and internet technologies should also be utilized. Efforts can draw on the successes of other innovative public health campaigns (for example, HIV/AIDS prevention). Efforts should emphasize immunization as a core component of the right to health and proactively communicate the risks and benefits of immunization to individuals, communities and the media in order to address misguided concerns. Communications and social research to identify the barriers and drivers of vaccination should inform the development of context-specific messages. Lessons on vaccines and immunization should be included in the basic education curriculum.

Programme strategies could also include measures that create incentives for individuals and community health workers to fulfil their immunization responsibilities, provided that they respect the autonomy and informed consent of beneficiaries. Potential incentives include conditional cash or in-kind transfers, bundling of immunization with curative services, or media recognition (for example, for community leaders). Here social research is also needed to determine the conditions under which incentives contribute to improved coverage and which types of incentives are appropriate for a given context. For example, preliminary evidence on conditional cash and in-kind transfers is encouraging in places where vaccination rates are relatively low, but rigorous evaluation of the design and implementation will need to be done in every setting to get the effects right and make sure the intervention is cost-effective. Also, mechanisms must be in place to ensure availability of supply.

Making change happen will require meaningful participation of individuals and communities in the development and implementation of all demand generation strategies. It will also require new and stronger advocates who have the local knowledge, credibility and frontline experience necessary to



drive change. Participation of in-country CSOs will be crucial to developing strong advocacy efforts and should be supported by CSOs capacity building efforts. Here again an effort that promotes collaboration between evidence generators with evidence users could provide training for champions and link with local social and professional networks, which are an important source of grassroots immunization champions. Health care workers should receive communications training so that they can effectively communicate with the media and with local communities when there are reports of serious adverse events following immunization in order to allay fears and address vaccine hesitancy. Current advocates must recruit new voices – potentially including educators, religious leaders, traditional and social media figures, family physicians, community health workers and trained immunization champions. Researchers and technical experts will also have an important role in creating greater community awareness and providing credible responses to misinformation regarding immunization.

Table 3: Summary of recommended actions for Outcome 2

Individuals and communities understand and demand immunization as both their right and responsibility	
Promote the benefits of immunization.	<ul style="list-style-type: none"> • Proactively communicate the risks and benefits of immunization to address vaccine hesitancy. • Utilise social media tools and lessons from commercial and social marketing efforts. • Leverage new mobile and Internet-based technologies. • Include immunization in the basic education curriculum. • Conduct communications research.
Create incentives to stimulate demand	<ul style="list-style-type: none"> • Create incentives for immunization while respecting the autonomy of beneficiaries (for example, cash or in-kind transfers, bundling of services, media recognition). • Conduct social research.
Build advocacy capacity.	<ul style="list-style-type: none"> • Train health care workers on effective communication techniques, esp. to address vaccine hesitancy and to respond to reports of serious adverse events following immunization in order to maintain trust and allay fears. • Create national or regional advocacy plans that involve CSOs. • Build capacity of CSOs. • Recruit new voices, including those of educators, religious leaders, traditional and social media personalities, family physicians, community health workers, and trained immunization champions (among others). • Link global and national advocacy efforts with social and professional networks at the community level.

The evolution in **individuals understanding and demanding immunization** over the course of the decade will be monitored by tracking the following indicators:

- *Indicator(s) capturing knowledge, attitudes, beliefs, and practices on immunization (Note: To develop this indicator, a new research agenda is needed. Data will likely need to be collected via survey and sources may differ by country; existing surveys (DHS, MICS, and KAP) could be leveraged or, if needed, new surveys could be developed)*
- *Indicator based on analysis of media coverage on immunization (immunization week and rest of year) (Note: although it doesn't currently exist, this indicator should be possible to define in the near term and as such can serve as a short-term proxy for the first indicator. To develop this indicator existing expertise in the field of media will need to be leveraged).*



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Outcome 3: The benefits of immunization are equitably extended to all people

Today, four of every five children receive at least a basic set of vaccinations during infancy and are therefore able to lead healthier, more productive lives. In this decade, the benefits of immunization should be more equitably extended to children, adolescents and adults. Achieving this outcome will mean that every eligible individual is immunized with all appropriate vaccines, irrespective of geographic location, age, gender, disability, educational level, socioeconomic level, ethnic group or work condition, thereby reaching underserved populations and reducing disparities in immunization both within and between countries. Because disease burdens tend to be disproportionately concentrated in more marginalised populations, reaching more people will not only mean achieving a greater degree of equity, but will also mean having a greater health impact.¹² Furthermore, disease eradication and elimination goals cannot be met without achieving and sustaining high and equitable coverage.

In 2002, WHO, UNICEF, and other partners introduced the concept of Reaching Every District¹⁶ (RED), a first step toward achieving more equitable coverage. Through its various operational components—which include re-establishing outreach services, providing supportive supervision, linking services with communities, monitoring and use of data, and district planning and resource management—the RED strategy was able to expand the provision of immunization services. Similarly, initiatives aimed at disease eradication and elimination or rapid mortality reduction have used strategies such as national or sub national immunization days (for polio eradication) and supplementary immunization activities (for measles and rubella elimination, measles mortality reduction and neonatal tetanus elimination). More recently strategies collectively referred to as periodic intensification of routine immunization (PIRI) have been used to reach the unreached with immunization, packaged with other primary health care interventions.

Nevertheless, even these strategies continue to miss populations, for example those that reside outside of traditional social and governmental structures. To sustain the gains of these historical efforts and achieve and sustain disease control goals, the RED strategic approach should be recast as “Reaching Every Community.” To attain more equitable coverage, the definition of community should be expanded beyond geographically defined communities to also include communities defined by other characteristics that are often associated with dominant patterns of deprivation.

The first step in implementing the Reaching Every Community approach will be the development of tools to identify everyone who needs access to immunization services. Today, many health programmes are set up to act only “when they come across their target group” rather than to actively seek, track, and follow the status of all individuals. Despite registers, vaccination cards, and monthly reports, newborn babies sometimes are not brought into the system, and even when they are, follow-up for additional vaccinations over their life-course is poor. In addition, the current aggregation of data as they are reported upward removes a level of granularity that would otherwise allow immunization programmes to tailor solutions to specific underserved communities and groups.



To address these gaps, individuals should be given, as early as possible in life, a unique identification number. Some countries have started to introduce national-identification-number systems, which this innovation could leverage. Other countries may need to design such systems from zero. By linking this number to each dose of vaccine given and maintaining a centralised database, modern communication technology can track each individual's immunization status, alert individuals or their parents and health workers of doses due, and report on coverage. Other health interventions and important disease episodes should be recorded in a similar way through the same system, turning the immunization card into a true health card.

Once underserved communities have been identified, specific plans should be developed to reach them. To reach communities that for social or geographic reasons do not have access to health systems, in-country stakeholders can develop tailored, targeted strategies for reducing inequities. Specific strategies to reach underserved and marginalised groups should include vulnerability assessments and the development of community-tailored microplans. Although microplans have historically been focused on geographic units at the district or sub-district level, their use can be expanded to other marginalised communities, like religious groups, urban migrants, and ethnic minorities. Drawing on the experiences of successful polio vaccination campaigns, in-country-stakeholders can also use approaches like decentralised planning and outreach to populations that are remote, nomadic, or historically have been marginalised. New strategies for reaching the urban poor and urban migrants will also be necessary. Given the tenuous and evolving community structures, the extremely inadequate security, and the fact that sometimes the most unifying force in these urban and peri-urban areas is a shared and deep-seated mistrust of outsiders, especially governments, new approaches to community outreach will be especially critical for reaching these groups.

Historically, it took decades before new vaccines used in high-income countries became available in low- and middle-income countries. Steps are being taken to address this inequity, including introduction of new vaccines through support provided by the GAVI Alliance, however much more needs to be done to sustain and extend these gains. In particular, faster access to new vaccines has to be extended to countries not covered by current mechanisms, such as GAVI support and PAHO revolving fund. In addition, immunization programmes should also develop specific plans to support life-course immunization, particularly as vaccines (for example, those against HPV and influenza) aiming at different age groups emerge. This will not only mean creating strategies for reaching individuals across their life-course, but also developing plans for the systems that will monitor and track progress with respect to life-course immunization. Likewise, targeted plans should be developed to ensure access to immunization during humanitarian crises, outbreaks and in conflict zones. These plans should include a focus on communication and should also include provisions for the development of vaccine stockpiles, among other things.

Social and operational research is needed to inform the design and test the effectiveness of all these strategies. Key areas of focus for this research could include identifying the main causes of low coverage, assessing economic barriers to immunization, understanding the best approaches for reaching individuals of various ages, and assessing what incentives work best for reaching different groups, among others.

To implement these strategies, collaboration will be critical. Equity-based immunization programmes should partner with CSOs and take advantage of community structures (for example, working with



religious leaders and traditional birth attendants, and using birth registries) to enhance communication and provide services. Partnerships with CSOs will also be crucial for reaching and gaining the trust of communities that are not defined by geography. Partnerships with the private sector should also be explored to facilitate delivery to rural areas or other hard-to-reach communities. Public-private partnerships will be needed to design, adapt, and manage new tracking systems with the most up-to-date knowledge. Partnerships across government sectors (for example, with educational institutions) and coordination with programmes that focus on vulnerable populations will likewise be essential. To support these collaborations, governments must allocate increased resources to underserved communities and ensure programmes have sufficient, well-trained personnel to execute strategies effectively. In addition, efforts to provide high-quality immunization services to all children will need to continue unabated so that gains to date are not lost.

Table 4: Summary of recommended actions for Outcome 3

The benefits of immunization are equitably extended to all people	
Reach Everyone.	<ul style="list-style-type: none"> • Recast "Reaching Every District" to "Reaching Every Community" • Develop or coordinate with existing national-identification-number systems to improve immunization information and tracking and to inform outreach or targeted strategies. • Introduce appropriate new vaccines into national immunization programmes • Establish a life-course approach to immunization planning and implementation, including new strategies to assure equity across the life span. • Prevent and respond to vaccine-preventable diseases during disease outbreaks, humanitarian crises, and in conflict zones. • Conduct operational and social science research to identify successful strategies to reduce inequities and improve the quality and delivery of immunization services. • Engage underserved and marginalised groups to develop locally tailored, targeted strategies for reducing inequities.
Engage communities.	<ul style="list-style-type: none"> • Develop and empower community health workers to use information to identify and serve missed populations (for example, provide incentives and equip the workers with mobile technology). • Take advantage of community structures to enhance communication and deliver services (for example, traditional birth attendants, birth registries). • Involve CSOs in community outreach and planning. • Develop new approaches to community engagement for urban and peri-urban areas.

The degree to which **the benefits of immunization are equitably extended to all people** over the course of the decade will be monitored by tracking the following indicators:

- % of districts (or lowest possible administrative level) with less than 80% coverage with 3 doses of DTP containing vaccine against baseline (Note: selected as the standard measure of equity across countries given data availability and high relevance to most countries)
- % progress against baseline for coverage with 3 doses of DTP containing vaccine by dominant pattern(s) of deprivation for country (as defined by countries) (Note: selected to reflect the need for country-specific approaches to measuring improvements in equity. Data collection likely to be every few years by survey)
- % of children protected at birth against tetanus at district level (or lowest possible administrative level) (Note: selected to capture equity across the life-course and because the lack of PAB is closely tied to social marginalisation and lack of access to health system)
- Number of WHO recommended vaccines in national immunization schedule



- *% of target population immunized with other WHO recommended vaccines*

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Outcome 4: Strong immunization systems that are an integral part of a well functioning health system

The many interconnected components of an immunization system require multi-disciplinary attention to build a cohesive, non-fragmented and well-functioning programme that coordinates and works in synergy with other primary health care programmes.

Immunization delivery platforms have and should continue to be used to deliver other interventions (for example, Vitamin A, deworming, bednets). Furthermore, as new vaccines become available that target some but not all pathogens that cause diseases, such as pneumonia, diarrhoea and cervical cancer, it is important that their introduction is used as an opportunity to scale up the delivery of other complementary interventions in a coordinated and synergistic manner in order to control these diseases. For example, the vaccines against pneumococcus and rotavirus (diseases that together account for almost one-third of all child deaths) should be complemented with other actions to protect, prevent, and treat. A child's chance of escaping from a potentially deadly bout of pneumonia or diarrhoea, even after vaccination, increases significantly with adequate nutrition, good hygiene practices, a clean environment and, in severe cases, access to treatment.

New vaccine deployment should therefore be accompanied by comprehensive disease-control plans both within countries and globally. Coordination of immunization with other services should take place at all levels of a country's programmes, involve outreach efforts and participation by health centres, and should be part of programme management. Coordinating immunization with integrated primary-health-care programmes may also facilitate social mobilisation efforts, helping to generate community demand for services (Outcome 2) and address inequity (Outcome 3). Additionally, efforts should be made to ensure that global vaccine programmes focused on eradication and elimination goals (for example, polio and measles campaigns) are incorporated into immunization programmes more broadly and do not operate in silos.

Coordinated approaches to the delivery of immunization and other services rely on strong health systems. Health systems encompass a range of functions from policy and regulation to information and supply chain systems, human resources and overall programme management and financing. Some of these functions have been dealt with in other sections of this document. This section discusses the actions required to strengthen the information, human resource, supply chain and logistics components of health systems.

Access to timely high quality information is critical to the functioning of immunization. Critical information includes process indicators that allow the programme to monitor its performance and take corrective action and outcome indicators that measure the impact of the programme. Immunization information systems need to be linked to the broader health information systems, but at the same time be readily accessible and meet the immunization programme needs.



Monitoring of immunization coverage and drop-out rates has been in place since the onset of the Expanded Programme on Immunization (EPI) to guide programme effectiveness. While the quality and timeliness of reporting of data has steadily increased over the years, administrative coverage data are still of inadequate quality in many countries. Furthermore, the use of data at the district and community levels to take corrective action is still deficient. New approaches to immunization tracking through unique identification numbers (discussed in Outcome 3) can improve the quality of immunization coverage data and facilitate the development of comprehensive immunization registries. New technologies, including hand-held communication devices and mobile phones, can support this effort and facilitate data sharing. Armed with higher-quality data and new data-analysis tools, programme managers at all administrative levels can use information to improve programme performance, allocate funding appropriately and more effectively track progress. Monitoring immunization delivery through the private sector will be important to get accurate estimates of coverage.

Disease surveillance is critical to monitor the impact of immunization and changes in disease epidemiology, and inform decision-making on adoption and sustained use. Disease surveillance platforms need to be strengthened to improve the quality and sharing of information. Capacity for post-licensure surveillance of adverse events should be established in all countries. Robust epidemiological data will also be crucial for understanding vaccine effectiveness and guiding priorities in the R&D community and will help identify the areas of greatest R&D need (Outcome 6).

With the increasing complexity of immunization programmes and with ambitious new goals, it is important that adequate numbers of trained health workers are available to manage the programme and deliver services. Since frontline health workers deliver not only vaccinations but also primary health care interventions and health education, more coordinated and comprehensive training and supervision of health workers will ensure the coordinated and synergistic delivery of all interventions. Health care workers need to not only explain why immunization is important, but also give advice to individuals and communities on nutrition, creating a healthier environment, and recognizing the danger signs when someone falls ill. To effectively play this role, health workers need ongoing and very practical pre- and in-service training with updated, relevant curricula and post-training supervision. Immunization programmes should ensure that this training and supervision is effectively extended to community-based health workers. Civil society organisations should help with training and coordination of these workers.

Health workers can only be effective if sufficient supplies (vaccines, supplements, medicines) are available when they need them. With an increasing number of vaccines that are more expensive, supply chains and waste management systems need to be expanded and made more efficient and reliable. They should be designed to minimise bottlenecks and maximise effectiveness and agility. They should also take into account and make an effort to minimize the environmental impact of energy, materials, and processes used for immunization both within countries and globally. The availability of new technologies provides the opportunity to innovate, not only to improve the management of immunization supply chains, but also to seek increased synergies with other sectors and supply systems for other health interventions. Another potential area of innovation relates to understanding lessons learnt from the private sector practices and supply chain management and exploring tasks that could be outsourced to private sector companies to create greater efficiency.



It will be essential to ensure that immunization supply systems are staffed with adequate numbers of competent, motivated, and empowered personnel at all levels. Likewise, improvements to health information systems should also support the management of immunization activities and resources, helping staff ensure that adequate quantities of vaccines are always available to meet demand. All efforts to build immunization capacity should be implemented in such a way that they benefit both immunization programmes and broader national health efforts.

Developing stronger, more efficient, comprehensive approaches to disease control and immunization will require ministries of health to take the lead in strengthening and coordinating immunization programmes and health systems more broadly. They can draw on academics to help develop and deploy new tools and approaches to service delivery. CSOs can contribute to the development of integrated programmes so that they are aligned with local realities and incorporate community-based human resources. Communities can ultimately hold their governments accountable by demanding integrated services. Regional and global organisations can also help by ensuring that data and best practices are shared in and across countries and that country programmes have access to analytical tools, and development partners can provide supplemental financial resources, if needed.

Table 5: Summary of recommended actions for Outcome 4

Strong immunization systems that are an integral part of a well functioning health system	
Develop comprehensive and coordinated approaches.	<ul style="list-style-type: none"> • Ensure that global vaccine programmes focuses on eradication and elimination goals (for example, polio and measles campaigns) are incorporated into national immunization programmes and do not operate independently. • Ensure that new vaccine deployment is accompanied by comprehensive plans to control targeted diseases.
Strengthen programme monitoring and surveillance programmes.	<ul style="list-style-type: none"> • Improve the quality of immunization administrative coverage data and promote its analysis and use at all administrative levels to improve programme performances. • Develop and promote the use of new technologies for collection, transmission and analysis of immunization data. • Further strengthen and expand disease surveillance systems to generate information for decision-making, monitoring impact of immunization and changes in disease epidemiology. • Strengthen mechanisms for disease and post licensure surveillance.
Build capacity of frontline workers.	<ul style="list-style-type: none"> • Ensure that immunization and other primary-health programmes have adequate human resources. • Increase levels of in-service and post service training for human resources, and develop new, relevant curricula that approach immunization as a component of comprehensive disease control. • Promote coordinated training and supervision of community-based health workers.
Strengthen infrastructure and logistics.	<ul style="list-style-type: none"> • Improve cold-chain capacity and logistics, as well as waste management. • Minimise the environmental impact of energy, materials, and processes used in immunization supply systems, both within countries and globally. • Staff supply systems with adequate numbers of competent, motivated, and empowered personnel at all levels. • Establish information systems that help staff accurately track the available supply.

Progress towards **coordination of immunization programmes** over the course of the decade will be monitored by tracking the following indicators:

- *Planning cycles or targets of immunization plans are aligned with national health plans*



- *Indicator for missed opportunities in immunization (Note: Work is needed to define a specific indicator to capture missed immunization or other health intervention opportunities due to lack of coordination between immunization and other health programmes)*

Progress towards **the strengthening of health systems** over the course of the decade will be monitored by tracking the following indicators:

- *DTP1 – DTP3, DTP1 - measles dropout rate (Note: DTP1 to measles dropout rate selected because it covers a longer time horizon than the DTP1 to DTP3 and so is a better indicator of health system strength and follow-up. However, because DTP1 to measles dropout rate could theoretically result in a negative figure, DTP1 to DTP3 dropout rate was added to balance out this weakness)*
- *# of stock-outs of any vaccine or syringes at the national and district level*
- *% of mothers and babies who received postnatal care visit within two days of childbirth (Note: selected as a measure of overall health system strength)*
- *% births attended by skilled health personnel (alternative HR indicators under discussion) (Note: selected as a measure of overall health system strength)*
- *Number of independent data reviews conducted in the last 24 months*

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Outcome 5: Immunization programmes have sustainable access to long-term funding and quality supply

To meet the DoV goals, actions must be taken both within countries and globally to increase the total amount of available funding for immunization from both countries and development partners. Countries should take action to strengthen the financial components of the in-country health-planning process in order to ensure that decisions regarding priorities in budgets are well informed. Development partners should support countries through more predictable current and new funding partner engagement and the continued improvement and use of innovative financing mechanisms, such as the International Finance Facility for Immunization¹⁷ (IFFIm) and Advanced Market Commitments¹⁸ (AMCs).

For both countries and development partners, advocacy efforts should be focused on obtaining a renewed commitment to past funding pledges as well as support for longer-term funding agreements. Support from development partners should be coupled with country self-funding wherever possible and an emphasis placed on mutual accountability between countries and their development partners.

There is also need to improve the allocation, accountability and sustainability of funding. Coordinating funding support from development partners and other external sources to target national budget priorities will ensure that funds are addressing the most pressing country needs. Funding allocation strategies should be revisited periodically to confirm they are achieving goals, such as eradication and elimination of disease, as quickly and effectively as possible. Feedback loops should be established to enhance programme sustainability, results, and impact. One potential methodology to explore is a pay-for-performance funding system. This would include linking international, national, and local funding



distribution to specific performance metrics and leveraging the resulting metrics to promote programme improvement.

Innovative pricing and procurement mechanisms are needed to alleviate funding pressure and to support the development and scale-up of new and existing vaccines. Innovations will be particularly important for those lower- and lower-middle-income countries that do not have access to the GAVI Alliance, UNICEF and PAHO pricing and procurement mechanisms, and where more than 75 million children under the age of five live. Mechanisms to explore include differential pricing using new approaches to define price tiers and pooled negotiation or procurement methods for lower-middle-income countries. Current models to consider include the PAHO Revolving Fund's short-term credit and pooled-demand mechanisms and the pooled negotiation approach practiced by the Gulf Cooperation Council's Group Purchasing Programme.

Long-term sustainable funding will be an incentive to manufacturers, thereby improving supply security. In addition, supply-side interventions are needed. A growing proportion of affordable vaccines that are used to immunize the world's population are manufactured in middle and low income countries. In the coming decade, these countries will have not only a requirement to ensure the quality, safety and efficacy of vaccines used domestically but also a growing global obligation to protect and enhance security of the global immunization enterprise. Potential supply-side interventions to ensure quality, safety and efficacy include identifying and disseminating best practices in manufacturing and quality control, investing in R&D capabilities, and initiating technology transfers and co-development agreements. In addition, each country should develop the capacity to monitor and assure the safe use of vaccines, in line with the strategy defined in the WHO global vaccine safety blueprint initiative. Action should also be taken to strengthen national regulatory systems and develop globally harmonized regulations to ensure the increasing demand for regulatory reviews can be managed in an effective and timely manner. These supply-side interventions need to be based on solid business cases developed by countries to assure the impact of these significant and long-term investments.

Making change happen with respect to sustainable funding will necessitate commitments from governments and development partners as well as from additional countries joining the development partner ranks. Likewise, sustainable supply will require the multi-sectoral involvement of governments (for example, science and technology, trade, industry and health sectors) to create an environment that helps suppliers strengthen their capabilities. Countries with emerging economies have a particularly important role to play in both these cases, given their high rate of economic growth and the rapid expansion of the supply base there. Achieving greater alignment between supply and demand will require that countries and manufacturers commit to continuing an ongoing dialogue. It will also require that global and regional organisations commit to maintaining the forum that facilitates this dialogue.

To increase alignment, activities currently performed by the UNICEF Supply Division and the GAVI Alliance to improve communication and coordination among countries, vaccine manufacturers, and public-sector organisations should be further expanded. Countries need a forum where they can more clearly communicate expected demand for new vaccines and provide guidance on desired product profiles. This first-hand information would enable suppliers to make more informed product-development and capacity-planning decisions, thereby mitigating product-development and supply risk. This information would also help development partners and other public-sector organisations establish more defensible and reliable strategies and support plans.



Table 6: Summary of recommended actions for Outcome 5

Immunization programmes have sustainable access to long-term funding and quality supply	
Increase total amount of funding.	<ul style="list-style-type: none"> • Establish a commitment for governments to invest in immunization according to their ability to pay and the expected benefits. • Engage new potential-funding partners. • Diversify sources of funding—include the private sector, insurance companies, and patients as part of the contribution to prevention-and-service-delivery programmes. • Continue to leverage innovative funding mechanisms.
Increase affordability for middle-income countries.	<ul style="list-style-type: none"> • Strengthen budgeting and financial management in-country to better integrate financial and health care planning and priority setting. • Coordinate funding support from development partners and other external sources. • Evaluate and improve funding support mechanisms on the basis of their effectiveness in reaching disease goals. • Base funding on transparency and objectivity in order to ensure the sustainability of programmes. Promote the use of cost and cost-benefit arguments in the fund raising, decision making, and defence of immunization funding.
Improve allocation of funding in low- and middle-income countries.	<ul style="list-style-type: none"> • Strengthen budgeting and financial management in-country to better integrate financial and health care planning and priority setting. • Coordinate funding support from development partners and other external sources. • Evaluate and improve funding support mechanisms on the basis of their effectiveness in reaching disease goals. • Base funding on transparency and objectivity in order to ensure the sustainability of programmes. Promote the use of cost and cost-benefit arguments in the fund raising, decision making, and defence of immunization funding. • Explore pay-for-performance funding systems.
Secure quality supply.	<ul style="list-style-type: none"> • Develop regulatory and legal structures and capability investments that ensure secure high-quality vaccine supply and that increase innovation and manufacturing capabilities. • Build and support networks of suppliers to share best practices and to improve capabilities and quality control. • Expand activities to improve communication and coordination among countries, vaccine manufacturers, and public-sector organisations.

The extent to which **immunization programmes have access to long-term funding and quality supply** over the course of the decade will be monitored by tracking the following indicators:

- *% of routine immunization costs financed through government budgets*
- *% of immunization financing gap (as projected in cMYP) met by development partner*
- *For GAVI-supported countries: % of co-financing requirements met and % of supported vaccines that continue to be funded post-graduation (Note: selected to reflect the unique circumstances of GAVI countries)*
- *Number of suppliers for each vaccine type (a. WHO prequalified, b. others)*

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Outcome 6: Country, regional and global R&D efforts maximize the benefits of immunization

In the coming decade, targeted and innovative research and development efforts are needed to accelerate the development of new and improved vaccines, and contribute to the optimization of vaccine formulations and immunization delivery programme logistics. In addition, advances in discovery-based research will lay the groundwork for impact in future decades. For this to be most effective, scientists from disciplines not previously engaged in vaccine research (systems biology, nanotechnology, structural biology and metabolomics) will need to be recruited to the effort. Similarly, engineers, chemists, and IT-technologists will also have key roles in this endeavour.

WHO has conducted a detailed study of disease prioritisation¹⁹ and the Institute of Medicine (IOM) is in the process of developing a model to aid decision-makers toward ultimately prioritising preventive vaccines based on health, economic, demographic, programmatic, and social impact criteria as well as scientific, technical and business opportunities. The DoVC has not undertaken a vaccine or disease prioritisation exercise. A spectrum of R&D opportunities is offered from which stakeholders can choose to invest according to their own priorities and their perceptions of the return on their investments.

Recognizing that investments in research and development will yield results over time, the DoV focus is on the progress that can be achieved in near-, mid- and long term time frames that will improve the efficiency and effectiveness of vaccine delivery and bring about the next generation of vaccines. With that goal in mind, to accelerate scientific progress in the coming decade, the global research community must embrace new ways of working. Across all R&D activities, increased engagement and consultation with those who are involved in vaccines and immunization is needed to ensure that technologies and innovation are prioritised according to their real demand and added value. New arrangements will also be required to facilitate access to know-how and sharing of critical technologies while acknowledging and respecting intellectual property rights.

The R&D community should adopt best practices in portfolio and partnership management, including identification of early indicators of success and failure to inform milestone-based investments. The community should also consider new approaches to ensure promising vaccine candidates are advanced from discovery to development, particularly where market incentives are insufficient. Concerted action will be required over the course of the decade to build the specific architecture that will enable these new ways of working.

Similarly, capacity building and human resource development is needed in developing countries to conduct R&D, including finding better ways to evaluate immunization programmes. Capacity will be built through peer-to-peer training and exchanges between countries. Greater networking among research centres (from discovery to clinical trials) will facilitate the exchange of ideas and efficiently build partnerships between high-, middle- and low-income countries' institutions.

The research community must also embrace a research agenda that focuses on opportunities for transformational impact that spans disease areas and employs multidisciplinary approaches. To improve programme efficiency and increase vaccine coverage and impact, priority areas should include research on the use of effective information through modern communication technologies and social research to understand the cultural, economic and organisational determinants of immunization. Cost-effectiveness analysis will guide the introduction and prioritisation of vaccines, and hence representative



epidemiological, immunological and operational studies and studies of vaccine impact will be needed. Operational research on the most effective delivery approaches is needed to overcome the challenges posed by life-course immunization (infant, adolescent, pregnant women, elderly, among others) and vaccination in emergency and outbreak situations. Research on immunological and programmatic interference effects and optimization of delivery schedules will be required as more new vaccines are introduced into routine programs and immunization is extended beyond the first year of life. In the case of special populations, such as pregnant women, establishment confirmation of safety will be particularly important.

Research is needed to accelerate development, licensing and uptake of vaccines that are currently in early development, including development of technologies for more efficacious and less expensive manufacturing of vaccines. Greater access to the technology and know-how for adjuvants and their formulation into vaccines is needed to advance progress on developing new and more effective vaccines. Non-syringe delivery mechanisms and vaccine packaging that best suit the needs and constraints of countries, thermostable vaccines and new bioprocessing and manufacturing technologies are priority research areas to accelerate the development of next-generation vaccines that are more effective, less expensive and easier to manufacture and deliver. Additionally, the development and aggressive pursuit of a global regulatory science agenda will improve manufacturing efficiency, better characterize products, improve clinical trial design, and safeguard the highest standards for vaccine safety and efficacy. In this dimension, research on animal models and *in vitro* systems that better predict safety and efficacy would shorten the development time to bring safe and effective vaccines to communities.

Vaccine discovery research at the interface between host and pathogen is needed to enable the development of new vaccines. Advancing knowledge of innate and adaptive immune responses will permit more rational vaccine design. Strengthening the understanding of immunologic and molecular characteristics of microbes through systems biology will lead to identification of new antigenic targets for vaccine development and effective ways of predicting immune protective immune responses and mechanisms of protection. Appropriate studies of host genetics and biomarkers will contribute to understanding the causes of variation in human population responses to vaccines.

Case studies and progress updates are being developed on disease and technology-specific examples to demonstrate the needs and potential value of the research areas described above. A collection of case studies has been assembled based on the specific challenges that they each pose, rather than prioritised according to their disease burden. They have been selected to represent vaccines against one bacterial disease (Group A Streptococcus), one parasitic disease (Leishmania) and three viral diseases (Respiratory Syncytial Virus, Epstein - Barr virus and Cytomegalovirus). Case studies on a regulatory science agenda, new delivery technologies, implementation and operational research needs, need for new bioprocessing and manufacturing technologies, and vaccine discovery science will also be prepared. Progress updates will be provided on malaria, HIV and tuberculosis vaccines because there are already dedicated R&D initiatives for these diseases.

Concerted action among the research community, manufacturers, health professionals, programme managers, National Immunization Technical Advisory Groups (NITAGs) and development partners will be needed to attain the full potential of research and development in the next decade. Methods and arguments for prioritisation and allocation of scarce resources will have to be agreed by these groups,



balancing the tensions between country-driven choices and the need for large-scale research efforts and markets in order to sustain development and commercialisation. Health professionals, programme managers and NITAGs can help identify areas where innovations could be made, and assess their real demand and added value. Development partners can help enforce a judicious allocation of resources for R&D, according to the agreed priorities. And the research community and the manufacturers will hold the main responsibility for promoting innovation and pursuing the research agenda defined above.

Table 7: Summary of recommended actions for Outcome 6

Country, regional, and global R&D efforts maximize the benefits of immunization	
Improve capabilities.	<ul style="list-style-type: none"> • Build capacity and human resources in developing countries to conduct R&D. • Increase networking among research centres for efficient building of partnerships between high-, middle- and low-income countries' institutions. • Recruit scientists from disciplines not previously engaged in vaccine research.
Invest in R&D enablers.	<ul style="list-style-type: none"> • Engage with end users to prioritise vaccines and innovations according to perceived demand and added value. • Adopt best practices in portfolio and partnership management for R&D.
Implementation and operational research	<ul style="list-style-type: none"> • Research the use of more effective information through modern communication technologies. • Conduct representative epidemiological, immunological and operational studies and studies of vaccine impact to guide cost-effective analysis. • Perform operational research on improved delivery approaches for life-course immunization and vaccination in emergency situations. • Perform research on interference effects and optimum delivery schedules.
Vaccine manufacturing technology Research	<ul style="list-style-type: none"> • Promote greater access to technology, know-how, and intellectual property for adjuvants and their formulation into vaccines. • Develop nonsyringe delivery mechanisms and vaccine packaging that best suit the needs and constraints of countries' programmes. • Develop thermostable vaccines. • Develop new bioprocessing and manufacturing technologies. • Develop a global, regulatory, science research agenda.
Vaccine discovery research.	<ul style="list-style-type: none"> • Research on the fundamentals of innate and adaptive immune responses, particularly in humans. • Improve current understanding of the causes of variation in human-population response to vaccines.

The extent to which **R&D efforts maximize the benefits of immunization** will be monitored by tracking the following indicators:

- *Licensure and launch of vaccine or vaccines against one or more major diseases not currently vaccine preventable, such as dengue, hookworm, leishmaniasis, malaria, and improved TB*
- *Proof of concept for a vaccine that shows 75% efficacy for AIDS, TB or malaria*
- *Licensure & launch of a new version of an existing vaccine with improved posology, presentation and thermo stability*
- *New WHO standards for a research based regulatory agenda*



6. Health and economic returns on investment in immunization

The GVAP has outlined a set of ambitious goals and target outcomes for the decade to broaden the impact and reach of immunization across the globe. Extending the coverage of existing vaccines and the introduction of new vaccines has the potential to avert millions of future deaths and hundreds of millions of cases and generate more than \$XXB in economic impact over the decade. However, it will take significant investment to achieve these potential benefits of immunization.

It is projected that the scale up of immunization globally in the world's 94 low and lower middle-income countries will cost approximately \$XX-YYB cumulatively over the course of the decade (from 2011–2020; see Figure XX).

The majority of these costs will support bolstering the routine immunization program globally where coverage rates for vaccines are expected to increase substantially. For example, coverage for the pneumococcal vaccine is projected to go from 8 percent today to 89 percent by 2020, and coverage for the Penta vaccine is projected to move from 50 percent today to 92 percent by 2020. These aggressive coverage aspirations combined with substantial birth cohorts in lower-income countries will lead to costs of routine immunization increasing by more than XX percent between 2011 and 2020, and representing up to XX percent of the total costs for the decade.

In addition to expanding coverage within the routine immunization programme, it is anticipated that up to five new vaccines will be introduced during the decade in the 94 focus countries of this analysis: cholera, dengue, malaria, inactivated polio vaccine, and typhoid. Many of these vaccines will be introduced only during the latter half of the decade and will represent about XX percent of total costs from 2015 to 2020. The introduction of a broader portfolio of vaccines will also shift the mix of total costs from immunization service delivery in the early part of the decade (about XX percent of total costs) to vaccine acquisition at the end of the decade (around XX percent of total costs).

Overall resource requirements to match global demand for immunization are expected to reach about XX times today's levels by 2020. This means that securing funding to meet these resource needs will be critical. Using historical and current resource allocation for immunization, and assuming that countries continue to increase their commitments to immunization and that the GAVI Alliance successfully renews its funding in the second half of the decade, it is estimated that the available funding for immunization programmes over the course of the decade could total roughly \$XXB.

The DoV's aspirations and the resources anticipated will still result in a projected cumulative resource gap of \$XX-YYB. In particular, it is expected that much of this resource gap will affect the ability to purchase vaccines and injection supplies in the latter half of the decade as routine immunization programmes begin to reach scale in most countries and several new vaccines are introduced.

In addition to the investment required to fund the ongoing acquisition and service delivery for immunization programmes, it is also important to recognize the need for a sustained funding commitment for vaccine R&D.

Conservative estimates of the resources required for vaccine product development for neglected diseases during the decade suggest a \$XX-YYB investment. This figure represents only product



development costs for the neglected portfolio of diseases and does not include resources that will be required for other priorities such as basic research, epidemiologic investigations, and operational and implementation investigations.

Although R&D costs will represent only a fraction of the total costs for vaccine acquisition and service delivery, a robust R&D engine is a critical enabler of future deaths averted, economic productivity, and eradication and elimination of disease in this decade and beyond. Particular focus will be needed for the development of vaccines for which there is not a strong commercial market and toward disease non-specific R&D priorities, many of which have been outlined in the recommended actions for Outcome 6. The resource needs for these and other vaccine R&D programmes are likely to increase the projected resource gap to achieve the DoV vision.

Realising the full potential of immunization and achieving the DoV's vision of a world in which all individuals and communities enjoy lives free from vaccine-preventable diseases can be achieved only by bridging this resource gap.

This will require commitment from all stakeholders: country governments to continue making immunization a priority in resource allocation decisions; development partners to sustain and bolster access to funding for immunization in spite of competing priorities; and the entire community to continue efforts to reduce the cost of vaccine procurement and immunization service delivery.

7. Accountability, monitoring, and evaluation

The accountability framework for the DoV will have three main elements: 1) stakeholder commitments to implement the actions recommended in the GVAP 2) indicators for DoV goals, outcomes, and actions 3) a structure and process for monitoring progress. Through the global consultation process, the groundwork has been laid for each of these elements and is summarized below. Further development and implementation of the accountability framework will take place over the course of 2012.

Stakeholder commitments: Individuals and communities, governments and health care workers have primary responsibility for immunization. To fulfil these responsibilities, these stakeholders require the support of academia, manufacturers, global agencies, development partners, civil society, media and the private sector. Stakeholders' roles and responsibilities are summarized in Appendix 2. Success now relies on stakeholders committing to the DoV goals and outcomes, setting specific targets, developing country-specific plans that are informed by the global vaccine action plan and country priorities, and mobilising required resources. Regional and global stakeholders must likewise commit to implementing specific actions that need to be carried out at a global level. During 2012 a process will be defined by the Leadership Council to secure final endorsement of roles and responsibilities and stakeholder commitments to specific actions.

Indicators: Once stakeholder commitments are made, progress should be tracked at least two levels. First, progress should be tracked toward the DoV's elimination, eradication, and morbidity and mortality reduction and immunization coverage goals. Second, progress must be tracked toward each of the six DoV outcomes by measuring progress against a 2011 baseline for each of the recommended indicators. To track progress against both goal and outcome level indicators, investments are needed to improve



data quality and develop more robust monitoring and evaluation systems in-country. Regular audits should be conducted to verify data quality.

Structure and process to monitor progress: The structure and process to monitor and evaluate progress will be defined by the DoVC Leadership Council and will build on existing structures and processes if possible. Progress needs to be reviewed annually, beginning in 2013, by countries, the WHO Regional Committees and the WHA.

8. Acknowledgements

This document was developed under the auspices of the Decade of Vaccines Collaboration Leadership Council, composed of Margaret Chan (World Health Organisation), Anthony Lake (United Nations Children's Fund), Anthony Fauci (National Institute of Allergy and Infectious Diseases), Seth Berkley (GAVI Alliance), Joy Phumaphi (African Leaders Malaria Alliance), and Christopher Elias (Bill & Melinda Gates Foundation).

The Decade of Vaccines Steering Committee guided the development and consultation of the document: Pedro Alonso (co-chair, Institute of Global Health of Barcelona), Ciro de Quadros (co-chair, Sabin Vaccine Institute), Nicole Bates (The Bill and Melinda Gates Foundation), Zulfiqar Bhutta (Aga Khan University), Lola Dare (The Centre for Health Sciences Training, Research and Development), Helen Evans (GAVI Alliance), Lee Hall (National Institute of Allergy and Infectious Diseases), T. Jacob John (retired, Christian Medical College, Vellore, India), Jean-Marie Okwo-Bele (World Health Organisation), Orin Levine (Johns Hopkins Bloomberg School of Public Health), David Salisbury (United Kingdom Department of Health), Anne Schuchat (National Centre for Immunization and Respiratory Diseases, Centres for Disease Control and Prevention), Peter Singer (University Health Network and University of Toronto), Lucky Slamet (National Agency of Drug and Food Control, Indonesia), Gina Tambini (Pan American Health Organisation), Jos Vandelaer (UNICEF), and Sandy Wrobel (Applied Strategies).

Eight working groups (Delivery, Global Access, Public & Political Support, R&D, Costing & Funding, Health & Economic Benefits, Accountability Framework Indicators, Communications) involving more than 100 participants have collaborated in the development of the document. More than additional 180 people participated in the working group discussions. The following individuals have been members of the working groups.

Delivery Working Group core members: Amani Abdelmoniem (Ministry of Health, Sudan), Mercy Ahun (GAVI Alliance), Shams Aifeen (ICDDR), Silvia Bino (Institute of Public Health, Albania), Brent Burkholder (CDC), Pradeep Halder (Ministry of Health and Family Welfare, India), Clifford Kamara (Sabin Vaccine Institute), Najwa Khuri-Bulos (Jordan University Hospital), Rebecca Martin (CDC), Susan McKinney (USAID), Muhammad Pate (Ministry of Health, Nigeria), Robert Steinglass (John Snow, Inc.), Liang Xiaofeng (Chinese CDC), John Wecker (PATH), Simon Wright (Save The Children UK). More than 70 additional individuals participated in the discussions of the Delivery Working Group, and 12 individuals from WHO and UNICEF were resource people to the group.

Global Access Working Group core members: Girindre Beeharry (The Bill & Melinda Gates Foundation), Kim Bush (The Bill & Melinda Gates Foundation), David Cook (IAVI), Harkesh Dabas (Clinton Health



Access Initiative), Patricia Danzon (The Wharton School, University of Pennsylvania), James Droop (Department for International Development), Christopher Egerton-Warburton (Lion's Head Global Partners), David Ferreira (GAVI Alliance), Lauren Franzel (PATH), Björn Gillsater (UNICEF), Amanda Glassman (Center for Global Development), Shanelle Hall (UNICEF), Robert Hecht (Results for Development), Miloud Kaddar (WHO), Mohga Kamal-Yanni (OXFAM), Subhash Kapre (retired, Serum Institute), Lothe Lene Jeanette (Norwegian Agency for Development Cooperation), Ian Lewis (UNICEF), Margie McGlynn (IAVI), Julie Milstien (University of Maryland), Neeraj Mohan (Clinton Health Access Initiative), Melinda Moree (BIO Ventures for Global Health), Mary C. Muduuli (African Development Bank), Raja Rao (The Bill & Melinda Gates Foundation), Daniel Rodriguez (Pan American Health Organisation), Helen Saxenian (Results for Development), Meredith Shirey (UNICEF), Maya Vijayaraghavan (CDC), Melinda Wharton (CDC), Piers Whitehead (NeoVacs), Prashant Yadav (University of Michigan), Michel Zaffran (WHO). Johns Hopkins Bloomberg School of Public Health provided one resource person to the group.

Public and Political Support Working Group core members: Geoff Adlide (GAVI Alliance), Luis Barreto (retired, Sanofi Pasteur Canada), David Curry (University of Pennsylvania), Shereen El Feki (Global Commission on HIV and the Law), David Gold (Global Health Strategies), Elizabeth Gore (UN Foundation), Jennifer Kates (Kaiser Family Foundation), Kaia Lenhart (GMMB), Jesus Lopez-Macedo (UNICEF), Adrian Lovett (ONE), Maziko Matemba (Health and Rights Education Program, Malawi), Gregory Poland (Vaccine), Kammerle Schneider (IAVI), Kamel Senouci (Agence de Medecine Preventive), Nelson Sewankambo (Makerere University), Damian Walker (The Bill & Melinda Gates Foundation), Peg Willingham (UN Foundation). Over 30 additional individuals participated in the discussions of the Public and Political Support Group. The Bill & Melinda Gates Foundation and McLaughlin-Rotman Centre for Global Health provided one resource person each to the group.

R&D Working Group core members: Alex von Gabain (Intercell), Bruce Gellin (US Department of Health and Human Services), Jesse Goodman (Food and Drug Administration), Marie-Paule Kieny (WHO), Margaret Liu (International Vaccine Institute), Christian Loucq (International Vaccine Institute), Adel Mahmoud (Princeton University), Tom Monath (Kleiner Perkins Caufield & Byers), Gary Nabel (National Institutes of Health), Regina Rabinovich (The Bill & Melinda Gates Foundation), Rino Rappuoli (Novartis Vaccines & Diagnostics), Steve Reed (Infectious Diseases Research Institute), Adam Sabow (McKinsey & Company), Chris Wilson (The Bill & Melinda Gates Foundation). Around 110 individuals participated in the discussions of the R&D Working Group.

Costing & Funding Working Group: Logan Brenzel (The Bill & Melinda Gates Foundation), Santiago Cornejo (GAVI Alliance), Eliane Furrer (GAVI Alliance), Lauren Franzel (PATH), Gian Gandhi (UNICEF), Patrick Lydon (WHO), Helen Saxenian (Results for Development), with consultancy services provided by Applied Strategies and The Boston Consulting Group.

Health & Economic Benefits Working Group: Dagna Constenla (John Hopkins University), Peter Hansen (GAVI Alliance), Lisa Lee (GAVI Alliance), Orin Levine (John Hopkins University), Sachiko Ozawa (John Hopkins University), Meghan Stack (John Hopkins University), Damian Walker (The Bill & Melinda Gates Foundation).

Accountability Framework Indicators Working Group: John Grove (The Bill & Melinda Gates Foundation), Daniel Thornton (GAVI Alliance), Tony Burton (WHO), Dragoslav Popovic (UNICEF), David



Brown (UNICEF), Chung-Won Lee (CDC) with consultancy services provided by The Boston Consulting Group.

Communications Working Group: Courtney Billet (NIAID), Hayatee Hasan (WHO), Richard Hatzfeld (Sabin Vaccine Institute), Hannah Kurtis (PAHO), Christian Moen (UNICEF), Jeffrey Rowland (GAVI Alliance), Catherine St. Laurent (The Bill & Melinda Gates Foundation).

All WHO and UNICEF member states were briefed as part of the UNICEF missions briefing on the 19th of January in New York and the WHO Executive Board that took place in Geneva on January 20th 2012. In addition, stakeholders from more than 90 countries and 220 organisations have participated in consultation events. Appendix 5 contains a list of all countries and organisations that have contributed to the document.

The DoV Collaboration Secretariat was responsible for preparing the Global Vaccine Action Plan in close coordination with the Steering Committee and the Working Groups. The members of the Secretariat were: Hugh Chang (Advisor to Co-chairs), Enric Jané (Advisor to Co-chairs), Altaf Lal (Technical Director), Laura Moya (Working Group Coordinator), Magdalena Robert (Director), Santiago Porto (Project Manager), Joan Tallada (CSO Coordinator), and Laurie Werner (Working Group Coordinator).

The Steering Committee members endorse the Global Vaccine Action Plan and generally agree with its findings. The document represents a common vision of the Steering Committee, incorporating inputs from members of the different working groups, academia, civil society, industry and inputs received through various consultations. Naturally, not every view expressed in this document reflects the views of all individuals and institutions that participated in the development of the plan. Individuals and institutions might have different perspectives on some of the issues. The views expressed by individuals do not represent the position of the institutions they belong to. The Steering Committee members would like to publicly thank all stakeholders engaged in this collaboration.

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Appendix 1: Summary of recommended actions

Outcome 1: All countries commit to immunization as a priority	
Establish and sustain commitment to immunization.	<ul style="list-style-type: none"> • Ensure up-to-date vaccine legislation in all countries, including provisions for public funding and for monitoring and reporting. • Develop comprehensive national-immunization plans that are part of overall national-health plans through a bottom-up process including all stakeholders. • Set ambitious but attainable country-specific targets within the context of morbidity and mortality reduction goals. • Scrutinise, defend, and more closely follow immunization budgets and immunization program activities.
Convince decision makers of the value of immunization.	<ul style="list-style-type: none"> • Explore models to promote collaboration between evidence generators and evidence users • Articulate and highlight equity arguments for immunization. • Articulate and highlight economic arguments for immunization. • Include immunization in the agendas of governing body meetings at all levels and in other social, health and economic forums
Strengthen local decision-making.	<ul style="list-style-type: none"> • Create or strengthen independent bodies that guide country decision-making (for example, NITAGs). • Develop more effective ways for national regulatory agencies (NRAs), health-sector-coordination committees (HSCCs), and interagency coordination committees (ICCs) to support immunization programmes. • Create regional forums and peer-to-peer exchange of information, best practices, and tools. • Create expanded, more transparent mechanisms for aggregating, sharing, and using information to monitor commitments.
Outcome 2: Individuals and communities understand and demand immunization as both their right and responsibility	
Promote the benefits of immunization.	<ul style="list-style-type: none"> • Proactively communicate the risks and benefits of immunization to address vaccine hesitancy. • Utilise social media tools and lessons from commercial and social marketing efforts. • Leverage new mobile and Internet-based technologies. • Include immunization in the basic education curriculum. • Conduct communications research.
Create incentives to stimulate demand	<ul style="list-style-type: none"> • Create incentives for immunization while respecting the autonomy of beneficiaries (for example, cash or in-kind transfers, bundling of services, media recognition). • Conduct social research.
Build advocacy capacity.	<ul style="list-style-type: none"> • Train health care workers on effective communication techniques, esp. to address vaccine hesitancy and to respond to reports of serious adverse events following immunization in order to maintain trust and allay fears. • Create national or regional advocacy plans that involve CSOs. • Build capacity of CSOs. • Recruit new voices, including those of educators, religious leaders, traditional and social media personalities, family physicians, community health workers, and trained immunization champions (among others). • Link global and national advocacy efforts with social and professional networks at the community level.



Outcome 3: The benefits of immunization are equitably extended to all people	
Reach Everyone.	<ul style="list-style-type: none"> • Recast "Reaching Every District" to "Reaching Every Community" • Develop or coordinate with existing national-identification-number systems to improve immunization information and tracking and to inform outreach or targeted strategies. • Introduce appropriate new vaccines into national immunization programmes • Establish a life-course approach to immunization planning and implementation, including new strategies to assure equity across the life span. • Prevent and respond to vaccine-preventable diseases during disease outbreaks, humanitarian crises, and in conflict zones. • Conduct operational and social science research to identify successful strategies to reduce inequities and improve the quality and delivery of immunization services. • Engage underserved and marginalised groups to develop locally tailored, targeted strategies for reducing inequities.
Engage communities.	<ul style="list-style-type: none"> • Develop and empower community health workers to use information to identify and serve missed populations (for example, provide incentives and equip the workers with mobile technology). • Take advantage of community structures to enhance communication and deliver services (for example, traditional birth attendants, birth registries). • Involve CSOs in community outreach and planning. • Develop new approaches to community engagement for urban and peri-urban areas.
Outcome 4: Strong immunization systems that are an integral part of a well functioning health system	
Develop comprehensive and coordinated approaches.	<ul style="list-style-type: none"> • Ensure that global vaccine programmes focuses on eradication and elimination goals (for example, polio and measles campaigns) are incorporated into national immunization programmes and do not operate independently. • Ensure that new vaccine deployment is accompanied by comprehensive plans to control targeted diseases.
Strengthen programme monitoring and surveillance programmes.	<ul style="list-style-type: none"> • Improve the quality of immunization administrative coverage data and promote its analysis and use at all administrative levels to improve programme performances. • Develop and promote the use of new technologies for collection, transmission and analysis of immunization data. • Further strengthen and expand disease surveillance systems to generate information for decision-making, monitoring impact of immunization and changes in disease epidemiology. • Strengthen mechanisms for disease and post licensure surveillance.
Build capacity of frontline workers.	<ul style="list-style-type: none"> • Ensure that immunization and other primary-health programmes have adequate human resources. • Increase levels of in-service and post service training for human resources, and develop new, relevant curricula that approach immunization as a component of comprehensive disease control. • Promote coordinated training and supervision of community-based health workers.
Strengthen infrastructure and logistics.	<ul style="list-style-type: none"> • Improve cold-chain capacity and logistics, as well as waste management. • Minimise the environmental impact of energy, materials, and processes used in immunization supply systems, both within countries and globally. • Staff supply systems with adequate numbers of competent, motivated, and empowered personnel at all levels. • Establish information systems that help staff accurately track the available supply.



Outcome 5: Immunization programmes have sustainable access to long-term funding and quality supply

Increase total amount of funding.	<ul style="list-style-type: none"> Establish a commitment for governments to invest in immunization according to their ability to pay and the expected benefits. Engage new potential-funding partners. Diversify sources of funding—include the private sector, insurance companies, and patients as part of the contribution to prevention-and-service-delivery programmes. Continue to leverage innovative funding mechanisms.
Increase affordability for middle-income countries.	<ul style="list-style-type: none"> Strengthen budgeting and financial management in-country to better integrate financial and health care planning and priority setting. Coordinate funding support from development partners and other external sources. Evaluate and improve funding support mechanisms on the basis of their effectiveness in reaching disease goals. Base funding on transparency and objectivity in order to ensure the sustainability of programmes. Promote the use of cost and cost-benefit arguments in the fund raising, decision making, and defence of immunization funding.
Improve allocation of funding in low- and middle-income countries.	<ul style="list-style-type: none"> Strengthen budgeting and financial management in-country to better integrate financial and health care planning and priority setting. Coordinate funding support from development partners and other external sources. Evaluate and improve funding support mechanisms on the basis of their effectiveness in reaching disease goals. Base funding on transparency and objectivity in order to ensure the sustainability of programmes. Promote the use of cost and cost-benefit arguments in the fund raising, decision making, and defence of immunization funding. Explore pay-for-performance funding systems.
Secure quality supply.	<ul style="list-style-type: none"> Develop regulatory and legal structures and capability investments that ensure secure high-quality vaccine supply and that increase innovation and manufacturing capabilities. Build and support networks of suppliers to share best practices and to improve capabilities and quality control. Expand activities to improve communication and coordination among countries, vaccine manufacturers, and public-sector organisations.

Outcome 6: Country, regional, and global R&D efforts maximize the benefits of immunization

Improve capabilities.	<ul style="list-style-type: none"> Build capacity and human resources in developing countries to conduct R&D. Increase networking among research centres for efficient building of partnerships between high-, middle- and low-income countries' institutions. Recruit scientists from disciplines not previously engaged in vaccine research.
Invest in R&D enablers.	<ul style="list-style-type: none"> Engage with end users to prioritise vaccines and innovations according to perceived demand and added value. Adopt best practices in portfolio and partnership management for R&D.
Implementation and operational research	<ul style="list-style-type: none"> Research the use of more effective information through modern communication technologies. Conduct representative epidemiological, immunological and operational studies and studies of vaccine impact to guide cost-effective analysis. Perform operational research on improved delivery approaches for life-course immunization and vaccination in emergency situations. Perform research on interference effects and optimum delivery schedules.
Vaccine manufacturing	<ul style="list-style-type: none"> Promote greater access to technology, know-how, and intellectual property for adjuvants and their formulation into vaccines.



technology Research	<ul style="list-style-type: none">• Develop nonsyringe delivery mechanisms and vaccine packaging that best suit the needs and constraints of countries' programmes.• Develop thermostable vaccines.• Develop new bioprocessing and manufacturing technologies.• Develop a global, regulatory, science research agenda.
Vaccine discovery research.	<ul style="list-style-type: none">• Research on the fundamentals of innate and adaptive immune responses, particularly in humans.• Improve current understanding of the causes of variation in human-population response to vaccines.



Appendix 2: Stakeholder responsibilities

We have an opportunity to achieve real progress in the next decade. Realization of this potential is contingent upon all stakeholders having clearly defined and coordinated responsibilities. Primary responsibility is held by individuals and communities, governments and health professionals, as recipients and providers of immunization. Other stakeholders also have an important role in achieving the target outcomes.

Individuals and communities, as recipients of immunization, should do the following:

- Understand the risk and benefits of vaccines and immunization and view it as part of being a responsible citizen
- Demand safe and effective immunization programmes as a right from their leaders and government and hold leaders and government accountable for providing them
- Participate in public-health discussions and be involved in key decisions about immunization processes
- Participate and contribute to the immunization delivery process and convey the needs and perspectives of their communities to the policy-makers

Governments, as the main providers of immunization, should do the following:

- Prioritise and assume full ownership over their national immunization programmes to create equity-driven programmes that reach every community
- Work with stakeholders within and outside of governments
- Ensure that immunization programmes are adequately staffed with delivery and management personnel who are well trained and given appropriate incentives
- Increase support for national immunization programs and ensure financial sustainability by 2020
- Depending upon countries' income and as economies grow, fund an increasing proportion of domestic immunization programmes, progressing to fully funding domestic programmes, and then funding global immunization efforts
- Develop and introduce laws, regulations, and policies that support immunization programmes and a secure, high-quality supply base, if necessary
- Increase awareness of the importance of immunization to improve a population's health and its contributions to strengthening health systems and primary health care
- Effectively convey messages on vaccines to create demand
- Engage dialogue with communities and media and use effective communications techniques to convey messages about vaccines and to address safety concerns. Encourage and support research on vaccines and vaccination issues. Also encourage education at all levels on vaccines
- Collaborate regionally and internationally on advocacy programmes, evidence sharing, and coordinated preparedness
- Participate in open dialogues with manufacturers to ensure affordability of current and new vaccines
- As economies grow, funding an increase proportion of domestic immunization programmes, progressing to fully funding domestic programs, and then funding global immunization efforts

Health professionals should do the following:

- Provide high-quality immunization services and information on them



- Introduce vaccine courses at university and health colleges along with continuing education for all health-care providers (medical, nursing, pharmacy, and public-health practitioners)
- Identify areas where immunization services could be improved and innovations made
- Serve as credible voices for the value of vaccines and recruit other advocacy voices
- Use existing and emerging technologies to improve delivery and better capture information
- Engage dialogue with communities and media and use effective communications techniques to convey messages about vaccines and to address safety concerns

Academia should do the following:

- Promote innovation to accelerate the development of new and improved vaccines, contribute to the optimization of vaccine formulation and immunization programme logistics, and lay the groundwork for the impact of immunization in future decades
- Pursue a multidisciplinary research agenda that focuses on transformational impact and is based on the needs of end users
- Develop vaccines and technologies that will optimize and maximize vaccine delivery
- Embrace new ways of working that speed up scientific progress
- Improve dialogue with other researchers, regulators, and manufacturers in order to align actions and increase effectiveness in responding to local and global immunization challenges
- Provide the core data, methods, and arguments that help drive the continued prioritisation of immunization both globally and locally
- Engage more with systematic reviews to identify areas where solid scientific evidence exists (which should be basis of health policies) and those areas where such evidence is lacking (which would be the basis for future primary research)
- Provide evidence and outline best immunization practices
- Support the development of manufacturing capabilities
- Promote budget allocation for vaccine and immunization research

Manufacturers should do the following:

- Continue to develop, produce, and supply innovative and high-quality vaccines
- Support research and an education agenda for immunization
- Participate in open dialogues with countries and the public sector to ensure sustainable access of current and new vaccines
- Continue to innovate manufacturing processes and pricing structures
- Support the media outreach for the EPI program to increase awareness
- Support rapid scale-up and adoption as new or improved vaccines emerge
- Develop partnerships that support the growth of manufacturing capabilities and increase vaccine supply and innovation
- Work in coordination with other partners on vaccine and immunization advocacy

Global agencies, such as WHO, UNICEF, the World Bank and GAVI Alliance, should do the following:

- Promote country ownership
- Continue to define norms and guidelines to improve vaccine and immunization services, striving toward greater equity and sensitivity to gender and subpopulation (including minorities, age groups, etc.)



- Promote synergies between immunization and other health services as well with other sectors such as education, economic development, and financing
- Work with all stakeholders to improve technical assistance to strengthen immunization and other components of health systems
- Encourage, share, and support evidence-based decision-making across the spectrum of development, health, and immunization stakeholders
- Engage partners to generate popular demand for immunization, and support programme research and improvements
- Promote the idea of sustainable national funding and engage rapidly emerging economies as funding partners
- Develop mechanisms for mutual accountability that hold all governments, programmes, and development partners responsible for committed levels of support
- Promote a dialogue between manufacturers and countries to align supply and demand
- Pursue innovative financing and procurement mechanisms that reinforce country ownership and promote equity and affordability for low- and middle- income countries

Development partners should do the following:

- Promote country ownership
- Fulfil institutional mandates and missions in the health field
- Promote country ownership and country-led health, vaccine, and immunization plans that include budgets for improving access to services and reducing the equity gap in coverage
- Promote comprehensive, integrated packages of essential interventions and services that include vaccines and immunization and strengthen health systems
- Provide predictable long-term funding aligned with national plans and encourage new and existing partners to fund vaccines and immunization
- Participate in international advocacy through access to open evidence that can be shared
- Maintain transparent and coordinated funding, accompanied by performance-based evaluation

Civil society, including NGOs and professional societies, should do the following:

- Get involved in the promotion and implementation of immunization programs
- Participate in the development and testing of innovative approaches to deliver immunization services that reach the most vulnerable people
- Follow national guidelines and regulations in the design and delivery of immunization programmes that fulfil the duty of accountability to national authorities
- Educate, empower, and engage vulnerable groups and communities on their right to health, including vaccines and immunization
- Build grass-roots initiatives within communities to track progress and hold governments, development partners and other stakeholders accountable to providing high-quality immunization services
- Contribute to improved evaluation and monitoring systems within countries
- Engage in country, regional, and global advocacy beyond the immunization community to ensure vaccines and immunization are understood as a right for all
- Collaborate within and across countries to share strategies and build momentum for improved health, vaccines, and immunization



Media should do the following:

- Promote and implement immunization programs
- Engage in country, regional, and global advocacy beyond the immunization community to ensure vaccines and immunization are understood as a right for all
- Use effective communications techniques to convey messages about vaccines and to address safety concerns

Private sector should do the following:

- Promote and implement immunization programs
- Support the diversification of sources of funding for immunization programmes (private sector, insurances, patients...)
- Engage in country, regional, and global advocacy beyond the immunization community to ensure vaccines and immunization are understood as a right for all



Appendix 3: Costing, Funding, and Health outcomes methodology and assumptions

Projecting the costs and available finances for scaling up immunization in an effort to achieve the target outcomes of the Decade of Vaccines Collaboration Global Vaccine Action Plan, 2011-2020

Objective	To project the cost and available financing for scaling up immunization services in order to achieve the target outcomes for the Decade of vaccines as laid out in the Global Vaccine Action Plan (GVAP)
Methods	Projections of annual and cumulative total costs and financial flows were made to characterise the resource needs for delivering a range of existing and key pipeline vaccines over the decade in world's poorest countries where the benefits of immunization are expected to be greatest. The projections draw upon and consolidate information from existing forecasts and costing studies as well as country-specific data available from country immunization plans. The analysis focuses on projecting costs and financial flows likely to be available to cover those costs for vaccines and injection supplies, associated delivery efforts and immunization-specific system costs (e.g. cold chain). The financing projections model the domestic funding flows from country governments, support received through the GAVI Alliance, and other major sources of development assistance for immunization.

Introduction

The collective recognition of immunization's potential has led the global health community to call for the "Decade of Vaccines" (DoV). The vision for the DoV is a world in which all individuals and communities enjoy lives free from vaccine-preventable diseases. Its purpose is to extend, by 2020 and beyond, the full benefits of immunization to all people, regardless of where they are born, who they are, or where they live.

In May 2011, the Sixty-fourth World Health Assembly (WHA) welcomed the DoV vision and endorsed the development of a Global Vaccine Action Plan (GVAP). This plan will build on the success of the Global Immunization Vision and Strategy (GIVS), launched in 2006 as a first-ever ten-year strategic framework to realise the potential of immunization. The purpose of the GVAP is to bring all stakeholders together to ascertain collectively what countries and the entire immunization community want to achieve over the next decade, determine concrete actions to make change happen, and define indicators and processes to monitor and evaluate progress.

A critical component in moving from a set of documents to action and results is an analysis of financial resource availability and requirements to facilitate the vision delineated in the GVAP. The remainder of this document provides of an overview of the methodology and approach that underpins this analysis. Instead of covering all actions in the GVAP, this analysis focuses on the costs, projected financing, and resulting funding gap, under different scenarios, to immunize target populations in low and lower-middle income countries with existing vaccines and upcoming vaccines that are expected to address significant disease burden in these countries.



Methods

Countries included

While the Decade of Vaccines Collaboration (DoVC) is intended as a global enterprise, the immunization cost and financing projections analysis focused on 94 countries, consisting of all those classified as low (35) or lower-middle income (57) by the World Bank in 2011, as well as two countries that are now in the process of graduating from GAVI eligibility and are classified as upper-middle income countries.

^{iv} A table listing the specific countries included in this analysis can be found below. Due to data availability for key variables, the sample dropped to 89 countries but the remaining countries represent >99% of the total birth cohort of the 94 countries. Of the 94 countries in the scope of the analysis, 57 are currently eligible for new GAVI support, 16 are countries that are currently graduating from GAVI support, and 21 countries are ineligible for GAVI support.

^{iv} World Bank income classification released July 2011, based on 2010 GNI per capita. Low-income countries have a 2010 GNI per capita of \$1,005 or less. Lower- middle income countries have a GNI per capita of between US\$1,006 and \$3,975.



Table 1: Country scope for analysis

Country	WB Income Classification	Country	WB Income Classification	Country	WB Income Classification
Afghanistan	LIC	Uganda	LIC	Togo	LIC
Bangladesh	LIC	Zimbabwe	LIC	Morocco	LMIC
Benin	LIC	Angola	LMIC	Nicaragua	LMIC
Burkina Faso	LIC	Armenia	LMIC	Nigeria	LMIC
Burundi	LIC	Belize	LMIC	Pakistan	LMIC
Cambodia	LIC	Bhutan	LMIC	Papua New Guinea	LMIC
CAR	LIC	Bolivia	LMIC	Paraguay	LMIC
Chad	LIC	Cameroon	LMIC	Philippines	LMIC
Comoros	LIC	Cape Verde	LMIC	Samoa	LMIC
Congo, DR	LIC	Congo, Rep	LMIC	São Tomé & Príncipe	LMIC
Eritrea	LIC	Côte d'Ivoire	LMIC	Senegal	LMIC
Ethiopia	LIC	Djibouti	LMIC	Solomon Islands	LMIC
Gambia	LIC	Egypt	LMIC	Sri Lanka	LMIC
Guinea	LIC	El Salvador	LMIC	Sudan, N.	LMIC
Guinea-Bissau	LIC	Fiji	LMIC	Sudan, S.	LMIC
Haiti	LIC	Georgia	LMIC	Swaziland	LMIC
Kenya	LIC	Ghana	LMIC	Syria	LMIC
Korea, DR	LIC	Guatemala	LMIC	Timor-Leste	LMIC
Kyrgyzstan	LIC	Guyana	LMIC	Togo	LMIC
Liberia	LIC	Honduras	LMIC	Turkmenistan	LMIC
Madagascar	LIC	Indonesia	LMIC	Tuvalu	LMIC
Malawi	LIC	India	LMIC	Ukraine	LMIC
Mali	LIC	Iraq	LMIC	Uzbekistan	LMIC
Mozambique	LIC	Kiribati	LMIC	Vanuatu	LMIC
Myanmar	LIC	Kosovo	LMIC	Viet Nam	LMIC
Nepal	LIC	Lao, PDR	LMIC	West Bank & Gaza	LMIC
Niger	LIC	Lesotho	LMIC	Yemen	LMIC
Rwanda	LIC	Marshall Islands	LMIC	Zambia	LMIC
Sierra Leone	LIC	Mauritania	LMIC	Azerbaijan	UMIC
Somalia	LIC	Micronesia	LMIC	Cuba	UMIC
Tajikistan	LIC	Moldova	LMIC		
Tanzania	LIC	Mongolia	LMIC		

The analysis has focused on these countries in part because given highly constrained government spending on health in these countries, they are in a general sense least likely to have the financial capability to completely self-fund desired immunization services and, therefore will require the most support of the global community to achieve the target outcomes of the GVAP.



Vaccines included

While all vaccines are important within the wider scope of the DoVC, the vaccines that have been included in the scope of this analysis are those vaccines that are for use in humans, currently available, and in many cases, widely used, along with newer vaccines that are expected to significantly address the vaccine-preventable disease burden^v within the 94 countries included in the country scope identified above. In addition to vaccines licensed and available today, the analysis also accounts for the expected introduction of several new vaccines over the course of the decade. Veterinary vaccines and vaccines primarily recommended for therapeutic use (e.g. Rabies vaccines) as well as vaccines predominantly employed outside of resource-poor settings (e.g. Seasonal Flu vaccines) were excluded from the analyses.

For the purposes of defining methods and identifying data sources, two (non-mutually exclusive) categories were used to classify the vaccines covered in the analysis: (1) Vaccines delivered via campaigns and associated with Accelerated Disease Control (ADC), Eradication, or Elimination initiatives and (2) Vaccines delivered through routine immunization programs. This categorization was helpful since delivery costs differ markedly depending on the delivery strategies (e.g. primarily through infrequent vaccination campaigns versus the routine vaccination), and the timing and intensity of delivery efforts (that affect costs) differ depending on whether the vaccines/disease were associated with high-level global or regional eradication, elimination or ADC initiatives. The table below summarizes the vaccines/diseases in each of the categories.

^v The list of vaccines was drawn from a previous effort undertaken by WHO on behalf of GAVI to characterize vaccines by public health priority. The terms of reference of this work are available here: http://www.who.int/immunization/sage/Categorization_Activity_SAGE.pdf. While the main findings from this work are summarized here: http://fr.gavialliance.org/resources/3_Vaccine_Investment_Strategy.pdf.



Table 2: Vaccine/Disease Scope for analysis

(1) ADC/ Elimination/ Eradication Vaccines (Delivered via campaigns)	<ul style="list-style-type: none"> • Conjugated Meningitis A • Measles • Oral Polio Vaccine (OPV) 	<ul style="list-style-type: none"> • Rubella • Tetanus • Yellow Fever
(2) Routine Vaccination Programs	<ul style="list-style-type: none"> • Cholera (campaign) • Conjugated Meningitis A • Dengue (routine) • Hepatitis B • Human Papilloma Virus • Inactivated Polio Vaccine (IPV) • Japanese Encephalitis (routine and catch up) • Malaria (routine) • Measles (1st and 2nd dose) • Non-penta DTP and inc. tetravalent combinations • OPV • Penta (DTP-HepB-Hib) • Pneumococcal • Rotavirus • Rubella • Tuberculosis (BCG) • Typhoid (conjugate) (routine) • Yellow Fever 	

The vaccination schedule and targeting strategies selected for each of these vaccines was based on global guidance (e.g. from WHO Position Papers, SAGE Guidance). While for pipeline vaccines where such information is often not available, assumptions about the delivery strategy as well as the expected timing of licensure were based on the advice of vaccine development experts particularly from relevant Product Development Partnerships. These were analytical assumption rather than pre-suppositions of guidance and decisions on the part of regulators and individual countries.

Cost and financing components included

For each of the above categories included in the analysis, costs were developed in three segments: vaccine and injection supplies, vaccine delivery (including capital cold chain operation costs) and capital investment in cold chain capacity. The vaccine delivery and capital investment in cold chain costs were then combined into a single *delivery* cost category.

Delivery costs for routine services include:

- Human resources (*national, subnational, district and service levels*)
- Cold chain equipment and their overheads (*installation, energy, maintenance and repairs*)
- Vehicles and transport
- Programme management



- Training and capacity building
- Social mobilization, IEC and advocacy
- Disease surveillance

Delivery costs for supplemental campaigns include:

- Operational costs of campaigns (incl. for epidemic response)
- Social mobilization
- Disease surveillance
- Technical assistance (at country level only)

Costs refer to immunization-specific costs only and human resources costs for individuals partially dedicated to immunization. Other shared health system costs such as buildings were excluded. Total costs to sustain current gains and to incremental needs to scale up over the next decade were included

Cost projections on a country-by-country basis were developed and aggregated for the categories of vaccines described in Table 2 covering the period 2011-2020. The assumptions and methodology for the baseline cost scenario are summarized below. In addition, low and high scenarios were created. All costs are presented in constant 2010 US\$.

For each of the vaccine groups included in the analysis, financing flows were projected from three financing sources: (i) Country Governments, (ii) the GAVI Alliance, and (iii) Other Development Partners (i.e. bilateral donors, multilateral agencies and philanthropic agents).

(1) Accelerated Disease Control (ADCs), Elimination and Eradication programs

The World Health Organisation (WHO) and United Nations Children's Fund (UNICEF) lead the implementation of country-level programs for a variety of disease control, eradication and elimination efforts to combat vaccine-preventable diseases (listed in Table 2 above). These programs produce plans and forecasts detailing the key activities, and the cost associated with the implementation of these programs.

These plans and forecasts have been used as the basis for projecting both the costs of vaccine and injection supplies, and vaccination delivery for each of these programs over the decade as well as for other critical activities necessary for administering the programs.

(a) Vaccine Costs

The target populations and planned timing of vaccination campaigns to achieve the relevant disease control, eradication or elimination goals over the course of the decade were taken from the plans as delineated by the programs. These were combined with estimates of current vaccine prices (provided by UNICEF Supply Division) to create forecasts of the vaccine/injection supply costs of these programs.

(b) Delivery Costs



Delivery costs for the ADC, Eradication and Elimination programs were separated into *core costs* incurred primarily by implementing partners to facilitate programs, *operational costs* to physically deliver vaccines and run the vaccination campaigns and *contingency funds* in the case of disease outbreaks.

Core costs cover critical activities – for example to stimulate demand (Social Mobilization) and to monitor the incidence and prevalence of disease (Surveillance) in affected countries. Core cost projections were also taken at face value from the program plans where available. In the absence of long-term projections for this cost component, recent core cost estimates were projected forward based on the program forecasts. Operational costs encompass all running costs outside of vaccines and core costs to implement a vaccination campaign. Country-specific operational cost information recorded in comprehensive multi-year immunization plans (cMYPs) were used to generate metrics which were applied to the aforementioned forecasts to project the running costs of all planned campaigns. Finally, contingency funds include the resource needs to procure and manage vaccine stockpiles and monies held in reserve to implement reactive campaigns in the event of disease outbreaks – These amounts are based on historic needs and taper off over time as it is assumed the ADC, Elimination and Eradication programs make progress towards their respective goals. These costs were also taken directly from program plans.

(2) Routine Vaccination programmes

(a) Vaccine Costs

Demand forecasts for traditional routine vaccines already on the market were estimated on a country-by-country basis using existing demand forecasts from WHO, UNICEF as well as GAVI (Strategic Demand Forecast version 4.0 and Adjusted Demand Forecast version 4.0). These demand forecasts were then combined with estimated prices to project the costs of these vaccines and related injection supplies. For GAVI-eligible countries, GAVI price forecasts were used on a disease-by-disease basis. For the non-GAVI lower middle income countries (LMICs) in the analysis, baseline prices were assumed to be held constant at the same differential between current GAVI prices and PAHO Revolving Fund prices. Using the demand forecasts and price forecasts, the acquisition costs of vaccines and associated supplies were projected.

For vaccines still in the pipeline, demand forecasts were developed based on expert input obtained through interviews with Product Development Partnership (PDP) representatives and other external stakeholders familiar with these vaccines under development. Expected acquisition costs for these vaccines were projected by applying these demand forecasts to a projected price per dose for each of the vaccines in this segment.

(b) Delivery Costs

Delivery costs include the main components of routine immunization service delivery systems: *human resources at all levels of the system and ongoing capacity building (training); the supply chain and logistics systems needed to store and transport vaccines (cold chain equipment, vehicles, transport...), and the cost of program management (information systems, M&E...), social mobilisation and disease*



surveillance. The approach to estimate the delivery costs rested on separating those costs for service delivery and those costs for vaccine delivery.

The **service delivery** costs are those that are needed to implement the national immunization programme to deliver the immunization services. Information provided by countries in their cMYPs was the basis of the costing and financing estimates for delivery. Under the auspices of the Global Immunization Vision and Strategy (GIVS), countries launched a process to strategically plan for their national immunization programme including estimating the current and future costs required to reach the goals and targets of their programme. Based on the wealth of information available for approximately 65% of the countries (58) in scope, a bottom-up costing exercise using a standard ingredients approach to costing was undertaken by countries. From this sample of real data from countries, average unit costs by typology of country was used to impute missing values for the remaining 35% of countries for which point estimates were not available. The needs for scaling up were derived from a variety of sources linked to the anticipated coverage projections and how countries have identified priorities, strategies and needs within their cMYPs.

The **vaccine delivery** costs are those that are needed to ensure adequate supply of vaccines through the health system and to store and transport vaccines in a safe and effective manner throughout the entire supply chain and logistics systems of countries (from the national vaccine store to a service delivery point in a health centre or outreach post). In other words, these encompassed all the cold chain costs for storing vaccines (whether the capital equipment or their recurrent overheads) and the logistics of transporting vaccines (whether the vehicles or their recurrent overheads).

The WHO global forecast for cold chain and logistics is the basis of the costing for vaccine delivery. The global forecast tool estimates (using the same demand forecast assumptions for vaccines) the on-going needs to maintain the existing cold chain infrastructure in place along with the incremental needs to scale up needs to raise coverage and introduce new vaccines. Because the global forecast tool does not include transport logistics, an extensive review of available information



Table 3: Summary of the approach to estimate the cost of Delivery

	Costs included	Costs included	Description	Information Sources
Delivery	Service Delivery	Human resources	At all levels of the system	cMYPs data from 58 countries with unit-costing and typologies approach to extrapolate to other countries.
		Program management	Including M&E, information systems, planning...etc	
		Training	Training of health care workers and on-going capacity building	
		Social mobilization	Activities to stimulate demand for immunization services including IEC, advocacy and communications	
		Disease surveillance		
	Vaccine Delivery	Cold chain equipment	At all levels of the system	WHO Global Forecast cold chain forecast at national level. Subnational needs extrapolated using cMYP data on the % of cold chain costs by level of the system
		Cold chain overheads	Installation costs; energy to run the cold chain (electricity, fuel, propane...), maintenance costs and spare parts/repairs	Country specific indicators derived from cMYP data (cold chain overheads as a % of cold chain equipment by level of the system).
		Vehicles	At all levels of the system (ex: refrigerated trucks, 4WD, motorcycles...)	Country specific indicators derived from cMYP data (vehicle costs % of cold chain equipment by vehicle type and by level of the system).
		Transport	Cost of fuel, maintenance, overheads (registration/insurance) repairs/spare parts...	Country specific indicators derived from cMYP data (Transport as a % the cost of vehicles by vehicle type and by level of the system).

Due to its unique service delivery, HPV delivery costs were defined on the basis of findings from several pilot demonstration projects as reported by PATH.

Incremental capital cold chain costs were analyzed on a country-by-country basis. Total expected volume of vaccines was compared to country-level cold chain capacity. If capacity was projected to exceed country capacity in a given year, incremental cold chain needed was estimated using relevant cost per volume cold chain benchmarks.

Financing projections

Financing projections were developed across three main sources: public spending on health from government's own sources, GAVI Alliance funding, and other development partners. These projections were calculated for the vaccines described in Table 2.

(i) Government flows for immunization

The methodology to project government flows for immunization rested on relying on the available financing data provided by countries in their national multi-year immunization plans (cMYPs). The analysis of this data was the basis of the government financing estimates for both vaccines and systems costs. For countries that did not have cMYP, a methodology of unit financing and typologies was applied



in a similar fashion as done on the costing side. For SIAs, typologies were based on population groupings since the per capita investments by governments tend to be lower for midsize/larger countries (i.e. population ≥ 10 million) than much smaller countries (i.e. population < 10 million) – mainly due to economies of scale that can be leveraged in the former. For government financing for routine vaccination services, rather than using a typology by population groups, the GAVI co-financing groupings were used that stratify countries since these groups provide a proxy of the ability to finance vaccines and immunization. This typology groups countries into Low Income, Intermediate, Graduating and Non-GAVI.

In broad terms the method for projecting government flows involved generating a baseline estimate of government funding for the year 2010 derived from the cMYP data. This baseline estimate was projected forward between 2011 and 2020 based on IMF projections of real GDP growth. The assumption underlying the projection methods is that growth in the health budget of countries will grow at the same rate as economic growth. In other words, the base case funding assumes that governments will continue to provide the same share of the health budget for immunization as they currently do over time – despite the fact that in absolute terms, the amount governments contribute will increase in line with economic growth forecasts.

In the baseline scenario, no additional government funding was assumed to be available for the mainly new or pipeline vaccines that are not part of the traditional/basic EPI vaccines or those supported by GAVI (e.g. malaria, dengue vaccines)

(ii) GAVI Alliance Funding

For those vaccines delivered through campaigns and that are part of ADC activities but that are funded by GAVI, (i.e. MenA, yellow fever, rubella), GAVI Alliance funding was assumed to cover the full costs of the vaccines/injection supplies, while for operational costs, it was assumed that GAVI will provide funding at least equivalent to current levels (i.e. US\$0.30 per targeted person).

For routine GAVI-supported vaccines, GAVI's own financing projection assumptions were applied through 2020 to determine the amount of finances GAVI will provide for New Vaccine Support over the decade. The analysis does not include any GAVI funding that is and might be made available for delivery activities associated with routine vaccination programmes/systems.

(iii) Other Development Partner Funding

Other development partner funding aside from contributions to immunization that occur through GAVI Alliance funding have not been included for the purposes of this analysis.

Developing estimated future resource requirements

Vaccine acquisition costs and delivery cost projections have been combined with aggregated financing flow projections on an annual basis to estimate the funding gaps/incremental resource requirements on an annual basis needed to successfully scale up immunization programs globally in line with the coverage targets outlined within the GVAP.



Limitations

- This exercise does not analyze or attempt to approximate the cost of the implementation of the Global Vaccine Action Plan. The analysis described above is only an exercise to determine the vaccine acquisition and service delivery cost and resource availability for increasing coverage of existing vaccines and the introduction of new vaccines over the course of the decade.
- The costs projections produced from this effort to do not include the agency overhead costs for the implementation and maintenance of the GVAP – there may be additional resources required for this activity
- Costs and funding for Research and Development activity are not captured in this analysis
- Costs and funding for Advocacy and Political Support activity are not captured in this analysis
- The approach taken for this exercise builds on existing sources of information and global projection of needs generated by different groups (e.g. Polio, Measles, etc) in order to leverage the best data available, when possible. Because of this approach, it is difficult to ensure a consistency in the methods throughout the work, and a complete mitigation of double counting risks
- The costs are limited to a priority set of countries although the aspirations of the Decade of Vaccine and GVAP are global.

While it is important to acknowledge the limitations of the analysis that was conducted, it is not believed that any of the limitations outlined above will alter the directional nature of the results of this exercise.

Projected cost for vaccine research and development

Predicting future needs in research and development is complicated and subject to much uncertainty. Nevertheless, a small effort was undertaken to generate a ballpark estimate of the resources that will be required to fund vaccine research and development for the decade in order to provide an R&D complement to the far more sophisticated vaccine acquisition and service delivery costing effort. The R&D effort utilizes existing data and does not link to the underlying assumptions used to project cost for vaccine acquisition and service delivery described above.

A baseline of current annual spend was taken from 2010 data from the Global Funding of Innovation for Neglected Diseases (G-FINDER) report^{vi}. The data within this report is generated through an extensive survey process of major funders of research and development including public sector organisations, philanthropic funders and private sector organisations. The scope of the G-FINDER includes diseases which disproportionately affect individuals in developing countries, diseases for which there is a need for new products and diseases where there is insufficient commercial market to attract R&D by private industry. A full listing of the diseases included in the vaccine scope of the G-FINDER can be found in the table below.

^{vi} The vaccine R&D baseline was taken from the Policy Cures G-FINDER Report 2011. This report is available for download here: http://www.policycures.org/downloads/g-finder_2011.pdf



G-FINDER Disease / Vaccine Scope	<ul style="list-style-type: none">• Bacterial pneumonia & meningitis• Buruli ulcer• Dengue• Diarrhoeal diseases• Helminths (worms and flukes)	<ul style="list-style-type: none">• HIV / AIDS• Malaria• Kinetoplastids• Rheumatic fever Salmonella infections• Trachoma• Tuberculosis
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Projections for 2011-2020 were developed based on the work of the Bill and Melinda Gates Foundation (BMGF) Risk Adjusted Portfolio (RAP) model which includes a similar portfolio of diseases as the G-FINDER^{vii} but focuses on only the BMGF-supported candidates within that portfolio. The RAP model is a tool used by BMGF to predict future cost of vaccine R&D. For the purposes of this analysis, it has been assumed that the cost of global neglected disease vaccine R&D will follow a similar growth trend as that of the BMGF RAP portfolio through 2020. Given the uncertainty of future vaccine R&D investment requirements, a range was developed based on two projection methodologies. In the first, costs for BMGF-supported candidates increased according to the RAP projections while costs associated with other candidates were held constant through the decade. In the second methodology, costs for all candidates were assumed to increase at the same rate as the BMGF-supported candidates.

The above methodology provides a high-level cost estimate of vaccine R&D for the period 2011-2020. It is important to note that this result represents only vaccine product development costs for the G-FINDER neglected disease portfolio and does not include resources that will be required for diseases outside of this scope or for other R&D priorities such as basic research, epidemiologic investigations, and operational and implementation investigations.

^{vii} BMGF RAP portfolio diseases include Cholera, Dengue, ETEC, Hookworm, HIV, Leishmaniasis, Malaria, Pneumococcal, Rotavirus, Shigellosis, Tuberculosis and Typhoid



Appendix 4: Health outcomes methodology and assumptions

Projecting the health and economic impact from scaling up immunization in an effort to achieve the target outcomes of the Decade of Vaccines Collaboration Global Vaccine Action Plan, 2011-2020

Health Outcomes Analysis

Forecast impact of 2011-2020

A. Sample data output. Data shown for persons vaccinated for DoV high impact scenario

Vaccine-preventable Disease	Vaccination strategy	Number of persons vaccinated*	Number (percent) of total deaths averted	Number of deaths averted per 1,000 persons vaccinated
Hepatitis B	routine	643-728M	5.3-6.0M (51.2%)	8.3
Hib	routine	555-640M	1.4-1.7M (14.0%)	2.6
Pneumococcal	routine	368-429M	1.6-1.8M (15.4%)	4.3
Rotavirus	routine	265-288M	0.8-0.9M (7.7%)	3.1
Human papillomavirus	routine	35M	0.5M (4.7%)	15.1
Yellow fever	Routine	174-198M	0.0M (0.3%)	0.2
Meningococcal meningitis A	campaign & routine	316-324M	0.3-0.3M (2.3%)	0.8
Japanese encephalitis	campaign & routine	655M	0.1M (0.6%)	0.1
Rubella	campaign & routine	1,031M	0.4M (3.7%)	0.4
TOTAL (2011-2020)			10.5-11.7M (100.0%)	

B. Indicator: Future deaths averted calculated over period of mortality risk in vaccinated cohorts

C. Period: 2011-2020

D. Countries: 94 countries, consisting of all those classified as low (35) or lower-middle income (57) by the World Bank in 2011, as well as two countries that are now in the process of graduating from GAVI eligibility and are classified as upper-middle income countries were considered in scope for the purposes of this analysis. Due to data availability, some small countries were omitted for practicality purposes; it is not expected that this omission will alter the directional nature of this analysis.



E. Vaccines and vaccination strategies

Hepatitis B	Routine infant
Hib	Routine infant
Pneumococcal	Routine infant
Rotavirus	Routine infant
Human papillomavirus	Routine 10-13 year old girls
Yellow fever	Routine infant (YF SIAs were conducted prior to 2011)
Meningococcal meningitis	Routine infant + one-time SIA (all 1-29 year olds)
Japanese encephalitis	Routine infant + one-time SIA (all 1-15 year olds)
Rubella	Routine infant + one-time SIA (all 9 month-39 year old girls/women)

F. Model source and structure

Hepatitis B	CDC, WHO	Static natural history population-based cohort
Hib	JHU (Lives Saved Tool)	Static cohort
Pneumococcal	JHU (Lives Saved Tool)	Static cohort
Rotavirus	JHU (Lives Saved Tool)	Static cohort
Human papillomavirus	Harvard	Static cohort
Yellow fever	GAVI (LRCI)	Estimate of 0.2 deaths averted per 1,000 vaccinated from a static cohort model estimate for Nigeria applied to projected numbers vaccinated during 2011-2020
Meningococcal meningitis	GAVI (LRCI)	Estimate of 1.04 (SIA) and 0.08 (routine infant) deaths averted per 1,000 vaccinated from a static cohort model estimate of the NmA investment case applied to projected numbers vaccinated by each strategy during 2011-2020
Japanese encephalitis	PATH	Static cohort
Rubella	UK Health Protection Agency Centre for Infections, CDC, WHO	Dynamic cohort

G. Population projections: UN Population Division 2008 (hepatitis B, YF, NmA, JE, HPV, rubella) or 2010 (Hib, rotavirus, Sp) revision

H. Coverage projections: GAVI Strategic Demand Forecast 4.0, 4 October 2011; GAVI Adjusted Demand Forecast

I. Underlying disease burden



Hepatitis B	Pre-vaccination HBsAg serosurvey data (many countries)
Hib	WHO/CHERG 2008 under-5 pneumonia deaths (many countries) x pre-vaccination proportion radiographic pneumonia cases due to Hib (probe studies in 4 countries)
Pneumococcal	WHO/CHERG 2008 under-5 pneumonia deaths (many countries) x pre-vaccination proportion radiographic pneumonia cases due to Sp (probe studies in 4 countries)
Rotavirus	WHO/CHERG 2008 under-5 diarrhea deaths (many countries) x pre-vaccination proportion severe gastroenteritis due to rotavirus infection (many countries)
Human papillomavirus	Pre-vaccination retrospective surveys of women with invasive cervical cancer with use of molecular techniques to determine the proportion due to HPB and due to specific HPV genotypes (many countries)
Yellow fever	Pre-vaccination 1993 study modeling the impact of vaccination in Nigeria during 1991-2026. Model based on many disease burden studies in Nigeria (one country, little comparable data elsewhere). Only epidemic disease burden considered. Impact based on marginal increase in coverage since year prior to start of GAVI support.
Meningococcal meningitis	Based on a pre-vaccination prospective hospital surveillance study in Niger conducted during 1981-1996 (one country, little comparable data elsewhere)
Japanese encephalitis	Based on a 2011 review of population-based surveillance studies. Some pre-vaccination some post-vaccination) (several countries)
Rubella	Pre-vaccination retrospective rubella serosurveys to determine age-specific incidence (many countries)



Economic Impact Analysis – Value of Statistical Life Methodology

Objective

To present the economic benefits of reduced mortality from immunization over the Decade of Vaccines (2011-2020) in line with 1) health impact figures based on the GAVI Strategic Demand Forecast (SDF) v4.0; and 2) DoV Costing analysis using the Adjusted Demand Forecast (ADF).

Methods

Value of Statistical Life Concept

We used the Value of Statistical Life (VSL) methodology to estimate the economic impact of vaccines over the Decade of Vaccines. The value of a statistical life is based on the idea that individuals make trade-offs every day between health and risk of death, such as driving a vehicle, smoking a cigarette, and eating unhealthy food.¹ The value of a statistical life is based on the estimated amount of income a typical individual is willing to trade off to reduce the risk of death.²

A value of statistical life is derived from both wage risk studies, which use labor-market data, and stated population preference studies, which ask individuals how much they are willing to pay to avoid certain risks of death.³⁻⁵ The reductions in risks are multiplied across a large population. For example, if each member of a population of 10,000 is willing to pay \$660 on average for a one in 10,000 decrease in his or her risk of dying, the value of a statistical life is calculated as \$6,600,000 (\$660 x 10,000).

Estimating the value of a statistical life helps policy makers determine how much they should spend on programs that prevent death in their populations. The results are used widely in high-income countries to assess investments such as in preventing road traffic accidents or drowning, or in ensuring clean air and safe drinking water.^{6,7} Specifically, the United States has presidential executive orders encouraging the use of value of a statistical life in policy evaluation and cost-benefit analyses by the Department of Transportation and the Environmental Protection Agency.⁸⁻¹⁰ In the United States, a program that costs less than the US value of \$6.6 million to save a child's life would be considered a worthy investment.

Deaths averted calculations

Our inputs were the number of future lives saved from 9 vaccines administered during 2011-2020. The deaths averted were accrued from the time of vaccination through a lifetime. The vaccines included in this analysis were:

- Haemophilus influenzae* type b (Hib),
- Pneumococcal conjugate,
- Rotavirus,
- Rubella,
- Meningococcal meningitis,
- Hepatitis B,
- Human papillomavirus (HPV),
- Japanese encephalitis (JE) and
- Yellow fever

Mortality impact of the above nine vaccines in 73 GAVI-eligible countries was estimated using two different coverage forecasts from GAVI (Adjusted Demand Forecast and Strategic Demand Forecast),



and five disease models from research teams at the Centers for Disease Control, PATH, UK Health Protection Agency, Harvard School of Public Health, and Johns Hopkins Bloomberg School of Public Health. The number of deaths averted in eight non-GAVI eligible middle-income countries was estimated by multiplying the ‘number of children fully vaccinated’/1000, as forecasted by the SDF, by ‘deaths averted per 1000 vaccinated’ for 6 vaccines (Hib, PCV, rotavirus, rubella, Hep B, JE), as modeled by the above research teams.

	GAVI 73 countries									8 Middle Income Countries*					
Vaccines	Hib	PCV	Rota	Rub.	Men A	Hep B	HPV	JE	YF	Hib	PCV	Rota	Rub.	HepB	JE
Coverage	ADF	ADF	ADF	SDF	ADF	ADF	SDF	SDF	ADF	GAVI Strategic Demand Forecast (SDF)					
Mortality Impact Model	Mortality Impact Research Team results <u>PLUS</u> additional deaths averted from scale-up to ADF coverage. Additional deaths estimated using “Deaths averted per 1,000 vaccinated” by disease.									Estimates derived from “Deaths averted per 1,000 vaccinated” by disease from GAVI analysis					

*Countries include: Egypt, El Salvador, Guatemala, Iraq, Morocco, Paraguay, Philippines, Syria

Value of Statistical Life Calculations

Following the standard rules used by the US Congressional Budget Office¹¹ and the most recent literature in the field, we adopted a benchmark value of a statistical life for the United States of \$6.6 million per life saved, in 2010 US dollars. This estimate is based on studies of compensating wage differentials among jobs with varying risks of death and interview-based approaches from sixty articles in ten high-income countries,^{4,12} adjusted for inflation and real income growth.¹³ This figure lies between the value used by the US Department of Transportation (\$6.1 million in 2010 dollars)¹⁰ and the estimate adopted by the US Environmental Protection Agency (\$8 million in 2010 dollars).⁸

Since there are very few studies on the value of statistical life in low-income countries, we used the “benefits transfer” method to adjust the VSL in the United States to individual low and middle income countries.^{13,14} An income elasticity of 1.5 was chosen based on studies in low-income countries which suggest that people with lower incomes are willing to take on greater occupational mortality risk than those with greater incomes.¹⁵ Value-of-statistical-life adjustments were made using projected gross domestic product per capita figures for the United States and each low-income country. Per capita gross domestic product projections for 2010-16 were adopted from the International Monetary Fund and trended forward for the years 2017-20 based on the past five years and converted to 2010 US dollars.

Example Countries	GDP per capita (2010\$)	Elasticity 1.0	Elasticity 1.5	Elasticity 2.0
India	\$1,458	\$205,103	\$36,075	\$6,345
Pakistan	\$1,035	\$145,541	\$21,564	\$3,195
Nigeria	\$1,350	\$189,944	\$32,150	\$5,442
Congo, DR	\$192	\$27,053	\$1,728	\$110
Ethiopia	\$368	\$51,764	\$4,574	\$404



Since our analysis combined vaccines that target both childhood and non-childhood diseases, we converted the value of statistical lives in each country to the value of a statistical life years (VSLY). We divided the value of statistical life by the country's discounted average life expectancy at birth to obtain the VSLY. We then multiplied the VSLYs by the country's discounted average life expectancy at age of death for each vaccine-prevented disease to get the adjusted value of statistical life. For non-childhood diseases, we discounted the value of future deaths 3% annually back to the year of vaccination. While these VSLY conversions did not affect childhood diseases, it reduced the value of statistical life estimates for non-childhood diseases where the health benefits of childhood or adolescent vaccination do not accrue until many years in the future (e.g., among adults). To calculate the overall value-of-statistical-life values, the number of lives saved as a result of vaccine use was multiplied by the adjusted value-of-statistical-life for each country.

Uncertainty Ranges

We conducted sensitivity analyses to show the uncertainty ranges around each value-of-statistical-life estimate in the model. We carried out computer simulations using the Monte Carlo method, varying three key variables: (1) the benchmark value-of-statistical-life value (which varied from \$6.2 million to \$8.1 million), (2) the income elasticity (which varied from 1 to 2), and (3) the mortality estimates, which varied from 30 percent to 297 percent of the baseline based on our previous assumptions.¹⁶ A probability distribution was applied to each variable where 10,000 iterations of the model were run using @RISK software (version 5.7).

The values represent the total aggregated value-of-statistical-life figures, with an uncertainty range. This can be interpreted as the amount that families with children at risk of death value lowering their risk of death by improving childhood immunization coverage. We present the base estimate and uncertainty range under the following 4 scenarios:

- (1) Countries which introduced with GAVI support, using the SDF
- (2) All GAVI countries, using the SDF
- (3) All GAVI countries using the SDF, plus the 8 MIC countries using the SDF
- (4) All GAVI countries using the ADF, plus the 8 MIC countries using the SDF

Limitations

Our estimates are limited by the data inputs and may underestimate the economic gains from immunization over the Decade of Vaccines. The health impact estimates we received were developed using varying model assumptions and most do not include herd immunity. So for vaccines like pneumococcal conjugate, where childhood vaccination may reduce the risk of disease among adults, we will have underestimated this health and economic benefit. We also only model the economic benefits from reduced mortality without including a valuation of averted morbidity. Due to limited health impact data, we have not included the impact from pertussis vaccine, or rubella in GAVI-eligible countries that introduced without GAVI support. In the 8 non-GAVI eligible middle-income countries, demand forecasts were based on the more conservative SDF and impact from HPV was not included. The conservative SDF estimates were also used for rubella, HPV and JE.

Our estimates are different from those obtained by calculating treatment and productivity costs, because they also capture the non-economic value that people place on human life. They are derived



from individual judgments of trade-offs between financial rewards and increased mortality risk and attempt to place a value not just on productivity loss due to death, but also on living longer and healthier lives.

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Appendix 5: List of list of all countries and organisations that have contributed to GVAP

Preliminary - Work in progress until consultation is finished

Organisations whose members have provided inputs and comments to the Global Vaccine Action Plan

Government agencies: Agencia Española de Cooperación y Desarrollo, Center for Disease Control and Prevention (CDC), Chinese Centers for Disease Control (CDC), Control of Infectious Diseases Department, Institute of Public Health, Albania, Department of Biotechnology (India), European Medicines Agency, Federación de Planificación Familiar Estatal, Food and Drug Administration (FDA), Health Canada, Health Protection Agency, National Institute for Food and Drug Control, National Institute of Biological Standards and Control, National Institute of Immunology, National Institutes of Health - National Institute of Allergy and Infectious Diseases, National Medicines & Poisons Board, National Primary Healthcare Development Agency of Nigeria (NPHCDA), Norwegian Agency for Development Cooperation, Paul Ehrlich Institut, RIVM National Institute of Public Health & Environment, Supreme Board for Drugs (Yemen), The President's Emergency Plan for AIDS Relief, UK Department for International Development, US Department of Defense, US Department of Health and Human Services.

Health professionals: American Academy of Pediatrics, Hôpital d'Enfants de Rabat, International Pediatric Association, Sudan Pediatric Association, Uganda Paediatric Association.

Academia: AAAS, Aga Khan University, Barcelona Centre for International Health Research, Center for Vaccine Development, Center for Vaccine Ethics and Policy, Centre for Health Sciences Training, Research and Development, Centro para Vacunas en Desarrollo, Chinese University of Hongkong, China, Christian Medical College, Chulalongkorn University, Emory University, Faculté de Médecine - Marrakech, Fred Hutchinson Cancer Research Center, Fundacio Clinic per a la Recerca Biomedica, Georgia Institute of Technology, Griffith University, Indian Council for Medical Research, Infectious Diseases Research Institute (IDRI), Institut Català d'Oncologia, Institut Pasteur, International Agency for Research on Cancer, International Centre for Diarrhoeal Disease Research Bangladesh (ICDDR), International Centre for Genetic Engineering and Biotechnology (ICGEB), Jawaharlal Nehru University, John Hopkins University, Jordan University Hospital, Karolinska Institute, London School of Hygiene & Tropical Medicine, Lund University, Mahidol University, Makerere University, Menzies School of Health Research, Molecular Biophysics Unit Indian Institute of Science, National Institute of Child Health, Karachi, Pakistan, Novartis Vaccines Institute for Global Health, Oswaldo Cruz Foundation, PGI, Chandigarh, Princeton University, Ragon Institute, Rockefeller University, Tehran University of Medical Sciences, The University of Phillipines, Manila, The Wharton School, University of Pennsylvania, University College London, University of Geneva, University of Alabama, University of Antwerp, University of California- San Francisco, University of Cape Town, University of Erfurt, University of Gottingen, University of Kwazulu-Natal, University of Maryland, University of Melbourne, University of Michigan, University of Minnesota, University of Oxford, University of Sidney, University of Tennessee, University of Toronto, University of Warwick, Vaccine Research Group (VRG), Mayo Clinic, Walter Reed/AFRIMS Research Unit Nepal, Wellcome Trust.

Manufacturers: Aridis Pharmaceuticals, Baxter, Bharat Biotech, BIO, Biofarma, Biological E, Bio-Manguinhos, Butantan Institute, CNBG, Crucell Vaccines, Developing Countries Vaccine Manufacturers Network, GlaxoSmithKline Biologicals, Inovax, Intercell, International Federation of Pharmaceutical



Manufacturers and Associations, Merck, NasVax, Novartis Pharma AG, Novavax, Pfizer, Sanofi-Aventis, Serum Institute, The Biovac Institute.

Global agencies: GAVI Alliance, Pan American Health Organisation, UNICEF, United Nations, World Bank, World Health Organisation.

Development partners: African Development Bank, Clinton Health Access Initiative, Lions Club International Foundation, Rotary International, Slim Foundation, The Bill & Melinda Gates Foundation.

Civil society: @Verdade, Action for Global Health, ActionAid, Agence de Médecine Préventive (AMP), AIDOS, American Association for Cancer Research, American Red Cross, Americans for Informed Democracy, Asociation Lalla Salma de Lutte contre le Cancer (ALSC), Association d'Assistance aux Développement, BIO Ventures for Global Health, Center for Global Development, Center for Strategic & International Studies, CESTAS, CORE Group, DSW, European Parliamentary Forum, European Public Health Alliance, Every Child by Two, Farmamundi, Global Commission on HIV and the Law, Global Health Advocates, Global Health Council, Global Health Technologies Coalition, Health Action International, Health and Rights Education Program, Interact Worldwide, International Council of Voluntary Agencies, International HIV/AIDS Alliance, International Red Cross, International Research Foundation for Development, ISGLOBAL, Kaiser Family Foundation, Kenya AIDS NGOs Consortium (KANCO), Kid Risk, Inc., Knowledge Ecology International, Light Africa International, Malaria No More, Management Sciences for Health, Médecins du Monde, Medecins Sans Frontières, Medicus Mundi, Nothing But Nets, ONE, Oxfam, PATH, Philippine Foundation for Vaccination (PFV), Plan International, Planeta Salud, PMNCH CSO constituency, PSI, Regroupement des ONGs et Associations du Secteur de la Santé (ROASSN-Niger), Results for Development, SANRU, Save the Children, Sightsavers, Stop AIDS Alliance, Swaasthya, Task Force for Global Health, TB Alert, Terre des Hommes, The Communications Initiative, The INCLEN Trust International, UN Foundation, Union des ONG du Togo, Union for International Cancer Control, United Methodist Church General Board of Church and Society, Welthungerhilfe, World Vision.

Private sector: Applied Strategies, The Boston Consulting Group, Bernard Fanget Consulting, Codexis, Dynavax, Evergreen Associates, Global Health Strategies, GMMB, John Snow, Inc., Kleiner Perkins Caufield & Byers (KPCB), Lion's Head Global Partners, Liquidia Technologies, McKinsey & Company, MedImmune, NeoVacs, S.A., Weber Shandwick.

Countries of the individuals and organisations that provided inputs and comments to the Global Vaccine Action Plan: Albania, Angola, Armenia, Australia, Austria, Bangladesh, Barbados, Belgium, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Central African Republic, Chad, Chile, China, Colombia, Democratic Republic of Congo, Denmark, Ecuador, Egypt, , Estonia, Ethiopia, Finland, France, Gabon, Gambia, Germany, Ghana, Honduras, India, Indonesia, Iran, Ireland, Italy, Japan, Jordan, Kenya, Malawi, Maldives, Mali, Mexico, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands, Niger, Nigeria, Norway, Pakistan, Papua New Guinea, Paraguay, Portugal, Qatar, Republic of Kazakhstan, Rwanda, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Somalia, South Africa, South Korea, South Sudan, Spain, Sudan, Sweden, Switzerland, Syrian Arab Republic, Tanzania, Thailand, Timor-Leste, Togo, Tunisia, Uganda, United Kingdom, United States of America, Uzbekistan, Yemen, Zambia, Zimbabwe.