Economic Case for Eradicating Polio

POLIO GLOBAL ERADICATION INITIATIVE

Summary

The Polio Eradication and Endgame Strategic Plan 2013-2018 (The Plan)[1] has been developed to capitalize on a unique opportunity to eradicate a disease only the second time in history. The ambitious Plan will cost $5.5 billion to implement and require additional resources from countries.[2] In the current fiscal climate of scarcity, it is important to examine the economic case for continuing to invest in polio eradication.

As recently as the 1980s, polio crippled an estimated 350,000 children every year.[3] So far, the Global Polio Eradication Initiative (GPEI) has ensured that millions of people are now walking who would have been paralyzed. The disease remains endemic in only three countries—Afghanistan, Nigeria, and Pakistan, and fewer than 250 children were paralyzed in 2012. The investment of $9 billion since GPEI's initiation in 1988[4] has been critical to this success. It has already generated net benefits of $27 billion, out of the total $40-50 billion previously estimated.[5]

Building on an existing body of work,[6] this report offers a forward-looking perspective on the benefits of eradication using updated cost inputs that underlie the Plan.[7] It establishes three core economic arguments for continuing to invest in polio eradication:

1. Eradication is more cost-effective than the alternatives presented;

2. GPEI's commitment to strengthen immunization systems and support other health priorities will bring additional economic benefits;

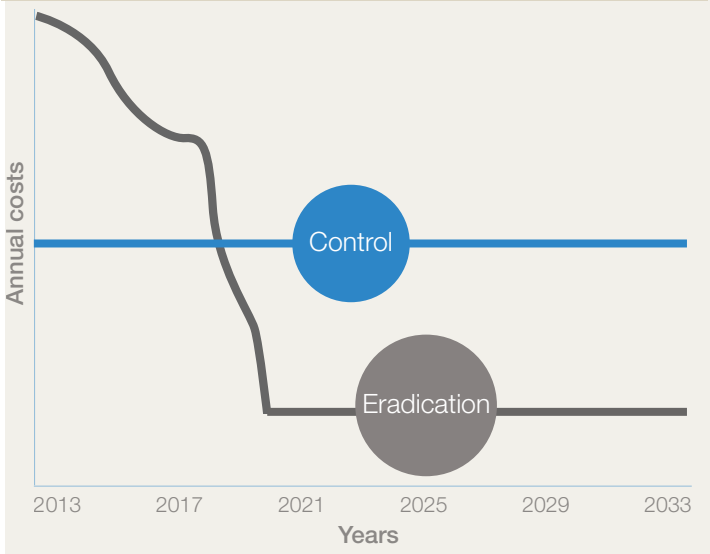
3. GPEI is carefully managing its resources and making efforts to be more efficient.

[1] For the latest Polio Eradication Endgame and Strategic Plan please visit www.polioeradication.org
[2] Cost of eradication has several components: GPEI funding, in-country spend on eradication and ongoing spend on polio vaccines through the routine immunization system
[3] In 1988, prior to the start of GPEI, annual polio incidence was estimated to 350,000 or more. See also WHO's factsheet on polio at http://www.who.int/mediacentre/factsheets/fs114/en/
[4] $9 billion investment includes funding to GPEI in 104 countries, excludes in-country eradication spend, unless part of the GPEI financial resources requirements
[5] Duintjer Tebbens RJ, Pallansch MA, Cochi SL, Wassilak SGF, Linkins J, Sutter RW, Aylward RB, Thompson KM. Economic analysis of the Global Polio Eradication Initiative. Vaccine 2011;29(2):334-343. This study estimated total net benefits of $40-50 billion for the 104 countries that benefit from the GPEI over the period of 1988-2035, with an additional $17 billion or more arising from delivering Vitamin A as part of polio vaccine campaigns.
[6] See note 5 and Thompson KM, Duintjer Tebbens RJ. Eradication versus control for poliomyelitis: An economic analysis. The Lancet 2007;369 (9570):1363-71. This prospective economic analysis of eradication versus control demonstrated that pursuing a policy of control in perpetuity implied greater health and financial costs than eradication.
[7] Reflects the current Plan and up-to-date estimates for key costs such as product prices, cost of immunization, required surveillance and outbreak control. The primary focus of this analysis is the 38 countries that receive the vast majority of GPEI funds.

To evaluate the first core argument, the costs and benefits of eradication were compared to viable alternatives over a period of time.[8] Two alternatives to eradication were considered: relying solely on the existing routine immunization (RI) infrastructure, and a control policy aimed at keeping the number of polio cases below a certain annual level. Consistent with past research,[9] relying on current levels of routine immunization would lead to a rapid resurgence of polio cases and result in hundreds of thousands of paralyzed children annually within a number of years. Pursuing a strategy of control may be less expensive than eradication in the next few years, but the cumulative costs of this approach over time (operational costs, but also productivity losses and treatment costs) would quickly overtake the costs of eradication, as shown in *Exhibit 1*.

Exhibit 1

Control has lower costs in the first few years, but the cumulative costs quickly overtake those of eradication



Source : Team Analysis, GPEI Plan

Compared to the alternatives considered, eradicating polio is the most cost-effective choice based on the benefits from eradicating polio alone. Even with an additional $5.5 billion invested, and continued investment by countries, the Plan promises to yield up to $25 billion in additional net benefits over the next 20 years. These benefits apply to the 38 countries that are the core beneficiaries of GPEI funding[10] and do not take into account the additional benefits possible over a longer time period globally.

The second core argument demonstrates the potential benefits GPEI will bring to other health programs. In the past, these contributions were largely opportunistic. From 1988 to 2010, it is estimated that GPEI workers administered up to 1.3 billion doses of Vitamin A during polio campaigns, averting at least 1.1 million deaths and creating an economic benefit of at least $17 billion.[11]

For the first time, strengthening immunization systems and legacy planning are included as integral components of the Plan, and these contributions will generate additional economic benefits. In particular, the Plan sets explicit targets to increase immunization coverage in the 10 countries most affected by polio. In Nigeria alone this could prevent ~30-35,000 deaths between 2014 and 2018 and result in an economic benefit of ~$4 billion.[12]

The third core argument is that GPEI has taken an active approach to resource management to maximize efficiency and ensure the donors' investments are well-spent. This includes working with partners to manage costs for Oral Polio Vaccine (OPV) and Inactivated Polio Vaccine (IPV), improving operational efficiency, and securing advance funding.

While the economic benefits of investing in eradication are clear, experience has shown that gains in the battle against polio are precarious. Until eradication is completed, the world remains at risk of the disease reemerging, resulting in tragic, avoidable health outcomes as well as the potential for increased costs. Eradication will require a concerted, focused effort, along with full investment in the Plan.

[8] See Thompson and Duintjer Tebbens 2007, note 5.
[9] See notes 5 and 6
[10] Estimated benefits are to the 38 countries receiving technical assistance and supplemental funding from GPEI (majority of GPEI funding) Does not include the potential benefits to other countries covered by GPEI who receive only smaller amounts of funding.
[11] See Duintjer Tebbens et al. 2011, note 5.
[12] Deaths averted from increased immunization calculated based on ratio of deaths averted per 1,000 children immunized. Economic benefits based on averted productivity losses. For more details see section 2 and technical appendix

1. Polio eradication is the most cost-effective option

To compare eradication to other scenarios, the study started by estimating the full costs of eradication and post-eradication activities. The costs of GPEI will continue to be substantial over the next six years until wild poliovirus transmission is interrupted and certification is completed. GPEI plans for countries to stop using OPV by 2019, leading to a significant drop in costs. However, countries will need to continue immunization with IPV for at least several more years. There is significant uncertainty surrounding the exact policies countries will pursue after they stop using OPV. Three different post-eradication scenarios were considered:

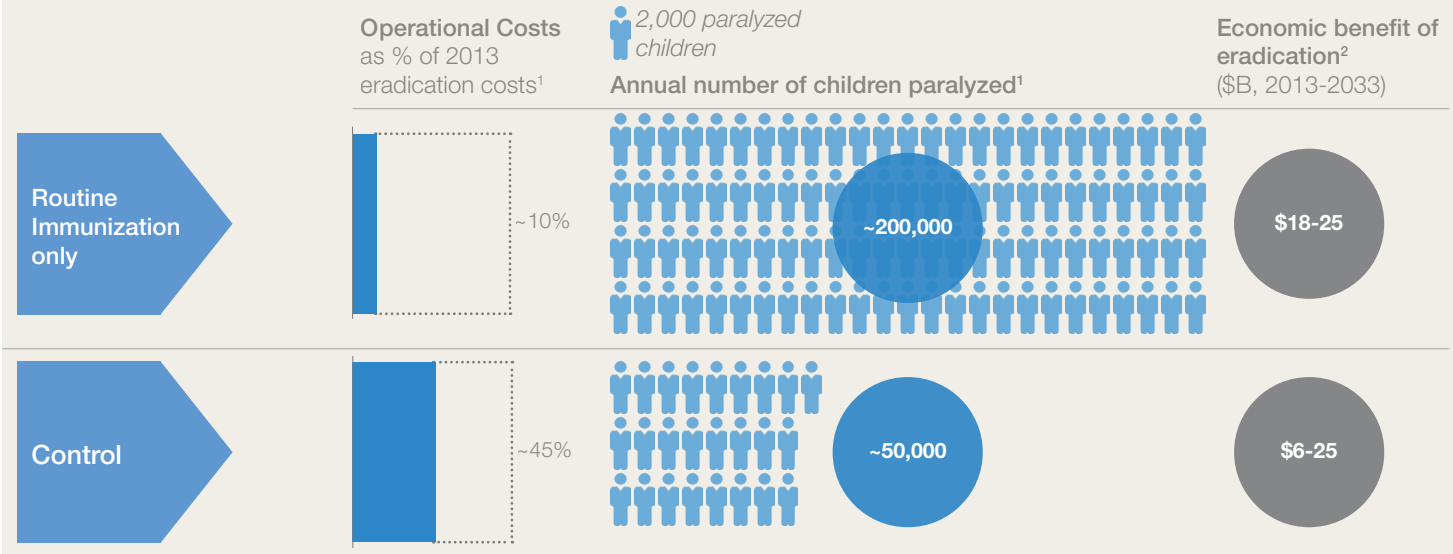
1. Minimum IPV use assuming only one dose per child for 5 years post OPV cessation;
2. Ongoing IPV use with one dose per child;
3. Ongoing IPV use with three doses per child.

Even the most aggressive assumptions on IPV use involve costs of no more than $500 million per year for the 38 countries in this analysis. As a result, total eradication and post-eradication costs amount to an estimated $10-16 billion over 20 years (2013-2033).

This study considers two alternatives to the eradication scenarios:

1. Halting GPEI and relying upon the existing routine immunization system, and
2. Implementing a control scenario that establishes a maximum number of cases and then adjusts the intensity of campaigns to try and stay below that number.

Exhibit 2
Routine immunization and control would lead to a rapid resurgence of polio cases



[1] Relative to 2013 GPEI budget. Note that GPEI costs are not constant and decrease significantly during 2013-2018. Control costs remain stagnant.
[2] Discounted at 3%, includes operational costs and costs of cases for control and eradication scenarios
SOURCE: Team analysis, GPEI Plan

Relying on routine immunization is the least expensive option in terms of operational costs. However, the current immunization infrastructure is insufficient to create enough population immunity against the poliovirus in high-risk geographies. This would lead to a resurgence in the disease to 200,000 cases of paralysis a year within five years. When fully accounting for treatment expenses and the economic losses associated with these cases[13], the cumulative costs of relying on RI over the next 20 years exceed $35 billion.[14] The net benefit of eradication would thus be $19-25 billion over the same period.[15]

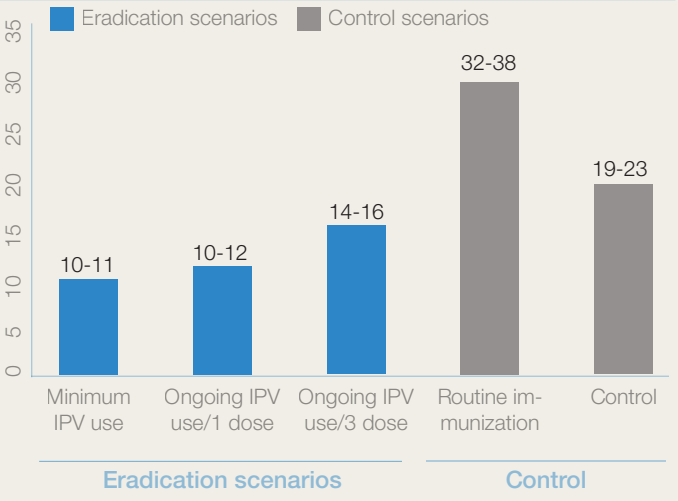
It has been suggested that funds spent on polio eradication could instead be directed at strengthening the routine immunization infrastructure in countries where it is weak. However, it would take years to strengthen systems in most countries sufficiently. Relying on current levels of routine immunization, particularly in the countries most at risk for polio, would lead to a rapid resurgence of polio cases and result in hundreds of thousands of paralyzed children annually within a number of years. To keep incidence low, supplemental immunization activities (SIAs) would still be required.

In the second option, a relatively high level of activity would be maintained in the three endemic countries (Afghanistan, Nigeria, Pakistan) and India, with reduced spending in other countries. Assuming only one supplemental immunization activity (SIA) every 18 months in non-endemic areas, past analysis[16] suggests incidence would stabilize at about 50,000 cases of paralysis each year within three to five years. Operational costs would be significantly lower in the near term (about 45% of projected spending in 2013), but total costs would rapidly surpass annual eradication costs, given the burden of polio cases (treatment costs, lost productivity). In this scenario, eradication would generate net benefits of $6-10 billion over 20 years.

Exhibit 3

All eradication scenarios are more cost effective than alternatives

Total discounted cost for modeled scenarios-2013-33 ($B, 2013)[1]



[1] Present value discounted at 3%
SOURCE: Team analysis

A "heavy control" scenario to keep incidence closest to current levels (below 2,000 cases) was also considered. Prior analysis clearly demonstrated that heavy control scenarios lead to more costs than eradication. These findings remain valid, as the infrastructure required would be similar to eradication.[17] However, it is unlikely that an effort to control incidence at such low levels could be sustained for more than three to five years. Without the end goal of eradication, momentum required to sustain an intense coordinated effort would be lost. The result would be a spread of polio to more countries and a growing number of outbreaks. *(See information on costs and burden of outbreaks on page 5)*

[13] Economic losses associated with polio cases were calculated using DALYs and GDP per capita. For details please refer to the technical appendix
[14] Undiscounted cumulative cost over 20 years ~ $51 billion, discounted at 3% ~$35 billion
[15] Relative to midpoint of low and high estimate of eradication cost (~$13B)
[16] Analysis based on Thompson and Duintjer Tebbens, see notes 5 and 6
[17] Thompson KM, Duintjer Tebbens RJ. Eradication versus control for poliomyelitis: An economic analysis. The Lancet 2007;369 (9570):1363-71. This prospective economic analysis of eradication versus control demonstrated that pursuing a policy of control in perpetuity implied greater health and financial costs than eradication.

In fact, any control scenario would be difficult to execute. Without the motivation of eradicating polio, countries would struggle to recruit the large numbers of health workers and volunteers who have been crucial to polio eradication to date. They also would likely face tremendous challenges in sustaining the required spending and political will.

To summarize, eradication is more cost-effective than alternatives considered. Eradication will have high costs up front, but costs then drop to much lower levels required for routine IPV immunizations. Costs for control remain stable at a high level over time.

Looking at eradication more broadly—over time and geography—leads to even greater returns. Extrapolating just 10 additional years, for 30 years in total, eradication benefits would reach up to $45 billion.[18] This analysis does not include the potential cost savings of avoiding outbreaks in high and middle income countries, like the 2010 outbreak in Tajikistan that led to over 400 cases and spread to the Russian Federation as well.

Costs and burden of outbreaks

If the intensity of the fight against polio decreases, the world is at a much higher risk of outbreaks. As GPEI's experience shows, preventing outbreaks not only avoids the tragic health outcomes of polio, but is also a more cost-effective approach. In late 2003-2004, five Nigerian states stopped delivering the polio vaccine amid rumors about its safety. Although these states started using OPV again by the end of 2004, GPEI spent over $220 million on outbreak response alone in 2005. The virus also spread to 19 countries that were previously polio-free, forcing GPEI to spend another $150 million controlling outbreaks in 2006.[19] Only eradication can eliminate the risk of outbreaks for good.

[18] Relative to average cost of low and high estimate of eradication cost over 30-year period ($11 and $17B)
[19] GPEI Annual Report 2005

2. GPEI's commitments to strengthen immunization and support other health priorities will bring additional economic benefits

GPEI has built an infrastructure that reaches an unparalleled number of the world's poorest and most disadvantaged children. Its network of over 18,000 polio staff represents the single largest source of technical assistance for immunization in low-income countries.[20] Additionally, millions of volunteers and workers from national health agencies and ministries support the polio program, especially during campaigns. Each National Immunization Day in India, for example, involves 2.5 million vaccinators and 155,000 supervisors. The program continually reaches nomadic children who had never received any health services in Nigeria, migrant children of brick kiln workers in India, and children in conflict areas like Sudan, Somalia, and Sri Lanka that are untouched by other health programs.

The new Plan emphasizes leveraging this unique infrastructure to support other health programs, primarily by strengthening the delivery of immunization services (Plan Objective 2) and through legacy planning to ensure that investments in polio eradication contribute to future health goals (Plan Objective 4).

GPEI has set targets and milestones to increase immunization coverage in the highest-risk areas of 10 countries by 10% each year, from 2015 to 2018.[21] GPEI will collaborate with national authorities, GAVI, and partners in developing annual plans for strengthening immunization systems. The experience of GPEI in Bihar, India shows the power of this approach. The Bihar polio program not only achieved eradication but simultaneously contributed to increasing RI coverage from 19% in 2005 to 67% in 2010 *(Exhibit 4)*.[22]

GPEI has now set a target that by the end of 2014 its workers in 10 focus countries spend at least 50% of their time on activities intended to strengthen RI coverage. This includes activities such as improving program management, strengthening micro-planning, engaging communities, and monitoring of program performance.[23]

In just one of the focus countries, Nigeria, improving the low RI rates (approximately 47% in 2011 for DTP3, according to WHO) would have tremendous benefits. Increasing immunization coverage by 10% annually between 2014 and 2018 could save ~30-35,000 lives[24] and translate into an economic benefit of ~$4 billion by averting economic productivity losses.[25] Although many institutions contribute to improved immunization coverage, GPEI and its workers already support other immunization activities, and this contribution will increase over the next several years.

GPEI also has leveraged its infrastructure to support other health outreach. From 1988 to 2010, it is estimated that GPEI workers administered up to 1.3 billion doses of Vitamin A during polio campaigns, creating an economic benefit of over $17 billion.[26] Polio program staff have also supported surveillance of and response to measles, tetanus, meningitis, yellow fever and cholera. Furthermore, GPEI has assisted with public health and humanitarian emergencies such as SARS, the Asian tsunami of 2004 and the Pakistan floods in 2010-11.

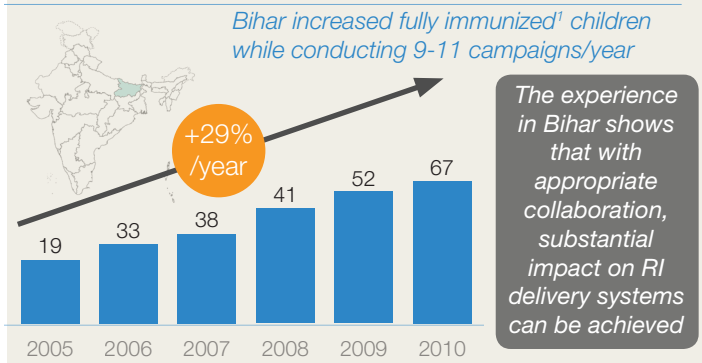
In India, the polio program infrastructure developed as part of GPEI is now supporting the fight against other diseases. In 2012, India's National Polio Surveillance Project (NPSP) serologically investigated 135 measles/rubella outbreaks, testing nearly 700 samples in its laboratories. In the same year, NPSP and UNICEF India polio staff conducted about 95% of the 42,000 immunization monitoring sessions in Bihar and more than 60% of the 205,000 sessions in Uttar Pradesh.[27]

Moreover, the newly-launched effort to ensure that GPEI's staff and infrastructure support other health priorities after eradication will increase the program's long-term global health impact.

Exhibit 4

In Bihar, GPEI infrastructure has helped to drastically strengthen immunization coverage within 5 years

Percentage of fully immunized[1] children in Bihar, India (2005-10)



[1] Fully immunized children =BCG, DTP3, OPV3, measles
SOURCE: BMGF

[20] WHO long-term human resource plans (2013), UNICEF internal data
[21] Angola, Afghanistan, Chad, Democratic Republic of the Congo, Ethiopia, India, Nigeria, Pakistan, Somalia, South Sudan. Plan sets as a target to reach 10% increase in 80% of high risk districts.
[22] Fully immunized children (DTP3, OPV3, measles, BCG)
[23] GPEI is updating its terms of reference for staff with monitoring and evaluation measures to assess the results of these activities and to ensure accountability for immunization strengthening.
[24] Deaths averted are calculated based on ratios of deaths averted per 1,000 infants vaccinated for the four vaccines used in this calculation. Based on Lee et al., 2013 "The estimated mortality impact of vaccinations forecast to be administered during 2011–2020 in 73 countries supported by the GAVI Alliance"
[25] Economic costs averted are equal to the total number of deaths averted multiplied by the average life expectancy at one year of age in Nigeria (57.6 years) and the Nigerian GDP per capita (~$2,500). Equals $145,000 per death averted. Excludes costs associated with treatment costs and economic losses from morbidity
[26] Benefits from Vitamin A are not included in the past benefits of $27 billion referred to in the Introduction
[27] WHO Country Office for India, UNICEF, National Polio Surveillance Project

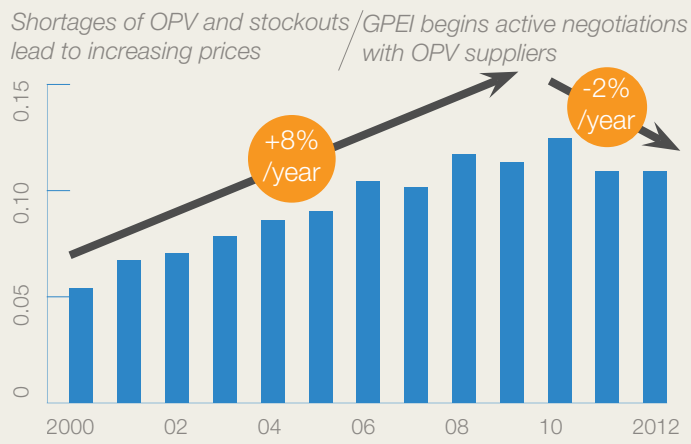
3.GPEI is making significant efforts to strengthen resource management

GPEI, together with UNICEF Supply Division and international partners, is taking steps to strengthen resource management—such as reducing the cost of IPV and OPV (with significant benefits for all countries), improving operational efficiency (based on a full review of program operations), and securing advance funding.

Vaccine costs are a significant part of the GPEI budget. OPV and IPV account for 15% of the 2013-2018 GPEI budget. The price for OPV doubled between 2000 and 2009, driven by stockouts and new product introductions (bOPV and mOPV), but now remains relatively stable. This is partly the result of a more active intervention of GPEI and its partners in managing product costs.

Exhibit 5
GPEI and its partners are actively managing OPV costs

OPV price per dose ($USD, 2000-2012)

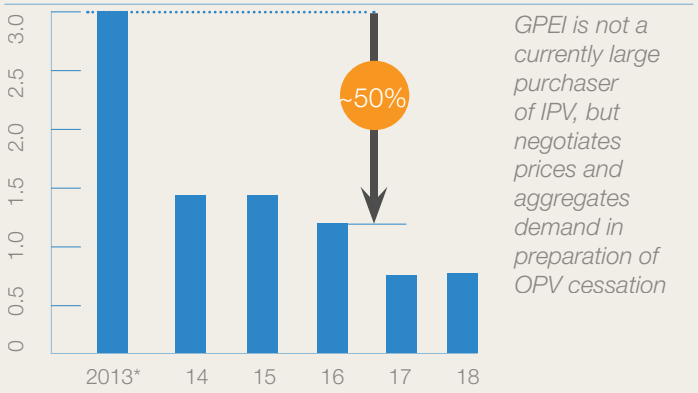


SOURCE: WHO/UNICEF IPV price projections, GPEI, OPV prices

Similar efforts are underway for IPV. Historically, GPEI has not been a major purchaser of IPV. But plans to integrate IPV into RI schedules in preparation for global OPV cessation have led GPEI to look for ways to reduce IPV costs. UNICEF currently pays $3.00 per dose of IPV. An investment in driving reliable supplies of low-cost IPV should bring prices down by more than 50% by 2015, and ongoing investments and initiatives will likely drop IPV prices below $1 per dose in GAVI-eligible countries.[28]

Exhibit 6
GPEI is working to bring prices for IPV below $1 per dose

IPV price per dose ($USD, 2013-2018)



** Prices currently paid by UNICEF*
SOURCE: WHO/UNICEF IPV price projections, GPEI, OPV prices

As part of its planning for eradication, GPEI recently has reviewed all program costs for the next six years and conducted in-depth analysis of all GPEI-funded activities and country budgets. If broadly implemented, the resulting recommendations would lead to a reallocation of resources to the highest-value initiatives in the Plan.

[28] Serum Institute of India made a public announcement that it intended to supply IPV at under $1 per dose
[29] OPV orders typically include a buffer or "planned wastage" to allow for wastage and prevent stock outs. Standard recommended buffer is 10-15%

GPEI partners have already committed to and begun to implement two significant changes that could save $75 million between now and 2018:

1. Increasing adherence to OPV buffer policies (also known as "planned wastage"),[29] which could reduce OPV demand without compromising security of supply; and

2. Adjusting the frequency and quality of vaccinator trainings. Since 60-90% of vaccinators are repeat vaccinators, conducting fewer trainings and providing more on-the job coaching and monitoring would improve service quality.

GPEI is reviewing other potential program changes, including estimating target population levels more accurately. In some places, the number of children who need the polio vaccine is often over-estimated. Better estimates could lead to purchasing fewer vaccines, and free $100 million or more from the GPEI budget. GPEI partners are currently evaluating options to develop and refine implementation of these additional program changes.

Lastly, by developing and funding a long-term plan for polio eradication up front, GPEI minimizes the risk of incurring additional costs later. In the past, GPEI has had to cancel immunization campaigns due to inadequate or unpredictable funding. This has disrupted programs, delayed success, and led to countless outbreaks in previously polio-free countries. In recent years, outbreak costs have remained stable at around $50M annually as GPEI has increased surveillance and aggressively sought to reach even the most difficult to find children through campaigns. *(See information on cost and burden of outbreaks on page 5)*

Upfront commitments for full funding give certainty to GPEI, allowing the program to concentrate on eradication activities instead of fundraising or preparing for funding shortages. The assurance of full funding also allows GPEI to execute the long-term components of the plan, including immunization strengthening, instead of solely focusing on interrupting transmission.interrupting transmission.

Conclusion

The eradication of polio is within sight, but success is not assured. And success will require investing significant resources. However, as outlined in this paper, eradication remains unequivocally more cost effective than the alternatives presented. Risks and uncertainties remain. Ongoing security issues and instability in the few remaining polio-endemic areas are real threats, and any delays in eradication would result in tragic health outcomes and increased costs.

Continuing to invest in GPEI makes economic sense, as eradication is more cost effective than any plausible alternative. This is especially true when taking into account GPEI's contributions to health programs beyond polio.

Failure to act will allow polio to continue claiming victims and threatening to spread to other polio-free countries. In contrast, eradicating polio will create a polio-free world and significant momentum for other public health initiatives.

This report was developed for the Bill & Melinda Gates Foundation in consultation with the GPEI partners with the support of McKinsey & Company.

Notes

A more detailed analysis exploring the global net benefits of eradication is underway.

A technical appendix laying out the methodology for analyses in this document is available upon request