THE PAKISTAN EXPANDED PROGRAM ON IMMUNIZATION AND THE NATIONAL IMMUNIZATION SUPPORT PROJECT: AN ECONOMIC ANALYSIS

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WORLD BANK GROUP
Health, Nutrition & Population

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The Pakistan Expanded Program on Immunization and the National Immunization Support Project

An Economic Analysis

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Abstract: Pakistan faces a formidable challenge in eliminating the polio virus from the country. With transmission of the polio virus substantially slowing in the Africa region, the only two countries worldwide with ongoing endemic polio transmission may soon be Pakistan and Afghanistan. A substantial number of the polio cases or infant paralysis occurring in Afghanistan is linked to cross-border transmission from Pakistan. The ongoing cycle of polio infection is not just a tragedy for the children of Pakistan, it is a global public health emergency constituting one of the final barriers to permanently eradicating polio.

The outbreaks of vaccine-preventable diseases in Pakistan result in significant costs to individuals and to society. These include costs associated with visits to health care providers, hospitalizations, disability, and premature deaths. Despite a slow decline over the past 10 years, the under-five mortality rate in Pakistan remains high, with more than 400,000 deaths annually in this demographic over the past twenty years. Pakistan is lagging behind other South Asian countries in improving this indicator.

This paper demonstrates clear economic benefits and efficacy of the National Immunization Support Project (NISP), which is financing interventions in terms of DALYs saved, and establishes that this approach is affordable and economically effective with a high rate of return. In addition to increased investment, the effectiveness of the Expanded Program on Immunization can be enhanced by improving the capacity building of health professionals, as well as by improving logistics of program interventions to reach marginalized populations, remote areas, and pockets of resistance. An increased financial investment alone will be insufficient to address the root causes of persistent under-coverage of immunization in Pakistan. It is imperative that ample attention and resources

be diverted to strengthen the procurement systems, local and provincial management capacity, and reporting mechanisms, among other capacity improvements.

Keywords: EPI, financing, immunization, Pakistan

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LIST OF ACRONYMS

ADP	Annual Development Program
AEFI	Adverse Effects Following Immunization
AGPR	Accountant General Pakistan Revenues
AHP	Accelerated Health Program
ASFR	Age-Specific Fertility Rates
BCG	Bacillus Calmette–Guérin
BMGF	Bill & Melinda Gates Foundation
CEA	Cost-effectiveness Analyses
CER	Cost-effectiveness Ratio
CMR	Child Mortality Rate
CMYP	Comprehensive Multi-Year Plan
DALY	Disability-Adjusted Life Year
DDO	Drawing and Disbursement Officer
DfID	Department for International Development, United Kingdom
DHO	District Health Officer
DLI	Disbursement Linked Indicators
DTP	Diphtheria–Tetanus–Pertussis
EDO	Executive District Officer
EPI	Expanded Program on Immunization
FIC	Fully Immunized Children
FY	Fiscal Year
GAVI	Global Alliance for Vaccine and Immunization
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GIVS	Global Immunization Vision and Strategy
GVAP	Global Vaccine Action Plan
HMIS	Health Management Information System
HNP	Health, Nutrition and Population
ICER	Incremental Cost-effectiveness Ratio
IMHE	Institute for Health Metrics and Evaluation
IMR	Infant Mortality Rate
JICA	Japan International Cooperation Agency
KP	Khyber Pakhtunkhwa
LHW	Lady Health Worker
MICS	Multiple Indicator Cluster Survey
NAM	New Accounting Mode
NISP	National Immunization Support Program
NeoMR	Neonatal Mortality Rate
PBS	Pakistan Bureau of Statistics
PCO	Pakistan Census Organization

PDHS	Pakistan Demographic and Health Survey
PIFRA	Project to Improve Financial Reporting and Auditing
PIHS	Pakistan Integrated Household Survey
PKR	Pakistan Rupee
PDHS	Pakistan Demographic and Health Survey
PSLM	Pakistan Social and Living Standards Measurement Survey
RI	Routine Immunization
S1	Scenario 1
S2	Scenario 2
SAGE	Strategic Advisory Group of Experts
SAR	South Asia Region
SBP	State Bank of Pakistan
U5MR	Under-Five Mortality Rate
UN	United Nations
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USD	United States Dollar
VPD	Vaccine-Preventable Disease
WB	World Bank
WHA	World Health Assembly
WHO	World Health Organization

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EXECUTIVE SUMMARY

Immunization is one of the most important advances in public health. Over the last century, more lives have been saved by the global expansion of immunization coverage than any other health intervention. Ample evidence attests to the success of immunization programs. Vaccination is a cost-effective method to improve aggregate health status and it improves the fairness of resource distribution. Public investment in vaccination helps change the distribution of health in favor of deprived segments of the society. Because the greatest gains from vaccination may accrue to sections of the population that are disadvantaged in terms of their existing health or socioeconomic status, expanding access to immunization interventions reduces health inequalities and strongly supports the twin goals of the World Bank Group for poverty reduction and inclusive development.

Despite the clear array of benefits that stem from nationwide vaccination, Pakistan continues to experience outbreaks of vaccine-preventable diseases due to problems in the immunization program that lead to low coverage. The outbreaks result in significant costs to individuals and to society. These include costs associated with visits to health care providers, hospitalizations, disability, and premature deaths. Despite a slow decline over the past 10 years, the under-five mortality rate in Pakistan remains high, with more than 400,000 deaths annually in this demographic over the past twenty years. Pakistan is lagging behind other South Asian countries in improving this indicator.

To achieve the Millennium Development Goal 4 of reducing child mortality, Pakistan needed to sustain a reduction in child mortality rates (CMRs) of 4.2 per annum between 2000 and 2015. However, Pakistan only achieved a rate of 1.13 per annum as of 2012.[1] In large part, this gap in CMRs is a function of low immunization coverage in Pakistan. Approximately 43 to 62 percent of children are estimated to be fully vaccinated. And this estimate varies considerably across geographic, social, and cultural boundaries.

Historical data highlight three issues of concern with the national immunization coverage. First, progress in expanding coverage of childhood vaccination countrywide continues to be slow. The latest Pakistan Demographic and Health Survey (PDHS 2012-13) indicates that less than half of all children are fully immunized in Pakistan.[2] The proportion of fully immunized children aged 12 to 23 months in Pakistan increased by only 19 percent in the 20 years preceding 2012-13.

Second, the follow up for second and third waves of vaccination for children remains inadequate. For example, the BCG vaccine, which is administered at birth, constitutes 85 percent of all vaccines administered in the country. Although more than 75 percent of children in Pakistan received the first dose of DPT, only 65 percent subsequently were

[1] The authors' calculations are based on estimates from the following studies: "Neonatal, Post-neonatal, Childhood, and Under-5 Mortality for 187 Countries, 1970-2010: A Systematic Analysis of Progress Towards Millennium Development Goal 4." 2010. *The Lancet* and *Building Momentum: Global Progress towards Reducing Maternal and Child Mortality*. 2010. IMHE, University of Washington.

[2] Children were considered "fully immunized" when they had received one dose of BCG, three doses of DPT, three doses of polio, and one dose of measles vaccine.

inoculated with DPT3. Immunity against measles is especially low in Pakistan. Only about two-thirds (61 percent) of children have received the first vaccine dose.

Third, there are marked and alarming variations in immunization coverage across provinces, districts, and genders. For example, the 2012-13 PDHS shows that the proportion of fully immunized children in Sindh and Balochistan has dropped from 35 percent to 16 percent and from 37 percent to 29 percent since 2006-07, respectively. Khyber Pakhtunkhwa (KP) and Punjab have shown slow but steady progress on the same metrics. Gender variations are also evident in the data. Gender variations also exist: immunization rates among boys is 56 percent – five percentage points higher than for girls, at 51 percent. This trend prevails in provinces.

Pakistan faces a formidable challenge in eliminating the polio virus from the country. With transmission of the polio virus substantially slowing in the Africa region, the only two countries worldwide with ongoing endemic polio transmission may soon be Pakistan and Afghanistan. A substantial number of the polio cases or infant paralysis occurring in Afghanistan is linked to cross-border transmission from Pakistan. The ongoing cycle of polio infection is not just a tragedy for the children of Pakistan, it is a global public health emergency constituting one of the final barriers to permanently eradicating polio. The Government of Pakistan has urgently prioritized improving the performance of the Expanded Program on Immunization (EPI) to interrupt polio virus transmission and to deliver routine immunization services as a fundamental public health service.

Why is progress in improving immunization in Pakistan slow and fragmented? Several demand and supply side challenges are among the causes. On the supply side, for instance, the prioritization placed on EPI has been inconsistent, particularly funding and technical assistance relative to other public health campaigns. A lack of capacity of available human resources, or local-level planning, management, logistics, and monitoring, evaluation, and surveillance has resulted in poor EPI performance. Moreover, the recent devolution of health service management to the districts and provinces has impeded national coordination and planning. Specifically, the EPI has not been able to sustain its human resources for several reasons, including poor worker motivation due to low remuneration, political interference, underutilization of vaccinators and Lady Health Workers, and reduced opportunities for in-service staff capacity building in logistics, monitoring, evaluation, and surveillance.

On the demand side, various social and political factors diminish EPI effectiveness. According to the Ministry of Health (2003), about 10 percent of Pakistani families are unwilling to vaccinate their children. Some communities expect door-to-door service by female staff, while others categorically reject immunization on cultural grounds. The gap in f immunization knowledge among the community impedes them from actively seeking immunization services. Recent targeting of polio workers and staunch opposition to immunization campaigns in selected areas of Pakistan emerges as a new barrier, threatening coverage in areas that have been particularly affected by the polio virus. As a consequence of these supply and demand side constraints, Pakistan continues to battle endemic circulation of polio, alongside outbreaks of diseases such as measles and diphtheria, which have been largely suppressed in other countries.

The current political context of Pakistan presents additional challenges and opportunities to improve EPI performance and overcome constraints. Overcoming the challenges will require strong leadership, good governance, and effective management—particularly at the district and provincial levels. Although the management of health services, including immunization, has devolved to the provinces, the federal level stewardship function for EPI is maintained within the Ministry of National Health Services, Regulation and Coordination (MONHSRC). However, the extent to which federal roles like policymaking, oversight, and monitoring and evaluation will be managed by the MONHSRC remains unclear. Despite the existence of serious concerns about the capacity of provincial programs, the devolution nevertheless has created clear opportunities for increased access, accountability, ownership, and equity in national immunization programs.

The EPI programs in Pakistan also suffer from financial fragmentation, with multiple sources of financing from federal and provincial development budgets and from the considerable international support that flows off-budget. This fragmentation causes inefficiencies due to the delayed flow of funds and unpredictable resource projections. In addition, it limits accountability due to failures of accounting and reporting. The financial sustainability of the EPI is threatened by the continued reliance on the development budget and off-budget international support. Program governance and accountability mechanisms are weak and fragmented among federal, provincial, and district levels. World Bank analysis indicates an average annual loss to Pakistan of PKRs 4 billion due to inefficiencies in vaccine procurement and program management.

Given the highlighted challenges and internationally demonstrated cost-effectiveness of immunizations, Pakistan is embarking on enhancing the scope and coverage of its immunization program as articulated and endorsed by the Government of Pakistan in a new Comprehensive Multi-Year Plan (CMYP). The National Immunization Support Project (NISP) is under preparation as a financing mechanism for the CMYP. The NISP will coordinate results-based financial support from Gavi, the Vaccine Alliance (Gavi), the World Bank, and the Bill & Melinda Gates Foundation (BMGF). When the cost of vaccine purchase is subsidized, some members of the population may be able and willing to pay out-of-pocket to be vaccinated, which would reduce the financial burden on the health care system. The generation of private demand could improve the affordability and financial sustainability of immunization programs. Critical to the success of the program, however, will be ensuring that vaccines are available to members of the population who are unable to pay user charges.

This report answers the following questions: How much financing would be required if Pakistan wants to achieve its target of full immunization against preventable diseases for children between 0 and 23 months? And, what would be the subsequent economic benefits of intervention? Although it is established both globally and nationally that immunization has been the most cost-effective public health intervention, it is nonetheless imperative to measure the affordability of immunizations. Pakistan spends less than 1 percent of its GDP on health and it seems crucial to increase fiscal space for health. As the government aims to move to UHC, and needs to prioritize investments in the health sector, it is important to have information about the costs and impacts of investments in order to inform allocation of limited resources.

By estimating the unit cost of immunization and combining this with coverage data from various rounds of the PDHS and the Pakistan Social and Living Standards Measurement Survey (PSLMS), two immunization coverage scenarios are constructed to calculate cost-effectiveness ratios for Pakistan and its provinces. The unit cost estimates of vaccination are built for future years and cover all aspects of program functions. Based on these unit cost estimates, the authors built scenarios with and without interventions for the overall cost and benefit analysis. Ultimately, the findings demonstrate clear economic benefits in terms of DALYs saved due to expanded immunization in Pakistan. The proposed intervention is affordable and economically effective with a high rate of return. In addition to increased investment, the effectiveness of national EPI programs could be enhanced by increasing the capacity building of health professionals, and managing the logistics of the interventions to reach marginalized populations, remote areas, and pockets of uptake resistance.

INTRODUCTION

Immunization is one of the most important advances in public health. Immunization saves more lives worldwide than any other health intervention. Immunization programs are responsible for the eradication, elimination, containment, and control of infectious diseases that were once common globally. Although people can benefit from immunization at any stage of the life cycle, due to their immature immune systems, infants and young children particularly benefit from the protection offered by immunization against vaccine-preventable diseases (VPDs). Immunization offers dual benefits: vaccinated individuals are directly protected and if a sufficient proportion of the population is vaccinated against the disease, "herd immunity" results.[3] According to the World Health Organization (WHO), immunization annually averts two to three million deaths, in addition to preventing illness and disability.

Immunization is one of the most cost-effective public health interventions that exist. For every dollar, invested in childhood immunization, $16 can be saved in health care costs, wages and productivity due to illness and death. If the full value of people living longer, healthier lives is taken into account, the return on investment rises to $44. In total, immunization will yield more than $586 billion in economic benefits from 2011-2020 worldwide (Ozawa et al. 2016).

The cost of implementing an immunization program is typically much less than that of treating the disease that would otherwise occur (WB 2010). Mounting evidence indicates that immunization against disease is the most potent tool to reduce the burden of disease and the single most cost-effective public health intervention. Yet despite the proven public health benefits of vaccines, inefficient and under-resourced public immunization interventions in many parts of the world, including Pakistan, result in VPDs that continue to pose significant and unnecessary costs to individuals and society. Such costs include those associated with visits to health care providers, hospitalizations, and premature deaths. To build on the success of the smallpox eradication program, the WHO initiated the Expanded Program on Immunization (EPI) in 1974 to expand childhood vaccination worldwide based on global guidelines and standardized vaccination schedules. The EPI was launched to ensure that all children, in all countries, benefit from life-saving vaccinations. Pakistan launched the EPI in 1978.

In accord with international standards and through its EPI, Pakistan aims to immunize all children between 0 and 23 months against eight VPDs, including tuberculosis, poliomyelitis, diphtheria, pertussis, tetanus, hepatitis B, haemophilus influenza type b (Hib), and measles. Newer vaccines that will further extend the EPI are either in the process of rollout, for example, pneumococcal vaccine and inactivated polio vaccine, or they are under consideration, for example, rotavirus vaccine, inactivated polio vaccine, with support from Gavi.

[3] Herd immunity or herd effect, also called community immunity, describes a form of immunity that occurs when the vaccination of a significant portion of a population (or herd) provides a measure of protection for individuals who have not developed immunity. See T.J. John and R. Samuel. 2000. "Herd immunity and herd effect: new insights and definitions." *Eur. J. Epidemiol*. 16 (7): 601–6. Herd immunity theory proposes that in contagious diseases that are transmitted from individual to individual, chains of infection are likely to be disrupted when large numbers of a population are immune or less susceptible to the disease. The greater the proportion of individuals who are resistant, the smaller the probability that a susceptible individual will come into contact with an infectious individual.

Immunization coverage in Pakistan remains low and consistently lags behind the regional median, for reasons explained below. To narrow the gap in coverage, the proposed Comprehensive Multi-Year Program (CMYP) seeks to increase access to routine childhood immunization in Pakistan by building upon the EPI framework, and particularly by focusing on coverage, equity, and quality.

This report presents an economic analysis of EPI. The primary aim of this study was to assemble evidence for the National Immunization Support Program (NISP) as a financing tool for the CMYP and to gauge the necessary level of investment to enhance national immunization coverage under the proposed plan. The authors also provide estimates of unit cost per child to attain full inoculation against VPDs. The unit cost analysis also presents aggregated program costs and an economic analysis based on divergent immunization coverage scenarios. The analysis presented here is disaggregated by province to inform policymaking at the provincial levels.

The results of this analysis are supported by a global and local literature review of the economic analysis of immunization. Secondary data from the Pakistan Demographic and Health Survey (PDHS) 2012-13 and various rounds of Pakistan Social and Living Standards Measurement Survey (PSLM) are used to build future immunization coverage scenarios for each province and for Pakistan at the aggregate level. Primary data collected on the unit cost of immunization is also presented. The WHO methodology for cost estimation is used and all aspects of program functions are considered as part of the unit cost of a fully immunized child (WHO 2002). The analysis was enriched by a review of global immunization commitments and collating local evidence of EPI achievements to identify neglected areas in the context of financing for immunization. The finding of incremental cost-effective analysis indicates the economic benefits of increasing the immunization coverage.

BACKGROUND

Pakistan is the world's sixth most populous country with a population of 180 million and a gross national income (GNI) per capita of USD $1,440 in 2015.[4] The under-five mortality rate remains high, despite a slow decline over the past 10 years. In the last two decades, more than 400,000 child deaths have occurred annually in this age group. Pakistan's decrease in infant and under-five mortality rates lags behind other South Asian countries.

To achieve the Millennium Development Goal (MDG) 4 of reducing child mortality, Pakistan needed to sustain a reduction in child mortality rates (CMR) of 4.2 per annum between 2000 and 2015. However, Pakistan only achieved a rate of 1.13 per annum as of 2012.[5] Because Pakistan has missed immunization targets for VDPs, it consequently missed CMR rate reduction targets. Immunization coverage in Pakistan remains low. The proportion of children who are fully immunized is between 43 and 62 percent. The percentage of immunized children varies considerably across geographic, social, and cultural boundaries.[6] As a consequence, Pakistan continues to face endemic circulation of polio and outbreaks of diseases such as measles and diphtheria, diseases which are almost unheard of in many other countries.

A principal reason for Pakistan's low immunization coverage rates is inefficiencies in the health system and inadequate spending on health and education. The combined public expenditure on these two important sectors was less than 2.5 percent of gross domestic product (GDP) in FY 2012-13—one of the lowest in the region. The entire public expenditure on health in Pakistan constitutes less than one percent of national spending. Notably, while Pakistan's population continues to grow at 2 percent per annum, it has undergone a major demographic transition over the last 40 years. Its dependency ratio has declined from 90 percent in the early 1960s to 68 percent today. The immediate implication of this falling dependency ratio is the increased proportion of the working-age population. But even the increase in working-age individuals will not translate into a driver of economic growth if only limited resources continue to be devoted to education and health, thereby lowering the quality of available human capital in terms of health and productive skills.

Pakistan's current political context presents challenges and opportunities to improve immunization coverage and expand investments in health. Meeting these health challenges will require strong leadership, good governance, and effective management, particularly at the provincial and district levels. In the context of the 18th Amendment to the Constitution, which was passed by Parliament in April 2010, a particular set of issues remains to implement fundamental reforms, restructure institutions, and strengthen systems. While the 18th Amendment enhanced provincial autonomy and fiscal space by devolving federal legislative powers and responsibilities to the provinces, it did not clarify the federal government's role in national health planning and coordination. In addition, the EPI campaign faces the emerging concerns of attacks on immunization workers and the

[4] See http://data.worldbank.org/country/pakistan (accessed November 2016).
[5] The authors' calculations are based on estimates from the following studies: Neonatal, Post neonatal, Childhood, and Under-5 Mortality for 187 Countries, 1970-2010: A Systematic Analysis of Progress towards Millennium Development Goal 4. 2010. *The Lancet* and Building Momentum: Global Progress towards Reducing Maternal and Child Mortality. 2010. IMHE, University of Washington.
[6] PDHSs and PSLMs, program data, and published research.

internal displacement of the population in two provinces of Pakistan (Planning Commission and UNDP 2013).

Health service management, including immunization, is now the responsibility of the provinces. The EPI stewardship function at the federal level is now with the Ministry of National Health Services, Regulation and Coordination (MONHSRC). Yet, the extent to which federal roles like policymaking, oversight, and monitoring and evaluation will be managed by the MONHSRC remains unclear. Despite the existence of serious concerns about the capacity of provincial governments' EPI programs, the devolution has presented clear opportunities for increased access, accountability, ownership, and equity in immunization programs.

PERFORMANCE OF THE EPI

Infant and under-five mortality rates in Pakistan are alarmingly high. The most recent data indicate that of 1,000 live births, 74 infants and 89 children under five die before their first and fifth birthdays, respectively.[7] A significant proportion of these deaths are preventable by immunizing pregnant mothers and children. Since 1978, the EPI has been responsible for the nationwide immunization of children in Pakistan (Hasan et al 2010).[8] In the early phase of the program, less than 2 percent of Pakistani children were fully immunized in 1982. This figure quickly rose to 59 percent in 1984 (Ministry of Health 2003). In 1985, the program was re-launched as the Accelerated Health Program (AHP).

Immunization coverage decreased to 47 percent in the mid-1990s due to donors withdrawing their financing in early to mid-1990s without commensurate increase in domestic resources. Coverage, however, improved in 1996 (Ministry of Health 2003). Another milestone was achieved with the introduction of Gavi support of two new vaccines in the late 1990s and in 2001, the Hep-B and Hib vaccines. In 2008, the program introduced the Pentavalent vaccine, which simplifies the schedule for full vaccination to five visits during the child's first year of life (WHO).[9,10]

Table 1. Percentage of Children 12-23 Months of Age Receiving Vaccines in Pakistan

		DPT			Polio			Measles	All vaccinations
	BCG	1	2	3	1	2	3		
PDHS (1990-91)	70	64	60	43	65	61	43	50	35
PIHS (1995-96)	73	73	64	58	71	65	58	47	45
PIHS (1996-97)	76	76	70	63	80	76	67	49	49
PIHS (1998-99)	65	67	63	58	77	76	70	55	49
PIHS (2001-02)	67	71	67	63	68	91	89	57	53
PSLM (2004-05)	82	82	81	80	82	81	81	78	77

[7] Pakistan Demographic and Health Survey 2012-13.
[8] In the earlier phase of the program, six diseases were included. The program was expanded to eight preventable diseases in the 2000s. The diseases are poliomyelitis, neonatal tetanus, measles, diphtheria, pertussis (whooping cough), hepatitis-b, hib pneumonia and meningitis, and childhood tuberculosis.
[9] WHO Pakistan EPI Programme Sheet: http://www.emro.who.int/pak/programmes/expanded-programme-on-immunization.html.
[10] A child is vaccinated at birth, at the 6th, 10th and 14th weeks, and then at nine months of age.

		DPT			Polio			Measles	All vaccinations
	BCG	1	2	3	1	2	3		
EPI (2006)	78	75	69	65	74	69	64	63	57
PDHS (2006-07)	80	75	67	59	93	91	83	60	47
PSLM (2007-08)	82	83	81	79	95	94	93	76	73
PSLM (2010-11)	88	88	87	85	81	81	79	82	81
PSLM (2011-12)	85	85	84	83	98	98	96	81	80
PDHS (2012-13)	83	77	71	63	90	86	82	50	54

In Pakistan, different data sources show distinct coverage figures for available vaccines—particularly the PSLMS and the PDHS (see Table 1). Even as the PSLMS results indicate that polio vaccination rose from 58 percent in 1995-96 to 83 percent in 2006-07, PDHS data show higher figures for polio coverage in Pakistan (see Table 1).[11] Though the program is still far from attaining adequate immunization coverage,[12] it is encouraging that only 5 percent of children did not receive any vaccination in 2012-13, a significant drop from 28 percent in 1990-91 (PDHS). Undoubtedly, the program can reach the desirable targets with proper implementation.

Table 2. Reported burden of VPDs in 2013 compared to 2008

Indicators	2008	2013
Polio	117	303
Measles (lab confirmed)	1,129	8,749
Tetanus Neonatal	320	898
Diphtheria	32	183
Rota		2,148
Rubella		1,113
Pertussis	169	250
Pneumonia		1,290

Three notable concerns with national immunization coverage can be identified from this data. First, the results show slow improvement in the proportion of children receiving all the recommended vaccinations. The latest PDHS 2012-13 demonstrates that just over half of all children are fully immunized in Pakistan (see Table 1).[13] According to the PDHS, the proportion of immunized children in Pakistan has increased from 35 percent in 1990-91 to 54 percent in 2012-13.

Second, the follow up on children for the second and third waves of vaccination is inadequate. The BCG vaccine administered at the time of birth, for example, constitutes 85 percent of all vaccines administered in the country. While more than three-fourths of children received the first dose of DPT, only 65 percent were inoculated with all three doses. Moreover, although 90 percent of children received the first polio vaccine, only 80

[11] In PDHS, the respondent is a mother while it is the head of household in PSLM. See Khan and Khan 2012.
[12] The objective of the EPI was to achieve 90 percent full immunization coverage and to eradicate measles by 2010 and interrupt polio virus transmission by 2005.
[13] Children are considered to be "fully immunized" when they have received one dose of BCG, three doses of DPT, three doses of polio, and one dose of measles vaccine.

percent received the third dose. Immunity against measles remains most fraught. Only about two-thirds (61 percent of children from all over the country received the first dose of the vaccine. These shortcomings are reflected in the recent outbreaks of measles and the emergence of polio cases in multiple areas of Pakistan. In 2012, officials reported 14,984 confirmed cases of measles to the WHO Strategic Advisory Group of Experts (SAGE). To mitigate these outbreaks, more systematic and sustained immunization efforts are required.

Third, marked variations in immunization coverage exist across provinces and districts—as well as by gender (see Table A.8 in Annex I). For instance, the PDHS 2012-13 shows that the proportion of fully immunized children in Sindh and Balochistan provinces fell from 35 to 16 percent and 37 to 29 percent since 2006-07, respectively (see Table A.10 in Annex I for full details). As much as one-fifth of infants and children in rural Balochistan have received any vaccinations (PDHS 2012-13). In contrast, Khyber Pakhtunkhwa (KP) and Punjab provinces have shown steady progress in child immunization rates. The findings in the PDHS are corroborated by trends shown in PLSMSs, which also reveal declines in immunization coverage within Balochistan and Sindh in recent years. As recorded by both PDHS 2012-13 and PSLMS 2011-12, most of the decreased coverage in Balochistan is attributed to significant drops in coverage for all vaccines except for polio.

The PDHS 2012-13 displays a five percentage point difference in national vaccination coverage by gender: 56 percent versus 51 for boys and girls. Gender differences within many provinces are even more significant. A study conducted in four districts of Pakistan shows that male children in Khairpur were 1.4 times more likely to be vaccinated than female children, after controlling for all background characteristics (Cockcroft et al 2011). Urban and rural differentials are just as notable. At the national level, 66 percent of children in urban areas are vaccinated compared to just 48 percent in rural areas. The figures are particularly alarming for Sindh and Balochistan. In Sindh province, 51 percent of children receive vaccines in urban areas, compared to just 14 percent in rural areas. In Balochistan, these figures are 36 percent and 12 percent, respectively.

CAUSES OF LOW IMMUNIZATION

There are myriad reasons for the persistence of low immunization coverage in Pakistan, on both the demand and supply side. On the demand side, limited access to immunization services—due mostly to an inadequate number of vaccinators—and lack of information on the part of parents were found to be the most important reasons for low vaccination coverage in Pakistan (Hasan et al 2010). According to the Ministry of Health (2003), about 10 percent of families were unwilling to vaccinate their children. Some communities expect door-to-door service by female health workers, known as Lady Health Workers, while others categorically reject immunization. The dearth of immunization knowledge among communities impedes them from actively seeking immunization services.

On the supply side, the poor performance of EPI in Pakistan has been well documented, particularly in the realm of program governance, performance management, and accountability. Two studies that reviewed program performance attest that reduced attention to capacity building of available human resources, local-level planning, management, logistics, monitoring, evaluation and surveillance has resulted in poor EPI

performance (Pildat 2010 and Masud 2012).[14] Additionally, the EPI has not been able to sustain its human resource development for several reasons, including poor worker motivation due to low remuneration, political interference, and underutilization of available human resources, for example, vaccinators and Lady Health Workers, as well as reduced opportunities for in-service staff capacity building in logistics and monitoring, evaluation, and surveillance. Moreover, worker fatigue due to regularly conducted campaigns against polio and other diseases have reduced the worker hours available for EPI. These factors have resulted in overall underperformance of the program. Furthermore, anecdotal evidence suggests that program management has also deteriorated over the last decade due to increased political interference. The recent violent targeting of polio workers and the staunch opposition against immunization campaigns in selected areas of Pakistan has emerged as a new barrier, threatening coverage in areas that are particularly affected by the polio virus.

Lower capacity is also reflected in procurement problems, also contributing to poor EPI performance (Masud 2012). Procurement of vaccines and other required items, cold chain monitoring, and maintenance of equipment for the EPI has been poorly managed. With limited available resources, the procedures and mechanisms needed to manage the logistic system have been lacking. With the implementation of the 18th Amendment in July 2011—and given the possibility of limited capacity of the provinces for procurement—this problem is likely to be aggravated and result in stock-outs, poor quality vaccines, and overall negative effects on coverage outcomes. World Bank analysis indicates that Pakistan incurs an average annual loss of PKRs 4 billion due to such inefficiencies in vaccine procurement and program management, in addition to declines in the quality and equity of immunization services.

The resource shortage is yet another problem contributing to poor EPI performance. Additional resources are needed for recurrent expenses, human resource expansion, capacity building, training, and social mobilization. Even beyond increasing gross investment, streamlining and consolidating existing financing schemes is necessary to fundamentally improve EPI performance. The current fragmented financing, which encompasses multiple funding sources and delayed funding flows reduces program accountability and threatens financial sustainability.

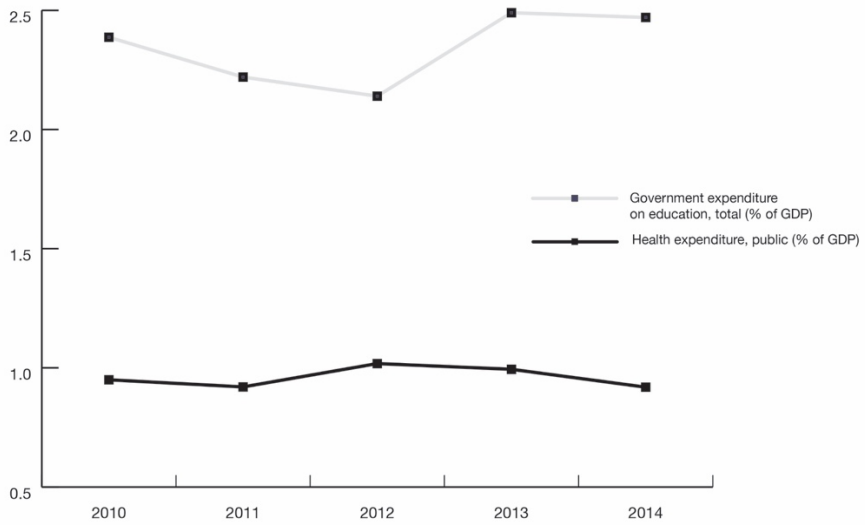
EXPENDITURES ON IMMUNIZATION

Like many developing countries, out-of-pocket payment is a dominant mode of healthcare financing in Pakistan. The government expenditure on health does not exceed 0.9 percent of GDP (Figure 1), while the share of out-of-pocket payment is 1.7 percent of GDP and 86.8 percent of private expenditure on health (World Bank 2014). Experts believe as much as 0.12 percent of GDP is required to achieve a herd immunity threshold (Ministry of Health 2003). Health expenditures in Pakistan are low compared to other South Asian countries. Only Bangladesh and Nepal spend less on health than Pakistan does (see Table 3). The gap between expenditures in Pakistan and the average expenditures in South Asia is quite large. Maldives is an outlier among these countries, spending $408.8 per capita on health. Compared to Pakistan, India spends almost double, and Bhutan and Sri Lanka almost triple. The difference in expenditures is reflected in health indicators such

[14] Tayyeb Masud and Kumari Vinodhani Navaratne. 2012. The Expanded Programme on Immunization in Pakistan: Recommendations For Improving Performance. Health, Nutrition and Population (HNP) Discussion Paper. World Bank. Washington, DC.

as mortality rates. Sri Lanka and Maldives have the lowest mortality rates, followed by Nepal, Bangladesh, and Bhutan. Among South Asian countries, only Afghanistan has worse indicators than Pakistan.

Figure 1. Public expenditure on health and education in Pakistan (as % of GDP)



Source: World Bank Open Data, 2016

After devolution in 2010, responsibility for the EPI shifted to the provincial governments. The federal EPI cell now has limited responsibilities for procurement, coordination, and technical guidance (Government of Pakistan 2012-13). The EPI is implemented through 2,649 fixed health centers, 4,564 outreach health teams, 98 mobile teams, vaccination camps, and trained Lady Health Workers (LHWs) from the provincial departments of health. The program is financed by the government budget with support from WHO, UNICEF, Rotary International, and the Japan International Cooperation Agency (JICA) along with Gavi.

The EPI immunizes approximately five million children every year. The 2008 cost of immunization was USD $104,313,977, roughly USD $24.51 to fully immunize a child (Hasan et al 2010).[15] The cost of immunization can be reduced considerably by achieving universal immunization coverage due to the external benefits of herd immunity and scale economies. The 2014 cost of the EPI was estimated at USD $137.5 million (Federal EPI Cell 2009), using the 2001-15 Comprehensive Multi-Year Plan (CMYP) to estimate the total costs of the national program. This study adopted a different approach to collecting primary data by aggregating data for each of the program components from all provinces, using the PIFRA and other secondary documents.

[15] The study assumed 77 percent coverage rate as per PSLM 2004-05 and a target of immunizing 5.8 million children.

Table 3. Comparison of Child and Maternal Health for South Asia Region 2010

Country	Health Expenditure per Capita (Current USD)	Mortality Rate, under-5 (per 1,000) live births)	Maternal Mortality Ratio (per 100,000 live births)
Afghanistan	44.2	103.7	460
Bangladesh	24.8	47.2	240
Bhutan	89.1	48.1	180
India	51.4	61.2	200
Maldives	408.8	13.0	60
Nepal	27.6	45.5	170
Pakistan	28.0	90.0	260
Sri Lanka	82.0	10.3	35

Source: Global Lessons on Cost of Delivery of Immunization Services.

PROPOSED MITIGATION THROUGH CMYP AND NISP

The Government of Pakistan has endorsed a national comprehensive multi-year plan for immunization (CMYP) to align coverage with global best practices and to mitigate the difficulties discussed above. The National Immunization Support Project (NISP) is being prepared as a financing mechanism for the CMYP, and it is coordinating results-based financial support from Gavi, the World Bank and the Bill & Melinda Gates Foundation (BMGF). NISP seeks to bolster the existing EPI initiative through financial investment, programmatic reform, and efficiency correction. Each of these mitigation measures is addressed in turn.

First, the NISP includes an infusion of financing through a single platform to coordinate international support to expand immunization coverage. Increased investment is coupled with the use of standard government budgetary and accounting mechanisms to track and record expenditures over time, thereby promoting transparency in fund flows. The majority of funds will be administered directly by the Provincial Departments of Finance to reduce financing delays and improve disbursement efficiency. Administering financing through standardized pipelines will streamline national access to donor funds and improve accountability and sustainability.

Second, the NISP focuses on bolstering programmatic governance, performance, and accountability. Its performance-based financing structure—including the use of disbursement linked indicators (DLI)—aligns incentives for success in health and finance throughout the district, provincial, and federal levels by linking fund flows to an array of results indicators. A portion of the program's concomitant investment is allotted to building management and reporting systems provincially. These systems are to be paired with the provision of finance at the federal level to build coordination, standards, and reporting capacity nationwide.

Third, a core goal of the NISP is to correct inefficiencies in the present immunization program and increase public expenditures on immunization. The focus will be primarily on strengthening procurement systems for current and new vaccines. Procurement

improvements will be paired with accurate tracking systems of vaccine stocks, which will ensure an uninterrupted feedback loop for inventory and cold chain management. NISP also will build management capacity at the federal and provincial levels. These improvements will allow the program to reap economies of scale and reduce wastage, thereby decreasing the overall unit cost of immunization relative to the baseline.

The CMYP proposes a substantial expansion of coverage and a programmatic overhaul of immunization services in Pakistan. To quantitatively model this proposed expansion, we offer below an economic analysis of the EPI, both at baseline extrapolation and with predictions, including the investments proposed under NISP, and the total amount of investment needed to meet NISP goals for enhancing national immunization coverage. The analysis provides unit cost measures per child to achieve full vaccination against VPDs. The unit costs enable top-level deduction of aggregated program costs, alongside a country-level fiscal analysis of divergent immunization coverage scenarios. The analysis is further disaggregated at the provincial level to inform policymaking under the newly devolved framework.

The cost and financing measures produced by this analysis are critical to the sustainability and impact of the CMYP. Not only can these assessments facilitate federal and provincial preparation for coverage expansion, but they can also facilitate programmatic planning on a range of dimensions, including fund flows, resource mobilization, and system design. To illustrate, provincial variations in unit costs of vaccination—which, as demonstrated below, can be significant—can inform disbursement levels throughout the country. Understanding also can improve the precision of the budgeting process for immunization, thereby enabling finances to be directed towards issues of highest need. Furthermore, cost estimates will provide benchmarks for intermediate and end-program evaluations, thereby ensuring that funds are being accountably and sustainably spent. Perhaps most crucially, these estimates can guide the overall level of investment made by the NISP by identifying the precise level of funds required to meet the coverage enhancement targets.

INVESTIGATION INTO UNIT COST ANALYSIS

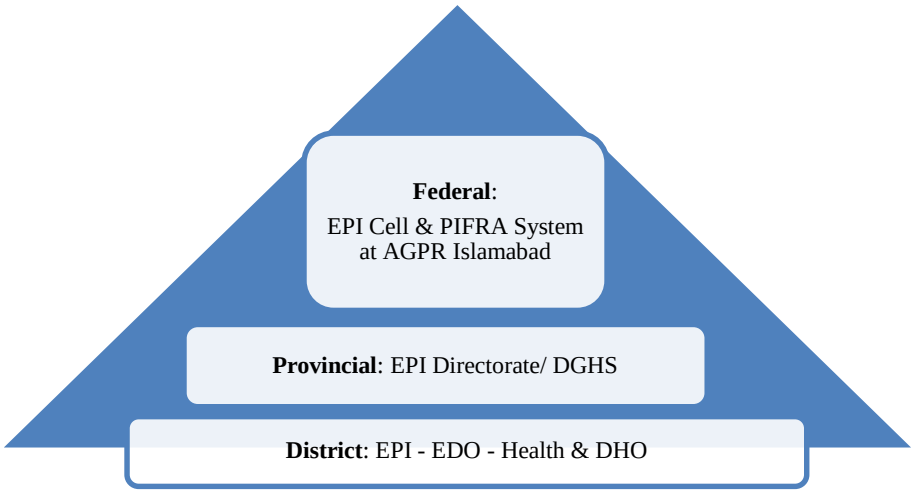
We approximated the unit cost of immunization for coverage across regions in Pakistan. The estimates were used to build scenarios regarding equitable coverage for immunization against preventable diseases for children between 0 and 23 months and subsequently to estimate the economic benefits of intervention. Given that Pakistan spends less than 1 percent of its GDP on health, an increase in EPI coverage will increase public expenditures, even with a highly favorable cost-effectiveness ratio of intervention. Keeping in view the meager resource available to the health sector, it is essential for program managers and policy makers alike to estimate the total and incremental cost of coverage expansion in Pakistan. It bears noting that the focus of the NISP finance—and accordingly, the analysis here—is on routine immunization (RI), as opposed to supplemental or acute immunization campaigns. RI involves regular, programmatic outreach on a year-around basis, in contrast to the sudden, short-term initiatives often conducted in response to epidemics or disease outbreaks.

METHODOLOGY AND APPROACH TO ESTIMATE UNIT COSTS

This section describes the methodology adopted to estimate the unit cost of delivering child immunization services in Pakistan and its provinces. The unit costs are estimated as per the WHO methodology (see Appendix A for details). In brief, this standardized method involves isolating programmatic inputs, quantifying them, and weighting them by unit prices and the utilization rates to derive an aggregate cost measure. The PIFRA database at the Accountant General Pakistan Revenues (AGPR) office—which consolidates health expenditures data at the federal, provincial and district levels—is the main source of unit costs. Unit cost data include personnel, vaccine, supply, medical equipment, delivery system, salaries and wages obtained from DDO level data. In addition, the analysis is conducted keeping in view the post 18th Amendment scenario in which provincial governments are responsible for preparing and implementing their own coverage plans. Therefore, the authors made several visits to provinces to collate cost data on immunization from respective EPI officials.

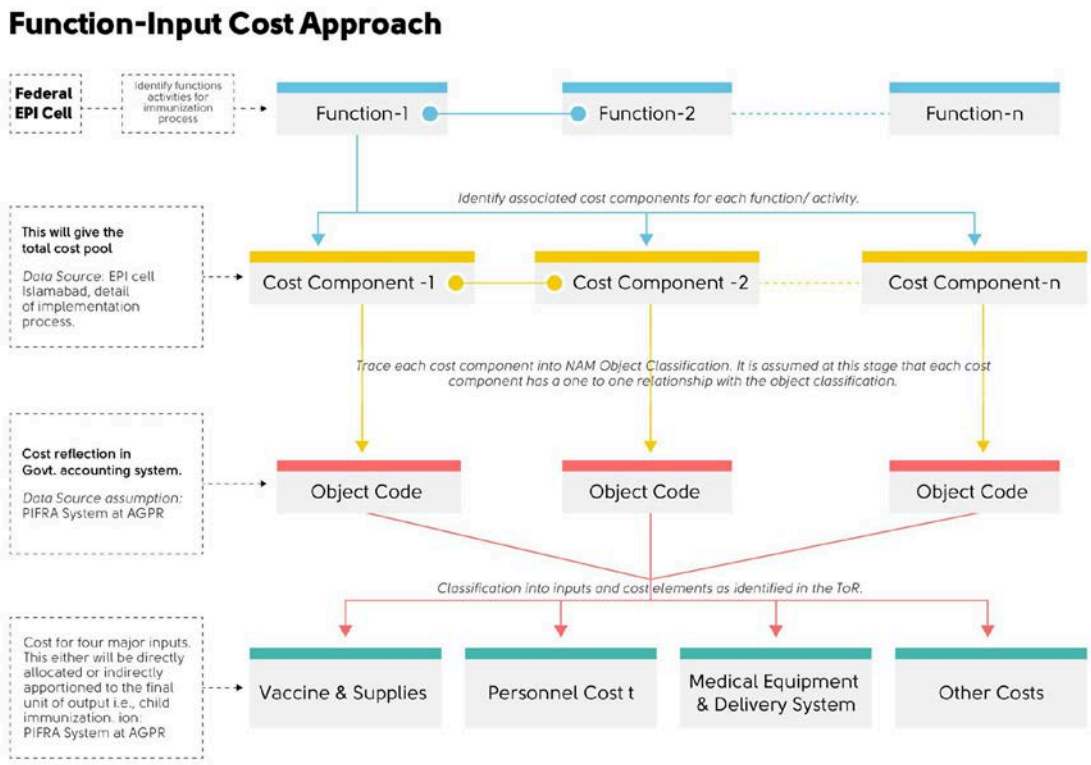
The data on cost was collected using a top-down approach (see Figure 2). The existing immunization program mechanism in Pakistan takes the shape of a pyramid. The federal government is responsible for developing national policy, hosting technical advisory group meetings, procuring vaccines, and managing central control storage. Provincial and district governments are responsible for immunization program execution and all operating costs. The data collection exercise began with the Federal EPI cell to obtain all information pertaining to existing implementation arrangements. Relevant financial information was obtained from the PIFRA system available at the AGPR office. The immunization program expenditures are also available from NAM Chart of Accounts, which are classified on the basis of input costs identified in the terms of reference.

Figure 2. Information Collection Approach



The representation of the information collection approach in Figure 2 helps to define the boundaries of the program, to explain the distribution of roles among provinces, and to indicate the immunization process flow in the country. A function-input cost approach (see Figure 3) is adopted by linking cost components to specific functions within the immunization process, thereby ensuring that each step of the immunization process has been accounted for and all input costs have been incorporated into the final unit cost (see Annex II, Table A.1).

Figure 3.


Function-Input Cost Approach
Federal EPI Cell
Identify functions activities for immunization process
Function-1
Function-2
Function-n
Identify associated cost components for each function/ activity.
This will give the total cost pool
Data Source: EPI cell Islamabad, detail of implementation process.
Cost Component -1
Cost Component -2
Cost Component-n
Trace each cost component into NAM Object Classification. It is assumed at this stage that each cost component has a one to one relationship with the object classification.
Cost reflection in Govt. accounting system.
Data Source assumption: PIFRA System at AGPR
Object Code
Object Code
Object Code
Classification into inputs and cost elements as identified in the ToR.
Cost for four major inputs. This either will be directly allocated or indirectly apportioned to the final unit of output i.e., child immunization. ion: PIFRA System at AGPR
Vaccine & Supplies
Personnel Cost t
Medical Equipment & Delivery System
Other Costs

UNIT COST OF VACCINE DELIVERY PER IMMUNIZATION

Based on provincial primary data for 2011-12, the cost of fully immunizing a child in Pakistan is estimated at USD $64. Estimates for different provinces are produced in Table 4. The aggregate cost figure for Pakistan is derived from a weighted average of provincial costs by population size, which varies substantially across provinces. Punjab has the lowest unit costs for fully immunized child (FIC) at USD $61, while Balochistan has the highest at USD $81. The principal reason for this difference is population density. The more densely populated urban areas require lower per capita resources to provide health facilities and incur lower travel costs while reaching a higher proportion of the local population with immunization services. Rural facilities also have greater cold chain and vaccine management challenges, which increase wastage rates. Balochistan is the least dense, most rural, and largest province in Pakistan. Therefore, it is unsurprising that it has the lowest and most stagnant vaccination coverage with the highest immunization unit cost of any province.

Table 4. Unit Cost (USD/ FIC)

Unit Cost	Base 2011-12
Pakistan	64.2
Punjab	60.8
Sindh	65.4
KP	69.7
Balochistan	80.9

The unit costs are also linearly projected for future periods as well (see Table 4.1). For instance, in FY 2019-20, the cost of a FIC in Pakistan is projected to be USD $99. In the terminal year of the analysis (FY 2029-30), the cost of FIC is projected to reach USD $169 in Pakistan and USD $212 for Balochistan). The cost increase projection incorporates expected depreciation of local currency, expected inflation, and population-demographic trends.

Table 4.1 Unit Cost per FIC in Pakistan and Provinces (in USD*)

	2013-14	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2024-25**	**2029-30**
Pakistan	72	75	80	84	89	93	129	169
Punjab	68	71	75	79	84	88	122	159
Sindh	73	77	81	85	90	95	131	171
KP	78	82	86	91	96	101	140	183
Balochistan	90	95	100	106	112	118	162	212

* USD $1 = PKR 89.24 (FY 2011-12) is used as the base. For consecutive years, the unit cost varies by 5.5 annual inflation. Statistics and DWH Department, State Bank of Pakistan.

PROGRAM COST AND ECONOMIC RETURNS ANALYSIS

METHODOLOGY AND DATA USED

The methods applied and the assumptions used to create two scenarios at the national and sub-national levels in our economic analysis are described here. Both service and survey statistics are obtained through sources that are identified under each table and in the figures presented below. The unit cost estimates and the projections presented in the previous section are used here as inputs (see Tables 4 and 4.1).

The following steps were undertaken in preparation of the analysis:

1. Birth cohort projections based on demographic data were prepared.
2. Vaccination actual coverage was estimated based on representative national surveys.
3. Burden of disease information was incorporated in terms of DALYs.
4. Vaccine efficacy was incorporated based on expert opinion and past studies.
5. Provincial data were assembled on the unit cost of vaccine and the delivery required for full immunization.
6. Cost in terms of USD $and coverage data for each province was combined.
7. Gap in coverage in terms of numbers of births and its cost was estimated.
8. The incremental cost-effectiveness ratio (ICER) of the vaccination program was estimated using alternative scenarios.
9. Return on investment was estimated.

Population and birth cohorts were based on One Health software that takes into account a host of variables from the latest PDHS. Provincial population shares were made using data from the Population Council (see Provincial Profiles 2013, Annex Table-A.2). The One Health software projections are based on age-specific fertility rates (ASFR), population age structures, and annual population growth rates from Pakistan's 1998 population census. Demographic data used in this study includes successive annual birth cohorts and are not adjusted for death rates. WHO methodology is adopted in the analysis, which suggests that for the purpose of forecasting vaccine supply, the total number of births is recommended as the denominated benchmark for population scaling. This generates the safest estimate and thus ensures that sufficient vaccine is procured (WHO guidelines 2002).

The noteworthy implication of falling fertility rates on population projection is that future birth cohorts in Pakistan will start to fall gradually after FY 2016-17 (Kugelman and Hathaway 2009). This will affect our analysis in two ways: (1) proportional coverage will improve as the target population will be reduced by 20,000 to 40,000 annually until 2020; (2) the real impact of declining fertility will be felt after the completion of the current CMYP financed through NISP, when Pakistan will reach replacement level fertility.

To determine the future cost of immunization for Pakistan and its provinces, two coverage scenarios were built starting from FY 2014-15 to 2029-30. The first scenario (S1) is based on past provincial trends as noted in the PSLM and PDHS. It assumes that no significant additional efforts are made to improve coverage rates and that provinces will maintain the status quo after devolution. In this scenario, coverage rates are accordingly assumed to increase by 0.05 percentage points annually for each province. The second scenario (S2) assumes implementation of the CMYP for immunization, including NISP financing, where additional funding and capacity building efforts are designed to improve immunization rates through 2030. The provinces of Balochistan and Sindh are assumed to adopt a faster

pace of immunization adoption, an additional 8 and 6 percentage points, respectively. These scenarios are based on expert opinion and past observed trends and behavior of provinces. The base year values for both scenarios remain the same as in S1 (see FY 2011-12, Table 7). Finally, the cost effectiveness ratios are calculated for each FY using following formula:

$$ICER = \frac{Cost\ of(S2) - Cost\ of(S1)}{\text{DALYs saved in S2} - \text{DALYs saved in S1}}$$

The ICER is suitable where decisions are to be made on alterative scenarios. It is calculated in USD $per DALYs saved—a measure of effectiveness. The WHO has set thresholds for different regions to grade interventions as "very cost-effective," "cost-effective" or "not economically viable." In accordance with these guidelines, if the ICER is less than per capita GDP, then it is "very cost-effective," and if it exceeds three times per capita GDP, then it is deemed "not economically viable." Incremental cost-effectiveness analysis requires two or more options to construct net cost and net benefits of alternate scenarios.

Table 5 provides specific details on different parameters used to obtain economic analyses for this report, including a per capita GDP threshold for Pakistan.[16] Provincial GDP figures are referenced in the base year 2005-06, and a 6 percent growth rate is assumed after 2017.[17]

Table 5. Assumptions Used in the Analysis

Parameter	**Domain**	**Range**		**Reference**
		Start	End	
Time span of analyses	**Fiscal year**	**2011-12**	**2029-30**	**Report objective**
Demography: Population growth rates (in percent)	Pakistan	2.06	1.38	Population Council provincial profiles (forthcoming)
	Punjab	2.02	1.29	
	Sindh	2.17	1.40	
	KP	2.36	1.61	
	Balochistan	2.10	1.60	
GDP growth rates	Percent	3% initially, 6% after 2017-18		Authors' estimates
Per capita GDP	US dollars	1,323	2,265	National income accounts
Exchange rate	1 USD = PKR	89	234	Data from SBP. Depreciation assumed 5.5% per annum

[16] The WHO threshold values for this region are between the range of USD 2,769 and 8,306.

[17] Provincial GDP estimates are taken from Punjab: Social Sector Public Expenditure Review, World Bank 2013.

Parameter	Domain	Range		Reference
		Start	End	
Time span of analyses	**Fiscal year**	**2011-12**	**2029-30**	**Report objective**
Total Fertility Rate	Births per women	3.94	2.40	Based on various PDHS and past trends
DALYS[18] from VPD age 0-5 years*	Rate / 100,000	Lo 39,156 Mid 56,984 Hi 85,229		IHME GBD 1990-2010 Published 29-Aug-2013
Vaccine efficacy	Percent of DALYs saved by vaccine	17 percent		Expert opinion, Masud (2010)
Vaccination Coverage scenarios	Percent of FIC among 12-23 months	See table below		PDHS, PIHS, PSLM
Unit Cost of FIC Including pneumococcal	In US Dollars	See table below		Data collected from provinces
Inflation Rate	Annual Percent	5.5		Assumed

***** No herd effect is assumed.

Table 6. Vaccine Coverage Base Value (% FIC)

Region	FY 2011-12
Pakistan	49
Punjab	60
Sindh	28
KP	52
Balochistan	15

Source: PDHS 2012-13.

Table 6 reports the baseline figures used to build two coverage scenarios for economic analysis. These are based on PDHS 2012-13.

COST OF FULLY IMMUNIZED CHILDREN FOR DIFFERENT COVERAGE SCENARIOS

This section estimates the cost of interventions at various coverage scenarios. Table 7 shows the percent of children who will be fully immunized given assumed scenarios. If

[18] Disability-adjusted life year (DALY). One DALY means one lost year of healthy life. DALYs were first used in The Global Burden of Disease and Injury (GBD) study, a joint study of the World Bank, the World Health Organization (WHO) and Harvard School of Public Health. DALY is a standard measure used in quantifying societal burden of disease. Data source for DALY is taken from Pakistan Global Burden of Disease Study Results 1990-2010. 2013. Seattle: United States: Institute for Health Metrics and Evaluation (IHME).

past trends are followed—and no additional intervention is undertaken—then Pakistan will fully immunize 52 percent of children in 2014-15. In the case of intervention through the CMYP supported by NISP, an estimated 60 percent of children will be immunized in the same year. It is assumed that the 80 percent coverage targets for all provinces in FY19-20 will be achieved.

Table 7. Percent of FIC by Different Levels of Coverage Scenario

Region	Scenario	2014-15	2015-16	2016-17	2017-18	2018-19	2024-25	2029-30
Pakistan	S1	52	53	54	55	56	62	67
	S2	60	64	68	72	76	85	90
Punjab	S1	63	64	65	66	67	73	78
	S2	68	70	73	75	78	85	90
Sindh	S1	31	32	33	34	35	41	46
	S2	48	54	61	67	74	85	90
KP	S1	55	56	57	58	59	65	70
	S2	62	66	69	73	76	85	90
Balochistan	S1	18	19	20	21	22	28	33
	S2	39	48	56	64	72	85	90

S1= Follow past trends.
S2 = NISP intervention.

Table 8 shows total coverage costs under the two scenarios, as well as additional costs incurred as a result of improved coverage, with respect to the coverage differences in S2 and S1 scenarios. Pakistan will require expenditures of USD $257 million to USD $412 annually until 2025 if it follows scenario S2. In contrast, to reach 90 percent coverage targets, Pakistan would need an investment of USD $731 million in the terminal year of this analysis (see Table 8). If the past trend (S1) continues and minimal increases in coverage rate are achieved, then Pakistan will require USD $218-288 million for the next five years until FY 2018-19. This in effect constitutes baseline spending on vaccination. Therefore, an additional USD $38 to 111 million per annum are necessary to increase EPI coverage of the country from 57 percent in 2014-15 to 76 percent in FY 2018-19 to achieve S2 targets. This increased investment estimate reflects declining FIC unit costs due to wastage reductions, which is explained further below.

These estimated unit costs vary by province. For example, because Punjab is the most populated province, it would require a comparatively larger investment. According to the projected financial outlays, Punjab would require USD $155-216 million to increase coverage under S2. Notably, if NISP intervention (S2) is adopted to achieve higher targets, then the gap between costs under S1 and S2 widens in future periods. However, to sustain S2 targets in the last year of the project, Balochistan would have to spend three times more than its S1 expenditure. For Sindh, doubling S1 expenditures would be necessary.

Table 8. Cost of FIC by Different Levels of Coverage Scenario (in million USD)

Region	Scenario	2014-15	2015-16	2016-17	2017-18	2018-19	2024-25	2029-30
Pakistan	S1	218.4	234.8	252.0	269.8	288.2	411.9	534.0
	S2	257.1	289.4	323.9	360.4	399.1	575.7	730.8
	DIF	38.7	54.6	71.9	90.6	110.9	163.8	196.8
Punjab	S1	144.3	153.9	164.6	175.6	186.9	261.1	332.7
	S2	154.6	168.3	183.6	199.5	216.2	304.1	383.9
	DIF	10.3	14.4	19.0	23.9	29.3	42.9	51.2
Sindh	S1	32.4	35.3	38.4	41.5	44.8	67.8	91.3
	S2	49.6	59.6	70.3	81.9	94.2	140.6	178.6
	DIF	17.2	24.3	32.0	40.3	49.3	72.8	87.3
KP	S1	36.6	39.9	42.7	45.7	48.7	70.1	91.6
	S2	41.6	47.1	52.3	57.7	63.5	92.1	118.3
	DIF	5.1	7.2	9.5	12.0	14.7	22.0	26.6
Balochistan	S1	5.1	5.8	6.4	7.0	7.7	12.8	18.3
	S2	11.2	14.4	17.7	21.4	25.3	38.9	50.0
	DIF	6.1	8.6	11.4	14.3	17.5	26.1	31.7

Source: Authors' calculation.
S1 = Follow past trends.
S2 = NISP intervention.
Dif = Difference in cost due to increased coverage (net cost in million USD).

Figure 4 shows EPI expenditure as a percentage of GDP under different scenarios for Pakistan and its provinces. Notably, the expenditures remain below 0.2 percent throughout the period of analysis for Pakistan and for all provinces under both scenarios. Over time, the EPI outlays increase due to rising annual birth cohorts in initial years, and then gradually fall as total fertility rates decrease and the size of birth cohorts consequently falls as well. Though the impact of decreases in fertility rates is more prominent in Punjab, where outlays fall as a percentage of GDP, these have significant impact at the national level as well. Because of this decrease, even after doubling the cost of immunization, EPI expenditures as percent of GDP would remain less than 0.40 percent.

Figure 4. Expenditure on EPI as a Percentage of Provincial GDP by Coverage Scenario

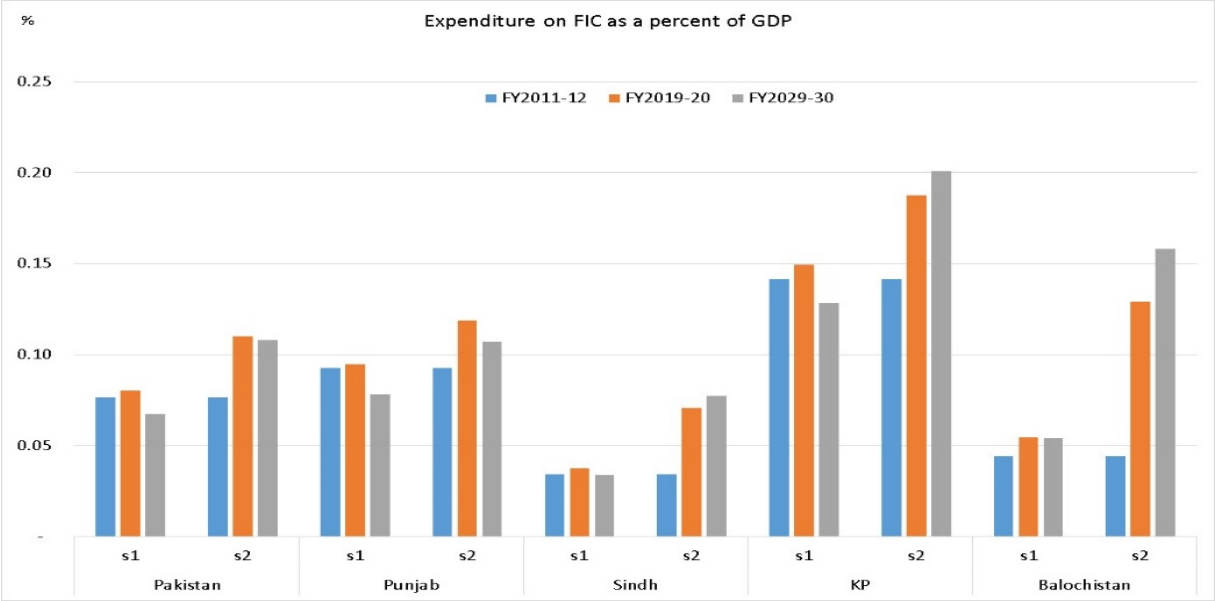


Table 9 presents resources needed to achieve different coverage targets for FY 2014-15. The cost of fully immunizing 60 percent, 65 percent, and 70 percent of children nationwide is estimated, and then differences in coverage scenarios are tabulated. Pakistan needs an additional USD $44 million to immunize 60 percent of its children, USD $65 million for 65 percent of the children, and USD $85 million to immunize 70 percent of its children. If the target of 60 percent is achieved, then about 3.41 million children will be immunized. These figures are 3.69 million and 3.98 million for the 65 percent and 70 percent targets.

Table 9. Resources Required to Achieve Different Coverage Targets in FY 2014-15

	Coverage Target		
	60%	65%	70%
EPI cost without support (million USD)	205	205	205
Additional funding required to reach targets (million USD)	44	65	85
Total EPI cost of FIC to meet the target (million USD)	249	270	290
Total number of children fully vaccinated in Pakistan	3,409,951	3,694,113	3,978,276

Source: Authors' Calculations.

EFFICIENCY GAINS THROUGH COVERAGE IMPROVEMENTS

The WHO and UNICEF guidelines indicate that national immunization programs must cover all districts. Reaching national-level targets is meaningless if even a few districts lag behind. In Pakistan, even though national level coverage is improving at a very slow rate

in a number of districts, the situation is deteriorating. Although 10 districts have shown improvements in coverage, 22 districts have immunization rates below 20 percent (see Table 10). Substantial variation in coverage exists across individual districts but the reality is hidden beneath provincial and national figures. Pakistan's first priority should be to eliminate the differentials in coverage across districts. An essential first step will be to improve the mechanisms for tracking and verifying data on coverage and program performance. The efficiency of the program will increase if the provincial EPI offices convert the current high-level EPI plans into digitized micro-level plans that contain much greater detail. The aim must be to produce revised, computerized micro-plans for at least 80 percent of union councils at the district and provincial levels, and then to ensure that all districts report on progress via integrated management information and evaluation systems to ensure completeness in coverage.

Table 10. Number of Districts in Pakistan by Percentage of FIC

	2008-09		**2010-11**	
Immunization Coverage (Percent FIC)	**Districts**	**%**	**Districts**	**%**
Below 20	22	20.4	21	19.1
20-39	28	25.9	25	22.7
40-59	30	27.8	24	21.8
60-79	22	20.4	34	30.9
80 or above	6	5.6	6	5.5
Total number of districts	108	100.0	110	100.0

Source: Authors' calculations based on PSLM district-level surveys.

The expansion program can improve its effectiveness with online surveillance, including zero-cost reporting for VPDs, and an adverse effects following immunization (AEFI) system for 80 percent of all district health facilities. Micro plans that have area maps, estimations of the target population in each community, vaccine logistics, and HR requirements are essential to equitable planning. Calculations for target coverage, identification of high-risk areas, and procurement of vaccines and syringes should be facilitated by effective planning and management, which would also reduce waste. Timely aggregation at the union council level will improve management function. Thus, data will be readily available for monitoring and analysis of union-council coverage and can be aggregated upstream to observe *tehsil* and district level coverage. Integration of computerized micro plans into existing health management information system (HMIS) will improve management function and evidence-based decision making, thus bringing positive returns in terms of improved coverage at lower costs.

The success of immunization programs depends heavily upon vaccine inventory management, including proper storage and handling of vaccines. As per specifications, all health facilities require at least 95 percent of functional cold chain equipment at all levels. This will increase the benefits of vaccination. The failure to adhere to cold chain requirements may reduce vaccines' efficacy, resulting in lack of protection against VPDs despite inoculation. The loss of vaccine effectiveness due to nonfunctional cold chain is cumulative, permanent, and irreversible. The proposed intervention will prove to be a cost

saving strategy since vaccines may be wasted if they are exposed to extremely low or high temperature, resulting in increased costs to replace the wasted vaccines, human services, and specialized transportation. Indirectly, this intervention is also expected to bring net positive economic returns through improvement in system efficiency.

Efficiency gains are possible through awareness campaigns on electronic media, disaggregated by provinces. The low coverage ratio in Pakistan pertains not only to supply side problems, but also serious demand side issues as well. For instance, a significant number of parents, especially in rural and tribal areas, are non-literate or uneducated about health issues, particularly the importance of vaccination. Data reveals that among non-immunized children, 45 percent were not immunized due to misconceptions about the efficacy of immunization, fear of side effects, and lack of knowledge about immunization (see Table 11). Parents ignore the importance of vaccination against VPDs and are generally unaware of the consequences of not immunizing their children. As such, many children are vaccinated only if the facility is provided at their doorstep, as parents do not assume responsibility to immunize their children. Some parents reject the immunization of their children, even if the government provides the service.

Table 11. Reasons for Not Immunizing a Child by Province

Reasons for never immunizing a child	Province				Total
	Punjab	Sindh	KP	Balochistan	
Cannot afford it	.5	3.5	2.0	4.1	1.8
No team has visited	32.3	21.6	14.9	15.2	24.8
Facility too far away	9.3	6.0	4.4	11.6	8.7
Do not know about	8.7	8.1	.5	14.5	8.6
Child will get sick	18.1	15.8	39.0	18.8	21.5
No female staff	.5	0.0	0.0	.1	.3
No answer	2.6	3.0	9.8	8.0	5.0
Unnecessary	10.8	36.2	13.2	24.6	16.3
Other	17.3	5.9	16.2	3.1	13.1
Total	100.0	100.0	100.0	100.0	100.0

Source: PSLM/ HIES 2011-12, authors' calculations.

Moreover, due to security threats for vaccinators in Pakistan, workers are unable to provide services in higher-risk regions unless protected by local communities. Only when reluctant parents are willing to vaccinate their children can efforts to improve coverage be increased. Addressing these issues through behavioral change communication campaigns—particularly addressing misconceptions and myths—will facilitate immunization coverage. This component, in alignment with supply-side intervention, is expected to bring positive economic returns through improved coverage and greater DALYs saved.

ECONOMIC BENEFITS OF INTERVENTION

For the economic evaluation of intervention, two criteria were used. First, the cost of one DALY saved was compared with per capita GDP. And second, if relevant, the cost of one DALY saved is compared with a higher threshold set at three times the per capita GDP. As described above, incremental cost-effective ratios are calculated using net costs as the numerator (S2 – S1 cost) and net benefit as denominator (S2 DALYS saved – S1 DALYs saved). It can be seen from Table 12 that the cost of one DALY saved is significantly less than the per capita GDP of Pakistan, and this holds true for all provinces. The cost per DALY saved is highest in Balochistan followed by KP, Sindh and then Punjab. Even in Balochistan, however, the incremental cost of coverage is less than half of per capita GDP. Results thereby remain below both threshold values and, most importantly, effectiveness increases with increases in coverage during the project life cycle.

Table 12. Incremental Cost-effective Ratios (USD per DALY saved) and WHO threshold.

	2014-15	2015-16	2016-17	2017-18	2018-19	2024-25	2029-30
Pakistan ICER	1,175	1,240	1,308	1,380	1,456	2,008	2,626
Punjab ICER	1,073	1,132	1,194	1,260	1,329	1,833	2,395
Sindh ICER	1,153	1,216	1,283	1,354	1,428	1,969	2,574
KP ICER	1,230	1,298	1,369	1,444	1,524	2,101	2,746
Balochistan ICER	1,427	1,505	1,588	1,675	1,767	2,437	3,185
Per Capita GNP* (USD)	1,298	1,321	1,357	1,407	1,459	1,839	2,265
Three times per capita GNP* (USD)	3,893	3,962	4,070	4,220	4,378	5,516	6,796

* WHO regional threshold

RETURNS ON INVESTMENT UNDER NISP

The net present value of the proposed interventions, though difficult to estimate, is positive. Within the CMYP, the proposed NISP program will improve immunization coverage in a number of ways: (1) by strengthening management, governance, and stewardship functions (2) by addressing the fundamental systemic weaknesses that underlie poor performance and accountability of EPI in Pakistan; by improving service delivery performance through increasing equitable access to EPI services at the union-council (UC) level by improved planning, management of human resources and strengthened supply chain management at the point of service delivery; (3) by demand generation through exploring and expanding innovative strategies to empower communities to access immunization services and promote positive behaviors for acceptance and seeking of immunization services; and (4) by improving capacity in technical areas for increased immunization coverage through strengthening of the federal EPI cell in national coordination, project management, and analytic capacities as well as health system strengthening elements.

The NISP financing model is designed to address current weaknesses in immunization financing by:

a) Providing a single financing platform to coordinate multiple sources of international support for Routine Immunization e.g., World Bank, Gavi, the Gates Foundation, and USAID,

b) Using standard government budgetary and accounting mechanisms to deliver the majority of funds directly to the federal Ministry of Finance and provincial Departments of Finance.

c) Introducing a performance-based financing structure to incentivize outcomes which are aligned with the endorsed national comprehensive multi-year plan for immunization.

d) Addressing serious program inefficiencies by building management capacity, accurate tracking of vaccine stocks, and immunization coverage.

The current proposed financing package comprises: (1) USD $50M World bank IDA credit, (2) USD $25M buy-down from the Gates Foundation: conditional on results, which would convert the USD $50 million IDA loan into a USD $31.3 million loan free of interest and service charges, (3) A multi-donor trust fund held at the World Bank and disbursed together with the IDA credit, with initial contributions of a USD $80M grant from Gavi and a USD $10M grant from USAID (to be confirmed) and (4) a USD $20M grant from the World Bank Health Results Innovation Trust Fund (HRITF) supported by the Department for International Development, United Kingdom (DfID) and the Government of Norway in year two.

Excluding the ultimate increase in coverage ratio, the benefits of the project—especially in terms of demand generation, enhanced capacity of the concerned staff, and improved governance—cannot be easily translated into monetary terms. Therefore, this economic analysis makes use of quantitative data along with qualitative analysis. The overall benefits of the project include better use of public and donors' funds for immunization, improved service delivery, result-based management, better micro-plans based planning, and enhanced demand for immunization. The project aims at improving capacity in technical areas and improving human resource management, both of which will improve internal capacity, resulting in a more qualified workforce available to run the federal EPI cell. Furthermore, more informed decisions in planning at the UC level would be taken. The strengthened supply chain management, along with positive behaviors of communities for acceptance and seeking of immunization services, will increase the overall coverage ratio.

NISP intends to increase the coverage ratio from 54 percent in 2012-13 (PDHS) to 80 percent in 2019-2020, as the success of immunization programs more generally depends heavily upon high immunization coverage ratios of the target group. To this end, the project sets coverage targets for the next five years, and the following economic analysis is based on three scenarios of burden of disease from VPD for the under-five population. This analysis assumes three scenarios with different DALYs: (i) a low scenario of 39,156 DALYs per 100,000; (ii) a mean scenario of 56,984 DALYs; and (iii) a high scenario of 85,229 DALYs per 100,000.[19]

[19] Based on analysis by Institute for Health Matrix and Evaluation (IHME) "Global Burden of Diseases, Injuries, and Risk Factors Study 1990-2010" wherein results for Pakistan were published in August 2013; http://ghdx.healthdata.org/global-burden-disease-study-2010-gbd-2010-data-downloads.

Table 13. Return on Investment

Fiscal year	Scenario 1 (Low)		Scenario 2 (Mean)		Scenario 3 (High)	
	DALYs saved by NISP	Annual Economic Value (USD)	DALYs saved by NISP	Annual Economic Value (USD)	DALYs saved by NISP	Annual Economic Value (USD)
2013-14	21,908	30,364,59	31,883	44,189,810	55,900	77,477,682
2014-15	32,944	46,547,12	47,944	67,740,360	84,059	118,768,69
2015-16	44,035	63,425,76	64,084	92,303,956	241,119	347,295,26
2016-17	54,941	80,671,13	79,956	117,401,26	260,358	382,288,19
2017-18	65,659	98,279,89	95,554	143,027,41	278,897	417,460,21
2018-19	**76,144**	**116,188,2**	**110,814**	**169,089,52**	**296,722**	**452,764,94**
2019-20	86,374	134,356,1	125,700	195,529,37	154,761	240,734,35
2020-21	85,804	136,060,9	124,871	198,010,42	164,972	261,600,43
2021-22	84,897	137,236,5	123,550	199,721,24	174,647	282,318,94
2022-23	83,864	138,199,3	122,047	201,122,50	183,802	302,887,51
2023-24	82,735	138,986,4	120,405	202,267,90	192,455	323,306,11
2024-25	81,547	139,650,1	118,675	203,233,84	200,659	343,632,98
2025-26	80,485	140,509,3	117,131	204,484,16	208,576	364,126,24
2026-27	79,187	140,926,4	115,241	205,091,28	215,857	384,155,12
2027-28	77,831	141,203,7	113,268	205,494,76	222,627	403,895,94
2028-29	76,415	141,326,6	111,208	205,673,66	228,850	423,249,15
2029-30	74,941	141,291,4	109,062	205,622,43	234,511	442,140,60

According to the high scenario the project will save about 1.16 million DALYs[20] over five years (see Table 13). The minimum discounted[21] economic value of this achievement is USD $1,719 million,[22] and total present value of the benefits would be many times higher than the above figure since benefits will increase beyond the allotted five-year period, even as costs decline. For instance, total DALYs saved over the next 16 years until 2030 are estimated 3.34 million, which would contribute in present value terms USD $5,491 million. The estimated DALYs averted, according to the mean scenario, are 0.4 million over the next five years and about 1.7 million by the end of 2030. The corresponding figures of economic gains are USD $590 million and USD $2,816 million. Finally, under the low scenario, the project is expected to save 0.27 million DALYs over the life of the project and 1.17 million by the end of 2030. The corresponding monetary gains are USD

[20] Calculations of DALYs are based on the project's target of 80 percent coverage.

[21] Economic analysis assumes 3 percent discount rate.

[22] DALYs saved are multiplied by the discounted value of per capita GDP. The maximum gain can be found by multiplying DALYs saved by three times per capita GDP.

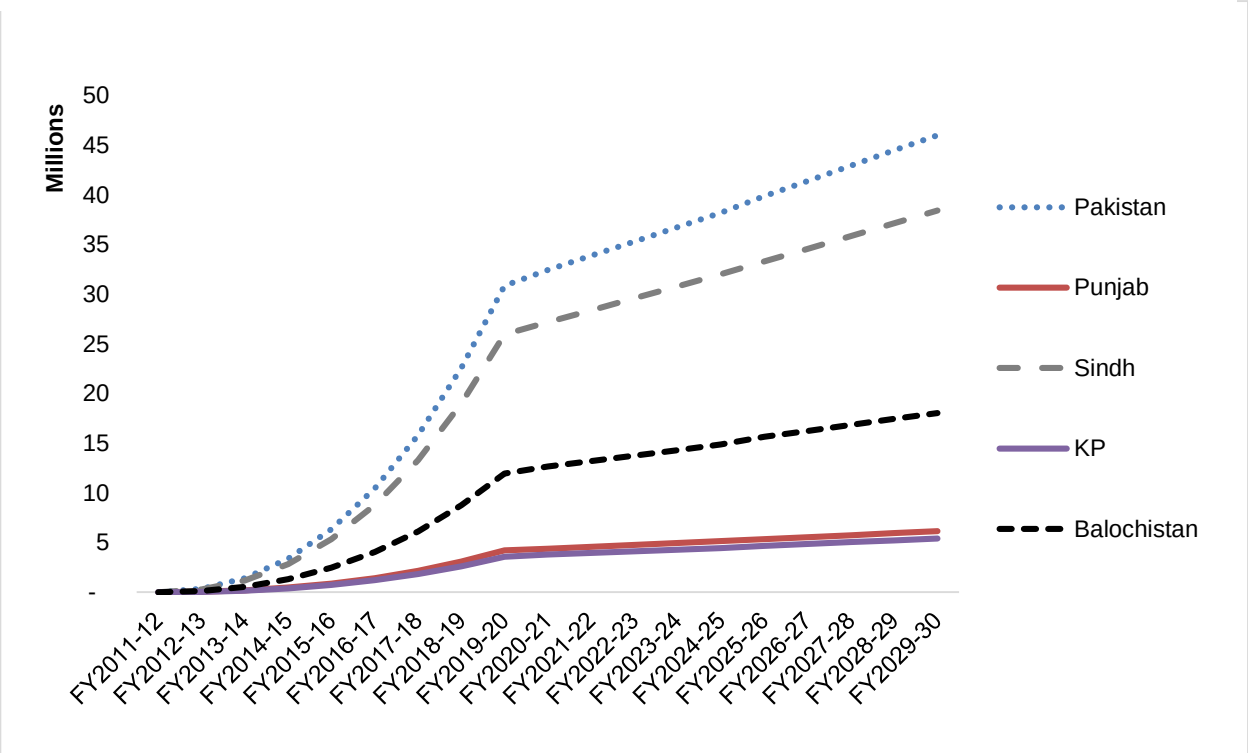
$405 million and USD $1,935 million, respectively. In all scenarios, the project is economically feasible.[23]

COST-SAVING AND EFFICIENCY GAINS

In addition to the return on investment cited in Table 14, additional savings can be generated from improvements in EPI coverage and resultant declines in unit costs. For example, the needs assessment for vaccine procurement under the present arrangements is based on an estimation of total annual births. This assumption incorporates intrinsic wastage in vaccine procurement and administration by procuring greater levels of supplies than required in practice. Since not all children actually become immunized, wastage of procured vaccines results due to overestimating the required procurement levels. And since vaccine supplies in excess of demand simply turn to waste, the resultant overhead costs can be reduced substantially by increasing coverage through planning, diligent monitoring, and governance. These adjustments will directly result in unit cost declines from improving vaccine utilization.

The total extent of savings can be tabulated through differences in coverage between the S1 and S2 scenarios. The S2 scenario incorporates waste reductions. Wastage rates are

Figure 5. Additional savings (USD million) through reduction in wastage



assumed to be a constant 5 percent for vaccines per annum. Nonetheless, the estimates likely understate potential savings. Wastage rates are typically higher for monovalent vaccines due to the increased storage required per FIC among other reasons. Additional potential savings from reducing waste in the NISP intervention amount to nearly USD $90

[23] The analysis in main text assumed 17 percent vaccine efficacy. Nonetheless, if we assume higher vaccine efficacy then economic benefits would increase. For instance, at 30 percent vaccine efficacy, above discussed high, mean, and low scenarios would yield $7432 million, $4969 million and $3414 million respectively.

million during the project period, assuming that all waste is eliminated (see Figure 5). Among the provinces, savings are higher for Sindh and Balochistan, primarily because coverage rates are low in these regions relative to the population size, meaning that wastage rates are comparatively high. Overall, as can be seen in the following graph, the rate of saving increases with each year of the project and continues beyond the formal length of the intervention, given that systems put in place by NISP will be sustained beyond the life of the project.

Even beyond direct wastage reductions, there is reason to expect declines in unit costs of FIC over time. Improvements in vaccine and cold chain technology will continue to reduce spoiling of vaccines and create lower-cost supply chains. As vaccine multivalence increases, FIC unit costs will also decline, as noted above. Innovations in delivery could reduce transport costs of renewed supplies. These trends are not explicitly modeled here to ensure a conservative savings estimate, but nonetheless the cost-efficacy of the proposed intervention over the ensuing years is even more favorable than estimated.

CONCLUSIONS

Based on available data on public finance and health outcomes, the authors sought to understand the financial cost of the CMYP and NISP intervention that aims to fully immunize children between 0 and 23 months against preventable diseases. Efficiencies delivered under the NISP financing mechanism were particularly considered. The analysis demonstrated clear economic benefits and efficacy of this intervention in terms of DALYs saved. The analysis also established that the proposed intervention is affordable and economically effective with a high rate of return. The minimum discounted value for this project is USD $435 million and the maximum is USD $1,719 million, based on low to high DALYs saved by the end of the project in 2019-20. Such benefits would climb even higher by 2029-30, at an estimated USD $1,796 million to USD $5,491 million—figures that far exceed the costs of the intervention. All cost-effective ratios remain well within the WHO thresholds set for this region.

Based on these results, increased investment in immunization is affordable and would generate substantial economic returns for Pakistan. It is worth noting that this intervention is economically feasible even with conservative assumptions of benefits—namely, where the estimate of DALYs saved is low and vaccine efficacy is assumed at only 17 percent. Thus, the program can yield higher returns if vaccine storage can be improved, which can be achieved by establishing and reinforcing online surveillance, improving monitoring of vaccine logistics, and building staff capacity. Finally, reductions in vaccine wastage can save nearly UD$86 million over the life of the project. These projections rest on conservative assumptions that set aside expected unit cost declines of FIC by way of technological development.

Nevertheless, the report highlighted that in addition to increased investment, the effectiveness of the EPI could be enhanced by improving the capacity building of health professionals, as well as by improving logistics of program interventions to reach marginalized populations, remote areas, and pockets of resistance. As the estimated affordability of enhanced coverage suggests, increased financial investment alone will be insufficient to address the root causes of persistent under-coverage in Pakistan. It is imperative that ample attention and resources be diverted to strengthen the procurement systems, local and provincial management capacity, and reporting mechanisms, among other capacity improvements. Such improvements would increase the value for each dollar spent and augment the intervention along dimensions of quality and equity.

The economics analysis also suggests the need to weigh a broader array of considerations to effectively target the intervention. For example, the higher FIC unit costs in rural regions suggest the need for a particular allocation of funds and focus within the program on these areas of Pakistan. Balochistan, for instance, showed a FIC that is roughly 30 percent higher than the countrywide median—a figure larger than per capita GNP—for reasons that rest in part on cultural variations in the local perception of immunization services. The reasons for higher wastage in such areas are not entirely economic. Understanding the phenomenon will be crucial for a project that seeks fundamentally to increase demand for vaccination services, lest wastage costs climb too high. Already, FIC unit costs exceed previous literature averages of approximately $24-28 (Brenzel and Politi 2012 and Hasan 2010). These differences stem from a variety of factors, spanning political economy constraints, as increased devolution has hampered coordination and scale economies; cultural reductions in willingness-to-vaccinate, resulting in increased wastage; and even currency fluctuations that alter supply costs, to

name just a few. Integrating this interplay of sociological, political, financial, and cultural drivers with economic factors will strengthen the reach and efficacy of national efforts to enhance EPI.

Finally, regional and gender disparities will have to be challenged. Data reveals that while 10 districts have increased immunization coverage, there are 22 districts that still possess immunization rates below 20 percent. The priority should be to address differentials in coverage across districts and regions to ensure equitability. Most importantly, different provinces have cited distinctions in cultural motivations for declining to vaccinate children. The program must reach these marginalized segments of society and devise plans to overcome societal resistance. This is a matter as much of efficiency as equity.

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ANNEX

UNIT COST OF FULLY IMMUNIZED CHILD

Table A.1 presents the unit cost in USD dollars for a FIC for Pakistan as a whole and for each province from 2013 until 2030, assuming a 5.5 percent annual inflation rate. The methodology used to derive unit cost is explained in Annex II. The unit cost is lowest in the more densely populated province of Punjab and highest in Balochistan. The unit cost in 2030 is approximately two and half times more than the current cost.

Table A.1. Unit Cost per Fully Immunized Child in USD

Fiscal Year	Pakistan	Punjab	Sindh	KP	Balochistan
2012	64.2	60.8	65.4	69.7	80.9
2013	67.8	64.2	69.0	73.6	85.3
2014	71.5	67.7	72.7	77.6	90.0
2015	75.4	71.4	76.7	81.9	95.0
2016	79.6	75.4	81.0	86.4	100.2
2017	84.0	79.5	85.4	91.1	105.7
2018	88.6	83.9	90.1	96.1	111.5
2019	93.5	88.5	95.1	101.4	117.7
2020	98.6	93.3	100.3	107.0	124.1
2021	104.1	98.5	105.8	112.9	131.0
2022	109.8	103.9	111.6	119.1	138.2
2023	115.9	109.6	117.8	125.7	145.8
2024	122.3	115.6	124.3	132.6	153.8
2025	129.0	122.0	131.1	139.9	162.2
2026	136.1	128.7	138.3	147.5	171.1
2027	143.6	135.8	145.9	155.7	180.6
2028	151.5	143.3	153.9	164.2	190.5
2029	159.9	151.1	162.4	173.3	201.0
2030	168.7	159.4	171.3	182.8	212.0

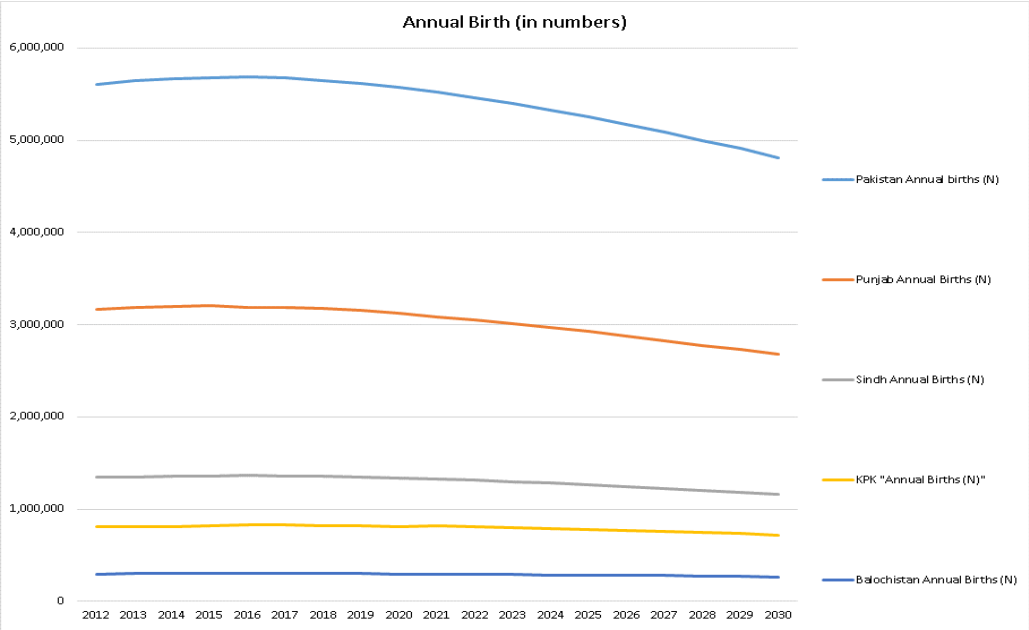
PROJECTION OF ANNUAL BIRTHS IN PAKISTAN

Table A.2 presents successive birth cohorts, that is, the annual number of births for Pakistan and its provinces. The current year figures are from the most recent nationally representative surveys. Population projection software is used for future birth cohort projections. The data in Table A.2 estimate the size of interventions needed to achieve the target coverage ratio. About 5.6 million children born each year in Pakistan need to be vaccinated. More than half of these expected births will occur in Punjab. Data in Table A.2 also show that the birth cohort is expected to decline after 2016 due to lower fertility rates, which will also lower the burden of immunization. In the province of Punjab, where fertility regulation is high, the fertility rate is lower, despite its dense population. Declining provincial annual birth rates will be reflected in a decreased birth cohort in Pakistan overall.

Table A.2. Annual Birth Cohort (in numbers)

Fiscal Year	Pakistan	Punjab	Sindh	KP	Balochistan
2012	5,603,908	3,162,021	1,341,724	804,573	295,589
2013	5,643,204	3,184,194	1,351,133	810,215	297,661
2014	5,669,109	3,198,811	1,357,335	813,935	299,028
2015	5,683,251	3,206,791	1,360,721	815,965	299,774
2016	5,684,927	3,190,883	1,363,727	828,027	302,289
2017	5,674,339	3,184,941	1,361,188	826,485	301,726
2018	5,651,041	3,171,864	1,355,599	823,092	300,487
2019	5,617,292	3,152,921	1,347,503	818,176	298,693
2020	5,575,429	3,129,423	1,337,461	812,078	296,467
2021	5,525,167	3,085,238	1,327,836	814,936	297,157
2022	5,466,754	3,052,621	1,313,798	806,320	294,015
2023	5,400,250	3,015,485	1,297,816	796,511	290,438
2024	5,327,557	2,974,894	1,280,346	785,789	286,529
2025	5,251,037	2,932,165	1,261,956	774,503	282,413
2026	5,171,069	2,873,412	1,244,162	772,084	281,410
2027	5,087,633	2,827,049	1,224,088	759,627	276,870
2028	5,000,544	2,778,656	1,203,134	746,624	272,130
2029	4,909,566	2,728,102	1,181,245	733,040	267,179
2030	4,814,851	2,675,472	1,158,456	718,898	262,025

Figure A.1. Annual Birth Cohorts (in numbers): Punjab and Pakistan decline due to uptake in fertility regulation



COVERAGE RATIO AND THE TARGET POPULATION

Two scenarios are assumed with regards to immunization coverage. The first scenario (S1) assumes that the past trend of increase in coverage will continue in the future. The second scenario (S2) is built under the NISP intervention, which is expected to significantly increase immunization coverage. The past trend is estimated on the basis of various rounds of Pakistan Demographic and Health Survey (PDHS 1991, 2007, 2012) and Pakistan Social Living Standards Measurement Survey (PSLM 2000 to 2012). The past trend shows that immunization rates increase by 1 percentage point annually. However, under NISP intervention, an annual increase of 3-8 percentage points is assumed. Combining the target population from Table A.2 (above) with the following Table A.3 will help to build various coverage scenarios and the estimated expenditure to immunize children in Pakistan. The scenario of coverage data on immunization will determine the level of effort that is required to eliminate vaccine preventable disease in Pakistan.

Table A.3. Percent of FIC under Different Scenarios

Fiscal Year	Pakistan		Punjab		Sindh		KP		Balochistan	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
2011-12	48.8	48.8	60.0	60.0	28.0	28.0	51.7	51.7	15.0	15.0
2012-13	49.8	52.7	61.0	62.5	29.0	34.5	52.7	55.3	16.0	23.1
2013-14	50.8	56.6	62.0	65.0	30.0	41.0	53.7	58.8	17.0	31.3
2014-15	51.8	60.5	63.0	67.5	31.0	47.5	54.7	62.3	18.0	39.4
2015-16	52.7	64.4	64.0	70.0	32.0	54.0	55.7	65.9	19.0	47.5
2016-17	53.7	68.3	65.0	72.5	33.0	60.5	56.7	69.4	20.0	55.6
2017-18	54.7	72.2	66.0	75.0	34.0	67.0	57.7	72.9	21.0	63.8
2018-19	55.7	76.1	67.0	77.5	35.0	73.5	58.7	76.5	22.0	71.9
2019-20	56.7	80.0	68.0	80.0	36.0	80.0	59.7	80.0	23.0	80.0
2020-21	57.7	81.0	69.0	81.0	37.0	81.0	60.7	81.0	24.0	81.0
2021-22	58.7	82.0	70.0	82.0	38.0	82.0	61.7	82.0	25.0	82.0
2022-23	59.7	83.0	71.0	83.0	39.0	83.0	62.7	83.0	26.0	83.0
2023-24	60.7	84.0	72.0	84.0	40.0	84.0	63.7	84.0	27.0	84.0
2024-25	61.7	85.0	73.0	85.0	41.0	85.0	64.7	85.0	28.0	85.0
2025-26	62.6	86.0	74.0	86.0	42.0	86.0	65.7	86.0	29.0	86.0
2026-27	63.6	87.0	75.0	87.0	43.0	87.0	66.7	87.0	30.0	87.0
2027-28	64.6	88.0	76.0	88.0	44.0	88.0	67.7	88.0	31.0	88.0
2028-29	65.6	89.0	77.0	89.0	45.0	89.0	68.7	89.0	32.0	89.0
2029-30	66.6	90.0	78.0	90.0	46.0	90.0	69.7	90.0	33.0	90.0

S1: Baseline Scenario, S2: Improved coverage with NISP intervention

Results in Table A.2 and A.3 are further combined to find the target population in numbers under the two scenarios. The data in Table A.4 reflect incremental effort required to increase immunization each year. By the end of year 2030, nearly 130,000 additional children in Pakistan will be immunized compared to the previous year.

Table A.4 Number of FIC under Different Scenarios

Fiscal Year	Pakistan		Punjab		Sindh		KP		Balochistan	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
2011-12	2,733,466	2,733,466	1,897,213	1,897,213	375,683	375,683	416,232	416,232	44,338	44,338
2012-13	2,809,066	2,972,875	1,942,358	1,990,121	391,829	466,141	427,253	447,779	47,626	68,834
2013-14	2,878,652	3,207,774	1,983,263	2,079,227	407,201	556,507	437,354	478,593	50,835	93,446
2014-15	2,942,666	3,437,580	2,020,278	2,164,584	421,824	646,343	446,605	508,618	53,959	118,036
2015-16	2,997,480	3,659,012	2,042,165	2,233,618	436,393	736,413	461,487	545,394	57,435	143,587
2016-17	3,048,641	3,874,016	2,070,211	2,309,082	449,192	823,518	468,892	573,580	60,345	167,835
2017-18	3,092,634	4,079,018	2,093,430	2,378,898	460,904	908,251	475,198	600,308	63,102	191,561
2018-19	3,130,337	4,274,245	2,112,457	2,443,514	471,626	990,415	480,542	625,632	65,712	214,685
2019-20	3,162,762	4,460,343	2,128,008	2,503,539	481,486	1,069,968	485,081	649,663	68,187	237,173
2020-21	3,186,369	4,475,385	2,128,814	2,499,043	491,299	1,075,547	494,937	660,098	71,318	240,697
2021-22	3,207,350	4,482,738	2,136,835	2,503,149	499,243	1,077,315	497,768	661,182	73,504	241,092
2022-23	3,222,334	4,482,208	2,140,994	2,502,853	506,148	1,077,187	499,678	661,104	75,514	241,064
2023-24	3,232,234	4,475,148	2,141,923	2,498,911	512,138	1,075,490	500,809	660,063	77,363	240,684
2024-25	3,238,319	4,463,382	2,140,480	2,492,340	517,402	1,072,663	501,361	658,327	79,076	240,051
2025-26	3,237,999	4,447,119	2,126,325	2,471,134	522,548	1,069,980	507,517	663,993	81,609	242,013
2026-27	3,236,629	4,426,241	2,120,287	2,459,533	526,358	1,064,956	506,924	660,875	83,061	240,877
2027-28	3,231,231	4,400,479	2,111,779	2,445,217	529,379	1,058,758	505,713	657,029	84,360	239,475
2028-29	3,221,539	4,369,514	2,100,639	2,428,011	531,560	1,051,308	503,842	652,405	85,497	237,790
2029-30	3,207,537	4,333,366	2,086,868	2,407,925	532,890	1,042,611	501,311	647,008	86,468	235,823

S1: Baseline Scenario, S2: Improved coverage with NISP intervention.

COST OF IMMUNIZING CHILDREN

The above tables show that the number of children increases with the increase in immunization coverage ratio, which will require additional resources to immunize the increased number of children. Table A.5 shows the expenditures required to immunize the number of children presented in Table A.4. In the base year 2012, these expenditures were 173 million USD. Assuming an increase in the price of vaccines and an increase in the immunization coverage ratio, this amount is expected to increase to USD 534 million under S1, during which 67 percent children will be immunized. In S2, however, about 90 percent of the children targeted to be immunized will require expenditures estimated at USD 731 million.

Table A.5. Cost of Fully Immunized Children by Coverage Scenario (million USD)

Fiscal Year	Pakistan		Punjab		Sindh		KP		Balochistan	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
2011-12	173	173	115	115	25	25	29	29	4	4
2012-13	187	199	125	128	27	32	31	33	4	6
2013-14	202	227	134	141	30	40	34	37	5	8
2014-15	218	257	144	155	32	50	37	42	5	11
2015-16	235	289	154	168	35	60	40	47	6	14
2016-17	252	324	165	184	38	70	43	52	6	18
2017-18	270	360	176	200	42	82	46	58	7	21
2018-19	288	399	187	216	45	94	49	63	8	25
2019-20	307	440	199	234	48	107	52	70	8	29
2020-21	327	466	210	246	52	114	56	75	9	32
2021-22	347	492	222	260	56	120	59	79	10	33
2022-23	368	519	235	274	60	127	63	83	11	35
2023-24	390	547	248	289	64	134	66	87	12	37
2024-25	412	576	261	304	68	141	70	92	13	39
2025-26	435	605	274	318	72	148	75	98	14	41
2026-27	459	636	288	334	77	155	79	103	15	43
2027-28	483	667	303	350	81	163	83	108	16	46
2028-29	508	699	317	367	86	171	87	113	17	48
2029-30	534	731	333	384	91	179	92	118	18	50

S1: Baseline Scenario, S2: Improved coverage with NISP intervention.

BENEFITS OF IMMUNIZATION

The benefit of immunization can be measured by the number of DALYs saved by effective immunization. One DALY equals one lost year of healthy life. The DALYs per birth from VPD are taken from the burden of VPDs data for Pakistan, published by Institute for Health Metrics and Evaluation (IHME 2013) in the Global Burden of Disease (GBD) 1990-2010. Three scenarios with respect to DALYS are built: Low (39,156/ 100,000 births), Medium (56,984/ 100,000 births) and High (85,229/ 100,000 births). The IHME GBD data is available for all child deaths. It was further assumed that only 17 percent of child deaths are preventable through vaccines, that is, vaccine preventable deaths (VPD). Therefore, DALYs were deflated to 17 percent to arrive at the conservative figure used in the analysis (see Table A6).

Table A.6. Total DALYs Saved by Fully Immunizing Children

Fiscal Year	Pakistan		Punjab		Sindh		KP		Balochistan	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
2011-12	181,954	181,954	126,288	126,288	25,007	25,007	27,707	27,707	2,951	2,951
2012-13	186,986	197,890	129,293	132,473	26,082	31,029	28,440	29,806	3,170	4,582
2013-14	191,618	213,526	132,016	138,404	27,105	37,044	29,113	31,858	3,384	6,220
2014-15	195,879	228,823	134,480	144,086	28,079	43,024	29,728	33,856	3,592	7,857
2015-16	199,528	243,563	135,937	148,681	29,049	49,019	30,719	36,304	3,823	9,558
2016-17	202,933	257,875	137,804	153,704	29,901	54,818	31,212	38,180	4,017	11,172
2017-18	205,862	271,521	139,350	158,352	30,680	60,458	31,632	39,960	4,200	12,751
2018-19	208,372	284,516	140,616	162,653	31,394	65,927	31,987	41,645	4,374	14,291
2019-20	210,530	296,904	141,651	166,649	32,050	71,223	32,290	43,245	4,539	15,787
2020-21	212,101	297,905	141,705	166,349	32,703	71,594	32,946	43,940	4,747	16,022
2021-22	213,498	298,394	142,239	166,623	33,232	71,712	33,134	44,012	4,893	16,048
2022-23	214,495	298,359	142,516	166,603	33,692	71,703	33,261	44,007	5,027	16,046
2023-24	215,154	297,889	142,578	166,340	34,091	71,590	33,336	43,937	5,150	16,021
2024-25	215,559	297,106	142,482	165,903	34,441	71,402	33,373	43,822	5,264	15,979
2025-26	215,538	296,023	141,539	164,492	34,784	71,223	33,783	44,199	5,432	16,110
2026-27	215,447	294,634	141,137	163,719	35,037	70,889	33,743	43,991	5,529	16,034
2027-28	215,088	292,919	140,571	162,766	35,238	70,476	33,663	43,735	5,615	15,941
2028-29	214,442	290,858	139,829	161,621	35,383	69,981	33,538	43,427	5,691	15,829
2029-30	213,510	288,451	138,913	160,284	35,472	69,402	33,370	43,068	5,756	15,698

The economic benefit of immunization can be approximated by multiplying the country's per capita GDP by the DALYs saved by immunization. Table A.7 presents the current and future projected GDP per capita of Pakistan. Table A.7 shows that the ICER of immunization for the terminal year of this analysis will remain below the WHO threshold for Pakistan.

Table A.7. WHO Threshold and Incremental Cost Effective Ratio

Fiscal year	Per Capita GDP WHO threshold (USD)	3 times per capita GNP WHO threshold (USD)	Pakistan ICER - NISP intervention (USD/ DALY)	Punjab ICER - NISP intervention (USD/ DALY)	Sindh ICER - NISP intervention (USD/ DALY)	KP ICER - NISP intervention (USD/ DALY)	Balochistan ICER - NISP intervention (USD/ DALY)
2012	1,212	3,637					
2013	1,257	3,772	-472	-443	-476	-508	-589
2014	1,278	3,833	-498	-467	-502	-536	-621
2015	1,298	3,894	-525	-493	-530	-565	-655
2016	1,322	3,962	-554	-520	-559	-596	-692
2017	1,357	4,070	-585	-549	-590	-629	-730
2018	1,407	4,220	-617	-579	-622	-664	-770
2019	1,459	4,377	-651	-611	-656	-700	-812
2020	1,515	4,543	-687	-644	-692	-739	-857
2021	1,573	4,718	-725	-680	-730	-779	-904
2022	1,634	4,901	-766	-717	-771	-822	-954
2023	1,698	5,095	-808	-757	-813	-867	-1,006
2024	1,767	5,300	-853	-798	-858	-915	-1,061
2025	1,839	5,516	-901	-842	-905	-965	-1,120
2026	1,915	5,744	-951	-888	-955	-1,018	-1,181
2027	1,995	5,985	-1,004	-937	-1,007	-1,074	-1,246
2028	2,080	6,241	-1,060	-989	-1,062	-1,133	-1,315
2029	2,170	6,511	-1,118	-1,043	-1,121	-1,196	-1,387
2030	2,265	6,796	-1,180	-1,100	-1,183	-1,262	-1,463

Table A.8. Child Immunization by Antigen and Province
Pakistan Demographic and Health Survey (various years)

Survey and Year	BCG	DPT1	DPT2	DPT3	Polio 0	Polio1	Polio2	Polio3	Measles	Fully immunized	No vaccination	With vacc. card	N
Punjab													
1990-91	75.8	69.6	66.6	46.7	10.2	70.7	67.3	46.9	54.4	**38.6**	22.2	31.2	763
2006-07	85.5	80.9	72.3	64.5	58.6	95.5	93.4	84.6	65.1	**52.6**	3.8	23.8	865
2012-13	91.6	87.2	81.0	76.3	72.0	97.4	95.2	92.4	70.0	**65.6**	1.5	40.7	1,215
Sindh													
1990-91	60.2	54.5	50.3	33.0	20.4	54.0	50.3	33.0	41.2	**25.3**	38.5	25.7	244
2006-07	76.7	67.3	56.4	47.6	51.2	92.2	89.9	84.1	50.7	**37.0**	6.3	19.7	373
2012-13	78.5	65.1	56.8	38.6	68.9	87.2	82.2	77.5	44.6	**29.1**	8.5	25.9	437
KPK													
1990-91	63.8	60.0	51.9	44.0	10.1	60.0	52.3	44.5	48.2	**37.6**	33.5	31.3	165
2006-07	71.1	67.5	62.4	56.4	62.6	91.3	87.9	81.0	56.6	**46.9**	7.5	33.9	222
2012-13	79.7	77.1	73.9	69.6	70.8	83.6	79.5	75.7	57.8	**52.7**	12.0	39.7	309
Balochistan													
1990-91	37.1	36.5	28.5	22.9	2.7	39.3	29.1	23.4	34.1	**17.8**	57.2	18.6	43
2006-07	63.0	60.8	60.0	46.7	32.5	69.2	66.3	62.9	54.0	**35.2**	28.9	10.6	61
2012-13	48.9	37.7	33.7	27.1	34.8	78.1	74.9	60.6	37.3	**16.4**	20.8	8.0	88
Pakistan													
1990-91	69.7	64.1	60	42.7	na	64.8	60.5	42.9	50.2	**35.1**	28.3	29.6	1,215
2006-07	80.3	74.8	66.5	58.5	56.3	93	90.6	83.1	59.9	**47.3**	6	23.7	1,522
2012-13	85.2	78.8	72.7	65.2	69.4	92.3	89.2	85.3	61.4	**53.8**	5.4	36.0	2,074

na: not available

Table A.9. Effectiveness Parameter Used in Analysis
(The figures are relatively close to Pakistan's IMR)

VPD	per 100,000			
	DALY	**Death**	**YLD**	**YLL**
Acute hepatitis A	787	9	38	767
Acute hepatitis B	290	3	24	281
Acute hepatitis C	1	0	1	0
Acute hepatitis E	382	4	18	376
Cirrhosis hepatitis B	64	1	0	64
Cirrhosis hepatitis C	41	0	0	41
Diarrheal diseases	28,101	323	975	27,563
Diphtheria	274	3	0	274
Hepatitis	1,094	12	60	1,064
HiB meningitis	1,817	21	8	1,812
Lower respiratory infections	32,573	379	151	32,447
Measles	491	6	2	490
Meningitis	5,593	65	23	5,577
Meningococcal	435	5	2	434
Pneumococcal meningitis	1,264	15	8	1,259
Pneumoconiosis	15	0	0	15
Pruritus	10	0	10	0
Rabies	336	4	0	336
Upper respiratory infections	61	0	34	32
Varicella	575	7	2	575
Vitamin A deficiency	17	0	17	0
Whooping cough	11,010	128	48	10,982
Total	**85,229**	**989**	**1,423**	**84,389**

Source: IHME GBD Results 1990-2010. Published August 29, 2013.

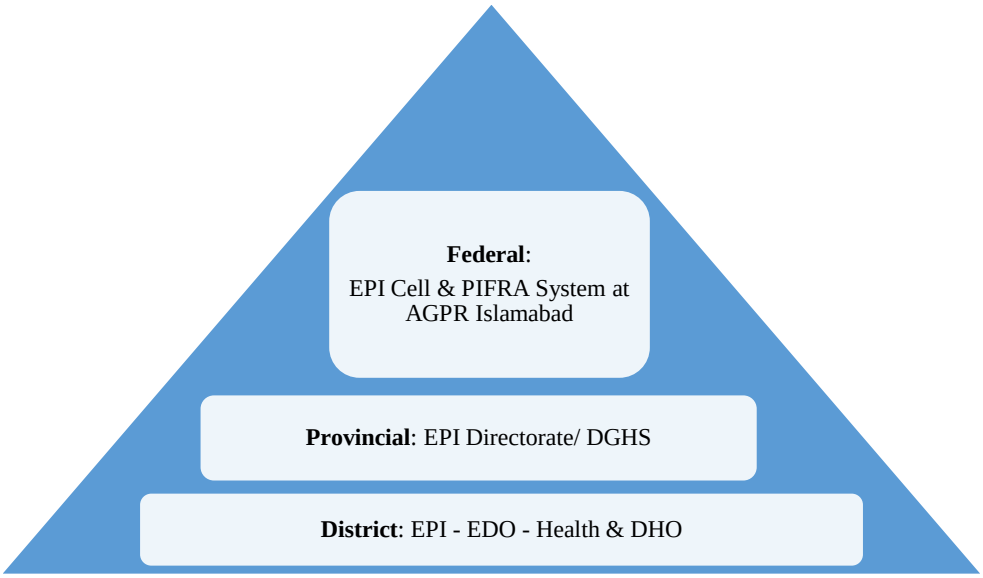
ANNEX II

UNIT COST ESTIMATION

Data Collection Method and Approach to Estimate Unit Cost

The data on cost is collected using a top down approach. Pakistan's existing immunization mechanism is pyramid shaped. The federal government is responsible for developing national policy, hosting technical advisory group meetings, procuring vaccines, and controlling central storage. The provincial and district governments are responsible for executing vaccinations and all operating cost. The data collection exercise started by obtaining all information pertaining to the existing implementation arrangement from the federal EPI cell. The financial information was obtained where available from the PIFRA system, which is maintained at the Accountant General Pakistan Revenues (AGPR) office. The immunization program expenditures are also available from the NAM Chart of Accounts, which are classified on the basis of input cost identified in the terms of reference. The following approach was used for information gathering.

Figure B.1. Information Collection Approach



The structure depicted in Figure B.1 helps to define the program boundaries, clarify the distribution of roles among provinces, and document the flow of the immunization process in the country. The associated cost components for each activity within the process flow include, e.g., procurement of vaccines and the associated cost components, including the price of vaccines, freight, insurance, etc. The function-input cost approach links the cost components to activities/ functions within the immunization process and ensures that every activity/ function of the immunization process is accounted for and all input costs are incorporated into the final unit cost (see Table B.1).

Figure B.2. Function-Input Cost Approach

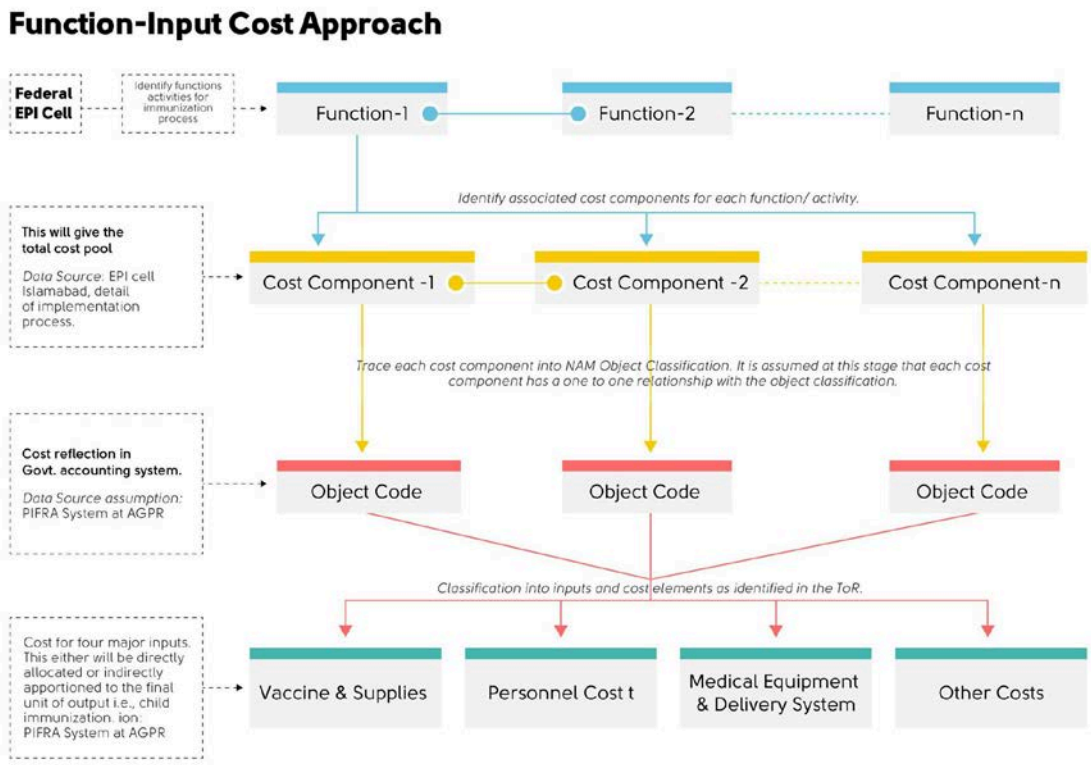


Table B.1. Function-Input Cost Table

Function/Activity	Cost Components	Object Code as per NAM[24]	Input Cost
Procurement			
Cold Storage and Distribution			
Immunization Delivery Personnel Cost			
Monitoring & Supervision			
Media & Social Mobilization			

Unit Cost Estimation

Unit costs are defined as the cost of immunizing a child once with a single antigen. The unit cost is calculated on a full cost basis, taking into account all resources being employed for immunization. For the purpose of costing, we employ the financial cost method, which measures resources in terms of expenditures incurred or money paid for the actual resources consumed. Therefore, opportunity cost will not figure in this unit cost of immunization. The annual average unit cost is calculated as follows:

$$\text{Average unit cost per annum} = \frac{\text{Total cost incurred for delivery of vaccine injection to child}}{\text{Number of contacts* during the year}}$$

Total cost incurred for delivery of vaccine to child = Direct cost + Apportioned indirect cost

Direct cost = Cost for which benefit is directly traceable to the final output. (e.g., price of vaccine, salaries of vaccinators, etc.)

Indirect cost = All overhead costs, including utilities, management costs, etc.

*A contact is defined as vaccine injection delivery to the child through a fixed center, outreach, and mobile teams. It is the basic unit of output for which cost is to be ascertained. In our analysis, immunization is a function of the number of contacts. Thus, if there are six contacts per child as per the national immunization schedule, the total immunization cost per child will be worked out as six times the unit cost per contact.

Cost Classification

In the analysis, the immunization cost is classified on the basis of input, which is the simplest, most manageable, and widely understood method. The basic input classifications relevant to the unit cost analysis include: (i) Personnel; (ii) Vaccine and Supplies; (iii) Medical Equipment and Transport, and (iv) Other Costs. The cost is further divided into capital and recurrent. It is important that all costs are presented on an annual basis, which requires spreading capital costs over the useful life of the assets. The annualizing of capital cost is done using the straight line method. The third dimension is to categorize cost into direct and indirect costs with respect to the cost objective, i.e., the cost of a fully immunized child. The direct cost would be directly attributable to the

[24] New Accounting Model (NAM)

immunization, while indirect cost will be apportioned based on the nature of the cost item. The following classification scheme is used.

Table B.2. Cost Classification Scheme

Level -1	Level-2	Level-3
Personnel Cost	Recurrent	Direct
	Capital	Direct
Vaccines & Supplies	Recurrent	Direct
	Recurrent	Direct
Medical Equipment & Delivery System	Capital	Direct
	Capital	Direct
	Capital	Indirect
Other Cost	Recurrent	Direct
	Recurrent	Indirect
	Recurrent	Indirect
	Recurrent	Indirect
	Recurrent	Indirect
	Recurrent	Direct

Data Collection

Under the existing arrangement, the role of the federal government is restricted to procuring vaccines and disposables. The expenditure is reflected in its budget. The procured vaccines are dispatched to each province through a cold chain delivery system that extends to the district level. The provinces are financing EPI through their development budget and have opened a separate DDO (cost center) for the EPI Program in their respective Annual Development Program (ADP). At the district level, the EPI has been integrated into the existing preventive program, which is financed from the current budget.

The preliminary review of EPI implementation in Pakistan suggests that it varies across provinces. Since the devolution of health, each province has developed its own formula to distribute the responsibilities between provincial and district governments. The financing responsibilities for each cost component also vary by province and district. The data sources are separately identified within each province depending upon the prevailing practice.

In addition to providing budget support for the EPI, donors have also provided in-kind aid such as purchasing equipment and providing training, etc. These in-kind contributions are not captured in the government budget and information relating to them is directly obtained from the donor agencies or from the EPI cell. The following templates were used to collect information from country financial management system Project to Improve Financial Reporting and Auditing (PIFRA).

Table B.3. Federal EFI Development Expenditure with Function and Object Codes

Federal Government							
Ministry	Health[1]						
Program Name	Expended program on immunization (CDD) NIH Islamabad						
Source	Development Expenditure on Revenue Account						
Grant no.							
Detail Function	0741	Public health services					
Sub Detailed Function	074120	Other Health Facilities and Preventive Measures					
DDO Code	ID1298						
		2010-11		**2011-12**		**2012-13**	
Object Codes	**Description**	**Budget**	**Actual**	**Budget**	**Actual**	**Budget**	**Actual**
A011	Pay						
A012	Allowances						
A032	Communication						
A033	Utilities						
A034	Occupancy cost						
A038	Travel and Transportation						
A039	General[2]						
A041	Pension						
A063	Emntertainment & Gifts						
A096	Plant & machinery						
A097	Furniture						
A124	Building and structure						
A130-3	Repair and Maintenance						
Total							

[1] In year FY 2012-13, the budget for EPI prgram was shifted to 'Inter Provinical Coordination Division'.

[2] This object head pertain to cost of Medicine purchased

Table B.4. Provincial Development Expenditure Function and Object Codes

Punjab							
Total Financing	?						
Total Coverage	?						
Department	Health						
Program Name	Preventice Health Care Program						
Project Name	Strengthening Expanded Program for Immunization						
Project Code	LO9100189						
Source	Development Expenditure on Revenue Account						
Grant no.	PC22036						
Detail Function	073	Hospital Services					
Sub Detailed Function	073101	General Hospital Services					
DDO Code	LE4206						
		2010-11		**2011-12**		**2012-13**	
Object Codes	**Description**	**Budget**	**Actual**	**Budget**	**Actual**	**Budget**	**Actual**
A3201	Postage & telegraph						
A3202	Telephone & trunk call						
A3204	Electronic communication						
A3801	Training-domestic						
A3805	Travelling Allowance						
A3807	POL charges helicopter, Airplanes and Staff cars						
A3901	Stationary						
A3902	Printing and publication						
A3903	Conference, seminar and Workshop						
A3907	Advertising and publicity						
A3927	Purchase of drug and medicine						
A3942	Cost of other stores						
A3970	Others						
Total							
Districts	----------						
Total Financing	?						
Total Coverage	?						
Source	Current Budget						
		2010-11		**2011-12**		**2012-13**	
Object Codes	**Description**	**Budget**	**Actual**	**Budget**	**Actual**	**Budget**	**Actual**
A011	Salaries						
A3805	Travelling Allowances						
A130-3	R&M						
A3807	POL						
A033	Utilities						
A3901	Stationary						
Total							

Table B.5. Hospital Services Development Expenditure Function and Object Codes

Sindh							
Total Financing	?						
Total Coverage	?						
Department	Health						
Program Name	Preventive Program						
Project Name	Operational Support for EPI Sindh						
ADP No.	11321						
Project Code	*Under each EDO Health there is a seprate project code for EPI operational cost*						
Source	Development Expenditure on Revenue Account						
Grant no.	SC22051						
Detail Function	073	Hospital Services					
Sub Detailed Functior	073101	General Hospital Services					
DDO Code	*Each EDO Health is a seprate DDO in provincial budget for EPI project*						
		2010-11		**2011-12**		**2012-13**	
Object Codes	**Description**	**Budget**	**Actual**	**Budget**	**Actual**	**Budget**	**Actual**
A03805	Travelling Allowance						
A03807	POL charges helicopter, Airplanes and Staff cars						
A03826	Transportation of Goods						
A13001	Transportation						
A13101	Machinery & equipment						
Total							
Districts	----------						
Total Financing							
Total Coverage							
Source	Current Budget						
		2010-11		**2011-12**		**2012-13**	
Object Codes	**Description**	**Budget**	**Actual**	**Budget**	**Actual**	**Budget**	**Actual**
A011	Salaries						
A3805	Travelling Allowances						
A130-3	R&M						
A3807	POL						
A033	Utilities						
A3901	Stationary						
Total							

Non-Financial Information

In each province, the following non-financial information is also gathered to facilitate the calculation of the unit cost of a fully immunized child.

a. Targeted population (number and percentage).
b. Immunization coverage (number and percentage).
c. Number of annual vaccines procured.
d. Number of annual contacts.
e. Percentage of wastage.
f. Number of vaccinators.
g. Asset record for cold chain equipment.
h. Number of vehicles.

Limitations on Unit Cost Estimation

a. No information on EPI expenditure from district health budget.
b. In Punjab, 95 percent of expenditure relates to salaries.
c. There is no reporting on number of contacts. Coverage by the antigen can be a basis for determining the number of annual contacts.
d. There is no annual vaccine consumption report by districts at the provincial level. Coverage by the antigen can be a basis for determining number of annual contacts.
e. It is difficult to isolate EPI expenditure at district level. Salaries of vaccinators are combined under salaries and wages head.
f. The cost of facility used by EPI staff is difficult to ascertain; however, the cost is negligible.
g. The donor in-kind aid needs to be quantified.
h. Syringes and disposable costs are procured by the Federal EPI cell, MONHSRC.

Pakistan faces a formidable challenge in eliminating the polio virus from the country. With transmission of the polio virus substantially slowing in the Africa region, the only two countries worldwide with ongoing endemic polio transmission may soon be Pakistan and Afghanistan. And a substantial number of the polio cases or infant paralysis occurring in Afghanistan is linked to cross-border transmission from Pakistan. The ongoing cycle of polio infection is not just a tragedy for the children of Pakistan, it is a global public health emergency constituting one of the final barriers to permanently eradicating polio.

The outbreaks of vaccine-preventable diseases in Pakistan result in significant costs to individuals and to society. These include costs associated with visits to health care providers, hospitalizations, disability, and premature deaths. Despite a slow decline over the past 10 years, the under-five mortality rate in Pakistan remains high, with more than 400,000 deaths annually in this demographic over the past twenty years. Pakistan is lagging behind other South Asian countries in improving this indicator.

This paper demonstrates clear economic benefits and efficacy of the National Immunization Support Project (NISP) financing intervention in terms of DALYs saved and establishes that this intervention is affordable and economically effective with a high rate of return. In addition to increased investment, the effectiveness of the EPI can be enhanced by improving the capacity building of health professionals, as well as by improving logistics of program interventions to reach marginalized populations, remote areas, and pockets of resistance. An increased financial investment alone will be insufficient to address the root causes of persistent under-coverage in Pakistan. It is imperative that ample attention and resources be diverted to strengthen the procurement systems, local and provincial management capacity, and reporting mechanisms, among other capacity improvements.

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