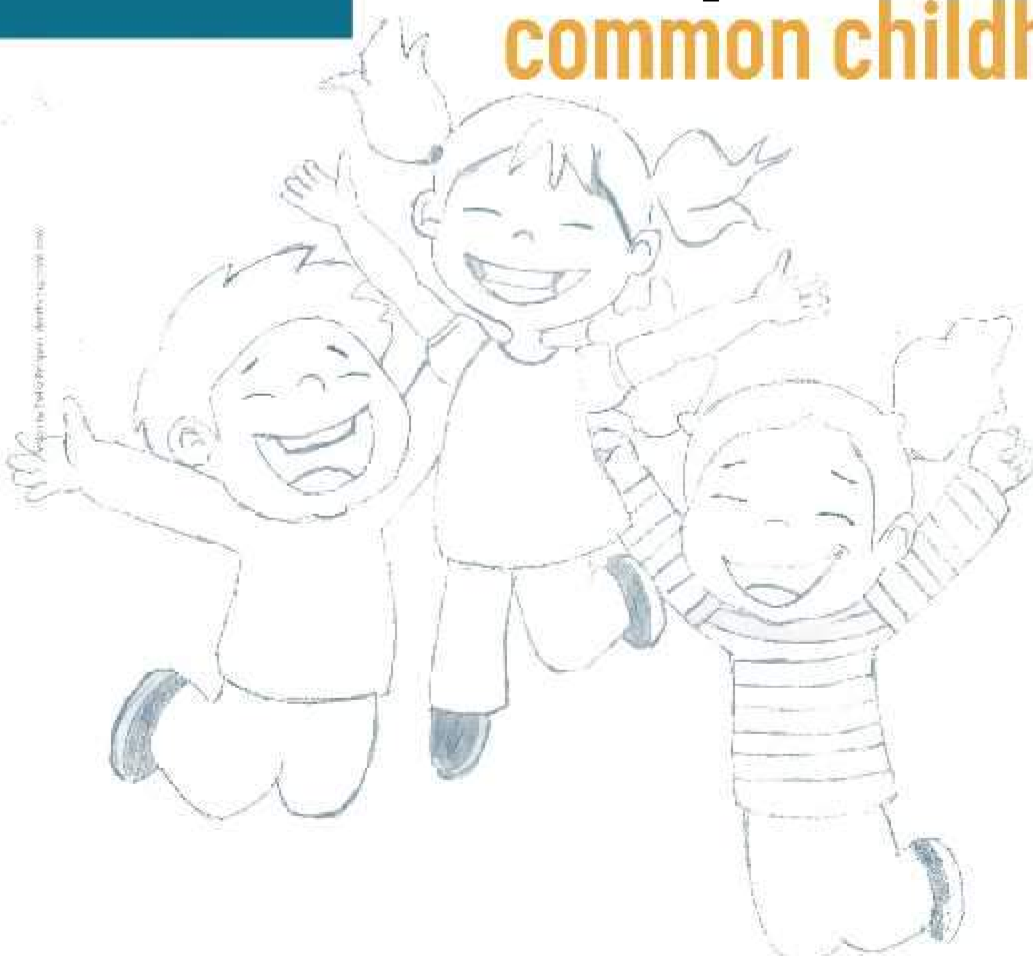
Karin Stenberg
Health Economist
World Health Organization

Ludovic Queuille
Avenir Health
Rachel Sanders
Panamerican Health Organization
Marcus Cadet
Ministry of Public Health and Population, Haiti

Claire Lebrun
Specialist in health and gender equality
COPRIN CChC

Benefit-Cost Analysis

Costs and benefits of child immunization and management of common childhood illnesses in Haiti



COPENHAGEN CONSENSUS CENTER

Haïti Priorise
Un plan de développement alternatif

Costs and benefits of child immunization and management of common childhood illnesses in Haiti

Haïti Priorise

Karin Stenberg, *World Health Organization, Geneva, Switzerland*

Ludovic Queuille, *Panamerican Health Organization, Port-au-Prince, Haiti*

Rachel Sanders, *Avenir Health, Washington DC, USA*

Marcus Cadet, *Ministry of Public Health and Population, Port-au-Prince, Haiti*

Working paper as of October 6, 2017.

info@copenhagenconsensus.com
www.copenhagenconsensus.com

This work has been produced as a part of the Haiti Priorise project.

This project is undertaken with the financial support of the Government of Canada. The opinions and interpretations in this publication are those of the author and do not necessarily reflect those of the Government of Canada.

Academic Abstract

Haiti is the poorest country in the American region, with the highest rate of child mortality. In 2013 the under five mortality rate (deaths per 1000 live births) was estimated at 69, compared to a regional average of 18. These deaths (the equivalent of 49 child deaths per day) are to a large extent preventable.

This analysis estimates costs and benefits of expanding coverage of child immunization and management of common childhood illnesses in Haiti; the implementation of which will result in prevention of child deaths. We present research conducted as part of the Haiti Priorise project, under the leadership of the Copenhagen Consensus Center.

Within this paper we focus on deaths occurring after the newborn period. The main causes of death among children aged 1-59 months are estimated to be acute lower respiratory infections (ALRI) accounting for 32% of mortality, and diarrhoeal diseases accounting for 16%. Every year over 8,500 children are estimated to die from these two causes.

Our analysis considers firstly the role of immunization in preventing the conditions that result in illness and death among children, and secondly management of common causes of illness that result in death (diarrhea, pneumonia). We model the impact of providing essential services through a primary health care approach.

We estimate costs and health impact of hypothetical scenarios where coverage would be increased from current levels to reach 80% or 95% in 2018 and with such coverage maintained until 2036. We project reductions in child mortality that would follow from providing packages of preventive interventions (immunizations), curative care, and a combination of both. Deaths averted are translated into economic benefits and compared against the projected costs, in order to derive cost benefit ratios. Each healthy life year gained is valued at 3 times GDP per capita, in line with the standard methodology of the Copenhagen Consensus research.

The highest benefit-cost ratios are obtained for routine immunization. When benefits and costs are discounted at 5%, the benefit-cost ratio is estimated to be around 10. Expanding coverage to include pneumococcal vaccine brings the BCR down to between 3 and 5.

Expanding management of diarrhea and pneumonia, primarily through community-based care, has a BCR of between 6 and 7. Finally, combining an extensive immunization programme with the costs and impact of managing diarrhea and pneumonia results in estimated BCRs of around 4.5 – which is still a high return to investment.

Our analysis indicates that the implementation of a comprehensive package of both preventive and curative care would avert over 71,000 child deaths over the implementation period (2018-2036), if made universally available (95% coverage), and bring the under-five mortality ratio down from current 69 to reach 51 deaths per 1000 live births (a reduction by 62%). This is very close to the target U5MR of 50 in the national child health strategy. The greatest absolute gains in terms of deaths averted and reduction in mortality rates is estimated to derive from management of common childhood illness. This is partially due to the lower starting coverage of these interventions.

The projected additional cost per year 2018-2036 varies between 8 and 100 USD million depending on the scope of the package and the target coverage. The average annual per capita cost varies from USD 0.72 for expanding routine immunization to USD 8.26 for the expanded immunization plus management of childhood illness.

Policy Abstract

Overview

Haiti is the poorest country in the American region, with the highest rate of child mortality. In 2013 the under five mortality rate (deaths per 1000 live births) was estimated at 69, compared to a regional average of 18. These deaths (the equivalent of 49 child deaths per day) are to a large extent preventable.

This analysis estimates costs and benefits of expanding coverage of child immunization and management of common childhood illnesses in Haiti; the implementation of which will result in prevention of child deaths. We present research conducted as part of the Haiti Priorise project, under the leadership of the Copenhagen Consensus Center.

Rationale for Intervention

Within this paper we focus on deaths occurring after the newborn period. The main causes of death among children aged 1-59 months are estimated to be acute lower respiratory infections (ALRI) accounting for 32% of mortality, and diarrhoeal diseases accounting for 16%. Every year over 8,500 children are estimated to die from these two causes.

Our analysis considers firstly the role of immunization in preventing the conditions that result in illness and death among children, and secondly management of common causes of illness that result in death (diarrhea, pneumonia). We model the impact of providing essential services through a primary health care approach.

Results

We estimate costs and health impact of hypothetical scenarios where coverage would be increased from current levels to reach 80% or 95% in 2018 and with such coverage maintained until 2036. We project reductions in child mortality that would follow from providing packages of preventive interventions (immunizations), curative care, and a combination of both. Deaths averted are translated into economic benefits and compared against the projected costs, in order to derive cost benefit ratios. Each healthy life year gained is valued at 3 times GDP per capita, in line with the standard methodology of the Copenhagen Consensus research.

The highest benefit-cost ratios are obtained for routine immunization. When benefits and costs are discounted at 5%, the benefit-cost ratio is estimated to be around 10. Expanding coverage to include pneumococcal vaccine brings the BCR down to between 3 and 5, depending on the price assumption for the vaccine.

Expanding management of diarrhea and pneumonia, primarily through community-based care, has a BCR of between 6 and 7. Finally, combining an extensive immunization programme with the costs and impact of managing diarrhea and pneumonia results in estimated BCRs of around 4.5 – which is still a high return to investment.

Summary table. Benefits, Costs, and Benefit-Cost Ratios relative to expanding coverage beyond current coverage (incremental scenario), at a 5% discount rate

Package	Target coverage	Benefits NPV	Costs NPV	BCR
Package 1. Routine EPI 2015	80%	25,926,653,976	2,763,165,721	9.4
	95%	47,332,806,077	4,545,114,386	10.4
Package 2. Routine EPI 2015 + PCV-13 (scenario A)*	80%	51,661,271,214	15,969,157,708	3.2
	95%	74,218,176,210	20,231,337,413	3.7
Package 2. Routine EPI 2015 + PCV-13 (scenario B)**	80%	51,661,271,214	11,883,481,359	4.3
	95%	74,218,176,210	15,179,075,425	4.9
Package 3. Management of common childhood illness	80%	95,314,961,732	15,174,626,919	6.3
	95%	128,976,584,623	18,865,558,436	6.8
Package 4 Combination Routine EPI + PCV13 + management of common childhood illness	80%	130,218,915,748	30,638,986,601	4.3
	95%	171,613,815,321	38,401,077,784	4.5

Benefits are valued at 3x GDP. Costs and benefits are presented in Net Present Value terms for 2018-2036; discounted at 5%. The overall quality of evidence is rated as high. * Price for PCV-13 estimated at USD 17 per dose. ** Price for PCV-13 estimated at USD 3.3 per dose.

Our analysis indicates that the implementation of a comprehensive package of both preventive and curative care would avert over 71,000 child deaths per year if made universally available (95% coverage), and bring the under-five mortality ratio down from current 69 to reach 51 deaths per 1000 live births (a reduction by 62%). This is very close to the target U5MR of 50 in the national child health strategy. The greatest absolute gains in terms of deaths averted and reduction in mortality rates is estimated to derive from management of common childhood illness. This is partially due to the lower starting coverage of these interventions.

Implementation challenges

The interventions discussed within this paper are delivered through population-and community based approaches as well as primary level care. For this type of intervention, health system capacity constraints can more easily be overcome than for example skilled care at birth which is much more reliant on specialized skills. Immunization provides an example of health services for which, even in the short term, money can overcome poor system capacity. Adding new vaccines to the immunization schedule is costly – as we have seen the newly introduced antigens place a considerable burden on the immunization programme – but such a package remains cost-effective and with BCRs around 4 (at 5% discount rate).

Similarly, allowing community-based care to play a large role in the provision of integrated management of childhood illness (IMCI) is a key strategy in a country like Haiti where current health workforce numbers are far below recommended minimum benchmarks. Our model still assumes a significant share of service delivery would happen at primary level facilities, so accessibility to health facilities needs to improve in order to expand coverage.

The projected additional cost per year 2018-2036 varies between 8 and 100 USD million depending on the scope of the package and the target coverage. The average annual per capita cost varies from USD 0.72 for expanding routine immunization to USD 8.26 for the expanded immunization plus management of childhood illness. Haiti benefits from support from GAVI for immunization activities, but these do not cover the full resources required. Moreover, issues around long term sustainability need to be considered.

Acknowledgement

The authors would like to thank Dr Dr P. C. Faye (PAHO Haiti, Immunization Advisor) and Dr J. Pedroza (PAHO Haiti Health System & Services Advisor) for their contributions.

Acronyms

ALRI: Acute lower respiratory infections

BCR: Benefit-cost ratio

BCG: Bacille Calmette Guerin vaccine

CBA: Cost-benefit analysis

CBR: Cost-benefit ratio

DTP3: third dose of diphtheria and tetanus toxoid and pertussis vaccine

EPI: Expanded Programme on Immunization

GCEA: General Cost Effectiveness Analysis

GDP: Gross Domestic Product

EMMUS: Enquête Mortalité, Morbidité et Utilisation des Services

HLY: Healthy Life Year

HTG: Haitian Gourde

IMCI: Integrated Management of Childhood illness

IMR: Infant Mortality Rate

LiST: Lives Saved Tool for child and maternal health

MCV1: Measles vaccine dose 1

ORS: Oral Rehydration Solution

POL3: third dose of polio vaccine

U5MR: under-five mortality rate (deaths occurring between age 0 and 4, per 1,000 live births)

MSPP: Ministère de la santé publique et de la population

NMR : Neonatal Mortality Rate

NPV: Net Present Value

PCV13: Pneumococcal conjugate vaccine

PNS: Politique Nationale de Santé

SDG: Sustainable development goal

THE: Total Health Expenditure

USD: US dollar

WUENIC: WHO/UNICEF Estimates of National Immunization Coverage

Contents

1. Introduction

This paper is structured as follows: the Introduction section of the report describes the current situation of child health in Haiti. The Theory section explains how the cost-benefit analysis was conducted, including data sources and assumptions for information on costs and health benefits, and how health benefits were valued in economic terms. Outcomes are presented and discussed in the Results section. Finally, a Conclusion section summarises the main findings.

1.1 Development policy in the Haitian context

Haiti is the poorest country in the American region and is also considered a “fragile state” because of the low performance on human development indicators, low scores on governance due to chronic political instability and weak institutions. Moreover, the country has a high risk for emergencies caused by various natural disasters. Environmental, economic and political crises occur frequently.

Economic growth is limited. The country suffers from high currency depreciation, high inflation (14% in 2016) and a high trade deficit (Haiti imports three times more than it exports). Almost a quarter of GDP comes from the Diaspora (US $ 2.1 billion in 2015, source: World Bank). With 50% of the population below 23 years of age, the population is growing faster than the economy. Thus, gross domestic product (GDP) per capita is now lower than that of 20 years ago, and around two-thirds of the current population (11 million) are estimated to live in poverty. The drought in 2015 and Cyclone Matthew in 2016 have seriously affected the country[1] especially the agricultural sector, which accounts for one-fifth of GDP mainly for the poor. Inequalities are high and increasing with a Gini coefficient of 0.66 in 2012 vs. 0.61 in 2010 (UNDP, 2014).

Despite these challenges, overall population health has improved in recent years. Overall life expectancy has increased from 54 years in 1990 to reach 63 years in 2013 (WHO 2016a). However overall mortality levels and morbidity from both communicable and infectious diseases remain higher than other countries in the Latin America and Caribbean region, and Haiti's health indicators are more comparable to low-income countries in other regions (Table 1).

[1] The damage caused by cyclone Matthew has been estimated at 32% of GDP [Gouvernement de la République d’Haïti/Système des nations Unies/Banque interaméricaine de développement/Banque Mondiale (2017). Evaluation des besoins post catastrophe pour le cyclone Matthew - Haïti. Port-au-Prince, Haïti p.100].

Table 1. Comparative statistics for Haiti vs other countries in the region

	GDP per capita, PPP current international $ - 2015*	Health expenditure per capita (current US$),2014**	Life expectancy at birth, total (years) in 2015 ***	Maternal mortality ratio *** (modelled estimate, per 100;000 live births), 2015	Infant Mortality Rate*** (per 1,000 live births)	Under five mortality rate, (per 1,000 live births) – 2015***
Haiti	1,757	61	63	359	52	69
Bolivia (Plurinational State of)	6,954	209	69	206	31	38
Honduras	5,095	212	73	129	17	20
Guatemala	7,722	233	72	88	24	29
Dominican Republic	14,237	269	74	92	26	31
Latin American and Carribean region	15,455	714	75	67	15	18

* GDP per capita, PPP (current international $) – 2015; http://data.worldbank.org/indicator/NY.GDP.MKTP.PP.CD. **Per Capita THE at average exchange rate (US$), 2014 (http://apps.who.int/gho/data/view.main.HEALTHEXPCAPHTI?lang=en) *** source: UN estimates

There is a stark disparity between the GDP and THE per capita in Haiti compared to other countries in the region, as well as overall health outcomes (Table 1). Overall levels and morbidity from both communicable and infectious diseases remains high, as do nutritional deficiencies. Early 2016, one third of the Haitian population (3.6 million) was estimated to suffer from hunger, of which 1.5 million (14%) in a situation of severe food insecurity.[2] The sanitation situation poses serious environmental and public health problems – with uncontrolled urbanization and subsequent lack of water and sanitation, which facilitates the transmission of disease.

Current total health expenditure per capita is US$ 61.5 (in 2014 at average exchange rate). The share of public expenditure on health is limited - estimated as less than 10% of total health expenditure. For the current fiscal year (2016/2017), the health sector share of the government budget, which has been continuously decreasing for 20 years, represented less than 5% of the national budget despite a 15% target set in the national health policy (2012). The main sources of funding for health are private health expenditure, with direct out of pocket payments on the rise and generally accounting for more than 50%

[2] These estimates were prior to Hurricane Matthew, which worsened the situation on the southern peninsula of the country.

of health expenditure; as well as external funding from donors – which tends to focus on short term results and is not aligned with national priorities. External funding is volatile with large fluctuations over time in response to various health crises (the peak being the post-earthquake 2010 period), resulting in limited sustainability of funding to strengthen the foundations of the health system. Moreover, the majority of external funds bypass the government, thereby limiting the strengthening of public institutions. This contributes to the existence of vertical programs and the multiplicity of projects which poses challenges for the Ministry of Health (MSPP) to lead overall health sector governance processes. The supply of health services is limited and fragmented, with inequities in accessibility to, and use of, services.

With the post-2015 Sustainable Development Goals (SDGs), countries are taking on a broad development agenda, where the Health Goal (SDG3) plays a key role for sustainable development. SDG3 includes a target specifically addressing child health, namely to end preventable deaths of newborns and children under 5 years of age, by 2030 with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-5 mortality to at least as low as 25 per 1000 live births.

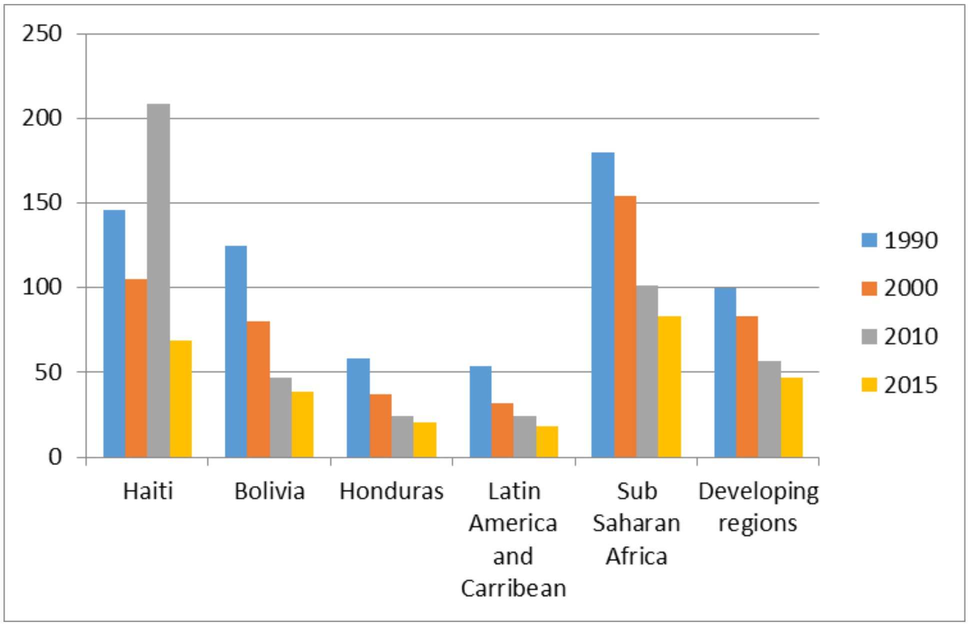
Given the limited resources available in low-income countries such as Haiti, decisions need to be made carefully with regards to how to best invest available funding. This document presents the results of a Cost-Benefit analysis (CBA) for providing child immunization and management of common childhood illness in Haiti. Benefit-Cost ratios (BCR) indicate the value of benefits obtained for every dollar (or Haitian Gourde) invested; and are one type of evidence that can be used to inform policy discussions around priority setting. It should however not be the only one, since other criteria such as equity, feasibility, financial sustainability and acceptability will also carry important weight to inform decisions around resource allocation.

1.2 Child health in Haiti

As shown in Figure 1, the under-five mortality rate in Haiti was reduced by more than half between 1990 and 2015. However, at 69 deaths per 1,000 live births, it remains far above the regional average. Bolivia and Honduras, among other poor countries in the region (table 1), have succeded in much lower U5MRs. Haiti also saw a sharp increase in the U5MR in 2010 following the catastrophic 2010 earthquake. Applying the latest estimated U5MR (2015) to the projected number of children living in 2017, results in an estimated 17,760 child deaths occurring in 2017 – or 49 deaths per day.

Out of total deaths happening among children under five, 36% (one in three) are assumed to occur in the first month, with an estimated newborn mortality rate of 25.4.[3] 75% (three out of four) child deaths are assumed to occur in the first year, thus an estimated IMR of 52.2 in 2015. The remaining 25% of deaths occur in years 1-4 of life. Expressed in another way, 52 out of 1000 children do not survive to their first birthday, and 69 out of 1000 children do not reach 5 years. These deaths are to a large extent preventable through expanding access to quality affordable health care.

Fig 1. Changes in under five mortality rates over time, selected regions and countries



Source: The UN Inter-agency Group for Child Mortality Estimation released the latest estimates on child mortality (http://www.childmortality.org/), September 2015 estimates.

The main causes of death among newborns are dealt with by interventions delivered around birth, and a separate analysis has been conducted to analyse those interventions.[4] In this paper we focus on deaths occuring after the age of 1 month. The main causes of death among children aged 1-59 months are estimated to be acute lower respiratory infections (ALRI) accounting for 32% of mortality, and diarrhoeal diseases accounting for 16% (Table 2).

[3] Because of the poor civil registration system for births and deaths in Haiti, we use the UN estimates for child mortality in our analysis.

[4] The analysis in our companion paper for Haiti Priorise on the costs and benefits of providing skilled care before and during birth in Haiti includes interventions delivered to improve newborn survival.

Table 2. Causes of child mortality, by age group

Cause of death	0-27 days	1-59 months	0-4 years
HIV/AIDS	0	1.1	0.7
Diarrhoeal diseases	1	15.9	10.4
Pertussis	0.2	2.6	1.7
Tetanus	0.8	0	0.3
Measles	0	0	0
Meningitis/encephalitis	0	5.6	3.5
Malaria	0	0.4	0.2
Acute lower respiratory infections	6.5	31.8	22.5
Prematurity	30.7	3	13.2
Birth asphyxia and birth trauma	25.7	2.8	11.2
Sepsis and other infectious conditions of the newborn	18.6	0	6.8
Other communicable, perinatal and nutritional conditions	6.8	14.4	11.6
Congenital anomalies	8	6.4	7
Other noncommunicable diseases	0.3	4.8	3.2
Injuries	1.3	11.2	7.6

Source: Global Health Observatory, http://apps.who.int/gho/data/view.main.ghe3002015-HTI?lang=en . Estimates for 2015.

Lower respiratory infections – or pneumonia - is the second most common cause of premature death among the overall population, and diarrheal disease the fourth most common cause (IHME, 2016). When considering death and disability combined, these two conditions are the second and third largest causes of loss of healthy life (IHME, 2016).

Overall mortality rates are higher in rural areas where access to services is more limited. In addition, there are inequities in survival between rich and poor, as well as by place of residence. Table 3 presents estimated mortality rates from the latest EMMUS survey for the highest and lowest income quintile. The risk of death is significantly higher for the lowest income quintile, with an overall difference of 1.7 for all deaths 0-4 years, and a particularly marked difference among children aged 1-4 years, by a factor of almost 4 :1.

Table 3. Mortality rates for children under five years of age by top and bottom quintile (2012)

Income quintile	Neonatal mortality rate (0-28 days)	Post-neonatal infant mortality rate (29 days-11 months)	Infant mortality rate (0-11 months)	Children aged (12-60 months)	Under-five mortality rate (0-4 years)
Lowest quintile	32	30	61	44	104
Highest quintile	27	24	51	12	62

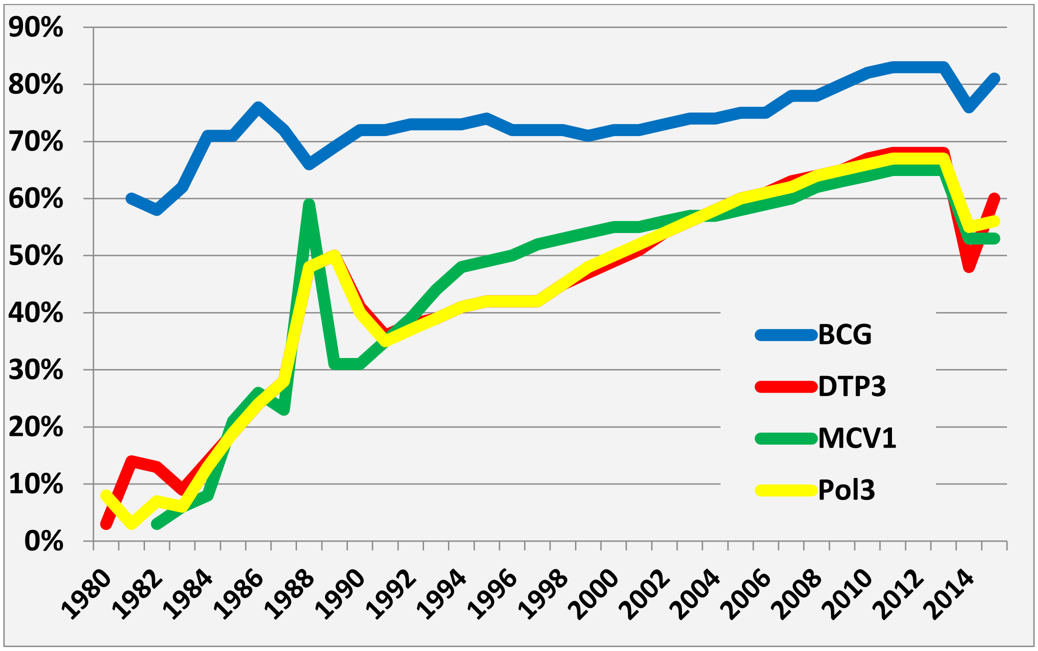
Source : EMMUS V

Immunization

Childhood immunization is one of the most effective investments in public health. Vaccines are cost-effective, provide lifelong protection and result in reduced mortality and morbidity (http://www.gavi.org/about/value/ and/or http://www.gavi.org/a-propos/le-bien-fonde-de-la-vaccination/).

Different sources of data exist for analyzing levels and trends in vaccine coverage. We use the WHO / UNICEF reference estimates (WUENIC) as estimated by Burton A. & al. (2009). An analysis of changes in vaccine coverage of BCG, DTP3, MCV1 and POL3 of Haiti since 1980 shows a fairly steady upward trend similar to that of other countries in the region [Queuille L. & V. Ridde (2016)]. However, there was a recent significant drop in coverage in 2014 (Figure 2). EPI officials attribute this drop in vaccine coverage to shortages in vaccine materials (vaccines, syringes, etc.) at different levels of the supply chain, explained in part by funding delays. [Queuille L. & V. Ridde (2016b). p.114.].

Fig 2. Change in immunization coverage 1980-2015



Source: WUENIC, 2017.

With limited vaccination coverage, the number of unvaccinated children reached 120,520 in 2014. (Direction du programme élargi de vaccination (PEV)/MSPP (2016). p. 25). These children remain exposed to epidemics of vaccine-preventable diseases.

The analysis of changes in vaccine coverage has shown that disparities by sex, urban/ rural, and socio-economic status have decreased but differences remain for the level of maternal education, and geographic province (EMMUS II, EMMUS III, EMMUS IV, EMMUS V)

Management of childhood illness

Integrated Management of Childhood Illness (IMCI) is an effective, low-cost strategy that aims to improve the health status of children at both the institutional and community levels. IMCI was adopted by the Ministry of Public Health and Population in 1995 as a key strategy for improving child health in Haiti. It includes management of diarrhea and pneumonia as key strategies for improving child health.

In Haiti, three critical programmatic elements were identified for IMCI implementation: 1) improved partnership between health facilities and communities 2) adequate and accessible care combined with community information 3) promotion of key family practices for child health and nutrition.[5] However a 2004 review noted that implementation has been challenging [Arrive E, Perez P, Pierre LMW (2004)].

The MSPP has developed a National Strategic Plan for integrated Child Health 2014-2019 [MSPP (2013). P.50]. It aims to contribute to strengthening the health system by ensuring access to basic health services without financial, geographical or social barriers to meet the needs of children and improve their health situation in Haiti. Some of the targets include:

- 100% of health facilities providing IMCI
- At least 80% of community health workers trained in community IMCI
- At least 80% of health facilities providing care free of charge to children below age 5
- Reduce under-five mortality ratio to 50 deaths per 1,000 live births.

1.3 Policy and Health System

The national health policy (PNS) was defined in 2012 for a forward looking period of twenty-five years 2012-2037 [MSPP de la République d'Haïti (2012a).]. It aims to reduce the morbidity and mortality associated with the main health problems identified, based on an adequate, efficient, accessible and universal health care system. It is operationalized by the 2012-2022 Health Plan (PDS) [MSPP de la République d'Haïti (2012b)]. Within the PDS, child health is covered under the component of strengthening health service delivery. It includes five areas related to reducing child mortality : i) neonatal health; ii) children affected with HIV ; iii) integrated management of childhood illness (IMCI) including vaccination ; iv) nutrition; and v) school health.

The Expanded Program on Immunization (EPI), developed since 1983, is led by the EPI Department of the Ministry of Public Health and Population (MSPP). It is managed by the Inter-Agency Coordination Committee (ICC) chaired by The Minister of Health.

The EPI follows a 5-year planning cycle. The 2016-2020 comprehensive multi-annual vaccination plan (cMYP) targets newborns, children under one year of age, children between one and four years of age and pregnant women, with the objective to achieve national level effective coverage for all EPI vaccines to children aged less than one year to reach at least 95% by 2020.

[5] Peter J Winch, Karen Leban, Larry Casazza, Lynette Walker and Karla Pearcy (2002). An implementation framework for household and community integrated management of childhood illness. HPP.

It also sets targets for the introduction of new vaccines. Strategic areas of intervention include service delivery; governance and programme management, epidemiological surveillance and information system, and communication and demand generation.

The vaccination schedule determined the costs of immunization activities, and is included as Annex 1. The cost of newly introduced vaccines such as antirotavirus and pneumococcal vaccine is much higher than traditional vaccines. The estimated costs for traditional vaccines are estimated at US$ 558 thousand in 2020 vs an estimated US$ 6.2 million required to deliver the newly introduced vaccines. [Queuille L. (2017). p.4].

According to the latest published national health accounts (2012/2013), one fifth of current health expenditure by function was devoted to preventive care (19%); and 3% of current health expenditure by area was spent on immunization (MSPP of the Republic of Haiti (2015b)).

In 2013, only half of health facilities (52%) provided the basic service package.[6] [Institut Haïtien de l'Enfance (IHE) et ICF International. 2014.] Access to health services is heavily constrained by financial and geographic barriers. Cost is the main reason for not consulting. Seven out of 10 women do not seek medical help for lack of money, while 43% do not seek medical help because of lack of transportation. Thus, for these and other reasons, traditional medicine constitutes the first resort to care for a majority of the population [EMMUS V]

2. Theory

2.1 Objective

The objective of this study is to estimate the cost, benefits, and the relative return on investment from prevention and management of common childhood illnesses in Haiti.[7] The theory underpinning this analysis is that the rate of return to investments differs across different health sector interventions. However, evidence on the value for money of making one investment versus another may not be readily available and thus current investment plans may not follow the most optimal pattern. By making information on the benefit-cost ratio available, decisions around priority setting can be better informed, and decision makers can be informed about the trade-offs of making one investment choice versus another.

[6] Moreover, individul facilities do not systematically offer all services on a daily basis.

[7] The analysis presented here shares a common methodology with two other analyses conducted for the Haiti Priorise project: for providing skilled care before and during birth, and interventions to reduce the transmission and disease burden of HIV / AIDS.

2.2 Overall approach and scope of analysis

The overall approach taken is to project health impact and costs associated with scaling up child health interventions, specifically (i) immunization services; and (ii) management of respiratory infections and diarrheal disease. The projected health outcomes are translated into economic benefits and compared against the projected costs, in order to derive cost benefit ratios.

The analysis is primarily focused around distributional concerns in terms of making additional resources available in order to provide services to those that currently do not have access, thereby improving their welfare.[8]

2.2.1 Interventions included

We model an expansion of four packages, as follows:

Package 1 (P1) Routine EPI. This package includes vaccines that were delivered in Haiti as part of the Expanded Programme on Immunization (EPI) in 2015, addressing measles, diphteria, pertussis, tetanus, polio, diarrhea and tuberculosis.[9] This includes the following vaccines:

- BCG single dose
- Polio three doses
- Pentavalent / DPT + Hib
- Measles single dose
- Rotavirus vaccine

If we consider the two major causes of burden diarrhea and pneumonia: the rotavirus vaccine addresses diarrheal disease while the Hib vaccine is effective in reducing pneumonia deaths.

Package 2 Routine EPI + additional vaccines

Package 2 includes the same vaccines as in P1, with the addition of the pneumococcal conjugate vaccine (called PCV13) which protects against 13 types of pneumococcal bacteria. The pneumococcal vaccine effectively protects against pneumonia (Lucero MG, Dulalia VE, Nillos LT, et al. 2009),

---

[8] Within this paper we do not consider a reallocation or repurposing of current resources and thus improving efficiency of current investments, which would be a different type of analysis.

[9] The current EPI package also includes IPV (inactivated polio vaccine) and Measles Rubella: however those vaccines were not included in our analysis.

Package 3 Management of childhood illness

As seen above, pneumonia and diarrhea are important causes of premature child mortality. We therefore consider a package of interventions to address such childhood illness through primary level health care, namely through the provision of:

- Oral antibiotics for pneumonia
- Management of diarrhea with Oral Rehydration Solution (ORS) and zinc
- Antibiotics for treatment of dysentery

Case management of pneumonia and ORS have been found to be highly cost-effective (Edejer et al, 2005).

Package 4 Combination child health

The fourth package is a combination of preventive and curative care. Table 4 summarizes the packages considered.

Table 4. Packages considered in analysis

Package	Interventions
Package 1. Routine EPI 2015	Vaccines: BCG, Polio, Measles single dose, DTC/Penta, Rotavirus
Package 2. Routine EPI 2015 + PCV-13	Vaccines: BCG, Polio, Measles single dose, DTC/Penta, Rotavirus + PCV13.
Package 3. Management of common childhood illness	Oral Rehydration Solution + zinc Oral antibiotics for pneumonia Antibiotics for treatment of dysentery
Package 4 Combination Routine EPI + PCV13 + management of common childhood illness	Vaccines: BCG, Polio, Measles single dose, DTC/Penta, Rotavirus + PCV13. Oral Rehydration Solution + zinc Oral antibiotics for pneumonia Antibiotics for treatment of dysentery

2.2.2 Analytical framework and Perspective

Table 5 illustrates the cost and benefit accounting framework used for this analysis. Additional detail on each component covered is provided in the sections below.

Table 5. Cost and benefit accounting framework used in analysis

Costs		Estimation of costs in the analysis
Non-market valued	• Patient health care seeking cost (transport, time lost in productive activity due to care-seeking) • Volunteer labour	Not included
Market-valued health sector costs	Direct costs related to intervention delivery: • Commodities: e.g., the drugs, vaccines, supplies and lab tests needed for each service. • Supply chain costs and commodity waste • Service delivery costs (inpatient bed days, outpatient visits) – which include operational costs and health worker time. • Programme costs (administrative costs for running the programme and ensuring quality of care).	Costs are estimated using an inputs based approach (Quantities and Prices)
Benefits		Estimation of benefits in the analysis
Non-market valued benefits	Intrinsic health benefits: • Increased longevity • Increased wellbeing and quality of life • Increased social participation	Instrumental and intrinsic benefits are captured in a combined measure for the value of statistical life, estimated at 3x GDP per capita per DALY
Market-valued benefits	Instrumental health benefits: • Increased employment (reduced absence due to illness and death) • Increased productivity (increased quality of human capital due to greater wellbeing) • Fewer days of work lost by family members caring for those who are ill	
	Savings: • Reduced expenditure on medical care (effect of preventive interventions)	Not included

The perspective taken for estimation of costs is to only include the direct costs incurred by the health system. We therefore do not include any indirect cost incurred by the households or individuals seeking care, e.g., for transport, lost income, etc. [10]

2.2.3 Time horizon

The analysis is conducted for a time horizon of 20 years, from 2017 to 2036. Costs and benefits are effectively captured for 19 years i.e., from year 2018 onwards, with year 2017 as the comparator (baseline).

[10] An analysis of previous research undertaken for the Copenhagen Consensus processes in Bangladesh and Haiti demonstrated a wide variation in the extent to which household costs were incorporated.

2.2.4 Scenarios

Incremental scale-up scenarios

The analysis considers an increase in coverage, and estimates costs and benefits associated with the additional number of services provided. The counterfactual for the incremental analysis is the current level of coverage and the current epidemiology of the country. The costs and health benefits are compared to the current status quo.

Coverage levels

We analyse costs and benefits resulting from providing all interventions and packages at two target coverage levels: 80% and 95%. The reason for this is to assess how benefit-cost ratios may vary across different target levels.[11] In situations where the current coverage of an intervention is already above one of the target coverage levels, the output for that intervention is zero.

2.2.5 Tools

The analysis was carried out using a recently developed tool: *Spectrum – General Cost Effectiveness Analysis (GCEA).* This tool is developed by the World Health Organization in order to support the incorporation of cost-effectiveness analysis into the widely used Spectrum platform of tools for priority setting and decision making.[12] Spectrum consists of several software models that are widely used for health projection modelling, including the Lives Saved Tool (LiST) for child and maternal health. LiST is a model developed by the Institute for International Programs at Johns Hopkins Bloomberg School of Public Health, to support projections of health impact from scaling up health and nutrition interventions on maternal, newborn, and child health. The model been used for over 10 years and is regularly updated to incorporate the latest evidence from the scientific literature and household survey data (see Walker N et al (2013a), and Walker N et al (2013b)).

2.3 Calculation of costs and benefits

2.3.1 Projecting increases in people reached

Costs and benefits are driven by how many people will receive an intervention. We project changes in coverage levels, which are then converted into numbers of people reached with the different health

[11] Our presentation of results focuses on the 95% coverage scenario scine this approximates universal coverage.
[12] http://www.avenirhealth.org/software-spectrum.php

interventions. Each intervention is associated with specific assumptions around the effect on child mortality.

Most recent data available on current coverage is used to determine the number of people reached in the current year (2017). In the scale-up scenario, the target coverage is immediately reached in year 2 (2018), and then kept constant throughout the analytical time period. The example below in Table 6 illustrates (years beyond 2023 not shown since coverage remains constant). The analysis of packages takes the average current coverage of the interventions included within the package, to derive an estimated starting coverage for the package.

Table 6: Scaling up management of childhood illness to 80% target coverage*

Interventions included in Package 3	2017	2018	2019	2020	2021	2022	2023
ORS for diarrhea treatment	52.9	80	80	80	80	80	80
Zinc for diarrhea treatment	0.3	80	80	80	80	80	80
Antibiotics for treatment of dysentery	10.7	80	80	80	80	80	80
Treatment of pneumonia (ALRI)	39.0	80	80	80	80	80	80
Average coverage within package 3	25.7	80	80	80	80	80	80

*projections beyond 2023 not shown since they remain at constant level

We estimate costs as the difference between the costs incurred in the scale-up scenario, and the cost incurred in the counterfactual scenario. Similarly, health outcomes in the scale-up scenario are compared with those in the counterfactual scenario.

2.3.2 Determining the population in need and baseline coverage

The Spectrum DemProj module includes demographic projections from the UN population medium variant. [13] We used these standardised projections as they are deemed more reliable than the Population projections from the Haitian Institute of Statistics (Institut haïtien de statistique et d'informatique (IHSI)) given that the most recent census in Haiti was carried out in 2003, and the overall weakness of the IHSI projections are widely acknowledged.

Table 7 shows the assumptions used for the target population, population in need, and current (baseline) coverage of each intervention. The population in need reflects current incidence of illness, and therefore determines the share of the target population that requires the intervention.

[13] UN population projections. *https://esa.un.org/unpd/wpp/Download/Standard/Population/*

Example of coverage estimation:

In 2018 the estimated number of children under five is estimated to be 1,216,056. The average number of episodes of diarrhea per child per year is 3.2. There will therefore be an estimated total of 3,891,379 diarrhea episodes in children. Coverage with ORS is currently estimated to be 52.9%. This would mean that 2,058,539 child-episodes are treated with ORS. However if the intervention was scaled to 80% or 95% coverage, an additional 1,054,563 vs 1,638,270 episodes of illness would be managed with ORS.

Table 7. Target population, Population in need, and Current coverage

	Target population	Population in need (disease incidence) (%)	Current coverage (%)	Source for population in need and/or current coverage
Immunization				
Rotavirus vaccine	Infants surviving past one month	100	43	WUENIC
Measles vaccine		100	53	WUENIC
DPT vaccination		100	60	WUENIC
Hib vaccine		100	60	WUENIC
Polio vaccine		100	56	WUENIC
BCG vaccine		100	81	WUENIC
Pneumococcal vaccine		100	0	WUENIC
Management of childhood illness				
ORS for diarrhea	Children 0-4 years	320	52.9	WHO incidence estimates, EMMUS for coverage
Zinc for diarrhea treatment		320	0.3	WHO incidence estimates, EMMUS for coverage
Antibiotics for treatment of dysentery		16	10.7	It is assumed that around 5% of diarrhoea cases need to be treated with antibiotics due to presence of bloody diarrhoea or shigellosis.
Pneumonia treatment (children)		1.3	39.0	WHO incidence estimates, EMMUS for coverage

2.3.3 Determining at what level of the health system interventions are delivered

Table 8 outlines assumptions for delivery levels. Such assumptions are important because within our model service delivery costs differ depending on where services are delivered (see section 3.3.5).

Table 8. Assumptions on delivery level for child health interventions

Intervention	Community	Outreach	Clinic	Hospital

Immunization				
Rotavirus vaccine	70%		30%	
Measles vaccine	30%		70%	
DPT vaccination			80%	20%
Hib vaccine			80%	20%
Polio vaccine	0%	40%	50%	10%
BCG vaccine	0%	40%	50%	10%
Pneumococcal vaccine	0%	40%	50%	10%
Management of childhood illness	0%	40%	50%	10%
ORS	0%	40%	50%	10%
Zinc (diarrhea treatment)	0%	40%	50%	10%
Antibiotics for treatment of dysentery	0%	40%	50%	10%
Pneumonia treatment (children)	70%		30%	

A considerable share of services are expected to be delivered at the community level. One strategy to deliver disease-specific care in the face of the health care worker crisis that has been adopted in Haiti is the utilization of community health workers (CHW) to strengthen public health. So-called *agents de santé* provide basic support including growth monitoring, oral rehydration solution, breastfeeding support and immunizations. (Jerome J, Ivers L, 2010).

3.3.4 Estimating health impact

Health impact projections are derived from the Lives Saved Tool, or "LiST" (Winfrey W et al, 2011). The effectiveness data used in LiST have been documented in detail elsewhere (Walker N et al, 2013a). Effectiveness data are organized into impact matrices for each cause of death, and reflect the anticipated effect of an intervention's coverage increase on a given cause of death. Reductions in cause-specific mortality are estimated by applying intervention effectivenesses and affected fractions to intervention coverage changes. Within our analysis, impacts of interventions are calculated separately for seven causes of child mortality: diarrhea, sepsis, asphyxia, pneumonia, meningitis, pertussis, and "other". Some of these data are summarized below in Table 9. The effectiveness data refer to the percent of deaths due to a specific cause that are reduced by the intervention, and the affected fraction refers to the percent of deaths due to a specific cause which are potentially able to be impacted by a specific intervention (for more details on projected effectiveness see Walker N et al, 2013a).

The reductions in under-five and infant mortality in the scale-up scenarios are translated into total deaths and then to deaths averted compared to a constant coverage scenario, whilst linking to total population and total number of live births and population size in each age cohort, as calculated in the Demographic projection module of Spectrum (DemProj).

Table 9. Impact matrix showing effectiveness of interventions on xx causes of child mortality (source: LiST)

	Cause of death: diarrhea		**Cause of death: pneumonia**		**Cause of death: meningitis**		**Cause of death: pertussis**	
Intervention	Effectiveness	Affected Fraction	Effectiveness	Affected Fraction	Effectiveness	Affected Fraction	Effectiveness	Affected Fraction
Immunization								
Rotavirus vaccine	0.81	0.234						
Measles vaccine								
DPT vaccination							0.84	1.00
Hib vaccine			0.93	0.2126	0.93	0.46		
Polio vaccine								
BCG vaccine								
Pneumococcal vaccine			0.58	0.328	0.58	0.52		
Management of childhood illness								
ORS	0.93	0.90						
Zinc (diarrhea treatment)	0.23	1.00						
Antibiotics for treatment of dysentery	0.82	0.10						
Pneumonia treatment (children)			0.70	1.00				

Additional impact estimates within our model not shown in this table includes: the effect of measles vaccine on measles; and the effect of pneumococcal vaccine on other causes of death.

Spectrum-GCEA converts health outcomes - such as child deaths averted - into healthy life years (HLYs). Deaths averted are calculated as the difference between the projected number of deaths occurring in the current coverage scenario and in the scaleup scenarios. Deaths averted are then converted to healthy life years gained based on the estimated age at time of death, average life expectancy for that age bracket, and the health state valuation, or disability weight for that age group.[14] In this current analysis we only consider impact on life expectancy; and estimates exclude morbidity because of lack of data on disability. Each death averted is added to the demographic (population) projection which has a "background disability weight" as individuals are exposed to future health risks.

3.3.5 Estimating costs

We estimate four types of costs associated with each package:

- Commodities: e.g., the drugs, vaccines, supplies and lab tests needed for each service.
- Supply chain costs and commodity waste: these costs are included as a percentage (%) mark-up on the commodity cost.
- Service delivery costs (inpatient bed days, outpatient visits) – which include operational costs and health worker time.
- Programme costs: these include administrative costs for running the programme, as well as training and supervision.

It should be noted that a constant cost per input is used for commodities and service delivery costs – meaning that we have not made any assumptions on for example increasing outpatient visit cost as coverage expands.[15]

Commodities

Assumptions for the number of drugs and supplies required per service are provided through the OneHealth Tool cost assumptions, which are fully integrated into the Spectrum-GCEA. These contain default regimens that are based on standard WHO protocols and expert opinion. The intervention regimens include: 1) required drugs and supplies, and 2) number/length of outpatient and inpatient visits. While default regimens are embedded in the Tool, each input can be modified to represent a given country's context. Table 10 indicates the average commodity cost and average number of health visits per

[14] Spectrum-GCEA includes a formula that calculates HLYs as a function of the Difference in deaths * average life expectancy * (1-health state valuation). This is repeated for each age bracket – e.g., 0-4 years, maternal deaths, and stillbirths. For the analysis presented here however, we applied the standard assumptions of the Copenhagen Consensus methodological approach in terms of valuing years of years of life lost (YLL).

[15] While it could be argued that costs per person reached would increase as coverage expands, information about the local cost expansion curve (cost function) is not available.

intervention. More details can be found through consulting the OneHealth Tool cost assumptions document.[16]

Table 10. Average commodity cost and average number of outpatient visits and inpatient days per intervention as used in the analysis

Intervention	Commodity cost (US$)	Number of outpatient visits*
Immunization		
Rotavirus vaccine	7.59	3
Measles vaccine	0.71	2
DPT vaccination	1.84	3
Hib vaccine	10.36	3
Polio vaccine	0.75	3
BCG vaccine	0.67	3
Pneumococcal vaccine	51.10 and 10.06. in two separate scenarios	3
Management of childhood illness		
ORS	0.72	1
Zinc (diarrhea treatment)	1.60	(included in ORS above)
Antibiotics for treatment of dysentery	0.36	2
Pneumonia treatment (children)	0.47	3

*Visits can be combined as per the immunization schedule in Annex 1. In our modelling we estimated unique visits for each immunization event, which would tend to overestimate costs and result in more conservative Benefit-Cost-ratios

One issue of particular importance when considering GAVI-funded vaccines is what price to use. For the pneumococcal vaccine we used a unit price of USD 17, which is close to the price for the PAHO Revolving Fund (USD 15.5 per dose). However, if the analysis is made using the UNICEF price (USD 3.30 par dose), then the costs are significantly lower. We therefore consider two price scenarios for the pneumococcal vaccine.

Markup rates for supply chain costs and commodity waste

An increase in the number of people reached with the interventions will also incur a cost in terms of transporting greater amounts of commodities through the health system. We apply a mark-up rate to the value of commodity costs in order to approximate resource requirements for expanding the supply chain. A recent review by Sarley et al. (2010) reports estimates undertaken by various USAID | DELIVER PROJECT

[16] OneHealth Tool Intervention Assumptions Document
http://avenirhealth.org/Download/Spectrum/Manuals/Treatment%20Assumptions%202016%201%2010.pdf

studies in different countries. Estimates range from 1 to 44% for different commodities and country settings. Sarley et al. classify 49 countries into groups, with Haiti belonging to a group for which the generic model indicates that the mark-up rate is 30%.[17] We therefore apply a 30% rate.

Moreover, with respect to medicines that are stored but not used before their expiry date, data is lacking but we applied an overall assumption of 5% waste to supplies and commodities. We applied higher rates of wastage for vaccines where data was available from the 2020 targets in the costed immunization strategy 2016-2020 (MSPP/OPS-OMS (2016).

Health Service Delivery costs

Health Service Delivery costs refer to shared costs such as health worker salaries, the running cost of the facility and equipment, and utilities such as water and electricity. As mentioned above, assumptions for the average number of outpatient visits required per service are based on standard WHO protocols and expert opinion. Our analysis of child health interventions considers only outpatient care, with interventions delivered through a primary health care model. We used the WHO-CHOICE modelled estimates for Haiti as the starting point (Table 11). In order to validate the WHO-CHOICE estimates we examined existing studies carried out in Haiti on service delivery costs. For more details see Annex 2. A comparison of WHO-CHOICE estimates with the locally derived estimates suggests that they fall within the same ball park.

We used an assumption that 50% of services will be delivered through public sector facilities and 50% through privately managed facilities, and used the average of the WHO-CHOICE cost estimates.[18]

---

[17] Sarley D, Allain L, Akkihal A. Estimating the global in-country supply chain costs of meeting the MDGs by 2015. Arlington, Va, USAID/DELIVER Project, 2009. Available at: http://pdf.usaid.gov/pdf_docs/PNADP080.pdf. See Table 5.

[18] Current health system data indicates that 47% of health facilities are private, 37% are public, and 16% ae mixed [Source : MSPP (2015). Liste des institutions sanitaires du pays. Port-au-Prince, Haïti. p.105].

Table 11. Estimated cost per outpatient visit used in the study (US$ 2014)

Generic name of delivery level	Community	Outreach	First level clinic/ Health Centre	Hospital
Cost per outpatient visit (US$)/ public sector assumption	1.39	1.39	1.72	1.95
Cost per outpatient visit (US$$)/ private sector assumption	1.96	1.96	2.43	2.75
Cost per outpatient visit (US$): average public/private	1.67	1.67	2.07	2.35

Notes to Table 11. Costs for outreach are derived from the category "health centre without beds". Costs for first level clinic/health centre are derived from the category ""health centre with beds". Costs for Hospital based outpatient care are derived from the category of primary level hospital.

Programme costs

Programme costs refer to costs that are incurred at an administrative level that is outside the point of delivery, and reflect a set of activities that are aimed at improving the quality of delivery or encouraging the uptake of services. These include activities such as training, supervision, and general programme management. The WHO-CHOICE project provides a set of default assumptions around the resources needed for an efficiently run programme implementing 10 interventions at full coverage. Using the WHO-CHOICE assumptions and price estimates for Haiti results in an average annual programme cost of USD (2014) 5.37 million (Table 12).

Table 12. Annual estimated programme cost to run an efficient programme implementing 10 interventions at full coverage (USD 2014)

Category	Estimated annual cost, thousands (USD 2014)	Scaled to number of interventions (scope)	Scaled to coverage target	Rationale for scale
Human Resources for planning and administration	1,455	Yes	No	This category refers to overall management of the programme; production of norms and standards etc thus is not linked to coverage
In-service training	489	No	Yes	Training costs increase with coverage
Supervision	2,035	No	Yes	Supervision costs increase with coverage
Monitoring and Evaluation	877	No	No	Monitoring and evaluation is assumed to be carried out under the overall health system thus no additional specific effort by maternity care programme
Transport	346	Yes	Yes	Transport costs increase with coverage and with scope of programme
Communication, Media & Outreach	25	No	Yes	Communication costs increase with coverage
General Programme Management	140	No	No	This category refers to overall management of the programme; production of norms and standards etc thus is not linked to coverage nor to the scope
SUM	**5,367**			

Source: WHO-CHOICE 2017 (www.who.int/choice)

To validate these estimates, we examined existing documents that project programme costs. For example the Immunization strategy costing for 2016-2020 includes a category of "Gestion du programme" which amounts to USD 5.64 million, which is close to the WHO-CHOICE default estimates. For comparisons with other available reports see Table 13. The comparisons indicate that estimates of programme costs range widely. The reason for this may include the scope of work, the anticipated coverage levels to be attained in the years to come, the assumptions on effectiveness and quality of the programme, and sometimes budget projections being carried out to match the likely available resources (as opposed to aspirational estimates).

Table 13. Comparing WHO-CHOICE estimates with available estimates for programme costs (USD million)

WHO-CHOICE Defaults	Immunization costing[19] category of "Gestion du programme" (year 2020)	HIV/AIDS REDES (average of 2014-2015)	HIV/AIDS CCM under category of "Module 12. Gestion du programme"	SRH costing[20]
USD 2014	USD 2015	USD 2014/2015	Average years 2 and 3[21]	Average 2014-2016
5.37	5.65	24.97	2.13	0.91

In view of the above comparison, and the challenges entailed with comparing the different estimates for programme costs and what they refer to, we apply the standard WHO-CHOICE programme costs for this analysis, with one general adjustment made: the price of motorcycles (within transport costs) was adjusted from $1,827 to $5,000 (based on prices used for the cost projections of the 2016-2020 Immunization strategy). We also made specific adjustments for immunization: when reviewing the cost estimates for the 2016-2020 immunization strategy, we found that some components of immunization programme costs are higher because of more intensive outreach activities. We therefore used different assumptions for immunization programme costs. As an example the generic WHO-CHOICE programme costs assume that a programme would require 30 cars and 20 motorcycles for a country the size of Haiti. The immunization strategy costing calls for 250 motorcycles. We therefore increased the number of motorycles for the immunization programme to 250.

[19] MSPP/OPS-OMS (2016). Calcul des coûts du plan pluriannuel complet en faveur de la vaccination 2016-2020. Port-au-Prince, Haïti. Fichiel Excel

[20] Costing du Plan Stratégique Santé de la Reproduction Et Planification Familiale 2013-2016. Costs extracted for IEC, Training, Supervision and M&E

[21] Estimates include HR, but does not include costs for Training, which are included under other modules.

Table 14. Final estimates used within model for programme cost to run an efficient programme implementing 10 interventions at full coverage (USD 2014)

Category	Original estimate	With adjustment for motorcycle price	With adjustment for motorcycle quantity
1. Programme-Specific Human Resources	1,454,601	1,454,601	1,454,601
2. Training	489,251	489,251	489,251
3. Supervision	2,034,719	2,034,719	2,034,719
4. Monitoring and Evaluation	877,196	877,196	877,196
5. Infrastructure and Equipment		-	
6. Transport	345,958	357,071	1,331,408
7. Communication, Media & Outreach	25,333	25,333	25,333
8. Advocacy	-	-	-
9. General Programme Management	139,873	139,873	139,873
SUM	**5,366,930**	**5,378,042**	**6,352,380**
Note		These estimates were used for child health	These estimates were used for Immunization

The programme costs are incorporated into our analysis as follows:

- For each single intervention or package, a corresponding programme cost is estimated. This estimate takes into account adjustments based on the number of interventions in the package, and the target coverage level, as shown in table 12. For example:
  - The assumption is that a programme running at full capacity can support the implementation of 10 interventions at a 100% coverage rate. If running with fewer than 10 interventions, certain costs such as those related to human resources and vehicles are reduced.
  - The assumption is that many costs remain constant regardless of the coverage level of interventions delivered by the programme and are only influenced by the number of interventions delivered. They are treated as a fixed cost. However other components of programme costs are scaled to coverage, such as in-service training and supervision visits (i.e. achieving lower coverage targets require fewer health workers to be trained, and less supervision efforts).
- For an incremental scenario analysis, the programme cost is relative to current coverage. Therefore, only those components that are scaled with coverage are included in the programme costs. Annex 3 provides an example.

3.3.6 Converting health impact into economic benefits and deriving Benefit-Cost Ratios

Valuing health impact

Health impact is estimated in terms of healthy life years gained. This is effectively the same as a DALY, but where DALYs as measured by Global Burden of Disease studies are properly speaking a loss measure and Healthy Life Years measured in cost-effectiveness analysis are a gain measure. To value benefits in monetary terms, the Healthy Life Years gained by year are multiplied by the year-specific estimated GDP per capita. There are numerous reviews available that discuss the valuation of health gains using so-called values of statistical life (VSL). Jamison et al (2012) noted that existing estimates for counties generate a range of VSL valuations that range between 2 to 4 times GDP per capita. The VSL estimations include both the intrinsic valuation of a healthy life (health and life having a value in its own right) as well as the economic contribution to society, including higher labor productivity. The methodology used here is the standard approach adopted by the Copenhagen Consensus analyses which present HLYs valued at 3 times GDP per capita (we also present results using 1 and 8 times GDP per capita in Annex 4). [22]

In addition to attributing a dollar ($) value to the intrinsic value of health, healthier populations also bring additional benefits, including higher labor productivity and reduced spending on treatment. For the purpose of this analysis we assume that labor productivity gains are captured within the 3 times GDP per capita estimate.

Calculating Benefit-cost ratios

Costs are summed for the entire period of analysis and converted from US$ 2014 to HTG 2016 using price deflator data from IMF World Economic outlook April 2016, in order to be consistent with the valuation of health benefits in HTG 2016.

Estimates of costs and benefits were discounted at 3, 5 and 12% discount rate. Benefit-cost ratios (BCRs) were calculated by dividing the total benefits with the total intervention costs. This ratio estimates the return on investment, i.e., the economic benefits that would be realized for each dollar invested.

[22] It can be argued that the instrumental part of the HLY is dependent on the age of the individual, and that different individuals might have different productivity gains depending on their age, educational level etc. However, the standard approach recommended by the Copenhagen Consensus for the Haiti Priorise project does not consider such variation in valuation per healthy life year gained.

3. Results and Discussion

3.1 Direct benefits

Table 15 indicates the number of children reached with the different packages at current coverage, as well as the additional number of services that would be provided if expanding towards 95% coverage. The greatest increase in service reach would be for provision of zinc to manage diarrhea: if this was implemented to scale, an additional 4 million episodes per year would be treated with zinc. When comparing the number of treatment episodes needed for diarrhea and pneumonia in a scenario with and without vaccines, one would expect to see more episodes treated for illness in scenario P3 which does not include the protective effect of vaccines. However what we find instead is that more children are being treated in scenario P4 and this is due to more children surviving from the preventive effects of the vaccines, and thus being exposed to new risks and requiring treatment. The LiST model includes a built-in link between the scale-up of preventive intereventions and the risk of illness. Due to the scale-up of Hib and pneumococcal vaccine within our model, the incidence of pneumonia drops from an initial 1.3 episodes per child per year to reach 1.2 episodes per child per year.

Table 15. Number of additional services and projected health outcomes with an increase in coverage to 95% target coverage, compared with a constant coverage scenario, 2018-2036

Intervention	Number of people reached in baseline year 2017 (*)	Average additional number of people reached by year, 2018-2036 (**)
Immunization		152,925
Rotavirus vaccine	107,687	127,881
Measles vaccine	132,731	110,350
DPT vaccination	150,261	110,350
Hib vaccine, Hep vaccine	150,261	110,350
Polio vaccine	140,244	120,368
BCG vaccine	202,853	57,759
Pneumococcal vaccine	0	260,612
Management of childhood illness		
In scenario P3 scaled to 95% coverage		
ORS	2,050,852	1,970,374
Zinc (diarrhea treatment)	11,631	4,009,595
Antibiotics for treatment of dysentery	20,741	180,320
Pneumonia treatment (children)	596,247	894,351
In scenario P3 scaled to 95% coverage		
ORS	As above	1,956,792
Zinc (diarrhea treatment)	As above	3,996,014
Antibiotics for treatment of dysentery	As above	179,641
Pneumonia treatment (children)	As above	982,327

(*) Modelled estimates based on parameters as outlined in section 2.3.2; (**) modelled estimates for a combined package P4 scaled to a 95% coverage scenario.

All four packages will lead to significant reduction in child mortality (Table 16). Management of common childhood illness (P3 and P4) is estimated to have greater absolute gains in terms of deaths averted and reduction in mortality rates, than the scale-up in immunization coverage. This is partially due to the lower starting coverage of the treatment interventions. Implementing a comprehensive package of both preventive and curative care (P4) is estimated to avert over 71,000 child deaths over the implementation period if made universally available (95%), and bring the under-five mortality ratio down from current 69 to reach 51 deaths per 1000 live births (a reduction by 62%). This is very close to the target of 50 in the national child health strategy.

Table 16. Deaths averted through child immunization and management of common childhood illnesses, total 2018-2036 (modelled estimates)

Package	Target coverage level (%)	Under-five deaths averted (2018-2036)	Under-five deaths averted (annual average)	U5MR achieved	IMR achieved
Package 1. Routine EPI 2015	80	14,691	773	66	50
	95	24,437	1286	64	49
Package 2. Routine EPI 2015 + PCV-13	80	29,119	1533	63	48
	95	41,599	2189	61	47
Package 3. Management of common childhood illness	80	72,388	3810	59	46
	95	95,377	5020	55	44
Package 4 Combination Routine EPI + PCV13 + management of common childhood illness	80	52,816	2780	55	43
	95	71,461	3761	51	41

3.2 Cost projections

As shown in Table 17A and 17B, total additional resource need per year varies between 8 and 100 USD million depending on the scope of the package and the target coverage. Programme support costs constitute a significant share of the estimated additional resource need (29-51%). The average annual per capita cost varies from USD 0.72 to 8.26.

Table 17A. Breakdown of costs by type of input, by package (incremental scale-up, USD 2014)

		Breakdown of costs (million USD)						
Intervention	Target coverage level	Comm odities	Service Delivery	Supply chain	Programm e costs	Average annual cost (additional)	Average annual per capita cost (additional)	Total additonal cost 2018-2036 (millions)
Package 1. Routine EPI 2015	80%	1.8	1.8	1.6	3.5	8.7	0.7	166
	95%	2.8	3.0	2.6	8.8	17.3	1.4	328
Package 2. Routine EPI 2015 + PCV-13 *	80%	14.2	3.0	14.0	15.1	46.2	3.8	878
	95%	17.5	4.4	17.2	22.8	61.9	5.1	1,176
Package 2. Routine EPI 2015 + PCV-13 **	80%	5.9	3.0	14.0	15.1	38.0	3.1	722
	95%	7.4	4.4	17.2	22.8	51.8	4.3	983
Package 3. Management of common childhood illness	80%	2.6	20.8	0.9	24.5	48.9	4.0	929
	95%	3.3	25.8	1.2	31.3	61.5	5.1	1,169
Package 4 Combination Routine EPI + PCV13 + management of common childhood illness	80%	16.8	23.7	14.9	22.3	77.7	6.4	1,476
	95%	20.8	30.1	18.4	30.9	100.2	8.3	1,904

Estimates in this table are not discounted. * Price for PCV-13 estimated at USD 17 per dose. ** Price for PCV-13 estimated at USD 3.3 per dose.

17B. Breakdown of costs by type of input, by intervention (incremental scale-up), Percentage shares of estimated incremental cost 2018-2036 (total for 19 years)

Intervention	Target coverage level	Commodities	Service Delivery	Supply chain	Programme costs
Package 1. Routine EPI 2015	80%	21%	21%	19%	40%
	95%	16%	18%	15%	51%
Package 2. Routine EPI 2015 + PCV-13*	80%	31%	6%	30%	33%
	95%	28%	7%	28%	37%
Package 2. Routine EPI 2015 + PCV-13**	80%	21%	7%	34%	37%
	95%	19%	8%	31%	41%
Package 3. Management of common childhood illness	80%	5%	43%	2%	50%
	95%	5%	42%	2%	51%
Package 4 Combination Routine EPI + PCV13 + management of common childhood illness	80%	22%	31%	19%	29%
	95%	21%	30%	18%	31%
	95%	21%	21%	19%	40%

* Price for PCV-13 estimated at USD 17 per dose. ** Price for PCV-13 estimated at USD 3.3 per dose.

3.3 Benefit-cost ratios

Table 18 presents the estimated benefit-cost ratios of packages implemented at 80% and 95% coverage. When benefits and costs are discounted at 5%, benefit-cost ratios for immunization are higher for the routine vaccines (P1) than for an expanded package including pneumococcal vaccine (P2). Expanding coverage with the current package of vaccines has a BCR of around 10, while the inclusion of pneumococcal vaccine brings the BCR down to between 3 and 5, depending on price assumptions for the PCV-13 vaccine.

Expanding management of diarrhea and pneumonia, primarily through community-based care, has a BCR of between 6 and 7. Finally, combining an extensive immunization programme with the costs and impact of managing diarrhea and pneumonia results in estimated BCRs of around 4.5 – which is still a high return to investment.

Table 18. Benefits, Costs, and Benefit-Cost Ratios relative to expanding coverage beyond current coverage (incremental scenario), at a 5% discount rate

Package	Target coverage	Benefits NPV	Costs NPV	BCR
Package 1. Routine EPI 2015	80%	25,926,653,976	2,763,165,721	9.4
	95%	47,332,806,077	4,545,114,386	10.4
Package 2. Routine EPI 2015 + PCV-13*	80%	51,661,271,214	15,969,157,708	3.2
	95%	74,218,176,210	20,231,337,413	3.7
Package 2. Routine EPI 2015 + PCV-13**	80%	51,661,271,214	11,883,481,359	4.3
	95%	74,218,176,210	15,179,075,425	4.9
Package 3. Management of common childhood illness	80%	95,314,961,732	15,174,626,919	6.3
	95%	128,976,584,623	18,865,558,436	6.8
Package 4 Combination Routine EPI + PCV13 + management of common childhood illness	80%	130,218,915,748	30,638,986,601	4.3
	95%	171,613,815,321	38,401,077,784	4.5

Benefits are valued at 3x GDP. Costs and benefits are presented in Net Present Value terms for 2018-2036; discounted at 5%.

** Price for PCV-13 estimated at USD 17 per dose. ** Price for PCV-13 estimated at USD 3.3 per dose*.

Table 19 provides summary BCRs for all packages at three discount rates: 3%, 5% and 12%. BCRs are lower when a higher discount rate is used, but still remain at 1.3 or higher for a 12% discount rate, thus implying good value for money. When applying a 3% disount rate, the BCR is between 5.5 and 15.6 for the different packages.

Table 19. Summary Table for Benefit-Cost Ratios, based on projected health impact relative to projected cost, at selected discount rates (incremental scenario)

Package	Target coverage	BCR 3%	BCR 5%	BCR 12%
Package 1. Routine EPI 2015	80%	14.2	9.4	3.8
	95%	15.6	10.4	4.3
Package 2. Routine EPI 2015 + PCV-13*	80%	4.9	3.2	1.3
	95%	5.5	3.7	1.5
Package 3. Management of common childhood illness	80%	9.4	6.3	2.7
	95%	10.2	6.8	2.9
Package 4 Combination Routine EPI + PCV13 + management of common childhood illness	80%	6.4	4.3	1.8
	95%	6.7	4.5	1.9

*Note: Benefits are valued at 3x GDP. * Price for PCV-13 estimated at USD 17 per dose. As shown above, the BCR is higher when considering a lower price for the vaccine.*

Benefit cost ratios are slightly higher for 95% compared to 80%, reflecting increasing returns to scale as fixed costs (the relatively large programme costs) are spread out over the number of people reached. The quality of evidence is discussed in section 3.5 below.

3.4 Discussion

Interventions aimed at childhood diseases and expanded immunization coverage have been described as having BCRs of around 20 (Jamison et al. 2012; Foster and Bryant, 2013).

The interventions discussed within this paper are delivered through population-and community based approaches as well as primary level care. For this type of intervention, health system capacity constraints can more easily be overcome than for example skilled care at birth which is much more reliant on specialized skills. Immunization provides an example of health services for which, even in the short term, money can overcome poor system capacity. Adding new vaccines to the immunization schedule is costly – as we have seen the newly introduced antigens place a considerable burden on the immunization programme – but such a package remains cost-effective and with BCRs around 4 (at 5% discount rate).

Similarly, allowing community-based care to play a large role in the provision of integrated management of childhood illness is a key strategy in a country like Haiti where current health workforce numbers are far below recommended minimum benchmarks. Our model still assumes a significant share of service delivery would happen at primary level facilities, so accessibility to health facilities needs to improve in order to expand coverage.

Coverage of IMCI to date has been limited in Haiti, and the reasons include limited government health budget allocation, differences in budget for different diseases and components within the budget (thus fragmentation rather than integration). Resource availability is thus a key constraint for implementing these highly cost-effective interventions.

Our analysis entails running a country-contextualized model to project mortality reductions, healthy life years gained, and then translate these into economic benefits. The GCEA-Spectrum approach makes use of evidence to date on the relationship between medical interventions and health outcomes as drawn from the global literature. The inputs required to deliver the medical interventions are largely standardized, following WHO guidelines. Input assumptions were compared with local guidelines by country experts. There is somewhat more uncertainty related to the prices of inputs: we mostly used global defaults because of difficulties accessing local prices, but where we could, we used the local prices (like vehicles). The most limiting assumption however is the valuation of HLYs as a multiple of GDP/capita given that the final BCR becomes highly reliant on the current and projected economic outputs of the country, and a country with higher GDP would automatically have a higher BCR if costs were the same. This is why estimates need to be considered as context-specific and highly sensitive to the assumed economic value of the projected health gain.

The GCEA-Spectrum approach can be completely customized to the local context, and thereby adds significant added value compared to alternative approaches that use pre-published unit costs derived from other settings for the resource needs. Moreover, the model provides a dynamic modelling approach whereby preventive efforts are taken into account and enters into a feedback loop, affecting the predicted need for curative care. The approach offers transparency regarding the assumptions used and the cost components of each intervention, as opposed to using prior publications of cost estimates, where assumptions around the definition of the interventions and the associated cost and impact estimates may not always be clear to the reader.

3.5 Quality of evidence

Overall limitations

Our model assumes an instantaneous jump to 80% or 95% coverage in year 2, which is obviously not meant to be realistic. The approach nevertheless provides an indicative estimate on the benefts and costs of implementing child health interventions, which can be compared against those of other investment options.

We have not undertaken sensitivity analysis. While such an extension would be informative, it was not done for this particular study given the uncertainties for each of the components of the benefit-cost ratios.

Quality of benefit measure

The estimate of health benefits uses the LiST model which incorporates effectiveness estimates that have been reviewed by the Child Health Epidemiology Reference Group (CHERG), established in 2001 by the World Health Organization. We therefore have high confidence in the projection of health outcomes.

At the same time we acknowledge considerable uncertainties regarding the effectiveness estimates in particular related to the quality of care provided. Our estimates are not intended to be precise, but to provide an indicative benefit-cost ratio for expanding child health interventions.

Our analysis focuses on child mortality. We have not considered broader morbidity gains, and estimates are therefore conservative. The valuation of averted mortality into HLYs follows a standard transparent approach based on disability weights. The subsequent valuation of HLYs in economic terms follows the standard recommendation of the Copenhagen Consensus to value each HLY (or DALY) gained as 3 times GDP per capita. As shown in section 2.2.2, this is assumed to capture both intrinsic and instrumental values of health. In Annex 4 we present ranges for the estimates when valuing each HLY as 1 or 8 times GDP per capita.

Quality of cost measure

Our model uses standardized WHO-CHOICE costs, because of the transparency of these in terms of separating out quantities from price assumptions. We examined available studies carried out in Haiti to contextualize assumptions. However, most standard assumptions for input prices were retained. On the other hand, quantity assumptions are contextualized to local demography, epidemiology and coverage. Assumptions behind quantities of resource use are reported transparently, and quantities are reported separately from costs (e.g., number of outpatient visits per intervention; number of people reached per intervention). Such reporting aligns with principles of high quality economic evaluation.

One issue of particular importance when considering GAVI-funded vaccines is what price to use. For the pneumococcal vaccine we developed two scenarios to take into account different price assumptions: one scenario with a unit price of USD 17, which is close to the price of the PAHO Revolving Fund (USD 15.5 per dose); and a second scenario using the UNICEF price (USD 3.30 per dose). The BCR is higher when considering the lower vaccine cost. A similar scenario analysis could have been undertaken for other variables. We only considered the price of PCV-13 since this is a significant cost driver for an expanded immunization package.

Our focus on recurrent provider costs limits the scope of costs included – i.e, we do not include any indirect cost incurred by the households or individuals seeking care, such as for transport, and lost income. While this approach is consistent with many analyses in the field, not including care seeking (demand side) costs likely results in an underestimate of the true resource costs, and therefore can be considered an overestimate of the BCR.Given the above, we have still rated the quality of the estimates as high, since we have used pre-existing projection models vetted by expert groups, and because we report transparently on assumptions used.

4. Conclusion

The objective of this study is to estimate the cost, benefits, and the relative return on investment from providing child immunization and management of common childhood illnesses in Haiti.

SDG3 includes a specific target 3.1 for child health mortality, namely to end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce under-five mortality to at least as low as 25 per 1000 live births. Our projections do not achieve a target as low as 25, but almost reaches the target of 50 as set within the national child health policy. Scaling up immunization and management of common childhood illness can therefore play an important role and represent "low-hanging fruits" for the health sector to improve population health. Our analysis indicates that expanding immunization can result in benefits around 10 times higher than the costs incurred for traditional vaccines, and 3-5 times higher when incorporating new vaccines. Treating (uncomplicated) diarrheal disease and pneumonia among children would have BCRs of 6-7.

Benefits from investing in child health have high rates of return which go beyond short-term health gains; they include longer term productivity gains and sustainable development. These demonstrated benefits should be considered; and strategies be put in place to make sure that easily preventable deaths are avoided.

5. References

Arrive E, Perez P, Pierre LMW (2004). Integrated management of childhood illness. The example of Haiti. University Agency of La Francophonie.

Avenir Health, Spectrum – General Cost Effectiveness Analysis (GCEA) – Beta version (not publicly available).

Burton A. & al. (2009). WHO and UNICEF estimates of national infant immunization coverage: methods and processes. Bulletin of WHO; 87: 535-541. Doi: 10.2471 / BLT.08.053819.

Lucero MG, Dulalia VE, Nillos LT, et al. Pneumococcal conjugate vaccines for preventing vaccine-type invasive pneumococcal disease and pneumonia with consolidation on x-ray in children under two years of age. Cochrane Database Syst Rev 2009. http://www.ncbi.nlm.nih.gov/pubmed/19821336.

Edejer TT, Aikins M, Black R, Wolfson L, Hutubessy R, Evans DB. Cost effectiveness analysis of strategies for child health in developing countries

BMJ 2005; doi: https://doi.org/10.1136/bmj.38652.550278.7C (Published 10 November 2005)

Cite this as: BMJ 2005;:bmj;bmj.38652.550278.7Cv1

EMMUS V. Cayemittes, Michel, Michelle Fatuma Busangu, Jean de Dieu Bizimana, Bernard Barrère, Blaise Sévère, Viviane Cayemittes et Emmanuel Charles. 2013. Enquête Mortalité, Morbidité et Utilisation des Services, Haïti, 2012. Calverton, Maryland, USA : MSPP, IHE et ICF International.

EMMUS IV. Cayemittes, Michel, Marie Florence Placide, Soumaïla Mariko, Bernard Barrère, Blaise Sévère, Canez Alexandre. 2007. Enquête Mortalité, Morbidité et Utilisation des Services, Haïti, 2005-2006. Calverton, Maryland, USA : Ministère de la Santé Publique et de la Population, Institut Haïtien de l'Enfance et Macro International Inc.

EMMUS III. Cayemittes, Michel, Marie Florence Placide, Bernard Barrère, Soumaïla Mariko, Blaise Sévère. 2001. Enquête Mortalité, Morbidité et Utilisation des Services, Haïti 2000. Calverton, Maryland, USA : Ministère de la Santé Publique et de la Population, Institut Haïtien de l'Enfance et ORC Macro.

EMMUS II. Cayemittes, Michel, Antonio Rival, Bernard Barrère, Gérald Lerebours, et Michaèle Amédée Gédéon. 1995. Enquête Mortalité, Morbidité et Utilisation des Services (EMMUS-II), Hai~i 1994/95. Calverton, Maryland USA : Institut H~tien de l'Enfance et Macro International Inc.

Foster S and Bryant M , 2013. A Framework for Estimating Benefits of Investing in Maternal, Newborn, and Child Health, Department of International Health, Boston University School of Public Health, Boston, USA.

FNUAP/ ONUSIDA/OPS-OMS/ UNICEF (2017). Projet conjoint SNU/Canada <Résilience du système de santé maternelle, néonatale et infantile dans le Sud et la Grand'Anse – Haïti>. UNFPA, Port-au-Prince, Haïti. p.80.

Gouvernement de la République d'Haïti/Système des nations Unies/Banque interaméricaine de développement/Banque Mondiale (2017). Evaluation des besoins post catastrophe pour le cyclone Matthew (Haïti). Port-au-Prince, Haïti p.100

IHME (2016) Haiti country profile (http://www.healthdata.org/haiti)

IHE et ICF International. Soins de Santé, Haïti, 2013. Rockville, Maryland, USA

Institut Haïtien de l'Enfance (IHE) et ICF International. 2014. Évaluation de Prestation des Services de *Soins de Santé, Haïti, 2013*. Rockville, Maryland, USA : IHE et ICF International

Jamison, D. T., P. Jha, R. Laximinarayan, and T. Ord. 2012. "Infectious Disease, Injury and Reproductive Health." Copenhagen Consensus 2012 Challenge Paper

Jerome J, Ivers L. Community Health Workers in Health Systems Strengthening: A qualitative evaluation from rural Haiti. AIDS (London, England). 2010;24(Suppl 1):S67-S72. doi:10.1097/01.aids.0000366084.75945.c9.

Koné Georges (2011). Analyse des coûts et financement des soins de santé primaire dans la zone goavienne en Haïti. Médecins du Monde (MDM), Port-au-Prince.

Miller S and Belizan JM 2015. The true cost of maternal death: individual tragedy impacts family, community and nation. Reproductive Health 2015 12:56 DOI: 10.1186/s12978-015-0046-3

MSPP de la République d'Haïti (2012). Politique nationale de santé (PNS). MSPP, Port-au-Prince, Haïti.

MSPP de la République d'Haïti (2012b). Plan directeur de santé 2012-2022. MSPP, Port-au-Prince, Haïti..

MSPP (2013). Plan stratégique national pour la santé intégrale de l'enfant en Haïti 2014-2019. MSPP/OPS-OMS, Port-au-Prince, Haïti.

MSPP of the Republic of Haiti (2015a) unite d'etudes et de programmation (UEP) , RAPPORT STATISTIQUE 2015

MSPP of the Republic of Haiti (2015b). National Health Accounts 2012-2013. MSPP, Port-au-Prince, Haiti.

Direction du programme élargi de vaccination (PEV)/MSPP (2016). Plan pluriannuel complet 2016-2020 en faveur de la vaccination. DPEV/MSPP, Port-au-Prince, Haïti.

MSPP/OPS-OMS (2016). Calcul des coûts du plan pluriannuel complete en faveur de la vaccination 2016-2020. Port-au-Prince, Haïti. Fichiel Excel.

MSPP, Costing du Plan Stratégique Santé de la Reproduction et Planification Familiale 2013-2016. Costs extracted for IEC, Training, Supervision and M&E

Queuille L. & V. Ridde (2016a). Analyze the performance of the expanded immunization program to strengthen its financial sustainability - Haiti. Strategic Information Note. PAHO / WHO, Port-au-Prince, Haiti. P.4].

Queuille L. & V. Ridde (2016b). Aide-mémoire d'évaluation de la viabilité financière du programme élargi de vaccination - Haïti. MSPP-OPS/OMS, Port-au-Prince, Haïti. p.114.].

Queuille L. (2017). Estimation des coûts du PPAc 2016-2020 – Haïti. Note d'information stratégique (Mars 2016)/ MSPP-OPS/OMS, Port-au-Prince, Haïti..

PAHO (2017). Health In The Americas.WDC: PAHO, 2017. A paraître.

Sarley D, Allain L, Akkihal A. Estimating the global in-country supply chain costs of meeting the MDGs by 2015. Arlington, Va, USAID/DELIVER Project, 2009. Available at: http://pdf.usaid.gov/pdf_docs/PNADP080.pdf. See Table 5.

Salomon et al Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010. Lancet 2012. https://www.ncbi.nlm.nih.gov/pubmed/23245605

Stenberg, Karin et al. 2014 Advancing social and economic development by investing in women's and children's health: a new Global Investment Framework. The Lancet , Volume 383 , Issue 9925 , 1333 - 1354

UNDP République d'Haïti (2014). Rapport OMD 2013 – Haïti un nouveau regard. Résumé exécutif. Port-au-Prince. p.4).

UNFPA, ICM, WHO (2014), The State of the World's Midwifery (SoWMy) 2014: A Universal Pathway. A Woman's Right to Health.

USAID, Analyse de Coûts du Paquet Minimum des Services de santé (PMS) d'Haïti 2011. Santé pour le Développement et la Stabilité d'Haïti / Pwojè Djanm: Analyse de Coûts du Paquet Minimum (PMS) à Haïti, 2011 Cambridge MA: Santé pour le Développement et la Stabilité d'Haïti—Pwojè Djanm; Management Sciences for Health, 2012.

USI/CRCHUM, Unité de santé internationale / Université de Montréal (2011). Coûts de la prise en charge de la santé maternelle, périnatale et reproductive en Haïti. Université de Montréal, Port-au-Prince/Montréal.

Walker N, Tam Y, Friberg I. Overview of the Lives Saved Tool (LiST). (2013a) BMC Public Health; 2013: 13(Suppl 3): S1. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847271/.

Walker N (a), Yenokyan G, Friberg IK, Bryce J. (2013b). Patterns in coverage of maternal, newborn, and child health interventions: projections of neonatal and under-5 mortality to 2035. Lancet. 2013 Sep 21;382(9897):1029-38. doi: 10.1016/S0140-6736(13)61748-1.;

WHO (2005) World Health Report 2005: Make every mother and child count

WHO, UNFPA, UNICEF and Mailman School of Public Health. Averting Maternal Death and Disability (AMDD) (2009): Monitoring emergency obstetric care: A Handbook

WHO (2015) Health Statistics 2015

WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division (2015). Trends in maternal mortality: 1990 to 2015. http://www.who.int/reproductivehealth/publications/monitoring/maternal-mortality-2015/en/

WHO (2016a) Health Statistics 2016

WHO (2016b) Global strategy on human resources for health: workforce 2030.

Winfrey W, McKinnon R, Stover J. Methods used in the Lives Saved Tool (LiST). BMC Public Health 2011, 11(Suppl 3): S32. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3231906/.

Annex 1. Vaccination schedule

Table A1. Haiti Immunization schedule

VACCINATION DES ENFANTS					
VACCINS	**NOMBRE DE DOSE**	**AGE D'ADMINISTRATION ET INTERVALLE ENTRE LES DOSES**	**SITE**	**VOIE**	**QUANTITE/DOSE**
BCG	dose unique	De la naissance à 11 mois	Deltoïde	I.D	0,05 ml
POLIO ORAL	dose 0 dose 1 dose 2 dose 3	De la naissance à 14 jours 2 mois ½ ou 10 semaines 4 semaines après la 1ère dose 9 mois avec le RR		Orale	2 gouttes
VPI	dose unique	1 mois ½ ou 6 semaines	Tiers moyen face supéro externe Cuisse	I.M.	0,5 ml
ANTI ROTA VIRUS	dose 1 dose 2	1 mois ½ ou 6 semaines 4 semaines après la 1ère dose		Orale	1,5 ml
PENTA	dose 1 dose 2 dose 3	1 mois ½ ou 6 semaines 4 semaines après la 1ère dose 4 semaines après la 2ème dose	Tiers moyen Cuisse	I.M.	0,5 ml
DTP	Rappel 3 doses Rattrapage	1 an après la 3ème dose de Penta de 1 à 5 ans pour les non vaccinés Penta	D Deltoïde	I.M.	0,5 ml
RR	dose 1 dose 2	A partir de 9 mois 4 mois après la 1ère dose	Deltoïde	S.C.	0,5 ml
PNEUMOCOQUE 2017	dose 1 dose 2 dose 3	1 mois ½ ou 6 semaines 4 semaines après la 1ère dose 4 semaines après la 2ème dose	Tiers moyen face supéro externe cuisse	I.M.	0,5 ml
VACCINATION DES FEMMES					
dT	dose 1 dose 2 Rappel 1 Rappel 2 Rappel 3	Femme enceinte 1 mois après la 1ère dose 6 mois après la 2ème dose 1 an après la 3ème dose 1 an après la 4ème dose	Deltoïde	0,5 ml	I.M.

Annex 2. Health service delivery costs

In order to validate the WHO-CHOICE estimates we examined existing studies carried out in Haiti on service delivery costs. These included:

- Analyse de Coûts du Paquet Minimum des Services de santé (PMS) d'Haïti 2011 (USAID) Santé pour le Développement et la Stabilité d'Haïti / Pwojè Djanm: Analyse de Coûts du Paquet Minimum (PMS) à Haïti, 2011 Cambridge MA: Santé pour le Développement et la Stabilité d'Haïti—Pwojè Djanm; Management Sciences for Health, 2012.
- Koné Georges (2011). Analyse des coûts et financement des soins de santé primaire dans la zone goavienne en Haïti. Médecins du Monde (MDM), Port-au-Prince.
- Unité de santé internationale / Université de Montréal (2011). Coûts de la prise en charge de la santé maternelle, périnatale et reproductive en Haïti. USI/CRCHUM Université de Montréal, Port-au-Prince/Montréal.
- MSPP/PNLS (2016). Rapport REDES 2014/2015 – Estimation du flux des ressources et dépenses liées au VIH/SIDA. MSPP/PNLS, Port-au-Prince.

As an illustrative example, the table below shows data extracted from the USAID (2011) study for selected interventions.

Table A2. USAID (2011) study, average standard cost, 100% coverage scenario *(Haitian Gourde (HTG) and USD)

	Consultation Prénatale, HTG	USD 2011	Vaccination < 5 years BCG, HTG	USD 2011	Match to delivery level in GCEA	Default 2010 cost in Spectrum GCEA (public sector)
Dispensaries ONG	77	1.90	13	0.32	Community	1.26
Zones Ciblées	102	2.52	14	0.35	Outreach	1.26
CSL ONG (Facility without beds)	79	1.95	9	0.22	Clinic	1.56
CSL ZC	120	2.96	11	0.27	Clinic	1.56
CAL ONG(Facility with beds)	90	2.22	10	0.25	Clinic	1.56
CAL Zones Ciblées	77	1.90	11	0.27	Clinic	1.56
Average (community and outreach level)	89.5	2.21	13.5	0.33		
Average (clinic level)	91.5	2.26	10.25	0.25		
Average (interventions combined) - community and outreach	51.5	1.3				
Average (interventions combined) - clinic	50.9	1.3				

**Taking only the cost of "Personnel technique" and "Coûts fixes par Service"*

The comparison illustrates a number of points:

- Facility based studies show a large variation in costs for different types of services
- Facility based studies show a large variation in costs between different delivery levels
- Based on a quick comparison, the WHO-CHOICE estimates fall within the same ball park as the locally derived estimates.

The above also illustrated how sensitive the cost assumptions are to which services are included in an average weighted package. To do such weighting is beyond the scope of this project. The comparison suggests that WHO-CHOICE estimates for service delivery costs can be used to inform the analysis.

Annex 3. Estimates of programme costs use in analysis

This annex provides an example to illustrate how programme costs are scaled to 95% for package 3: management of common childhood illness. The package includes the following 4 interventions:

- ORS for diarrhea treatment
- Zinc for diarrhea treatment
- Antibiotics for treatment of dysentery
- Treatment of pneumonia (ALRI)

The average coverage across the 5 interventions is 25.7%. Scaling coverage to 95% would require an additional USD 1.1 million dollars for overall programme activities in relation to training, supervision, transport and communication activities, according to the model used. This approach assumes an effective management of resources, and may underestimate actual needs. However we were not able to validate the estimates for this particular exercise.

Table A3. Programme costs assumptions for management of common childhood illness

Category	Estimated annual cost, for a fully functioning programme with 10 interventions thousands (USD 2014)	Rule applied	Resulting value for incremental cost to increase coverage from 25.7% to 95%, (thousands USD 2014)
Human Resources for planning and administration	1,455	• Cost depends on the scope of the package • Same cost at all coverage levels	0
In-service training	489	• Same cost regardless of scope of package • Cost differs according to coverage level	187
Supervision	2,035	• Same cost regardless of scope of package • Cost differs according to coverage level	446
Monitoring and Evaluation	877	• Same cost regardless of scope of package, and for all coverage levels	0
Transport	357*	• Cost depends on the scope of the package • Cost differs according to coverage level	529
Communication, Media & Outreach	25	• Same cost regardless of scope of package • Cost differs according to coverage level	10
General Programme Management	140	• Same cost regardless of scope of package, and coverage level	0
SUM	**5,378**		**1,172**

*Costs for transport updated to incorporate Haiti-specific prices for motorcycles.

Annex 4. Estimates of BCRs with differential valuation of health benefit

Table A4. Benefit-cost ratios with health benefits valued at 1, 3 and 8 times GDP per capita.

Intervention	Discount rate	BCR (benefits valued at 1 x GDP per capita)	BCR (benefits valued at 3 x GDP per capita)	BCR (benefits valued at 8 x GDP per capita)
Package 1. Routine EPI 2015	3%	5.2	15.6	41.5
	5%	3.5	10.4	27.8
	12%	1.4	4.3	11.6
Package 2. Routine EPI 2015 + PCV-13*	3%	1.8	5.5	14.7
	5%	1.2	3.7	9.8
	12%	0.5	1.5	4.0
Package 3. Management of common childhood illness	3%	3.4	10.2	27.2
	5%	2.3	6.8	18.2
	12%	1.0	2.9	7.8
Package 4 Combination Routine EPI + PCV13 + management of common childhood illness	3%	2.2	6.7	17.8
	5%	1.5	4.5	11.9
	12%	0.6	1.9	5.1

Note: based on the 95% coverage target scenario.. * Results shown here for scenario with price for PCV-13 estimated at USD 17 per dose.

Haiti faces some of the most acute social and economic development challenges in the world. Despite an influx of aid in the aftermath of the 2010 earthquake, growth and progress continue to be minimal, at best. With so many actors and the wide breadth of challenges from food security and clean water access to health, education, environmental degradation, and infrastructure, what should the top priorities be for policy makers, international donors, NGOs and businesses? With limited resources and time, it is crucial that focus is informed by what will do the most good for each gourde spent. The Haïti Priorise project will work with stakeholders across the country to find, analyze, rank and disseminate the best solutions for the country. We engage Haitans from all parts of society, through readers of newspapers, along with NGOs, decision makers, sector experts and businesses to propose the best solutions. We have commissioned some of the best economists from Haiti and the world to calculate the social, environmental and economic costs and benefits of these proposals. This research will help set priorities for the country through a nationwide conversation about what the smart - and not-so-smart - solutions are for Haiti's future.

Haïti Priorise

Un plan de **développement** alternatif

For more information visit www.HaitiPriorise.com

COPENHAGEN CONSENSUS CENTER

Copenhagen Consensus Center is a think tank that investigates and publishes the best policies and investment opportunities based on social good (measured in dollars, but also incorporating e.g. welfare, health and environmental protection) for every dollar spent. The Copenhagen Consensus was conceived to address a fundamental, but overlooked topic in international development: In a world with limited budgets and attention spans, we need to find effective ways to do the most good for the most people. The Copenhagen Consensus works with 300+ of the world's top economists including 7 Nobel Laureates to prioritize solutions to the world's biggest problems, on the basis of data and cost-benefit analysis.