Costs and Benefits of Vaccinating
Children 0-1 in Haiti
COSTS AND BENEFITS OF VACCINATING CHILDREN 0-1 IN HAITI

Haïti Priorise

Magdine Flore Rozier Baldé
Assistant Unit Manager/ Economist
Ministère de la planification et de la coopération externe


Translated from French by Steffaney Zohrabyan, professional translator.
**Academic Summary**

This analysis report of the costs and benefits involves a topic of great importance in the field of health in Haiti. It covers the intervention "full immunization for children under one year in Haiti by strengthening immunization and health services." This research is part of the scope of work for Haiti development solutions, mandated by the Copenhagen Consensus Center via the project *Haiti Priorise*. In addition to the research of a beneficial solution at the lowest cost, the program is specifically focused on the immunization of children under the age of one with the aim of mitigating the infant mortality problem in Haiti. In this context, the study is therefore devoted to a comprehensive estimate of the costs and benefits of immunizing children under the age of one.

Knowing that in Haiti, children are dying every year because of diseases preventable by immunization, and that immunization coverage is weak, it must be a serious undertaking to significantly reduce the infant mortality rate. According to the latest data from the EMMUS-V survey (Haiti Mortality\(^1\), Morbidity and Service Utilization), the infant mortality rate is very high at 59 per thousand, and only 45 of 100 children have received every immunization dose. The reasons provided include their inaccessibility due to the remoteness of health centers, the lack of availability of immunizations, the lack of skilled health personnel, poor quality health centers, etc.

On the other hand, it should be noted that the MSPP (Ministry of Public Health and Population), in collaboration with some local and international organizations, has made great strides in reducing the infant mortality rate. The data from the EMMUS V indicates that the infant mortality rate has decreased over the past decade. In 2000, it was 80 per thousand, while in 2012 it dropped to 59 per thousand live births. These efforts made must be amplified to achieve a significant reduction in infant deaths. Thus, in this sense of continuity, this document is designed to reduce infant mortality through the increase and effectiveness of immunization coverage in children under one year.

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\(^1\) Enquête Mortalité, Morbidité et Utilisation des services (EMMUS-V), MSPP (2012).
The program is also focused on the development of qualified personnel for the administration of immunizations and also the availability of basic amenities needed to ensure the quality of immunization services. It will be executed over a period of five (5 years), which will begin in 2017 and end in 2021, throughout the territory.

The evaluation is based on a "Cost-Benefit" analysis approach that includes comparing the expected benefits against the expected costs of a program. The calculations were performed in an Excel spreadsheet. The results are estimated in a cost-benefit report that expresses the expected benefits for every gourde spent.

The analysis estimates that the implementation of the program allows Haiti to prevent more than 16,000 deaths from preventable diseases through immunizations such as: diphtheria, neonatal tetanus, whooping cough and measles. According to the Department of the Expanded Program on Immunization (MWED)\(^2\), the measles and neonatal tetanus in particular are the biggest cause of child deaths under the age of 5. Accordingly, full immunization remains one of the most beneficial investments in the health sector.

**Policy Summary**

**Overview and Context**
Existing data from the Haitian health system revealed a low level of support for infant health as shown in the indicators below:

- The infant mortality rate in Haiti is the highest in the Caribbean\(^3\) at **59 per thousand** live births. Preventable diseases through immunization are among the main causes of infant mortality in Haiti.

- The majority of personnel providing immunization services are not trained. Of the 644 health institutions providing infant immunization services, only 264 institutions had\(^4\)

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\(^2\) Evaluation de la Prestation des Services, de Soins de Santé, EPSSS, MSPP, p. 57. 2013, Port au prince.
\(^3\) https://www.unicef.org/haiti/french/health.html
\(^4\) Evaluation de la Prestation des Services, de Soins de Santé, EPSSS, MSPP, Port au prince.
personnel that had been trained in the Expanded Program on Immunization

- National immunization coverage is low, only 45 percent of children are fully vaccinated. Inaccessibility of some vaccines is one of the factors explaining this low coverage.

The intervention "full immunization for children under one year in Haiti by strengthening immunization services" aims to strengthen existing immunization services in each health institution nationwide. This strengthening aims to develop skilled personnel and immunization equipment required in every health institution immunization service. Accordingly, this program plans to immunize approximately 864,846 additional children over the next 5 years (2017-2021). This would bring the immunization coverage rate to 90% by 2020.

Factors relating to the implementation
Costs related to the implementation of this program are: the cost of immunizations, the cost of injection equipment, the cost of transportation and the cost of training the immunization services personnel. All these costs total an amount of 2.4 billion gourdes discounted at 5% for the duration of the program.

Explanation
The various benefits of the program implementation include the following:

- The benefits of reducing infant mortality

For the 16,506 lives saved with the intervention, the present value of economic benefits are estimated at 32 billion gourdes.

- The health care savings

The present value of profits saved by the country from curative care for children with preventable diseases through immunization is estimated at over 16.2 million gourdes.

- The income saved by parents

The total present value of income saved by the parents throughout the duration of the program
is estimated at 281.7 million gourdes.

Overall, the benefits expected from the program's implementation is estimated at over 32.3 billion gourdes.

Thus, an investment in this area is highly recommended as it provides a considerable reduction in health costs, a return on the money invested, and other economic benefits that may increase the well-being of the Haitian people.

The table below shows the amounts of costs and benefits of the program with three different reduction rates. The cost-benefit ratios are greater than all of them, the expected benefits are greater than the costs.

**Summary table**

<table>
<thead>
<tr>
<th>Program</th>
<th>Discount Rate</th>
<th>Benefits</th>
<th>Cost</th>
<th>BCR</th>
<th>Quality of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full immunization for infants 0-1 years old</td>
<td>3%</td>
<td>51,700,040,844</td>
<td>2,515,927,655</td>
<td>21</td>
<td>Strong</td>
</tr>
<tr>
<td></td>
<td>5%</td>
<td>32,298,188,123</td>
<td>2,411,997,070</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12%</td>
<td>11,003,713,106</td>
<td>2,105,122,115</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>
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   2.2 OBJECTIVES
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WORKS CITED

WEBSITES CONSULTED
1. Introduction
In recent years, Haiti has registered a significant improvement in the provision of child healthcare services. The results of the surveys on the Haiti Mortality, Morbidity and Service Utilization (EMMUS V) showed that immunization coverage increased from 34% in 2000 to 41% in 2006, reaching 45% in 2012. The rate of infant mortality was 80 per thousand in 2000 while in 2012 it dropped to 59 per thousand live births. These improvements are the result of efforts by the Ministry of Public Health and Population (MSPP) with the support of some local and international organizations to reduce infant mortality and improve immunization coverage. Positive progress has been made in this area with the progress of the Expanded Program on Immunization (EPI).

Nevertheless, the infant mortality rate remains very high. The reasons provided include their inaccessibility due to the remoteness of health centers, the lack of availability of immunizations, the lack of skilled health personnel, poor quality health centers, etc.

Infectious diseases remain one of the main causes of infant deaths. With a high ARI rate at 20.4% (Acute Respiratory Infections) in children, only 45 out of 100 children have received all their immunization doses. This alarming situation could deteriorate even more now that the birth rate is accelerating as the country sinks into poverty. Newborns are exposed to all kinds of diseases. These require serious support to significantly reduce the infant mortality rate from preventable diseases through immunizations such as diphtheria, tetanus, pertussis, and measles.

Thus, the programs and the efforts already made must subscribe to a principle of continuity. The program below was established in order to significantly reduce the infant mortality rate

2. Intervention presentation
2.1 Description
The intervention "full immunization of children aged 0-1 years by strengthening immunization services throughout the territory" aims to strengthen existing immunization services in the 644 health institutions within the area of study (the entire country).
This reinforcement has two components: the first is to develop qualified personnel for the administration of immunizations and the second is to make the basic amenities needed to ensure the quality immunization services available.

**Part 1: Establishment of qualified personnel:**

Skilled health personnel are essential to achieve a management and efficient delivery of immunization services. This part of the program aims at training personnel at all levels of immunization services in the Expanded Program on Immunization (EPI). It includes training and retraining of personnel in the EPI. This will help maintain and increase the level of immunization coverage and quality.

- **Part 2: Availability of immunization equipment needed for all immunization services in health institutions:**

The immunizations included in the full immunization of children are defined in the immunization schedule established by the Ministry of Public Health and Population (MSPP) in accordance with the recommendations of the World Health Organization (WHO). As of 2013, the full immunization of a child includes: BCG tuberculosis vaccine, the Polio 0 dose at birth, the three doses of the pentavalent diphtheria vaccine, the tetanus vaccine, the pertussis vaccine, three doses of the polio vaccine and the measles vaccine. According to the immunization schedule, these immunizations should be administered to the child during their first year of life. Accordingly, this aspect of the program tends to make these vaccines available in sufficient quantities in health and other institutions, as well as other basic equipment such as injection equipment (syringes and needles...). The program also includes transporting the vaccines.

### 2.2 Objectives

The program "full immunization of children aged 0-1 years by strengthening immunization services throughout the territory" has the following objectives:

- Contribute to the reduction of infant mortality in the country.

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5 La liste des vaccins incluse dans la vaccination complète de l’enfant se modifie chaque année
6 Rapport statistique 2013, MSPP.
● Bring the national immunization coverage to 90% by 2020
● Have qualified staff in the Expanded Program on Immunization (EPI) at all levels of providing immunization services
● Improve the quality of immunization services offered by the institutions

2.3 Duration and Scope of the Project

2.3.1 Duration
The project will be implemented over a period of five (5) years, starting in 2017 and ending in 2021.

2.3.2 Program demographics and dimensions
The program will take place throughout the territory of the Republic of Haiti. Administratively, the country's ten departments and health institutions providing immunization services are distributed as follows:

<table>
<thead>
<tr>
<th>Departments</th>
<th>Health institutions providing immunization services</th>
</tr>
</thead>
<tbody>
<tr>
<td>West</td>
<td>198</td>
</tr>
<tr>
<td>South</td>
<td>58</td>
</tr>
<tr>
<td>South-East</td>
<td>48</td>
</tr>
<tr>
<td>North</td>
<td>54</td>
</tr>
<tr>
<td>North-West</td>
<td>76</td>
</tr>
<tr>
<td>North-East</td>
<td>27</td>
</tr>
<tr>
<td>Central</td>
<td>35</td>
</tr>
<tr>
<td>Artibonite</td>
<td>83</td>
</tr>
<tr>
<td>Nippes</td>
<td>27</td>
</tr>
<tr>
<td>Grand-Anse</td>
<td>38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>644</strong></td>
</tr>
</tbody>
</table>

Source: EPSSS 2013

The program aims to reach 60% of unvaccinated children under one year old in Haiti. A total of 862,346 children aged 0-1 years will be immunized in the next 5 years (2017-2021). The national immunization coverage rate will rise gradually to 60% respectively in 2017; 70% in 2018; 80% in 2019; and reach 90% by 2020 and 2021.
Accordingly, all health institutions in the country that provide immunization services will be strengthened within the scope of this project.

2.3.3 Beneficiaries
Children aged less than one year will be the direct beneficiaries of the program, as well as parents who will save time and money. The Haitian health system also benefits by reducing spending on health care for children.

3. Costs and Benefits Calculation

3.1 Methodology
The methodology used is that of the Cost-Benefit Analysis (CBA), which compares the benefits to the costs of a project or program. The results of this analysis are expressed in the "cost-benefit ratio" report (BCR) which indicates the level of profit that is obtained by each gourde spent.

3.1.1 Data Sources

- **Demographic Data**
  
  As part of this work, the data on projections of the infant population aged 0 to 1 year that have been used are those produced by the Haitian Institute of Statistics and Informatics (IHSI) and the Latin American Center for Demography (CELADE) - Population Division of ECLAC jointly with the United Nations Population Fund (UNFPA) for the period of 1900-2020. Regarding the infant population estimate of the year 2021, the calculation was made by the researcher. Based on existing projections, an average growth rate was calculated for the estimation.

The table above shows the infant population projection by single age.
Table II.

<table>
<thead>
<tr>
<th>Age</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>264,438</td>
<td>264,550</td>
<td>254,530</td>
<td>264,375</td>
<td>264,084</td>
<td>264,005</td>
</tr>
<tr>
<td>1</td>
<td>259,247</td>
<td>259,612</td>
<td>259,846</td>
<td>259,942</td>
<td>259,894</td>
<td>260,055</td>
</tr>
<tr>
<td>Total</td>
<td>523,685</td>
<td>524,162</td>
<td>514,376</td>
<td>524,317</td>
<td>523,978</td>
<td>524,060</td>
</tr>
</tbody>
</table>

Source: IHSI/CELADE/UNFPA

- **Macroeconomic variables used in calculations**
  - The average annual inflation rate in Haiti is 7.38%. It is assumed to be constant throughout the duration of the program.
  - The real exchange rate is assumed to be constant throughout the duration of the project at 63.38 gourdes/USD.

**3.1.2 Cost estimation method**

All major costs linked to the program are included in the calculations and they were quantitatively evaluated within the scope of this work. The base year is 2017. The three reduction rates used are: 3%, 5%, 12%.

- **Cost of immunization equipment**
  The total cost of the immunization was calculated from data provided by the WHO and the MSPP on the unit cost per immunized child was $78 USD in 2016. This amount has been adjusted for annual inflation throughout the duration of the program. No additional vaccine administration costs were added.

- **Cost of injection equipment**
  The cost of injection equipment was estimated by the researcher based on that which has been calculated in the MSPP cMYP (comprehensive Multi-Year Planning). As part of this program, the cost of injection equipment accounts for 60% of the estimated cost in the cMYP.

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7 Banque de la République d’Haïti, taux d’inflation moyenne 2009-2016
8 PPAC: Plan Pluriannuel Complet du programme élargi de Vaccination 2011-2015
● **Program transportation and maintenance cost**

The hypotheses used by the researcher include: the program's transportation and maintenance costs, which represent 2% and 5% of the cost of vaccines and injection equipment, respectively.

● **Cost of training personnel**

The total cost of training the estimated immunization personnel throughout the entire 2011-2015 EPI Multiannual MSPP Plan was referenced and adjusted for inflation in the context of this work.

3.1.3. **Benefit estimation method**

All major benefits linked to the program are included in the calculations and they were quantitatively evaluated within the scope of this work.

● **Benefit of reducing the infant mortality rate**

In this part, the benefits of reducing the infant mortality rate were estimated in monetary terms. The disability-adjusted life years (DALYs) due to premature death and the Gross Domestic Product (GDP) were used to estimate the economic losses that would occur without the program, or economic benefits that will be gained with the program. To obtain the monetary value of economic benefits gained by the country, the economic value of each Daly avoided through immunization has increased the number of lives saved throughout the duration of the program.

It should be noted that the calculation was done based on three different scenarios: low, medium and high.

● **Economics of health care (economic value of avoided morbidity)**

In this part, the current value was estimated in monetary terms for: the economic benefits gained by families or healthcare systems with the reduction of morbidity from diseases preventable through immunization. Knowing that in Haiti, Acute Respiratory Infections (ARI) are one of the main causes of infant mortality, the sick child who has symptoms of ARI should be immediately taken in for a consultation at a healthcare facility. Thus, the calculation was made
on the amount of gourdes spent on consultations and how much could be saved by reducing the rate of Acute Respiratory Infections (ARI) in children.

It is assumed that the program has reduced the rate of ARIs in Haiti by half (50%) to approximately 20.4% (EMMUS V). It is therefore appropriate to multiply the number of averted infections (through the program) by the average cost of curative care for children under five years of age (444 gourdes)\(^9\) to estimate the amount of gourdes saved.

- **Savings for the parents**

In this part, the current value that has been estimated is that of the benefits (income) that would be lost due to the sickness of a child and that would could be saved through immunization. Accordingly, the value of unpaid time spent by productive mothers at the bedside of their disabled children following an infectious disease is estimated in monetary terms. Given that, firstly, the value of time for the average person in Haiti is fixed at 50% of annual average wage and the other, 2% of children\(^{10}\) with ARIs are disabled each year. Half the average salary should be multiplied in Haiti by the number of children with disabilities to estimate annual income earned by mothers.

### 3.1.4 Sensitivity Analysis

In this part, the parameters and their variations which could affect the program were identified. A number of sensitivity tests and the key variables of the model were carried out to identify sources of uncertainty that the project faces and finding the appropriate mitigation measures to reduce the exposure to uncertainty. The extent of variation of these parameters is shown in the table below.

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\(^9\) Karna Georges KONE, 2011, Analyse des coûts et financement des soins de santé primaires dans la zone goavienne, en Haïti, Médecin du Monde

\(^{10}\) NB: Hypothèse du chercheur: 2% d’enfant handicapés suite à une IRA
Table III.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Baseline scenario</th>
<th>From</th>
<th>To</th>
<th>Increase interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccine prices</td>
<td>$78</td>
<td>-20%</td>
<td>+20%</td>
<td>+10%</td>
</tr>
<tr>
<td>Exchange rates</td>
<td>63.38 gourdes</td>
<td>-25%</td>
<td>+20%</td>
<td>+10%</td>
</tr>
<tr>
<td>Inflation</td>
<td>15%</td>
<td>-30%</td>
<td>+20%</td>
<td>+10%</td>
</tr>
<tr>
<td>Consultation cost</td>
<td>444</td>
<td>-25%</td>
<td>+20%</td>
<td>+10%</td>
</tr>
</tbody>
</table>

3.2 Results

3.2.1 Impact of the program

- **Benefit of reducing the infant mortality rate**

The "immunization of children" intervention, with a percentage of 90% efficiency, would prevent 16,506 infant deaths. The present value of economic benefits of these deaths averted shows that for a DALY value estimated at 3x the GDP per capita and a 5% discount rate, the country would gain 32 billion gourdes for all lives saved with the program.

- **Health Care Economics**

In the baseline situation (without the intervention), the number of children with an ARI each year in Haiti is estimated to be over 106,000, or an ARI rate of 20.4%. With the program, the number of children was reduced by half (10.2%), meaning 53,465 thousand children. Accordingly, the present value of benefits (income) spared by the healthcare system or the parents for the curative care for children with an ARI is estimated at over 16 million gourdes throughout the intervention.

- **Immunization benefits for parents:**

In addition to the direct impact of immunization on reducing mortality rates, immunizations also help reduce long-term disability due to infectious diseases in children. The disabled child forces an active parent, especially the mother, to interrupt their professional activities to remain at their bedside. Thus, immunizing children not only provides parents with the ability to economize their finances but also increase their productive time.

The results of the analysis on the benefits of immunization for parents shows that without the
program, ARIs will be responsible for the disability of more than 2,000 children each year in Haiti. The mothers of these children with disabilities cannot work properly and this largely affects the family's economic situation. With the program, parents can save on average more than 61.9 million gourdes per year. The total present value of income saved by the parents throughout the duration of the program is estimated at 281.7 million gourdes.

- **Economic benefits and total economic costs**

Overall, the economic benefits at a 5% discount rate is approximately 32.3 billion gourdes for a total cost of 2.4 billion gourdes. As illustrated the following graph:

### 3.2.2 Cost-Benefit Ratio (BCR)

The cost-benefit ratio is estimated as the present value of benefits over the present value of costs. It allows us to measure the benefits expected by society for each gourde invested in infant immunization. The results of the program's cost-benefit analysis show that for a 5% reduction, the cost-benefit ratio is 13, the ratio being greater than one (1) unit implies that the expected return is 13 times larger relative to each gourde spent. Therefore, the program is beneficial, as shown in the table below.

<table>
<thead>
<tr>
<th>Program</th>
<th>Discount Rate</th>
<th>Benefits</th>
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<td>2,105,122,115</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

### 3.2.3 Sensitivity Analysis

The parameters that have the greatest impact on the program are vaccine prices and exchange rates. Vaccines are important inputs for the implementation of the program. Naturally, when immunization prices fall below $78 USD or $62 USD per child immunized, that is to say, a negative variation of 20% of vaccines, the cost-benefit ratio (BCR) would be affected positively. Thus, for a reduced value to 3%, the BCR is estimated at 21. So, the project becomes much more profitable. Conversely, any increase in the price of vaccines significantly reduces the cost-benefit ratio.
The same observation was made for the exchange rate, any upward variation reduced the BCR. For a variation at a 20% decline in the exchange rate, profits of 49.3 billion gourdes were recorded.

The sensitivity analysis indicates that the variation of parameters such as: inflation and the cost of consultations have no significant impact on the cost-benefit ratio of the program.

4. Conclusion
Finally, we have seen several key elements in the cost-benefit analysis of the full immunization of children aged 0 to 1 year project in Haiti. It remains a fact that the infant mortality rate in the country is the highest in the Caribbean; likewise, the national immunization coverage that could remedy this situation remains very low and there is a care provider training deficit in the area. Thus, program to be implemented includes fully immunizing infants aged 0-1 years throughout the national territory while strengthening immunization services. So for a good evaluation of this program, as we have just seen, we used the "cost-benefit analysis" approach. The results of the analysis show that the estimated costs are significantly lower compared to the benefits. For example, at a 5% reduction rate, the cost-benefit ratio shows that for every gourde invested, the expected return is thirteen (13) times over. Accordingly, the programs aimed at reducing child mortality through infant immunization will procure a considerable discount on health costs, a return on the money invested, and other economic benefits that may increase the welfare of the Haitian population.

As the project is economically viable and beneficial, it seems plausible that investment in this area would be a wise and commendable choice.
Works Cited


Websites consulted
1.- file:///F:/IFPMA-IVS-FR_FactSheet3-17.1.13.pdf


3. - www.unicef.org/french/supply/index_57476.html
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.