

Factors influencing use of vaccination services and vaccination coverage in Haiti

Katja Schamp
The Netherlands

Master in International Health

KIT (Royal Tropical Institute)
Vrije Universiteit Amsterdam (VU)

Factors influencing use of vaccination services and vaccination coverage in Haiti

A thesis submitted in partial fulfilment of the requirement for the degree of
Master in International Health

by

Katja Schamp
The Netherlands

Declaration:

Where other people's work has been used (either from a printed source, internet or any other source) this has been carefully acknowledged and referenced in accordance with departmental requirements.

The thesis '**Factors influencing use of vaccination services and vaccination coverage in Haiti**' is my own work.

Signature:



Master in International Health
March 2015 – February 2020

KIT (Royal Tropical Institute)/ Vrije Universiteit Amsterdam
Amsterdam, The Netherlands
February 2020

Organised by:

KIT (Royal Tropical Institute)
Amsterdam, The Netherlands

In co-operation with:

Vrije Universiteit Amsterdam/ Free University of Amsterdam (VU)
Amsterdam, The Netherlands

Table of contents

List of figures and tables	v
List of abbreviations	vi
Abstract	vii
1 Introduction.....	viiviii
2 Context and Background on Haiti.....	1
2.1 Short history	1
2.2 Geography	1
2.3 Demography	1
2.4 Culture.....	2
2.5 Politics	2
2.6 Economy.....	3
2.7 Country Health status.....	3
3 Problem statement.....	4
4 Justification.....	6
5 Study objectives	8
5.1 Overall objective.....	8
5.2 Specific objectives	8
6 Methodology	9
6.1 Analytical framework	9
6.2 Literature review	10
6.3 Analysis of data set.....	11
6.3.1 <i>Data set description</i>	11
6.3.2 <i>Data analysis</i>	11
7 Study results	13
7.1 Literature review	13
7.1.1 <i>The factors for use of vaccination services in Haiti</i>	13

7.1.2	<i>The Expanded Programme on Immunization in Haiti</i>	20
7.1.3	<i>The vaccination coverage in Haiti in children under-5</i>	20
7.2	Analysis of data set	22
8	Discussion	24
9	Limitations.....	27
10	Conclusion	28
11	Recommendations.....	29
	References	30
	Acknowledgement	33
	Annex 1: Fiche E: Examen physique	34
	Annex 2: Fiche F: Revue de dossier	37
	Annex 3: Fiche G: Status Socio-Economique	38
	Annex 4: Group characteristics.....	39
	Annex 5: Time of administration of vaccines.....	40
	Annex 6: Descriptive analysis of vaccination coverage at CRUO	41
	Annex 7: Logistic regression analysis of vaccination coverage at CRUO	42
	Annex 8: Short summary of vaccination coverage in Haiti in children under-5 and coverage CRUO ..	43

List of figures and tables

	Page
Context and Background on Haiti	
Figure 1: Population pyramid Haiti 1990 and 2015	1
Figure2: Departments of Haiti and its population distribution	2
Problem statement	
Figure 3: Causes of death in children under-5 2017 in Haiti (%)	4
Figure 4: Burden of disease 2017 for Haiti DALY's)	4
Justification	
Table 1: Mother and child care based on DHS	6
Methodology	
Figure 5: Analytical framework for Health Service Utilization	9
Figure 6: Detailed model of 'population characteristics'	10
Table 2: Categories used for calculations	12
Results	
Table 3: Difference in coverage between first born or child 6 or higher	16
Table 4: Short summary of vaccination coverage in Haiti in children under-5	20
Table 5: Group characteristics	39
Table 6: Time of administration of vaccines	40
Table 7: Descriptive analysis of vaccination coverage at CRUO	41
Table 8: Logistic regression analysis of vaccination coverage at CRUO	42
Discussion	
Table 9: Short summary of vaccination coverage in Haiti in children under-5 and coverage at CRUO	43

List of abbreviations

95%CI	95% confidence interval
ANC	Antenatal care
BCG	Tuberculosis-vaccine (Bacillus Calmette-Guérin)
CAL	<i>Centres de santé A Lits</i> (health centre with bed)
CPAP	Continuous Positive Airway Pressure
CRUO	<i>Centre de Référence d'Urgences Obstétricales</i>
CSL	<i>Centres de santé Sans Lits</i> (health centre without bed)
DHS	Demographic and Health Survey Programme
DTP	Diphtheria, tetanus and pertussis-vaccine
EMMUS-VI	<i>Haiti Enquête Mortalité, Morbidité et Utilisation des Services 2016-2017</i>
EPI	Expanded Programme on Immunization
EPSSS	<i>Évaluation de la Prestation des Services de Soins de Santé 2017-2018</i>
FDG	Focus group discussions
GAVI	Global Alliance for Vaccines and Immunization
GDP	Gross Domestic Product per capita
GVAP	The Global Vaccination Action Plan (2011-2020)
HCR	<i>Hôpitaux Communautaires de Référence</i> (Referral hospital)
HepB	Hepatitis B
Hib	Haemophilus influenza-b
KMC	Kangaroo Mother Care
LBW	Low-birth-weight
LMIC's	Low-and-middle-income-countries
MCV	Measles Containing Vaccine
MINUSTAH	The United Nations Stabilization Mission
MOV	Missed opportunities for vaccination
MSF	<i>Médecins sans Frontières</i> (Doctors Without Borders)
MSPP	<i>Ministère de la Santé Publique et de la Population</i> (The Ministry of Public Health and Population)
NBW	Normal-birth-weight
OPV	Oral Polio Vaccine
Penta	Pentavalent-vaccine (diphtheria, tetanus, pertussis, hepatitis B and Haemophilus influenza-b)
PMS	<i>Paquet Minimum de Service</i> (Minimum Package of Services)
SIA	Supplementary Immunization Activity
SSPE	<i>Services de Santé de Premier Echelon</i> (First level Health Services)
UCS	<i>Unités Communales de santé</i> (Community health centers)
UNICEF	United Nations Children's Fund
UNMIH	The United Nations Mission arrived in Haiti
VPD	Vaccine-preventable disease(s)
WHO	World Health Organization

Abstract

Introduction: Haiti suffers from the worst health outcomes in their region. Vaccine-preventable diseases (VPD) contribute largely to the under-5 mortality and morbidity. Nevertheless, use of vaccination services is low.

Methodology: This thesis describes the factors influencing the use of vaccination services and the vaccination coverage in Haiti. A literature review has been conducted and a data set on vaccination status of 0-24 month old infants from a non-governmental-institution in Port-au-Prince has been analysed. An analytical framework has been used to present this information.

Results: Main environmental barriers are political instability, a decentralized health care system, insufficient health expenditure and insufficient (human) resources. The population with low socioeconomic status seems most affected by lower vaccination coverage. Coverage is too low to prevent outbreaks of infectious diseases. Our risk analysis and calculations on coverage were comparable to the findings in literature.

Discussion/recommendations: Even in a good health environment run by a NGO, vaccination uptake can be improved significantly. A relatively simple intervention would be health education and promotion. Stakeholders should focus on meeting basic needs and creating a stable public health system for Haiti to rely on.

Key words: Haiti; health services utilization; immunization programs; vaccination coverage.

Word count: 11515

1 Introduction

Vaccines have proven to be the most successful and cost-effective public health intervention ever. For most high income countries it has been a great contribution to modern medicine and present-day healthcare. Where some parts of the world worry because of loss of trust in this medical preventive measure and dropping coverage rates with outbreaks of infectious diseases, others worry because they do not have access to this particularly wanted and needed instrument.

As a medical doctor I am confronted with the effect of the presence and absence of vaccines in every aspect of my work. As a Tropical doctor I experienced the difficulties of access and the consequences in the form of preventable infectious diseases. As a General Practitioner in training I encounter patients with questions about additional vaccines, questions about safety and children who are not vaccinated.

For Haitians access to and use of vaccination services is a large problem and many people are still dying from preventable diseases. By addressing the barriers we aim to give recommendations to increase the uptake of vaccine services and coverage.

2 Context and Background on Haiti

2.1 Short history

In 1492 Christopher Columbus arrived on the island and he named it Hispaniola. Rapidly its indigenous inhabitants became extinct as they were forced to slavery and suffered from diseases brought by their Spanish settlers. Over the years slaves from the African continent were brought in as replacement and work on the sugarcane plantations. In 1697 with 'The Peace of Rijswijk', the western one third of the island was ceded to the French, present Haiti. The eastern part became present Dominican Republic. At the end of the 18th century a revolution against the French was led by the former slave Toussaint L'Ouverture, leading to the abolishment of slavery and preparing Haiti to be the first independent nation led by a former slave.^{1,2}

2.2 Geography

The island is part of the North American continent and is situated in the Caribbean between the North Atlantic Ocean and Caribbean Sea. Hispaniola (Haiti and The Dominican Republic), together with Cuba, Jamaica and Puerto Rico form the archipelago The Greater Antilles. Haiti covers 27,750km² of land and this western part of the island is about 80% rough and mountainous, with the highest point being 2,680m above sea level. Haiti's capital is Port-au-Prince, is divided in 10 departments and the urban areas occupy 2% of the landmass.^{3,4} The country has a tropical climate and this zone is prone to natural hazards such as hurricanes, earthquakes and seasonal droughts. In 2010 a 7.0 magnitude earthquake took the life of approximately 300,000 inhabitants, destroyed the homes of 1.5 million persons and was the largest earthquake in over 200 years. This was followed by a cholera outbreak where 705,207 cases and 8,559 deaths were recorded over the next 3.5 years. Hurricane Matthew blew over in October 2016 and affected roughly 2.1 million people, not only by destroying their housing but the rebuild infrastructure and agriculture as well.^{1,5} Most Haitians rely on agriculture, but deforestation and land corrosion because of wide use of tree-based fuels occasionally cause heavy flooding and pose a threat on this source of food and income.⁶

2.3 Demography

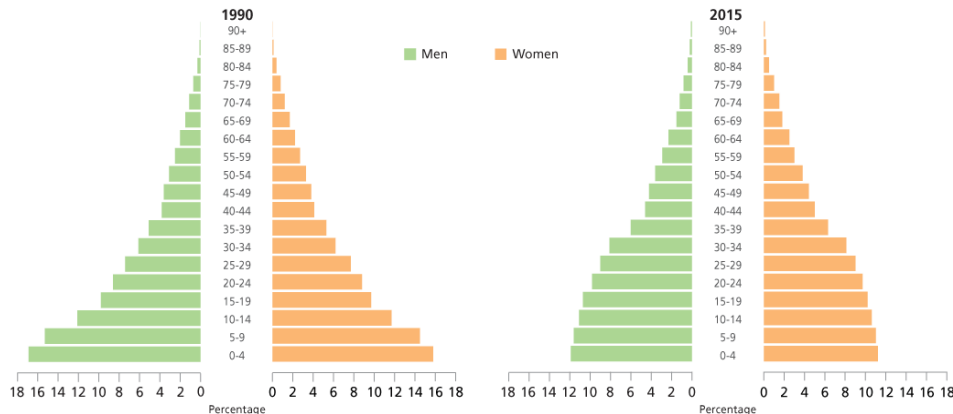


Figure 1: Population pyramid Haiti 1990 and 2015³

In 2018 Haiti counted over 11 million inhabitants.⁷ Haiti has a young population with over 50% under the age of 25 and more than 30% are under the age of 15.³ The population has doubled over the last 30 years and the life expectancy has increased with 13 years to an average of 62 years in 2012. The change in population structure as seen in Figure 1 can be explained by decreased infant mortality followed by decreased fertility rates (3.1 in 2013).^{3,8}

The population is spread evenly through the country with the exception of the metropolitan area of Port-au-Prince, where lives almost a quarter of the total population. More than half of the population lives in urban areas with a small preference for the coast line(Figure 2).^{3,9} In 2012, the adult literacy rate was 77%¹⁰ and lower than the surrounding countries: 99.75% in Cuba and for the Dominican republic it was 90.16% in 2012 and 93.78% in 2016. The global literacy rate was estimated over 90% in 2012 and 2018.¹¹

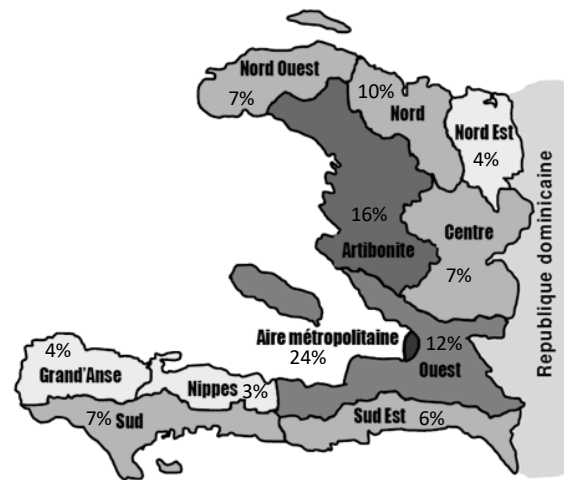


Figure2: Departments of Haiti and its population distribution¹²

2.4 Culture

The majority of the Haitian population is of African origin and only a small proportion is white or mixed. The official languages are French and Creole. The majority of the population adhere to Christian beliefs, where the Roman Catholic religion is the largest, followed by Protestantism. Vodou has been recognized as an official religion since 2003. The religion is based on the West-African Vodun-religion, brought over by the slaves and they adhere a god, spiritual beings and spirits of their ancestors. Officially it is a small group, but many Haitians involve elements of Vodou in their religion and daily life.¹³

2.5 Politics

After independence from France in 1804 Jean-Jacques Dessalines declared himself emperor. The decades after that were characterized by frequent changes in heads of state and partition of its population which continued until present time.¹

The 20th century started with the occupation of the United States because of fear of loss of their investments in the country. They left in 1934, but maintained fiscal control up to 1947.

Throughout the 1960's up to and including the 1980's Haiti was ruled by father and son dictators Francois "Papa Doc" and Jean-Claude "Baby Doc" Duvalier, the latter was forced to exile in 1986.¹

From 1995 to 2017 the United Nations were in Haiti, supporting the national leaders. Their mission was to restore democracy, provide political stability and strengthen the national army and police.¹

Nowadays there are violent protests against the president because of corruption, worsening inflation and fuel shortages.¹⁴

2.6 Economy

Haiti is the poorest country in Americas with 59% of its population living below the national poverty line. The Gross Domestic Product per capita (GDP) in 2017 is estimated at \$765 by the World Bank and with a Gini-coefficient of 0.61 in 2012 it is one of the most unequal countries in the Americas.¹⁵ The political uncertainty has a great influence on the economic growth due to decreasing investments and foreign aid. While large proportion of the annual budget is coming from foreign aid.¹⁵ People in the rural areas are considerably poorer than the ones in the urban areas¹⁰ and there is an estimation of 40% unemployment in the country.⁵

2.7 Country Health status

The maternal mortality ratio modelled estimate in Haiti has been increasing over the years with 437/100,000 live births in 2000 to 480/100,000 live births in 2017. The opposite has happened with under-five mortality: in 1990 it was 145/1000 live births and it reduced to 65/1000 live births in 2018. Solely in 2010, the year of the earthquake, an increase has again been observed to 209/1000 live births. Globally the maternal mortality ratio modelled estimate decreased from 342/100,000 live births in 2000 to 211/100,000 in 2017. The under-five mortality decreased as well with 93.2/1000 live births in 1990 to 38.6 in 2018.¹⁶

3 Problem statement

Despite the presence of a multi-year plan to rebuild and strengthen their health care system¹⁷ and a specific plan for their Expanded Programme on Immunization (EPI),¹² Haiti still had the highest under-5 mortality rate in the Western hemisphere in 2017.¹⁸ A large component of their mortality and morbidity is invariably being dominated by infectious diseases like acute respiratory infections, including pneumonia, and diarrhoeal diseases (Figure 3 and 4).^{4,8}

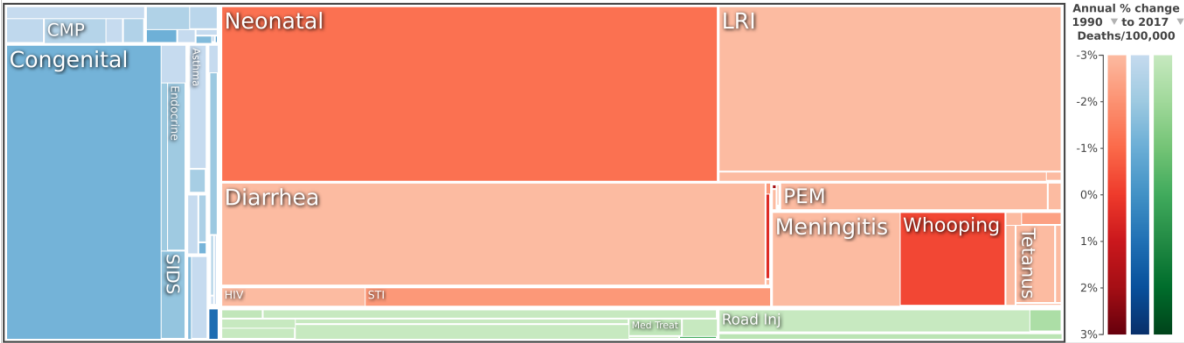


Figure 3: Causes of death in children under-5 2017 in Haiti (%)¹⁹

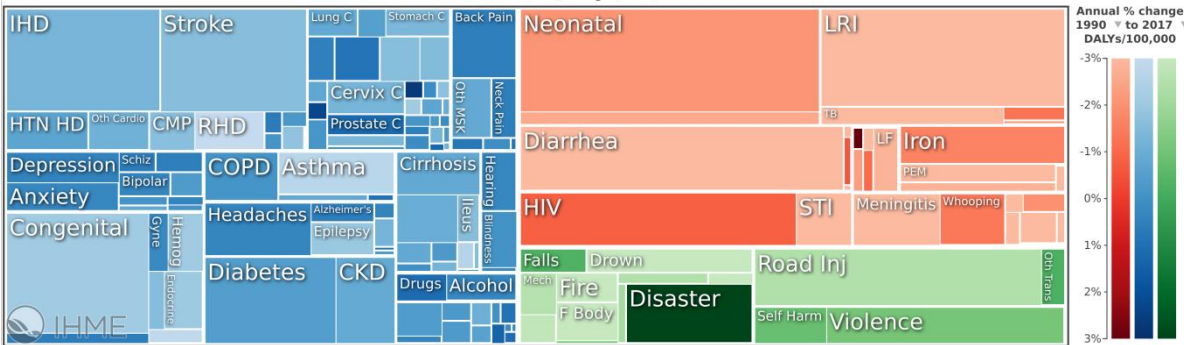


Figure 4: Burden of disease 2017 for Haiti (DALY's)¹⁹

According to a national survey on morbidity and mortality in 2017 10% of children under-5 had symptoms of respiratory tract infection 2 weeks preceding the survey, with a slightly higher prevalence of 13% in de metropolitan area of Port-au-Prince. For diarrhoea this percentage was 21% nationally, with the highest prevalence in the age group of 6-11 months: 38%.⁴ This survey also showed that only 41% of children between 12 and 23 months received all basic vaccinations.⁴ The above mentioned infections are predominantly being caused by bacteria and viruses, of which (the spreading) can be prevented by vaccination, the so called Vaccine-preventable Diseases . Poor vaccination coverage may play a role in both high mortality and morbidity rates in Haiti.

The effects of high mortality and morbidity rates go beyond health only. High costs of healthcare and sickness lead to spending and loss of productivity for the person itself, their family, as well as for the country. These disadvantages can be temporarily, but there is the danger of illness leading to permanent disability. Illness can lead to deterioration of cognitive skills in children, less physical strength and reduced performance at school and productivity with no benefit for society and the economy.²⁰⁻²³

To address the problem of VPD's the Expanded Programme on Immunization was created in 1974 by the World Health Assembly with the goal to immunize all children worldwide and protect them from the infectious diseases which could lead to serious illness, disability or death. The foundation of EPI

was a reaction to the success of eradicating smallpox and a step to achieve health for all. The six diseases targeted at that time were tuberculosis (BCG-vaccine), diphtheria, tetanus, pertussis (DTP-vaccine), measles and poliomyelitis.

Since 1974, new vaccine antigens are added to national programmes and most countries have added hepatitis B and Haemophilus Influenza type b (Hib-vaccine). Also, many low income countries are considering to add rotavirus, rubella and pneumococcal vaccines to their EPI schedule.²⁴

Over the years the use of vaccines has proven to be a very efficient, successful and the most cost-effective intervention ever to reduce child mortality and morbidity by controlling and even eradicating infectious diseases. VPD's like measles, polio and pertussis have decreased in incidence and the annual number of deaths in children under five fell from an estimated 9.6 million in the year 2000 to 7.6 million in 2010 globally. This was a result of immunization together with better health education, improved hygiene and access to clean water and sanitation.²⁵ Haiti has been polio-free since 1991 and the elimination of measles and (congenital) rubella was confirmed in 2014.²⁶

The positive effects of immunization are clear, however developing and maintaining a vaccination programme needs dedication and resources. Vaccines have been here for years, but challenges in uptake remain. Some are universal, some are more concentrated in low-and-middle-income-countries (LMIC's).

For instance national legislation may dictate that vaccines need local licensing. Prequalification by the WHO or other organizations may be seen as insufficient. This can cause a delay in incorporation in the EPI and use.²⁷ Also financing vaccines, materials, logistics and human resources can be a large hurdle. Support from donors like Global Alliance for Vaccines and Immunization (GAVI) is available, but it may differ in time and type of support.²⁸ Immunization needs a steady long term commitment. Likewise, supply through cold chain and logistics can be difficult in countries without reliable access to transportation, roads, electricity and storage.²⁷ And equally as important, without human resources none of the earlier mentioned factors will function and there will be no communication nor service delivery for the people.

In Haiti determining and providing for the national immunization need is largely dependent on organizations like WHO, UNICEF, GAVI and foreign donors.¹² This applies to the routine immunization and Supplementary Immunization Activities (SIA). The EPI is integrated in the primary healthcare level and is part of the Minimum Package of Services (*Paquet Minimum de Service (PMS)*) with distribution points and outreach possibilities in 695 institutions. The vaccines in the EPI are free of charge. Unfortunately the institutions do not offer widespread services and there are many missed opportunities like insufficient numbers of staff, insufficient training of staff, lack of supervision, lack of inventory control, vaccine shortages, non-functioning cold-chains, poorly planned outreach and poor communication between providers and the people.^{12,29}

Unfortunately, we are also facing increasing problems globally such as outbreaks due to low immunization rates. The WHO speaks of the highest number of reported measles cases since 2006.^{30,31} People loose trust in vaccines because of false statements among other things, with a tendency of lower trust in higher income areas.³² Regions with social instability have to manage with collapsing health systems and pockets of low coverage. Also, travelling long distance has become more accessible leading to the spread of pathogens, possibly into an area unknown with these diseases or with low herd immunity. A terrible example being the introduction of cholera into Haiti by the UN peacekeepers after the earthquake.³³

At the end of 2019 there are reports from Haiti on outbreaks of diphtheria leading to illness and death.^{34,35} Also numbers on reported measles cases around the world keep increasing. This news puts an emphasis on the need of high vaccination coverage again. As a start Haiti took action by introducing a national vaccination campaign in July 2019 that targeted measles, rubella and polio.³⁶

4 Justification

Haiti deals with a high burden of disease and a scarcity of literature on immunization practices. Few studies present numbers of coverage and what remains underexposed are the factors influencing the use of vaccination services. Also, as demands are regularly changing, so is the vaccination schedule. This schedule should be easily available for everyone involved, but the content of the Haitian EPI cannot be found easily in a single document.

Data from Doctors without Borders (MSF) can give us an insight in vaccination practices. MSF started to support Jude-Anne-Hospital in Port-au-Prince in 2006 to address the high maternal mortality in the county. The hospital was destroyed by the earthquake and Centre de Référence d’Urgences Obstétricales (CRUO), an obstetrical emergency hospital, was set up as replacement. They discovered a gap in neonatal and paediatric services in Haiti and chose to expand their services with a neonatal care unit. CRUO offers free care 24 hours a day to high risk pregnant women with (pre)eclampsia, haemorrhage or in need of a caesarean section. For the neonates they offer Continuous Positive Airway Pressure (CPAP), oxygen, caffeine, IV fluids, antibiotics, anticonvulsants, incubator care and Kangaroo Mother Care (KMC). These services are more extensive than offered in Haiti in general. Table 1 displays basic mother and child care according to The Demographic and Health Survey of Haiti in 2017-2018.²⁹

Basic acts for emergency obstetric care (%)									
	antibiotics	oxytocin	anti-convulsant	assisted delivery	manual placenta removal	curettage	resuscitation of newborn	blood transfusion	caesarean section
Metropolitan area	87	87	48	87	65	59	57	39	57
National level	77	87	40	86	60	52	55	19	26
Health care providers having ever received education in immediate care for newborns (%)									
	breastfeeding	infection prevention	thermal care	umbilical cord care	KMC				
Metropolitan area	40	30	36	40	31				
National level	33	25	31	31	26				
Availability of essential medicines for newborns (%)									
	antibiotic ointment for eyes	chlorhexidin	injectable antibiotic						
National level	61	34	60						

Table 1: Mother and child care based on DHS²⁹

MSF conducted a prospective cohort study at CRUO from 2014 to 2017 with infants born there. The study objective was to compare health and developmental outcomes between low-birth-weight (LBW) and normal-birth-weight (NBW) infants born at CRUO for up to 24 months. The rationale behind this study was to have a better view on the long term outcomes of LBW infants in resource-limited settings. Exploring whether treatments in CRUO were always in the best interest of the infant on the longer term, because keeping very young, small neonates alive might actually cause long term serious physical, emotional or developmental harm. One of the components addressed during this study was to monitor vaccination uptake in the infants enrolled in the study. Additionally, CRUO was a temporary point of vaccination as well.

With the data collected we have the ability to describe the vaccination coverage for the cohort at CRUO and use this information to determine factors which influence vaccination coverage in an urban setting in Haiti.

With this thesis I aim to describe the current EPI schedule, the vaccination coverage of infants between birth and 24 months of age in urban Haiti and the factors influencing use of vaccination services. With this information I aim to give recommendations which may be useful for national and international stakeholders concerned with the implementation of EPI in Haiti.

5 Study objectives

5.1 Overall objective

To describe the vaccination coverage and the factors influencing the use of vaccination services in Haiti using data obtained by a cohort of infants born in the Centre de Référence d'Urgences Obstétricales in Port-au-Prince between October 2014 and February 2015 and followed up for 24 months (corrected for gestational age) and complementing it with a literature review.

5.2 Specific objectives

1. To describe factors influencing the use of vaccination services in Haiti.
2. To describe the Expanded Programme on Immunization in Haiti.
3. To describe the vaccination coverage in Haiti.
4. To describe the vaccination coverage at CRUO.
5. To give recommendations to the local authorities and key stakeholders in Haiti who are concerned with improving vaccination coverage.

6 Methodology

This thesis consists of two components. The literature review addresses the objectives to describe the factors influencing the use of vaccination services, the EPI and the vaccination coverage in Haiti. The analysis of secondary data addresses the objective to describe the vaccination coverage at CRUO.

6.1 Analytical framework

We used an analytical framework to provide a clear structure. The Andersen and Newman Framework of Health Services Utilization is one of the most frequently used frameworks for analyzing utilization of healthcare. “The purpose of this framework is to discover conditions that either facilitate or impede utilization. The goal being, to develop a behavioural model that provides measures of access to medical care.” It is a model which tries to integrate environmental, provider and individual elements with the decision to seek care. The model was developed in the 1960’s and adjusted in four phases which resulted in the final framework in the 1990’s.^{37,38}

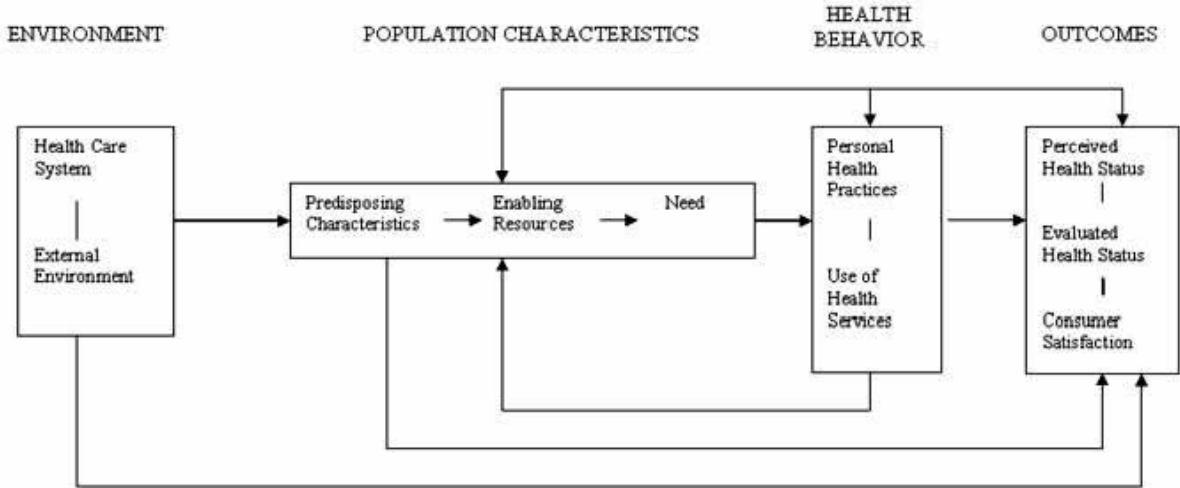


Figure 5: Analytical framework for Health Service Utilization

For the most part the literature review describes the section ‘environment’ and ‘population characteristics’ while the secondary data describes ‘use of health services’. Describing ‘outcomes’ of services utilization is not an objective of this thesis.

The original model has a more detailed explanation of the section ‘population characteristics’. The second model (figure 6) focusses on these details.

I chose to describe the demographics ‘age’ and ‘sex’ for both the infant as well as for the caregivers. I added ‘marital status’ to demographic, ‘family size’ to social structure and ‘region/urban-rural’ to community to the model, because there is information available on these factors and they can influence health service utilization.

Also the section ‘need’ is not applicable. Feeling the ‘need’ of a health service because of symptoms, disabilities, etc. is too late for a preventive service like routine vaccination. There cannot be prevention after having a vaccine-preventable disease. The need for use of preventive services will be discussed in the section ‘health beliefs’.

POPULATION CHARACTERISTICS

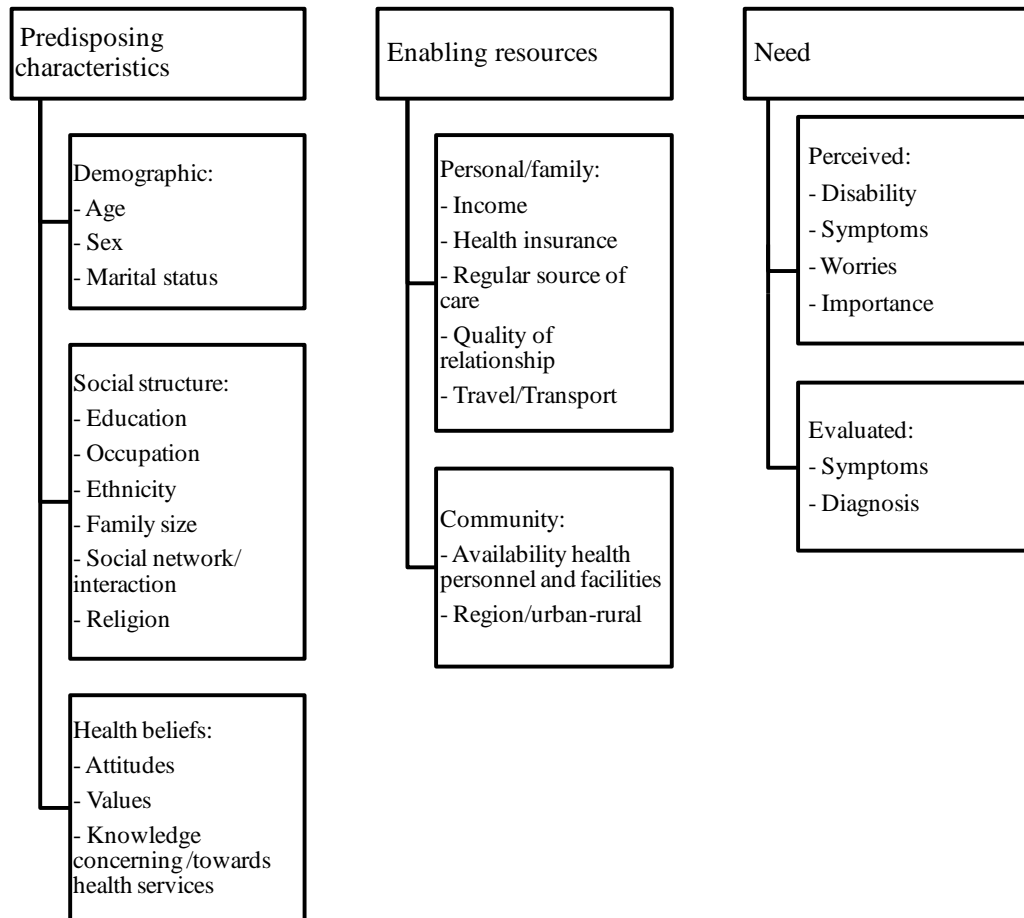


Figure 6: Detailed model of 'population characteristics'

6.2 Literature review

For the literature review we used the electronic database PubMed, including MeSH terms when applicable, and Google Scholar search machine. The following key words were entered as single and/or combinations of: Haiti; immunization programs; vaccination coverage; mass vaccination; infectious disease; health care; social determinants of health; socioeconomic; community; education; work; housing; lifestyle; culture; ethnicity; race; religion; vodou; health care facilities, manpower and services; health beliefs; (preventive) health services.

We included grey literature where relevant and actively searched content from the World Health Organization, World Bank, USAID; Ministry of Health Haiti, Global Alliance for Vaccines and Immunization and the BCC news and the Central Intelligence Agency .

Due to the scarcity of available literature, we placed no restrictions on publication dates. The language restriction was English, but some grey literature was in French. A snowball search was conducted as well.

6.3 Analysis of data set

6.3.1 Data set description

We have a secondary dataset from a study conducted by MSF: 'Health and developmental outcomes of low-birth-weight infants born at the Centre de Référence d'Urgences Obstétricales, Port-au-Prince, Haiti.' This prospective cohort was executed to identify risk factors associated with negative health and developmental outcomes in LBW-infants in comparison to NBW-infants.

710 infants were enrolled, of which 500 were LBW. The infants were born at CRUO between October 2014 and February 2015 and followed up from birth and post discharge at 3, 6, 12, 15, 18, 21 and 24 months, corrected for gestational age. After birth the infants received basic treatment at CRUO if necessary. The follow-up consisted of registering their history with respect to illness and treatment, vaccinations received and feeding problems; performing of an extensive physical examination and treatment of illness if necessary; receiving relevant vaccinations according to a schedule by MSF.

Multiple forms were used to register information on the infant, mother and family. At discharge and at every follow-up visit a new form was filled out. For this study the following were used:

- *Fiche E: Examen physique*
Every visit the infant underwent a physical examination and information was gathered on themes like physical abnormalities, development, illness, breast feeding and vaccinations among other things.
- *Fiche F: Revue de dossier*
The medical file of the infant and mother was checked for any irregularities or outstanding situations around and during labour and the first days of life.
- *Fiche G: Status Socio-Economique*
Information on education and employment of the parents.

For the analysis we focused on age throughout the cohort, gender and birth weight of the infant. From the parents we used information on marital status, educational level and employment. Vaccinations we reported on were BCG (to protect against tuberculosis), Pentavalent (diphtheria, tetanus, pertussis, hepatitis B and Haemophilus influenza), polio, measles and rotavirus.

6.3.2 Data analysis

For the analysis we used the statistics programme Stata, version 15.1 (StataCorp, College Station, TX, USA). After extensive data cleaning, appending, merging and recoding we have created one database with all the data we needed from all infants, including the date of administration of all the vaccines. Missing data was handled as 'no vaccination' or 'no answer'.

We derived our definition of complete immunization from the MSF schedule. This included one dose of BCG-vaccine, four doses of Polio-vaccine, three doses of Pentavalent-vaccine, one dose of Measles-vaccine and two doses of Rotavirus-vaccine within 24 months of age.

For analysing timely vaccination we divided the vaccines in three categories: received in time, not received in time, not received at all. With calculating the age of the infant at any vaccination we

could compare this to the recommended MSF schedule. We used strict margins because there is little time between multi-dose vaccines and all the margins should be about the same for comparison. We calculated the frequencies, proportions and their 95% confidence intervals (95%CI) of the vaccination coverage throughout the cohort.

For the data analysis with the infants who completed the 24 month follow-up we calculated how many months (1 month = 30 days) they were in the cohort. The last visit according to the schedule was at 24 months, but some caretakers visited earlier. 345 children were brought for their last visit and out of this group, 11 had their last consultation before they completed the 24 month follow-up. Because of the small difference of 3%, we chose to accept this discrepancy and used the '24 months-label'.

Suitable variables were recategorized to facilitate the analysis (Table 2). For 'marital status' and 'educational level mother' the variable with less categories showed a stronger association, we used these for the calculations.

Variable	Categories	Merged categories
Marital status	'single' 'married' 'cohabitation' 'separated'	'single and separated' 'married and cohabitation'
Educational level mother	'primary and less' 'secondary' 'post secondary'	'primary and less' 'secondary and up'
Educational level father	'primary and less' 'secondary' 'post secondary'	'primary and less' 'secondary and up'
Employment mother	'yes' (manual labour, office job, other) 'no' (without work, student)	
Employment father	'yes' (manual labour, office job, other, without pay) 'no' (without work, student)	

Table 2: Categories used for calculations

For the descriptive analysis we calculated frequencies, and proportions with CI's and to test associations between the different variables and complete immunization we used chi-square tests.

To identify predictors for infants being fully vaccinated at 24 months we calculated Odds Ratios, their 95% CI and p-values using univariate logistic regression. For the calculation of the conjoint p-value of a multiple-category-variable the command 'testparm' was used. Variables with a p-value <0.05 were used for multivariate logistic regression. The model was adjusted for sex.

7 Study results

7.1 Literature review

7.1.1 The factors for use of vaccination services in Haiti

In the following chapter the framework of Andersen and Newman³⁷ will be used to describe health service utilization in Haiti with reference to immunization. Every section of the framework will be described from left to right.

An important note is that in the case of immunization of infants aged 0-24 months it is always the caregivers decision to vaccinate the child. Therefore we will mainly discuss the health service utilization of the caregivers in the following chapter.

ENVIRONMENT

Health care system

The **Ministry of Public Health and Population** (MSPP) is responsible for healthcare, guided by a 25 year health plan developed in 2012.¹⁷ The plan's main objective is to reduce morbidity and mortality relating to the major health problems and make their health system adequate, efficient and accessible for the entire country. Incorporated in that plan is guidance of multiple **donors**, who all bring financial support.

Health is **decentralized** and the formal health services network consists of ten health departments and multiple Communal Health Units (*Unités Communales de santé* (UCS)), which all need to provide a Minimum Service Package (*Paquet Minimum de Service* (PMS)) and need to coordinate the primary health level. UCS have executive power over projects, financing and public services, including EPI. Unfortunately Haiti has not been able to apply this model in the entire county, because of lack of resources to set up and maintain this structure and lack of political will to follow the decentralization model. Not all UCS's correspond with an administrative division nationally.^{12,39}

In the current **health system** in Haiti, the health structures can either be public, private or mixed and the system contains three levels.

The primary level enables the population to access First-Level Health Services (*Services de Santé de Premier Echelon* (SSPE)) and consist of two sub-levels. The first sub-level has clinics, Health Centres without beds (*Centres de santé Sans Lits* (CSL)), Health Centres with beds (*Centres de santé A Lits* (CAL)) and medical practices. The second sub-level includes Community Reference Hospitals (*Hôpitaux Communautaires de Référence* (HCR)) with access to Internal Medicine, Surgery, Paediatrics, Obstetrics and Gynaecology.

The secondary level includes the Departmental Hospitals and the specialized medical practices allowing a recourse to specialized care.

The tertiary level mainly focuses on research and training. This includes University Hospitals and Specialized Hospitals such as psychiatry hospitals and a sanatorium and they provide national referral care.³⁹

According to the List of Health Institutions of Haiti (*Liste des Institutions Sanitaires du Pais, 2015*), the country has 1048 **health institutions** of which more than 8% is not functioning. 74% of these institutions are dispensaries and CSL, 14% are CAL and 12% are hospitals.

The Western department has the largest concentration of all of the health institutions mentioned above: 12% of all dispensaries, 60% CSL, 36% CAL and 57% of all hospitals nationwide. Artibonite and the Northern department are second and third in health facilities in the country. The majority of the institutions are private: 47%, 37% is public and 16% is mixed. The Western department has the highest concentration of private institutions in Haiti: 52%. Followed by the North with 12.45% and Artibonite with 12.24%.⁴⁰

Availability of services: The Demographic and Health Survey of Haiti in 2017-2018 '*Évaluation de la Prestation des Services de Soins de Santé*' (EPSSS) assessed that 42% of the institutions offer basic services. Preventive services for children under-5 are not always available and 66% offers immunization. Divided over the types of health institutions: 60% of hospitals offer immunization; 65% of CAL; 57% of CSL and 74% of dispensaries²⁹

Out of all public institutions 87% are supposed to provide immunization, from the private non-profit ones 43%, from the private for-profit 45% and from the mixed 75%. Although a substantial proportion of facilities are meant to provide vaccines, shortages are common. For example, basic vaccines like DTP or Pentavalent, Polio, Measles and BCG were only available in 58% of all institutions.²⁹

Percentage of institutions that offer childhood immunization per department: North-West 90%; Grande-Anse 85%; South 76%; Nippes 74%; Artibonite 69%; South-East 62%; Centre 58%; West 58% (Aire Métropolitaine 51%; rest West 66%); North-East 54%; North 50%.²⁹

The EPSSS presents the availability of immunization services by type of vaccine and number of possible days a week to vaccinate. All departments have different availability in type and time.²⁹ Also, vaccinations can be provided as part of the EPI or SIA.¹²

The government created the **PMS** in 2006. This package includes: comprehensive care for children; care during pregnancy, childbirth and reproductive health; medical and surgical emergencies; treatment and prevention of communicable diseases; basic dental care, health education, availability and access to essential medication; sanitation, save access to drinking water and vaccinations.³⁹ Not all levels of the public health system are required to offer the PMS, it mainly occurs at the primary level. The PMS is not costed in the health expenditure.⁴¹ No information was found on payment/ out-of-pocket expenditure for vaccines.

For **vaccine management** Haiti uses the WHO 'Vaccination Supply Stock Management' system to control, document and track the storage and distribution of the vaccines and supplies.⁴²

A **cold chain** system is needed to store and transport the vaccines at a specific temperature. This is needed for the vaccines to hold their potency. In Haiti this system consists of three levels. On a national level there are temperature regulated storage warehouses that hold all the vaccines for the country in Port-au-Prince. The intermediate level has depots in the ten departments and some difficult to reach geographical areas. The depots are provided with electric- and solar-powered refrigerators. In the peripheral level the health facilities are provided with propane, electric- and/or solar-powered refrigerators. During 2012-2014, after the earthquake, international organizations helped to strengthen this system and the capacity of storage increased with 91% to hold 103% of the required vaccines on a national level and on an intermediate level storage increased with 285% to hold 100% of the required vaccines.⁴²

Health expenditure in 2017 it was stable around 1-2% of the GDP, but decreasing to 4.4% of total government expenditure, what translates to \$13 per capita. The MSPP allocates 90% of their budget to human resources, leaving little for supplies and other necessities. Also 38% of their total health budget is spend in the hospital sector.⁴¹

The country relies greatly on foreign aid, but after the earthquake financial support went down and the health sector suffered most.⁴¹ Between 2012 and 2014 contributions decreased by 161%.¹⁰ In

2011-2012 64% was financed by donors, an additional 7% came from the government and households paid 29%. For the first three months after the earthquake hospital services were free, however this was unsustainable. Out-of-pocket expenses have been rising again, almost to pre-earthquake levels in 2017.⁴¹

Haiti does not have policies for **human resources** in health which results in poor management. There is an imbalance between administrative staff and care providers. Also, Haiti lost a significant amount of health care workers during all the natural disasters.

An assessment conducted by the MPSS in 2016 concluded that there are 23,344 health professionals, 15,980 in the public sector and 7,364 in the private sector. This translates to 1.4 physicians and 1.8 nurses /10,000 inhabitants in the public sector and 1 physician and 2.1 nurses /10,000 in the private sector. The physicians in the public sector are spread through the country with 2.1/10,000 in the West department, 1.8 in North, 1.3 in Northeast, 1.3 in South, 0.7 in Northwest and less than 1 in the rest of the departments. The same trend exist in the private sector.³

Also productivity of health personnel is low. The World Bank assessed that an average of 6 patients are seen per day by one person and health care workers regularly work in the public and private sector at the same time, what leads to high absence of staff but with receiving of a full salary. The estimated salary-waste is 3 million dollars per year.⁴¹

Knowledge on the importance of vaccinations is spread by **health education**. In Haiti all types of institutions in every sector have a communication and social mobilization strategy for vaccination activities. Communication by the way of health professionals in 10% of the institutions, community health workers (55%), village chiefs (6%), criers (77%), churches (48%), schools (30%), community meetings (25%) and other strategies (12%).²⁹

External environment

Haiti is prone to **natural disasters**, aggravating the existing poor living conditions. In the last decade alone the country had to deal with a major earthquake, destructive hurricanes and several droughts and flooding. Not only did it lead to death and injury of thousands of inhabitants and health workers, but it also destroyed housing, public buildings including health facilities, infrastructure and fields for food supply repeatedly.¹

Women and men have equal constitutional rights in Haiti, however reality shows otherwise. Women regularly have to cope with exclusion and harassment. Examples of **gender** inequality are that women attend less secondary education than men, have less jobs (in higher positions), experience worse health and gender based violence.⁴³⁻⁴⁵ Haiti ranks 144 in the Gender Inequality Index.⁴⁴ A national survey showed that 29% of women aged 15 or older had suffered an act of violence, for married women it was up to 45% in relation to partner violence.⁴ However, immunization coverage was equal for boys and girls.^{4,46}

The constant **political instability** does not facilitate improvement or development of the country and it has consequences for the economy as well as for health care. How low expenditure on health influences health care utilization on a macro-level has been discussed in previous chapters.

POPULATION CHARACTERISTICS

Predisposing

Demographic

In this study population **age** has no influence, since infants of 0 to 24 months fully depend on their caregivers for all care.

As mentioned above, the **sex of the infant** has never been reported to have influence on immunization coverage in Haiti.

Social structure

Coverage is higher among infants of mothers with **education** in comparison to mothers without education.⁴⁷ The 'Survey of Mortality, Morbidity and Utilization of Services in Haiti' (*Haiti Enquête Mortalité, Morbidité et Utilisation des Services* (EMMUS) shows the percentage of fully vaccinated children increases with the education level of their mother, 28% of those whose mother has no education and 53% for mothers with secondary school level.⁴ A World Bank report from 2014 showed the same results with 33% coverage without education and 51% for secondary or higher education.¹⁰ The same trend was shown in a national cluster survey in 2012 on measles and rubella.⁴⁶

Occupation has been taken into account in a national cluster survey in 2012 on measles and rubella in Haiti and there was no difference in vaccination coverage of children aged 1 to 4 between unemployed families of someone in the household with a permanent job. After the SIA there was a slight benefit for the children with unemployed families.⁴⁶

No information was found on the effect of **ethnicity** on immunization coverage.

The DTP3 coverage was higher among the first born and went down with a higher birth order in a family, a WHO report showed influence of **family size**. Coverage was notably lower for child number 6 or higher.⁴⁷ The EMMUS in Haiti showed a similar trend (Table 3).⁴

Type of vaccine	First born	Child 6 or higher
BCG	91	67
DTP3	65	40
Polio3	63	41
Rotavirus2	69	44
Measles	70	44
Full vaccination	48	29

Table 3: Difference in coverage between first born or child 6 or higher

A **social network** can be a good support system for both caregivers and children. In south-western Haiti the fathers provided more for their children than in other regions of the country. Fathers would regularly meet to advice each other on how to help their families best and learn about family and child health. In 2010 the presence of these 'Fathers' Clubs' had a positive outcome for children aged 1 and 2 on vaccination status, vitamin A supplementation and growth monitoring. Child weight and mortality were not affected.⁴⁸

The largest official **religion** in Haiti is Christianity, but many involve elements of Vodou in their religion and daily life. This influences the way they look at sickness and health (care), their **health belief**. The occurrence and severity of a certain disease is attributed to supernatural entities or (un)known enemies for a large part of the population. For over 70% of the population **traditional medicine** is the first choice in the form of medicinal plants, bonesetters, traditional birth attendants or healers. Because of relief sought in traditional medicine and self-medication a delay in services from modern medicine often occurs. These delays may be an important factor in high mortality.¹⁷ According to the World Bank the prevalence for visiting a traditional healer is lower, 4% in urban and 8% in rural areas. Also **self-medication** is 5% in the highest and 10% in the lowest quintile.¹⁰

Health beliefs

Values concerning health and illness can be influenced by personal experiences as by those from a social or societal network. How someone values health is personal but can be directed by culture or religion. Also knowledge or health education contributes to the value of health and personal health practices. All of these factors have been addressed earlier in this chapter.

The 2018 annual report from GVAP addresses these factors again by highlighting reasons for Haitian parents not to vaccinate their children. For children who have never been vaccinated: 'Unaware of need for vaccination' 68.4%; 'Fear of side reactions' 52.6%; 'Wrong ideas/ perceptions about contraindications' 57.9%. For children who were not fully vaccinated: 'Unaware of need of vaccination' 65.2%; Unaware of need to return for 2nd or 3rd dose' 73.9%; 'Wrong ideas/ perceptions about contraindications' 60.9%; 'No faith in immunization (cultural/ religious reasons)' 43.5%.⁴⁹

No other studies that addressed health beliefs on vaccinations in Haiti were found. However, there are reports on comparable services like antenatal care (ANC). Both services are preventive and comprehend (mother and) child care.

A mixed-methods study from Doctors of the World on health service utilization executed in 2014 in rural mountainous area of Petit Goave and Grand Goave highlighted the importance of **knowledge** of health and services, but also showed inhibiting factors. The majority of the women in the focus group discussions (FGD) had good **knowledge** of the benefits of ANC. Awareness on danger signs during pregnancy was higher among women from rural areas. In the FGD's with men there was **low knowledge** of causes of maternal and neonatal death and how to prevent them. One third of the women stated that using health services depended on permission of usually the male partner. Women in rural areas had less ANC visits, less attendance of a skilled birth attendant, less skilled postnatal and newborn care than the women in urban areas.

Women's **attitudes towards health services**: satisfaction was low. They mentioned they did not like the way they were treated: excessive waiting times, lack of involvement and absenteeism of providers or material at the OPD's. During birth they felt lack of respect, privacy and confidentiality. So even with good knowledge there are multiple factors outweighing use of health services.⁵⁰

Enabling

Family

The **age of mothers** can influence the immunization coverage of their children. A national cluster survey in 2012 on measles and rubella demonstrated a slightly higher odds ratio of 1.60 for coverage among 1-4 year olds in the maternal age group of 20 years and older in comparison to mothers under 20.⁴⁶

The **sex of the parent** might affect vaccination coverage. Traditionally the women are seen as the caregivers and the ones being responsible for the health of their infants, but sometimes they are working outside of the house, leaving the children with their fathers. One small study in department Grande-Anse in 1996 showed that male caregivers are associated with poorer child health status.⁵¹

Marital status of the mother did not have an impact on the vaccination coverage among 1-4 year olds in the national cluster survey in 2012 on measles and rubella.⁴⁶

Differences in **income** lead to worse health outcomes and service utilization for the poorest in Haiti according to the World Bank report. The lower quintiles have a higher need with the largest proportion of stunted children, underweight, diarrhoea and respiratory infections. Also their burden of expenses on health is relatively higher. In Haiti people spend an average of 1.7% of their income on health and the extreme poor spend 5.5% more than the moderate poor and 11.7% more than the non-poor. Most of these out-of-pocket expenditures is spend on medication, roughly 60%.¹⁰ The

most important reason for people not to use care is expenses, it affected 65% in the poorest and 39% in the richest quintile. This problem was evenly divided for all departments (78-84%). Expenditure is two times higher in the urban areas, what might be because of better health care services due to more beds and medical staff next to more equipment.¹⁰

These expenses cover the direct costs. No information of the effect of opportunity costs on vaccination coverage in Haiti was found, for example stop working to escort a child to a health service.

EMMUS showed that the coverage in 2017 was twice as high for children in the highest quintile compared to those in the lowest: 66% and 30%.⁴

Contradictory are the findings on **price of services**. In a national survey in 2016 on 905 health facilities 86-94% stated that costs of care was not a problem.⁵² A World Bank report on the other hand stated that lack of financial resources is one of the top reasons the poorest do not use health services, but the top quintile suffers as well, 65% for the poorest and 49% for the top quintile. Over the years this trend stayed the same.¹⁰

Vaccinations included in the EPI are free of charge, therefore **health insurance** should not have an influence on the use of this service.

For most infants in Haiti their parents are their **regular source of care**, but there is a large group of children that do not live with their parents. Because the parents are deceased or the children have been send to live with another family. All children who live without their biological parents are at risk of not receiving necessary care. The EMMUS has estimated that 11% of children under 18 lost one or both of their parents and 41% live with two biological parents. These numbers stayed the same since 2012. There are variations between departments: 25% in South-East and 18% in Area Metropolitan of children under 18 are living without biological parents. Thereby 17% are in the lowest quintile and 27% in the highest.⁴

These numbers do not display the **quality of the relationships** with the caregivers. Hundreds of thousands of children in Haiti live as 'Rastavèks'. They are send to live with wealthier families and work as unpaid domestic servants in hope of a better existence and education, usually they are girls. This system is acceptable for most Haitians, but it is also seen as modern slavery. They are vulnerable to neglect, abuse and are less educated than their peers, however there is almost no information on their physical health.^{53,54}

Travel distance or possibilities is a regular obstacle. Either absence of (good) roads or means of transport, or lack of money to pay for the journey. 48/478 caregivers did not choose to vaccinate because of 'no transport/ too far'.⁵⁵ This situation did not differ between departments or over the years 2005-2012.¹⁰ The EMMUS reported: 10% had to travel <1km to a health facility, 48% 1-9km, 11% 10-14km and 31% >15km. People in urban areas had more access to facilities within 1km: 13% versus 7% in rural areas. In rural areas 20% went on foot, in the urban areas 15%. Median time to reach the facility was 29 minutes, with 30% of the people travelling 1-2 hours. In rural areas 24% need >2 hours to reach a facility and 6% in urban areas. The poorest need the most time relatively.⁴

Community

In Micro Vaccination Planning the **community** and local actors participate in improving immunization coverage through local monitoring and corrective strategies. Of the 651 health institutions providing immunization services, 53% had documentation on how to implement this. Also 88% had a possible communication or social mobilization strategy.²⁹

The **availability** of health personnel and facilities and difference between regions have been discussed in the section 'health care system'.

An **urban or rural** living environment has consequences for vaccination coverage. Urban areas have more health services with better equipment and distance to facilities are shorter, like mentioned earlier in this chapter. National surveys in Haiti show that the Metropolitan areas have more fully immunized infants than the rural, 48-50% versus 36-37%.^{4,55} Likewise, the **geographical areas** show a variation in coverage, from 27% in the Southeast to 61% in the North.⁴ No information on the relation between socioeconomic status and the departments in Haiti has been found.

HEALTH BEHAVIOUR

Personal health practices

No information on the effect of these practices on use of vaccination services in Haiti was found.

Use of health services

A study published in 2018 investigated the influence of **quality** on primary healthcare utilization in Haiti based on the EMMUS and a census of health facilities. In rural areas the quality of the infrastructure at facilities was positively associated with completion of vaccinations for children under-5. Also they made a prediction model for service utilization based on quality of infrastructure and service, independent from area of residence. Quality of service would contribute more to use of vaccination services than quality of infrastructure.⁵⁶

No other studies that addressed health service utilization for vaccinations in Haiti were found. However, there are reports on comparable services like antenatal care (ANC). Both services are preventive and comprehend (mother and)child care.

Comparable was the DHS, which connected data from two of their national surveys in Haiti in 2015. With the EMMUS and a health facility survey they analyzed the relationship between health service environment and service utilization. It showed that all clusters had an ANC facility within 5-10km. Also **service readiness** was associated with 4 or more ANC visits per pregnancy and **better quality** of care in rural areas, but receiving more ANC visits and high quality care was more prevalent in the urban areas.⁵⁷

The EMMUS presented data of health service utilization in general. The majority of people who are **looking for treatment** chose a hospital (52%), after that a health clinic (21%) and a group chooses not to seek treatment (20%). Since 2005 the hospital is still the first choice **facility** and its use increased from 37%. In urban areas health facilities are used more than in rural areas, 84% versus 77%. Children under 15 make most use of the health facilities.

When people are injured, the lowest quintile shows the lowest **admission** rates (75%) in comparison to the highest quintile (88%).

In 56% there was a health facility closer to home and this option was used more in urban areas (63% versus 50%). People older than 50 years and from the lowest quintile chose most for the nearest facility. Reasons not to choose the nearest facility: best equipment(47%); more competent staff(44%); cheaper(18%); other(15%); waiting time(12%); friendlier staff(9%). Younger people used costs as main reason. The main reason for not using any facility at all were the high costs(58%).⁴

7.1.2 The Expanded Programme on Immunization in Haiti

According to the EMMUS in 2017 a Haitian child was considered fully vaccinated when it received the following vaccinations before the age of 24 months:

- ♦ one dose of BCG-vaccine that protects against tuberculosis;
- ♦ three doses of Pentavalent-vaccine for diphtheria, tetanus, pertussis, hepatitis B and Haemophilus influenza;
- ♦ three doses of Polio-vaccine;
- ♦ one dose of Measles-vaccine;
- ♦ two doses of Rotavirus-vaccine.⁴

According to a report on the National Survey in 2009 the Measles-rubella-vaccine was introduced in the EPI in 2008.^{46,55}

An EPI country report by WHO in 2019 showed some differences with the schedule mentioned by the EMMUS: one extra dose of DTP-vaccine; two extra doses of Polio-vaccine; three doses of Pneumococcal-vaccine. This schedule did have a timeframe.⁵⁸

No official document was found for the EPI schedule. Thus no information on the types of vaccines to administer, nor at which point in time.

7.1.3 The vaccination coverage in Haiti in children under-5

Documentation on vaccination coverage in Haiti is very scarce. There exists a multi-annual national Demographic and Health survey which includes vaccination coverage based on the EPI: 'Survey of Mortality, Morbidity and Utilization of Services in Haiti' (*Haïti Enquête Mortalité, Morbidité et Utilisation des Services* (EMMUS)).⁴ Additionally, some surveys are performed during immunization campaigns.^{46,55}

WHO together with UNICEF published survey reports based on data from published and grey literature, including EMMUS, to make estimates of immunization coverage over time.¹⁸

Type of vaccine	EMMUS 2017	EMMUS 2017 metropolitan area	Measles Survey 2012	National Survey 2009	WHO 2017
BCG	83	85.0		87	76
Polio0		50.0			
Polio1	84	87.3		93	
Polio2	70	71.8		84	
Polio3	54	53.6		74	66
DTP1				92	80
DTP2				81	
DTP3				75	60
Penta1	84	84.8			
Penta2	72	73.6			
Penta3	55	54.8			
Measles	61	60.9	before 59; after 91	47	53
Measles2					25
Rubella					53
Rota1		71.1			56
Rota2		55.6			
Hep B3 + Hib3					58
Full immunization*	41	38.6		40	

*BCG, DTP1, DTP2, DTP3, OPV1, OPV2, OPV3, Measles

Table 4: Short summary of vaccination coverage in Haiti in children under-5 (%)

BCG

The national survey in 2009 showed that BCG coverage was 87% and that 45% was vaccinated timely according to their schedule (<4wks after birth).⁵⁵ In 2017 the EMMUS published 83% of infants 12-23 months.⁴ Over time WHO estimates showed stability of coverage around 80% (78-83%) from 2007 to 2013 with a small fluctuation in 2014 (76%) and 2015 (81%) and a decrease after that in 2016 (72%) and 2017 (76%).¹⁸

OPV1

The national survey in 2009 showed that the 1st dose of Oral Polio Vaccine1(OPV1) coverage was 93% and that 26% was vaccinated timely according to their schedule (6 to 8 weeks after birth).⁵⁵ In 2017 the EMMUS published a coverage of 84% of infants 12-23 months.⁴

OPV2

The national survey in 2009 showed that OPV2 coverage was 84% and that 10% was vaccinated timely according to their schedule (10 to 12 weeks after birth).⁵⁵ In 2017 the EMMUS published a coverage of 70% of infants 12-23 months.⁴

OPV3

The national survey in 2009 showed that OPV3 coverage was 74% and that 6% was vaccinated timely according to their schedule (14 to 16 weeks after birth).⁵⁵ In 2017 the EMMUS published a coverage of 54% of infants 12-23 months.⁴ Over time the WHO estimates showed an increase of polio coverage from 61% in 2006 to 67% in 2013, and afterwards a decrease from 55% in 2014 to 39% in 2017. Coverage of Inactivated Polio Containing Vaccine was 66% in 2017 though.¹⁸

DTP1 or pentavalent1

The national survey in 2009 showed that DTP1 coverage was 92% and that 26% was vaccinated timely according to their schedule (6 to 8 weeks after birth).⁵⁵ In 2017 the EMMUS published 84% coverage of pentavalent1 of infants 12-23 months.⁴ Over time WHO estimates showed stability of DTP1 coverage around 86% (84-88%) from 2006 to 2013 with a decrease in 2014 (72%) and a stable coverage again from 2015 to 2017 around 80%.¹⁸

DTP2 or pentavalent2

The national survey in 2009 showed that DTP2 coverage was 81% and that 9% was vaccinated timely according to their schedule (10 to 12 weeks after birth).⁵⁵ In 2017 the EMMUS published 72% coverage of pentavalent2 of infants 12-23 months.⁴

DTP3 or pentavalent3

The national survey in 2009 showed that DTP3 coverage was 75% and that 6% was vaccinated timely according to their schedule (14 to 16 weeks after birth).⁵⁵ In 2017 the EMMUS published 55% pentavalent3 coverage of infants 12-23 months.⁴ Over time WHO estimates showed an increase of DTP3 coverage from 60% in 2006 to 68% in 2013, a decrease in 2014 of 48% and a stable coverage again from 2015 to 2017 around 60%.¹⁸

Measles

The national survey in 2009 showed that measles coverage was 47% and that 9% was vaccinated timely according to their schedule (9 to 10 months after birth).⁵⁵

In 2012 a national survey was performed around the time of the nationwide SIA to assess the measles coverage. 59.4% of 5959 children aged 1-9 year were vaccinated before the SIA. After the SIA they reached a total of 91% coverage nationally. 31.5% received their first dose during the SIA, 50.7% received their second dose during the SIA and 8.7% already received 2 doses before the campaign.⁴⁶ In the years 2002-2011, investigated in a group of a thousand people and prior to the

SIA, a coverage was achieved around 90.9% (89.2-93.1%) with a dip in 2011 (83.5%). 40.2% (30.5-56.4%) received at least one dose and 50.7% (27.2-60.3%) received at least two doses.⁴⁶ The EMMUS of 2017 published a measles coverage of 61% of infants 12-23 months.⁴ The WHO estimates showed an increase of coverage over the years from 59% in 2006 to 65% in 2013, and after that a stable decrease to 53% in 2014 to 2017. The coverage of a second dose of Measles Containing Vaccine (MCV) was 26% in 2016 and 25% in 2017.¹⁸

Rubella

The coverage for immunization with Rubella are taken directly from the measles coverage: WHO estimates showed an increase of coverage over the years from 59% in 2006 to 65% in 2013, and after that a stable decrease to 53% in 2014 to 2017.¹⁸

Rotavirus

This vaccine was introduced in 2014. The WHO estimates published 23% coverage in 2014, 43% in 2015, 48% in 2016, 56% in 2017.¹⁸

Hepatitis B and Haemophilus influenza

WHO estimates only report on the 3rd dose: 68% coverage in 2013, 48% in 2014, 60% in 2015, 58% in 2016, 58% in 2017. These estimates were derived from the pentavalent-vaccine which was introduced in Haiti in 2012.¹⁸

Complete immunization

The 2009 national survey analysed the vaccination coverage where 840 children with vaccination cards were included. 40.4% were fully vaccinated with the 8 recommended vaccinations. Timely vaccination differed per vaccination. Infants in the metropolitan area had higher coverage rates than the ones in the other departments.⁵⁵

The EMMUS showed full vaccination coverage of 41% of the infants of which only 18% had received timely vaccinations. 10% of infants 12-23 months were not vaccinated at all. This was a decrease after a period of moderate increase in the years before: 34% in 2000, 41% in 2012 and 45% in 2012.⁴

7.2 Analysis of data set

Thus far we have been focussing on the situation and determinants in the country. With the data from MSF we will zoom in on the urban area of Port-au-Prince and on a centre run by a non-governmental organization with more resources than most of the national institutions.

General findings

Out of the 710 infants included in the study 500 were LBW and 210 were NBW, 329 were male and 381 were female. Because of a neonatal sepsis outbreak 121 infants had passed away before discharge. During the 24 month follow-up another 29 infants were registered as they had passed away. 334 infants had completed the 24 month follow-up. The socioeconomic status of the parents was known in 477 of the cases. Concerning marital status, 106 parents were single, 172 cohabitated, 168 were married and 31 were separated. The majority of mothers and fathers did not complete the secondary level of education and 250 of the mother were unemployed, compared to 45 of the fathers (Table 5).

Findings on timely vaccination

The proportion of children that received vaccinations in general is high, with 69.73% for the Rotavirus 2- vaccination to 89.69% for the Polio 1-vaccination. The exception is the BCG-vaccination at birth with 52.69%. Yet the proportion of children that received them on time is relatively low, with 17.81% for the Pentavalent 3- vaccination to 49.22% for the Polio 1-vaccination (Table 6).

Findings on prevalence per variable

A total of 334 infants completed 24 months of follow-up. We compared 177 infants who were fully immunized with 157 infants who were not fully immunized. The prevalence of completed immunization after 24 months of follow-up was higher in the group of NBW-infants and was significantly increased in comparison with LBW-infants. In the category of marital status cohabiting parents had the highest prevalence of fully immunized infants, followed by married, single and separated parents, but with a borderline significance. No significant difference in prevalence was found for sex of the infant, educational level or employment of the parents (Table 7).

Findings on risk factor analysis

We used the merged categories for the variables because of a stronger association. The unadjusted analysis suggested that having a normal birth weight, having parents who either were married or cohabited and having a mother with secondary education or higher was associated with complete immunization for infants up to 24 months. No association was found for sex, educational level of the father or employment of the parents. Factors that remained associated with complete immunization after adjusted analysis were marital status and educational level of the mother. A weaker association was seen for normal birth weight and again no association for sex (Table 8).

8 Discussion

This study has identified factors influencing the use of vaccination services and the vaccination coverage for various areas in Haiti. The literature review focussed more on the factors that impede use of vaccination services and coverage nationally, while the analysis of the data focussed on vaccination coverage in a MSF-institution in the urban setting of Port-au-Prince. This knowledge will be integrated using the structure of the analytical framework.

ENVIRONMENT

Due to multiple factors the **MSPP** is having difficulties taking leadership in executing and maintaining their national health programme. The concept of **decentralized health** is spreading responsibilities, but cannot be effectuated properly without the cooperation of all departments because of lack of resources or will. Especially in a massive undertaking like an immunization programme where they cannot solely rely on the supply of vaccines, but need coordination in assessing the health need, communication strategies, training of human resources and organization of logistics on a national level. And this needs to be there always.¹²

A barrier is **health expenditure**. \$13 per capita is insufficient to take care of the needs of the Haitian people. The average low-income country spends \$15 per capita and to compare to its neighbouring countries: \$180 dollars is spend in the Dominican Republic and \$781 dollars in Cuba. The Latin American and Caribbean region has a public expenditure of \$336 dollars per capita.⁴¹ Also, the expenditure per health sector is unequal and is significantly more uneven than in countries with comparable economies. Substantial amounts go to specialists consultations, curative and emergency care in the hospital sector, leaving little for the primary level where many health issues can be addressed and prevented.⁴¹ After the earthquake in 2010 a lot of (donor)funding was earmarked for rebuilding the hospital sector, but without these donations the costs for maintenance have been unaffordable.⁴¹ So another difficult task for the MSPP is guiding the **donors**, who have their own motivation and conditions and may not always be the best for the health sector.

The **distribution of health institutions** in the country is uneven with the largest concentration in the west. For example there are 0.7 dispensaries or CLS/10,000 inhabitants on average, thus there are areas which have to cope with less.⁴⁰ A similar situation applies to **health personnel** with a preference for the west.³ An explanation for insufficient use of services can be low physical access and the remote and poor areas usually deal with this. With lack of human resources there is a risk of insufficient health education and promotion and loss of quality. Attending to more patients a day might cause time pressure for health workers, leaving little time for explanation or preventive measures. Less personnel can mean less **knowledge** as well. Thus, people can be withhold from information and care as they do not have the opportunity to choose or to refuse certain treatments, lifestyle or preventive measures like vaccinations. Even through our literary research we were unable to find crucial information on vaccination services, like the structure of the national vaccination programme. Also, we could not find information on the importance, the logistics for health workers or patients, communication strategies, existence of immunization cards or existence of official coverage registration. Earlier this decade a study on missed opportunities for vaccination (MOV) was done in the neighbouring country of The Dominican Republic. The focus of MOV had shifted from problems related to the health system, like vaccine storage and closed health facilities, to problems with health personnel and caregivers. As a reaction to this the communication strategies were developed to promote and monitor vaccination uptake in young children for both caregivers and health workers(ref).⁵⁹ This resulted in an increase in vaccination coverage for almost all of the antigens in the national EPI(ref website).⁶⁰

The unstable **political** situation in Haiti impedes the government to tend to the basic health needs of the people and it will be difficult to structurally improve these environmental problems. Without

stability it will be complicated to maintain the process of an immunization programme, which is a long-term commitment.

On top of this, unforeseen events like **natural disasters** make it very challenging to keep health care services running, especially preventive and chronic care, as the focus will be shifted to other priorities like emergency medicine. The country will be more vulnerable to outbreaks too. Another hurdle is delivering care without the physical building, supplies or possibilities to reach it.

POPULATION CHARACTERISTICS

Socioeconomic status comprises level of education, occupation and **social network**. Family can be part of this network, as do friends, neighbours, colleagues, customers or people who share the same beliefs. Uptake of vaccination services can be influenced by beliefs in this network and might be difficult to change. For many Haitians **traditional medicine** is an accepted choice of health care, but also a barrier for vaccination. Without relief from it people turn to modern medicine and in most cases it is too late for a preventive measure like immunization. Better **health education** will contribute to use of health services as well.

Our calculations found an effect of **marital status** and specifically being with or without partner. We found a stronger association for married or cohabitating partners with complete immunization than for single or separated partners. In one other study on Haiti this association was not found,⁵⁵ so information is very scarce. It is possible that the partners in our study had the advantage of an urban setting, with a bigger social network and more opportunities for health education. However, one can argue that this advantage should be seen in the group without partner as well.

We also found that infants with mothers as **primary caretaker** have higher immunization coverage. A suggestion from a small study was: When males substitute the female, they may leave their children alone because they have to work as well or attend their life stock.⁵¹ This can be linked to **quality of care**. Having a caretaker does not naturally mean that they have the best of interest for the child. There are thousands of child servants in Haiti, but without information on their health status. One can imagine they are looked after worse than related children. The influence of **sex of the infant** on the prevalence of complete immunization has not been demonstrated in our calculations. Neither has it been found in literature on Haiti,^{4,55} nor in a large multinational study.⁴⁷

Our calculations found a positive association between completed immunization and **educational level of the mother**. This trend of more fully immunized infants with higher educational level of the mother has been suggested in Haiti before,^{4,10} also solely for measles and rubella-vaccinations⁵⁵ and globally as well.⁴⁷ We did not find an association for **educational level of the father**. This corresponds with the mother being the caregiver traditionally and presumably she has the largest impact on many aspects of an infant's life, including health.

We found higher immunization coverage in infants with mothers above 20 years old in comparison to younger mothers in Haiti. This difference because of **age** was similar to other countries.⁴⁷ An explanation might be that these women are more educated, have more experience with other children or with the benefits of prevention through health (education).

Our calculations did not show an effect of **employment** of any of the parents on immunization coverage. There has been no strong evidence in literature either.⁵⁵ Employment interconnects with wealth and higher level of education, but there are more factors that facilitate employment like the economy and geography.

In Haiti immunization coverage was higher for **wealthy** infants than for the **poor**, a known factor in other countries as well.⁴⁷ However, vaccination services in Haiti are for free. This could be of easier and more frequent access to health and more health education for the non-poor. Also lower coverage was seen in **urban** areas. An explanation might be low density of health structures, less possibilities to **travel** due to travel costs or lack of proper transport or roads.

HEALTH BEHAVIOUR

Quality has a positive effect on **health service utilization**. Patients can be seen as customers of health. When they are attended to properly they will return. The majority of Haitians would seek treatment in a hospital rather than a health clinic. Also, they choose for better equipment and staff. In rural areas the quality of the infrastructure at facilities was positively associated with completion of vaccinations for children under-5. These observations might suggest that the (perceived) quality of services contributes to the use of them.

CRUO can be seen as an institution with high quality. Our calculations on coverage per vaccine at CRUO showed a constant coverage between 80 and 90%. The exceptions were BCG (70.14%), dose of polio at birth (52.96%) and the second dose of rotavirus (69.73%). Also coverage drops for succeeding vaccines with multi-dose vaccines. If we compare these numbers to the coverage for the metropolitan area in 2017⁴ (Table 9), we see a higher coverage of BCG there. Not vaccinating immediately after birth at CRUO might be a missed opportunity or can be due to poor documentation. A higher coverage of measles and rotavirus at CRUO might be explained by the benefit of intensive follow-up at that institution and because of lack of information in other institutes. What we also see in the metropolitan area is the decrease of coverage in multi-dose vaccines, but overall these were higher at CRUO, which again might be explained by guidance of CRUO. Some caregivers might be unaware of the need of a second or third dose.⁴⁹ The coverage on a national level showed the same trends.^{4,55}

Our analysis on timely vaccinations at CRUO showed that this proportion is low and this becomes lower with every subsequent dose for multi-dose vaccines. Comparable results were found by a national survey in 2009.⁵⁵ The EMMUS showed that 22.2% of all the basic vaccines were given on time (within 24 months after birth) in the metropolitan area.⁴ The timely coverage was higher at CRUO, which might be explained by the effect of regular long term follow-up, but still relatively low with the highest coverage not exceeding 50%. Caretakers might wait until the next appointment for their children to get vaccinated because it is more convenient for them.

Notably, according to our calculations having a NBW in this group might be suggestive of a higher chance of being fully immunized.

The conditions at CRUO are an enormous contrast with the reality of health care services in Haiti. Despite the dense urban location, the extensive guidance and good resources – finances, equipment and personnel – coverage is too low and outbreaks are emerging. Also CRUO was a temporary construction supported by MSF and with them leaving, so will the high standards.

9 Limitations

The infants enrolled in this study have specific characteristics. First, the health institution was established temporarily to support obstetric emergencies, so the infants may have experienced benefits from a delivery attended by a health professional. Second, the infants may have had certain health advantages because of this study, like regular physical examinations and follow-up or administration of vaccinations. Third, the institution was located in Port-au-Prince, so might solely represent infants from an urban area. Furthermore caretakers received payment for transport, increasing their opportunity to visit. So the results from this study might be an overestimation of the coverage in the metropolitan area.

The sample size was calculated for the original study to compare developmental outcomes between LBW and NBW. Another sample size might have been appropriate for this purpose. Also, due to a neonatal sepsis over 100 infants died.

Another limitation might be that our definition of complete immunization is slightly different than that from the presumable Haitian EPI. We incorporated an extra dose of polio at birth. Also, the other studies used for comparison have different definitions. Over the years the EPI schedule changed as well.

A limitation is that we used the '24 months-label' for complete follow-up and lost 3%, so an underestimation, of the cohort for the calculations.

Finally, literature on vaccination coverage or on Haiti in general is very scarce. Because of this we needed to incorporate almost all studies and reports. We have used small studies and with not very strong evidence. Also, because of lack of information we were required to use reports on comparable services like ANC.

10 Conclusion

The use of vaccination services in Haiti are influenced by many factors. Environmental factors such as a decentralized health care system, insufficient health expenditure and insufficient (human) resources impede health service utilization. The external environment is controlled by the unstable political situation which inhibits these factors to improve. Also, natural disasters destroy health institutions literally and the focus on basic health needs figuratively. The poor, the less educated and the rural population, i.e. population with low socioeconomic status, seem most affected by lower vaccination coverage. Even in a good health environment run by a NGO, vaccination uptake can be improved significantly. Concluding in Haiti being far from having an ideal health environment. However, a reasonable amount of the population characteristics that withhold infants from being vaccinated can be influenced positively just by health education and promotion. Our calculations pointed out potential risk factors for complete immunization which are supported by existing literature.

11 Recommendations

To government of Haiti:

Increase the budget on health and change the allocation over the health sectors. The focus of the budget should be on preventive health. This investment will lead to better health and will be more economically efficient, because the demand for curative health will decrease and will spending on it. Government of Haiti

Provide attention for children without a regular source of care. Haiti has to cope with a considerable amount of orphans due to all the disasters. A significant health gap will exist if they do not attend to these children. Government of Haiti

To MSPP:

Improvement of the decentralized health system. Every department has special needs when it comes to vaccination strategies due to differences in population or geography. An example is more outreach programmes in rural areas. This will allow the need of the people to be met.

Focus more on public health and basic health needs. The demand for medical attention and emergencies will decrease because of simple health interventions and education. Discuss this issue with donors and NGO's.

The public health system should take full responsibility for the Expanded Programme on immunization. Immunization is a public health intervention which needs a stable and long term commitment for it to succeed.

Better collaboration between different health actors is needed. Both public and private institutions offer vaccination services, but not all institutions, not all vaccines and not every day. One of the positive effects will be expansion of availability of services and a decrease in missed opportunities for vaccination.

The EPI schedule should be easily accessible for everyone.

Better division of (human) resources so that every department can benefit from the same manpower, knowledge and supplies. Also make use of experts opinions in needed areas.

More health education for both health workers and the population so they will understand and be educated in the importance of preventive medicine. Health promotion should be part of every consultation and campaigns through information on posters, flyers and media should be encouraged.

To stakeholders involved in research:

More research is needed to evaluate vaccination coverage and the factors influencing immunization.

References

1. Haiti profile - Timeline - BBC News. 31 May 2018 Available at: <https://www.bbc.com/news/world-latin-america-19548814>. (Accessed: 30th November 2019)
2. John Rely Beard. *Toussaint L'Ouverture: A Biography and Autobiography*. (1863).
3. Pan American Health Organization. HAITI. Available at: <https://www.paho.org/salud-en-las-americas-2017/?p=4110>. (Accessed: 30th November 2019)
4. Ministère de la santé publique et de la population. *Haiti Enquête Mortalité, Morbidité et Utilisation des Services (EMMUS-VI 2016-2017)*. (2017).
5. USAID. *Haiti ECONOMIC GROWTH & AGRICULTURAL DEVELOPMENT - FACT SHEET March 2017. Development* (2017). doi:10.1098/rspb.1993.0111
6. USAID. *Haiti ENVIRONMENT & NATURAL RESOURCES MANAGEMENT - FACT SHEET March 2017*. (2017).
7. World Bank - Haiti | Data. Available at: <https://data.worldbank.org/country/haiti>. (Accessed: 30th November 2019)
8. World Health Organization. *HAITI WHO statistical profile*.
9. Population data. Available at: <https://www.gapminder.org/data/>. (Accessed: 30th November 2019)
10. World Bank. *Investing in people to fight poverty in Haiti. International Bank for Reconstruction and Development 1*, (2013).
11. UNESCO- Education : Literacy rate. Available at: <http://data.uis.unesco.org/index.aspx?queryid=166#>. (Accessed: 30th November 2019)
12. Ministère de la santé publique et de la population. *Plan pluri annuel complet du programme elargi de vaccination PPAC-PEV 2011-2015*. (2013).
13. Institut Haitien de Statistique et d'Informatique. Available at: http://www.ihsi.ht/rgph_resultat_ensemble_population.htm#. (Accessed: 30th November 2019)
14. BBC - Haiti - News. Available at: <https://www.bbc.co.uk/search?q=haiti&filter=news&suggid=>. (Accessed: 1st January 2020)
15. Haiti Overview - Worldbank. Available at: <http://www.worldbank.org/en/country/haiti/overview#1>. (Accessed: 30th November 2019)
16. World Bank Open Data | Data. Available at: <https://data.worldbank.org/>. (Accessed: 30th March 2019)
17. Ministère de la santé publique et de la population. *Politique Nationale de Sante de la Republic d'Haiti - July 2012*. (2012).
18. World Health Organization. *WHO and UNICEF estimates of immunization coverage : Haiti*. (2017).
19. GBD Compare Health Data | IHME Viz Hub. Available at: <https://vizhub.healthdata.org/gbd-compare/>. (Accessed: 30th November 2019)
20. Bärnighausen, T., Bloom, D. E., Cafiero-Fonseca, E. T. & O'Brien, J. C. Valuing vaccination. *Proc. Natl. Acad. Sci. U. S. A.* **111**, 12313–9 (2014).
21. Economic benefits of vaccines - Gavi, the Vaccine Alliance. Available at: <https://www.gavi.org/library/audio-visual/presentations/economic-benefits-of-vaccines/>. (Accessed: 26th February 2019)
22. Mirelman, A. J., Ozawa, S. & Grewal, S. The economic and social benefits of childhood vaccinations in BRICS. *Bull. World Health Organ.* **92**, 454–456 (2014).
23. Walker, D. *et al.* Estimated economic impact of vaccinations in 73 low- and middle-income countries, 2001–2020. *Bull. World Health Organ.* **95**, 629–638 (2017).
24. WHO | The Expanded Programme on Immunization. *WHO* (2013). Available at: https://www.who.int/immunization/programmes_systems/supply_chain/benefits_of_immuni

- zation/en/. (Accessed: 18th February 2019)
25. WHO Global Vaccine Action Plan. *Global Vaccine Action Plan 2011-2020. WHO Library Cataloguing-in-Publication Data* (2013). doi:10.1016/j.vaccine.2013.02.015
 26. Pan American Health Organization. Country report: Haiti. Available at: https://www.paho.org/salud-en-las-americas-2017/?page_id=131. (Accessed: 25th February 2019)
 27. Hsiao, A., Desai, S. N., Mogasale, V., Excler, J. L. & Digilio, L. Lessons learnt from 12 oral cholera vaccine campaigns in resource-poor settings. *Bull. World Health Organ.* **95**, 303–312 (2017).
 28. Gavi, the Vaccine Alliance | Haiti. Available at: <https://www.gavi.org/programmes-impact/country-hub/americas/haiti>. (Accessed: 30th November 2019)
 29. Ministère de la santé publique et de la population. *Évaluation de la Prestation des Services de Soins de Santé 2017-2018 (EPSSS)*. (2019).
 30. WHO | New measles surveillance data for 2019. *WHO* (2019).
 31. Measles cases spike globally due to gaps in vaccination coverage. Available at: <https://www.who.int/news-room/detail/29-11-2018-measles-cases-spike-globally-due-to-gaps-in-vaccination-coverage>. (Accessed: 13th July 2019)
 32. WellcomeTrust. *Wellcome Global Monitor*. (2018).
 33. Secretary-General Apologizes for United Nations Role in Haiti Cholera Epidemic, Urges International Funding of New Response to Disease | Meetings Coverage and Press Releases. Available at: <https://www.un.org/press/en/2016/sgsm18323.doc.htm>. (Accessed: 30th November 2019)
 34. Ministère de la santé publique et de la Population. *Profil Statistique de la diphtérie 2018*. (2018).
 35. Pan American Health Organization. *Epidemiological Update Diphtheria*. (2019).
 36. Ministère de la Santé Publique et de la Population » Lancement officiel de la Campagne Nationale de Vaccination contre la Rougeole, la Rubéole et la Poliomyélite. Available at: <http://mspp.gouv.ht/newsite/?p=6295>. (Accessed: 24th August 2019)
 37. Anderson, R. Andersen and Newman Framework of Health Services Utilization. *J. Health Soc. Behav.* **36**, 1–10 (1995).
 38. Phillips, K. A., Morrison, K. R., Andersen, R. & Aday, L. A. Understanding the context of healthcare utilization: assessing environmental and provider-related variables in the behavioral model of utilization. *Health Serv. Res.* **33**, 571–96 (1998).
 39. Ministère de la santé publique et de la population. *RAPPORT DE LA CARTE SANITAIRE DU PAYS*. (2011).
 40. Ministère de la santé publique et de la population. *Liste des Institutions Sanitaires du Pays*. (2015).
 41. Cavagnero, Eleonora Del Valle; Cros, Marion Jane; Dunworth, Ashleigh Jane; Sjoblom, M. C. *Better Spending, Better Care: a look at Haiti's health financing*. **1**, (2017).
 42. Tohme, R. A. *et al.* Expansion of vaccination services and strengthening vaccine-preventable diseases surveillance in Haiti, 2010-2016. *Am. J. Trop. Med. Hyg.* **97**, 28–36 (2017).
 43. Gabriel, N. C. *et al.* “The women, they maltreat them... therefore, we cannot assure that the future society will be good”: Male perspectives on gender-based violence: A focus group study with young men in Haiti. *Health Care Women Int.* **37**, 773–789 (2016).
 44. United Nations Development Programme. Gender Inequality Index | Human Development Reports. Available at: <http://hdr.undp.org/en/composite/GII>. (Accessed: 8th August 2019)
 45. USAID. *Haiti WOMEN & GENDER - FACT SHEET March 2017*. (2017).
 46. Rania A. Tohme, Jeannot François, Kathleen Wannemuehler, Roc Magloire, M. Carolina Danovaro-Holliday, Brendan Flannery, Kathleen F. Cavallaro¹, David L. Fitter, Nora Purcell, Amber Dimer, Jordan W. Tappero, John F. Vertefeuille, and T. B. H. Measles and rubella vaccination coverage in Haiti, 2012: progress towards verifying and challenges to maintaining measles and rubella elimination. *Trop. Med. Int. Heal.* **19**, 1105–1115 (2014).

47. World Health Organization. *Explorations of Inequality: Childhood immunizations*.
48. Sloand, E., Astone, N. M. & Gebrian, B. The impact of fathers' clubs on child health in rural Haiti. *Am. J. Public Health* **100**, 201–204 (2010).
49. WHO Global Vaccine Action Plan. *Global Vaccine Action Plan - secretariat annual report 2018*. (2018). doi:10.1016/j.vaccine.2013.02.015
50. Perkins, J. *et al.* Determinants of Low Maternal and Newborn Health Service Utilization in Haiti: A Community-Based Cross-Sectional Study. *J. Womens Heal. Issues Care* **06**, 1–8 (2017).
51. Devin, R. B. & Erickson, P. I. The influence of male care givers on child health in rural Haiti. *Soc. Sci. Med.* **43**, 479–488 (1996).
52. Gage, A. D. *et al.* Assessing the quality of primary care in Haiti. *Bull. World Health Organ.* **95**, 182–190 (2017).
53. Haydocy, K. E., Yotebieng, M. & Norris, A. Restavèk children in context: Wellbeing compared to other Haitian children. *Child Abus. Negl.* **50**, 42–48 (2015).
54. Locatelli, L. *et al.* The experience of violence against children in domestic servitude in Haiti: Results from the Violence Against Children Survey, Haiti 2012. *Hepatology* **63**, 965–982 (2017).
55. Rainey, J. J. *et al.* Vaccination Coverage in Haiti: Results from the 2009 National Survey. *Vaccine* **30**, 1746–1751 (2012).
56. Gage, A. D. *et al.* Does quality influence utilization of primary health care? Evidence from Haiti. *Global. Health* **14**, 1–9 (2018).
57. Wang, W. *et al.* *The Relationship between the Health Service Environment and Service Utilization: Linking Population Data to Health Facilities Data in Haiti and Malawi (DHS Analytical Studies No. 51)*. (2015).
58. World Health Organization. *EPI Country Report*. **1**, (2019).
59. Garib, Z. *et al.* Missed Opportunities for Vaccination in the Dominican Republic: Results of an Operational Investigation. *Biomed Res. Int.* **2016**, (2016).
60. World Health Organization. WHO | Visualizations | Immunization coverage country punchcards. *WHO* (2016). Available at: <http://apps.who.int/gho/data/node.wrapper.immunization-cov>. (Accessed: 31st December 2019)

Acknowledgements

I want to thank Doctors Without Borders, who gave me the opportunity to use the data they collected in the field. I would also like to thank my thesis supervisor at MSF for the positivity and support during this process. I am thankful to my coordinators at KIT for the advise and all the knowledge I gained throughout the master.

And last but not least I want to thank my family and friends, who understood, gave me space and put up with me working on this thesis.

Annex 1: Fiche E: Examen physique

FICHE E

Infant Outcome Study



ID étude :

Fiche E : Examen physique _____		
Numéro d'hôpital de la mère : _____ et du bébé : _____		Sexe: M <input type="checkbox"/> F <input type="checkbox"/>
1. Date d'examen : JJ-MM-AA		
E1- Section à remplir uniquement lors de l'examen d'exeat		
2. Date de naissance: JJ-MM-AA	7. Apgar 1min	
3. Heure de naissance : HH :MM	Apgar 5 min	
4. Âge gestationnel à la naissance : semaines	Apgar 10 min	
5. Âge gestationnel à l'exeat : semaines	8. Tétracycline <input type="checkbox"/>	Vitamine K <input type="checkbox"/>
6. Poids à la naissance: g	9. Autres Médicaments :	
	
	10. Date de sortie : JJ-MM-AA	
	<input type="checkbox"/> « abandon » (bébé parti de CRUO sans avoir le OK du médecin)	
	<input type="checkbox"/> Transferts vers un autre centre de santé	
E2 -Section à remplir uniquement lors des visites de suivi à 3, 6, 12, 15 et 18 mois		
Antécédents rapportés par la maman, pour la période <u>depuis le dernier examen de suivi de l'étude:</u>		
11. Alimentation: <input type="checkbox"/> Allaitement		
<input type="checkbox"/> Lait maternisé / Formule		
<input type="checkbox"/> Autres lait (ex. lait de vache en poudre (ex. Alaska), lait de chèvre, etc)		
<input type="checkbox"/> Solide		
12. Si la maman n'allait plus, quand a-t-elle arrêté l'allaitement?: Âge du bébémois OU..... semaines		
13 Nombre d'admission à un hôpital		
14. Diagnostiques:.....		
.....		
15. Médicaments:.....		
.....		
16. Problèmes de santé :		
<input type="checkbox"/> Fièvre <input type="checkbox"/> diarrhée <input type="checkbox"/> pneumonie <input type="checkbox"/> infection urinaire <input type="checkbox"/> malaria <input type="checkbox"/> autres (préciser)		
.....		
E3- Les sections suivantes sont à remplir pour toutes les visites (exeat, 3, 6, 12, 15 et 18 mois)		
Anthropométrie		
17. Poidskg	18. Grandeur..... cm	20. Circonférence de tête cm
	19. Grandeur Toise.....cm	
21. W/H Z-score (poids/hauteur Z-score)	22. FTT (Oui/Non)	23. Autre diagnostique
Température		
24. Température :.....°C		
Cardiovasculaire		
	26. Souffle au cœur: Non <input type="checkbox"/> Oui <input type="checkbox"/> préciser : / 6	
25. Fréquence cardiaque /min	27. Pouls fémoraux G <input type="checkbox"/> D <input type="checkbox"/>	

ID étude :

Respiratoire										
28. Fréquence respiratoire..... /min	29. Bruits respiratoires : Non <input type="checkbox"/> Oui <input type="checkbox"/> préciser :									
	30. Détresse respiratoire: Non <input type="checkbox"/> Oui <input type="checkbox"/>									
Aspect général										
31. Aspect général <input type="checkbox"/> Normal <input type="checkbox"/> Anormal préciser :	35. Lymphadenopathie : Non <input type="checkbox"/> Oui <input type="checkbox"/> préciser :									
32. Pâleur : Non <input type="checkbox"/> Oui <input type="checkbox"/> préciser :	36. Cyanose: Non <input type="checkbox"/> Oui <input type="checkbox"/> préciser :									
33. Œdème : Non <input type="checkbox"/> Oui <input type="checkbox"/> préciser :	37. Éruption cutanée/ anomalie cutanée : Non <input type="checkbox"/> Oui <input type="checkbox"/> préciser :									
34. Ictère : Non <input type="checkbox"/> Oui <input type="checkbox"/> préciser :										
Visage										
38. Palais / bouche : Normal <input type="checkbox"/> Anormal <input type="checkbox"/> préciser :	39. Oreilles : Normales <input type="checkbox"/> Anormales <input type="checkbox"/> préciser :									
	40. Yeux : Normaux <input type="checkbox"/> Anormaux <input type="checkbox"/> préciser :									
Neurologique										
41. Fontanelle : Normale <input type="checkbox"/> Anormale <input type="checkbox"/> préciser :	Réflexes :									
42. Clonus: Non <input type="checkbox"/> Oui <input type="checkbox"/>	44. Plantaire : Présent <input type="checkbox"/> Absent <input type="checkbox"/>									
43. Tonus : normal <input type="checkbox"/> hypo <input type="checkbox"/> hyper <input type="checkbox"/> préciser :	45. Préhension (grasp) : Présent <input type="checkbox"/> Absent <input type="checkbox"/>									
	46. Moro *Seulement à l'axeat* : Présent <input type="checkbox"/> Absent <input type="checkbox"/>									
	47. Force 0-5/5:									
	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Bras</th> <th>Jambes</th> </tr> </thead> <tbody> <tr> <td>Droite</td> <td></td> <td></td> </tr> <tr> <td>Gauche</td> <td></td> <td></td> </tr> </tbody> </table>		Bras	Jambes	Droite			Gauche		
	Bras	Jambes								
Droite										
Gauche										
	48. Autres commentaires									
									
									
Abdomen										
49. Foie : Normal <input type="checkbox"/> Anormal <input type="checkbox"/> préciser :/cm	51. Rate : Normale <input type="checkbox"/> Anormale <input type="checkbox"/> préciser :/cm									
50. Nombriil : Normal <input type="checkbox"/> Anormal <input type="checkbox"/> préciser :	52. Anus: Normal <input type="checkbox"/> Anormal <input type="checkbox"/> préciser :									
Organes génitaux										
Masculin :	55. Féminin <input type="checkbox"/> Normal <input type="checkbox"/> Anormal									
53. Pénis Normal <input type="checkbox"/> Anormal <input type="checkbox"/> préciser.....	préciser :									
54. Testicules G <input type="checkbox"/> D <input type="checkbox"/> préciser :										
Membres										
56. Mains/bras : Normaux <input type="checkbox"/> Anormaux <input type="checkbox"/> préciser :	57. Pieds/jambes : Normaux <input type="checkbox"/> Anormaux <input type="checkbox"/> préciser :									
	58. Hanches Normales <input type="checkbox"/> Anormales <input type="checkbox"/> préciser :									

ID étude :

Développement :
 Bayley Scale pour le développement du nouveau-né (à 6, 12, et 18 mois seulement) : Utiliser le livret Bayley Scale

59. Statut de Vaccination

Evaluation de l'état vaccinal et rattrapage si nécessaire.

Vaccin	Dose	Age d'administration	Date Completé (JJ-MM-AA)
BCG	Dose unique	à la naissance	
Polio	Dose 0	à la naissance	
	Dose 1	6 semaines	
	Dose 2	2.5 mois	
	Dose 3	3.5 mois	
Pentavalent	Dose 1	1.5 mois	
	Dose 2	2.5 mois	
	Dose 3	3.5 mois	
Rougeole	Dose Unique	9 mois	

60. Condition:

- Vivant , développement normal / approprié pour son âge
- Vivant, avec handicap mineur ou condition ne limitant pas l'espérance de vie. Préciser :
- Vivant, avec handicap majeur ou une condition limitant l'espérance de vie. Préciser :
- Décédé → Date de décès JJ-MM-AA
 - accident
 - maladie
 - autre ou inconnu
 préciser :
- Abandon de l'étude

61. Diagnostic et plan de traitement:

.....

Examen Réalisé par :
 Signature :

Code d'employé de l'étude :

Annex 2: Fiche F: Revue de dossier

FICHE F

Infant Outcome Study



ID étude :

Fiche F : Revue de dossier	
F 1- # Dossier de la mère : _____	
1. Date de la revue du dossier:..... JJ-MM-AA	2. Code d'employé de l'étude qui fait la revue du dossier: <input type="text"/> <input type="text"/>
3. Médication d'intérêt: <input type="checkbox"/> Antibiotiques <input type="checkbox"/> stéroïdes <input type="checkbox"/> anti hypertensifs	
Notes :	
F2 –# Dossier du bébé : _____ OU <input type="checkbox"/> le bébé n'a pas été admis à CRUO (ne pas remplir la section F2)	
4. Date de la revue du dossier:..... JJ-MM-AA	5. Code d'employé de l'étude qui fait la revue du dossier: <input type="text"/> <input type="text"/>
Épisodes	
6. ECUN Non <input type="checkbox"/> Oui <input type="checkbox"/> notes :	9. Hypoglycémie Non <input type="checkbox"/> Oui <input type="checkbox"/> notes :
7. Septicémie Non <input type="checkbox"/> Oui <input type="checkbox"/> # épisodes :	10. Convulsions Non <input type="checkbox"/> Ou <input type="checkbox"/> # épisodes :
notes :	notes :
8. Apnée Non <input type="checkbox"/> Oui <input type="checkbox"/>	
notes :	
Traitement	
11. Photothérapie Non <input type="checkbox"/> Ou <input type="checkbox"/>	15. Oxygène Non <input type="checkbox"/> Oui <input type="checkbox"/>
12. Bilirubine – mesure la plus élevée	durée : heures OUjours
13. Transfusion Non <input type="checkbox"/> Oui <input type="checkbox"/>	16. Caféine Non <input type="checkbox"/> Oui <input type="checkbox"/>
durée : heures OUjours	durée : heures OUjours
14. Antibiotiques Non <input type="checkbox"/> Oui <input type="checkbox"/>	17. KMC - admis Non <input type="checkbox"/> Oui <input type="checkbox"/>
Durée totale :jours	18. KMC - Complété Non <input type="checkbox"/> Oui <input type="checkbox"/>
19. Notes	

Annex 3: Fiche G: Status Socio-Economique

FICHE G



Infant Outcome Study

ID étude :

Fiche G : Status Socio-Economique	
G3 – Situation du ménage	
A. Qu'est ce que c'est votre status mariée ?	<ol style="list-style-type: none"> 1. Pas mariée 2. Mariée 3. Separée 4. Divorcée 5. Cohabitation 6. Ne sait pas 7. Refuse de répondre
B. Combien de personnes habitent dans votre ménage	<input type="text"/> <input type="text"/> <input type="text"/>
G1 - Éducation	
A. Qu'est ce que c'est le niveau plus haut d'éducation <u>que vous</u> avez obtenue ?	<ol style="list-style-type: none"> 1. Pas d'éducation formelle 2. Moins que l'école primaire 3. L'école primaire complétée 4. L'école secondaire complétée 5. Université/École technique complétée 6. Ne sait pas 7. Refuse de répondre
B. Qu'est ce que c'est le niveau plus haut d'éducation que <u> votre mari (père d'enfant)</u> a obtenu ?	<ol style="list-style-type: none"> 1. Pas d'éducation formelle 2. Moins que l'école primaire 3. L'école primaire complétée 4. L'école secondaire complétée 5. Université/École technique complétée 6. Ne sait pas 7. Refuse de répondre
G2 – Emploi	
A. Qu'est ce que c'est votre status du travail	<ol style="list-style-type: none"> 1. Travail manuel 2. Travail du bureau 3. Travail sans salaire 4. Etudiant 5. Sans emploi 6. Autre (specifier _____) 7. Refuse de répondre
B. Qu'est ce que le status du travail de votre mari (père d'enfant)	<ol style="list-style-type: none"> 1. Travail manuel 2. Travail du bureau 3. Travail sans salaire 4. Etudiant 5. Sans emploi 6. Autre (specifier _____) 7. Refuse de répondre

Dernière mise à jour: 18 Avril 2015

Page 1 of 1

Annex 4: Group characteristics

Total infants	710
Gender	
male	329/710
female	381/710
Birth weight	
low < 2500	500/710
normal ≥ 2500	210/710
Marital status parents	
single	106/477
cohabitation	172/477
married	168/477
separated	31/477
Education level mother	
none	20/477
less than primary	15/477
primary completed	88/477
secondary not completed	261/477
secondary completed	16/477
university not completed	24/477
university completed	48/477
doesn't know	4/477
missing	1/477
Education level father	
none	8/477
less than primary	4/477
primary completed	30/477
secondary not completed	189/477
secondary completed	46/477
university not completed	68/477
university completed	92/477
doesn't know	39/477
missing	1/477
Employment mother	
yes	227/477
no	250/477
Employment father	
yes	425/476
no	45/476
unknown	6/476

Table 5: Group characteristics

Annex 5: Time of administration of vaccines

Type of vaccine	Age of administration (months)	Margin (months)	Received on time			Received not on time			Received			Infants in cohort with age of administration N
			n	%	CI95%	n	%	CI95%	n	%	CI95%	
BCG	at birth	0-1	337	47.46	43.81 - 51.15	161	22.68	19.74 - 25.91	498	70.14	66.66 - 73.40	710
Polio 0	at birth	0-1	290	40.85	37.28 - 44.51	86	12.11	9.91 - 14.73	376	52.96	49.27 - 56.61	710
Polio 1	1.5	0.5-2.5	253	49.22	44.91 - 53.55	208	40.47	36.29 - 44.78	461	89.69	86.74 - 92.04	514
Polio 2	2.5	2.5-3.5	166	32.42	28.50 - 36.61	266	51.95	47.61 - 56.27	432	84.38	80.96 - 87.28	512
Polio 3	3.5	3.5-4.5	111	22.47	19.00 - 26.37	288	58.30	53.89 - 62.58	399	80.77	77.04 - 84.02	494
Any polio	3.5								477	96.56	94.53 - 97.85	494
Pentavalent 1	1.5	0.5-2.5	226	43.97	39.72 - 48.30	233	45.33	41.06 - 49.67	459	89.30	86.31 - 91.70	514
Pentavalent 2	2.5	2.5-3.5	133	25.98	22.35 - 29.96	297	58.01	53.67 - 62.22	430	83.98	80.54 - 86.92	512
Pentavalent 3	3.5	3.5-4.5	88	17.81	14.68 - 21.45	308	62.35	57.98 - 66.53	396	80.16	76.40 - 83.45	494
Any pentavalent	3.5								455	92.11	89.37 - 94.18	494
Measles	9	8.0-9.0	190	44.50	39.83 - 49.26	167	39.11	34.58 - 43.84	357	83.61	79.76 - 86.83	427
Rotavirus 1	1.5	0.5-2.5	187	36.38	32.32 - 40.64	227	44.16	39.91 - 48.50	414	80.54	76.88 - 83.75	514
Rotavirus 2	2.5	2.5-3.5	127	24.80	21.25 - 28.74	230	44.92	40.64 - 49.27	357	69.73	65.60 - 73.51	512
Any rotavirus	2.5								412	80.47	76.80 - 83.68	512

Table 6: Time of administration of vaccines

Annex 6: Descriptive analysis of vaccination coverage at CRUO

Variable	n	N	%	CI95%	Chi-square	p-value
Sex						
male	92	163	56.4	48.7-63.9		
female	85	171	49.7	42.2-57.2	1.5192	0.218
Birth weight						
LBW	101	207	48.8	42.0-55.6		
NBW	76	127	59.8	51.0-68.1	3.8583	0.050
Marital status						
single	30	72	42.7	30.7-53.5		
married	73	132	55.3	46.7-63.6		
separated	5	14	35.7	14.3-65.0		
cohabitation	69	116	59.5	50.2-68.1	7.6299	0.054
Educational level mother						
primary and less	30	75	40	29.4-70.6		
secondary	114	201	56.2	49.2-63.0		
post secondary	33	55	60	46.3-72.3	0.4774	0.490
Educational level father						
primary and less	10	26	38.5	21.4-58.9		
secondary	96	172	55.8	48.3-63.1		
post secondary	57	110	51.8	42.4-61.1	2.8133	0.245
Employment mother						
yes	89	162	54.9	47.2-62.5		
no	88	172	51.2	43.7-58.6	0.4774	0.490
Employment father						
yes	160	300	53.3	47.6-58.9		
no	14	29	48.3	30.4-66.6	0.2715	0.602

Table 7: Descriptive analysis of vaccination coverage at CRUO

Annex 7: Logistic regression analysis of vaccination coverage at CRUO

				Univariate logistic regression			Multivariate Logistic regression			
Variable		n	N	%	OR	CI95%	p-value	OR	CI95%	p-value
Sex*	male	92	163	56.4	ref					
	female	85	171	49.7	0.76	0.50-1.17	0.218	0.87	0.55-1.38	0.557
Birth weight*										
	LBW	101	207	48.8	ref					
	NBW	76	127	59.8	1.56	1.00-2.44	0.050	1.59	0.98-2.55	0.058
Marital status*										
	single+separated	35	86	40.7	ref					
	married+cohabitation	142	248	57.3	1.95	1.19-3.21	0.009	1.98	1.18-3.32	0.010
Educational level mother*										
	primary and less	30	75	40.0	ref					
	secondary and up	146	256	57.0	1.99	1.18-3.36	0.010	2.12	1.24-3.63	0.006
Educational level father										
	primary and less	10	26	38.5	ref					
	secondary and up	153	282	54.3	1.90	0.83-4.33	0.128			
Employment mother										
	yes	89	162	54.9	ref					
	no	88	172	51.2	0.86	0.56-1.32	0.490			
Employment father										
	yes	160	300	53.3	ref					
	no	14	29	48.3	0.82	0.38-1.75	0.603			

* retained in multivariate model

Table 8: Logistic regression analysis of vaccination coverage at CRUO

Annex 8: Short summary of vaccination coverage in Haiti in children under-5 and coverage at CRUO

Type of vaccine	EMMUS 2017	EMMUS 2017 metropolitan area	Measles Survey 2012	National Survey 2009	WHO 2017	CRUO
BCG	83	85.0		87	76	70.1
Polio0		50.0				53.0
Polio1	84	87.3		93		89.7
Polio2	70	71.8		84		84.4
Polio3	54	53.6		74	66	80.1
DTP1				92	80	
DTP2				81		
DTP3				75	60	
Penta1	84	84.8				89.3
Penta2	72	73.6				84.0
Penta3	55	54.8				80.2
Measles	61	60.9	before 59;after 91	47	53	83.6
Measles2					25	
Rubella					53	
Rota1		71.1			56	80.5
Rota2		55.6				69.7
Hep B3 + Hib3					58	
Full immunization*	41	38.6		40		53.0

Table 9: Short summary of vaccination coverage in Haiti in children under-5 and coverage at CRUO