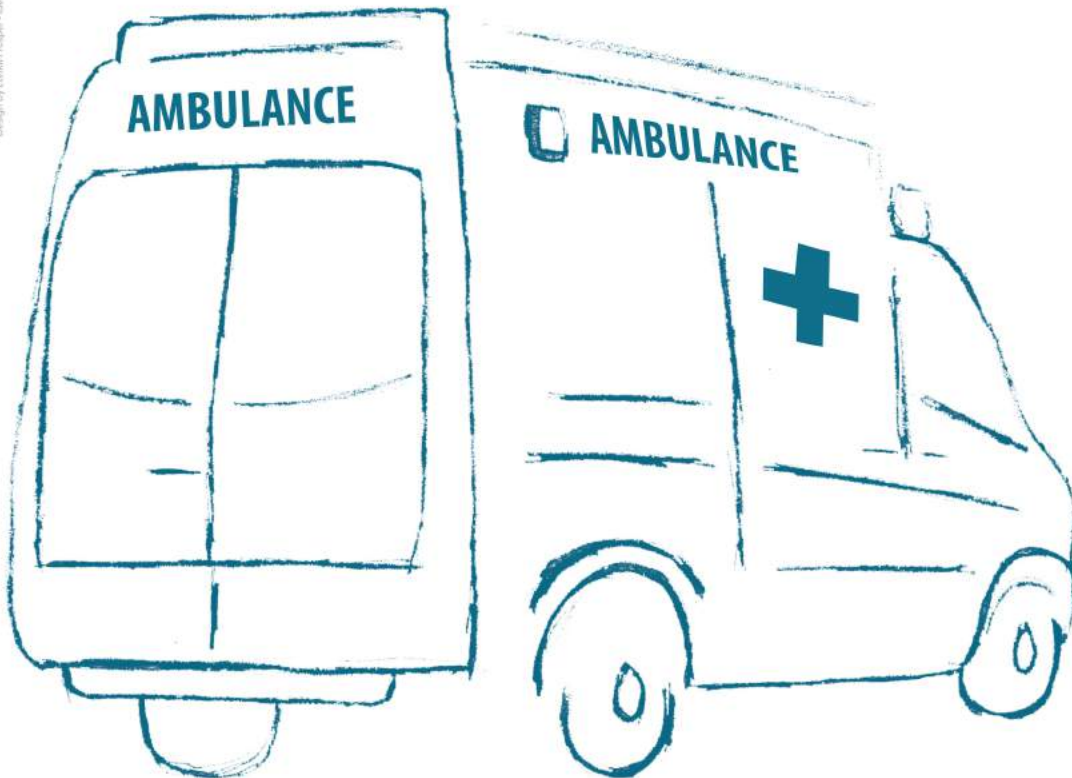


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Benefit-Cost Analysis

Developing the Ambulance System and Network



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Ambulance network and system development

Haiti Priorise

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Academic summary

Goal: To develop the system and network of paramedics in Haiti, taking into account country-specific factors, the need to save as many lives as possible, and to have an efficient response.

Methodology: Three interventions have been identified: the development of the urban network, that of the national network and increased use of the "first responders". The costs and benefits have been calculated by considering all household spending. The analysis was carried out on the basis of a costs-benefit ratio that considers the different effects of such an intervention on three aspects: trauma, ischemic cardiac disease and obstetric emergencies. That has demonstrated that whatever the scenario, and by combining 3 elements of action, the ratio reaches up to 25. This represents a definite gain; avoided deaths and disability-adjusted life years.

Taken individually, the availability of intervention proposing the use of first responders produces more advantages (15.8 Haitian gourde of "profits" for each gourde expended), about 1 and a half times more than the development of the city network and 5 times of the development of the national network (rural and urban).

Conclusion: The intervention using the "first responders and paramedics" should be combined with the development of the urban network. This collaboration provides a strong way to better care and more lives saved at the medical transport of different emergencies throughout the national territory. It remains a safe choice.

Summary of policies

- Overview and context

In a country like Haiti, qualified as a Low-Income Country or a Least Developed Country (LDC), there is much work to be done. The various sectors of social, political and economic life encountered a variety of challenges that for the most part support the weak performance of institutions. In Haiti, as in other countries in its class, most indicators are red. The index of human development is low, 0.483¹, the unemployment rate is 30%², that of extreme poverty by 24,7% to name a few. There have been numerous problems in terms of infrastructure, sanitation, education, the health sector is no exception as well, the maternal mortality ratios (157 per 100,000, Statistical Report, Survey of Mortality, Ministry of Public Health and Population) and infant mortality (57 per 1,000, Survey of Mortality, Morbidity and Use of Services (EMMUS) V) are amongst the highest in the region.

This situation has a negative impact on the country's development and on the well-being of its inhabitants. If it is necessary to act on different planes to find a lasting solution, it is nevertheless necessary to allow people to maintain or regain their health, which is key to their ability to work, to be productive, to pay taxes and, consequently, to contribute to their country's development.

Trauma is one of the scourges causing evitable mortality and disability. Their smooth implementation is essential because then we influence the chances of survival as well as the number of years without disabilities. This is what opens the interest among a country and its people to have high-quality and adequate trauma services. From the area of recovery to the host sanitary institution (SI) itself, every minute counts, acting significantly on life expectancy.

It is in this context that reflections on pre-hospital care were made, that is to say, before arriving at the SI, and those interventions have been proposed in this document.

¹ Human Development Report 2015, 2015, United Nations Development Programme.

² 2012 Ministry of Economy and Finance.

- Problem

More than 90% of trauma deaths occur in low and low-middle income countries. Globally, the rate of injury deaths - which are a better indicator of risk since they take into account the size of the population - are higher in low-income countries than in countries with higher income (*Injuries and violence, The facts, 2014, World Health Organization*).

In Haiti, between 2013 and 2014, 514,352 cases of accidents and emergencies were recorded. It should be noted that this number presupposes a sub-reported situation (Statistics Report, 2013, 2014, 2015, Ministry of Public Health and Population). On average 3/100 of the population has experienced an emergency during the past two years.

The number of cases transported by the ambulances of the Ambulance National Centre for this period is 9642, representing less than 2% (1.8%, more precisely) of the population having suffered from emergencies.

The National Ambulance Center (CAN) based in the capital is the only institution in the country offering various types of ambulance services. Apart from two other private ambulance organizations in the territory, which are offering paid services, CAN with its fleet of less than 100 ambulances, offers a free medical transport for the entire Haitian population.

The geographical context (winding roads, towns accessible only by sea or mountain trails, natural disasters) makes it difficult, if not impossible, national ambulance coverage with a single CAN.

To remedy this situation, three interventions were proposed "Establishment / Development of the urban network", "Development of the urban network" and "First responders and paramedics."

- Interventions

These interventions are elements of the development of the network and the ambulance system. They go through the establishment of the urban network or the development of the national network and the participation of trained citizens called for the cause "first responders". The interventions cover ten departments of the country.

The intervention “**establishment of the urban network**,” takes into account only urban areas and therefore the populations in urban areas. It requires the construction and operation of ambulance centers. The number of these is based on the number of ambulances required for the urban population and the assumption that a center can accommodate 10 ambulances. Considering a 5% discount, this intervention cost 561, 559, 893 Haitian gourde. This amount includes the costs for investment and operation for one year. This joins the advantages representing 4, 406, 893, 345 Haitian gourde. For each disbursement of a Haitian gourde, an estimated profit of 7.8 Haitian gourde can be expected.

The intervention “**development of the national network**” combines the establishment of an urban network and another in rural areas. Because of the specificities (related to for instance the accessibility) in rural areas, the network that is supposed to take place there, implies two things: 3 times more ambulances for every million inhabitants (compared with the urban network) and use of prepositioning strategy (with rotation in urban ambulance centers).

This network implies the existence of the urban network. Taking into account a reduction of 5%, the total cost (including investment and annual operating for urban and rural networks) is around 2, 320, 046, 967 Haitian gourde with the estimated benefits at 6, 587, 200, 390 Haitian gourde. This means that for every Haitian gourde spent, we can perceive a gain of 2.8 Haitian gourde.

If the choice can concern either one of these two interventions, it should always be paired with the establishment of “**first responders and paramedics**”.

This third action emphasizes the use of people (traditional midwives, teachers and others) volunteers at a community, trained in first aid techniques. This intervention requires a sum of \$ 80.369,344 Haitian Gourde for its implementation and with equally significant gains of 1.266, 324, 056 Haitian Gourde that gives us a benefit-cost ratio of 15.8. The efficiency by Haitian Gourde paid out is 15 Haitian Gourde and 80 cents, an efficiency far exceeding those of the first two interventions. This estimate assumes that these first responders put their knowledge and expertise on a regular basis.

- Costs

These costs imply firstly the acquisition (and maintaining) of resources: ambulances, inputs, local ambulance centers, the salaries of health workers in ambulances and paramedics at the centers and the other, training of several thousand first responders.

- Potential sources of income included in the procedure for its implementation

No source of income built into the intervention itself. However, some tracks seem promising if explored. As an example, the inclusion of a provision to pay the ambulance services at the level of public and private insurance, particularly those focusing on health (illness) and cars (accidents), could be considered with tools such as the health card. The local initiatives may be further developed, in particular those concerning mutuals and cooperatives.

- Potential sources of income included in the procedure for its implementation

The indicators of achievement would be calculated using the statistics from these ambulance centers and are defined in terms of numbers of lives saved. To follow up the implementation of this intervention is the responsibility of the National Health Authority (in accordance with its mandate) and returns to its regular monitoring activities through the use of its central and decentralized organs in their supervisory and monitoring powers. There should be no additional costs.

The response time to an emergency; the numbers of deaths prevented by type of injury as well as the DALY by category of emergency (heart disease and more specifically obstetric emergencies) are great ways of measuring these interventions.

- Description of potential implementing partners

The execution of such an intervention will be under the leadership of the Ministry of Public Health and Population in collaboration with its technical and financial partners, as the Brazilian and Cuban cooperation who signed together with the Haitian State the agreement from which originated the National Ambulance Center (ADC), the United States of America Aid (USAID) which recently donated ambulances to the CAN. The partners interested in strengthening of trauma services, certain specialized hospitals or more advanced centers in the areas of emergencies such as

Doctors Without Borders structures or even the Bernard Mevs hospital, to name but a few, are also potential partners for implementation.

- Schedule

Main steps

- Identification / build additional ambulance centers
 - Acquisition of ambulances and a sufficient stock of medical and non-medical supplies
 - Recruitment of the missing staff
 - First Responder Training
 - Deployment of first responders
- Previous

All these interventions, as currently configured, had no precedent.

- Risks

The risks associated with this procedure are particularly related to its financial sustainability, if certain factors of management and development are not taken into account.

- Justification for the intervention

Too many emergencies remain unhandled and considering the number of persons with disabilities as well as of avoidable deaths through appropriate pre-hospital care, it becomes necessary to think of a winning pattern for public health of the Haitian people, whatever their level of life, place of residence, skin color, age, gender or ideology.

Taking into account specific national realities, financial, rough terrain and other, the proposals **to establish the urban network** and **to use the first responders and paramedics** are the most economically advantageous. The second procedure (First responders and paramedics) is the most feasible, given the national financial problems even though the number of lives saved is lower in

the absence of standard ambulance. Having said that, combined with the establishment of the urban network (a health institution generally located within 250 km of a patient, the road transport is recommended as more profitable and the CAN could be considered to be an asset), this intervention will bring a contribution, accepting the fight against the avoidable deaths and disabilities resulting from injuries.

- Advantages

The benefits connected to these interventions are multiple.

The individual who suffers a trauma has a better chance of surviving. Once escaped death, the likelihood to pursue their activities without major constraint also becomes larger with the implementation of these interventions. He can thus contribute to household revenues he belongs and participate in the fiscal life of his country.

Deaths prevented the Disability Adjusted Life Years lead to a population with more people. These can work longer. There is therefore a greater manpower. This one is exploitable during more time. This increases the productivity at the national level with a positive impact both socially and economically. Other things being equal, we will witness a growth in production juggled for increased investment that will induce a larger GDP.

- Overview of the beneficiaries

The beneficiaries of such an intervention are that segment of the population who will have experimented at least one emergency (accidents, heart disease, obstetric complications, etc.) at home or not, during his life.

- Unmeasured advantage

The potential benefits of these interventions on the environment and in politics have not been measured.

- Factors relative to the implementation

The implementation of such an intervention requires some prerequisites. In fact, it is imperative to take into account the distinctive differences between rural and urban areas, and for this to apply the necessary measures in terms of approaches and resources, number and type. There must be a clear legal framework and national and standard norms regarding the pre-hospital services and medical transport.

To establish a first responder system increases the proximity and speed at the delivery of some vital pre-hospital services. So that this new category of actors would be totally and effectively functional, it is essential to have a normative framework and adequate training sessions.

TABLE 0. SUMMARY TABLE OF COSTS AND BENEFITS, COST BENEFIT RATIO BY INTERVENTION

Activity	Reduction	Advantage	Cost	CAR	Quality of evidence
Urban Ambulance network	5%	4 406 893 345	561 559 893	7,8	Medium
National ambulance network	5%	6 587 200 390	2 320 046 967	2,8	Medium
First responders and paramedics	5%	1 266 324 056	80 369 344	15,8	High

Note: All figures are based on a discount rate of 5%

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Introduction

With regard to health, a few seconds and some small acts can make all the difference; particularly when it comes to emergencies, the emergency defining itself by the endangerment in the near future - the hour or half-day - the physical integrity or the life of a person¹. As well, all that the patient might consider or feel as urgency is also considered to be an emergency.

In general, the emergency care is a challenge for health systems and particularly for those developing countries. Much of these emergencies is associated with the occurrence of trauma² outside health-care centers and requires pre-hospital care and services, that is to say, before getting to hospital. The data on an international scale is alarming. According to the World Health Organization, the injuries account for 16% of the overall disease burden. The burden of death and disability related to it is even more important in middle-income countries or of low income: 90% of the total burden of their responsibility. A person with trauma has 6 times less chance of survival in low-income areas than in high-income ones. The organization has made a health priority globally. This means, among other things, the establishment of structures and special mechanisms outside the health institutions, but in conjunction with them. Some studies show a decrease of 50%³ of medically preventable deaths after the implementation of system of care.

In the so-called of the North, the ambulance services manage much of the emergency and trauma, this, even those that occur in health institutions. To do this, these services are regulated by laws, should meet specific standards and are supported by multiple associations and financial mechanisms⁴. Other strategies of collection of information such as national surveys of emergency, reports of ambulance services and reform of pre-hospital services, enable a continuous

¹ Written by Droit-medical.com September 15, 2008 in the section Evolution. link (<http://droit-medical.com/actualites/evolution/208-urgence-medicale#ixzz4Hjd93OCC>) Consulted in December 2016

² L The World Health Organization (WHO) defines trauma as "a physical damage to a human body when subjected to brutal amounts of energy (mechanical, thermal, chemical, radiated) that exceed the threshold physiological or private tolerance of one or more vital elements such as oxygen and heat)

³ Guidelines for essential trauma care, 2004, World Health Organization

⁴ We can quote *Act pre hospital emergency services* Quebec and *Decree of 10 February 2009 laying down the requirements for the vehicles and the physical facilities at land medical transports* in France.

improvement of services and a higher rate of reduction of sequelae. The development of the ambulance sector is gradual and requires not only political will but also the inclusion of all the sectors.

In Haiti, it was not until 2012 that an ambulance center was established in the country, responding to a need that it is just impossible to see in time. This institution faces several limitations of various types such as inadequate resources or centralization. There is a sense of urgency of a more structured medical transport, more comprehensive, taking into account the realities of the country (highland therefore reduced access in certain areas, for example) and can help to increase the number of saved lives, the time to get to the nearest health institution and the most suitable in terms of management capacity.

This paper proposes three interventions to develop the system and the network of ambulances.

Documentary analysis

The urgency has no time or predetermined shape. Once known and reported, it should be managed as soon as possible to minimize the risk of injury or death. Pre-hospital services come into play and to intervene for the duration of the recovery, before arriving at the fixed point of delivery, at the place of occurrence of the emergency to the health institution. It then becomes important to invest in the establishment or improvement of an emergency management system (Olive Kobusingye C. et al, 2006)

Many studies show the benefits related to the existence of such a system. Thus according to the above quoted, services provided early can prevent global malaria mortality, deaths of about a million a year in sub-Saharan Africa, and also those caused by respiratory and diarrheal diseases in children or those caused by non-communicable diseases such as hypertension or diabetes.

Kobusingye et al are also proposing the following: for 1 million people, the number of injuries is estimated at 4,100 and deaths are associated to 900. With a capacity of resuscitation in the ambulance, 300 lives can be saved.

In a population of one million people, it is necessary to expect about 1100 deaths related to the cases of myocardial infarction and approximately 200 deaths suites obstetric complications. The use of ambulance services saves 400 lives: in whom obstetric emergencies and heart disease. This makes a grand total of 700, when we add the lives saved from traumas.

Similarly, these types of interventions are beneficial to pregnant women for who is, when at risk, impossible to determine in advance at which emergencies will be realized. The obstetric complications also have a better chance of arriving at the hospital when the ambulance is improved (Facilitating emergency obstetric care through transportation and communication, Bo, Sierra Leone. The Bo PMM Team. Samai O¹, Sengeh P., 1997)

The World Health Organization's report from 2002 "Reducing Risks, Promoting healthy life," notes that the percentage of overall mortality from trauma is 21.7, a figure that reached 31.1% in terms of years of losses life disability adjusted. The same report states that in most cases, these injuries occur in a young and resilient population and on which adequate emergency care have a favorable effect.

In the *Trauma mortality patterns in three nations at different economic levels: implications for global trauma system development* (J Trauma. 1998 May; 44 (5): 804-12; 812-4 discussion.

Mock CN¹, Jurkovich GJ, nii-Amon Kotei-D, Arreola-Risa C, Maier RV.), The authors concluded that efforts concerning the care of trauma should focus in pre-hospital care and trauma.

In addition, according to the document **Health and economic benefits of Improved injury prevention and trauma care worldwide**, it would be possible to save 72 million lives in the underdeveloped and developing countries with decreasing mortality from trauma via an investment in terms of trauma care (which would also include ambulance care).

In terms of organization of the pre-hospital care, the literature provides interesting information. While in developed countries the debate continues at the level of efficiency of the use of air medical transport (**Cost-effectiveness analysis of helicopter EMS for trauma patients.** Gearhart PA¹, Wuerz R, local I AR1997) in other countries (so-called less developed countries), the use of on-board vehicles as the motorcycle seems to be working. In fact, it was established that the road

ambulance system is more cost effective for transporting patients to health institutions in more than 250 km from the place of recovery (**Regional transport intensive care: a prospective analysis of distance, time and cost for road, helicopter and fixed-wing ambulance. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 22: 36, 2014** Brändström, H., Winsö, O., Lindholm, L. Haney, M.).

It has been shown that the laity people trained in first aid care are effective to give an appropriate response in situations of trauma with decreased trauma related mortality (**Training pre-hospital trauma care in low-income countries: the 'Village University' experience** Husum H¹, Gilbert M, Wisborg T, 2003).

On the other hand, the allied health professionals, doubled by ambulances reduce the incidence of pre-hospital deaths (**Low-cost improvements in pre-hospital trauma care in a Latin American city** Arreola-Risa C¹, Mock CN, Lojero L-Wheatley, de la Cruz O, Garcia C, Canavati F-Ayub, Jurkovich GJ2008).

Methodology and Data

In this document, we propose a **literature review** on the question of the organization of pre-hospital services. In doing so, the first research was done on the website of the World Health Organization (WHO) *who.int* with the input of the group of words **trauma care**, the results for hospital services were discarded in favor of guides establishing the guidelines of trauma services with emphasis on those under the pre-hospital field. The references of the first document served to find other electronic documents on this issue. This work helped to identify the best interventions and underlying assumptions.

We have also consulted the press reports of Haitian newspaper such as Le Nouvelliste during the third quarter 2016, as well as the official website of the Ministry of Public Health and Population (MSPP) [www. Mspp.gouv.ht](http://www.Mspp.gouv.ht).

The statistical data of population result from the online database of the World Bank.

The choice of interventions presented in this document is made on the basis of a cost-benefit analysis.

Cost Calculation. To calculate the costs of different interventions, the preferred sources of information were the statistical reports from 2014 and 2015 published by the MSPP. The components of emergencies are drawn there.

The draft document of the Public Investment Project (PIP) 1313-1-12-50-14 served to get a better knowledge of the expectations of the National Health Authority in the ambulance system. The various items of expenditure for the organization and operation of ambulance and urban networks are from the previous annual budget (2016-2017) of the National Ambulance Center (ADC). The number of staff as the intervention is calculated using the assumptions provided by Kobusingye et al. 2006.

The costs for the training of "first responders" are also based on assumptions given by Kobusingye et al. 2006. Those related to the specific context of Haiti (room rental for training, for example) are calculated based on Haitian realities and habits of MSPP.

Calculation of benefits. The benefits are calculated in terms of lives saved and DALYS whether a particular action is in place. Based on assumptions by Kobusingye et al. 2006, the benefits were determined. Based on the exercises of reduction (3%, 5% and 12%) of these DALYS, a monetary valuation of these benefits is made, thereby arriving at the analysis of cost-benefit ratio. The rate of reduction of 5% was used to settle the three interventions.

Cost-Benefit Calculation

Intervention "Establishment of the urban ambulance network" – Cost Calculation Hypotheses

Based on the work of Olive Kobusingye C. et al. (2006), the following is planned for the network ambulance system in urban areas:

- an ambulance for 30,000 people, that is 176 ambulances for the urban population in Haiti estimated at 5,327,640 million;

- 10 ambulances by ambulance center, making a total of 18 centers (calculation);
- A cost of 5.525 million Haitian gourde by ambulance and of 6.33 million Haitian gourde by ambulance center (calculation);

A staff of 9 people (in rotation) by ambulance: if Kobusingye et al. 2006 propose 7 people for the ambulance staff; there are other authors⁵ that propose 10. Assuming that an ambulance is working 24h and a staff of 2 people is required for each shift (8 hours) and a 2-day rest period is suggested, 9 people should be enough as staff by ambulance.

- A supervisor for 3 ambulances.

Sources of Information

We have use the data from the Public Investment Project for the establishment of an ambulance center, the 2016-2017 and the budget of the National Ambulance Centre and the Global Burden of Disease 2015.

⁵ Annual update in intensive care and emergency medicine, 2015, Jean-Louis Vincent.

TABLE 1. COSTS (HAITIAN GOURDE) OF INTERVENTION « ESTABLISHMENT OF URBAN AMBULANCE'S NETWORK » FOR A YEAR

Topics / resources	Quantity	Unit Cost	Total	Hypotheses
Ambulance center	18	6 330 000,00	111 289 066,33	10 ambulances per center
Ambulances	176	5 525 000,00	971 361 913,88	33 ambulances to 1 million inhabitants
Total investment			1 082 650 980,21	
Ambulance workers	1582	221 000,00	349 690 289,00	9 by ambulance
Supervisors	53	598 000,00	31 540 692,73	1 for each 3 ambulances
Ambulance operation center	18	252 000,00	4 430 465,20	
Fuel-ambulance	176	50 000,00	8 790 605,56	20 000km per year by ambulance
Maintenance ambulance	176	360 000,00	63 292 360,00	
Total operating			457 744 412,48	
<u>Total response "urban network Establishment"</u>			<u>1 540 395 392,69</u>	

Urban network of ambulance intervention - Advantages

The benefits based on assumptions made by Kobusingye et al. 2006, are shown in the table below. This intervention reduced by 33% deaths related to trauma, 18% of those related to ischemic heart disease, and half of deaths related to obstetric complications.

Types	Percentage of death reduction	Number of deaths averted	DALYS (unreduced)
Trauma-related deaths	33%	1260	55
Heart disease-related deaths ischemic	18%	949	21
Deaths involving obstetric complications	50%	330	54

Intervention "Development of national network" - Costing

For calculating the costs of the urban network, we shall keep the same hypothetical considerations of the first intervention. To those, for the rural network are added the following hypotheses:

- repositioning of ambulances to reduce considerably the time, knowing that in rural areas many road infrastructures are lacking;
- 3 times more ambulances per million inhabitants in urban areas, giving a total of 99 ambulances per million population;

Sources of Information

To calculate the cost of this intervention, we have used the Public Investment Project data concerning the establishment of an ambulance center, the 2016-2017 budgets of the National Ambulance Centre and the Global Burden of Disease 2015. The following table highlights the different elements considered in this calculation.

TABLE 2. COSTS (IN HAITIAN GOURDE) INTERVENTION "DEVELOPMENT OF THE NATIONAL AMBULANCE SYSTEM" FOR ONE YEAR

Topics / resources	Quantity	Unit Cost	Total	Hypotheses
Urban				
ambulance center	18	6330 000.00	111 289 066.33	10 ambulances per center
Ambulances	176	5525 000.00	971 361 913.88	33 ambulances to 1 million inhabitants
Total investment			1 082 650 980.21	
Ambulance workers	1582	221 000.00	349 690 289.00	9 by ambulance
Supervisors	53	598 000.00	31 540 692.73	1 for each 3 ambulances
Ambulance operation center	18	252 000.00	4 430 465.20	
Fuel-ambulance	176	50 000.00	8 790 605.56	20 000km per year by ambulance
Maintenance ambulance	176	360 000.00	63 292 360.00	
Total operating			457 744 412.48	
Grand total (urban)			1 540 395 392.69	
Rural area				
Ambulance center	0	6 330 000,00	-	pre-positioning strategy
Ambulances	569	5 525 000,00	3 145 321 603.59	99 ambulances to 1 million inhabitants
Total Rural Investment			3 145 321 603.59	
Paramedics	3985	221 000.00	880 690 049.01	9 by ambulance
Supervisors	171	598 000.00	102 258 000.00	1 to 3 ambulances
Ambulance operation center	0	252 000.00	-	pre-positioning strategy
Fuel-ambulance	569	50,000.00	28 464 448.90	20 000km per year by ambulance
Maintenance ambulance	569	360 000.00	204 944 032.09	
Total operating			1 817 672 547.28	
Grand total rural			4 962 994 150.87	
Total national response network development			5 902 073 526.28	

Intervention "Development of national network" - Advantages

The background of determining the benefits of this intervention is established by the hypotheses of Kobusingye et al. 2006.

This intervention resulted in a 50% reduction in deaths, due to obstetric complications and 18% in regard to mortality from ischemic heart disease, just like the urban network. Nevertheless, the percentage of reduction of trauma-related deaths is half of that expected with the establishment of the urban network, the delivery time to a health institution being longer in rural than urban areas.

The advantages are summarized in the table below.

TABLE 4. SUMMARY OF THE BENEFITS OF THE INTERVENTION "DEVELOPMENT OF THE NATIONAL NETWORK"

Types	Percentage of death reduction	Number of deaths averted	DALYS (unreduced)
Trauma-related deaths	*17%	1310,43	55
Heart disease-related deaths	18%	1972,44	21
Deaths involving obstetric complications	50%	686	54

**Kobusingye et al 2006 propose 33%, this percentage has been reduced to take into account the delivery time to a health institution*

Intervention First responders and paramedics - Cost Calculation

Hypotheses

The assumptions are taken from chapter 68 of the document The International Bank for Reconstruction and Development, 2006, The World Bank.

First responders

- 2500 stakeholders to 1 million people, making a total of 27,695 participants for the national population;
- 20 participants per instructor so 1385 trainers in total;
- 2 days of training.

The paramedics

For this category paramedical profession, the hypotheses are as follows:

- 50 paramedics per 1 million inhabitants 554 therefore required to cover the total population;
- 10 per trainer, so all 55 trainers;
- 25 days of training;
- 1 set paramedic.

The following table presents the components of costs related to the intervention.

TABLE 5. COSTS (IN HAITIAN GOURDE) INTERVENTION "FIRST RESPONDERS AND PARAMEDICS" FOR A YEAR

Topics / resources	Quantity	Unit Cost	Total	Assumptions
First responders (PI)	27695.08	549	15 209 828.57	2500 first responders to 1 million inhabitants
Trainers	1385	4983.333333	6900 691.67	1 trainer for 20 players
Training (rooms)	1385	20,000	27 695 083.62	1 room for 20 participants
Materials	1	1,800,180.435	1800 180.44	1 US dollar first speaker
Total PI			51 605 784.29	
paramedics	553.9017	19770.83333	10 951 097.65	50 per 1 million inhabitants
Trainers (paramedics)	55.39017	62291.66667	3450 345.83	1 trainer for 10 paramedics
Training (rooms)	55	-250000	13 847 541.81	1 room for 10 paramedics
Materials	1	36003.60871	36 003.61	1 US dollar Paramedic
Materials (kits)	1	478,571.045	478 571.04	16 US dollars per kit
Total paramedics			28 763 559.95	
Grand total (PI+Paramedics)			<u>80 369 344,24</u>	

Intervention "First responders and paramedics" - Benefit Calculation

The benefits of this intervention, based on assumptions of Kobusingye et al. 2006, relate solely to deaths related to trauma. It reduces them by 9%.

TABLE 6. SUMMARY OF THE BENEFITS OF THE INTERVENTION "FIRST RESPONDERS AND PARAMEDICS"

Types	Percentage of death reduction	Number of deaths averted	DALYS (unreduced)
Trauma-related deaths	9%	715	34

The following table summarizes this section and presents the costs and benefits with three different reduction rates (3%, 5% and 12%). The remarks made in this document are based on figures obtained with a 5% discount rate. Each benefit is valued monetarily in terms of Gross Domestic Product per capita of the year, in which a life is saved or avoided DALY. Then, the total is updated with regard to present time.

Here is the summary table of costs and benefits.

TABLE 7. COST-BENEFIT RATIO ACCORDING TO THE PROCEDURE

Activity	Reduction	Advantage	Cost	CAR	Quality of evidence
Urban ambulance system	3%	5 987 016 701	544 734 858	11,0	Average
	5%	4 406 893 345	561 559 893	7,8	
	12%	2 192 906 331	623 272 309	3,5	
National ambulance system	3%	8 772 312 411	2 253 275 495	3,9	Average
	5%	6 587 200 390	2 320 046 967	2,8	
	12%	4 503 330 968	2 564 154 651	1,8	
First responders and paramedics	3%	1 652 560 474	80 369 344	20,6	High
	5%	1 266 324 056	80 369 344	15,8	
	12%	637 862 961	80 369 344	7,9	

Conclusion

Following the benefits of the existence and use of ambulance services, it appears essential to set up a system giving the minimum to more clients / patients, while there's still time with the available resources.

TABLE 8. SUMMARY TABLE OF COST-BENEFIT RATIOS IN THE INTERVENTION

DALY = 3x GDP per capita

Activity	Reduction	CAR	Quality of evidence
Establishment of urban ambulance system	3%	11,0	Average
	5%	7,8	
	12%	3,5	
National ambulance network development	3%	3,9	Average
	5%	2,8	
	12%	1,8	
First responders and paramedics	3%	20,6	High
	5%	15,8	
	12%	7,9	

The calculations showed that the benefits far outweighed the costs; the various interventions are proposing value for money and showing them efficient character. Though the efforts at the legal and normative framework are to make for better implementation, they are nevertheless the solutions of choice given the realities. The combination of the use of first responders and paramedics and development of the urban network allows reaching a combo that cost-benefit ratio more and affecting the mortality rate related to trauma, ischemic heart disease and obstetric complications more remarkable.

Along the way, we will have to modernize this system, expand the range of services and strengthen the institutional system traumatic for even greater results.

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



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