

## Performance Analysis of Humanitarian Logistics: A Case Study of Children with Microcephaly

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**ABSTRACT:** Humanitarian logistics is increasingly present in helping the suffering and rescue of people affected by disasters. The search for faster, efficient and effective operations of this logistics contributes to the support to be developed. The research carried out in this work consists of a case study with children with microcephaly in Salvador - BA. The central question sought to investigate the importance and performance of humanitarian logistics in responding to slow-start disasters. The general objective of the research is to identify the logistic actions to assist in the development of these children. In order to investigate and analyze these actions, the support actions offered by people committed to help were sought and interviews were conducted with mothers and endemic agents, in which they reported the actual situation of this performance. With this research, it was possible to discuss the adequacy of improvements in the support centers of this city. Thus, it could be concluded that the support offered in the municipality is insufficient.

**KEYWORDS** Slow-onset disaster. Humanitarian Logistics. Zika Virus. Microcephaly

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### I. INTRODUCTION

Disasters occur in an unexpected way and result in damage and harm to local populations. Due to the frequency of occurrence and depending on its magnitude, it may require rapid relief operations to alleviate the suffering of those affected.

Disasters are caused through the impact of some extreme natural phenomenon or human activities on a given ecosystem. These, depending on the level of intensity and classification of their nature, result in consequences for this population (KOBAYAMA et al., 2006).

In this way, humanitarian logistics - LH is responsible for rapid deployment in the management of materials and organization in the flow of people. In addition, it also organizes all the food and medicine received through donations collected from other cities and states, and uses transportation resources such as helicopters, ambulances and boats to rescue these people and send them to lodgings for shelter and care.

Therefore, for LH performance it is necessary to know the classification of disasters. According to Leiras et al. (2017), these are classified according to the probability and speed of occurrence. In addition are the sudden-onset disasters characterized by destructive actions and calamities and slow-onset as pests, refugee crises and famines in Africa.

This article deals with a slow-onset disaster, the *Aedes aegypti* infestation that causes the spread of Zika virus and even microcephaly. This is a congenital malformation in which the brain does not develop to the standard (FENASAÚDE, 2016; WHO, 2016).

In July 2015, many pregnant women who had already been infected with Zika were hospitalized with neurological symptoms during pregnancy. Through the investigation carried out, hypotheses of the Zika relationship with the microcephaly presented in the babies were approached, which had its real confirmation on November 28, 2015 (BRASIL, 2017).

Based on this, the Health Surveillance Secretariat (SVS) computed the increase in the number of cases of children born with microcephaly in the last five years. According to the epidemiological bulletin, in Brazil, the year that presented the highest rate of these cases was in 2015 and in view of this, control and follow-up measures for the disease are under development. Thus, LH aims to propose mitigation actions to support affected people as well as the creation of new strategies and support technologies.

This paper deals with the investigation of the logistic actions developed by the Brazilian federal government to support the people affected by the slow - start disaster that caused the microcephaly outbreak as well as the treatment provided to them by the city of Salvador - BA.

## II. THEORETICAL FRAMEWORK – BUSINESS LOGISTICS

Logistics originated from the Greek Logistikos, which means mathematical calculation and reasoning. This word was used by army officers who commanded administrative activities and performed mathematical calculations, which is why these officers obtained the title of Logist (LEIRAS et al., 2017). However, the meaning we understand comes from the French Logistique, which means housing and refers to a terminology derived from transportation, supply and military accommodation.

Thus, logistics developed through a war strategy of military operations, these wars were long and tiring, so when they needed to replenish supplies at their military bases, the military used transportation as a mechanism to mobilize the military. weapons supplies, materials and products. In addition, the military used logistics as an alternative to escape routes and surprise attacks on their opponents (OLIVEIRA e FARIAS, 2010).

For Leiras et al. (2017) Military logistics involves the planning, execution, movement and maintenance of troops. Moreover, in order to achieve control and fluidity of operations, military logistics uses technology and automation for the efficiency and effectiveness of its logistics processes. Thus, they enable fast and constant communication about the infrastructure detailing of their processes and transportation. For this reason, this is considered the first of business logistics.

According to Ballou (2012) business logistics consists of the process of planning, execution and control of the movement of goods and services. In addition, it offers consumers goods and services wherever and whenever they wish. In view of this, the main objective of business logistics is to reduce the distance between production and demand, as well as to seek improvements in its distribution services.

Moreover, it is essential in the process of transmitting information about the logistics cycle, which occurs from the purchase of raw materials to the purchase of the product by the final consumer. This cycle occurs in an integrated manner and assures the final consumer possession of the product. If the information system of the storage or transportation operations fails, this product will not be obtained within the estimated time and will cause dissatisfaction to customers (NOVAES, 2017).

Ballou (2012) states that business logistics consists of a set of specific activities that characterize it, among them are: transportation, stock management and order processing.

### Transport

Transport was conceived by the Egyptians because of the need to transport goods quickly and cheaply. This made it easier for them to establish their buying and selling trades and to make their profits (LEIRAS et al., 2017).

According to Ballou (2012) this is the most important logistic activity, because it is through it that occurs the movement and storage of raw materials and finished products - PA in stock, i.e., he is responsible for operational planning. In addition, transport absorbs a large part of logistics costs, as this cost depends on the type of product to be transported. Therefore, when choosing a driving medium for PA, equipment or raw materials, some characteristics should be considered such as: reduced prices, delivery time, variability as well as losses and damages.

However, even if all deliveries have the point of origin and destination made by the same transport, the duration of the journey will not be the same due to climate variations, traffic congestion and others. Thus, for a company to fulfill its delivery on time, one must know the maximum transport capacity as well as the total distance of the route that it will travel, because the transport is chosen according to the distance of the route, time required and goods transported (BALLOU, 2012; ROSA, 2007).

### Stock Management

Stocks consist of accumulations of various materials, including raw materials, semi-finished materials and PA. The packaging of these supplies ensures their availability in unforeseen situations in their supply or production process, ie, late delivery, or unexpected increase in the amount of raw material expected. In addition, damage can also occur in materials and equipment, which slow the process and raise the level of inventory (CORRÊA; GIANESI; CAON, 2013).

Thus, these act as buffers between supply and demand; as a result changes in sales and production become constant and new opportunities for companies. Since the demand for product sourcing is uncertain, there is a need to maintain and manage supplies so that products are always available. For this reason, safety and reserve stocks should be available to meet market needs (BALLOU, 2012).

However, these also work as a business strategy, meaning some companies anticipate buying supplies through the speculation strategy. Speculation is the acquisition of materials in large quantities during their sale at low cost, which can be immediately absent (CORRÉA; GIANESI; CAON, 2013).

Kumar and Jayant (2017) add that the selection of suppliers enables good savings for the company, because it allows the reduction of risk and additional costs, discounts on total purchase and avoids possible delays in supplies.

Therefore, stock management plays a role in material replenishment points and the size of this batch for replenishment. Thus, they should proceed with low levels, as high level stocks correspond to inert capital. However, minimum quantities should be safeguarded, as claims may occur and having extra materials corresponds to customer satisfaction (BALLOU, 2012).

### **Order processing**

Order entry and processing is the activity that initiates product movement and service delivery. The speed of accurate sales information determines the efficiency of the operation, i.e. fast and accurate order processing minimizes customer response time (BALLOU, 2012).

To serve the consumer a long-term sales forecast is made. This forecast is based on past sales, price, promotions, and competitor actions. Thus, the information provided becomes data and feed the order entry into the system, that is, order processing is characterized as strategic planning and becomes responsible for the production plan (FLEURY; WANKE; FIGUEIREDO, 2013).

Therefore, order processing is fundamental and must be performed correctly, as the speed of sales and order information needs tuning so that information on supply and demand is not distorted as well as delays in fulfilling requests, reduction or increase in inventory level (BALLOU, 2012; FLEURY; WANKE; FIGUEIREDO, 2013).

### **Humanitarian logistics**

Humanitarian logistics - LH, as well as business logistics, is responsible for planning, transporting, storing and distributing supplies, however it differs by presenting as its main objective the support to people affected by disasters (LEIRAS et al., 2017).

Thus, this logistics acts according to the causes (calamities, destructive actions, pests or crises) and the speed of disaster propagation, which can occur quickly (suddenly) or slowly. In view of this, for LH to carry out good planning, storage, distribution and transportation, the spread and type of the disaster must be known, as there is an increase in the success of the response actions. For this reason, there are four operators that assist in the management of humanitarian logistics: the assessment, acquisition, storage and transport (VAN WASSENHOF, 2006b; LEIRAS et al., 2017).

In accordance with Leiras et al. (2017), the assessment consists in verifying and delineating the priority needs based on the demand pattern so that the planning of the operations can be well executed later. The acquisition is the flow of materials, i.e., the collection or purchase of priority resources to meet demand. As a result, if supplies are sorely needed, the lead time for this collection becomes a differentiator. Storage is the receipt and control of supplies purchased for distribution and transportation is based on the types of modalities to be used to redeem and distribute donated materials.

However, LH faces some difficulties during the disaster event. Among these: compromised infrastructure, high levels of demand uncertainty, lack of supplies, reckless volunteers, critical time, financial resources, technology as well as the uncoordinated form of some donors, the media, government and the military, in which they can compromise the chain with unsolicited donations (VAN WASSENHOF, 2006a; SHAFIQ; SORATANA, 2019).

According to Sant'anna (2016) people who make these donations do not specify the type of food, medicine and personal hygiene product as well as their conservation and validity; therefore, there is a need for more time to check these items, which can create bottlenecks that delay the entire process of donation transport and distribution.

The author adds that these delays result in wasted time, and that time in providing humanitarian aid is a determining factor between a person's life and death. In addition, volunteers should be aware and know the entire rescue process; otherwise they can hinder and compromise not only their own life as well as the life of those who need this help.

**Differences between fast and slow start responses**

The difference in the types of disaster response will depend on its level, evolution, origin as well as the damage caused. The level of the disaster is tied to its size and intensity. The evolution is consisted of whether this intensity occurs suddenly, gradually or by several other factors together. However, this evolution stems from the reason that originated the disaster, that is, the causative agent, and finally the consequences that the damage and damage they bring to the population (FURTADO et al., 2014). For this reason, the responses and management cycle for fast and slow-start disasters are also different and can be analyzed according to Table I.

**Table I:** Differences between fast and slow start responses using the four operations

Operators	Sudden-onset	Slow-onset
<u>Assessment</u>	Quickly diagnose demand; Delimit needs.	Collect demand data; Delimiting problems and needs; Identify humanitarian aid centers.
<u>Acquisition</u>	Call donations through the media or humanitarian partners.	Check resources to use; Conduct donation campaigns through digital tools or humanitarian partners.
<u>Storage</u>	Map location to logistics center; Receive donations and separate them by type.	Analysis of indicated storage location; Receive donations and separate them by type; Establish stock control for replenishment.
<u>Transport</u>	Delimit the types of transport needed to redeem and distribute supplies.	Verify the transports used in personnel management and resource receipt.

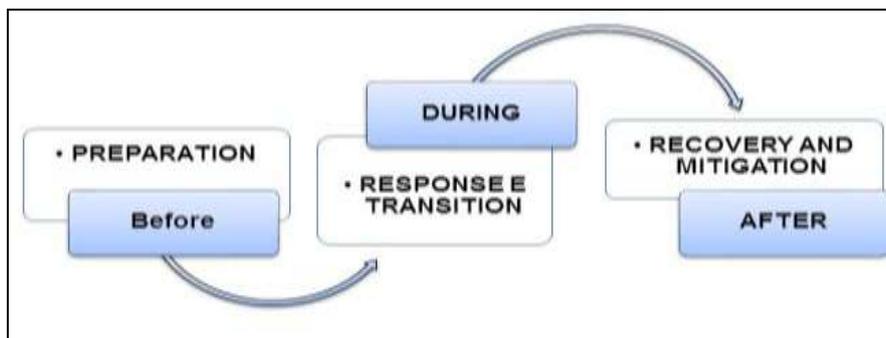
Source: Adapted from Leiras et al. (2017).

The four operators act similarly for fast and slow disasters. According to Table I above, the assessment operator is responsible for identifying and assessing demand, usually for rapid disasters this demand is determined shortly after the occurrence. For slow-start disasters, demand is accounted for and made available by informational data, so it becomes easier to delineate the need.

Acquisition consists of verifying the resources to be used; these are usually determined by humanitarian coordinators and logistics and requested from humanitarian partners (persons and bodies interested in helping). Storage is the operator who will verify the location for the installation of the logistics center, as this is where the separation and control of incoming material flow will occur. The transport operator is the support of the logistics center, as it will distribute the supplies and assist in the movement of people.

For this reason, these four operations are fundamental to the entire humanitarian chain, since they are the ones that help the response of these disasters by the action of LH in its phases, as well as to delineate the actual situation of the event and to delimit the resources and supplies to be used for the rescue and support.

Therefore, LH acts before, during and after these disasters. For sudden onset disasters the stages of disaster management are comprised of five phases: preparedness, response, transition, recovery and mitigation (HOWDEN, 2009; LEIRAS; BRITO JUNIOR; YOSHIZAKI, 2011). These steps were elaborated according to the LH performance, which is shown according to Fig. 1 below:



**Fig.1. Sudden Disaster Management Stages**

Source: Adapted from Howden (2009) and Leiras; Brito Jr; Yoshizaki (2011).

At the beginning of this stage, LH will act before the disaster occurs, as in some places it becomes possible to demarcate risk, exposure and vulnerability. In this way, the preparation stage with local people begins as the risks to the type of disaster become noticeable. According to Howden (2009), LH will offer instructions to locals, including: evacuation, obtaining necessary supplies and where to purchase them if local markets are damaged.

When disaster strikes quickly, such as calamities and destructive actions, LH actually begins to act in response and transition. This will trigger logistics activities to collect food and medical supplies as well as clothing and toiletries, so acquisition, storage and transportation operators become critical to this rapid response as well as assisting in their delivery transition to seeking support providers until the recovery phase.

According to Sant'anna (2016), after delimiting the needs and forecasting the demand, the acquisition of the supplies is made by donations through the outsourced transport in which they pick up these products to be stored and later distributed.

However, LH faces an obstacle, which comes down to forecasting affected demand, i.e., no matter how much one estimates the number of people living in that region when a disaster strikes, it is difficult to accurately measure those affected. This reason the operator evaluation is extremely important.

In addition, inaccurate information about this predictability of demand makes it difficult to assess priority needs in providing relief to victims. Because of this, uncertainty must be resolved as soon as possible and a logistics center should be set up to receive supplies, volunteers and relief providers (SANT'ANNA, 2016; TOMASINI; VAN WASSENHOVE, 2009).

After the disaster, LH seeks to provide ongoing support until the site is recovered. At this last stage of the management cycle, the houses are rebuilt, the population's infrastructure and livelihoods restored. In addition, preventive measures are put in place to minimize future impacts, but to carry out the post - disaster phase; LH needs financial resources for these humanitarian operations.

In slow-onset disasters, there is no cycle for managing this disaster, however, some authors report ways in which it can be handled. Table II below presents these main approaches.

**Table II: Main approaches elaborated by the authors.**

	Baemon e Balcik (2008)	Howden (2009)	Costa et al. (2017)	Günther;Ciccotti;Rodrigues (2017)	Leiras et al. (2017)
<b>Approach</b>	Chain of relief with four phases.	Management of information systems.	Planned response.	Long term response.	Implementation of definitive solutions.

Source: Authors data.

For slow-source disasters such as pests and crises, the response can be planned by having more time to prepare them, so good disaster diagnostic mapping as well as definitive solution implementations contribute to the uncertainties of whole humanitarian chain (COSTA et al., 2017; LEIRAS et al., 2017).

In addition, slow-onset disasters require both long-term and continuous responses, as in many of these disasters are the result of consequences of other fast-source disasters. In this way, you should consult the informational data, manage the collected needs information and establish the types of materials required. However, as it is a slow start response the process becomes gradual and in turn is necessary to use the replenishment system (HOWDEN, 2009; GÜNTHER; CICCOTTI; RODRIGUES, 2017).

According to Baemon and Balcik (2008) the chain of relief has four phases: assessment, deployment, sustainment and reconfiguration. This chain was adapted from Marlin Thomas, which encompassed the deployment, support, and reconfiguration phases. However, due to the need to identify the level of demand and its main priorities, authors Baemon and Balcik inserted the evaluation phase in this chain, which can be observed according to Fig. 2 below:

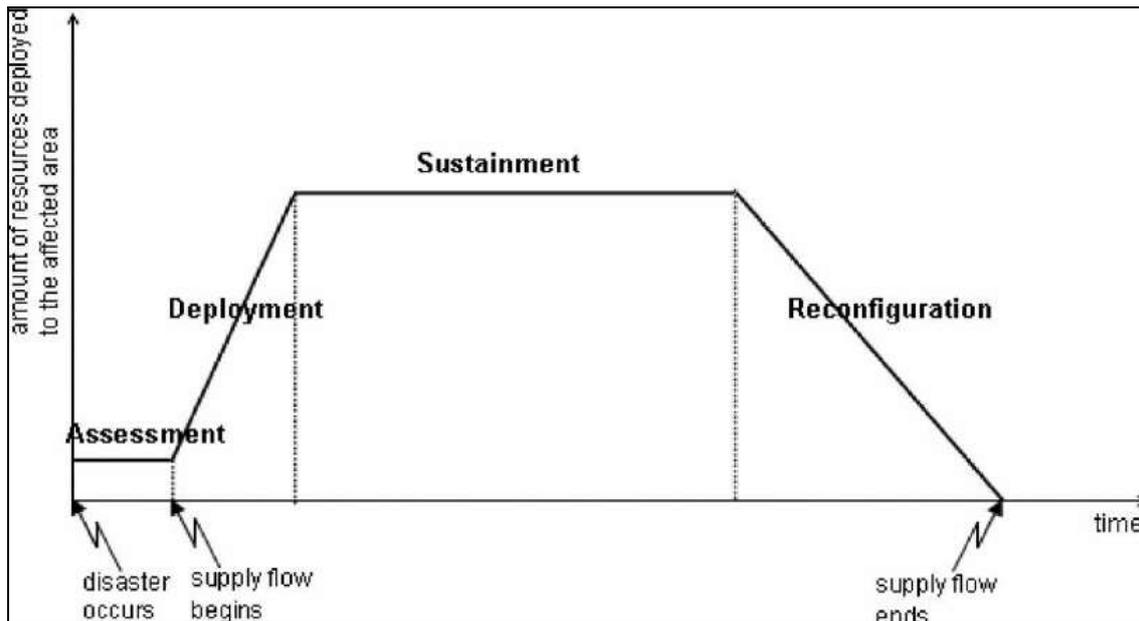


Fig. 2. Relief Chain Procedure

Source: Baemon and Balcik (2008).

According to the authors, the assessment phase is to identify the necessary resources of the demand. In the implementation, the humanitarian coordinators and others involved should check the possible alternatives to obtain more resources to meet this demand.

The sustainment phase has operations carried out for a certain period, which may be continuous or not. This phase is the most important for this work, as these operations are performed to support the affected and aggregate the operators: acquisition, storage and transportation. Reconfiguration is the completion of these operations, but the end of these operations will depend on the need for the requesting demand.

However, slow-onset disasters are most likely to occur in developing countries, where they lack infrastructure, sanitation and public health services. However, the cause of this disaster is not always clear and so humanitarian logistics use this challenge to categorize it and later designate the focus of humanitarian assistance (KOVACS; SPENS, 2009).

### Disasters

Disasters are phenomena originated by nature or caused by the action of man, which causes damage and harm to the affected community and it cannot obtain responsiveness and recovery from its own resources (UNISDR, 2009).

In view of this, it is essential to recognize risk factors as well as to combat them to ensure people's lives and to cope with disasters, i.e., vulnerabilities must be identified and then preventive and mitigation measures planned to reduce and prevent disasters possible risks. Thus, in order for sites to be resilient, i.e., recoverable, the basic and operative aspects for a better reconstruction must be considered (GÜNTHER; CICCOTTI; RODRIGUES, 2017; BRAZIL, 2017).

The basic aspects are the organization of disaster recovery, understanding and use of current and future risk scenarios, in order to strengthen the financial capacity of this recovery. Operative aspects seek the development of urban projects, the understanding of societal capacity for resilience as well as its infrastructure. Aspects for better reconstruction consist of a quick and effective response to calamities (BRAZIL, 2017).

However, these aspects may vary depending on the types of disasters, so this identification is required. Disasters are classified as natural and technological and have a range of subtypes. Those considered technological are subdivided into accidents with radioactive substances, hazardous products, urban fire, civil works, passenger transport and non-hazardous cargo. The natural ones are subdivided into geophysical, hydrological, meteorological, climatological and biological (FURTADO et al., 2014).

In this paper, the natural disaster studied corresponds to the biological one, in which it originates from the animal kingdom and affects the environment and society. Biological disaster consists of epidemic and hyperendemic outbreaks as well as pest infestations and epidemics such as *aedes aegypti* (CODAR, 2018).

### **Aedes Aegypti, Zika virus and microcephaly**

*Aedes aegypti* is a mosquito that has domestic habits during dawn and dusk, its survival occurs through the female, which feeds on human blood for reproduction. This occurs when the female is attracted to dark containers and lays her eggs in clean, still water, which she calls a breeding facility. However, if this female is infected with dengue, chikungunya and zika virus, and by feeding on a human, this virus can be transmitted and result in serious illness (BRAZIL, 2001; BRAZIL, 2016a).

Zika virus is an arbovirus transmitted by the bite of *Aedes aegypti*, an arthropod. Arboviruses spread rapidly in tropical regions and increase endemic infections. Its first detection occurred in sentinel monkeys in 1947 in the Zika forest in Uganda, and for this reason it was named after the site (BRAZIL, 2017; BRAZIL, 2016a; FENASAÚDE, 2016).

In Brazil, by the end of 2014 the symptoms of this virus were already present with several cases, including headache, low fever, mild joint pain, red spots on the skin, itching and redness in the eyes, these symptoms dissipate after 3 to 7 days. However, the first finding of this virus occurred in April 2015 through a researcher from UFBA, in which identified by blood samples that this infection came from the Zika virus (BRAZIL, 2017; FENASAÚDE, 2016).

Therefore, as there were few worldwide reports of the Zika epidemic, there was little concern. However, in mid-July, the large hospitals in Bahia, Pernambuco, Rio Grande do Norte and Maranhão saw an increase in the number of people hospitalized for neurological symptoms, which reinforced the hypothesis regarding zika, as these affected people have contracted it previously. The research conducted pointed to the possibility of the relationship of microcephaly with Zika during pregnancy, this relationship was confirmed by the MS on November 28, 2015 and since then new cases of babies with microcephaly were computed (BRAZIL, 2017).

Microcephaly is characterized as a congenital malformation, i.e., the brain does not develop properly. The identification of this malformation is standardized according to the cutoff points adopted by the World Health Organization (WHO), and its identification is essential for monitoring brain growth. For babies with head circumference below two standard deviations of the median, it is characterized only with microcephaly. However, if a head circumference below three standard deviations of the median is found in these infants, microcephaly is characterized as severe and may develop abnormalities (WHO, 2016).

### **III. CASE STUDY**

This study is divided into three stages. In the first stage was described the main logistic actions taken by all involved as the Federal Government, Non-Governmental Organizations (NGOs) and Ministry of Health (MS). Then, an analysis was performed through interviews in order to compare the proposed actions and their actual performance. In the last stage some adjustments of improvements for the support centers of the city of Salvador - BA were addressed.

#### **Stage 1: Identification of logistic actions**

The actions are guidelines which assists in the development of the plans. In view of this, the Federal Government created the National Plan to Fight *Aedes* and Microcephaly with three fronts: mobilizing and combating the *Aedes Aegypti* mosquito, caring for those affected and the development of technologies, education and research (BRAZIL, 2015).

#### **Mobilization and fight against the *Aedes aegypti* mosquito**

Mosquito mobilization and control have several resources to be used, among which are human resources (people), equipment, the flow of materials and products. In view of this, the participation of community agents and fight against endemics, the use of insecticide and larvicide application equipment for focal treatment and in difficult to reach strategic points, as well as the qualification of health and education professionals, are fundamental for LH's operational infrastructure (BRAZIL, 2015).

Community agents are responsible for discovering outbreaks, destroying and preventing mosquito breeding. These agents perform focal treatment and hard to reach places. For this reason, they must be fully trained, since if they are not trained the process will be compromised. However, before starting these treatments the agents use materials such as: 70% alcohol for laboratory larvae shipment, cotton, ethyl acetate, stirring rod, two nylon fishing larvae with different colors for the type of water, i.e. , one for drinking water and one for dirty water as well as insecticides, spare lamp to identify these larvae (BRAZIL, 2001).

Thus, when the outbreaks are located, the home inspection process begins with the focal treatment, which uses the larvae-fishing and lantern equipment as well as the larvicids products such as Temephós, *Bacillus turinghiensis israelensis* - BTI, and Metoprene, which makes it possible to identify and eliminate larvae. In addition, if it is identified by the presence of outbreaks in standing water, agents should instruct residents with the distribution of booklets offered by the public agency. Treatment for remote locations is

indicated for the newly infested regions of the mosquito, i.e., region of high demand. This treatment consists of an application of the residual insecticide layer on the outer walls of reservoirs that are not consumed by residents (BRASIL, 2001; BRASIL, 2009).

According to Brazil (2001) the insecticide enables the death of adult mosquitoes when they are sprayed by treatment with UBV, which is used to complement combat actions, i.e., is only used to establish control of outbreaks and epidemics. The operation of the UBV occurs by a small amount of fragmented insecticide in the portable nebulizer or powered by an open wagon vehicle coupling, this fragmentation results in aerosols released up to six meters from the ground eliminating the mosquito. For hard to reach areas, the portable UBV has the same characteristics as the motorized UBV. However, even if used in normal areas, its method cannot be employed if the wind speed exceeds 6 km / hour, because the product may spread and the main purpose will not be met.

### Care for affected people

The logistic actions in the care of the affected people are focused on providing assistance. This includes: robust equipment, transport, medicines, human and financial resources as well as help from humanitarian partners.

At the beginning of the epidemiological outbreak, images of some cases with infants with microcephaly were diagnosed by transfontanel ultrasound (an exam that diagnoses possible brain lesions), which allowed the visualization of the brain circumference, which was slightly smaller compared to the normal pattern (BRAZIL, 2017).

Thus, the MS expanded the Living Without Limit Plan, increased the distribution of the number of books with prenatal guidance and the number of CT scans for various states. In addition, it also created partnerships with the Ministry of Social and Agrarian Development, which enabled the Unified Health System (SUS) and the Unified Social Assistance System (SUAS), a rapid action strategy for strengthening the care of microcephaly children as well as the supply of medicines (BRAZIL, 2015; BRAZIL, 2016b; BRAZIL, 2017).

This strategy allows the SUS to identify and locate cases of microcephaly and promote the transport and accommodation of children and their relatives to the diagnostic service. In addition, SUS should refer children to the care service according to their needs and SUAS should collaborate with SUS in the search for children with microcephaly, as well as promote client assistance services (beneficiary) such as: access to exams, consultations, specialized treatments and the monitoring of development in a continuous and humanized way (BRASIL, 2016c).

In addition, the National Council of Municipal Health Secretaries - CONASEMS in partnership with UNICEF has supported the inclusion network project, in which it distributes educational booklets with guidance to family members and caregivers to stimulate and support the development of these children. In addition, by raising employees' financial resources, this partnership is able to distribute multisensory early stimulation kits to family members (BRAZIL, 2017; UNICEF, 2018).

This kit has: a sensory mat, roll, striped plate and pom-poms, flashlight, colored balls and cups, sponge, rattles as well as bracelets, spoon, mobile and another folder containing the guidelines for use of these materials in the environment (UNICEF, 2018).

### Technological development, education and research

Technological development, education and research are encouraged by the Federal Government to help diagnose the virus, develop children with microcephaly, and fight and control *aedes aegypti*. In addition, suppliers develop contracts to fund research and purchase robust equipment for the diagnosis of Zika infection (BRAZIL, 2015).

At the beginning of the confirmation of microcephaly cases, a doctor from the Oswaldo Cruz Foundation found viral Zika RNA in the amniotic fluid of pregnant women. The technique used for this detection is called reverse transcriptase reaction and polymerase chain reaction - RT-qPCR, which extracts the RNA that contains the genetic code, and then the reverse transcriptase enzyme copies the gene from that RNA to use the polymerase enzyme and make several copies. After these copies, the samples of these genes are placed in a gel viewer that allows demonstrating the result by amplifying this gene (BRASIL, 2017; NISHI et al., 2009).

In addition, Public Health Laboratories (Lacens) use other more robust methods such as ELISA, immunochromatography, immunofluorescence, RT-qPCR and Kato-Katz parasitology to detect Zika virus. However, due to the accuracy of the diagnosis, RT-qPCR is the most used, but due to the financial resources this technique is not available for all Lacens because its technological cost is high. Moreover, Fiocruz has worked on three fronts: the development of methods to control the mosquito, the development of the molecular and serological kit for rapid diagnosis, and the creation of a Zika vaccine. Another alternative developed in

partnership with the Leonidas Institute is the modification of mosquitoes and the creation of a larvicide dispersing unit for larval death (BRAZIL, 2017).

### Stage 2: Analysis of logistic actions

The analysis of the actions was performed through interviews with the endemic agents and the mothers of babies with microcephaly who attend the public hospital of Salvador - BA. Both questionnaires were constructed based on the identification of the actions taken by the intuitions mentioned in stage 1.

### Mobilization and fight against the aedes aegypti mosquito

The interview with endemic agents was based on a six-question questionnaire: What resources are used for focal treatment and difficult to reach places? Are there trainings for community agents? How do agents move to homestays? In the outbreak of epidemics, UBV is used. In your opinion the resources that the municipality has available is sufficient for combat? Are there distributions of booklets on prevention? What were the difficulties encountered in performing this control and what resources are used to remedy them?

In response to the questionnaire, the agents reported that for focal treatment it was found the use of Pyriproxyfen larvicide (similar to BTI and Temephós), the amount of this product distributed varies from 100 to 200 g, which are distributed among the team members and handled within the range indicated by the spoon.

In the small range of the spoon the product placed has its effect limited to every 50 liters, and if it exceeds 100 liters, two spoons are added. However, the larger range is suitable for tanks up to 500 liters. Moreover, for the strategic points where the possible outbreaks are located, the agents make biweekly visits and use more than 200 g of larvicide.

Regarding fixed support equipment, the city hall provides more than recommended by MS. These include: larvae fishing, larvae fishing aid connections, a plate, spoon, pickaxe, scale, pipette, alcohol tubes, flashlight, blue chalk (to identify real estate), red chalk (to identify mosquito-focused deposits) and clipboard for annotation.

For home visits the city hall provides two daily transports. The first is a three-way transportation allowance for travel to the fulcrum, but due to the integration system that value has been cut and the agents after walking to the fulcrum walk to the real estate. However, in the most distant households use a van, but this has to be combined first because the amount provided by the city hall differs between districts, that is, some districts have more transportation than others.

In the municipality, the treatment of remote sites was done by one person, but for its application the district coordinator must request a release from the Zoonoses Center (CZZ). When released, the insecticide is applied on foot with equipment on the back (portable UBV) that does the same procedure as the motor vehicle. However, this procedure should only be performed with authorization and in epidemic areas, as these products are expensive and only used in emergency situations.

The motorized UBV was suspended from this treatment because the environmental protection group won the ban on this vehicle because it not only fought the mosquito but also destroyed the ecosystem of the region in which it was applied.

Moreover, for reasons of public administration the standardized booklets in the previous management for instruction to residents are rarely distributed and have old information. In addition, it was also found that there is a lack of training for combat agents and lack of distribution of individual protection equipment (EPI) and sunscreen.

However, other factors that compromised the performance of LH were noticed, among them: the non-disclosure of the real cases of Zika virus in some blocks, the security risk to the agents in some localities of the city. Though, even if there is no solution, the trained agents do the work quickly because in some homes the mosquito's focus is noticeable.

In addition, another factor that harms LH is the partial refusal of residents and condominiums, because agents have no authority to perform the service and this is not done. Moreover, the larvicids product used for focal treatment is valid for one month, but home visits only occur every two months. As a precaution, the city hall instructs that agents cannot access homes that are only visually impaired people, unaccompanied minors and the elderly cannot enter the strategic point accompanied.

However, positive points have been reported about the recommendations administered by the city, which reports that only agents can transport the larvae in the tube with alcohol and this is performed with dead larva for safety reasons.

### Care for affected people

The interview with the mothers of babies with microcephaly was also based on the questionnaire with five questions: What difficulties did you encounter when going to the rehabilitation center? How do you see the evolution of your child's development with treatment? How did SUS help you with this help? Did you receive

the early stimulation kit and medicine? What do you think about public transport in Salvador - BA and the infrastructure to go to the public hospital?

In response, the mothers reported that they did not receive transportation and accommodation as proposed by SUS. In addition, they also did not receive the early stimulation kit and home information leaflet, although all know of the kit's existence and distribution, these resources have not been passed on. However, most received the booklet with the prenatal guidance.

Regarding the transportation offered, they said that they find it difficult to travel, because it is rare to get a car from the city hall to come to the hospital, so the care becomes slow to get, aggravates the situation and compromises the lives of babies.

Concerning support actions such as access to examinations, consultations, treatment and follow-up, it was noted the delay in scheduling the appointments because of the number of vacancies available and when this is achieved sometimes consultations are unscheduled without warning and mothers await a return from the radial, while they wait and seek an answer, the expense of transport increases.

Another factor that also compromises the performance of the operation is the issue of treatments, as they are not performed in the same hospital and doctors differ greatly due to internal transfers. For this situation, mothers use public transportation from Salvador, which does not always have empty seats and other supportive places.

In addition, in some hospitals physiotherapy and follow-up with the speech therapist are performed, but for follow-ups with a neurologist, they expect the availability of a vacancy. However, this is detrimental because doctors do not know the beneficiary and therefore some analysis processes become repetitive and tiring.

In front of the reports, they stated that if they had financial resources they would be followed up in private hospitals to avoid these disorders. However, even with all the difficulties they face, they are grateful that they have got the place to treat their children and expose how happy these children are with the treatment.

### **Technological development, education and research**

During the research of the guidelines were found several technological innovations as well as the incentive to research for a new vaccine. Among those mentioned in the first stage, there was only the non-refundable financial collaboration agreement No. 11.2.1328.1 between the National Bank for Economic and Social Development - BNDES and the Foundation for Scientific and Technological Development in Health - FIOTEC, to the development of the Zika virus vaccine.

### **Stage 3: improvement opportunities for support centers in the city of Salvador - BA**

Through these interviews it was possible to identify improvements in the operational process of humanitarian logistics in the support centers.

### **Mobilization and fight against the aedes aegypti mosquito**

In identifying the level of operational infrastructure, it was noted that the number of vehicles used for long distances differs between districts. Thus, it is suggested that these transportation be increased and distributed according to the greater demand of the districts.

It was also found that disclosure of actual cases of Zika virus within a few blocks was omitted. This hinders all performance in the combat process, since the actual demand of the problem was not computed and contributed to the outbreak of microcephaly. Thus, it is suggested that each district draw a mapping of the places where the greatest epidemic occurred.

In addition, campaigns and standardized and up-to-date information leaflets about the danger of aedes aegypti should be conducted, as partial refusals of residents and condominiums during the year would be reduced and combat would be conducted. It was observed that there is a lack of: training for the agents, adequate support point as well as the distribution of EPI and sunscreen for them.

The lack of these resources, as mentioned earlier, can hinder and compromise not only LH's combat performance but also his own life, so training and providing EPI, sunscreen and providing appropriate support points should be provided. . Regarding home visits, these should be conducted monthly, as the larvicids product has this validity.

### **Care for affected people**

In identifying the level of operational maturity, it was noticed that the displacement and the delay in care is a general problem faced by mothers. Thus, it is suggested that transport be performed through routing. For the delay in service, scheduling and re-booking of queries, specialized multicenter centers with scheduled appointments should be created for all the needs of this demand. In terms of public transportation, the city hall must make some buses directed to the support centers available.

#### IV. CONCLUSION

This paper presents a study on the logistic support actions for children with microcephaly, which allowed a comparative analysis between the proposed actions and the actual performance. For this analysis interviews were used in order to obtain more solid information about the operational infrastructure of humanitarian logistics in the city of Salvador - BA.

Thus, it was noticed that there are several factors that influence this performance, among them: the offer of transport, consultations and exams; the omission of the real cases of the Zika virus epidemic and the lack of training of endemic agents. Moreover, the omission of the actual cases of the epidemic prevented the actual computation of the cases for the management of disseminated information and consequently for the investigation of the microcephaly outbreak. Otherwise, lack of instruction from agents can cause performance failures and compromise the entire operation.

Based on this it was possible to conclude that the operational infrastructure of the city of Salvador-BA is not adequate enough to offer this support, since the proposed actions are in breach and the priority resources to support the support are missing.

In addition, a number of difficulties and limitations were encountered in carrying out this work, as despite being a modern theme there is little research related to slow-onset disaster response, probably because the response to these is planned and its demand is known. Another difficulty faced was finding a way to compare cases related to epidemics, since for this study a case focused on slow responses was not available.

However, even if this response is planned, LH performance becomes inefficient in solving these problems. Based on some slow case studies such as the famine and refugee crisis, it has been found that most of these disasters are not fully resolved, i.e., they always occur again and bring new consequences.

Nevertheless, through this study it was possible to see that at the beginning of the disaster several donors and humanitarian partners set out to help with the necessary resources, but many of them neglect the recovery stage as it is long term and so the supplies provided are interrupted or rarely offered.

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