The Healthcare Infrastructure of Leogane, Haiti: A Pre and Post-Earthquake Analysis Using Geographic Information Systems (Rough Draft 2)

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Abstract: Using GIS data collected on three separate trips to Haiti, this paper both maps and analyzes changes to the healthcare infrastructure of Leogane, Haiti as a result of the January 12, 2010 earthquake. While providing a general overview of all healthcare services, the paper focuses on the availability of medical services for women and children. The report finds that of the 34 clinics functioning prior the earthquake, 29 of these clinics are still functioning one-year after the earthquake. Eight new healthcare providers have also emerged since the disaster. Women and children’s medical services are now more accessible. Long-term efforts to improve healthcare services in Leogane should focus on collaboration between local clinics and international NGOs.

INTRODUCTION:

Leogane, Haiti is a coastal city located 16 miles west of Port-au-Prince. Leogane was the closest city to the epicenter of the January 12, 2010 earthquake that claimed an estimated 250,000 lives. Prior to the earthquake, the city’s population was estimated to be roughly 30,000; however, Leogane suffered extensive damage and thousands of people were killed in the event. Reports suggest that roughly 80% of buildings were either destroyed or severely damaged.¹

In the weeks following the earthquake, healthcare and humanitarian needs in Leogane were immense, and foreign doctors and international NGOs flocked to Leogane to help. Thus, the earthquake profoundly changed the healthcare infrastructure of Leogane in that it both damaged pre-existing medical providers while also encouraging the establishment of many new healthcare facilities. This report analyzes in detail these changes by using Geographic Information Systems (GIS) to conduct pre and post-earthquake comparisons of the healthcare infrastructure of Leogane. The findings also provide a general overview of the status of the healthcare infrastructure one year after the earthquake.

As long-term reconstruction efforts in Leogane continue, the findings in this study will prove critical in determining the healthcare needs of the community. The pre and post-earthquake comparisons provide insight into which aspects of the healthcare infrastructure of Leogane were most damaged in the earthquake, which will allow informed decisions to be made about how best to move forward and serve the city’s healthcare needs. The comprehensive description of healthcare services will also help to facilitate cooperation between small pre-established private clinics and new foreign healthcare providers. Lastly, the data contained in this report will be valuable in coordinating responses to future disasters or disease outbreaks. Overall, knowledge of the locations and activities of the health centers in the community could help to facilitate partnerships, gather useful health statistics, develop community standards of care, and coordinate local healthcare efforts both in calm times and during emergencies.

LITERATURE REVIEW:

Until now, little research has been conducted on the healthcare infrastructure of Leogane. The majority of articles published on Leogane pertain to efforts to eradicate Filariasis. These articles provide limited insight into Leogane’s general healthcare infrastructure.

Government censuses are unreliable. The local government’s 2009 census identified eight clinics that were serving Leogane, twenty-six less than the number of clinics identified in this study.

The World Health Organization also has little data on healthcare providers in Leogane. According to a report published by the WHO on October 4, 2010, “the earthquake damaged all health structures in Leogane, including Hospital St. Croix, Hospital Materno-Infantil, and Hospital Cardinal Leger.” As this report will show, many health structures in Leogane were not damaged enough to prevent them from operating at full capacity. The same report also contends that, “MSF-Switzerland is running the only functional hospital in Leogane.” In this report, it was discovered that MSF was one of four functioning hospitals in Leogane. The article also explains how cluster health meetings are helping build capacity in preparedness for future emergencies; however, from this investigation it was discovered that local, privately owned healthcare providers were not attending the cluster meetings.

A significant amount of articles have been published on the use of crowdsourcing data in the immediate aftermath of the earthquake. One report by Jessica Heinzelman and Carol Water, emphasized the role of open-source crisis-mapping software in the wake of the earthquake to collect, organize, and share critical information. According to their report, Haitians were able to use social media to send updates in real time in regards to trapped persons, medical emergencies, and specific needs in an community. This information was useful in coordinating relief efforts.

Another article, by Dave Farthing and Dr. Mark Ware, emphasizes the need for “disaster-response areas [to be] mapped in advance so that relevant geographic information would be available from day one.” It is hoped that the GIS data from this study will address this need while also providing a strong template from which to start crowdsourcing of data in the event of future disasters.

METHODOLOGY:

Data was collected on three separate trips to Haiti: once before the earthquake (June 1 – August 1, 2009) and twice after (June 1 – August 1, 2010 and January 2 – January 10, 2011). Data was collected and recorded using a handheld Trimble GeoExplorer 2008 GPS unit. Geographic coordinates of all health care providers within an eight-kilometer radius of downtown Leogane were recorded and when available, the doctor or healthcare coordinator of the particular site was interviewed. Prior to the earthquake a series of 23 questions were asked (see appendix item A for specific questions). For data collected after the earthquake, a different survey was used (see appendix item B). Due to time constrains, not all of the same questions were asked in both surveys.

For the purposes of this study, any site providing allopathic medical services to patients with at least one licensed nurse and at least weekly visits by licensed doctors was considered a healthcare provider. Hospitals were defined as

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5 Farthing, Dave and Mark Ware. When it comes to Mapping Developing Countries Disaster Preparedness is Better than Disaster Response. AGI GeoCommunity 2010.
facilities with at least 10 inpatient beds and an operating room that was functioning or would soon be functioning.

All data was imported into ArcMap 10, which was used to generate the maps in this study. One of these maps compares clinic location and population distribution in the city of Leogane. No census information was available regarding population density within the district of Leogane, so to map population density this study utilized clustering of schools and churches as indicators. Although the data on church and school locations dates back to a year before the earthquake, it is believed to still be representative of post-earthquake population distributions. While admittedly not perfect, this data at least provides a framework from which to begin to analyze these patterns.

FINDINGS:

Prior to Earthquake

Clinic type: Prior to the earthquake, the city of Leogane had 34 functioning clinics. The breakdown of clinic type was as follows: General (15), Dental (6), Women (4), Women and Children (2), Ears, Nose, Throat (1), Hospitals (1), Teen Health (1), AIDS/TB (1), Optometry (1). See table 1 for pre and post-quake comparisons of clinic type.

Inpatient Capabilities: Eight clinics had inpatient capabilities, providing an approximate total of 242 beds in the entire city. Major inpatient facilities were Cardinal Leger (28 beds), Sanatorum (170), Hosanna (14), and Help Hospital (20). The other four smaller facilities contributed a total of roughly 10 beds.

Surgery: Only one operating room in Cardinal Leger was functioning prior to the earthquake.

Labor and Delivery: Nine clinics offered Labor and Delivery services.

Commonly cited medical issues in the community: Malaria (cited 11 times), Malnutrition (8), Dermatological Problems (6), Oral Hygiene (5).

Price for a consultation: 119 Gourdes (approximately $2.95).

After Earthquake:

Clinic type: By January 12, 2011, one year after the earthquake, Leogane had 35 functioning clinics. The breakdown of clinic type is as follows: General (19), Hospital (4), Dental (4), Children (2), AIDS/TB (1), Optometry (1), Women (2), Ears, Ears, Nose Throat (1), Cholera Facility (1).

Inpatient Capabilities: One year after the earthquake, seven clinics had inpatient capabilities, providing a total of 294 beds. Major inpatient facilities are Cardinal Leger (20 beds), Sanatroum (50), Hosanna (14), Help Hospital (14), Comejo Hospital (10), and MSF (180). Other, smaller facilities contributed a total of roughly 10 beds. By January of 2012, Help Hospital intends to expand to 40 beds and Hopital St. Croix plans to reopen as a hospital with 48 beds. With these additions, by January 2012, Leogane will have 382 beds.

Surgery: Four facilities have functioning operating rooms: Cardinal Leger, Comejo Hospital, MSF, and Hopital St. Croix.

Labor and Delivery: Nine clinics offer Labor and Delivery Services after the earthquake.

Overall Effects of Earthquake:

In the aftermath of the earthquake, 14 clinics entirely collapsed. This number represents 41% of all clinics that were functioning prior to the earthquake. Of these 14 clinics, 10 have reopened either in a temporary structure on the same footprint or in a different location. Two other clinics that did not suffer damage have also closed since the earthquake. The reasons behind these two closings are unknown. Thus, in the wake of the earthquake, a total of just six clinics have stopped functioning.

For those clinics that did not collapse, many suffered at least some damages. Three of the
twenty clinics that survived the earthquake suffered extensive damages, with portions of the buildings or healthcare complex collapsing. Eight new healthcare providers have also emerged in Leogane since the earthquake. Six of these are international NGOs and two are local initiatives.

The total number of hospitals and general clinics has greatly increased in the aftermath of the earthquake, while the number of clinics specifically catering towards women’s health has decreased. It is important to note, however, that this decrease in women’s clinics has not affected the total number of maternal and children’s healthcare services available in Leogane. As table 2 demonstrates, the number of clinics offering labor/delivery services and birth control (i.e. contraceptives or family planning) has remained the same. The number of clinics offering prenatal care and infant immunizations has increased.

Tables:

Table 1: Clinic Specialty

Table 2: Number of Clinics Offering Women and Children Services

Maps:

This section contains the six maps that were modeled based on the data collected through the study. The first maps is found on the following page.
Map 1: Health Infrastructure of Leogane (pre and post-earthquake comparison)
Map 2: Earthquake Damage to Healthcare Infrastructure of Leogane
Map 3: Clinical Services in Leogane

Clinical Services in Leogane (Post Earthquake)
Map 4: Labor and Delivery Services in Leogane (pre and post-earthquake comparison)
Map 5: Clinic Location vs. Population Density in Leogane (Post Earthquake)
DISCUSSION:

The January 12, 2010 earthquake has had varied effects on the healthcare infrastructure of Leogane. In many respects, one year after the earthquake, the healthcare infrastructure of Leogane is stronger than it has ever been. According to an article by Patrick Adams in the World Report, “For the first time in its troubled history the city had a surplus of skilled care.... people are being treated for things they’ve had their whole lives.” Adams’ observations are true in many regards; however, there are still many serious short-comings within Leogane that need to be addressed.

First, the healthcare community is very much divided between privately owned clinics and foreign NGOs. Most foreign NGOs, particularly those that have arrived since the earthquake, have minimal knowledge of the private healthcare providers in Leogane and have done little to coordinate with them. Also, by providing services free of charge, international NGOs are putting economic pressure on private practices owned by Haitians. As a result, most private clinic interviewed as part of this study indicated a substantial decrease in the number of patients they treat per month as well as a decrease in their hours of operation. This economic pressure has the potential to push local doctors out of business. If the NGOs then leave Leogane or stop operating (as frequently happens), there is the potential that Leogane will be left with even fewer professional healthcare workers.

Also, particular medical services still remain unavailable to the community. The availability of dental care, for instance, has decreased since the earthquake. Two dental clinics closed in the wake of the earthquake, leaving just four functioning in Leogane. Only one of these four dental clinics is an NGO that provides subsidized treatment (Christianville Dental Clinic). It is also important to note that the spatial distribution of these clinics is unfavorable. The southwest region of Leogane is over five kilometers away from the closest dental facilities and over 12 kilometers away from the Christianville facility that offers subsidized care.

Ophthalmology is another underserved area of care. Leogane has no ophthalmologists and only one functioning optometry clinic that is part of the Christianville Complex. Because Leogane experiences a sunny, tropical climate, a high number of agricultural workers, a high level of pollution, and low levels of protective eye wear, there is likely to be a high prevalence of eye disease, especially cataracts. Further research on the prevalence of eye disease and cataracts in Leogane is necessary.

A geospatial analysis of population density versus clinic location also revealed three particular regions within the city of Leogane that appear to be underserved by clinics. In particular, three regions were observed that have relatively heavy population densities but are still over 2.0 kilometers from the nearest clinic. More research is necessary in these regions to determine whether this distance is sufficient to discourage utilization of medical services, especially with regards to pregnant women seeking professional labor and delivery services.

Women and children services in Leogane have expanded since the earthquake. The biggest addition of Women and children’s care has been through MSF. With a 180 bed facility, MSF conducts about 450 deliveries per month.

Also, as of January 2011, several new maternity centers were under construction in Leogane. For the purposes of this report, a maternity center is described as an inpatient facility specifically for pregnant women about to deliver or who have just recently delivered. Both Help Hospital and Malteser International report that they will have functioning maternity centers by September 2012. Hopital St. Croix expects to open  

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6 Adams, Patrick. Health-care Dynamic in Haiti.

7 Dr. Christiane, Personal Interview. 19 April, 2011. World Health Organization.
a maternity center by January 2012. According to the World Health Organization, The Luxemburg Red Cross is planning to build a large maternity hospital in the town of Gressier, located just east of Leogane. This facility will be equipped with 80-100 beds and an operating room; however, construction has not yet begun. If completed, this hospital will be a huge contribution to the women and children’s healthcare infrastructure of Leogane.

The number of Haitian OB/GYNs in Leogane has remained the same. These doctors are: Dr. Delson Merissier, Dr. Delice Patrick, and Dr. Boissonniiere Yves.

There are several limitations that must be considered within the context of this study. First, there is the possibility that particular clinics were inadvertently not mapped or interviewed. While this is unlikely due to the amount of time and care that was used in mapping, it remains a possibility. Second, this survey does not analyze the quality of care provided; it only offers binary insight as to whether or not particular services are provided. Third, because human translators were used during interviews, there was the possibility for miscommunication. Lastly, it is possible that the information provided by interviewees of particular clinics was not completely reliable. It is possible that interviewees felt the incentive to either exaggerate claims of clinic challenges or embellish the amount/types of services they provide for the community.

CONCLUSION:

The healthcare infrastructure of Leogane, Haiti is currently much stronger than it was prior to the 2010 earthquake. In fact, if plans are realized to reopen Hopital St. Croix and build the Luxembourg Red Cross Hospital in Gressier, healthcare availability in Leogane will be strong and almost self-sufficient. It is important to note, however, that some serious shortcomings still abound. In particular, efforts should focus on bridging gaps between international NGO and local healthcare providers. Also, although this paper describes the availability of medical care, it does not explore the quality of care. Future studies should analyze the quality of care.

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Appendix:

A) Pre-earthquake Survey:
1) What is the clinic’s name?
2) What is the primary patient population (women, children, family, subspecialty, etc.)
3) Services (inpatient, outpatient, surgical)?
4) Are Cesarean-Sections offered?
5) Are Hysterectomies offered?
6) Are Ovarian Cyst Removals offered?
7) Are Tubal Ligations offered?
8) Which of the following Women/Child Care services are offered: (labor/delivery, prenatal care, infant immunization, birth control)?
9) Hours of operation?
10) Price for a consultation?
11) Specific pediatric services available?
12) Number of doctors, and their specialty?
13) Number of nurses?
14) Number of nurse practitioners?
15) Is there a pharmacy present?
16) If so, how many pharmacists are there?
17) Is there an additional price for the medication?
18) How is the clinic funded?
19) Approximately how many patients per month does the clinic serve?
20) What, if any, community programs does the clinic provide?
21) What is the largest health issue in the community?
22) What are the biggest operational challenges for the clinic?
23) Is there any general contact information that can be provided?

B) Post-Earthquake Survey:
1) What is the clinic’s name?
2) What is the primary patient population (women, children, family, subspecialty, etc.)
3) Services (inpatient, outpatient, surgical)? How many beds?
4) Are Cesarean-Sections offered?
5) Are Hysterectomies offered?
6) Are Ovarian Cyst Removals offered?
7) Are Tubal Ligations offered?
8) Which of the following Women/Child Care services are offered: (labor/delivery, prenatal care, infant immunization, birth control)?
9) Hours of operation?
10) Specific pediatric services available?
11) Number of doctors, and their specialty?
12) How is the clinic funded?
13) Approximately how many patients per month does the clinic serve?
14) How was the clinic affected in the earthquake?
15) Have any medical services changed in the wake of the earthquake?
16) What are your long term plans in the community?

C) Clinic Table: All Clinics Included in this Study
* Options For Women and Children’s Services: Birth Control (B/C), Labor and Delivery (L/D), Prenatal Care (P/C), Infant Immunizations (I/I). ‘All’ includes all four of these services.

<table>
<thead>
<tr>
<th>Clinic Name</th>
<th>Type</th>
<th>Functioning Before Earthquake?</th>
<th>Functioning 1 Year After Earthquake?</th>
<th>Inpatient, Outpatient, Surgical?</th>
<th>Women and Children's Services</th>
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<td>Bethesda Health Centre</td>
<td>General</td>
<td>Yes</td>
<td>Yes</td>
<td>Inpatient/Outpatient (8 beds)</td>
<td>B/C</td>
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<tr>
<td>Centre de Prosch</td>
<td>Women and Children</td>
<td>Yes</td>
<td>Yes</td>
<td>Outpatient</td>
<td>All</td>
</tr>
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<td>Centre de Sante Maine Divine</td>
<td>General</td>
<td>Yes</td>
<td>Yes</td>
<td>Outpatient</td>
<td>L/D, P/C</td>
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<tr>
<td>Centre de Sante Marie Jean</td>
<td>General</td>
<td>Yes</td>
<td>Yes</td>
<td>Outpatient</td>
<td>P/C, I/I, B/C</td>
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<tr>
<td>Centre Hospitalier Hosanna</td>
<td>General</td>
<td>Yes</td>
<td>Yes</td>
<td>Inpatient/Outpatient (14 beds)</td>
<td>P/C, L/D, I/I</td>
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<td>Centre Materno Infantil</td>
<td>Women and Children</td>
<td>Yes</td>
<td>Yes</td>
<td>Outpatient</td>
<td>P/C, I/I, B/C</td>
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<td>Centre Sante Populare</td>
<td>General</td>
<td>Yes</td>
<td>Yes</td>
<td>Inpatient/Outpatient (2 beds)</td>
<td>All (but rarely do L/D)</td>
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<td>Christianville Dental Clinic</td>
<td>Dental</td>
<td>Yes</td>
<td>Yes</td>
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<td>none</td>
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<td>Christianville Eye Clinic</td>
<td>Eye</td>
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<td>Christianville General Clinic</td>
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<td>Yes</td>
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<td>P/C, B/C</td>
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<td>Clinic Medicale de Mithon</td>
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<td>Yes</td>
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<tr>
<td>Clinique de Desman Fleury</td>
<td>General</td>
<td>Yes</td>
<td>Yes</td>
<td>Outpatient</td>
<td>L/D, B/C</td>
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<tr>
<td>Clinique de Puple</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Clinique des Enfants</td>
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<td>Yes</td>
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<td>I/I</td>
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<td>Clinique Medical Le Bon Samaritan</td>
<td>Women</td>
<td>Yes</td>
<td>No</td>
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<td>Clinique Medicale</td>
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<td>Yes</td>
<td>No</td>
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<td>Clinique Centro de Sante</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Comejo Hospital</td>
<td>Hospital</td>
<td>No</td>
<td>Yes</td>
<td>All (10 beds, 1 operating room)</td>
<td>All</td>
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<td>Clinic Name</td>
<td>Services</td>
<td>Gender</td>
<td>Public/Private</td>
<td>Location</td>
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<td>Comejo Polyclinic</td>
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<td>Yes</td>
<td>Outpatient</td>
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<td>Dr. Merisier's Private Clinic</td>
<td>Women</td>
<td>Yes</td>
<td>Yes (shares structure with FHM clinic)</td>
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<td>Women</td>
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<td>Fosref</td>
<td>Teen Health</td>
<td>Yes</td>
<td>No</td>
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<td>Foundation of Sama</td>
<td>Eyes, Ears, Nose, Throat</td>
<td>Yes</td>
<td>Yes</td>
<td>Outpatient</td>
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<td>Heart to Heart</td>
<td>Clinic</td>
<td>No</td>
<td>Yes</td>
<td>Inpatient/Outpatient (surgical coming soon; currently have 10 beds. Will have 40 beds by September 2011)</td>
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<td>Help Hospital</td>
<td>Hospital</td>
<td>Yes</td>
<td>Yes</td>
<td>All (50 beds, 1 operating room)</td>
<td>L/D, All Surgeries</td>
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<td>Hermann Lunitierre</td>
<td>General</td>
<td>Yes</td>
<td>No</td>
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<td>Hopital Cardinal Leger</td>
<td>Hospital</td>
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<td>Yes</td>
<td>Outpatient, Surgical (inpatient coming soon ~48 beds by January 2012)</td>
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<td>Le Sourine Clinique Bucco Dentaire</td>
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<td>Le Vrai Repos</td>
<td>Dental</td>
<td>Yes</td>
<td>Yes</td>
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<td>Luxemborg Red Cross</td>
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<td>No (preconstruction phases)</td>
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<td>Malteser International</td>
<td>General</td>
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<td>Medisins San Frontiers (Doctors Without Borders)</td>
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