

# Rapidly-Deployed Small Tent Hospitals: Lessons from the Earthquake in Haiti

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**Conflicts of interest:** Dr. Rosen is CEO of Superior NanoBioSystems LLC, a company specializing in microfluidic nanotechnology.

**Keywords:** disaster; earthquake; education; hand-held; micro/nano-electromechanical; tent hospital

## Abbreviations:

FDA: (US) Food and Drug Administration  
FIRST: Fast Israel Rescue and Search Team  
IDF: Israel Defense Forces  
IDP: internally displaced person

Online publication: June 13, 2012

doi:10.1017/S1049023X12000799

## Introduction

The damage to medical facilities resulting from the January 2010 earthquake in Haiti necessitated the establishment of field tent hospitals. Much of the local medical infrastructure was destroyed or limited operationally when the Fast Israel Rescue and Search Team (FIRST) arrived in Haiti shortly after the January 2010 earthquake. The FIRST deployed small tent hospitals in Port-au-Prince (Figure 1 in online supplementary material) and in 11 remote areas outside of the city. Each tent was set up in less than a half hour. The tents were staffed with an orthopedic surgeon, gynecologists, primary care and emergency care physicians, a physician with previous experience in tropical medicine, nurses, paramedics, medics, and psychologists. The rapidly deployable and temporary nature of the effort allowed the team (including Drs. Rosen and Laor) to treat and educate, as well as provide supplies for, thousands of refugees throughout Haiti. In addition, a local Haitian physician, Dr. Emmanuel Verna, and his team created a small tent hospital to serve the Petion Refugee Camp and its environs. FIRST personnel also took shifts at this hospital.

Patients presenting to the small tent hospitals had problems directly and indirectly related to the earthquake. These problems included crush injuries, amputated limbs, limb fractures, and other injuries. However, from the second week onward, a large proportion of the patients suffered other problems, including infectious diarrhea, dehydration, general deterioration, meningitis, hypertensive crisis, diabetes, stroke, HIV-related infections, breast cancer, vaginal infections, urinary tract infections, labor, severely infected limbs, and/or suicide ideation and planning. Many patients suffered from the lack of continuous supply of medications for chronic illnesses. Some patients were transferred from the Israel Defense Forces (IDF) Hospital and other local hospitals for continuing care. Patient transfers, inundated hospitals, and destroyed medical facilities became major impediments to care.<sup>1,2,5,6</sup>

Small, field, tent hospitals can have a high impact and address critical needs when many of these impediments exist. However, several unmet needs for small, tent hospitals have been observed based on the Haiti earthquake experience.

## Unmet Needs

There was a critical need for monitoring and education regarding hygiene and tent safety for internally displaced persons (IDPs). Many of the refugees kept their stoves close to tent walls, left food uncovered out in the sun, did not wash hands, and used contaminated water. These IDPs may have lived in houses previously, and suddenly needed to adjust to living in tent cities. Therefore, these instructions were seen as a necessary preventive measure, and could be provided by ancillary staff of a small tent hospital, as was done by FIRST.

An important unmet need of the small, tent hospital was comprehensive laboratory data. For example, comprehensive data on electrolyte disorders and acid-base disturbances in crush injuries or general deterioration were needed to provide safe and comprehensive care. Data on infectious agents were needed to provide relevant care, such as neonatal fever, infected wounds, post-partum fever, and other manifestations of infections. Co-infections with known HIV patients were an additional problem, and therefore, knowing CD-4 status and identifying co-infections could have been helpful when a patient could not be transferred easily. On-site laboratory systems that assess renal function or dehydration status for older patients as well as newborns are important, as they are particularly susceptible to dehydration and electrolyte imbalances due to diarrhea. Correcting electrolyte disorders too rapidly can have dire consequences. In Haiti, an immediate assessment of water toxicology, serum electrolytes, blood and stool contents

may be helpful. Technologies that allow for the rapid identification of the pathogen and antibiotic susceptibility can aid the treatment effort for infectious diarrhea.<sup>3,4,7</sup>

Hand-held platform micro/nanotechnologies, also known as “labs-on-a-chip,” are being developed. Such chips can be disposable, and can contain many channels, allowing for the assessment of a variety of fluids. The constant replenishing of molecules within a channel facilitates reduced output time. For example, an Enzyme-Linked ImmunoSorbent Assay, which typically takes hours to achieve results, takes several minutes on a nano/microfluidic chip. This also holds true for polymerase chain reaction testing. Similar technologies can be used to develop pressure sensors. The complete configuration of a reader and chip can be similar to the home-based glucometers, which have been useful due to their small, mobile nature. There are a few FDA-approved, hand-held cartridge systems for biochemistry and hematology blood analyzers.<sup>3,4,6</sup>

Patient identification and electronic medical records are needed to facilitate long-term follow-up and transfer of care. Hand-held, integrated fingerprinting technologies implementing pattern recognition, along with face and name identification, can assist in these matters. The technologies can include integrated patient data, which can be networked and transferred.

### Lessons Learned

Several key points, based on the experience of rapidly deployed, small, field tent hospitals in Haiti, can inform future disaster relief efforts and the development of supporting technology:

- Tent hospitals can help to alleviate demands for service at larger hospitals that already are inundated; they are not a replacement for local hospitals;
- It is important to monitor the activities of nearby hospitals and their transfer capabilities, and be in continuous communication with local medical facilities. Local facilities must know the locations and capabilities of newly-formed field hospitals;
- Tent hospital teams should be comprehensive, and have relevant, diverse medical supplies;
- Education and monitoring for hygiene, tent safety, and food and water safety should be an integral part of relief efforts; and
- The use of new hand-held technologies to provide comprehensive laboratory data, as well as patient recognition and recording, can facilitate relief efforts. The use of these technologies also may encourage relief teams to bring more diverse medications that coincide with results from laboratory data.

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