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Lieutenant-Commander Amy Hunt and Canadian Captain Rory Macdonald tend to a Haitian woman and infant aboard the aircraft carrier USS *Carl Vinson*, 16 January 2010.

HUMANITARIAN RELIEF SURGERY: A ROLE FOR CANADIAN FORCES HEALTH SERVICES SURGICAL TEAMS POST-KANDAHAR?

by Andrew Beckett, Peter Chu, and Homer Tien

This article represents the views of the authors, and does not necessarily reflect the views of CFHS or DND.

Introduction

The Canadian Forces Health Services has provided highly capable combat surgical teams to Canada’s mission in Afghanistan from 2002 until the the present.¹ Our surgical teams at the NATO Role 3 hospital in Kandahar have provided expert-level care to coalition soldiers and allies, achieving an internationally enviable record in the process: 98 percent of all casualties treated at the Canadian-led hospital survived their injuries.² In the wake of our surgical experience in Afghanistan, the question becomes: “Where should these assets be used, and, most importantly, how should these assets be maintained?”

In the post-Second World War and Korean War era, CFHS did not optimally focus upon war surgery, focusing instead upon garrison health care for Canadian Forces (CF) members.³ This change in doctrine resulted in losing the lessons and experiences of emergency war surgery. When 1 Canadian Field Hospital arrived in Afghanistan, it was the first time

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since the Korean War that CF surgeons had been deployed into a combat theatre, except for the first Gulf War, Learning *new*, and relearning *old* lessons about war surgery was required by all CFHS members deployed to Task Force Kandahar.⁴

The international response to recent natural disasters, such as the 2010 Haitian earthquake, has demonstrated both the extremes of human suffering, as well as opportunities for the Canadian Forces to provide rapid humanitarian surgical relief. The intense media coverage of the Haitian earthquake and the DART (Disaster Assistance Response Team) deployment to the area provided a great amount of positive publicity for the CFHS and its role in conducting humanitarian operations.⁵

Canadian Defence policy has incorporated an increasingly more robust doctrine in the realm of humanitarian operations. In 2008, the Defence Leadership Team, in the publication *Strategy 2020*, noted that providing emergency humanitarian relief is one of the primary responsibilities of the CF to promote Canadian interests and values abroad, while contributing to international peace and security.⁶

More recently, the Canadian Expeditionary Forces Command (CEFCOM) Humanitarian Operations Contingency Plan (CONPLAN RENAISSANCE) has delegated to CFHS the responsibility to provide mission-specific medical and humanitarian services to those affected by a disaster. As part of the overall operational aim, CONPLAN RENAISSANCE is directed at saving lives and decreasing the suffering of those affected by disasters, while promoting a positive image of Canada, both abroad and at home.⁷

To achieve these goals, the CFHS needs to fully develop and operationalize its humanitarian relief surgery (HRS) doctrine. Not only would a CF HRS program fulfill the mission aims of CONPLAN RENAISSANCE and Defence 2020, but such a program would maintain the war surgery experience gained from prior conflicts for any future conflicts in which CFHS must provide support.

This article will review the literature dealing with the principles surrounding humanitarian relief surgery practices. It will then analyze the 1 Canadian Field Hospital surgical response to the Haitian earthquake, and compare these results to the contributions made in Haiti by other military forces and Non-Governmental Organizations (NGOs). Based upon this review, we will propose a humanitarian relief surgery doctrine for the CFHS that will achieve the mission objectives identified in CONPLAN RENAISSANCE and the Defence Leadership Team's Strategy 2020.



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Humanitarian Relief Surgery Concept

Canada has a long history of providing medical care in many humanitarian emergencies, including deployments to earthquakes in Turkey, Pakistan, and, most recently, in Haiti.

HRS is a high impact, high visibility health care practice that has achieved internationally recognized value for saving lives, relieving suffering, and promoting goodwill towards the country that provides the service. However, to be successful, an HRS doctrine must be understood within the context of what it *is*, what it is *not*, and, most importantly, what are its inherent limitations.

The focus of HRS is limited to providing surgical care in a war or disaster scenario for only a defined period of time, without attempting to develop or improve local surgical facilities. HRS provides basic life saving surgery, such as the treatment of fractures, the completion of traumatic amputations, and hemorrhage control. The primary mission of HRS is to provide the “greatest good for the greatest number of patients” through triage and the judicious use of surgical resources.⁸ The medical care provided by HRS in the circumstances of a disaster is different than the care one would expect to receive at a Canadian hospital. However, that care can still be provided ethically, efficiently, and with sound clinical benefit to the affected population.

A relatively current Canadian perspective on medical humanitarian operations can be summarized by the following statement:

“Medical solutions that come from individual, high-tech practices in the developed world are often inappropriate and even harmful at the site of an overseas disaster. Canadian involvement there is almost always of short duration and, when foreign troops withdraw, it is local resources that must take up the slack. It

follows that Canadians must learn how to live within the boundaries of local medical practice.”⁹

HRS, by its definition and own limitations, consists of care delivered to persons affected by a disaster or conflict, not the care delivered to combatants or care providers, who have become ill or injured within the area of operations. HRS does not aim to replace the local health care system over the long term.¹⁰ Rather, the HRS team provides definitive ‘life and limb-saving’ surgery to local patients; no further surgical interventions should be required after being discharged from HRS care. Combatants and care providers, in contrast, are often repatriated immediately to receive higher levels of care in their native countries.

passes the first seven days following a calamity. During this period, affected persons are recovered and brought to aid. Next is the *relief* phase (Days 8-50), where the bulk of HRS occurs. Finally, the *recovery* phase, which is implemented 50 days after the event, involves rebuilding the national health facilities, and this is when NGO health care services become more established. Because of the damage to local health care resources and infrastructure, the HRS must be self-sufficient for a limited time period until more permanent and higher-level care facilities can become operational again.

It has been well-described that deaths after trauma follow a trimodal distribution; a humanitarian disaster or emergency is not different. The first and largest peak, comprising 50 percent of the total number of deaths, is observed immediately upon or within seconds after injury. The second peak, which accounts for 30 percent of deaths, occurs up to four hours later, and the third phase, which accounts for 20 percent of patients who expire, occurs from four hours to days and weeks after the event. These latter patients often succumb to organ failure.¹¹ Therefore, to be of maximal benefit, the HRS team must intervene early to prevent the second and third peaks of post-traumatic deaths. In summary on this issue, to be effective in preventing deaths from a disaster, the HRS team must be self-sufficient and rapidly deployable, so that it can reach victims within hours or days after a disaster.

Non-Governmental Humanitarian Relief Surgery Response to the Haitian Earthquake

Medecins sans Frontiers (Doctors without Borders)

In the aftermath of the Haitian earthquake, Medicine Sans Frontiers (MSF) operations in Haiti provided 16 operating rooms and performed 1178 procedures between 12 January 2010 and 31 May 2010, at a cost of 11 million Euros (€936.32/case).¹² MSF now manages 16 operating theatres, and has more than 1200 hospital beds available at its various locations within Haiti. Overall, since the earthquake, MSF has assembled included a staff of 3228 members, has provided medical care to more than 92,000 patients, and had performed nearly 5000 surgeries between January and April 2010.¹³ A large-scale and prolonged operation of NGO medical facilities is paramount for the success of any relief and rebuilding operation after a disaster. However, this model, which necessitates a long deployment and the allocation of resources, requires a massive financial commitment and political ‘staying power.’ Prior to full mobilization of NGO resources, there remains a large gap in the number of organizations with the airlift capabilities to arrive shortly after a disaster occurs that can provide humanitarian relief surgery.

International Committee of the Red Cross

Data has yet to be published about Haiti from the International Committee of the Red Cross.



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The Humanitarian Emergency and Distribution of Trauma Deaths

An HRS team must arrive as soon as possible to a humanitarian emergency to exploit its full potential and to have the maximal impact. Arriving to an event too late can cost many lives because the opportunity to provide life saving care will have passed. A humanitarian emergency can be divided into three phases. The first is the *rescue* phase, which encom-

Military Humanitarian Relief Surgery Response to the Haitian Earthquake



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A DART team member takes a momentary rest pause, 15 January 2010.

DART and 1 Canadian Field Hospital in Haiti

The Canadian contribution to the Haiti relief effort consisted of a primary care medical platoon in the DART team comprising 40 personnel. The DART medical facility provided basic laboratory, blood bank, and radiology services. During its deployment, the Canadian DART medical facility logged 4922 medical and surgical encounters, only 3 percent of which were surgical consultations.¹⁴

- 1 Canadian Field Hospital a provided 100-bed field hospital facility, and a four-bed Intensive Care Unit (ICU).
- 1 Canadian Field Hospital provided two surgical teams, each consisting of one general surgeon, one orthopedic surgeon, and one anesthesiologist. The 1 CFH surgical teams commenced surgical operations 17 days after the earthquake, and were operational for 39 days in total thereafter. During that period, the unit performed 167 operations (cases) on 155 patients. Most of the cases were not related to trauma from the earthquake (13 percent), but rather, were for chronic neglected surgical problems (Table 1).¹⁵

“The Canadian contribution to the Haiti relief effort consisted of a primary care medical platoon in the DART team comprising 40 personnel.”

Surgical Cases	Number of cases
Inguinal Hernia and Hydrocele Repair	69
Umbilical Hernia Repairs	6
Hysterectomy	12
Open Reduction Internal Fixation	12
External Fixation	7
Circumcision	6

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Table 1. Surgical Cases by type performed by 1 Canadian Field Hospital in Haiti during a 39 Day Operational Period

Talbot *et al.* noted “... that greater clinical benefit might have been achieved through a lighter and more rapidly mobile surgical/resuscitation team for future Canadian Forces humanitarian and disaster response operations”.¹⁶ With the development of a light HRS program, the CF can improve this response time and provide more emergency and trauma surgery, rather than providing care for chronic surgical problems.

US Military in Haiti

The US military provided ground, air, and naval medical care, including the US Navy's hospital ship, *Comfort*, which arrived on 20 January, eight days after the initial earthquake. At that time, USNHS *Comfort* began accepting transfers of injured persons by navy helicopter to its more than 300 medical personnel, 12 operating rooms, and 500 beds. Between 19 January and 28 February 2010, the ship treated 1000 Haitian patients, and performed 850 surgeries.¹⁷ The operational capacity and flexibility of a hospital ship that is completely self-sufficient, secure, and mobile is highly desirable. However, this type of service is also very expensive, both as an initial investment, and by virtue of the cost of maintaining its operational effectiveness.

Israeli Defence Force Field Hospital in Haiti

The Israeli Defence Force (IDF) provided a 121-person field hospital after the Haiti earthquake and was fully operational in just 89 hours. Its field hospital provided 60 in-patient beds, including four beds in an intensive care unit with one operating room with a single operating table. This capability was later expanded to 72 ward beds, and a second operating table was also added. In its ten days of operation, the IDF field hospital treated more than 1100 patients and hospitalized 737 patients. The IDF ICU beds were used for patients whom the Israelis anticipated would be able to be stabilized within 24 hours or less. The practical implication of this prioritization scheme was that hospitalized patients who were deemed to have a small chance of survival were not likely to be treated in the ICU.^{18,19}

With respect to its surgical efforts, the IDF performed 244 operations on 203 patients with their staff of five general surgeons and seven orthopedic surgeons. The majority of traumas treated by this unit

included fractures and open wounds (Table 2).²⁰ The IDF field hospital case-load (Figure 1) shows that by arriving early to a disaster scene, many injured persons received urgent surgical care. As the days passed, the number of urgent trauma cases *decreased*, while the number of routine surgical cases *increased*.

ICD-9-CM Diagnosis	Patients n (%)
Fractures	265 (38.74)
Open wounds	188 (27.49)
Superficial injuries	120 (17.54)
Crush injuries	107 (15.64)
Contusions with intact skin surface	89 (13.01)
Burns	16 (2.34)
Dislocations	12 (1.75)
Internal injuries of the chest, abdomen and pelvis	12 (1.75)
Sprains and strains of joints and adjacent muscles	11 (1.61)
Intracranial injury (including skull fracture)	8 (1.17)
* Many patients had > 1 diagnosis	

Table 2. Occurrence of the 10 most Frequent Trauma Diagnosis Groups in 1041 Patients treated by Israeli Defence Force Field Hospital* (Adapted from Kreiss Y, Merin O, Peleg K, et al. Early disaster response in Haiti: the Israeli field hospital experience. *Ann Intern Med* 2010;153:45-8.)

The IDF HRS response to the Haiti earthquake was very rapid; it was operational just 89 hours after the earthquake. This is particularly commendable, given the distance the IDF had to travel to establish the hospital. The IDF triage process also appears to have been adhered to scrupulously, because the four-bed ICU was not overburdened by providing prolonged advanced medical care to unsalvageable patients.

However, some criticism of the IDF response was generated, given that they initially only provided one operating table, and then increased to just two operating tables, despite having 12 available surgeons. The large number of surgeons provided, although useful, increased the logistical footprint of the unit because food and accommodations were required for the 12 surgeons, even when they were not being utilized in the operating room. The 1 Canadian Field Hospital team had only one-third the number of surgeons that the IDF provided, but managed to perform 167 operations in 39 days with only four surgeons working in the same austere conditions. Sending fewer surgeons may be a reasonable choice for the CFHS, as it has fewer active duty surgeons than the IDF. Furthermore, it will reduce the logistical footprint of the hospital without affecting its operational tempo.

Humanitarian Relief Surgery Response to other Earthquakes

The military HRS response to the Haitian earthquake was similar to the experience of other field hospitals that have deployed to earthquake disaster zones. Specifically, much of the care was obstetrical in nature, or due to neglected surgical conditions caused by the devastation to the health care infrastructure. This was also due to the establishment of full field hospitals, which take time to establish and become operational. For example, the US 212th Mobile Army Surgical Hospital reported that 90 percent of its workload during their four-month deployment consisted of primary care following the 2005 Kashmir earthquake. They also noted that the requirements for surgical care decreased quickly after the first month. However, the unit only became operational 13 days after the earthquake after many persons had already died from earthquake-related trauma.²¹ Similarly, an American civilian field hospital that deployed to the Bam, Iran earthquake in 2003 performed only six surgical procedures, while treating a total of 727 patients. The majority of care provided by that civilian field hospital was obstetrical in nature.²² The experience of these two US HRS hospitals reflects a trend in relief surgery, and mirrors the experience of the CFHS in Haiti, namely that the longer it takes for a relief surgical hospital to establish after a disaster, the fewer are the lives that will be saved.

NGO Humanitarian Relief Surgery Doctrine

Two well-known organizations, the International Committee of the Red Cross (ICRC), and the World Health Organization (WHO), have established international reputations for providing HRS. Much of the existing doctrine for HRS was developed by these two reputable providers, who both publish extensively on the subject (www.icrc.org, and www.who.int/publica-

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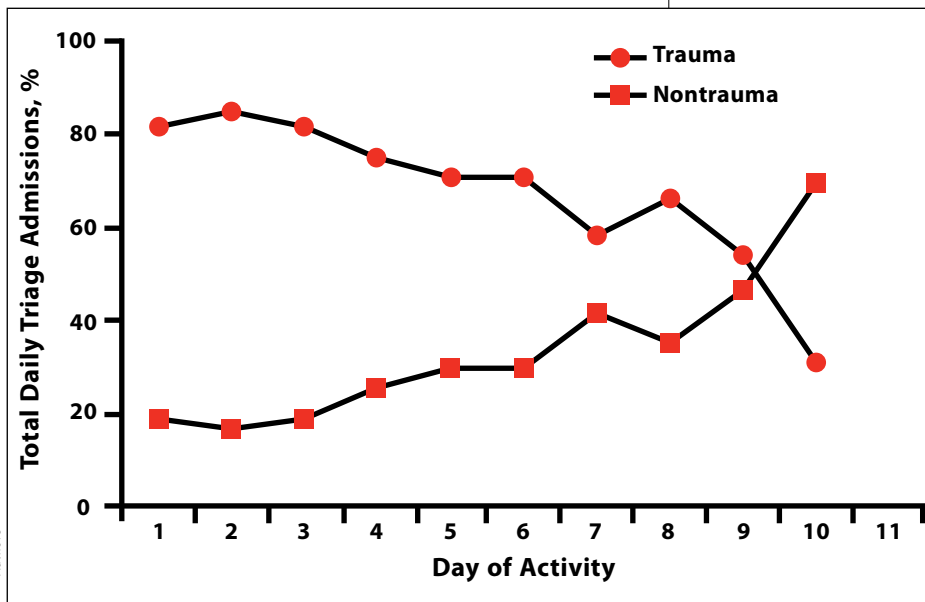


Figure 1. Israeli Defence Force Field Hospital Case Mix in Haiti. Adapted from Kreiss Y, Merin O, Peleg K, et al. Early disaster response in Haiti: the Israeli field hospital experience. *Ann Intern Med* 2010;153:45-8.

tions/en/). The ICRC has published several important documents that apply to the delivery of a HRS program. These include *Hospitals for the War Wounded*, *Surgery for the Victims of War*, *War Surgery*, *War Wounds with Fractures*, and several other useful documents available at the ICRC website.²³ In addition, the WHO has published on similar topics, including *Emergency and Essential Surgery: the Backbone of Primary Health Care*, and *Best Practice Guidelines on Emergency Surgical Care in Disaster Situations*, available at their website.²⁴



The ICRC and WHO doctrines published in the above publications can be applied to the development of a light surgical Humanitarian Relief Surgical team for CFHS humanitarian operations. The ICRC and WHO stated principles on war surgery have important implications for the delivery of care in HRS operations.

- Triage is paramount. Allowing critically ill and medically complex patients to die with dignity is important for doing 'the most good for the greatest number of patients.' This allows resources to be utilized by more salvageable patients.
- The ICRC doctrine describes intensive *nursing* units, not intensive *care* units. In ICRC's *War Surgery*, it is stated that ventilators and monitors may not be appropriate in ICRC intensive nursing units. In most

cases, pulse oximetry is all that is required for the monitoring of post-operative patients. The WHO states that an ICU does not necessarily need ventilators or other expensive machines. It suggests that oxygen should be available, that intravenous lines should be capable of running overnight, and that vital signs should have the capability of being measured at least hourly. The minimum standard for monitoring is by a pulse oximeter. The key feature identified for the success of an ICU by the WHO is overnight monitoring of the patient.

- The ICRC doctrine states that high quality surgery can be performed with simple x-ray services only, and that no computed tomography or complex x-ray machines are required.
- Blood should only be given to patients in shock with a good chance of survival. In many cases when blood is transfused at ICRC facilities, the transfusion is of fresh whole blood donated by a relative. In some areas of the world with endemic blood-borne diseases, the ICRC recommends that blood transfusions be entirely avoided. Often, in affected areas, cultural taboos exist regarding the giving or receiving of blood. To support a blood bank, the ICRC has a basic cross match system, but cannot screen for blood-borne diseases. ICRC field hospitals do not store fractionated blood products, as the refrigeration required to store plasma, packed red blood cells, and platelets cannot be assured.
- The ICRC does not provide microbiology laboratory services.
- The ICRC doctrine advocates only for primary repair of vascular injuries. If a primary repair is not possible, prosthetic grafts should not be used, and an amputation should be considered for high-grade vascular injuries.
- Most open fractures can be managed with debridement, washout, Plaster of Paris casting, and skin grafting. External fixation systems may be used for open fractures. However, because of limited diagnostic imaging support, surgeons using external fixation devices must be comfortable using them with *minimal* or *no* diagnostic imaging. Internal fixation should be used sparingly, and avoided if possible. The ICRC uses the AO/ASIF tubular systems for internal fixation when necessary.
- Anesthetic agents should be given intravenously. Most ICRC hospitals use the agent Ketamine for induction and maintenance of anesthesia. Inhaled agents require bulky equipment and gas circuits that may require sterilization after use in patients with infectious respiratory diseases. Many procedures are also done under local anesthetic, such as amputations and chest tubes.²⁵



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Developing a CF Humanitarian Relief Surgery Program

A CF HRS team would provide a rapidly-deployable field surgical detachment that could be mobilized with DART in response to a disaster or conflict. This surgical capacity would be in support of CF humanitarian operations until more established and permanent health care facilities can be established, or until the CF HRS element can be augmented by other CFHS services.

Some key features that should be considered when developing a CF HRS program include:

1. The CF HRS component from 1 Canadian Field Hospital would deploy as an integral part of the DART with members of the surgical team on the initial deployment.
2. The duration of the HRS deployment would be same as that of the DART (40 days).
3. The CF HRS element of the DART would be self-sufficient with respect to re-supplying for at least seven days.
4. The CF HRS team would be light, rapidly deployable, and would have a small logistical footprint. The team should be modular and easily expanded, with more advanced

Role 3- type equipment as it becomes available.

5. Other DART health care providers would assist with peri-operative care of patients during the first week of deployment.
6. Injured or ill CF members would be treated in the same way as on previous DART missions.
7. A defined list of key clinical procedures would be established to enable planning for the required equipment, medical expendables, and the necessary training of surgical staff (Table 3).

Specialty	Types of Procedures	Comments
General Surgery Procedures	Neck exploration: repair of trachea, esophagus, vascular injuries Chest: chest tube insertion, decortication for empyema Abdomen: perforated viscera, vascular injury, splenectomy, hernias, appendectomy, gallbladder, intestinal volvulus and bowel obstruction operations	Patient must be extubatable postoperatively Surgical drains required, only staplers required for unstable patients, but otherwise all anastomoses are hand sewn to reduce kit weight
Urology Procedures	Suprapubic catheter insertion Bladder repair Open urethral realignment Urethral Dilation Ureteric repair Caesarian Section	J-Stents required
Obstetrics and Gynecology Procedures	Emergency Hysterectomy Dilation and Curettage Salpingectomy/Salpingotomy/Oophorectomy	For Ectopic pregnancy or Ovarian Torsion
Orthopedic Procedures	Casting for closed fractures External Fixation for open fractures Washout, debridement and casting of open fractures	(if available resources permit)
Plastic Surgery Procedures	Skin grafts Flap coverage of open fractures	All flaps should be fasciocutaneous or musculocutaneous or cross pedicle flaps. No free flaps.
Neurosurgery	None	

Table 3. Suggested Types of Surgical Procedures to be offered by CF Humanitarian Relief Surgery Team, by Specialty.

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the CF HRS team would need enough OR instruments to perform up to 30 operations per day (15 cases per table) for the first seven days of a mission. This would provide enough time for a sterilizing machine to become fully operational. Additionally, the CF HRS team would need enough medical expendables for a projected 40-day mission.

How Would a CF HRS Team be received by the Affected Nation, NGOs, and the International Community?

Because the mandate for a CF HRS mission would be only 40 days, a great impact can be made on the care of survivors

without giving the perception of distracting from the NGO's long-term plans for the area. The Canadian Forces, with its new strategic air capability, could have surgical capabilities functional soon after a disaster or conflict, and even before NGOs arrive and become operational. This ability would set Canada apart from many other nations and NGOs. Once the NGO HRS care is functional, the CF HRS could re-deploy. A

Proposed Configuration of a CF Humanitarian Relief Surgery Team

To ensure a rapidly deployable and highly mobile HRS team, the logistical and personnel requirements must be small but sufficient to provide excellent HRS to affected persons. In keeping with what HRS providers have done in the past, the following organization would balance the competing interests of mobility and high-quality surgical relief care.

The composition of the CF HRS team would consist of as little as six highly-trained personnel added to the DART. The key members of this team would include a general surgeon, an orthopedic surgeon, two anesthetists, and two operating room nurses or technicians. This formula was shown to be effective during the 1 Canadian Field Hospital deployment to Haiti.

The equipment needed to provide care would be light, unlike that required for a Role 3 facility, as was utilized in Kandahar. The minimum required kit would be one-to-two operating tables, anesthesia machines/ventilators, and oxygen concentrators. Operating room lights, a generator, and an instrument sterilizing system would also be essential. No microbiology, biochemistry, or hematology laboratory equipment would be required. A patient's hematocrit could be determined with a centrifuge and a ruler. If available, the blood microanalyzers used by children's hospitals can run samples from a capillary tube of blood without the need for heavy equipment.²⁶

As suggested by the WHO guidelines, the CF HRS element should not run a blood bank. Blood should be donated by family members and transfused as whole blood that has been tested only for blood typing (ABO and Rh factor). Testing kits for Hepatitis B and C and HIV are very cheap, readily available, light, and quick to yield results.²⁷ However, depending upon the mission requirements, the storage of small amounts of fractionated blood products for CF members may be required for emergency use. To be completely self-sufficient,



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CF HRS team would be perceived as a significant contribution to those in desperate need by assisting overwhelmed local and NGO health care resources. However, an exit strategy must be well-planned with the NGO and national health services, so as to not abandon those institutions when the CF HRS mandate is complete.²⁸

by using our highly-trained CF surgical teams in HRS, we would help preserve part of the valuable war surgery experience that we gained in Afghanistan. This would allow the CFHS to maintain core surgical competence in austere environments, so that it will be prepared for the next challenge that the CF may meet.



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Ethical and appropriate care within the setting of a disaster or a humanitarian emergency can be provided within the guidelines established by internationally-recognized doctrines. The CFHS does not need to create or explore these complex ethical and clinical considerations in isolation.

In summary, the post-Afghanistan CFHS doctrine should implement an HRS team in the already-experienced DART formation. The addition of acute HRS care would add clinical strength and depth to the care that can already be delivered by the non-surgical health care services of DART. Because many people will be critically injured

after a disaster such as the Haiti earthquake, the surgical care offered by a CF HRS team may well be an individual's only chance for survival.



Conclusions

The addition of HRS to the DART and CFHS humanitarian operations would support the mission aims of CONPLAN RENAISSANCE and Strategy 2020. In addition,

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