Caring for Patients at a COVID-19 Field Hospital

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During the initial peak of coronavirus disease 2019 (COVID-19) cases, US models suggested hospital bed shortages, hinting at the dire possibility of an overwhelmed healthcare system.[1,2] Such projections invoked widespread uncertainty and fear of massive loss of life secondary to an undersupply of treatment resources. This led many state governments to rush into a series of historically unprecedented interventions, including the rapid deployment of field hospitals. US state governments, in partnership with the Army Corps of Engineers, invested more than $660 million to transform convention halls, university campus buildings, and even abandoned industrial warehouses, into overflow hospitals for the care of COVID-19 patients.[1] Such a national scale of field hospital construction is truly historic, never before having occurred at this speed and on this scale. The only other time field hospitals were deployed nearly as widely in the United States was during the Civil War.[3]

FIELD HOSPITALS DURING THE COVID-19 PANDEMIC

The use of COVID-19 field hospital resources has been variable, with patient volumes ranging from 0 at many to more than 1,000 at the Javits Center field hospital in New York City.[1] In fact, most field hospitals did not treat any patients because early public health measures, such as stay-at-home orders, helped contain the virus in most states.[1] As of this writing, the United States has seen a dramatic surge in COVID-19 transmission and hospitalizations. This has led many states to re-introduce field hospitals into their COVID emergency response.

Our site, the Baltimore Convention Center Field Hospital (BCCFH), is one of few sites that is still operational and, to our knowledge, is the longest-running US COVID-19 field hospital. We have cared for 543 patients since opening and have had no cardiac arrests or on-site deaths. To safely offload lower-acuity COVID-19 patients from Maryland hospitals, we designed admission criteria and care processes to provide medical care on site until patients are ready for discharge. However, we anticipated that some patients would decompensate and need to return to a higher level of care. Here, we share our experience with identifying, assessing, resuscitating, and transporting unstable patients. We believe that this process has allowed us to treat about 80% of our patients in place with successful discharge to outpatient care. We have safely transferred about 20% to a higher level of care, having learned from our early cases to refine and improve our rapid response process.

CASES

Case 1

A 39-year-old man was transferred to the BCCFH on his 9th day of symptoms following a 3-day hospital admission for COVID-19. On BCCFH day 1, he developed an oxygen requirement of 2 L/min and a fever of 39.9 °C. Testing revealed worsening hyponatremia and new proteinuria, and a chest radiograph showed increased bilateral interstitial infiltrates. Cefdinir and fluid restriction were initiated. On BCCFH day 2, the patient developed hypotension (88/55 mm Hg), tachycardia (180 bpm), an oxygen requirement of 3 L/min, and a brief syncopal episode while sitting in bed. The charge physician and nurse were directed to the bedside. They instructed staff to bring a stretcher and intravenous (IV) supplies. Unable to locate these supplies in the triage bay, the staff found them in various locations. An IV line was inserted, and fluids administered, after which vital signs improved. Emergency medical services (EMS), which were on standby outside the field hospital, were alerted via radio; they donned personal protective equipment (PPE) and arrived at the triage bay. They were redirected to patient bedside, whence they transported the patient to the hospital.

Case 2

A 64-year-old man with a history of homelessness, myocardial infarctions, cerebrovascular accident, and paroxysmal atrial fibrillation was transferred to the BCCFH on his 6th day of symptoms after a 2-day hospitalization with COVID-19 respiratory illness. On BCCFH day 1, he had a temperature of 39.3 °C and atypical chest pain. A laboratory workup was

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TABLE. **Key Lessons From a COVID-19 Field Hospital**

Lesson	Challenge	Solution
Update staff on changes	In the first case example, "hot zone"[a] float staff were unaware of administration-initiated changes to layout and storage, which led to delays in locating the stretcher and IV supplies.	We created a Medical Director role, shared among four lead physicians. The Medical Directors participate in administrative decisions and update and solicit feedback from the hot zone.
Unify communications systems	The BCCFH had no overhead paging system or operator to alert RRT staff, who are dispersed throughout the large hot zone, which is dimly lit at night. Additionally, the CRNA and EMS staff are located in the cold zone.[b]	We implemented a radio-based communication system for rapid response or other emergencies and radio verbal response checks during every shift.
Create a clinical drilling culture	There was a need to prepare staff for clinical emergencies while working with unfamiliar teams dressed in full PPE and in a nontraditional care environment.	We created mock RRT drills to practice responding to patient emergencies. These drills prepared staff, revealed supply gaps (eg, video laryngoscopy equipment and viral filters for bag masking patients) and led to environmental improvements, like enlarging the triage bay.
Review cases to improve performance	There was a need to evaluate patient care and address patient care gaps in a field hospital, which lacks institutional memory and the didactic culture of a teaching hospital.	Medical Directors present all emergency transfers weekly to a multidisciplinary quality oversight committee. Education sessions review clinical opportunities for learning with staff. For example, in the first case, the patient was placed on fluid restrictions for hyponatremia but was likely volume depleted; in the second case, beta-blockers were continued despite hypotension. These issues were identified during case reviews and presented to staff in a "morbidity and mortality" meeting format.

[a]The "hot zone" refers to the large, negative-pressure clinical care area.

[b]The "cold zone" refers to all other areas, such as break rooms, offices, and the ambulance bay.

Abbreviations: BCCFH, Baltimore Convention Center Field Hospital; COVID-19, coronavirus disease 2019; CRNA, certified registered nurse anesthetist; EMS, emergency medical services; IV, intravenous; RRT, rapid response team.

unrevealing. On BCCFH day 2, he had asymptomatic hypotension and a heart rate of 60-85 bpm while receiving his usual metoprolol dose. On BCCFH day 3, he reported dizziness and was found to be hypotensive (83/41 mm Hg) and febrile (38.6 °C). The rapid response team (RRT) was called over radio, and they quickly assessed the patient and transported him to the triage bay. EMS, signaled through the RRT radio announcement, arrived at the triage bay and transported the patient to a traditional hospital.

ABOUT THE BCCFH

The BCCFH, which opened in April 2020, is a 252-bed facility that's spread over a single exhibit hall floor and cares for stable adult COVID-19 patients from any hospital or emergency department in Maryland (Appendix A). The site offers basic laboratory tests, radiography, a limited on-site pharmacy, and spot vital sign monitoring without telemetry. Both EMS and a certified registered nurse anesthetist are on standby in the nonclinical area and must don PPE before entering the patient care area when called. The appendices show the patient beds (Appendix B) and triage area (Appendix C) used for patient evaluation and resuscitation. Unlike conventional hospitals, the BCCFH has limited consultant access, and there are frequent changes in clinical teams. In addition to clinicians, our site has physical therapists, occupational therapists, and social work teams to assist in patient care and discharge planning. As of this writing, we have cared for 543 patients, sent to us from one-third of Maryland's hospitals. Use during the first wave of COVID was variable, with some hospitals sending us just a few patients. One Baltimore hospital sent us 8% of its COVID-19 patients. Because the patients have an average 5-day stay, the BCCFH has offloaded 2,600 bed-days of care from acute hospitals.

ROLE OF THE RRT IN A FIELD HOSPITAL

COVID-19 field hospitals must be prepared to respond effectively to decompensating patients. In our experience, effective RRTs provide a standard and reproducible approach to patient emergencies. In the conventional hospital setting, these teams consist of clinicians who can be called on by any healthcare worker to quickly assess deteriorating patients and intervene with treatment. The purpose of an RRT is to provide immediate care to a patient before progression to respiratory or cardiac arrest. RRTs proliferated in US hospitals after 2004 when the Institute for Healthcare Improvement in Boston, Massachusetts, recommended such teams for improved quality of care. Though studies report conflicting findings on the impact of RRTs on mortality rates, these studies were performed in traditional hospitals with ample resources, consultants, and clinicians familiar with their patients rather than in resource-limited field hospitals.[4-13] Our field hospital has found RRTs, and the principles behind them, useful in the identification and management of decompensating COVID-19 patients.

A FOUR-STEP RAPID RESPONSE FRAMEWORK: CASE CORRELATION

An approach to managing decompensating patients in a COVID-19 field hospital can be considered in four phases: *identification*, *assessment*, *resuscitation*, and *transport*. Referring to these phases, the first case shows opportunities for improvement in *resuscitation* and *transport*. Although decompensation was identified, the patient was not transported to the triage bay for resuscitation, and there was confusion when trying to obtain the proper equipment. Additionally, EMS awaited the patient in the triage bay, while he remained in his cubicle, which delayed transport to an acute care hospital. The second case shows opportunities for improvement in *identi-*

fication and *assessment*. The patient had signs of impending decompensation that were not immediately recognized and treated. However, once decompensation occurred, the RRT was called and the patient was transported quickly to the triage bay, and then to the hospital via EMS.

In our experience at the BCCFH, *identification* is a key phase in COVID-19 care at a field hospital. Identification involves recognizing impending deterioration, as well as understanding risk factors for decompensation. For COVID-19 specifically, this requires heightened awareness of patients who are in the 2nd to 3rd week of symptoms. Data from Wuhan, China, suggest that decompensation occurs predictably around symptom day 9.[14,15] At the BCCFH, the median symptom duration for patients who decompensated and returned to a hospital was 13 days. In both introductory cases, patients were in the high-risk 2nd week of symptoms when decompensation occurred. Clinicians at the BCCFH now discuss patient symptom day during their handoffs, when rounding, and when making decisions regarding acute care transfer. Our team has also integrated clinical information from our electronic health record to create a dashboard describing those patients requiring acute care transfer to assist in identifying other trends or predictive factors (Appendix D).

LESSONS FROM THE FIELD HOSPITAL: IMPROVING CLINICAL PERFORMANCE

Although RRTs are designed to activate when an individual patient decompensates, they should fit within a larger operational framework for patient safety. Our experience with emergencies at the BCCFH has yielded four opportunities for learning relevant to COVID-19 care in nontraditional settings (Table). These lessons include how to update staff on clinical process changes, unify communication systems, create a clinical drilling culture, and review cases to improve performance. They illustrate the importance of standardizing emergency processes, conducting frequent updates and drills, and ensuring continuous improvement. We found that, while caring for patients with an unpredictable, novel disease in a nontraditional setting and while wearing PPE and working with new colleagues during every shift, the best approach to support patients and staff is to anticipate emergencies rather than relying on individual staff to develop on-the-spot solutions.

CONCLUSION

The COVID-19 era has seen the unprecedented construction and utilization of emergency field hospital facilities. Such facilities can serve to offload some COVID-19 patients from strained healthcare infrastructure and provide essential care to these patients. We share many of the unique physical and logistical considerations specific to a nontraditional site. We optimized our space, our equipment, and our communication system. We learned how to identify, assess, resuscitate, and transport decompensating COVID-19 patients. Ultimately, our field hospital has been well utilized and successful at caring for patients because of its adaptability, accessibility, and safety record. Of the 15% of patients we transferred to a hospital for care, 81% were successfully stabilized and were willing to return to the BCCFH to complete their care. Our design included supportive care such as social work, physical and occupational therapy, and treatment of comorbidities, such as diabetes and substance use disorder. Our model demonstrates an effective nonhospital option for the care of lower-acuity, medically complex COVID-19 patients. If such facilities are used in subsequent COVID-19 outbreaks, we advise structured planning for the care of decompensating patients that takes into account the need for effective communication, drilling, and ongoing process improvement.

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