Lessons Learned for Orthopaedic Care Within the NYC COVID Epicenter Using the United States Naval Ship Comfort

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Summary: Although elective surgeries and in-person office visits were greatly reduced during the COVID-19 crisis, orthopaedic surgeons continue to play a critical role in caring for both orthopaedic and nonorthopaedic problems during this pandemic. Orthopaedic departments provide the ability to off-load emergency departments of orthopaedic issues, redeploy staff to areas of need across the hospital system, and provide direct care to COVID-19 patients. The following will discuss the experience of a large academic orthopaedic surgery department within the epicenter of the COVID-19 pandemic with respect to redeployment of human capital and unique resources such as the United States Naval Ship Comfort as well as our recommended strategy for handling future disaster situations.

Key Words: COVID-19, disaster management, crisis management
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OVERVIEW

The novel coronavirus disease 2019 (COVID-19) has proved to be a global challenge. First reported in Wuhan, China, in December 2019, the virus spread rapidly through Europe and the United States with nearly 4 million cases worldwide as of early May 2020. Although the Middle East respiratory syndrome coronavirus (MERS-CoV) and severe acute respiratory syndrome coronavirus (SARS-CoV), previous novel virus epidemics, were more fatal, COVID-19 has spread more rapidly, making the scale of this pandemic far more reaching.

At the onset of the pandemic, public officials, both from government and health realms, were asked to prioritize the health of the group over the health of an individual.

During the COVID-19 pandemic, the role of orthopaedic surgeons seems disparate in comparison with internal medicine, infectious disease, and critical care colleagues. However, at the COVID-19 epicenter in New York City, staffing shortages have required orthopaedic faculty, residents, nurses, and assistants to serve on the front lines in the emergency department (ED) and in the makeshift intensive care units (ICUs) as medical health care workers while learning and redefining their roles as clinicians.

New York and the Federal Government mandated cancellation of elective surgery to free up resources, such as inpatient beds and ventilators, save personal protective equipment (PPE), enable the use of operating rooms (ORs) to become makeshift ICUs, and to free up health care personnel, such as anesthesiologists and nurses, to be redeployed to ICU level care of critically ill patients. To significantly increase the number of ICU beds to accommodate the surge of COVID-19 positive patients requiring ventilator support, our hospital converted more than 90% of our ORs to ICUs, which successfully expanded our ICU capacity by nearly 200%.

With most ORs converted to ICUs, we considered using ambulatory surgery centers (ASCs) for semiurgent orthopaedic procedures, but this option was ethically discordant and potentially unsafe at peak crisis because it mandated all resource diversion to COVID-related pursuits. Likewise, if a medical complication arose at the ASC there were very few resources available at the hospital to help, given the influx of COVID patients. Supplies, such as PPE, at ASCs were instead used to outfit local hospitals treating patients with COVID-19.

The government deployed federal funded emergency medical resources to the hardest hit areas, which included New York City. Examples included the United States Naval Ship (USNS) Comfort, the Javits Center, and pop-up field hospitals throughout the city. We had the unique opportunity to use the USNS Comfort for a variety of orthopaedic procedures. In the past, the USNS Comfort has been deployed to assist during natural disasters, to Haiti after the 2010 earthquake, and during wartime to the Persian Gulf during Operation Iraqi Freedom. The Mercy-class hospital ship has 1000 inpatient beds and 12 ORs. In this capacity, the USNS Comfort’s primary purpose was to provide medical and surgical treatment for active duty United States military personnel. In its capacity during the COVID-19 crisis, the ship served as an alternate overflow care site for New York area hospitals.

During this pandemic, the needs of patients and that of the hospital were constantly changing on a day-to-day basis. The recommendations for the Center for Disease Control and Prevention, the government, and hospital administration have been altered daily to accommodate the evolving knowledge surrounding COVID-19. The following review will discuss
the experience of a large academic orthopaedic surgery department within the epicenter of the COVID-19 pandemic and how it navigated redeployment of orthopaedic staff and residents and used the unique resources of the USNS Comfort for orthopaedic trauma overflow as well as our recommended strategy for handling future disaster situations.

**OUR EXPERIENCE**

Although orthopaedic surgeons, residents, providers, and staff are not trained to take care of these critically ill COVID patients with primarily nonorthopaedic issues, we were useful by off-loading our ED of orthopaedic trauma patients, redeploying staff to areas of need across the hospital system, and providing direct care to COVID-19 patients in the ED and makeshift ICUs created in many of our ORs. This section will describe the role our orthopaedic surgery department provided on a large academic hospital within the epicenter, New York City, during the COVID-19 crisis.

**Resident Redeployment**

Effectively using human capital to fit the ever-changing needs of the institution was difficult. It was important to prioritize fair and equal distribution of labor to minimize an individual exposure risk and reducing mass exposure of a majority of the redeployment staff. The Department of Graduate Medical Education (GME) ascertained which areas were in greatest need for house staff redeployment and attempted to match the skills of available house staff to the needs of the institution. When the skill set of available house staff did not match the need, then there were online and video primers to train house staff for their redeployment roles. The residency program director worked directly with the GME to determine which COVID-related care pathways were within the scope of our residents. The academic orthopaedic chief residents under the direction of the program director were responsible for division of house staff labor and fairly scheduling the orthopaedic residency program based on the institution’s needs (Fig. 1). The 3 major areas of orthopaedic resident redeployment were OR-ICUs, ED, and primary orthopaedic call, including urgent care ED overflow. Redeployment roles were consistent for all levels, including fellows, to ensure equal exposure risks. The human capital need during this COVID crisis changed rapidly and nearly daily, and it was important to establish a division of labor that allowed for flexible scheduling adjustments when the needs of the institution changed.

Those deemed “high risk” for complication from exposure or COVID illness were excluded from the redeployment pool and placed into virtual redeployment roles. Each team member was asked to self-designate as “high risk” if they felt they had extenuating personal circumstances that could be greatly complicated by COVID infection. Examples of this included pregnancy and personal as well as family member health conditions, such as immunosuppression that posed an increased risk of infection. All personnel who self-designated as “high risk” were not redeployed to COVID units. Instead, they were placed into virtual redeployment roles, which did not require direct in-person patient contact with suspected or known COVID cases. Examples of virtual deployment included telemedicine clinic visits and triaging phone calls for our institution’s Workforce Health and Safety Department (WHS). WHS was the department responsible for identifying, testing, and quarantining COVID positive health care workers across the institution.

Ensuring adequate PPE for residents and staff was a top priority of our institution and department. Throughout this crisis, our hospital maintained the necessary stockpiles of PPE for its workers. Regardless of a patient’s COVID infection status, the new standard PPE protocol included an N95 respirator, surgical mask, surgical cap, eye shield, nonsterile gloves, and a nonsterile gown.

Similarly, testing for COVID within the workforce was of great importance to the hospital system. The testing policies of staff evolved throughout the crisis. Early on, our institution only tested symptomatic individuals. Individuals with positive antigen tests were kept out of work for 2 weeks. These individuals needed to be cleared by WHS to return to work. Later on in the crisis, our institution expanded its testing policy to include asymptomatic individuals. If the antigen test was positive, and the team member was asymptomatic, they were kept out of work for 10 days.
Recently, serology testing has been made available to all staff. The results of the serology test do not alter attendance or PPE behavior.

**Orthopaedic Urgent Care Pathway**

To reduce the burden of the ED, and free up the providers to care for critically ill COVID patients, our department’s leadership, alongside ED leadership, established an orthopaedic urgent care pathway. In addition to regularly scheduled visits, we repurposed our hospital clinic to serve as an ED overflow urgent care clinic for certain orthopaedic injuries. A triaging ED physician and on call orthopaedic resident would determine if the patient’s complaint was appropriate for the ambulatory setting, without the anticipated need for admission or conscious sedation, and could be evaluated with the use of mini-fluoroscopy. If the ED patient met these criteria, the patient was discharged from the ED and immediately transferred to the orthopaedic ambulatory urgent care clinic for evaluation and treatment (Fig. 2). Any patient with nonorthopaedic complaints, respiratory symptoms, obvious limb deformity, need for intravenous antibiotics, infectious symptoms, or inability to ambulate with possibility of admission were deemed inappropriate for transfer and admitted under the standard ED pathway. Typical problems that were treated in our orthopaedic urgent care were hand lacerations, phalanx fractures, ankle sprains, and nondisplaced ankle and wrist fractures. Patients with hip fractures, septic joints, open fractures, and other major orthopaedic injuries that would require hospital admission were kept within the standard ED system.

**Operative Orthopaedic Injuries**

Because of conversion of ORs into ICUs, the operative capacity of our hospital system diminished. Emergent and urgent operative cases required approval by a perioperative surgical committee and the corresponding department chair. The process involved the submission of a form stating urgency and rationale for expedited surgery. The triage process appropriately prioritized life-threatening and limb-threatening conditions and urgent injuries. Approved COVID positive patients were designated to a specific COVID OR and COVID negative patients to a non-COVID OR. This prevented unnecessary exposure of negative patients to an OR that was routinely used for infected individuals. Although some orthopaedic injuries did fall under the category of urgent, the largest area of uncertainty among orthopaedic providers was nonurgent elective trauma, such as operative distal radius and ankle fractures. These patients were stable enough to be discharged home after appropriate closed reduction and immobilization but still often required operative care. These injuries did not qualify for utilization of OR resources during the peak of the COVID pandemic.

**United States Naval Ship Comfort**

The US federal government deployed the USNS Comfort to New York City to help relieve some of the burden of routine medical and surgical care that was displaced by COVID patients overwhelming our hospitals. The USNS Comfort was initially planned to be a non-COVID patient care entity, as a US Naval ship that functioned as a floating hospital with ORs and naval physicians and surgeons. Although the ship’s original mission was to treat only COVID negative patients, this rapidly changed to include COVID positive patients. This change was likely due to the inaccuracies and evolving status of testing, and eventually, COVID positive patients were treated on the USNS Comfort. The USNS Comfort played a role, although limited, in assisting with non-urgent orthopaedic trauma at our institution.

An accepting surgeon on board the USNS Comfort reviewed each case before accepting transferring. The ship’s orthopaedic capabilities focused on routine trauma care, however excluded arthroplasty. This federal resource helped our hospital
take care of patients with semiurgent injuries to prevent overburdening our scarce OR resources and preventing unwanted nosocomial COVID infections of orthopaedic patients due to the overwhelming proportion of COVID positive patients admitted at our institution. Examples of injuries with successful transfer from our institution to the USNS Comfort included an intraarticular distal radius fracture, a comminuted mid-shaft radius fracture, and intertrochanteric hip fracture. The USNS Comfort rejected transfers with femoral neck fractures and periprosthetic hip fractures because they lacked the instrumentation and implants to perform arthroplasty.

However, this transfer process was not without flaws or limitations. The USNS Comfort only allowed patients to be transferred directly from the ED or inpatient service, and not from an ambulatory setting, and only during the hours of 7 AM to 7 PM. It also did not have arthroplasty capabilities, which limited its potential for use in femoral neck fractures. During a 6-week period, 24 hip fractures and 1 periprosthetic hip fracture were presented to our institution. Of these 25 hip fractures, only 1 intertrochanteric fracture was successfully transferred to the USNS Comfort. Overall, the USNS Comfort provided some but limited orthopaedic support to the New York area in need. Because of government imposed limitations and restricted equipment, its full potential was not used. In the event of a future crisis, we recommend that the government expand its capabilities to include arthroplasty, allow same-day ambulatory surgery with patients arriving from home, and simplify the burdensome transfer process. Nonetheless, in a crisis situation, having a fully functioning military hospital with orthopaedic surgeons willing and able to off-load these semiurgent trauma patients was beneficial to our institution within the New York City epicenter, which at the time had scarce resources for OR cases due to the conversion of most ORs into makeshift ICUs.

RECOMMENDED ORTHOPAEDIC CRISIS PLAN
This section highlights our recommended disaster management plan. The 5 areas we discuss include: orthopaedic fracture management, orthopaedic urgent care, nonorthopaedic contributions, nonorthopaedic education, and continuing orthopaedic GME. This multifaceted approach aims to be standardized and reproducible. The purpose of this section is to propose recommendations that can be used by an academic orthopaedic surgery department when facing a similar crisis situation.

**Orthopaedic Fracture Management**
During a crisis with the cancellation of elective procedures, fracture care becomes the overwhelming majority of orthopaedic operative case volumes. To best use limited operative resources in a crisis, we propose a triage system that breaks down fracture management into 4 groups as follows: life/limb threatening, urgent (operative fixation <48 hours), nonurgent, and nonoperative (Fig. 3).

**Limb/Life Threatening**
Fractures that have an imminent threat to life or limb should be taken to the operating emergently. As in a noncrisis situation, the usual hospital protocols should remain in place for operative management. Examples of such include unstable pelvic ring injuries, dysvascular limbs, and fractures with devastating or pending soft tissue compromise. If warranted and within the usual standard of care, techniques such as external fixation and traction should be used to minimize the operative time, given the limited OR availability split among all surgical services. If patients are stable for transfer before definitive fixation, transfer to alternative care sites, with proper capacity and not enduring surge situations (such as the USNS Comfort), should be considered. These injuries should be appropriately triaged and stabilized in a normal fashion because emergent fixation provides the best chance in preventing high rates of morbidity and mortality.

**Urgent (<48 Hours)**
Fractures that require urgent (<48 hours) surgical intervention raise the uncertainty and difficulty in crisis situations. Examples of such include hip fractures and lower extremity long bone injuries. If OR availability seems adequate, these injuries should be kept “in-house” for fixation. If there is any concern that these injuries will experience unwarranted delays greater than 48 hours, alternative care sites should be considered. Although this may be difficult to predict, these injuries should be dealt with on a case-by-case scenario depending on situational pressures.

**Nonurgent**
Nonurgent injuries that do not require admission but will require operative fixation should not use limited hospital resources in a crisis situation. These injuries, normally

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**FIGURE 3.** Orthopaedic crisis fracture management.
booked electively from an outpatient setting, still need to be timely addressed to prevent morbid complications. ASCs should be used to provide care to these patients, if feasible and permitted by the local government. If these resources are not available or approved, transfer of care to other institutions should be considered. If other institutions are not accepting transfer and facing surge issues, federal resources such as the USNS Comfort and other military centers should be used. If not available, institutions should expeditiously request support and resources from the state and federal governments. We acknowledge that this is not an easy task and identify this as a critical area for future research and planning for crisis management.

**Nonoperative**

Fractures that can be appropriately treated with nonoperative modalities should indeed be treated nonoperatively. For example, ankle, distal radius, and clavicle fractures that do not meet operative criteria should be triaged with nonoperative care in a usual fashion. If at any point these injuries fail nonoperative management, they should be recategorized to the aforementioned “nonurgent group” and treated per group protocol.

**Orthopaedic Urgent Care**

The establishment of an orthopaedic urgent care can help off-load the ED by decreasing the volume of patients. We recommend repurposing outpatient clinic space as an orthopaedic urgent care if it is within acceptable proximity to the ED. For imaging, we recommend repurposing a mini-fluoroscopy machine. Figure 2 highlights the proposed patient flow system.

Patients arrive and are triaged by an ED provider per protocol. If patient has an isolated orthopaedic complaint with normal vitals, he or she is eligible for transfer. Major exclusion criteria include obvious deformity, open injury, need for intravenous antibiotics, need for laboratory work, infectious symptoms, or inability to ambulate potentially requiring admission. Together, the ED provider and orthopaedic provider on call determine if a patient is appropriate for transfer. If accepted, the patient is discharged from the ED without additional testing. In the orthopaedic urgent care, a typical clinic visit would ensue with the mini-fluoroscopy to aid in diagnostic imaging. This off-loads orthopaedic care and allows ED providers to care for complicated medical patients.

**Redeployment to Nonorthopaedic Area**

We identified the following 3 areas where orthopaedic residents and attendings can provide the most utility with proper supervision: EDs, medical/surgical ICUs, and medical/surgical (med/surg) inpatient floors. Most orthopaedic training programs include rotations in these areas. In addition, we recommend when need permits to team one orthopaedic resident with one orthopaedic attending for each redeployment shift because this increases comradery, compliments each other’s skill sets, and fosters mentorship in training.

**Emergency Department Redeployment**

The recommended responsibilities of an orthopaedic resident or attending in ED redeployment should be to take histories, perform physical examinations, and execute plans for patients with the Emergency Severity Index of 3 or greater. These patients are generally stable and do not face urgent life-threatening situations. The orthopaedic provider would present these patients to the appropriate ED physician and execute the discussed plan.

**Medical/Surgical Intensive Care Units**

Paired in attending–resident teams, orthopaedic personnel redeployed to ICUs will manage stable, critically ill patients with adequate supervision from intensivists. The roles of the redeployed team will include rounding with the team, writing progress notes, writing orders, performing level appropriate procedures (arterial blood gases, arterial lines, etc.), and executing the plans as discussed on rounds. Orthopaedic providers can off-load a time-consuming task work and allow the critical care specialists to create management plans of complicated, critically ill patients.

**Medical/Surgical Inpatient Floors**

The management of medical/surgical floor patients is another area of opportunity. The roles and responsibilities of these redeployed teams would be rounding with the team, writing progress notes, managing orders, and executing the discussed plans with adequate supervision. This would free up medical residents and providers to be assigned to roles of critical need, such as ICUs and step down units.

**Education During Crisis or Redeployment**

In a disaster situation where orthopaedic surgeons are required to help in areas outside the scope of normal practice, proper education is critical to safe and effective care. Ventilated and sedated patients, who require a higher level of care, need a variety of procedures. We recommend online modules and then, on the first shift, in-person training for the following procedures: intravenous line placement, arterial line placement, and nasogastric tube placement. By learning these skills, the orthopaedic surgery faculty and residents can provide relief for medical and nursing colleagues. The more comfortable individuals feel with these tasks, the broader their scope of redeployment may be and the more helpful they would be on the front lines.

**Continuing Orthopaedic Graduate Medical Education**

During the COVID crisis our residency program still strictly adhered to the resident duty hours put forth by the Accreditation Council for GME. Complying within the Accreditation Council for GME restrictions, continuing orthopedic GME during a nationwide shutdown was very important to our department. To comply with social distancing measures our orthopedic residency adapted its educational curricula to allow for virtual teaching. We instituted 3, 1-hour videoconference lectures per week. A faculty member from different subspecialties directed each lecture. In addition, we continued our resident-run 1-hour videoconference to review the operative trauma from the previous week.

In addition to our residency’s own virtual education, there was a significant increase in webinars and teleconferences sponsored by the various subspecialty societies. As social distancing requirements are loosened, these virtual
lectures should be considered for continued integration into traditional teaching structures.

CONCLUSIONS
Orthopaedic surgeons and team members are not primarily trained to take care of critically ill respiratory patients, but we can still play critically important roles during the COVID-19 crisis. With the establishment of an orthopaedic urgent care, staff redeployment to nonorthopaedic areas, and a streamlined fracture management system, we have the ability to off-load burden and resources from overwhelmed areas of our hospital system. Although we cannot predict the landscape of future crises, we hope that these recommendations can serve as a foundation for others facing disaster situations.

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