**The Case for Designated COVID-19 Hospitals**

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**One-Sentence Summary of Submission:** With the COVID-19 pandemic having the potential to completely overwhelm the U.S. healthcare system, designated COVID-19 hospitals can more effectively utilize resources and personnel, improve treatment, and limit nosocomial spread.

**BACKROUND**

COVID-19 is a zoonotic virus originating from the Hubei province of China. COVID-19’s typical presentation of fever and cough can rapidly escalate to acute respiratory distress syndrome (ARDS) and sepsis (1). The initial outbreak rapidly spread into what is now a global pandemic, infecting over 750,000 people and leading to over 37,000 deaths (2, 3). The massive influx of COVID-19 patients quickly overwhelmed healthcare systems throughout the world including Italy, South Korea, and Iran (4, 5).The global impact of COVID-19 has been profound, and the public threat COVID-19 represents to the United States (U.S.) is the most serious since the H1N1 influenza outbreak in 1918 (6).

COVID-19 has an estimated R0 of 2.24 - 3.58, leading to a doubling rate every 6.4 days and has thus far demonstrated global exponential growth. With the optimal antiviral therapy still unknown and vaccines still in the early stages of development, the most effective action to combat this pandemic is to limit the human-to-human transmission (3, 7).Without large-scale measures to decrease transmission, projections estimate that 81% of the U.S. would become infected (8). The impact of public health interventions, such as social distancing, will reduce this number to 20-50% of the U.S. becoming infected. What is especially important is it will lead to a more gradual increase in case volume with a less dramatic but prolonged peak of the pandemic (Figure 1). As described below, this becomes incredibly important for the ability of the U.S. healthcare system to cope (9, 10).

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**Figure 1.** The projected critical care beds needed (per 100,000) in the upcoming months based on the levels of community measures put in place (8).

**THE PROBLEM**

The U.S. has 925,000 staffed hospital beds with 75,000 - 90,000 of those being critical care beds (11).The number of full-featured ventilators in the United States is approximately 62,000, with an additional 98,000 ventilators that are not full-featured but can provide basic ventilatory support in emergent cases (12).Approximately 4-5% of the U.S. population will require hospitalization, with 30% of these patients requiring critical care admission (13).This equates to 13.1 - 16.4 million patients being admitted and 3.93 – 4.92 million ICU admissions. Even with these infections spreading across 3-6 months, the need for hospital beds may be at least eight times the actual hospital capacity. An additional consideration is that patients admitted to the hospital with COVID-19 infection have an average hospital stay of 10.4 days (8).This issue is compounded by the exposure physicians and other healthcare staff are experiencing, which may lead to up to 20% of healthcare staff being unable to work for periods of time from being ill or self-isolated from high-risk exposure (13).

An example that provides a more tangible set of numbers: Philadelphia is a relatively hospital-rich metropolitan area compared to most cities in the United States. The greater Philadelphia area is home to about 4.1 million residents with 10,228 staffed hospital beds, 941 ICU beds, and 150 ventilators (14-17).This would equate to a projected 164,000 – 205,000 patients requiring hospital admission and 49,200 - 61,500 requiring ICU admission. Most models suggest a majority of these infections will occur within a 3-month surge. If the lower end of the COVID-19 case projection (164,000) in the greater Philadelphia area were spread evenly across 12 weeks, then that would lead to roughly 13,700 cases weekly. With an average hospital stay of 10.4 days, this would overwhelm the hospitals within a week with patients that require admission continuing to come in at the same pace for 11 more weeks.

Manpower and supply shortages also remain a major limitation in the U.S. healthcare system’s ability to handle the pandemic. These include the previously mentioned undersupply of ventilators, personnel shortages secondary to exposure and/or contracting COVID-19, lack of personal protective equipment (PPE), and supply chain roadblocks. To make matters worse, hoarding of PPE by the general public and unequal distribution of supplies have created a serious nationwide shortage. This has forced some medical professionals to use PPE that is below clinical standards, putting themselves and patients at risk (18).

The presence of COVID-19 positive patients in every hospital has also led to a massive strain on the healthcare infrastructure. Healthcare personnel that have the skills and training needed to treat COVID-19 patients are not optimally utilized. They are decentralized working under various healthcare systems where standardization of protocols for prevention, containment, and treatment of the disease will most likely change in each institution, making it difficult to establish best practices and advance our understanding of COVID-19 management. The resources in dire need are distributed throughout all of the hospitals which ultimately leads to a wasteful duplication and inaccurate distribution of these badly needed supplies. In addition, hospitals have become high-risk for transmission of COVID-19. This exposes patients who are seeking treatment for other medical illnesses, particularly those with comorbidities that are especially susceptible to COVID-19. In addition, the strain COVID-19 places on personnel and resource utilization will ultimately delay and disrupt the care of other urgent healthcare needs, which has been projected to lead to more deaths than COVID-19 itself (19).

**SOLUTION**

The overwhelming nature of this pandemic requires innovative approaches to tackle even a portion of this problem. Without proactive capacity building, the healthcare infrastructure will collapse from the large number of infected individuals who need hospitalization.Currently, there is a complete disruption of services at all hospitals that have both COVID and non-COVID patients, leaving both patient groups inadequately cared for. In order to face the daunting demands of this pandemic, a designated COVID-19 hospital will help standardize care, optimize resource utilization, and protect non-COVID-19 patients and healthcare workers. This hospital would treat only those with confirmed COVID-19 infections and screen those suspected to have COVID-19, serving as the pandemic’s central command center of a designated county or region. Simultaneously, non-COVID hospitals would focus on caring for patients’ ailments that are unrelated to COVID-19 and minimize the risk of spreading the virus. This will allow for accurate allocation of resources, efficient use of personnel, and a better of understanding of the incidence, treatment efficacy, and outcomes of the COVID-19 infection in the community. This would also protect the general public from nosocomial spread of COVID-19.

The idea of a designated COVID-19 hospital has been effective in two countries with vastly different healthcare systems. Italy has been devastated by the COVID-19 pandemic and has had thousands of healthcare workers become infected with the virus. The Cotugno Hospital in Italy has been the exception. The Cotugno Hospital transitioned to a COVID-19 only hospital and has yet to have a single healthcare worker become positive for COVID-19. This has been achieved by strictly adhered to anti-contamination policies including healthcare workers having state of the art PPE: high-tech masks, protective googles, and full body waterproof suits. The hospital is equipped with disinfectant machines that staff and visitors walk through whenever entering specific areas. They have successfully implemented protocols that minimize any potential chance for contamination such as completely sterile and contaminated “zones” of each ward with separate staff assigned to each area and closing of all corridors when new patients are brought in to decrease the risk of transmission (20).These procedural changes and advanced PPE would not be possible in a hospital treating non-COVID and COVID patients.

As the first to encounter the outbreak, China has gained the most insight into handling the COVID-19 pandemic and has had a rapid decrease in new COVID-19 cases. After recognizing the seriousness of COVID-19, the Chinese government built two brand new hospitals strictly for COVID-19 in under two weeks, repurposed multiple hospitals to be COVID-19 only, utilized “fever-clinics,” which screened patients and selected which patients required COVID-19 testing and/or further imaging, and militantly tracked each new case, which helped guide decision making on a national scale (21).

These two examples represent the efficacy of COVID-19 only hospitals and demonstrate unique aspects we can utilize in the U.S. China and the Cotugno Hospital have experienced excellent results by isolating care of COVID-19 patients and creating infrastructure, policies, and protocols specifically for this pandemic.

**SUMMARIZED BENEFITS OF A COVID-19 HOSPITAL**

* **Supply Allocation**
	+ The designated COVID-19 hospital will thoroughly understand their supply needs and communicate this to local and state governments to more accurately allocate resources.
	+ Resources can be more efficiently distributed based on population, risk stratification, and new cases reported by COVID-19 hospitals.
	+ Centralizing inventory will allow for the most efficient use of these supplies. For example, ventilators can be rapidly deployed to a patient in need after disconnection from another patient.
	+ Medication and PPE can be ordered in mass quantities and any new available supplies can be expedited to the COVID-19 hospitals.
* **Infrastructure, Personnel, Patient Management**
	+ Cohorting of patients will limit nosocomial spread to non-COVID patients, visitors, and healthcare workers.
	+ Healthcare workers in COVID-19 hospitals will get prioritized PPE, limiting workforce exposure and the consequences (self-isolation, sick time, etc.) that can result.
	+ Centralizing of talent and experienced medical staff will allow them to see more COVID-19 patients and standardize methods of care.
	+ The designated COVID-19 hospital will have an in-house comprehensive testing center, with both virus detection and antibody detection capabilities, to expedite diagnosis, management, and isolation.
	+ The COVID-19 hospital can standardize antiviral regimens to allow for faster adaptability to poor responses and widespread improvement in treatment.
	+ Plasma from recovered patients can be acquired, stored, and used to treat future patients, all in the same hospital.
	+ The COVID-19 hospital can centralize training for less-experienced staff.
* **COVID-19 Sequestration and Public Health**
	+ Non-COVID hospitals can maintain standard of care for the general public and perform elective, urgent, and emergent cases with a lower risk of COVID-19 transmission.
	+ The COVID-19 hospital can act as an up-to-date resource for other healthcare facilities on handling COVID patients (potential exposure, suspected infected, transferring protocol etc.).
	+ The COVID-19 hospitals can facilitate a patient tracking system that local, state, and federal authorities can access so the pandemic is more clearly illustrated to government leaders. This will allow for policy and decision-making to be based on real-time data.
	+ COVID-19 hospitals can collect meaningful and standardized data on the demographics, symptomology, treatment efficacy, outcomes, and complications of infected patients. This can help create evidence-based guidelines and improve treatment.

**STEPS TO ACHIEVING A COVID-19 ONLY HOSPITAL**

**The key to achieving this rapidly is coordination and communication.**

**Step 1.** Establish the treatment/management protocols, guidelines for healthcare staff, and funding required to set up the hospital.

**Step 2.** Select a designated COVID-19 hospital based on location, resources, and infrastructure with the help of the local and state government.

**Step 3.** Select a designated “territory” for each COVID-19 hospital and set a plan in place for transferring suspected COVID-19 patients from non-COVID hospitals. This will require coordination and education of emergency medical services to safely transfer potentially infectious patients.

**Step 4.** Assess and estimate the requirement of supplies including ventilators, infusion pumps, beds, medications, portable HEPA filters, PPE, negative pressure air scrubbers, and other inventory specific to treating COVID infection.

**Step 5.** Recruit and establish personnel for the COVID-19 hospital including physicians, nurses, mid-level providers, technicians, respiratory therapists, and other necessary healthcare professionals.

**Step 6.** Coordinate with surrounding non-COVID hospitals on how personnel and resource allocation will shift in order to optimize COVID-19 treatment.

**Step 7.** Establish a timetable for transitioning to a COVID-19 dedicated hospital system and make the public aware of the impending changes to the healthcare system using local media. This must coincide with the timing of resource reallocation, personnel transitions, and agreement with neighboring hospitals.

**Step 8.** At the predetermined date, the designated COVID-19 hospital must stop taking admissions from non-COVID patients and neighboring hospitals must transfer suspected COVID-19 patients to designated hospital.

**Step 8.** Simultaneously, transfer non-COVID patients to neighboring hospitals.

**Step 9.** Begin treatment protocol standardization, data maintenance, and constant communication from designated hospitals to governing health organizations.

**Step 10.** Non-COVID hospitals will implement a screening tool to quickly decide which patients are transferred to the designated hospital. The non-COVID hospital can continue treating other medical illnesses and maintain standard of care. Elective surgeries can be gradually re-initiated at non-COVID hospitals.

**CONCLUSION**

The COVID-19 pandemic has created the need to rethink healthcare delivery. This rapidly evolving pandemic has the capability of completely overwhelming the U.S. healthcare system as it exists and with finite supplies and personnel, designated COVID-19 hospitals represent a glimmer of hope in a seemingly insurmountable situation. While vaccination is an extremely promising strategy, a COVID-19 vaccine is at the very least months away and requires us to act in the meantime (22).The creation of centralized COVID-19 healthcare delivery may be a pivotal moment in this country’s battle with the pandemic. This project would be no small undertaking and would require a collective effort from healthcare workers, hospital administrators, government officials, and the general public to overcome the numerous barriers that exist to creating a designated COVID-19 hospital system. However, this has been successful in other countries and we have the opportunity to learn from their experiences.

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