



Global Perspective Article

Developing and implementing an infection prevention and control program for a COVID-19 alternative care site in Philadelphia, PA



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Background: On March 27, 2020, the city of Philadelphia was given permission by Temple University to convert the Liacouras Center gymnasium to an alternate care site (ACS) to treat low-acuity COVID-19 patients. ACSs, especially those created to specifically care for infectious patients, require a robust infection prevention and control (IPC) program.

Methods: The IPC program was led by a physician and nurse partnership, both of whom had substantial experience developing IPC programs in US and low-resource settings. The IPC program was framed on a previously described conceptual model commonly referred to as the “4S’s”: Space, Staff, Stuff, and Systems.

Results: The gymnasium was transformed into red, yellow, and green infection hazard zones. The IPC team trained 425 staff in critical IPC practices and personal protective equipment standards. Systems to detect staff illness were created and over 3,550 staff health screening surveys completed.

Discussion: Use of existing guidance and comprehensive facility and patient management assessments guided the development of the IPC program. Program priorities were to keep staff and patients safe and implement procedures to judiciously use limited resources that affect infection transmission.

Conclusion: Planning, executing, and evaluating IPC standards and requirements of an ACS during a pandemic requires creative and nimble strategies to adapt, substitute, conserve, reuse, and reallocate IPC space, staff, stuff, and systems.

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On January 21, 2020, the first case of laboratory-confirmed infection due to the novel virus severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in the United States was identified in Seattle, Washington. Six weeks later, in early March, the first person in Pennsylvania was diagnosed with coronavirus disease-19 (COVID-19) disease. The subsequent rapid growth in COVID-19 cases in the Philadelphia region led most acute care hospitals to suspend nonurgent procedures and hospitalizations by mid-March. Very quickly, hospitals were required to assess their surge capacity in preparation for a possible large-scale, public health emergency.¹ Despite individual facilities’ efforts to accommodate a surge in patients with moderate-

to-severe COVID-19, multiple acute care hospitals in Philadelphia began to experience a surge in demand just 3 weeks after the first confirmed case was identified.

On March 27, Temple University granted the City of Philadelphia permission to use the Liacouras Center as an overflow medical facility for low-acuity COVID-19 patients.² A cache of supplies was delivered to the Center the next day from the Federal Emergency Management Agency (FEMA). In the span of a weekend, members of the Pennsylvania and Philadelphia Offices of Emergency Management (OEM), with support from permanent staff of the Liacouras Center, began to assemble materials on the arena floor. The Philadelphia Department of Public Health (PDPH) and Philadelphia OEM provided joint oversight of the set-up, staffing, and management of the facility. A Chief Executive, Medical and Nursing Officer were recruited to lead the on-site operations. Clinical (eg, nurses, physicians, pharmacists, respiratory therapists) and support staff (eg, environmental and dietary

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Fig 1. CSF-L patient care area.

services) were recruited from the Philadelphia Medical Reserve Corps (MRC), contracted staffing agencies and vendors, and the Department of Defense (DOD). Over the course of 3 weeks, the Liacouras Center was transformed into a surge field hospital known as the COVID-19 Surge Facility-Liacouras (CSF-L) (Fig 1). The CSF-L opened on April 16 and 4 days later received its first patients. Due to the success of public health mitigation efforts, the surge of patients needing hospitalization was blunted, and the CSF-L was open for only 10 days during which time it provided care for 14 patients. Providing infection prevention and control (IPC) consultation and services to a US-based alternative care site (ACS) during a viral pandemic is unprecedented. The aim of this paper is to describe the development and implementation of the novel CSF-L IPC program.

METHODS

Setting

Philadelphia is the sixth largest city in the United States with a population of over 1.5 million people. It is also the poorest large city in the country. Most hospital beds are in facilities that are members of extensive health care networks. According to 2018 data, Philadelphia County has approximately 5,320 adult staffed medical-surgical beds and 940 intensive care unit (ICU) beds,³ although pandemic planning included identifying additional hospital beds in each facility in the event of a surge of demand.⁴ The Temple University Liacouras Center is known as a premiere basketball facility and provides a unique and flexible space, which is also used for concerts, banquets, and trade shows. It is one of the largest indoor, public assembly venues in Philadelphia.

Materials

The initial material assets of the CSF-L were provided by FEMA. Key materials included: cots, commodes, walkers, bathing equipment, medical monitoring equipment, portable nonplumbed sinks, sharps containers, infectious waste receptacles, alcohol-based hand rub, and personal protective equipment (PPE).

Method

We utilized a previously described conceptual model to assess disaster responses and surge capacity, commonly referred to as the

“4S’s”: Space, Staff, Stuff, and Systems.^{5–7} This framework guided our development of a novel IPC program for this surge facility. In this article, we describe the “4S’s” of our program developed for the CSF-L and the related challenges at a COVID-19 ACS.

RESULTS

The rapid creation and unusual configuration of this facility, together with the challenges of new clinical teams unfamiliar with one another, and working together in uncomfortable PPE to provide high-quality patient care, necessitated some basic approaches to the development of our IPC program. These included:

1. Use of existing guidelines and other resources from expert groups whenever available^{8,9}
2. Adapt existing guidance to apply to the unique conditions of the surge field hospital
3. Standardize IPC processes to ensure the safety of patients and staff

Space

Because the Liacouras Center was neither designed nor engineered to care for patients, a comprehensive environmental and occupational risk assessment was undertaken prior to facility opening. Environmental health and safety experts, together with leaders of the IPC team, conducted an “all-hazard” risk assessment of the site for actual or potential risks to patients or staff; this team produced a comprehensive Health and Safety Plan for the CSF-L. The plan identified the need for engineering controls (eg, specifications for heating, ventilation, and air conditioning systems) and specified occupational IPC health and safety requirements, including PPE standards, daily monitoring of staff for acute illness, sanitation standards for both hand hygiene and equipment sanitation, as well as laundry and waste management recommendations. The identified IPC hazards and risk reduction plans, priorities and progress were reported and addressed by the CSF-L team before the facility moved forward in development.

A facility map was created that designated “red, yellow, and green zones,” each with a different level of infection risk and expectation for IPC practices and PPE use. Colored tape was placed on the floor to provide visual cues. Separate entrance and exit paths were designated for both staff and patients. The patient care and decontamination areas were designated as “red zone,” requiring the highest level

of PPE and to which physical access was strictly controlled. The “green zone” included the facility entrance and hallways leading to the staff locker room; only surgical masks were required while in these areas. The “yellow zone” was the interface between “red zone” and “green zone” where staff donned and doffed PPE. Nearby Liacouras offices were converted into PPE storage and distribution rooms.

Staff—IPC

IPC core team

The IPC team was led by a member of the PDPH's Healthcare-Associated Infections and Antimicrobial Resistance team (SEC) and a highly experienced nurse certified in IPC (MLM). Collectively, these co-leaders have over 50 years of experience serving as local, national, and international consultants and trainers for IPC programs. Additional critical IPC team members included Temple University medical students (ST and KF), a nurse practitioner experienced in family medicine and college health and a registered nurse experienced in IPC (GB and EL). Our team worked in concert with the PDPH and OEM staff on-site as well as the CSF-L leadership team.

Infection preventionist and designees

Given the unique setting, heterogeneous background of staff and challenges preventing nosocomial transmission of the SARS-CoV-2 virus and other potential health care-associated infections, Infection Preventionist (IP) coverage of the “red zone” on all shifts was considered an integral component of the IPC plan. A call for volunteers from the local chapter of the Association for Professionals in Infection Control and Epidemiology was released via the chapter listserv. Interested and available IPs were instructed to register through the Philadelphia MRC website. However, recruiting these IPs was a lofty goal given the intense increase of IP workload in their own facilities, so we began to seek IP designees, such as nurses or public health experts with advanced IPC knowledge.¹⁰ IP roles and activities were designed to support the necessary interprofessional collaboration of a staff new to the IPC standards of CSF-L and new to each other. Policies and job action sheets (position descriptions) were created for the following roles: Red Zone Infection Preventionist, Donning/Doffing Assistant, PPE Distributor and Staff Entrance Surveillance Monitor. It was important to have a core group of individuals assigned to these roles as their responsibilities included being familiar with policies and providing focused coaching to ensure staff adherence to essential infection prevention practices.

Stuff—IPC supplies and equipment

The FEMA Medical Station cache provided resources for a 250-bed facility. The included IPC resources included 1,070 N95 respirators of various sizes and models, 3 fit test kits, 900 surgical masks, 300 disposable isolation gowns, 192 face shields, and over 100 boxes of non-sterile examination gloves of various sizes. The cache also included 5 portable, nonplumbed sinks, and alcohol-based hand rub. Additional PPE resources were continuously being sought and obtained through vendors as well as private and public donations.

The availability and maintenance of the PPE inventory was critical for CSF-L operation. Prior to opening, a baseline inventory of every item was established and the PPE distribution room was organized to maximize space and to improve the efficiency of distribution. It was staffed 24 hours per day by a consistent group of registered nurses and 2 members of the DOD to standardize the process. All staff entering the patient care area (“red zone”) received an isolation gown, a face shield, and a fit-tested N95 respirator from the PPE Distributor. Their name and the items they received were recorded by hand in the PPE Distribution Log. This process was repeated each time the staff member entered the patient care area at the start of their shift

and after each scheduled break. Staff received a new or reprocessed N95 respirator each time they entered or re-entered the “red zone.” A running count of all items distributed was recorded every 6 hours on the daily PPE Inventory Tracking Form. Stock delivered to the PPE distribution room and items returned to stock after reprocessing were also recorded here. The numbers from the previous 24 hours were reconciled at the start of each day and entered by hand into the master inventory spreadsheet. Key Process Indicator reports outlining the number of days on hand of each item were generated daily and shared with the leadership team.

All PPE, except gloves and surgical masks, was reprocessed. Face shields, safety glasses, and goggles were disinfected on site by the decontamination staff in a designated, well-ventilated area away from patient care and all other activities, with a hospital-grade disinfectant. N95 respirators were reprocessed using a Bioquell Hydrogen Peroxide Vapor decontamination facility developed by a local hospital to maintain their own PPE supply. The used N95 respirators were prepared and packaged for transport by the waste management staff and were transported to and from the reprocessing facility every other day. Isolation gowns were reprocessed daily by a medical laundry service. All reprocessed items were then returned to the PPE distribution room and logged into the Inventory Tracking Form.

Systems and standards—IPC

Staff health surveillance at point of entry

One point of entry into CSF-L was established for all staff to ensure security and facilitate health screening. This area was staffed 24 hours per day by security personnel and a Staff Entrance Surveillance Monitor. Staff entering the building were required to wear a personal face mask and remain 6 feet apart from other personnel at all times; if someone did not have a mask, a surgical mask was provided. Surveillance was intended to identify individuals with clinical signs or symptoms suggestive of COVID-19 or other acute illness, or recent exposure to SARS-CoV-2. The daily entrance survey was accessed and completed by volunteers and staff using a QR (Quick Response) Code on their smartphone or if they had no smartphone, on a paper survey. Staff monitors verified that the survey was complete, asked about any positive answers and took each volunteer's temperature using a no-contact infrared thermometer. The names of all individuals who reported symptoms of an acute illness or a temperature >100.4°F were recorded for investigation; ill staff were instructed to return home and given instructions for self-monitoring and when to seek care. Staff who cleared the screening process signed in, performed hand hygiene using an alcohol-based hand rub, and proceeded into the facility. Staff entrance screening began on April 10 and responses were monitored daily through May 7. During that time period approximately 3,550 surveys were completed. No staff were noted to have a fever upon temperature check or a positive symptom screen at facility entry.

Staff IPC orientation and PPE competency check

Staff were recruited from the Philadelphia MRC (a group who serve the City during public health emergencies and large-scale events), contracted staffing agencies and vendors, and the DOD. This meant clinical staff came with varying experiences and approaches to infection control and nonclinical/support staff had little to no experience with IPC measures. We operated under the assumption that all staff needed training in CSF-L-specific IPC standards and measures. Thus, we developed orientation materials and training procedures in order to ensure that staff would be adequately protected and trained. We created an “Infection Prevention and Control Orientation” presentation that described proper protocols for entering the CSF-L with the screening survey, hand hygiene, PPE standards and processes, mask use and reuse, cleaning and disinfection, sharps

safety and occupational exposures, including needle sticks. This presentation also included videos from the CDC demonstrating proper donning and doffing technique. The IPC presentation and live PPE demonstration took approximately 30 minutes and was included with other orientation presentations on the facility and its mission, safety measures, and a tour of the patient care area. After completion of the orientation, clinical staff were fit tested using OSHA Respirator Fit Testing protocol by Environmental Health and Safety Consultants for the available N95 respirators. They were required to don and doff the PPE that would be available at CSF-L with trained IPC team members assisting and observing the techniques. Eleven orientation sessions were held between April 13 and April 23 and were attended by 425 staff.

PPE and hand hygiene standards

Given the unique clinical environment, rapidity of development of IPC standards, and challenges with equipment procurement, we used a process of rapid cycle tests of change to adapt the PPE process, while remaining aligned with current CDC guidelines. During the duration of the CSF-L development and use, every person on site was required to wear a face covering (either a cloth face covering or surgical mask). Plastic full-face shields were the standard eye and face protection for every person working in the patient care area. Safety glasses and goggles were provided as an alternate strategy for eye protection. Following the PPE standards obtained from the emergency field hospital opened at the Jacob K. Javits Convention Center in New York City and the most current CDC recommendations, the IPC team initially recommended that only providers of hands-on patient care would wear N95 respirators, while nonpatient care staff, such as environmental services, would wear a surgical mask. After further consideration of the open patient care environment, uncertainty of the infectivity of the patients, and goal of providing as much assurance of safety as possible to staff, we established a standard that all staff present in the patient care area (“red zone”) would wear an N95 respirator and eye protection. Because the number of disposable isolation gowns was limited, the IPC team, with support from a vendor, was able to obtain 500 reusable, fluid resistant isolation gowns for use by all staff while in the patient care area. Hand hygiene with alcohol-based hand rub was required before donning gown and gloves and after doffing gloves and gown, face shield and N95 respirator. Clean, intact gloves were required to be worn by all volunteers present in the patient care area. Hand hygiene with alcohol-based hand rub and glove change was required between each patient contact and when moving from dirty to clean activities. Although portable, nonplumbed sinks were available, they were ultimately not used in the patient care area because they had only a 5-gallon reservoir of water and therefore posed more challenges than benefits including needing to be refilled and cleaned often. Thus, wall-mounted alcohol hand rub dispensers were placed on the headwall of each bed space and table top dispensers were available at nursing stations and other staff work areas.

IPC quality measures

Safety and inventory were 2 guiding principles used in creating quality improvement measures at the CSF-L. When we experienced a 53% loss of N95 respirators during the first round of reprocessing, primarily due to makeup use, we added a strongly worded request to the orientation that all staff refrain from make-up use while in the facility. We also provided makeup removal wipes and posted reminders to not wear makeup along with our respirator loss rate in the locker room and staff lounge restrooms. After implementing these interventions, our respirator loss rate significantly decreased to <1%. Due to some variability in PPE donning/doffing training received by staff during different orientation sessions (as a result of rapidly and continuously evolving CDC guidelines and best practice

standards) a PPE and Hand Hygiene Quality Improvement Donning/Doffing Evaluation Tool was developed. The purpose was to assess proper donning and doffing procedures use by each staff member entering and leaving the “red zone” as well as correcting staff when needed. This was completed by the Donning/Doffing Assistant and included 1) assessment of an N95 respirator seal check, 2) proper hand hygiene use during donning, 3) use of the appropriate PPE doffing sequence, 4) hand hygiene at appropriate moments during doffing sequence, and 5) verification that no PPE other than a personal mask was worn in the “yellow zone” and “green zone.” When it was realized that there was confusion and concern around proper hand hygiene in the “red zone,” we developed a Hand Hygiene Quality Improvement Evaluation Tool to be completed by the Red Zone Infection Preventionist. This tool assessed the proper doffing of gloves, use of hand hygiene (alcohol-based hand rub for 20 seconds), and donning of new gloves between patients by providers. Although we designed these measures with the intention to implement all of them, we were unable to do so due to the lack of further need for and closure of the CSF-L.

DISCUSSION

In this report, we describe the development, implementation and management of an IPC program for a COVID-19 ACS. Key lessons learned included the need to: develop strategies to cope with real and potential shortages of critical supplies; adapt existing guidance for unique sites of care; standardize and continually assess staff use of PPE and fundamental IPC practices; and the importance of communication of IPC principles and concerns throughout the planning and management of this COVID ACS. A critical component of preparedness plans is surge capacity or the ability to adequately care for a significant influx of patients and be prepared for demands on supplies, personnel and physical space.⁶ Although much of disaster and surge capacity planning focuses on hospital-based care, the COVID-19 pandemic required various buildings and structures of opportunity across the country be converted to temporary field hospitals with the goal of increasing health care capacity and capability as needed.⁸ The Liacouras Center in Philadelphia was such a structure and rapidly converted to function as an ACS to assist regional health care facilities by providing nonacute care for adults with mildly to moderately symptomatic COVID–19.

The CSF-L IPC team, reporting to the Chief Nursing Officer, was quickly established. The team leaders had previously worked together, were well-versed on CDC IPC guidelines, and had extensive experience in establishing IPC programs in nontraditional and resource-limited settings nationally and internationally. This worked to the team’s advantage as we quickly identified program aims and delineated priorities. The team relied on real-time, action-oriented learning using the Plan-Do-Study-Act (PDSA) cycle for testing our initiatives—by planning it, trying it, observing the results, and acting on what is learned. This approach led to quick, early successes. For instance, we quickly realized that although FEMA provided resources for a 250-bed facility, only 152 beds could be set-up in order to maintain at least 6 feet of distance between patients. Another example, one of our first tasks was to establish the staff wellness check-in/surveillance procedure. Working closely with our facility operations and security colleagues, a single point of building entry was identified. The IPC team explored several options for collecting volunteer screening data. Based on convenience and ease of use, we selected the free online QR code generator to create a code for the survey, while concurrently configuring the physical space to accommodate the related activities. We conducted multiple PDSA cycles to improve the original concept, resulting in an efficient, effective, standardized process. A similar approach was used to standardize IPC staff orientation and PPE donning and doffing competency check-offs. PDSA

cycles were also used to navigate the IPC implications of the proposed system for facility access and flow of patients and for the support services of pharmacy, respiratory therapy, laboratory, patient linen and laundry, patient and staff food delivery, and waste (including medical waste and sharps) and garbage removal.

Predictably, the greatest challenge centered on managing PPE standards and clinical staff expectations. Due to the critical shortages of PPE and alcohol-based hand rub across the country, the CDC revised its recommendations for the safe and appropriate use of PPE several times during our planning stages. This dynamic combined with the initial uncertainty of the resources available to the CSF-L, made it difficult to develop IPC policies and procedures specific to this setting at the outset. There were also significant clinical staff concerns and anxieties surrounding PPE use. Staff from throughout the United States, varied practice settings (eg, intensive care units, emergency departments, medical-surgical units) and without prior experience working together had to adapt to the CSF-L IPC policies and procedures. Having an IP or IP designee present 24 hours a day, 7 days a week in the “red zone” was invaluable in managing staff IPC expectations. They provided real-time staff IPC adherence monitoring, education, coaching, support and CSF-L updates. In addition, a Frequently Asked Question sheet with answers and rationale to many commonly asked questions was created. It included questions such as “why are we not double gloving?”, “why are we not using hand sanitizer on top of gloves?”, “why are we not wearing a surgical mask over the N95 respirator?” Two factors underscored the importance of standardizing IPC practices in the CSF-L. First, the risk of exposure to COVID-19 in the CSF-L environment was possibly increased as compared to other practice settings given the open ward structure and minimal engineering controls available. Additionally, it was critical to establish a shared model of safe practice given the diversity of staff knowledge and experience with general and COVID-19-specific IPC practices. Less expected was the complexity of PPE inventory management. There was no computer access in the PPE distribution area, so inventory management was a labor-intensive, manual process prone to error. This risk was mitigated by assigning designated staff to the PPE distribution room. Had the CSF-L remained opened, tools such as the National Institute for Occupational Safety and Health (NIOSH) PPE Tracker mobile app could be used. However, future ACSs should utilize computerized inventory management systems, staffed by skilled personnel, to track all inventory.

One of the most important aspects of disaster and emergency response is ensuring effective, frequent and timely information exchange. Information exchange and management should be based on a system of collaboration, partnership, and sharing.¹¹ While collaboration and partnership were a part of preparing the CSF-L for patients, real-time information sharing to increase the IPC team’s situational awareness of CSF-L’s capabilities and resource needs, was at times challenging, given the plethora of agencies, personnel, and teams working independently, yet simultaneously in an effort to prepare for occupancy.¹² All ACS, particularly those developed in response to an emerging infectious threat such as SARS-CoV-2, will benefit from close partnerships between leaders, front-line and

support staff, and IPC experts. Finally, we believe our approach may have utility beyond the pandemic. Use of the “4S’s” Framework, coupled with action-oriented learning using PDSA cycles, could be used in other surge situations.

CONCLUSION

The IPC team worked quickly and efficiently to manage the constantly evolving circumstances and the time constraints that accompanied the opening of a COVID-19 pandemic ACS. Despite the growing scarcity of PPE, the CSF-L goals of ensuring an adequate supply of PPE and providing the safest environment for both patients and staff were achieved. The ability to leverage our collective IPC knowledge, skills, abilities, and energies to this situation has been extremely rewarding. In the spirit of volunteerism, we had the opportunity to work with an extraordinary group of people dedicated to a common goal.

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