

Safety Challenges of Converting a Community Hospital into a Dedicated COVID-19 Treatment Center

COVID-19 TREATMENT CENTER ONLY HOSPITAL

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BEGINNING IN MARCH 2020, a 123-bed community acute care hospital was converted into a dedicated COVID-19 treatment center. Given the nature of the pandemic, the site conversion involved expanding intensive care capabilities from six to 70 beds, with an additional 88 general medical beds (Gold et al., 2020). Safety and emergency management remained a clear focus during the commissioning and operation of the COVID-19 treatment center. This article presents specific challenges, resolutions and overall key lessons learned for success in safety and emergency management. The unique ability to discharge all but one COVID-19 positive intensive care unit patient, discontinue for 1 week all patient-related services including emergency services and surgeries, and implement a preplanned concept of operations allowed for a successful transition and established the framework for the facility's new mission.

Safety Management & Industrial Hygiene Challenges

The initial unknowns related to the method of transmission, potential seriousness of employee illness, and the frequently changing regulatory directives and guidance led to significant challenges to providing a safe and healthy work environment:

1. perceived increase in risk to personal and family health while working at a dedicated COVID-19 facility
2. uncertainty about PPE availability and supply chain replenishment capabilities
3. possibility of the World Health Organization and CDC designated transmission mode updating from droplet and contact precautions to airborne transmission
4. extended use and reuse of PPE
5. conversion of traditional patient care areas to cohort-based patient care

KEY TAKEAWAYS

- This article describes the conversion of an acute care hospital into a dedicated COVID-19 treatment center at the beginning of the pandemic and details the safety and emergency management challenges and lessons learned.
- Among the lessons learned is that communication is essential, including collaboration between many departments and specialties. Also key are the active involvement and support of senior leadership in safety and health decisions, as well as the early involvement of community partners and resources. Finally, flexibility is needed without compromising employee safety and health.

Resolutions

To minimize the risk of COVID-19 spread within the facility, engineering and administrative control recommendations established in a coordinated effort with infection control specialists were fundamental elements of design. The contamination and decontamination reduction principles traditionally applied to hazardous materials response were utilized in the COVID-19 treatment center (U.S. EPA, 2017). This included reorganizing the entire facility into support (cold/clean/unrestricted), contamination reduction (warm/buffer) and exclusion (hot/dirty/restricted) zones.

Support zones, color-coded green, were designated as unrestricted areas for administrative and ancillary support use only. Unrestricted zones were administrative, respite and dining areas implemented to limit the potential for contamination outside of patient care areas. This was consistent with the day-to-day social practices during the March 2020 time frame, before there was an understanding of the need for measures such as universal masking and occupancy limits, and the potential for asymptomatic transmission. All of these practices were eventually introduced into the supporting unrestricted zone as knowledge increased about the virus and protective measures. Support zone operations included pharmacy, laboratory, facilities and engineering services, environmental services, dietary, human resources, executive administration, employee temperature and wellness screening, restrooms, and break areas. The use of the green zone lowered employee anxiety regarding virus spread, maintained normal operating procedures to the extent possible and reduced PPE consumption.

Contamination reduction zones, color-coded yellow, were defined as semirestricted and were used for patient transportation into and out of the facility, to diagnostic imaging or procedure rooms, and between critical units and medical and surgical units. Transportation of laboratory specimens, cleaning supplies and equipment, and pharmaceuticals also occurred in this zone. In addition to facilitating transport, the yellow zone served as a buffer between the green zone and patient care areas. The exclusion zone was color-coded red and was defined as restricted for direct patient care only.

To decrease the potential for cross contamination and spread between zones, physical separation was used as much as possible (NIOSH, 2015). This included separate elevators for patient food delivery, ancillary transport including laboratory specimens, pharmaceuticals and patient trans-

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portation. It also included segregation of patient care areas for critical care (e.g., intensive care unit, emergency department, post anesthesia recovery units) and medical surgical care patients. Temporary removable walls were constructed in hallways and visitor waiting areas to segregate designated PPE donning/doffing areas. They were also used to create cooling zones for employee respite and prevention of heat stress without having to doff PPE.

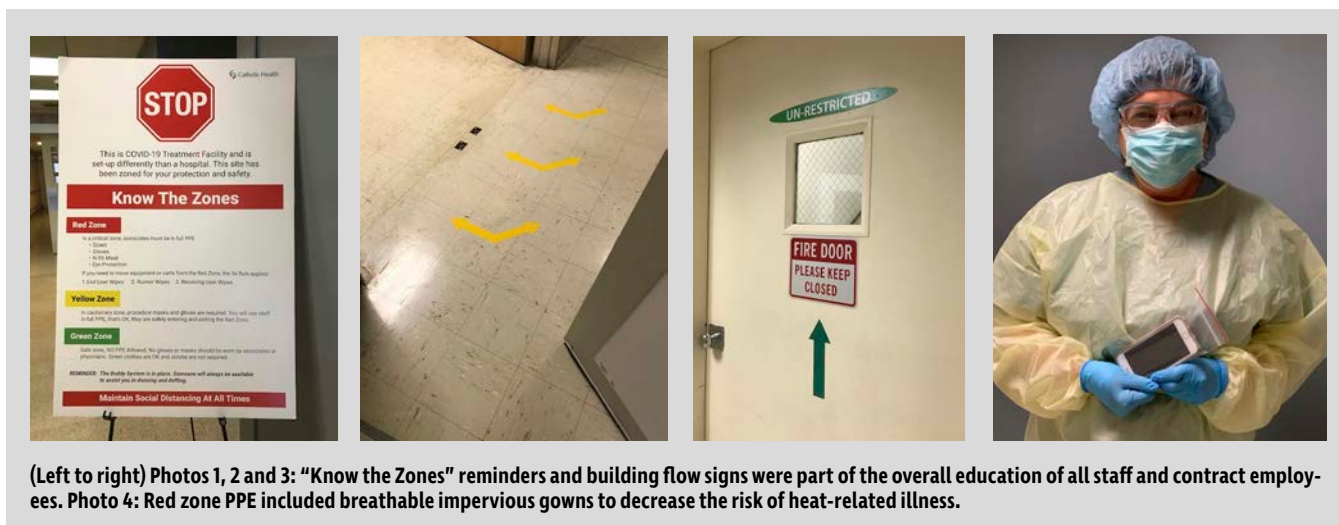
Doors that were not part of the fire protection plan for smoke compartments and areas of refuge were intentionally propped open to decrease the number of high-touch surfaces. The addition of temporary walls necessitated that emergency egress was safeguarded by updating evacuation maps and adding emergency exit signs. The placement of the walls was planned to minimize obstruction to fire detection and suppression systems or access to pull stations and fire extinguishers. The number of fire extinguishers was ultimately increased to lower the risk.

Heating, ventilation and air conditioning systems were adjusted to place rooms and open areas under neutral or negative pressure. The use of ancillary exhaust systems was also applied to supplement existing negative pressure isolation rooms for aerosol-generating procedures (CDC, 2020a).

Several work practices were implemented to decrease the potential for contamination between zones as associates and

equipment moved through the facility. Standardized and clearly visible signage were posted in each zone, including labeled transition points consisting of colored tape on the floor. A “three-wipe rule” was implemented for the transition between zones that consisted of wiping all equipment when it left the red zone, the yellow zone and again by the receiver in the green zone. Runners in the yellow zone guided red zone associates with a “clean as you go” wiping procedure when transporting patients. This allowed red zone associates to remain in full PPE while transitioning between zones without increasing contamination risk. Waste locations were strategically located for the elimination of exterior garbage from community emergency medical service companies. Designated environmental services staff and equipment were assigned by zone.

Education of all involved, including contracted employees, was mandatory. This included general staff training on building zones, employee and patient flow, knowing the zones and social distancing reminder signs (Photos 1 and 2). Special training was required for donning and doffing procedures. Trained peer coaches were assigned at all donning/doffing stations and included the use of visual aids in the form of posters and checklists. The buddy system was implemented to ensure PPE compliance and to monitor for symptoms of heat stress, physical exhaustion or mental fatigue. Intranet resources and training



videos were readily available, and a special training for environmental services and facilities associates was emphasized.

Several administrative controls were used to address the potential for heat stress. These included information posted in restrooms about urine color changes as related to dehydration. All associates received training on the signs and symptoms of heat stress, heat exhaustion and heat stroke. Posters were hung at all donning/doffing stations. Breathable impermeable gowns were used to decrease the risk of heat-related illness (Photo 3, p. 25).

PPE was promoted as an employee's last line of defense and was worn continuously within the yellow and red zones. The corresponding level of PPE prescribed per zone was:

- green: no PPE without a medical reason, passing the requirement of daily wellness checks and maintaining social distancing of 6 ft
- yellow: gloves and procedure mask
- red: gloves, NIOSH-approved respirator, procedure mask or disposable covering, impermeable gown, and eye protection (CDC, 2020a)

This approach decreased emergency response time and increased routine patient care and contact time by eliminating the need to don and doff between patients. Associates were issued daily scrubs from a central distribution point, and secure storage areas in the green zone were provided for personal items to reduce staff anxiety. Supply security, management and distribution were improved using card access and video monitoring. PPE periodic automatic replenishment levels (i.e., the minimum amount of product that should be on hand before additional product is delivered) and burn rates (i.e., the speed at which product is consumed) were assessed in real time at donning/doffing stations. Increased fit testing to evaluate respirator fit in extending the use and reuse conditions was delegated to employee health professionals.

Occupational health issues involving skin redness and breakdown from extended PPE use were assessed and addressed by a combination of donning/doffing observers and wound care

prevention specialists. Applying skin preparation and other skin protection products (that had minimal potential for respirator seal interference) reduced the occurrence of skin redness when applied in advance. Novel approaches included the use of donated button headbands to reduce ear breakdown from ear loops and straps.

Emergency Management Challenges

Healthcare organizations are required by regulatory and accreditation agencies to meet specific emergency management directives. As the need for competing resources increased throughout the community and the threat of unrelated emergency events impacting hospital operations remained present, a number of emergency management challenges were encountered:

1. limited community resources for increased mortuary operations
2. engagement of community first responders for on-site emergencies
3. ongoing potential for other natural or man-made emergencies
4. increased use of critical care equipment in nontraditional areas

Resolutions

Based on modeling predictions and clinical outcomes associated with COVID-19, the need for expanded mortuary capabilities was identified during the early stages of site planning (CDC, 2020b). The original morgue capacity included a single cooler with two drawers. A phased approach was used to expand the existing morgue space. To maintain normal operations and engagement with funeral directors, the autopsy room adjacent to the existing morgue cooler was used in the first expansion phase. This allowed funeral directors to use the same parking, elevator and documentation area in accordance with normal operating procedures. The autopsy room was cleared of equipment, insulated and fitted with an appropriately sized refrigeration unit to

maintain temperature for seven additional decedents. The final phase of morgue expansion involved the acquisition of a refrigerated trailer with capacity for nine decedents. Through the phased expansion plan, the treatment center mortuary capacity grew from two to 18 decedents. Additional lifting equipment and racking storage systems were also utilized in the expansion plan. Great care was taken to maintain the respect and dignity of the deceased. Privacy tents and overhead coverings were added to exterior pickup locations at the building rear.

Designated carts were used to transport the deceased from the patient care areas to the morgue. Patient

FIGURE 1 SAMPLE DASHBOARD TRACKING TOOL

A dashboard tracking tool was implemented to document the risk assessment, deferred actions and ongoing compliance with the Life Safety Code.

FIRE SAFETY	MANAGEMENT	TARGET PER YTD	REGULATORY REQUIREMENT	RESPONSIBLE DEPARTMENT
Fire Alarm Activations (Acute Sites) Actual			EC 02 03 01 EP 9	Security
Fire Alarm Activations (Acute Sites) False			EC 02 03 01 EP 9	Security
Fire Response Plan Issues Reported			EC 04 01 01 EP 9	Security
Fire Response Plan Issues Resolved		100%	EC 04 01 01 EP 9	Security
Fire Drills Conducted (Acute Sites)		12	EC 02 03 03 EP 1	Security
Completed Critiques on Fire Drills (Acute Sites)		12	EC 02 03 03 EP 5	Security
Fire Drill Issues Reported		100%	EC 04 01 01 EP 9	Security
Fire Drill Issues Resolved		100%	EC 04 01 01 EP 9	Security
Fire Drills Conducted during periods of construction		12	LS 01 02 01 EP 11	Security
Completed Critiques on Construction Fire Drills Conducted		12	EC 02 03 03 EP 5	Security
Fire Drill Issues Reported		100%	EC 04 01 01 EP 9	Security
Fire Drill Issues Resolved		100%	EC 04 01 01 EP 9	Security
Fire Drills Conducted		12	EC 02 03 03 EP 1	F&E / Safety
Completed Critiques on Fire Drills		12	EC 02 03 03 EP 5	F&E / Safety
Fire Drill Issues Reported		100%	EC 04 01 01 EP 9	F&E / Safety
Fire Drill Issues Resolved		100%	EC 04 01 01 EP 9	F&E / Safety
Fire Drills Conducted (7 Off Sites)		1 per year (7)	EC 02 03 03 EP 2	F&E / Safety
Completed Critiques on Fire Drills (7 Off Sites)		1 per year (7)	EC 02 03 03 EP 5	F&E / Safety
Fire Drill Issues Reported		100%	EC 04 01 01 EP 9	F&E / Safety
Fire Drill Issues Resolved		100%	EC 04 01 01 EP 9	F&E / Safety
Diesel Fire Pump Churn Test Weekly		52	EC 02 03 05 EP 6	Facilities & Engineering
Electric Fire Pump Churn Test Monthly		12	EC 02 03 05 EP 6	Facilities & Engineering
Control & Alarm Valves (checked/supervised, inspected)		12	25 9-3-2 & 9-4.1.1	Facilities & Engineering
Portable Fire Extinguisher Inspected		100%	EC 02 03 05 EP 15	Security
Portable Fire Extinguisher Inventoried		12	EC 02 03 05 EP 27	Facilities & Engineering
Excessively Hot Register Reset		4	EC 02 03 05 EP 1	Facilities & Engineering
Supervisory Signal Devices (except valve tamper switches)		4	EC 02 03 05 EP 2	Facilities & Engineering
Test Valve / Pressure Water Device - Semi-Annually		2 per year	EC 02 03 05 EP 2	Facilities & Engineering
Inspect FD Water Supply Connections - Quarterly		4	EC 02 03 05 EP 10	Facilities & Engineering
Test Valve Tamper Switches - Semi-Annually		2 per year	EC 02 03 05 EP 2	Facilities & Engineering
Kitchen Automatic Fire Suppression - Semi-Annually		2 per year	EC 02 03 05 EP 13	Facilities & Engineering
Hood Cleaning - Semi-Annually		2 per year	96 8.3	Facilities & Engineering

care services transferred the body into a zippered body bag onto the designated cart. The cart and body bag were wiped before leaving the red zone for transportation through the yellow zone to the morgue. Coordination with local funeral directors was established to properly secure and transfer patient belongings. Lift equipment was provided to assist funeral directors in transferring the body from the facility cart to the funeral home cart.

To ensure adequate response to the facility from external agencies in the event of an emergency, local responders were invited to tour the treatment center. Changes to the building layout and flow related to the established containment zone necessitated refamiliarization among agencies. Maps were provided to responders, and response expectations and capabilities were reviewed. Local agencies including police, fire and emergency medical services were represented and given the ability to ask questions and to help reduce the stigma associated with the treatment center. County sheriffs were staged in strategic external building locations for additional security presence. Local community partners also engaged the site in efforts to recognize the dedication of the treatment center staff. Response vehicles with lights and sirens came to show staff support and solidarity in the fight against COVID-19.

Emergency management drills, including a tabletop evacuation drill, were conducted to evaluate capabilities and educate staff on potential natural or man-made disasters. Both department-specific and full building evacuation scenarios were presented. The tabletop drill facilitated discussions on patient transport needs, emergency egress and evacuation routes, evacuation equipment availability, utilities and building resources, and ethical considerations. Training was provided to all associates on evacuation and fire safety procedures.

The increase in critical care patients and associated equipment increased power consumption under normal conditions at the facility. Utility capabilities were evaluated under normal operating conditions and in emergency outages. Staff were educated that all critical patient care equipment must be plugged into red outlets signifying emergency generator backup. Emergency generators were tested monthly using a load bank to minimize the risk to patients who were on ventilators in the event of power loss. Transfer switches were also evaluated to ensure that a loss of normal power would not interrupt the operation of critical equipment.

Compliance with the National Fire Protection Association Life Safety Code was maintained using regulatory guidance specific to the COVID-19 pandemic. Risk assessments were conducted to identify high-risk activities. Lower-risk activities were deferred. A dashboard tracking tool was implemented to document the risk assessment, deferred actions and ongoing compliance with the Life Safety Code (Figure 1).

Overall Key Lessons Learned for Success

The fundamental principles of safety and health management program success, including open and frequent communication with employees, leadership and community partners, were evident in the lessons learned:

1. Communication is essential, including collaboration between many departments and specialties.
2. The active involvement and support of senior leadership in safety and health decisions is key.

3. The early involvement of community partners and resources is critical.

4. It is also important to maintain flexibility without compromising employee safety and health.

Conclusion

The commission and operation of a dedicated COVID-19 treatment center presented unique challenges. Early implementation of foundational industrial hygiene and safety principles instituted a culture of safety focused on contamination control, employee protection and quality patient care. Crucial to the success of the long-term response to emergency events is staff resiliency. Protecting the safety and well-being of healthcare workers responding to the COVID-19 pandemic was the first and most important step in strategic response planning. Input from stakeholders including infection control and medical specialists, operations leadership, and all of patient care services was necessary to fully capture and respond to the challenges and opportunities for improvement. No healthcare acquired COVID-19 infections for staff were recorded during the operation of the treatment facility. An added benefit was the conservation of scarce PPE and the development of a highly specialized healthcare team with experience and knowledge in caring for the unique needs of COVID-19 patients. Emergency management focused on not only response to the pandemic but also potential secondary emergency events and preparedness actions.

Epilogue

The community room of the hospital that served as the incident command “war room” during the initial operations is now a vaccine point of dispensing clinic. The first healthcare workers were immunized against COVID-19 just 10 months later in December 2020. The emotion was palpable. **PSJ**

References

- CDC. (2020a, April 12). Infection control guidance: Summary of recent changes. www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html
- CDC. (2020b, Dec. 28). Funeral guidance. www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/funeral-guidance.html
- Gold, J.A.W., Wong, K.K., Szablewski, C.M., Patel, P.R., Rossow, J., da Silva, J., Natarajan, P., Bamrah Morris, S., Neblett Fanfair, R., Rogers-Brown, J., Bruce, B.B., Browning, S.D., Hernandez-Romieu, A.C., Furukawa, N.W., Kang, M., Evans, M.E., Oosmanally, N., Tobin-D'Angelo, M., Drenzek, C. . . Jackson, B.R. (2020, April 29). Characteristics and clinical outcomes of adult patients hospitalized with COVID-19—Georgia, March 2020. *Morbidity and Mortality Weekly Report*, 69(18), 545-550. <https://doi.org/10.15585/mmwr.mm6918e1>
- NIOSH. (2015, Jan. 13). Hierarchy of controls. www.cdc.gov/niosh/topics/hierarchy/default.html
- U.S. Environmental Protection Agency (EPA). (2017, Jan. 26). Safety zones. www.epa.gov/emergency-response/safety-zones

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