ER Contagion:
8 Ways to Beat the Second Wave

June 2020

Immediate and future strategies to prepare your Emergency Department for what's next in the age of COVID-19.

COVID-19 has disrupted health care systems and economies across the globe and hospitals are at the forefront of battling the pandemic. The impact to facilities has ranged from an overwhelming influx of predominately COVID-19-positive patients to an uneasy calm with empty beds, quiet emergency departments (EDs) and totally deserted operating rooms (ORs).

Both extremes present major challenges and financial impacts. There has been a significant impact on community trust in the safety of the health system, and hospitals. No one knows how many patients to expect through the door – even with application of sophisticated modeling. No one can reliably predict what set of symptoms patients will present with, or what underlying pathologies will predict deterioration or mortality. There is no known cure, no vaccine, and limited testing; and, unfortunately, this is likely to be true for years to come fighting COVID-19 and other infectious diseases of the future.

Hospitals around the world have attempted to bolster their capabilities to fight the disease while keeping patients and staff safe. These efforts have included changes in policies and procedures, evolving clinical protocols, and facility modifications. Medical personnel are attempting to apply evolving knowledge of COVID and develop the best processes for screening, diagnosing, treating, and making a safe and high-quality disposition.

The ER COVID-19 Design Task Force — a working group of clinical, design and engineering experts — was organized to review and capture this new information for future use. The focus of the Task Force has been to compile the knowledge and lessons learned, and then to distill that information into practical solutions that can be applied to the response for the "second wave" as well as future, long-term design solutions applicable to new construction and major remodeling projects.

COVID-19 has disrupted health care systems and economies across the globe and hospitals are at the forefront of battling the pandemic.

The Task Force reviewed previous publications and news stories, and facility responses during the pandemic, including those that have proven unsuccessful. Key front-line clinical, administrative, and executive staff from hospitals around the country have been extensively interviewed to gain insights into their various solutions. Selected international projects were also reviewed. No one strategy or modification has been a panacea. The strategies include both process and facility modifications.

The Key Ideas listed here are potential concepts, features and solutions that are in no way intended to be prescriptive or "must dos." They are rather considerations and options to assist facilities with their own decisions and paths forward.

Here are the Task Force's Key Ideas for upgrading medical facilities facing a "second wave" of COVID-19, predicted in the Fall of 2020, and future pandemics.

Key Ideas To Bolster Your Emergency Department

1 Enhance Entry Functions
Establish entry control and support essential initial-contact functions (e.g., PPE, testing, patient assessment).

2 Support and Reinforce Personal Protective Equipment (PPE) Management
Provide options for PPE storage, disposal, and recycling to avoid cross contamination.

3 Bolster Resistance to Pathogens
Implement strategies to minimize pathogen colonization in your facility (e.g., highly cleanable).

4 Enhance Heating, Ventilation and Air Conditioning (HVAC) Systems
Modify or supplement HVAC and mechanical systems at the unit and room level to minimize aerosolized transfer between staff and patients.

5 Strategize for Compartmentalization
Ensure that compartments for isolation have access to critical supplies, elevators, stairs, and interstitial spaces sufficient to be self-supporting as a unit.

6 Delineate Safe Zones vs. Hot Zones
Employ strategies to create clean zones or safe zones where precautions can be somewhat reduced, studying access and exits to reduce cross contamination and provide clean pathways.

7 Expand and Facilitate Telemedicine Usage
Broaden telemedicine services to preserve critical resources (e.g., PPE and staff) within the hospital.

8 Provide Surge Capacity
Utilize non-traditional strategies to augment capacity.

1. Enhance Entry Functions

At the outset of the pandemic, hospitals across the country recognized a need to control access to the hospital and the emergency department. Facilities began to limit the number of entries, and many facility leaders opted for a single-entry control point for the entire operation. In addition to entry control, screening and safety functions have been integrated into the processes at or near the entry, such as identifying highly infectious patients, providing PPE, and collecting information to determine appropriate disposition and routing for patients. What was once simply a door has transformed into a 'portal' where these and other functions take place. The addition of these functions has physical implications. For some hospitals this has involved establishing makeshift stations for the various new activities – very few already had fully constructed multifunction entry portals. The precise functions a facility chooses to perform at the entry will depend on the clinical processes and the capabilities in other parts of the facility.

Entry portals must have digital capability for the staff to use the needed phone, wireless computing, and emergency alerting processes that are in use everyday in the ED.

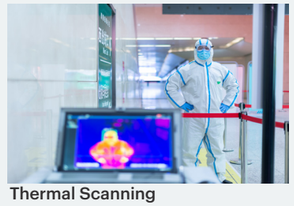
Since facilities must limit visitors during a pandemic, waiting room areas, a component of many entries, have been identified as a prime area for re-purpose. These areas have been used as space for diagnostic testing, surge bed expansion, holding areas, discharge functions, and command and control centers, in addition to small areas that need to be reserved for patients that still need to wait in an observed area.

"As opposed to temporary structures, we need to have well-conceived, comprehensive permanent spaces with proper lighting, weather control, negative pressure and be a natural extension of the emergency department."

James Augustine, MD
US Acute Care Solutions
Serves 200 emergency departments from Hawaii to New Hampshire

Short-Term Considerations

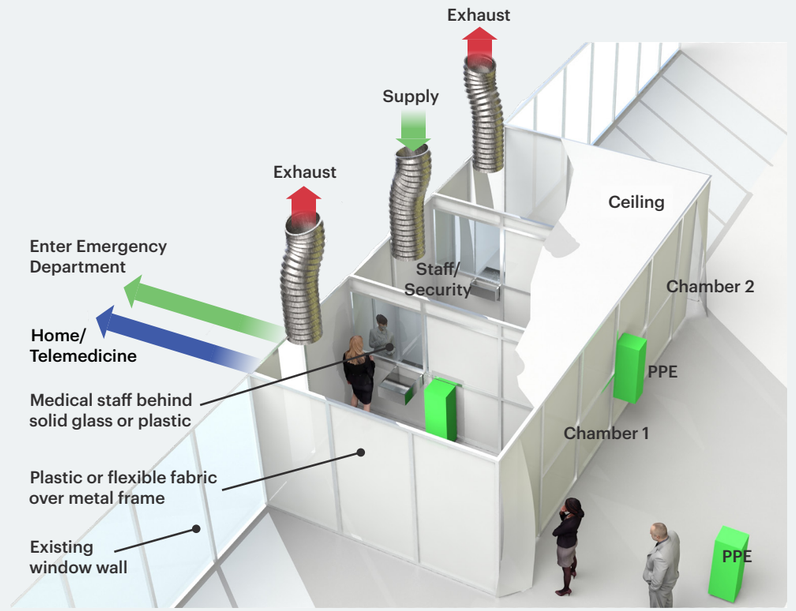
- Evaluate existing conditions of all entry and egress
- Place portal and entry functions inside or outside the ED entry door
- Consider temporary or prefabricated materials
  - Dry wall, plastic, plexiglass, composites
  - Low cost supportive framing
- Allow for staff visualization of and communication with patients from a protected position
  - Plexiglass, pass-through fenestration
  - Chamber/booth for testing and triage
  - Thermal scanning
- Provide PPE for donning upon entry to the campus and/or at the building entry control point
- Allow for insertion of various technologies
  - Temperature screening
  - Pulse oximetry
  - Rapid testing (see section 5)
- Consider temporary negative pressure



Thermal Scanning

Booth Testing and Triage

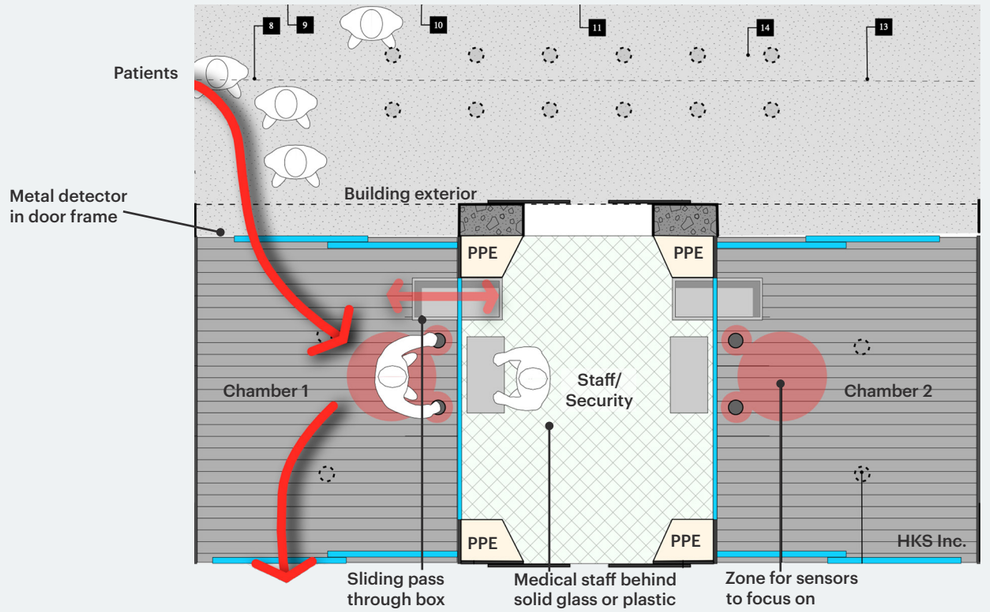
Portable Dividers at Patient Check-in



Long-Term Considerations

Facilities that face security concerns or expect to be involved in future pandemic or disaster responses are exploring solutions for permanent security and entry control while maintaining the welcoming, healing environment essential to the hospital industry. This is an opportune time to address these concerns.

- Integrate portal into expected entry control areas
- Double-door chamber with lock-down capability
  - Hard structure that protects security staff and allows visualization and communication
- Consider negative pressure capability
- Provide storage for supplies such as wheelchairs and PPE
- Incorporate hand-washing stations within or near the portal
- Provide space for insertion of new technologies that will enhance security, detection and diagnostics
- Consider individual patient pods that can be used for low-acuity patient types in standard care, and for a surge of patients



2. Support and Reinforce Personal Protective Equipment (PPE) Management

Shortage of proper PPE has been a universal concern across all facility types. In addition to simply having PPE, the placement and ability to don and doff PPE safely (in the appropriate places) can enhance infection control and help maintain the morale of the building occupants. In our discussions with facilities that had high COVID-19 impact, departments have worked diligently to ensure that PPE is strategically positioned and available to staff and patients.

Depending on the number of patients, their condition, and the quantity of PPE available, different protocols have determined what circumstances require what level of PPE and how often it should be changed. It is important to note that most PPE discards usually involve only the mask and gloves, therefore, little space needs to be allocated. The requirement to wear full PPE with gown and hood has typically been reserved for higher risk areas where a greater degree of aerosolization is expected. The need to conserve PPE has led some facilities to develop protocols for reusing PPE by utilizing H_2O_2 and UV disinfection methods.

The requirement to wear a mask while in the facility has been universally accepted, prompting widespread availability of masks prior to entering hospital buildings. Some facilities even provide PPE at the entry control point of the campus.

"Caring for acutely ill patients is challenging. Adding PPE can make the work harder. In time sensitive environments, searching for PPE and time spent donning and duffing may impact the efficiency of care. Our focus is to provide an environment that doesn't hinder health delivery, rather it amplifies the delivery of evidence-based care."

Sarah Holton, RN, BSN, MBA
Operations, HKS Advisory Services

Short-Term Considerations

- Place PPE at key entry points to facility, areas, rooms
- Designate areas for donning and doffing
  - Use color coding and barrier separations to designate hot zones, safe zones, don zones and doff zones (see section 6)
- Provide hand cleansing station convenient to doffing area
- Secure doffed materials collection placed for ease of removal
- Allocate space for cleaning and disinfection of reusable PPE (e.g., face shields, certain mask types, safety glasses)
- Strategically locate mobile PPE carts
- Install foot-operated door pulls to support low-cost hands-free door opening

Portable anterooms can be added at entry to exam rooms for doffing space or to provide a negative pressure

Foot-operated door pulls assist in hands free opening

Designated area for doffing and disposal at exit of exam room

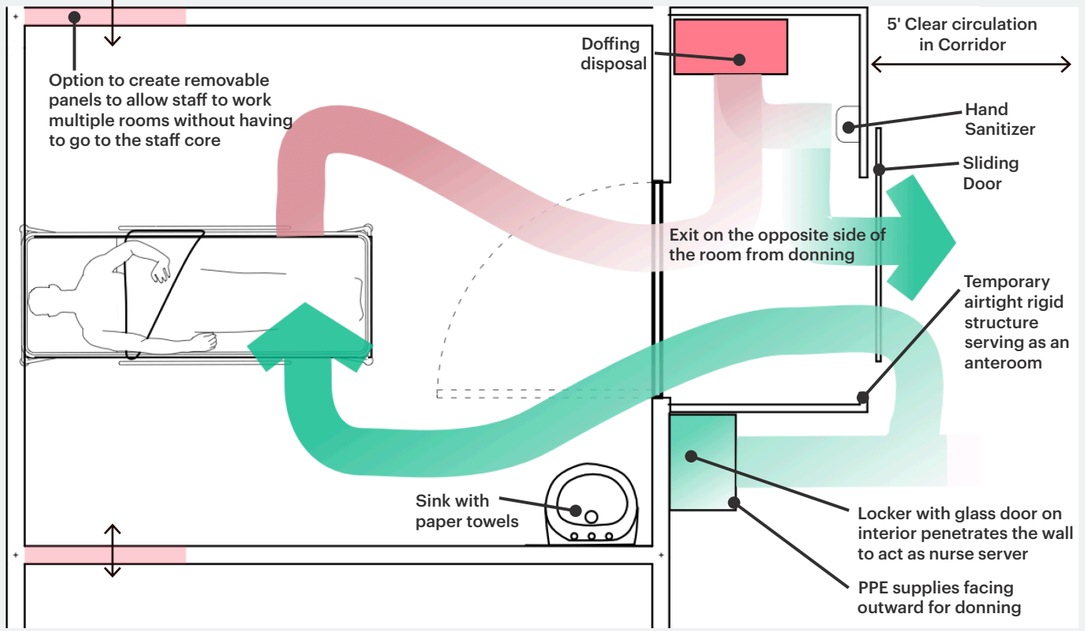
Long-Term Considerations

Facilities dealing with infectious disease or contaminants on a regular basis, may find it useful to have some or all of the following features to address these issues. Many of the features described in the short-term solutions for PPE can also be used in the long-term, if so desired. There are multiple design alternatives based on the level of contamination and each facility should evaluate individually.

The area needs to be designed for easy and rapid cleaning and disinfection without interfering with ongoing patient arrivals, EMS movement, and staff safety.

- PPE carts can be used to maintain flexibility of positioning, although some ante rooms may have permanent cabinetry
- Disposal stations built into rooms near exit
- Hand-hygiene station or sink at doffing area
- Hands-free door (e.g., foot door pull, automated)
- Separate donning and doffing areas from direct patient care areas (i.e., patient exam room)
- The layout should clearly delineate a separation between clean and soiled (See section 6)

Conventional exam/treatment room



Note: This is not intended to be an architectural solution, but rather a diagram of the flows.

3. Bolster Resistance to Pathogens

Regardless of the pathogen threat, proper strategies may help to reduce contamination in the ambient environment, reduce the chance of pathogen colonization, and mitigate the spread of infection among staff, patients, and other occupants of the facility. The concept of bolstering resistance to pathogens takes into account air purity, all surfaces, and water integrity. These concepts work in concert with the listed strategies of compartmentalization, PPE, safe zones, etc.

Another concept in developing the pathogen-resistant room is the ability to easily remove all items, including storage, so the room can be properly disinfected. The use of patient specific supply carts or mobile cabinetry that can withstand sterilization (e.g., heat, chemical) allows for this level of room disinfection between patients.

Rapid advances in surface technologies, including the development of self-decontaminating surfaces, have become increasingly common. However, many hospital systems have banned numerous antimicrobial chemicals because of their demonstrated toxicity for both human health and environmental health, and the lack of empirical literature demonstrating clinical effectiveness[1].

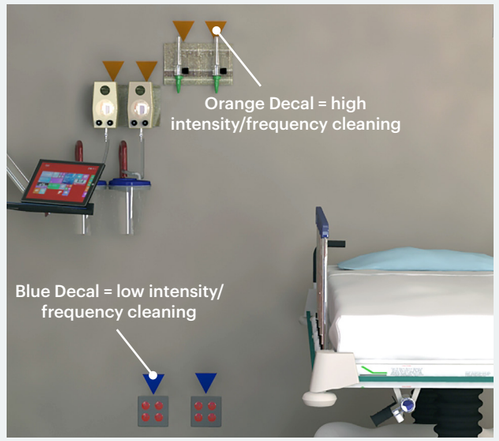
Most facilities are not in a position to resurface the entire department and change out their air handling systems immediately. However, a combination of proper cleaning techniques, disposal protocols, and a few modifications can provide a step forward in enhancing the pathogen resistance of the built environment.

"Creating a designated infectious disease unit that is designed to support health could manage all infectious patients regardless of acuity or condition. It is hard to justify a COVID-19 unit at this stage, but the need for isolation has always been present in healthcare and will continue to be."

David Vincent, AIA, ACHA
Emergency Design Leader, HKS

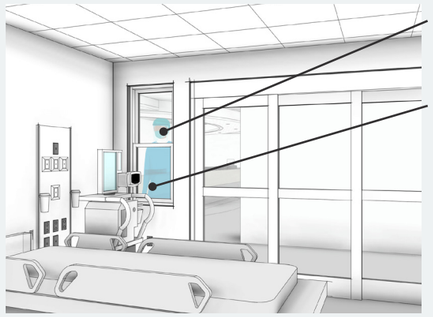
Short-Term Considerations

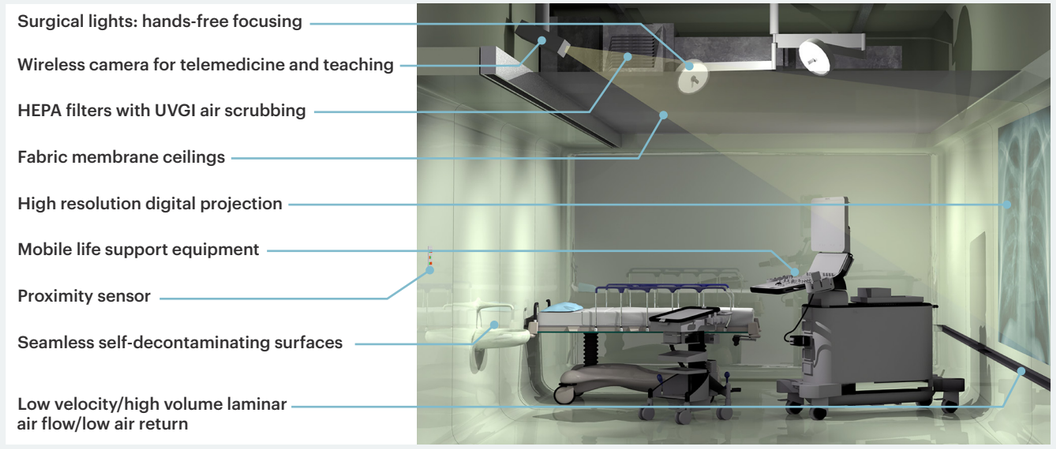
- Survey the surfaces
  - Cover high-risk surfaces with easily cleanable adhesive films
  - Mark high-touch surfaces with stickers or paint color to indicate to housekeeping that robust frequent cleaning is required
- Employ hydrogen peroxide misting or UV light disinfection
- Consider carts to replace fixed cabinets in rooms for ease of cleanability and disinfecting
- Implement temporary negative pressure with exhaust to enhance isolation areas
- Place select equipment outside of patient rooms where wiring and connections allow



Long-Term Considerations

- Evaluate use of materials for clinical effectiveness in reducing disease spread
- Sinks and drains require special attention as sources for contamination and infection
- Use easily cleanable surfaces, and minimize seams, cracks and reveals, and consider use of monolithic ceilings
- Use coves between floor and base, protect edges and corners, eliminate dust shelves
- Utilize high touch strip concept to enhance cleaning process
- Increase provision of corridor or centrally located sinks
- Seamless highly cleanable flooring with coved corners
- High level air filtration with ability for 100% air exhaust
- Plan for equipment/controls that can be kept outside of rooms by providing a conduit through the wall for wiring (ensure proper seal for pressure differential situations)
- Alternatively, plan for access to the equipment and controls from outside of the room (access panel or window).
- A unidirectional flow suite that allows doffing in a designated area separate from that of donning can reduce the risk of contamination and disease spread to staff
- Self-decontaminating, minimal touch bathrooms and vacuum toilets can be helpful in areas where toilets are shared by multiple people





[1] Kaiser Permenente. (2015) Banning use of antimicrobial agents for infection control. Retrieved on May 15, 2020 from https://k-p.li/3daZZ6W

4. Enhance Heating, Ventilation and Air Conditioning (HVAC) Systems

HVAC systems in medical buildings play a huge role in limiting the transmission of infectious disease among patients and health care workers. Many infectious diseases spread via airborne transmission. The World Health Organization on March 16, 2020 put out an “airborne precaution” for medical staff after a new study showed that COVID-19 can survive in the air for a period of time depending on factors such as heat and humidity. The HVAC systems in hospitals merit special attention because they provide a means of intercepting and destroying the virus to prevent circulating it throughout the hospital air system.

Several strategies can mitigate the transmission of disease via the ambient air. Ventilation is a primary control strategy, which can include dilution, exhaust, source capture, filtration, and the use of ultraviolet germicidal irradiation (UVGI). While many are long-term and costly retrofit solutions, during pandemics facilities may take some short-term measures to enhance the air quality and improve safety. Any designated isolation compartment should be engineered to be negative pressure relative to the rest of the building. However, in order to prevent inflow of pathogens from other areas, the air pressure at the cross-compartment doors should be only slightly negative.

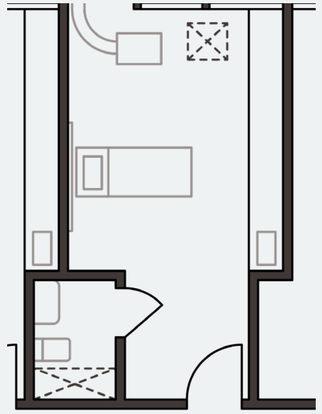
“Having an entire area of the emergency department that is negative pressure was a vital tool to respond and helped the staff feel safe.”

Patrick Cassell, RN, MSN, NE-BC, CPEN
Director of Emergency Services
Orlando Regional Medical Center

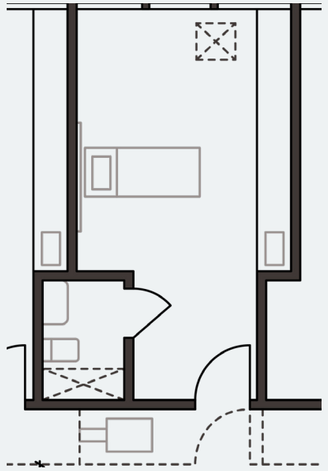
Short-Term Considerations

- Operate the air handling units serving the COVID-19 areas at 100% outside air with full exhaust
- Upgrade filters in air handling units to include High Efficiency Particulate Air (HEPA) final filters
- Create temporary negative pressure rooms with direct exhaust through HEPA filtration
- Install temporary ante rooms for negative pressure isolation rooms with HEPA filtration

In response to COVID-19, many hospitals created temporary individual air handling units for patient rooms dedicated to COVID-19 patients. These rooms were converted to negative pressure to protect the staff and the rest of the patient population.



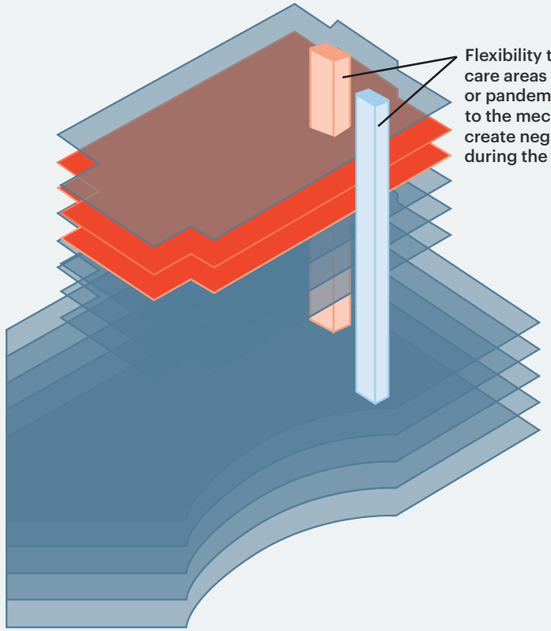
Single patient room converted to HEPA filtered negative pressure that is ducted through the exterior window. (Schematic plan of image of left). Adapted from 2020 American Society for Health Care Engineering.



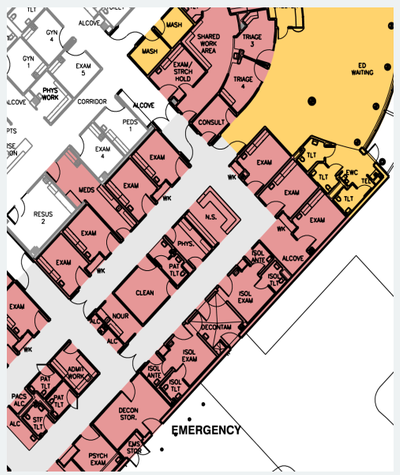
Single patient room converted to HEPA filtered negative pressure that is ducted through a "sealed" vestibule to the corridor. Adapted from 2020 American Society for Health Care Engineering.

Long-Term Considerations

- Air handling units for ED areas designed to handle 100% outside air for pandemic operation
- Purge mode that will allow the entire ED to be exhausted
- HEPA filtration on exhaust air discharge or stack fume exhaust system fans for air dilution
- Pressure monitors on all rooms and areas that require pressure compartmentalization
- Computational fluid dynamics design to validate directional airflow patterns
- Treatment of air with UVC lights, peroxide, ionic strategies in the ventilation system to purify air before it is returned to care areas



Flexibility to convert patient care areas for mass quarantine or pandemic control is essential to the mechanical system to create negative pressure zones during the event being isolated.



Washington Regional Medical Center used their emergency department expansion as an opportunity to designate an entry and eight-bed unit to isolation needs. This includes a separate entrance with decontamination shower and a switch that turns the unit to negative pressure when needed.

Image of Washington Regional Medical Center. HKS, Inc.

5. Strategize for Compartmentalization

The ability to compartmentalize a department or area into various zones can be a useful strategy to accommodate cohorts of patients as well as designate safe zones or hot zones (see section 6) that require varying degrees of precautions.

Considerations to create self-contained units include accessibility, elevators/stairs, corridors, and interstitial spaces, as well as access to critical resources (e.g., water, medical gases), supplies, and equipment. It also includes a review of ventilation systems and existing fire and life safety plans.

The strategy of using patient cohorts for protection of building occupants has taken many forms during the COVID-19 pandemic. Some facilities have attempted to cohort on the basis of COVID-19 positive vs. negative but found challenges with testing and accurate diagnosis and could not effectively execute the plan. Others developed strategies based on likelihood of aero-solizing infectious material. This would include the presence of cough or the need to perform invasive respiratory procedures such as intubation or suctioning. These types of patients have been placed in rooms or areas with higher levels of isolation and negative pressure. Another cohort strategy frequently cited includes patients with significant co-morbidities, or with combination of diagnoses such as COVID-19 with cancer, or heart disease. This would mean grouping together patients with shared medical complexities to provide an elevated level of care and protection.

However, some heavily burdened facilities have abandoned cohort strategies altogether. It is beyond the scope of this discussion to determine the optimal pandemic cohort strategy for a facility. This is dependent on the types of patients presenting, the volumes expected, testing capabilities and the existing conditions of the facility in general. Where cohort strategies are adopted, though, there are some physical facility concepts and features to support them. Some of these strategies have already been described in previous sections.

"It would have been helpful to separate COVID-19 patients from well patients but our emergency department was not designed for it."

Christine Carr, MD, CPE, FACEP
Professor, Emergency Medicine
Medical University of South Carolina
Chief Clinical Officer
Health Sciences South Carolina

"Emergency departments should be redesigned to account for infectious pandemics, should be almost completely negative pressure, and should have bio-containment capacity to separate into different areas for infectious and non-infectious patients."

Jerry Chiricolo, MD
New York Emergency Physician

Short-Term Considerations

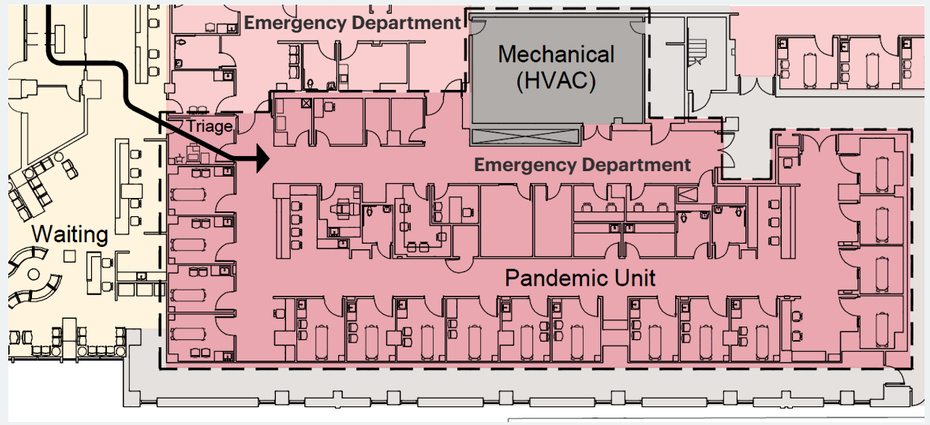
- Evaluate current HVAC system and fire door placement
- Use current secured interlocking double doors (e.g., fire doors) and smoke compartments to create cohort compartments
- Utilize selective installation of temporary doors, walls and dividers to create compartments
- Use temporary negative pressure and rerouting of ventilation in areas where useful
- Use tape, caulk, and sealers to limit air leaks
- Stock adequate supplies and equipment for self-sufficiency within each zone
- Color coding of areas to visually represent risk/ precaution level and help cue safe behavior

Many hospitals divide their EDs into multiple compartments based on acuity level, providing fire doors, typically on hold opens between compartments. By closing their fire doors, any facility can create subcompartments within the ED. Image of Banner - University Medical Center Phoenix ED Expansion. HKS, Inc.

Long-Term Considerations

Think of the Emergency Department like a Navy submarine. Any section of the submarine can be isolated and blocked during flooding, fire, contamination, etc. In the design of the ED, consideration can be given to areas that can be "segmented" from others. A practical approach to this might be to align these segments with fire door placement. Providing separate air handling for each of those compartments can be an effective strategy for cohort separations.

- Take advantage of fire door requirements to create cohort compartments
- Design ventilation system to isolate cohort compartments
- Use air pressure gradients that match the level of disease spread risk (e.g., highest positive pressure being immunocompromised patients, and lowest negative pressure for highly infectious patients or spaces)



This ED is designed to have the flexibility to convert patient care areas to "pandemic mode" for mass quarantine or pandemic events. The pandemic unit is able to function as a normal part of the ED from day to day, but provides the ability to become a self-contained isolation unit with negative pressure at the flip of a switch. Image of Orlando Regional Medical Center HKS, Inc.

6. Delineate Hot Zones vs. Safe Zones

In the hospital environment, the term safe zone has been applied to safety from violence, medication safety zones, and other situations. In this document the focus is regarding safety from the infectious pathogen. In the ED environment during a pandemic, it may not be possible to establish a 100% safe zone. Thus, this document is referring to relative safety where an individual may be able to function with less PPE or perhaps no special precautions. Staff members need to understand where it is safe to remove PPE and also feel confident that the area where they are donning PPE is safe from contamination. In order for such safe zone strategies to be effective, it is key for staff members to easily understand the delineation of the zone and the level of safety it is indicating. Whether done as a short-term measure or a long-term design solution, the delineation of the zone must be definitive. There must be clear indications by way of signage, color coding, lighting indicators, audio warnings, or a combination of these.

Being able to maintain the integrity of a safe zone is not simply a matter of painting the color green on the floor and declaring it safe. This is done in conjunction with the ventilation systems, surface disinfection and compartmentalization strategies indicated in the various sections of the document. Existing emergency access and exits should be studied to reduce cross contamination and provide clean pathways for supply. Sometimes it is necessary to pass items between safe zones and potentially contaminated areas. Well-designed openings (which can also be closed) in walls, doors, etc. can allow for exchange of supplies and equipment between areas with a lower degree of risk.

"Using physical and visual markers is an easy and important way to anchor staff and help cue them to the level of precautions needed in a given area."

Sheila Ruder, AIA, ACHA,
Senior Health Facility Planner, HKS

"Routes in the hospital were carefully defined, each step in the process was planned to protect patients and staff while keeping the hospital operating."

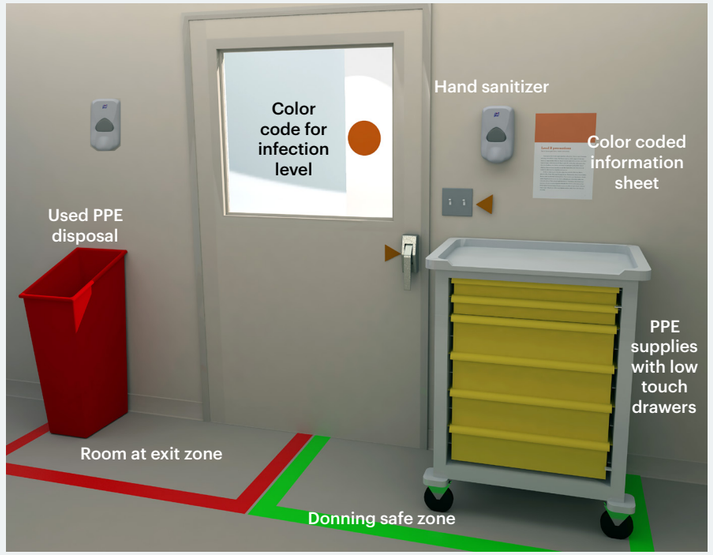
Jayne Willis, MSN, RN, NEA-BC, CENP
Chief Nurse Executive
Vice President, Orlando Health

Short-Term Considerations

Strategies to create clean zones or safe zones quickly and with little expense include:

- Color coding floors, walls or doors
  - Designated paint or a sticker on a door to indicate “hot zone” or "clean zone"
  - Designated paint or a sticker on the floor to indicate PPE donning before entering a “hot zone”
- Utilize tape or stanchions in circulation areas to direct and separate clean flows from potentially contaminated flows
- Ensure signage is simple and easily read across languages, perhaps including universally recognizable icons, to clearly delineate zones and cue appropriate behavior
- Add physical barriers, where appropriate, such as clear polycarbonates or other low cost construction materials, to separate zones
- Use portable screens for separation of zones or seating in waiting or other areas

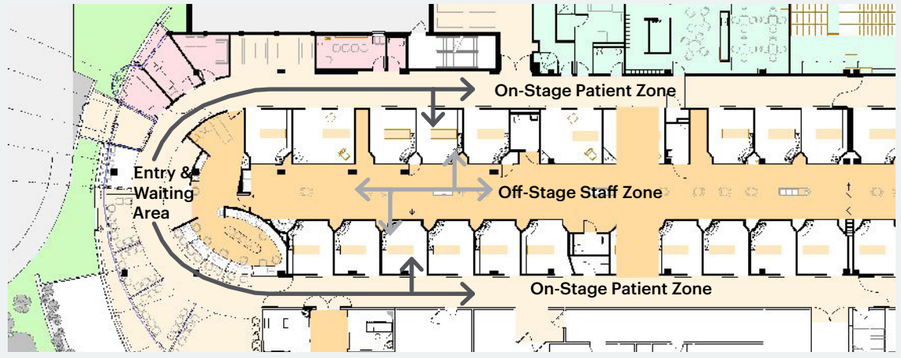
Portable Screens



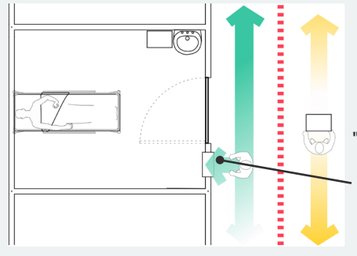
Long-Term Considerations

Solutions for safe zone delineation require careful design and planning because fixed features tend to predetermine how an area is to be used during a contingency. For example, if one created a color-coded hot and cold zone on the floor, it would be harder to change during a contingency and might cause confusion. However, a number of facilities regularly deal with infectious diseases or contaminated patients and would likely maintain the same use of those areas during a contingency.

- Use of distinctly different colors in flooring materials
- Color coded doors
- Embedded LED lighting that can change color to represent different conditions or status
- Color-coded signage that clearly signals expected behaviors within the zone
- On-stage/off-stage configurations providing staff space and flows that are secure and separate from patient traffic
- Pass-throughs for equipment access or supplies can enhance the integrity of safe zones.
- Use of an on-stage/off-stage ED layout provides clear and easy separation of patient and staff spaces, where the staff are off-stage in a work core, and the patients and supplies come through the on-stage corridor



This is a conceptual diagram of an on-stage/off-stage model, which utilizes a two-door entry into each exam room, and provides the staff a physically separate work.
This approach has been implemented at Wellspan York Hospital ED Expansion, HKS, Inc.



Separate corridor with tape to distinguish between "clean" and "non-clean" activities and equipment

Pass-through into patient room to allow for supplies to be delivered to the room without entering

7. Expand and Facilitate Telemedicine Usage

The use of telemedicine has become widespread during the COVID-19 pandemic. Regulatory hurdles have been removed (including HIPPA). There have been clear advantages to both providers and patients to utilize such services as opposed to presenting to the ED. It has allowed for preservation of resources such as PPE and has prevented many unnecessary exposures. Furthermore, telemedicine capability can allow for more personal communication with family members who may not be allowed in the facility due to distancing protocols. Accommodations can be made to facilitate such services. Three types of telemedicine have been documented and deployed to varying degrees:

- Incoming – Telemedicine support from outside specialists to the ED (from inside and outside the hospital)
- Outgoing – ED physicians providing telemedicine support outside the hospital
- Intra-ED – Observation of patients in the ED without the provider being physically in the area

Important components for effective telemedicine include proper communication devices, sufficient bandwidth, insulation of the provider from noise and distraction, and protection of the privacy of the patient being evaluated.

"Tele-health within the ED helped to limit needs for PPE, limited the number of providers in the area and in the room and is much safer as long as the care is the same."

Jerry Chiricolo, MD
New York Emergency Physician

"The relaxation of limits on use of tele-health and reimbursement have led to a HUGE increase in telemedicine use which has led to an irreversible foothold and represents a permanent loss to emergency departments — the genie is out of the bottle and has resulted in excess capacity in many emergency departments."

James Augustine, MD
US Acute Care Solutions

Short-Term Considerations

Establish a space that can support medical professionals providing telemedicine services

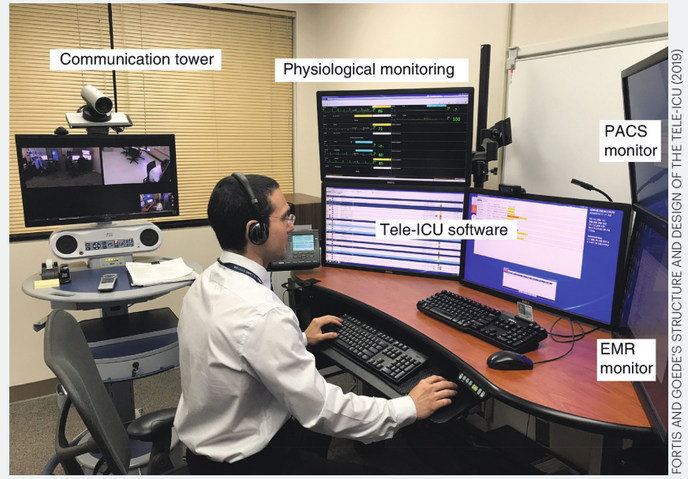
- Dedicate a non-essential room or create a temporary booth
  - Must have connectivity either hard wired or air wave – preferably both
  - Ensure acoustic privacy and speech clarity
  - Provide lighting for clarity of facial expressions

Establish patient spaces for incoming telemedicine support

- Consider fixed video camera placement for some patient rooms for remote monitoring
- Ensure lighting to convey accurate patient coloration
- Ensure acoustic privacy and speech clarity

GETTY IMAGES

Focus pods can be used to provide space for providers to have virtual visits in a minimal footprint that supports confidential, focused calls.



FORTIS AND GOEDE'S STRUCTURE AND DESIGN OF THE TELE-ICU (2019)

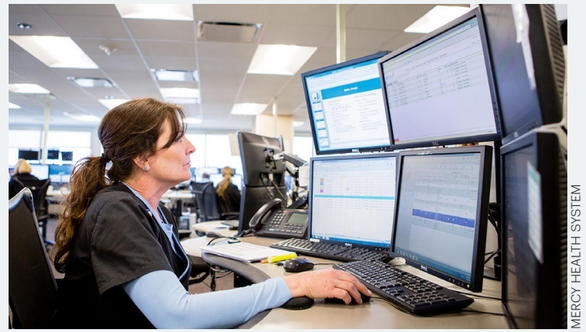
Proper design of spaces where telemedicine is provided is just as important as designing in-person care in supporting a therapeutic interaction.

Long-term Considerations

- Establish a space that can support medical professionals providing telemedicine services
  - Dedicate a telemedicine room(s)
  - Ensure acoustic privacy and speech clarity
  - Provide lighting for clarity of facial expressions, and reduce glare for camera and screens
  - Include health system logo either in the room or on the feed, to reassure patients who are new to telemedicine
  - Consider a center where the telemedicine care and hospital operations can be coordinated
- Establish patient spaces for incoming telemedicine support
  - Consider fixed video camera placement for some patient rooms for remote monitoring
  - Ensure lighting to convey accurate patient coloration
  - Control glare to the camera and screen
  - Ensure acoustic privacy and speech clarity
- Consider on-site tele-triage, which could be done in a tele-health booth allowing for assessment and tele-triage while limiting contagion entering the ED site

(Above and Below) The DxtER was designed to parallel the *Star Trek* diagnostic tool, the tricoder, and can identify 34 diseases including pneumonia, stroke and diabetes through the use of a tablet that is connected to a suite of Bluetooth sensors.

SOURCE: XPRIZE



MERCY HEALTH SYSTEM

(Above) Tele-health command centers, like Mercy's virtual command center, provide a single location for care givers to monitor virtual patients, provide acute care, and coordinate services for patients across the region.

HIGI KIOSK EXAMPLE

(Left) On-site tele-health booths may allow for assessment and tele-triage while limiting contagion entering the ED site.

8. Provide Surge Capacity

Emergency departments nationally have been operating at or beyond capacity, which poses a real challenge as future waves become a possibility without the benefit of a lowering of overall patient volumes. Surge capacity begins with the design of the outside access systems for the ED, including the parking lot and driveways, which can be configured to support the portal functions.

Pandemic response within the emergency department must not rely on the historically utilized contingency tool, hallway beds, even considering universal precautions. Although semi-private accommodation should be avoided, this is much preferred to hallway accommodations. In preparing for a facility surge response, every space adjacent to the emergency department should be considered for potential re-purpose, including adjacent units (e.g., auditorium, clinics), as well as exterior space (e.g., public drop-off, ambulance canopies). Open spaces will need to consider enclosing sides with prefab assemblies and subdividing interiors with flexible partitions and electrical, data and med gas capacity. The capacity to implement significantly resourced surge units will be central to ER strategy in the long-term.

Many of the solutions deployed in the first wave of COVID-19 have relied on temporary textile structures – mostly event tents – readily available. Despite their nimbleness, lightweight tents have major challenges, including providing negative pressure environments in response to pandemic conditions.

The hospital facility community already understands the concepts of setting up extra beds in open spaces and erecting tents for surge capacity. Our focus here is to provide a few non-traditional and less well-known ideas to assist.

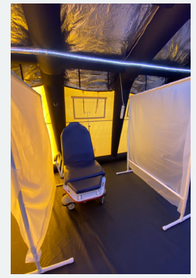
"The risk of deploying unnecessarily, or worse, not deploying timely as needed should be minimized by reducing the deployment cycle. Health services must include facility strategies in their surge checklists, supply chain solutions and staffing plans as they simulate deployment and surge operations."

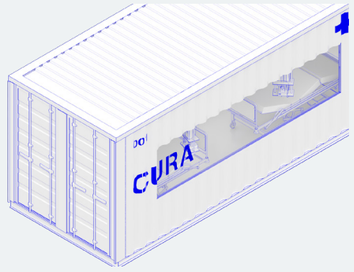
Arthur Brito, Arq., Intl. Assoc. AIA, EDAC, LEED AP BD+C, WELL AP
Senior Health Facility Planner, HKS

Short-term surge capacity options:

- Zone and resource immediately adjacent surface parking areas to receive environmentally controlled deployable structures, prefabricated, container-technology and/or inflatable units
- Rapidly connect to existing hospital sources of medical gases, water, nurse call, electrical and data outlets
- Rapid assembly of surge structures, including deployable headwalls
- Use portable equipment to minimize the need for bedside electrical and data infrastructure
- Use rigid structures such as mobile, portable, temporary buildings or building components capable of supporting interior negative pressure environments
- Provide well-stocked areas with high-use clinical and cleaning supplies, staff support provisions and waste staging to prevent unrelated circulation in and out of the surge unit

Memorial Hospital West utilized the space in front of its ED and parking area to create surge capacity for 16 beds and 12 triage bays. Inflatable tensile structures and self-made moveable divider panels were used. Deployable headwalls were used as needed.





Mobile plug-in intensive care units that are made from shipping containers and can be deployed to any location.
Image credit: CURA

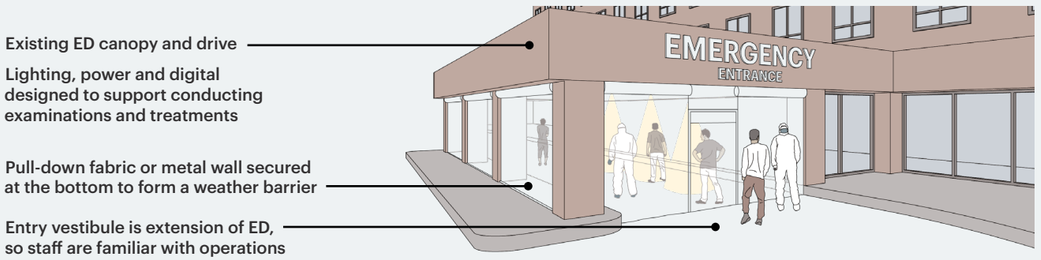
Mobile units can also be used for testing or triage.

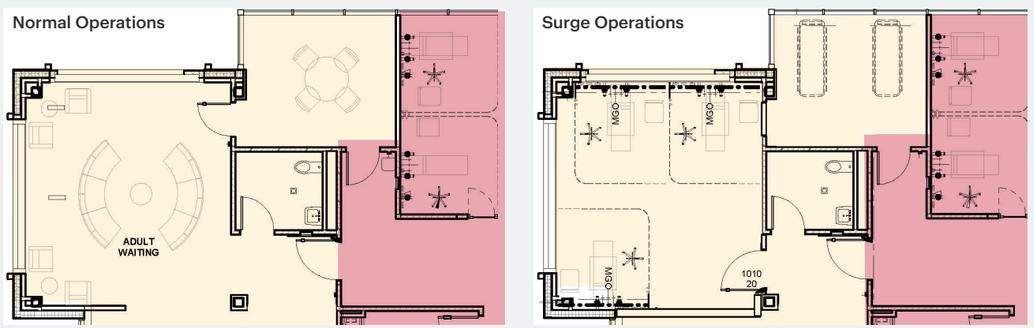
ED Pods can be used to be able to assess and treat more patients within the same area. These can be negative pressure if designed accordingly. This approach has been implemented at Northwestern Memorial Hospital, HKS, Inc.

Long-term surge capacity solutions:

A few simple features added in designing the hospital can dramatically increase the ability of a hospital to surge during a pandemic or other crisis.

- Provide additional head wall and oxygen sources in all ED rooms
- Use slightly "over-sized" ED treatment rooms to accommodate additional stretchers
- Pre-wire and pre-plumb common spaces with power, water, oxygen and suction that can be used as surge patient care areas during a pandemic
- Develop a docking area for temporary structures to quickly expand the hospital. Include access to electrical, water, and communications sources to support temporary structures
- Develop ED canopies that can be easily enclosed to become indoor space during contingencies
- All of the above features could remain "invisible" during normal operations





Support spaces can be designed with appropriate power and gases to enable surge into patient care spaces as needed, but be used for day-to-day purposes at waiting or other support functions. Image of Memorial Hospital West, HKS, Inc.

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