

Rules of Thumb for Limiting Contagion in Makeshift Facilities



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A word of caution about tent clinics

In response to the rapidly escalating COVID-19 pandemic, communities around the world will be deploying makeshift medical responses, including the quick construction of “temporary” tent clinics.

Not only are tents less-than-ideal facilities for the treatment of patients with highly infectious diseases, one thing we know from past epidemics is that temporary facilities can gain an unintended degree of permanence. Regardless of the tent’s design and construction, there is a strong possibility of contagion when infected and uninfected patients, family members, and healthcare providers are co-located in tight quarters. However, when a community has no better alternative than a tent facility, the following basic infection control strategies can help reduce the risk of contagion.

About this Document

The recommendations included in this document are intended to be rules of thumb when healthcare providers are forced into a scenario whereby the deployment of a tent clinic is unavoidable. These ARE NOT design recommendations intended to represent ideal deployment of emergency treatment facilities. Our hope is to illustrate important principles to keep in mind.

This document compiles learning from an on-the-ground effort to make sure a rapidly deployed tent clinic in Boston implemented key design principles to reduce infection control. As an example only, these strategies reference a two ward clinic composed of 20’ X 80’ tents with 10’ X 10’ vestibules (see plan on p. 4 of a tent clinic for the Boston Health Care for the Homeless Program (BHCHP), for which MASS was engaged during construction). These rules of thumb are not intended to be a design for this tent or any other facility, but contain principles that apply to many configurations and assemblies.

The attached plan shows how this two ward module may be aggregated to serve more patients and different patient populations. BHCHP found that separate, smaller wards allowed providers flexibility meeting the demands of rapidly shifting patient populations such as triage cases; untested, asymptomatic close-contact patients under observation; asymptomatic tested patients awaiting results; low and high risk symptomatic patients awaiting results; and confirmed positive patients. Note that for all asymptomatic and undiagnosed patients, infection control is critically important so that the tent clinic itself does not become an instrument of contagion.

More information regarding recommended furniture and equipment to include within this tent clinic can be [downloaded here](#). Please reach out to us at covidresponse@massdesigngroup.org if you have any questions, are seeking support, or have suggestions re: additional design topics you would like us to cover in our guides.

Acknowledgements

These rules of thumb are offered within rapidly evolving clinical and research contexts. Because there are no current guidelines specific to design for coronavirus, this document reflects MASS Design Group’s previous learnings designing for infection control, our recent experience consulting for Boston Health Care for the Homeless Program (BHCHP) on a COVID-19 tent clinic, and engagement with experts around best practices to respond to coronavirus. MASS is grateful to the experts who have advised on them. They do not represent the opinions or full understanding of any one person. Thank you to:

Edward Nardell, MD, Professor of Medicine. Departments of Environmental Health and Immunology and Infectious Diseases, Harvard School of Public Health. Harvard Medical School. Brigham and Women’s Hospital.

Jessie M. Gaeta, MD; Assistant Professor of Medicine, Boston University School of Medicine; CMO Boston Health Care for the Homeless Program

Joshua Barocas, MD; Assistant Professor of Medicine, Boston University School of Medicine; Infectious Diseases physician, Boston Medical Center

Nahid Bhadelia, MD, MA: Medical Director of Special Pathogens Unit, Boston University School of Medicine; Infectious Diseases physician, Boston Medical Center

Jim Crabb, PE, Principal, Mazzetti

James Petersen, PE, Petersen Engineering

COVID-19 is understood to be primarily spread by large droplets and perhaps secondarily by surface contamination. Some research indicates that it might become aerosolized in particular circumstances, which is a tertiary concern.

A tent clinic design must consider all three modes of contagion. The following pages represent best practices and rules of thumb to limit the transmission of diseases carried via these three modes.



Limit droplet spread between people.

Design for distances between people of 6' or more to prevent direct contact with respiratory droplets.



Mitigate contagion via surfaces.

Clearly identify and regularly clean and disinfect high-touch surfaces.



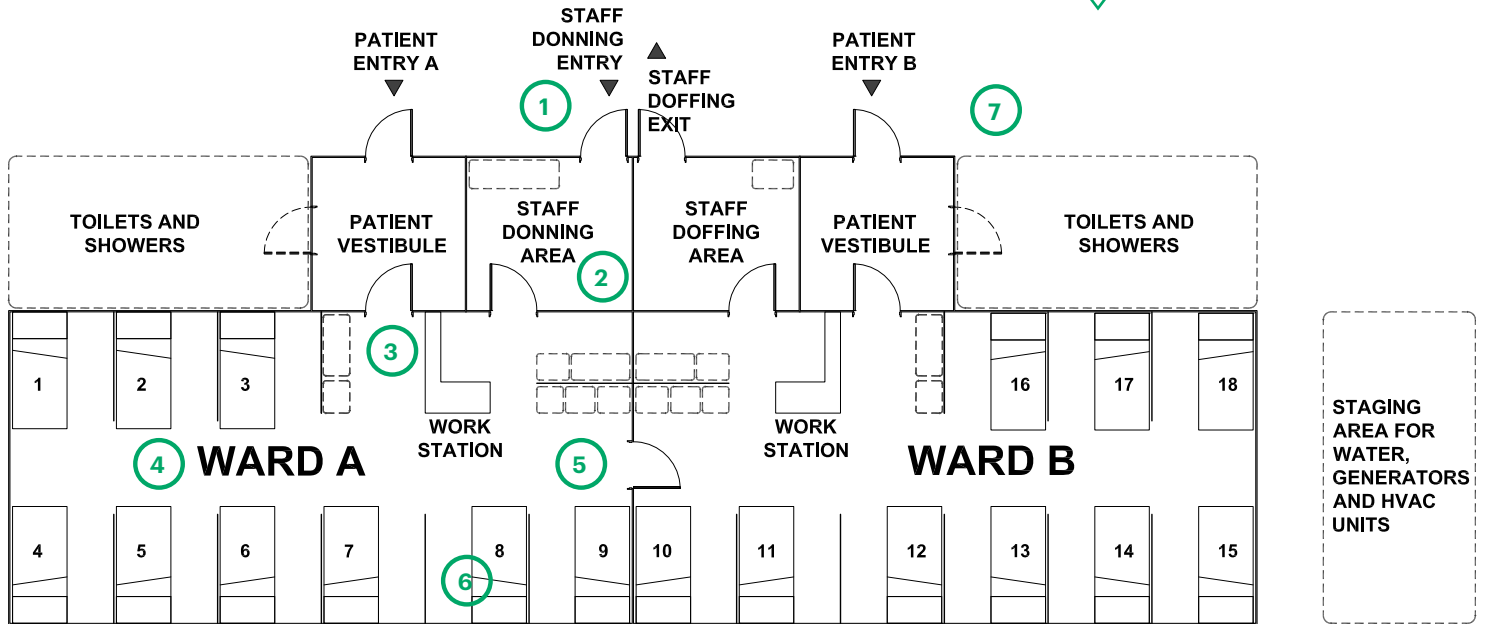
Control for airborne infection.

Prevent, dilute, and remove contaminated air.

Limit droplet spread between people.

Because experts best understand that COVID-19 is transmitted between people via direct contact with respiratory droplets, clinic designs should allow individuals to separate by a minimum of 6'. Basic planning ideas presented here can help minimize direct respiratory droplet spread.

A case study of a makeshift clinic: a tent clinic for Boston's Homeless. You can find a more detailed plan on p. 4



1 Create separate entrances for health care providers and patients. This helps prevent close contact between patients and providers not wearing Personal Protective Equipment (PPE), both inside and outside the tent.

2 Providers should enter directly into a donning vestibule or room, where they can put on their PPE before interacting with patients. (Re-donning supplies within the tent allow PPE to be refreshed.)

3 Use a work surface of simple materials such as medium density overlay (MDO), plastic laminate, or draped plywood to provide a cleanable and disinfectable buffer between a provider and an ambulatory patient at key locations. Page 6 shows one example of a simple site-built workstation.

4 Since tents come in fixed dimensions, it can be difficult to achieve plan arrangements that facilitate social distancing, but it is crucial. When possible, strive for larger aisle dimensions than the 6' between partitions and 5' between beds shown here.

5 Centralizing clinical staff spaces (e.g., workstations, storage, and donning and doffing areas) will make clinical work more efficient and limit uncontrolled interaction between providers and patients.

6 Separation of beds by a partition or tensioned vinyl screen of 8' high can help limit cross-contamination between patients and guide the flow of contaminated air.

7 A stand-alone 10' x 10' conditioned tent (not shown) can serve as a staff break area.

Mitigate contagion via surfaces.

The [CDC understands](#) that contaminated high-touch surfaces may be a transmission route for COVID-19. In a tent clinic, doors (often supplied with the tents), doorknobs, bed linens, partitions between beds, outlets, storage containers, counter tops, toilets, and sinks are examples of high touch surfaces.

Materials and surfaces should be deployed and installed to minimize touching, to make touch points obvious, and with the understanding that they must be frequently cleaned and disinfected.

- The CDC advises that cleaning of visibly dirty surfaces followed by disinfection is best practice for prevention of COVID-19.
- Cleaning removes dirt and most germs, while disinfection kills germs. The [CDC recommends](#) using a bleach solution, a 70% alcohol-based spray or wipe, or other proper disinfectant.
- A storage area for cleaning supplies and other non-PPE items should be provided.

Control for airborne infection.

The COVID-19 virus may [become aerosolized](#) by certain procedures such as intubation, positive-pressure airway ventilation, or a high-flow nasal cannula. Tent clinics that might eventually be treating patients needing aerosolizing procedures should plan for airborne infection control.

Airborne infection control systems require specialized equipment best specified by a mechanical/HVAC engineer. A few hours of time from an engineer in your community who understands your climate and locally available equipment and contractors can help incorporate the principles presented on the right into your tent clinic.



Source Control: Trap droplets before they spread

Beyond use of PPE for providers for droplet protection, the [CDC recommends](#) standard face masks, such as surgical masks, for confirmed and suspected patients. Aerosolizing procedures such as intubation should be source controlled with a portable HEPA filter/fan unit.



Dilution: Decrease the number of contaminants in the air

Contaminated air is diluted when it is combined with clean air. HEPA-filters or ultra-violet germicidal irradiation (UVGI) equipment can efficiently clean and then recirculate conditioned (heated/cooled/dehumidified) air. However, HEPA-filtration and UVGI strategies require specialized equipment and expertise. Alternatively, contaminated air can be diluted by adding fresh outside air (please note: while this is a technically simpler approach, it can be less efficient because it can require additional cost and energy to keep the air properly conditioned). While tent clinics should strive to meet [CDC guidelines](#) of 12 air changes per hour (ACH), 6 ACH or even 4 ACH will provide benefits over fewer air changes. Limits on equipment, ductwork, and power may in turn limit the number of achievable ACH.



Airflow Direction: Remove contaminated air before it spreads

Pressurizing the tent by installing vestibules, carefully sealing all the gaps between tent panels, supplying clean air through registers in ducts above the center aisle of the tent, and then exhausting air to the outdoors through a vent next to each patient's head at the tent perimeter may lessen the risk of contagion to providers and patients. See one possible perimeter vent detail on p. 5. With this airflow strategy, clean air only becomes contaminated immediately before it leaves the tent next to an individual sick patient's head. Conversely, airflow that stirs contaminated air within the tent, or pushes or pulls it past healthy people, may heighten the risk of contagion.

Additional Design Considerations

In addition to mitigating contagion via three modes of contamination, tent clinics should pay particular attention to the following opportunities to promote health.

Toilets, Showers, and Hand Washing Stations

Toilets and showers will likely be rented mobile units vulnerable to the three modes of contagion outlined previously. These rental units are spatially tight, and direct droplet contagion should primarily be addressed by patient management. Surface contamination must be addressed by cleaning between patients. Toilet and shower units should have passive or active ventilation systems. Ideally, different patient populations should not share the same units, and healthcare providers must have separate facilities. Be sure to install separate hand washing stations for patients and providers within the tents, whether mobile units or ones constructed on site.



Water, Power, and Ventilation

For water and power, tent clinics can most easily tie into an available adjacent building, utility pole, or fire hydrant. If necessary, for power, rent a mobile diesel generator that meets the amperage and phasing requirements for HVAC and other equipment. If water is transported to site and stored, anticipate a pump or gravity feed system.

Almost certainly a mobile HVAC unit will be required for three critical reasons: to provide comfort, to dilute air to as many as 12 ACH, and to create directional air flow. The HVAC unit must have the conditioning, ventilation, and control capacity to maintain consistent air flow and temperature, which is beyond the capability of many construction-grade fans and heaters.



Dignity and Efficacy

Tent clinics might offer the following to promote patient dignity, comfort and security:

Beyond stopping pathogens, tent clinics must support people. Voluntary patients who are contagious might leave clinics and further spread COVID-19 if the clinics seem unsafe to them, are uncomfortable, or are undignified. This is especially true for asymptomatic and untested close-contact observation populations who might perceive themselves as being at greater risk and discomfort within a clinic than outside of it.



A legible, obvious ventilation strategy (see p. 7 for an example) that clearly demonstrates environmental safety



Individual lockable storage for valuables, electronics, and medications



WiFi, power, and USB charging ports at patient beds



Partitions between beds for privacy and contagion control



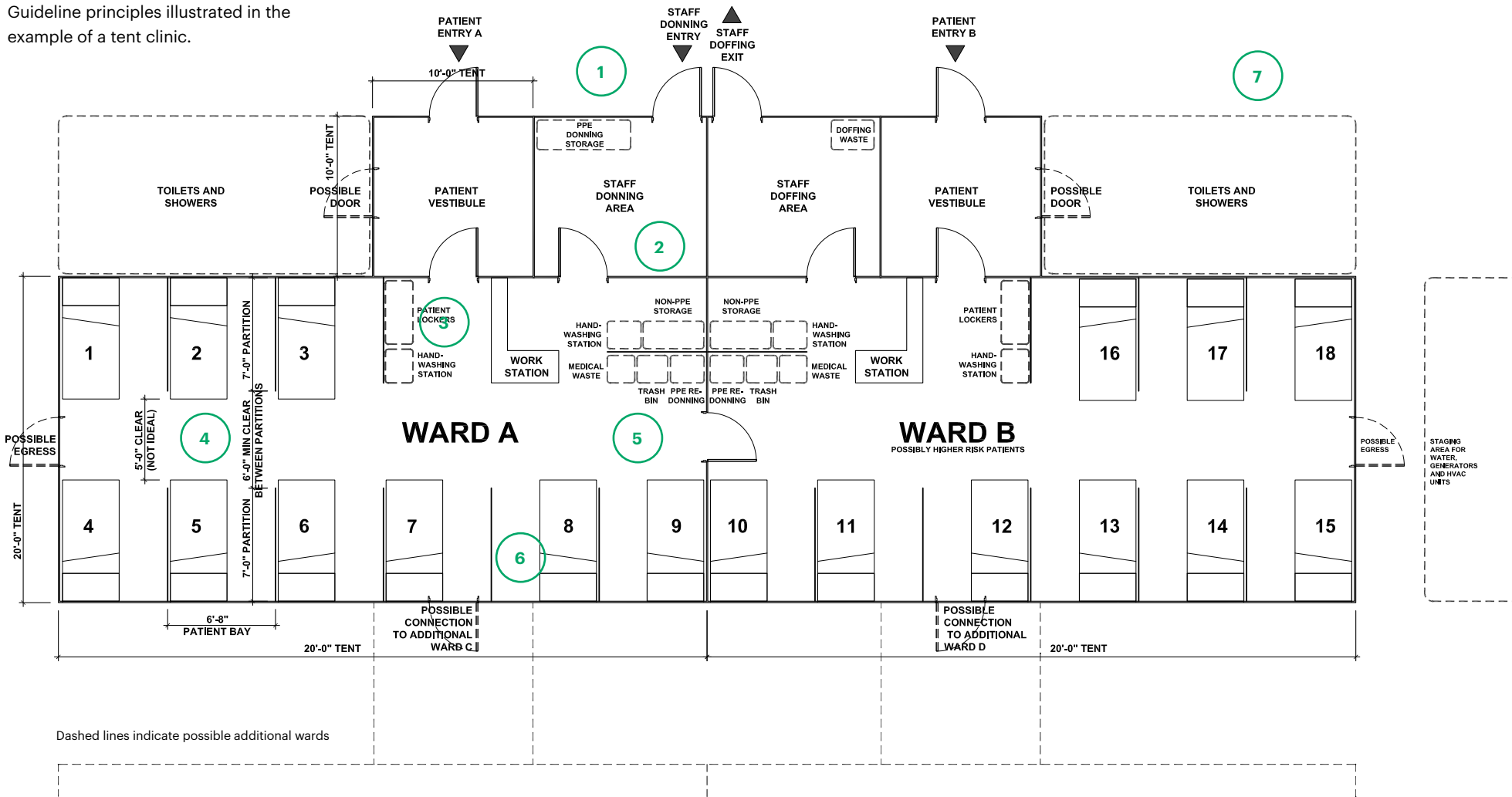
Covered large storage, such as a plastic tub, for clothing and personal items



Screens and access to streaming services like Netflix or Hulu for patients who lack these

Tent Clinic Plan Drawing

Guideline principles illustrated in the example of a tent clinic.



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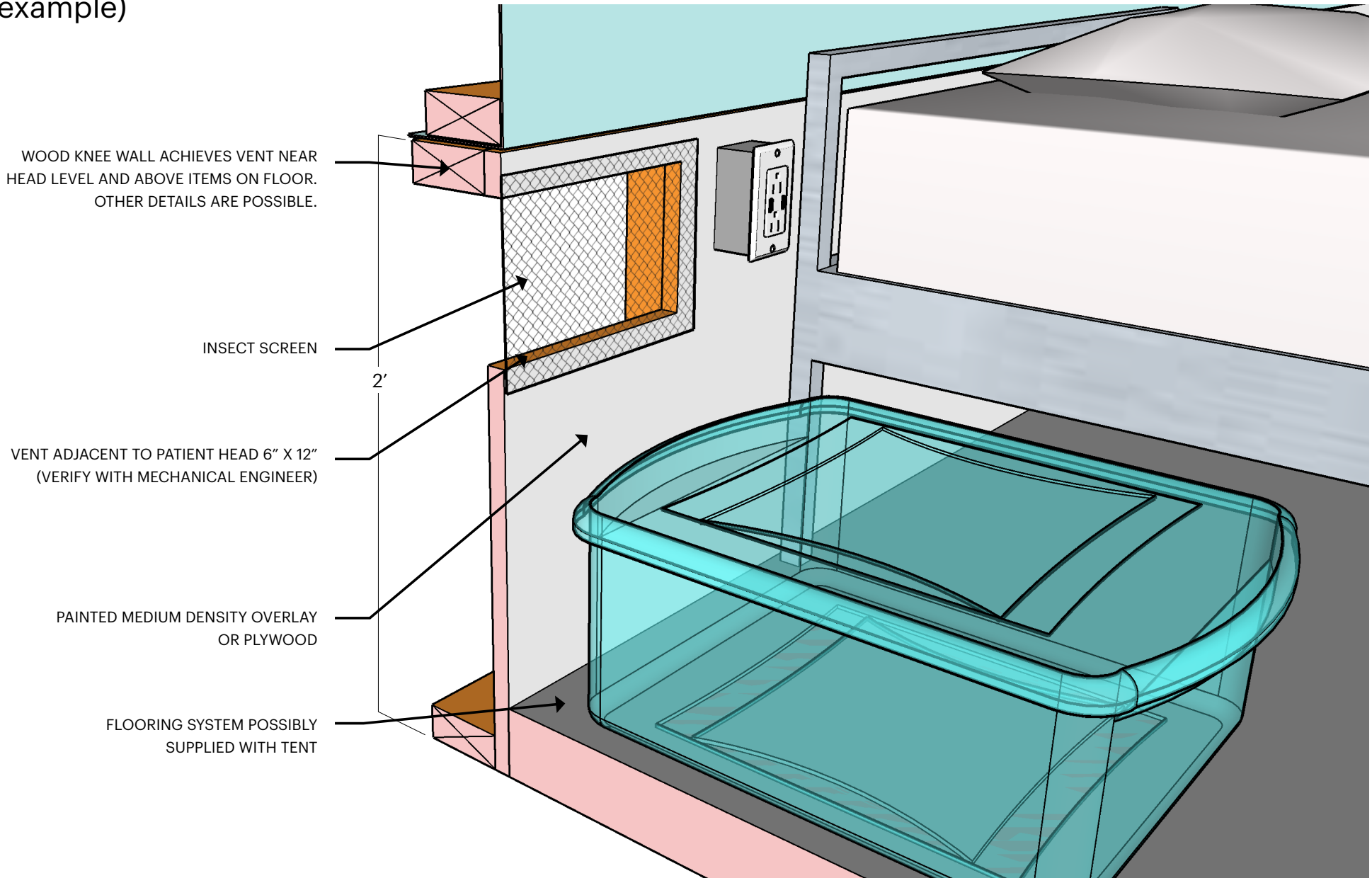
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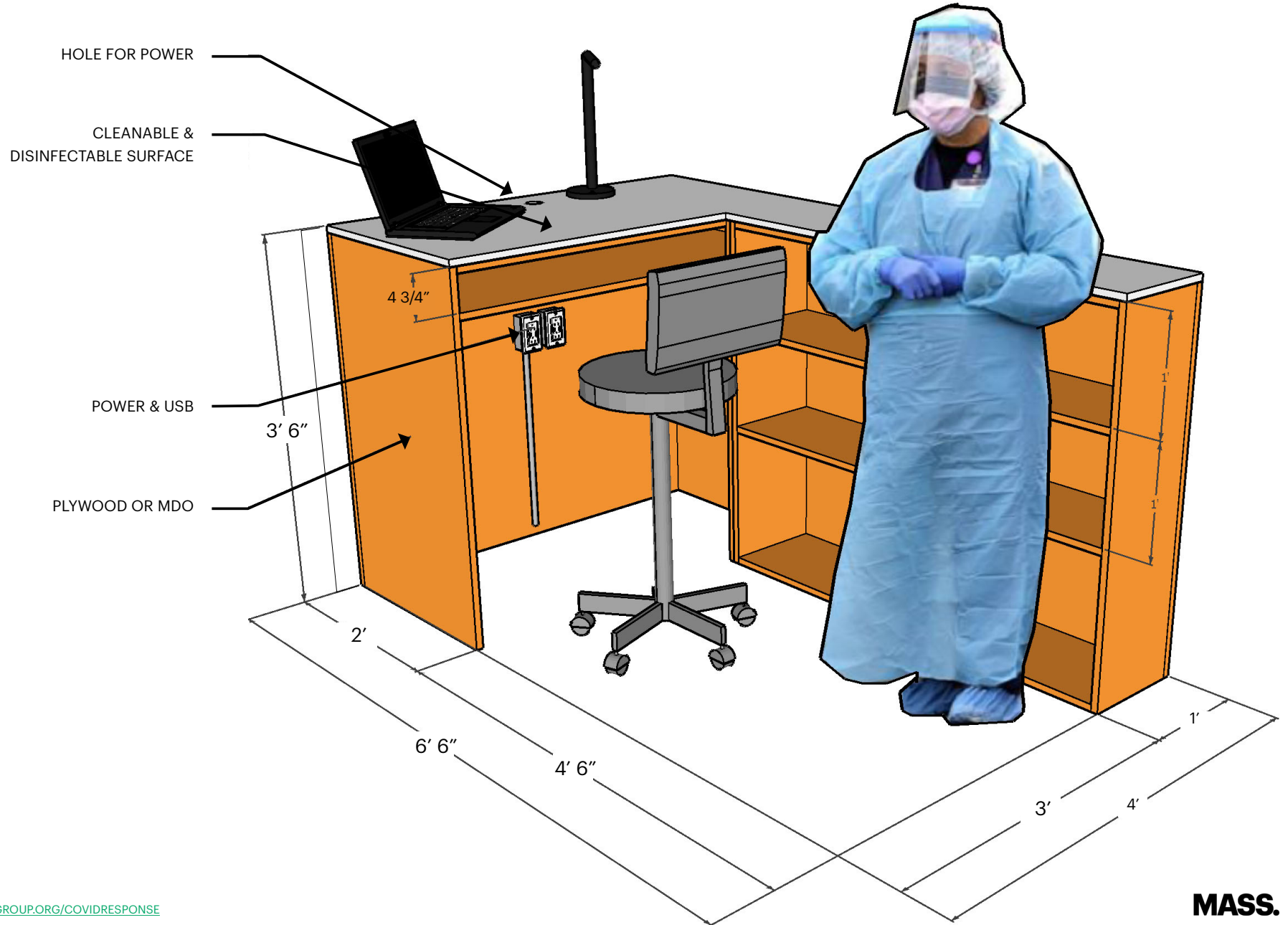
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Perimeter Vent Detail (example)



Healthcare Provider Workstation (example)



Ventilation Strategy — Butaro Hospital, 2011, Ward Section

