Coronavirus Treatment Center

FACILITY AND INFRASTRUCTURE GUIDELINES FOR LOW-RESOURCE SETTINGS

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Build Health International

IN COLLABORATION WITH Partners In Health

Introduction

The following guidelines are for building appropriate treatment centers for patients with COVID -19 in low-resource settings, in response to the unique challenges healthcare providers in these settings face. It promotes practical designs and construction standards that can be adapted to various settings and built with local resources.

For full construction drawings that can be used with these guidelines, visit
www.buildhealthinternational.org/COVID-Infrastructure-Resources

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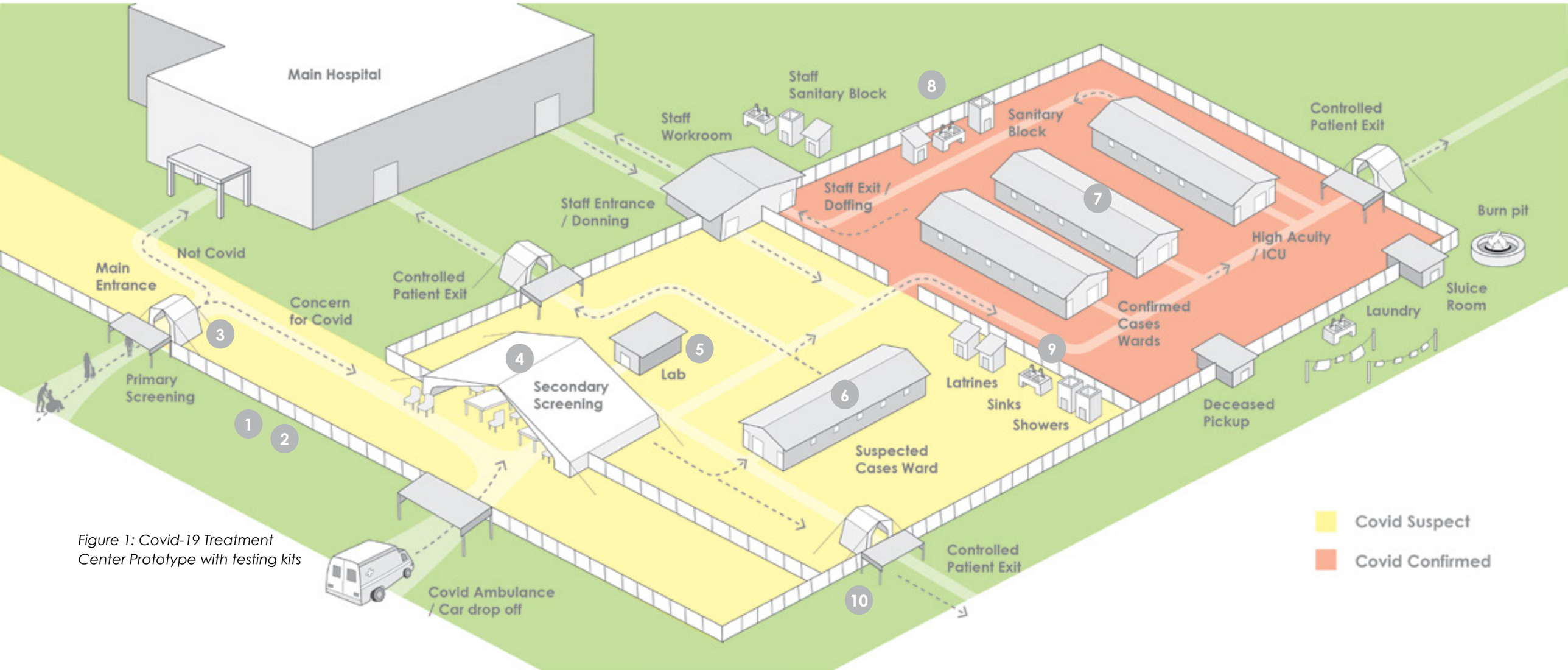

Figure 1: Covid-19 Treatment Center Prototype with testing kits

1. Sectioning / Entrances & Exits

- ☐ The Treatment Center must be sectioned off from the main hospital with physical barriers (see Sec.2 Fencing).
- ☐ All exits and entrances must be strictly controlled.
- ☐ Unidirectional flow for patients and clinical staff is optimal, which requires separate entrance and exits for staff and patients.
- ☐ Entry of all patients into the treatment center must be through the secondary screening area/triage.
- ☐ There should be at least one controlled patient exit with a hand-washing station and shower block nearby.
- ☐ There should be an exit for other required services such as laundry, the burn pit etc.
- ☐ There should be an exit to the morgue.
- ☐ Ensure that patients entering the facility keep a 2m distance between them while waiting in lines.

2. Fencing

- ☐ The entire Treatment Center should be enclosed in affordable fencing.
- ☐ These barriers should restrict access and be clearly identifiable as barriers without the need for signage, as many patients may not read.
- ☐ Fencing should be a **minimum of 4' (1.23 m)** in height.
- ☐ Consideration and caution should be used in making the fencing **taller than 5' (1.5 m)**, especially if it is an opaque material, so as to not cause anxiety for patients and family members being separated.
- ☐ Appropriate fencing options include: high plastic snow fence, chain link, or corrugated metal.

3. Primary Screening

- ☐ Screening should be set up at the main entrance of the hospital so that all patients undergo primary screening for Covid-19.
- ☐ Health care workers should be equipped with appropriate PPE.
- ☐ Screening can be a temporary tent with a few tables and chairs.
- ☐ Ensure that all entrances have screening to prevent anyone from entering the hospital (or health center) facility without appropriate screening.
- ☐ Screening should be equipped with at least one hand-washing station or sufficient hand sanitizer.
- ☐ Ensure that patients entering the facility keep a 2m distance between them while waiting in lines.

4. Secondary Screening Area (Triage)

- ☐ Every patient entering the Treatment Center must pass through the triage.
- ☐ Ensure that there is clear signage and direction for patients with concern for Covid-19 to move directly into triage without accidentally "slipping by" into other parts of the facility.
- ☐ The triage can be a temporary tent with a few tables and chairs.
- ☐ Health care workers should be equipped with appropriate PPE.
- ☐ Secondary screening should be equipped with at least one hand-washing station.

5. Laboratory

- ☐ A mini laboratory area should be accessible to the triage area to carry out rapid tests, including RDT for Coronavirus, as well as malaria, HIV, pregnancy and other rapid tests.
- ☐ There is the possibility for a larger lab in the COVID -19 Isolation Unit.

6. Suspect Ward

In the suspect ward there will be a mixture of patients with and without COVID - 19 and so the focus is to prevent nosocomial infection. This will be the most dangerous place for patients not infected with the virus so great care must be taken to protect them.

Patient Beds

There are a number of different options for patient bed spacing that will help to diminish the risk of transmission from patient to patient. The following guidelines assume a patient bed that is **3' (0.95m) wide**.

OPTION 1: SCREENS

- ☐ A minimum of 4.5' (1.4 m) spacing between beds with a screen between adjacent beds.
- ☐ The screen should be a minimum of 6' (1.8 m) in height and 5.5 - 6.5' (1.7 - 2m) in length starting from the wall at the head of the bed.
- ☐ The screen must be fixed to the floor and wall so it is stable and cannot be knocked over or moved.
- ☐ The screen must have a washable and smooth surface. This can be heavy duty plastic sheeting, or a similar imperious washable surface. If paint is used it must be washable and semi or gloss finish, preferably epoxy.

- ☐ In lieu of a fixed screen, a plastic curtain can be hung but it must be durable enough so that it holds up to repeated cleaning. The curtain should be tightly affixed to the wall at the head of the bed to prevent gaps for airborne transmission from patient to patient.

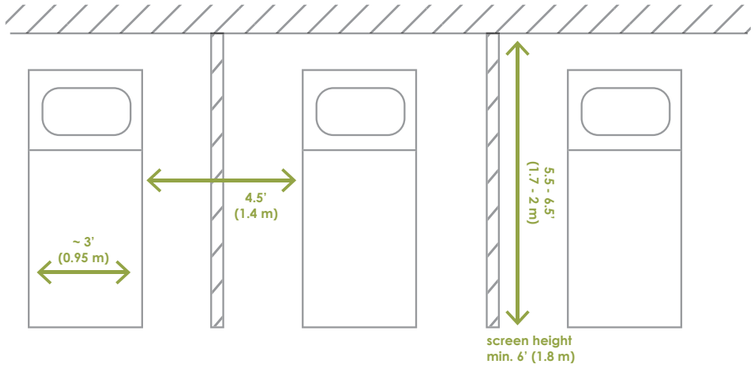

Figure 2: Suspect Ward Patient Bed Layout with Screens

OPTION 2: NO SCREEN FURTHER SPACING

- ☐ If screens are not possible, maintain a minimum of 6' (1.8 m) spacing between beds

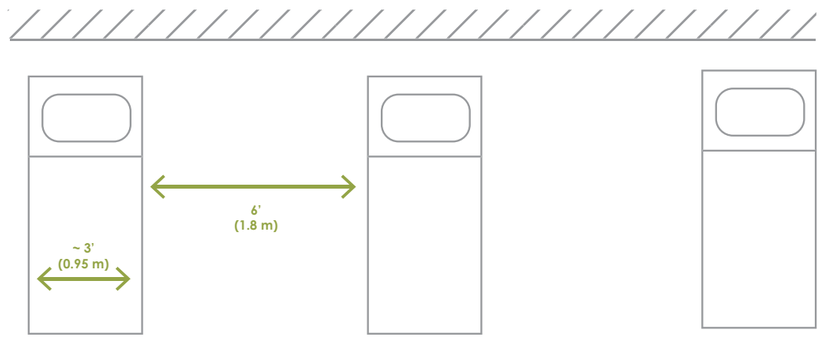

Figure 3: Suspect Ward Patient Bed Layout without Screens

NOTE that the ideal option would be screening AND greater spacing between beds at 6' or more

Ventilation

Adequate ventilation is required to prevent airborne infections and for patient comfort in hot, humid climates. The WHO recommends a minimum ventilation rate of 60 litres/second/per patient for mild and moderate wards and 160 litres/second/patient for severe wards, and airflow from agent source to areas with sufficient dilution (ex: outdoors).

One of the most significant challenges in designing low-cost wards will be meeting these requirements.

MECHANICAL VENTILATION

- ☐ Ideally, wards would be mechanically ventilated by exhaust fans discharging through the roof and air intake from low louvers, this will be sufficient to achieve a minimum of 12 air changes per hour.
- ☐ Ideally this can be accomplished with two redundant fans and a consistent supply of electricity.
- ☐ In many sites doing this kind of mechanical ventilation will be prohibited by either available funding or lack of equipment, or both.

ROTARY EXHAUST VANES / WHIRLYBIRDS

- ☐ If available, rotary exhaust vanes, or "whirlybird" ventilators should be installed at 3.5 m intervals along the roof line ridge to provide exhaust and maximize air changes.

DESIGNING SPACES THAT MAXIMIZE NATURAL VENTILATION

- ☐ Narrow wards, with large window openings above the patients on both sides of the wall encourage air changes per hour through natural air flow and movement.
- ☐ Vertical ceiling height should be a minimum of 3m (9.8') to encourage natural ventilation.
- ☐ Windows are important for cross ventilation (see windows)
- ☐ The air changes achieved will vary greatly depending on climate and other external conditions.

CEILING FANS

- ☐ Install large 4.5' (1.4 m) diameter ceiling fans at a minimum height of 9' (2.7) m above the floor.
- ☐ If affordable and available, an even larger diameter, slow turning HLV fan would be preferable, but note that these are rarely available in resource constrained settings.
- ☐ **CAUTION: Locally available ceiling fans should be limited to low speeds so that air movement is promoted but infectious droplets are not carried in the air stream.**
- ☐ As a rule of thumb, low speed is defined as a speed where a puff of smoke released in a room will travel no more than half a meter in a second.
- ☐ If possible a stop or a permanent setting mark should be placed on the rotary or slide fan controller to indicate the proper speed setting.

Windows

- ☐ Windows for the COVID wards are very important for cross ventilation.
- ☐ Ideally, there should be a window opening over or adjacent to each patient bed of around 9ft2 (0.84m2).
- ☐ In resource-constrained settings, a low-tech and simple window configuration may be suitable as described below:

WINDOW FOR LOW-RESOURCE SETTINGS

- ☐ Each window opening should have an insect screen applied from the outside and stapled onto the wall. This is to minimize both insects entering the space and to provide some rain intrusion protection during light rain storms.
- ☐ The roof should provide at least 3' (0.92m) over hang over the windows to provide adequate rain protection in light and medium storms with little wind.
- ☐ In the cases of wind driven rain an external shade can be used. The shade is rolled up above the window and tied in place with a thin piece of rope or cloth.

- ☐ The shade can be made from a plastic tarp or a similar flexible waterproof material.
- ☐ A small metal bar can be sewn into the bottom of the shade to weigh it down and prevent it from blowing around in a strong wind. The bar could be either a piece of #2 or #3 rebar or 6mm or 8mm threaded rod, and should be approximately 3' ((0.9m) in length.
- ☐ It is critical that the windows are left as open and unobstructed as possible for maximum air flow and the shade is only deployed in cases where wind driven rain would come in through the window.

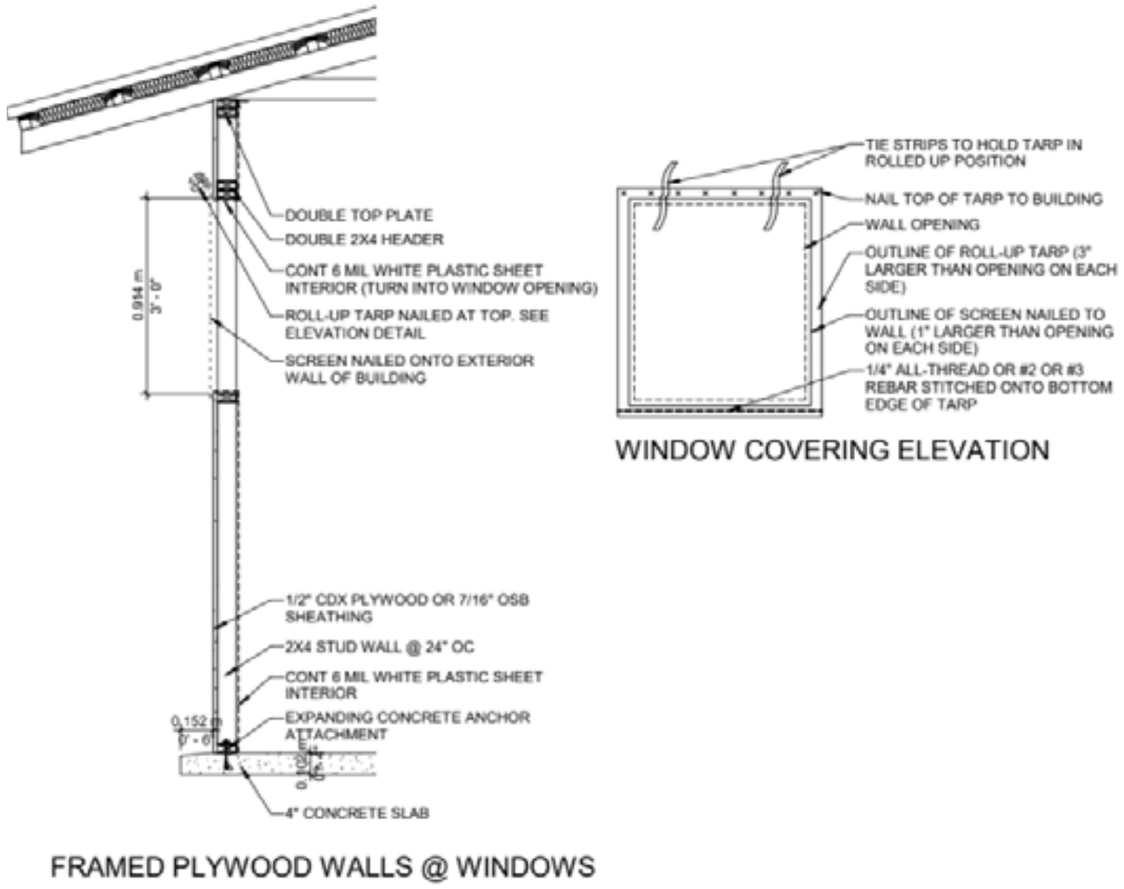

Figure 4: Drawing Details of Sample Window Configuration for Low-Resource Settings

Staff Spaces

Staff should be provided with donning and doffing spaces to facilitate proper use of PPE and with a clean workspace to allow for charting and note-taking after shifts.

Staff Donning

- ☐ The clinical staff entrance to the Coronavirus Treatment Center should include a donning space. All staff and caretakers entering the center should pass through this space and should don full personal protective equipment.
- ☐ The donning room can also serve as clean storage for equipment and supplies needed while inside the treatment center if outfitted with adequate shelving and space.
- ☐ A hand wash station should be included in the donning space.

Staff Doffing

- ☐ All staff and caregivers should exit the treatment center through the doffing room.
- ☐ The doffing room should have trash cans for disposable PPE and laundry storage for reusable PPE to be cleaned.
- ☐ The doffing room should be equipped with a handwash station (a staff shower in or near the doffing room is also a good idea).
- ☐ If the doffing room connects to other interior spaces, an anteroom should be provided at the exit of the doff room to help prevent infection spread and should be equipped with an additional handwashing station.
- ☐ Staff should only be able to enter the doffing space from the treatment center side.

Staff Workroom

- ☐ A workroom should be provided for doctors and nurses to record notes about patient treatment and fill out charts. The workroom should be located outside the perimeter of the treatment center but near the exit.
- ☐ The workroom can be located between the donning and doffing rooms as shown in the campus prototype. No backwards travel should be permitted to the doffing space if a direct connection is provided.
- ☐ Movable worktables and chairs should be provided for workstations. Filing systems should also be in place to organize patient records as needed.
- ☐ If connected to the donning and doffing spaces, the workroom is a good place to provide staff lockers or cubbies for secure storage of personal items while in the treatment center.

Treatment Center Entrances and Exits

Patient Flow

- ☐ Patients should enter through screening and should be cared for in the suspect area only long enough for tests to return. Upon return of the test, patients who test positive should move to the confirmed area and patients who test negative should exit directly through the controlled patient exit.
- ☐ Patient exits: patients who are exiting the Coronavirus Treatment Center should exit through the controlled patient exit. That exit should include hand washing facilities and provide a place to change into uncontaminated clothes. A shower is recommended to help prevent contamination from exiting the treatment center.

Material Flow

- ☐ Equipment needed by staff should be stored in the staff donning space and be carried into the treatment center by staff members starting their shift.
- ☐ Food, clean clothing, medical supplies, clean laundry, and additional equipment needed should enter via a time-controlled pass-through along the fence. The outside staff or family member providing the item should place it at the pass through when nobody on the inside of the treatment center is present. When that person has left, someone on the inside of the treatment center can then go pick up the item. This prevents direct spread from someone inside the treatment center to someone on the outside.
- ☐ Soiled, reusable materials, such as laundry, should exit via a specific area separate from the clean equipment entry passthrough. A cleaning/ sanitation facility in direct proximity to the treatment center should be provided for use exclusively on Coronavirus-contaminated items to prevent cross-contamination to the rest of the hospital. A unidirectional flow from the exit through the cleaning process should be provided to avoid contamination of cleaned items.
- ☐ Trash and waste should exit to a burn pit, incinerator, or other nearby waste disposal method where contamination can be destroyed.

Sidewalks

- ☐ If installing sidewalks, they should be a minimum of 6' (1.8) m wide and should be broom finish concrete of at least 1800 PSI compressive strength and a minimum of 3" (8cm) thickness on a compacted crushed stone base.

Flooring

- ☐ Flooring of wards should be smooth and cleanable to ensure proper sanitation.
- ☐ Polished and sealed concrete is an affordable and sanitary option.
- ☐ The concrete slab should have a minimum compressive strength of 1800 PSI and be a minimum of 4" (10 cm) thick on a compacted crushed stone base.

Walls

- ☐ The walls of the ward should be sturdy and waterproof. The interior walls should have a smooth, washable surface to ensure sanitation. In resource-constrained settings, a low-tech and simple wall configuration may be suitable as described below:

WALLS FOR LOW-RESOURCE SETTINGS

- ☐ The vertical studs of the wall will be made of 2 x 4 wood stud panels, 60 cm on center.
- ☐ 2x4s will also be used for a horizontal continuous single bottom and double thickness 2 x 4 top plate.
- ☐ The exterior of the wall should be sheathed in 12mm exterior grade plywood or OSB board. Plastic, a tarp, or Paint can be used to help seal and protect the exterior of the sheathing.
- ☐ The interior walls should ideally have a smooth washable surface. 12mm plywood or OSB board will be suitable, however if funding is constrained a 6 Mil white plastic continuous sheet can be used. Staple the sheet to the wood studs and plates every 30 cm.

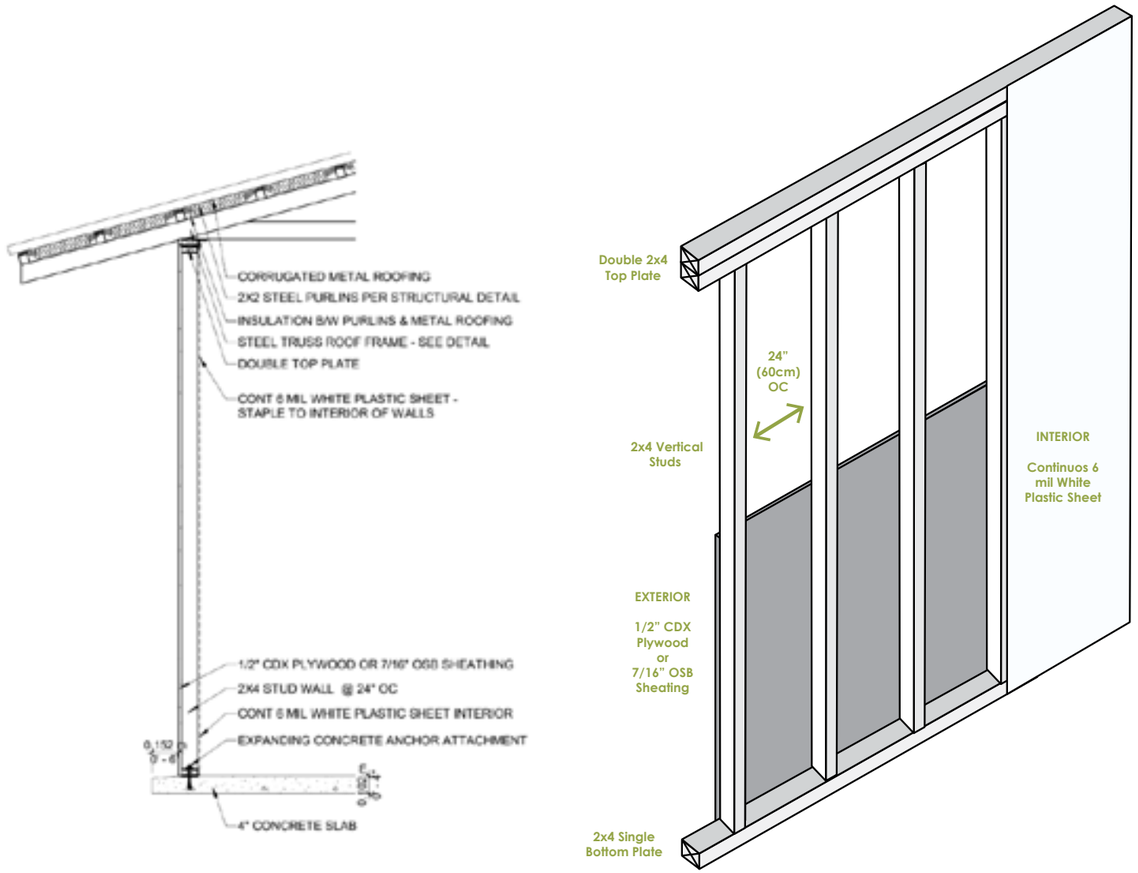

Figure 5: Drawing Details and 3D view of Sample Wall Configuration for Low-Resource Settings

Roof Structure

- ☐ A clear span design is one that only has supports at either end of the roof truss with no supporting pillars in the middle of the space, allowing for wide, open, usable space.
- ☐ A simple ward design can incorporate a clear span roof truss and a narrow building (around 24' / 7.3m wide) with enough room for two rows of beds against the outside walls. This design is simple to design and build and encourages natural ventilation.
- ☐ A clear span truss can be built out of either mild tube steel or wood lumber. For truss detail, see full construction documents at **www.buildhealthinternational.org/COVID-Infrastructure-Resources**.
- ☐ The roof should be built with a minimum overhang on the side walls of 3' (0.92m) to protect the window openings from sun and rain.
- ☐ The end walls should have a minimum overhang of 2' (0.6m)
- ☐ The longer the overhand the more protection from the rain and sun, and the cooler the building. (eg: 5' (1.5m) for side walls and 3' (0.9m) for end walls).
- ☐ Refer to the appendix for specific drawings for a 16-bed ward, with details for wood and steel trusses.
- ☐ CAUTION: Note that the large overhangs of the roof will create a significant uplift during a severe storm. Either carefully follow the drawings included in this set, specifically for attachment details for fixing the trusses to the walls, or have a structural engineer design your plans.

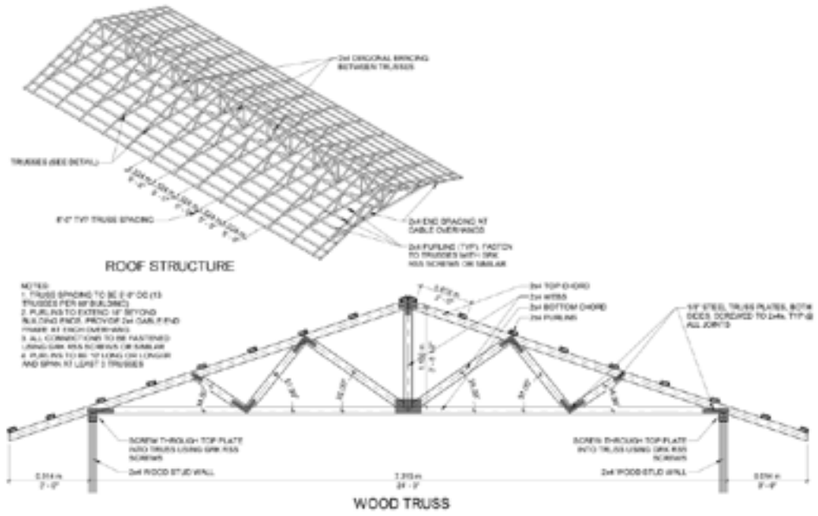

Figure 6: Wood Truss Drawing Details Sample

Roof Material

- ☐ Metal roofs greatly vary in type and quality from country to country. The roofing material must be factory painted and rust resistant, preferably galvanized steel.
- ☐ The minimum acceptable thickness of the material is 28 gauge, However 22 or 24, is preferably especially in areas that can be subject to high winds or tropical storms.
- ☐ In the roof drawing plans in the appendix steel corrugated roofing sheets are attached to the truss purlins.
- ☐ Ensure the roofing sheets overlap and are secured with appropriate fasteners such as hex head galvanized screws with a neoprene self sealing washers.
- ☐ For attaching to steel purlins use a self drilling self tapping screw that has a minimum thread length of 25mm.
- ☐ For attaching to wood purlins use a pointed tip high thread screw of a minimum length of 40 mm.

Roof Insulation

- ☐ If available locally and affordable, install fiberglass or Rockwool Batt insulation with a foil, mylar, or kraft paper face be installed perpendicular to the roof purlins continuously under the metal roofing.
- ☐ Even having as little as 50 mm of batt insulation will greatly reduce heat transmission from the roof during the middle of the day and will significantly help keeping the interior space cooler and more comfortable for staff and patients.

7. COVID Wards

In the COVID wards, all patients will have tested positive for the Coronavirus, so there is less risk of transmission between patients. This ward is similar to the suspect ward in many aspects (see previous section), however if resources are limited, beds may be placed closer together if needed and separation screens removed. Additionally, ceiling fans do not need to be set at low speeds to prevent the spread of droplets.

Patient Beds

- ☐ A minimum of 3' (0.9m) spacing between beds assuming a patient bed that is 3' (0.95m) wide.
- ☐ Screening between beds is not required.

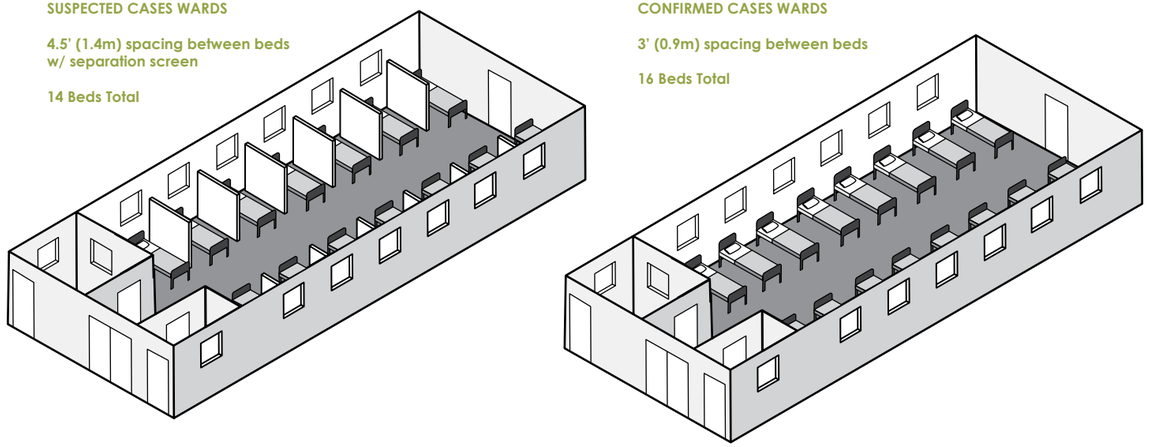

Figure 7: Comparing Bed spacing in suspected and confirmed cases

Ceiling Fans

- ☐ Ceiling Fans do not need to be set on a low speed setting.

8. Latrines / Shower Block

1: https://www.who.int/water_sanitation_health/hygiene/settings/ehs_health_care.pdf.pdf

- ☐ Improved Pit Latrines and bucket shower stalls are an affordable and appropriate option for low-resource settings.
- ☐ There should be at least 1 toilet per 20 users, and more than 30m away from users, with a hand-washing station nearby.[1]
- ☐ Theres should be at least 1 shower per 40 users.[1]
- ☐ Patients and staff should not share latrines or shower blocks.
- ☐ Ideally, staff will use latrines and shower blocks outside of the sectioned off treatment area.
- ☐ There should be separate pit latrines and shower blocks for patients with suspected cases and for those with confirmed cases.
- ☐ If possible, there should be separate pit latrines and shower blocks for men and women. Special attention should be paid to the design and separation of these facilities to minimize the risk of gender-based violence.
- ☐ See Wastewater / Sanitation section for further details.

9. Hand-washing Stations

- ☐ Hand-washing stations should be placed outside latrines, wards and at each main entrance, exit and waiting area. There should be:
- ☐ A minimum of 2 hand wash stations at each main entrance and each waiting area.
- ☐ A simple and affordable hand-washing station consisting of a bucket, plastic tap, wash basin can be set up as described below. Water can be drained off into a gravel pit.

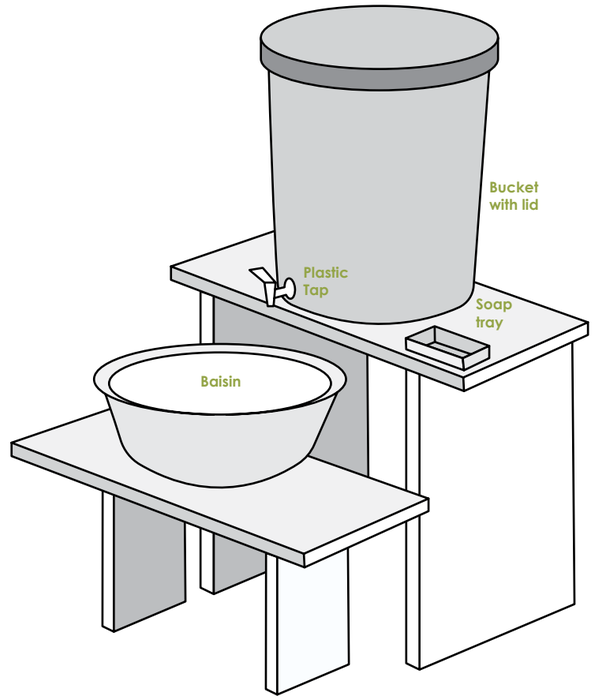

Figure 8: Hand-washing station example

10. Counseling

- ☐ Patients with mild symptoms or who are recovering will need to be counseled by a health practitioner before being discharged and sent homes.
- ☐ A tent, or simple tarp could be set up to create some level of privacy during counseling.

11. Water

Adequate water supply is required for hand washing, drinking water for patients, staff, and family caregivers, cleaning, patient bathing on discharge, laundry.

Sources

The available water sources on site will help inform the system design.

SCENARIO 1: AN ADEQUATE WATER SOURCE ON-SITE

- ☐ If there is an adequate water source on site for the existing hospital this could be used for the treatment center.
- ☐ Water sources could include a well or bore hole, a capture spring, and/or a community system.

SCENARIO 2: NO ADEQUATE WATER SOURCE ON-SITE

- ☐ Water must be trucked in and stored.

Amount of Water needed

- ☐ Non-potable water for ward: 50 litres per ward bed per day
- ☐ Non-potable water for triage/observation: 20 litres per bed/chair per day
- ☐ Potable water: 10 litres per person (including patients and staff)

System Configuration

SCENARIO 1: WATER SOURCE & PRESSURE ON-SITE

- ☐ If there is both an adequate supply and adequate water pressure in the system, piping can be extended from the main supply to the treatment center and then separated into potable and not potable branches.
- ☐ The potable branch goes through filtration or chlorination before being piped to water stations for drinking water.

SCENARIO 2: WATER SOURCE WITH NO PRESSURE ON-SITE

- ☐ If there is adequate supply but not adequate pressure, water for use at the treatment center should be collected in either large plastic tanks or a site built masonry cistern and then an electric circulation pump that is rated for continuous duty should be used to circulate for water at adequate pressure. Often 12-15 PSI/0.8-1.0 bar is adequate for this application.
- ☐ The assumption being made here is that creating pressure through elevation change is not possible as that likely would have been attempted.
- ☐ The scheme for potable water would remain unchanged but note that at low pressure it would be difficult to filter the water through media effectively as this requires typically pressure above 50psi/3.4 bar.

SCENARIO 3: POTABLE WATER SOURCE & PRESSURE ON-SITE

- ☐ If there is adequate water volume and pressure and it is already treated to be potable the system is easy to set up as there is no need

for a secondary treatment to produce potable water.

- ☐ Ensure that frequent testing is done to ensure water quality.

SCENARIO 4: NO ADEQUATE WATER SOURCE ON-SITE

- ☐ If there is no adequate water on site water must be stored in either manufactured tanks or a site built tank.
- ☐ Because of the complexity and cost of designing and building an elevated tank to create pressure, consider using a circulation and pressure pump.
- ☐ The water source should still be split between water that is untreated and goes directly to hand sinks and showers and water that is treated for drinking.

Potable Water Filtration and Treatment

- ☐ There are a number of proven methods to provide water treatment to make it safe to drink. Those methods vary greatly in scope complexity and capital and operating cost. These systems all have pluses and minuses and range from very simple chlorination to very complex reverse osmosis.
- ☐ It is imperative that each site have a qualified engineer in water, sanitation and hygiene design and and oversee the system.
- ☐ Additionally, it is recommended that a back up chlorination system always be designed into the system as these can be very simple and low cost insurance to not make patients sicker from waterborne viruses.

Reserve Capacity

- ☐ Aim to have a reserve capacity of water to last for a minimum of four days, especially if there is any concern about the consistency of the supply.
- ☐ In many sites this will not be practical or possible but should strongly be considered.

12. Sanitation / Wastewater

- ☐ Wastewater from hand sinks, janitorial sinks, and showers should be discharged by gravity into a holding tank for 48 hour retention and chlorination and then discharged into a soak pit, built to WHO and MSF guidelines.
- ☐ Toilets in temporary facilities should be dedicated pit latrines which discharge into a lined tight tank of sufficient size that requires pumping no more than twice per month.
- ☐ The lined pit latrine should have access and inspection hatches and vented to promote breakdown of solids to the WHO guidelines for “Improved Pit Latrines”.
- ☐ There should be an overflow pipe for liquid waste water at least 15 cm below the floor and run to a separate soak pit.

13. Electrical Power Supply

Consistent and safe electrical power is a fundamental requirement for quality health care. The scope of this document is primarily geared toward COVID-19 Treatment Centers that do not require ICU level care however we will touch on that briefly

Power Source Redundancy

- ☐ It is important to have at least two sources of electricity for non-ICU level care. This can be a combination of a diesel generator, solar, batteries or utility grid connection.
- ☐ If the only source of power is a generator, two redundant generators is recommended
- ☐ Install an automatic transfer switch between the two primary sources of power
- ☐ For ICU level case, a UPS installed to feed the receptacles for lights and power at 20kVA is recommended.

Capacity

- ☐ A 20m^2 triage (secondary screening) tent will need at least two electrical circuits: 1 for 120W of LED lighting, 1 for 1500W for equipment
- ☐ A typical 16-bed temporary ward with lighting, power for vital signs monitors, laptops, Dash 4000 monitors, mechanical ventilation will require 10-12kW each
- ☐ Recommendation for power for a 16 bed ward is as follows: Africa- 220V 18kW, 3 Phase 400V 32A; North America- 208V 25kW 1 Phase 2 Pole 208V 100Amp.

Oxygen (Electrical Power Needs)

- ☐ Bedside oxygen concentrators (eg: Air-Sep 10 LPM model) requires 6kW each
- ☐ For a low pressure "Flow only" Oxygen Concentrator 120 LPM would need 10.1kW feed 208V/3PH/35A or 400V/3PH/20A and a 60 LPM needs 5kW feed 208V/3PH/20A or 400V/3PH/10A.

Controls

- ☐ The main circuit breaker and electrical panel should be readily accessible but located outside of patient areas so that a technician can service without PPE.
- ☐ An automatic transfer switch and saddle tank for generators should be provided.
- ☐ Saddle tank should be sized to provide fuel for a minimum of seven days of continuous generator use.
- ☐ Generator and fuel tank should be outside perimeter of COVID treatment center.

Lighting & Receptacles

- ☐ Treatment and administrative areas need a minimum of 40 foot candles of illumination at 1 meter above the floor.
- ☐ All lighting should be securely hung on chain or wire at a minimum of 2.6 meters above the floor. (eg: LED strip lighting)
- ☐ All treatment areas should have a minimum of two duplex receptacles for each bed or patient exam chair.
- ☐ There should be no more than five duplex receptacles on each 20 amp circuit breaker.
- ☐ For ICU, there should be three dedicated 20 amp duplex receptacles for each bed all fed from UPS.

14. Waste Management

Sharp Containers

- ☐ Sharps Containers should be mounted at between 1.3-1.4 meters above the floor.
- ☐ The container should be placed in a visible location, within easy horizontal reach, and below eye level.
- ☐ The container should also be placed away from any obstructed areas, such as near doors, under sinks, near light switches, etc.
- ☐ Containers should be clearly visible to the health care worker.
- ☐ There should be one 5 liter sharps container for every 4 beds or patient exam stations, and no less than 1 sharp container per room.

Bio-hazard Waste

- ☐ Each exam room and ward should be equipped with clearly marked red bio-hazard bags which are 7-10 gallons and are in wheeled containers that have a food pedal operated lid.
- ☐ The bio-hazard bags should be collected and stored in a designated "sluice room" which has a second exit directly to the outside of the treatment center for removal.

Dirty Linens

- ☐ Dirty linens should be collected in a closed hamper in the sluice room which has a second exit directly to the outside of the treatment center for removal.

Disposal / Cleaning

- ☐ Sharps and Bio-hazard bags should be incinerated at a min of 800°C and ash should be buried in a lined pit by staff with PPE.

- ☐ Dirty Linens must be soaked overnight in solution of bleach and water and then washed and dried following normal hospital protocol.
- ☐ Goggles can be reused if soaked for two hours in Bleach and water solution before washing and drying.
- ☐ Disposal gowns and gloves should be incinerated.

15. Oxygen

It is strongly recommended that whenever possible that piped in wall oxygen be used in lieu of H-cylinders. If Piped in-wall oxygen is not possible or practical and if there is sufficient and reliable electrical infrastructure, 10 LPM stand-alone O2 concentrators are recommended.

Supply Quantity

- ☐ 10 LPM per bed is recommended for sizing piped oxygen planning

Reserve & Redundant Capacity

- ☐ If a manifold with high pressure oxygen cylinders is used then there should be an adequate supply for all the beds for 24 hours of use at 6 liters per minute. In a 16 bed ward this would translate to 96 LPM.
- ☐ A 75% diversity factory then can be applied so the 24 hour supply would be 96 LPM x 60 Min *.75= 4320 litters per hour.
- ☐ An H-cylinder yields approximately 7,000 usable liters; so for a 24 hour supply you would need 15 full cylinders.
- ☐ A reserve manifold which is in addition to the 15 cylinders should be a minimum of 4 full H-cylinders.
- ☐ The manifold and zone valve must be connected to an audible (and if possible) visual alarm to notify if there is a drop in oxygen pressure below 40 PSI.
- ☐ Ideally, there should be redundancy in O2. Bedside O2 concentrators are a good option.
- ☐ Anticipate that 40% of hospitalized patients will require O2.

Distribution

- ☐ Should be in clean copper type L or Type K tubing and installed per NFPA 99.
- ☐ Due to the emergency nature of the COVID-19 response it will be acceptable to use Viega ProPress copper fittings or mechanical brass fittings in lieu of brazing oxygen cleaned copper fittings.
- ☐ All fittings should be pre-cleaned and bagged or properly cleaned and rinsed in a solution of TSP and clean water

16. Mechanical Ventilation

- ☐ If there are resources for mechanical ventilation in the wards then this is recommended through the use of exterior exhaust fans and opposite wall/end air intake louvers to achieve 12 air changes/hour (ACH) by volume in the space.
- ☐ It may be possible in some locations and climates to achieve 12 ACH by using natural ventilation especially in a scheme that utilizes low intake and high exhaust.
- ☐ If this method is employed, it is strongly recommended that a professional engineer be consulted and that the space be tested for CO2 build up and transfer prior to the space being operationalized.
- ☐ If mechanical ventilation is used there should be two redundant exhaust fans sufficient for either fan alone to achieve 12 ACH.

17. Network / Internet Connectivity

- ☐ Ability to connect to the Internet whether via wire or via wireless connection wherever layout of facility deems necessary. (Suggest: Dual Wired RJ45 connections at each convenient and/or required location.)
- ☐ Wireless Access Points placed throughout the facility positioned for complete and optimum coverage.
- ☐ Dual Wired RJ45 connections at each convenient and required location
- ☐ Consider backup Internet source from 4G cellular routers, if available.

18. Fire Safety

Fire Extinguisher

- ☐ A10 lbs. type ABC Dry Chemical Multi Purpose Fire Extinguisher is small enough to be handled by most people and large enough to have some capacity to extinguish rapidly spreading flames.
- ☐ Additionally it is recommended that each facility be equipped with at least one wheeled 150 lbs. ABC dry chemical extinguishers with a 50' long hose.
- ☐ Lastly all fire extinguishers should be inspected to ensure they are not expired.

Smoke detectors

- ☐ Combination Smoke/CO2 Alarms are very useful and inexpensive.
- ☐ Use independent battery operated smoke detectors with a 10-year lithium Ion battery.
- ☐ Ideally, have a qualified electrician or engineer provide a layout for the smoke/co2 detectors.