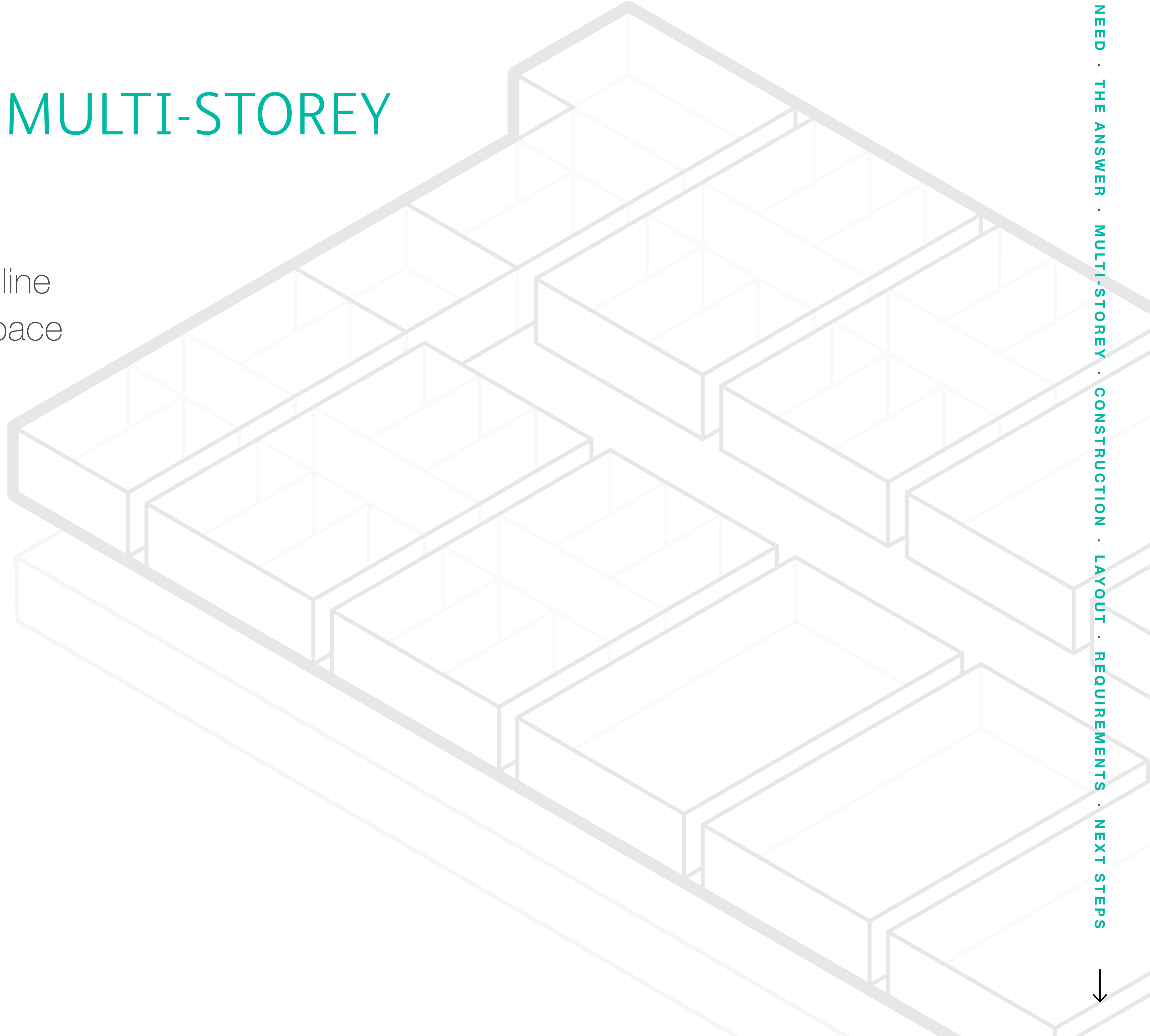
CareBox MULTI-STOREY

A modular design guideline
to provide healthcare space
in confined spaces



ARUP

As the number of people affected by the coronavirus pandemic continues to rise globally, Arup has mobilised a multi-disciplinary team to engage directly with multiple governments, healthcare bodies and NGOs around the world, offering our technical support and guidance.

Healthcare systems across the world are seeking new opportunities to increase their bed capacity at all levels of patient care, from the critical shortage of ICU beds to the provision of field hospitals dealing with large numbers of patients. We have developed a range of scalable, modular and rapid build solutions which can be implemented on existing healthcare campuses or as standalone facilities. This guideline is one of three scenarios to provide specific healthcare spaces for Covid-19 or similar infectious diseases:

1. Plug-in hospitals attached to existing healthcare infrastructures.
2. Confined spaces such as existing multi-storey car parks.
3. Non-confined spaces such as convention centres, sports halls or outdoor areas sheltered by tent or other temporary structure.

Through this collaboration, Arup has developed the CareBox project, applying robust engineering principles to address the immediate challenges of this pandemic. Arup is providing independent, multidisciplinary technical advice to governments, healthcare organisations, and international NGOs responding to the pandemic.

THE NEED

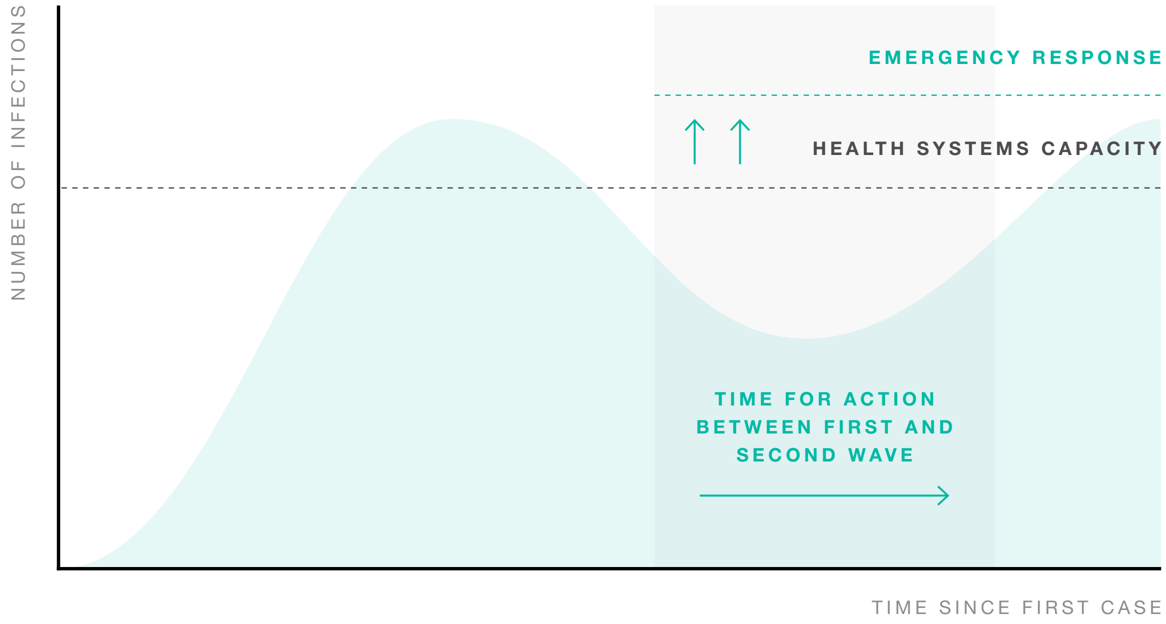
Preventing health system collapse

Flattening the curve is not the only action governments can take to prevent the collapse of healthcare systems. A parallel action is to rapidly increase the number of beds providing care to Covid-19 infected patients. This has been tried using different strategies in China, Italy, Spain, and now everywhere across the globe.

The first strategy is to increase the number of ventilation-assisted and intensive care beds inside the existing hospitals. This is happening everywhere but has a limit due to space constraints.

The next step is to open other beds elsewhere for temporary patients. Hotels are being used in many cities, but it fragments healthcare staff and requires the installation of medical gas utilities that are not easy to deploy.

The CareBox project is a Covid-19 specific modular solution, engineered for rapid deployment, optimization of transportation, replicability and scalability.



"The lessons I've learned after so many Ebola outbreaks in my career are be fast. Have no regrets. You must be the first mover. The virus will always get you if you don't move quickly. Speed trumps perfection."

Dr Michael Ryan,
Executive Director, WHO Health Emergencies Programme.

FLATTENING THE CURVE

The priority should be to flatten the curve. But it could still exceed the capacity of the health system. In that case, it is essential to plan for an increase in capacity that can be implemented in a very short time.

THE ANSWER

Prefabricated modules

The CareBox project identifies a range of solutions, which can be adapted to suit the available space and facilities.

ADAPTABLE DESIGN

The success of any scenario is to apply the core basis of design to a specific location, adapting the principle without losing its values.

FAST PRODUCTION

Units are prefabricated off-site using a worldwide supply chain under clear design principles.

TRANSPORTABLE

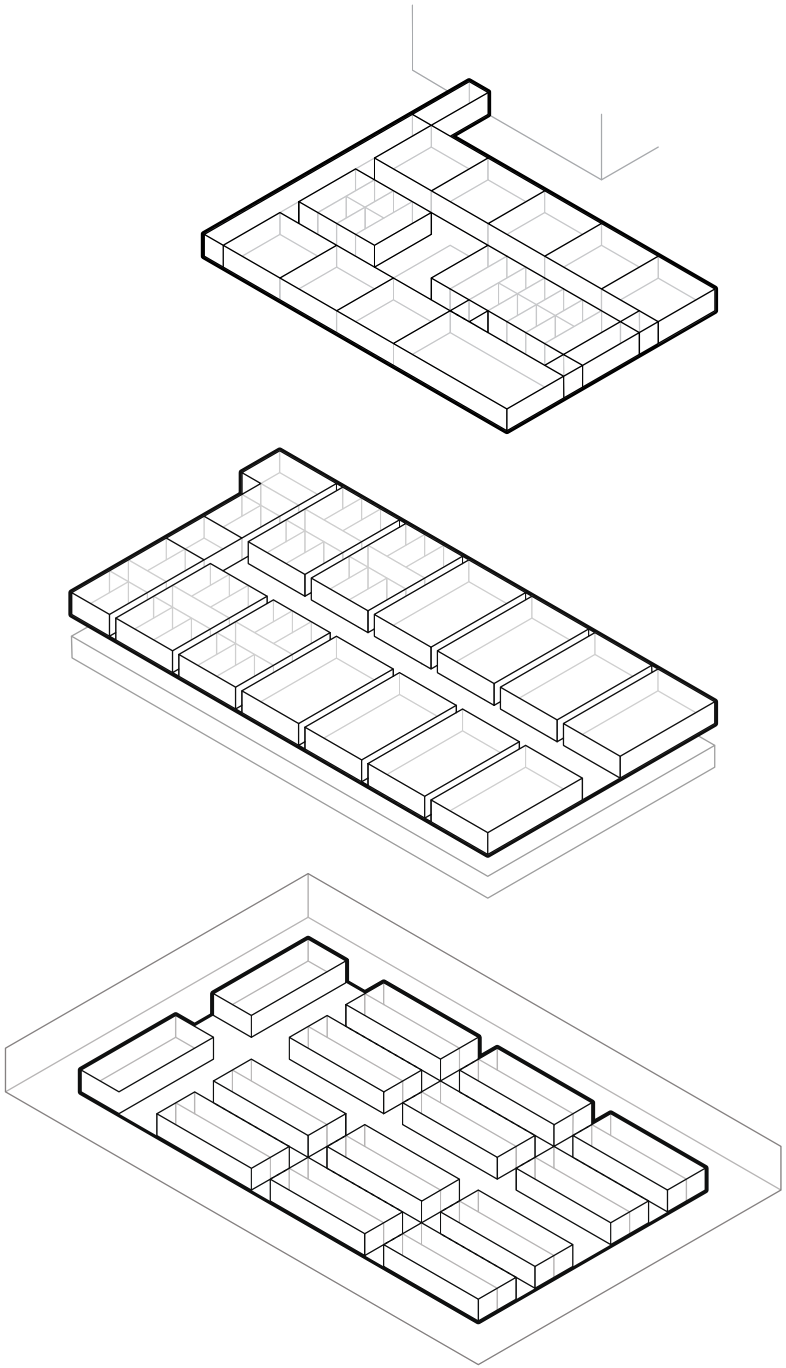
Modules and elements are shipped as flat panels in containers to allow for ship, truck or air cargo.

EASY TO DEPLOY

Once on site, their assembly is easy and repetitive, with a simple modular solution which can be implemented quickly.

COST-EFFECTIVE

The use of modular technologies enables economies of scale to maximise the speed of construction in an efficient manner.



A PLUG-IN
One or more wards connected to an existing hospital.

B MULTI-STOREY
Modules deployed in multi-storey car parks, next to a hospital or not.

C IN-DOOR
Beds and equipment inside existing convention centres or sport halls.

The multi-storey concept

Being able to install additional ward space in a multi-storey car park, or other restricted volumes such as vacant commercial space, provides the opportunity for healthcare premises to expand their capacity when there is limited available space, or for stand alone facilities to be constructed.

EXPAND CAPACITY

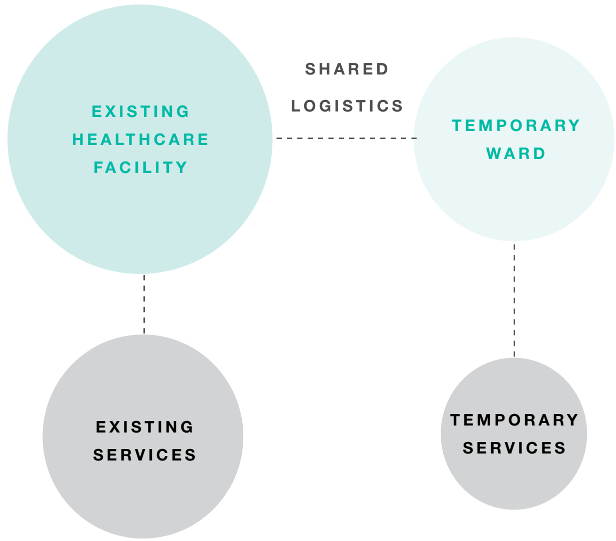
To expand the capacity of an existing facility, the solution must provide additional oxygen supplied ward space without adding pressure to the existing hospital systems, which are likely already strained. The concept is to provide a semi-standalone facility, which provides its own power, medical gases and ventilation, but can make use of the hospitals existing staff and logistical operations.

ADD CAPACITY

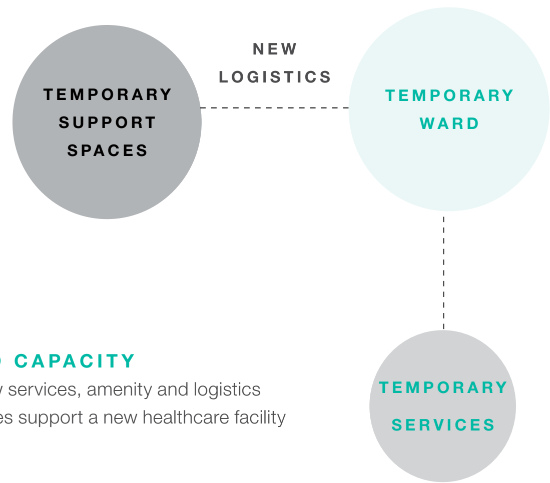
If a new facility is built, the necessary logistics and amenity spaces must also be built to support it. Consideration needs to be given to patient admissions, staff welfare, laundry and cleaning, as well as patient care.

In both cases, the concept provides a scalable solution that can be adapted to the site and needs of the hospital, additional spaces, such as staff amenity and welfare, can added to improve capacity if needed.

This document describes a method and approach that can be applied to the design and construction of new ward space. It does not provide a full ward design or healthcare planning layout, but outlines a philosophy that can be followed, and offers solutions to some of the challenges that will be faced. Local conditions, site constraints, regulations and guidance will shape the design of any ward built using this method, as will the specific needs of the hospital.



EXPAND CAPACITY
- **Independent** power, water, medical gases, heating & ventilation
- **Shared** staff, patient admissions, IT, laundry & cleaning and other logistical services.



ADD CAPACITY
- New services, amenity and logistics spaces support a new healthcare facility

Basis of design

The wards are designed in 16 bed modules, and include the following spaces.

- 16 ICU beds
- Clean & Dirty Utility
- Medicine Store
- Cleaners Rooms
- Patient WCs
- Patient Showers
- Clinical Storage
- General Storage
- Nurses Station
- Disposal hold

The entire ward is treated as contained space, with PPE gowning and de-gowning provided at the entrance, as well as air-locks for bringing patients and goods into and out of the ward.

Door and corridor widths are suitable for the movement of beds and other equipment (2m minimum), and sufficient space is provided around ward beds for the delivery of care. Accessibility requirements, such as disabled WCs and hoists, need to be reviewed on a case-by-case basis, depending on whether alternative ward spaces could be made available for patients with specific needs.

Evacuation routes are dependent on the specifics of the chosen site location; fire design input will be required.

Services are provided to meet the following criteria:

HVAC

- 10 air changes per hour provided by packaged air handling unit
- HEPA filters on extract air
- Temperature controlled by the ventilation system, 20-24°C

Medical gases

The following will be supplied to each bed:

- Inpatient ward: medical oxygen– 10 l/min, medical air (4 bar) – 20 l/min, medical vacuum – 40 l/min. 50% diversity.
- ICU ward/bed: medical oxygen – 40 l/min, medical air (4 bar) – 40 l/min, medical vacuum – 40 l/min. No diversity.

(The flow rates above are based on an assessment of a selection of typical equipment. The final rates will be agreed with the clinical team in accordance with local requirements.).

Water

- 150 l/day per normal bed, 200 l/day for ICU. 1 day storage, increase non-resilient supply
- Resilient incoming water supply required
- Hot water to be generated by local electric water heaters
- Clinical wash hand basins provided with cold water only

Power

- 2no. Generators with resilient UPS supply

Other services

Fire alarm, lighting, nurse call, oxygen enrichment monitoring, data and drainage will also be provided.

Construction

Construction of new clinical spaces within existing internal environments presents unique challenges, including;

- Constrained height
- Existing column grid and services
- Vertical movement of building materials, staff and patients

A method of constructing the space quickly and efficiently is needed. Typically this is done using prefabricated modules, assembled off-site, delivered and positioned to create a ready-made space. The constraints of working in an existing building make this approach impossible, and a more flexible approach is needed.

Vertical transportation

Vertical transportation of bedbound patients who are reliant on oxygen is a specific challenge, as it is unlikely that existing lifts are able to accommodate beds, and the use of oxygen delivery equipment in confined spaces is hazardous. For this reason, and to aid evacuation, it is recommended that ward levels are located on the ground floor with supporting facilities on upper levels if they are required. In the case of a multi-storey car park, patient evacuation could be undertaken using vehicle ramps, provided they are no steeper than 1:12.

CONSTRUCTION

Survey, design and build

Speed of construction is essential, so standardised components and prefabricated sections are used. These places further constraints that the existing space must satisfy.

SURVEY

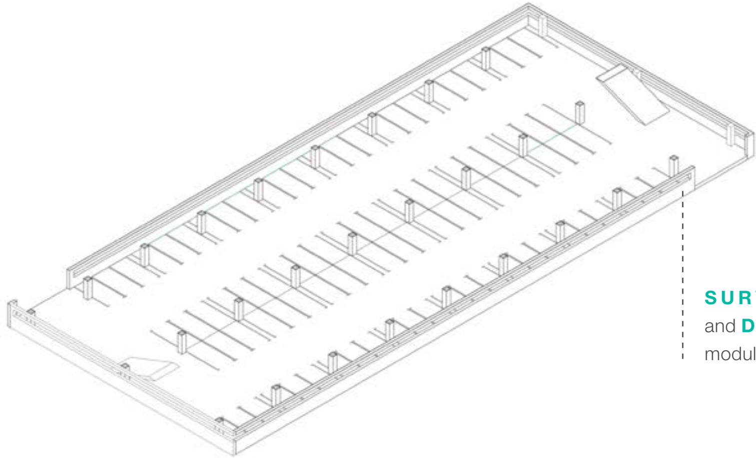
Module frames are built using 4ft (~1.2m) sections, limiting the height of the ward to a minimum of 8ft. The existing space must be surveyed to ensure it can accommodate the standard building blocks of the temporary ward, and that there is sufficient capacity in utilities and space to locate plant. Digital surveying techniques, such as laser scanning, can be used to speed up the process.

DESIGN

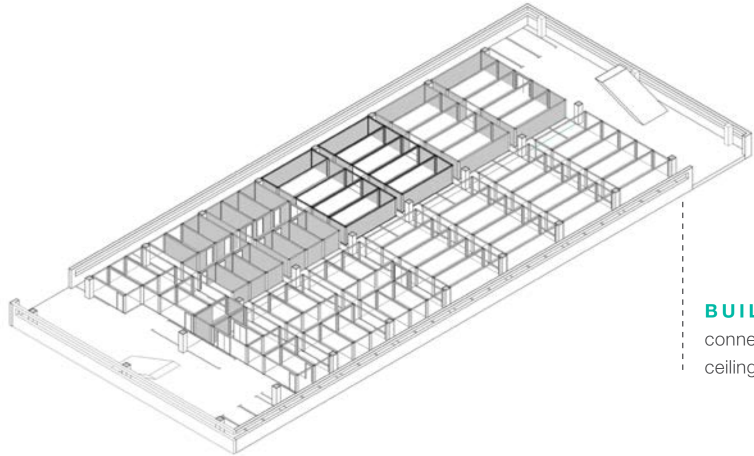
A template ward design is proposed in this document, however, the specific constraints of the existing building will require some element of rearranging, adding or omitting space as required. The modular approach and layout philosophy should be followed.

BUILD

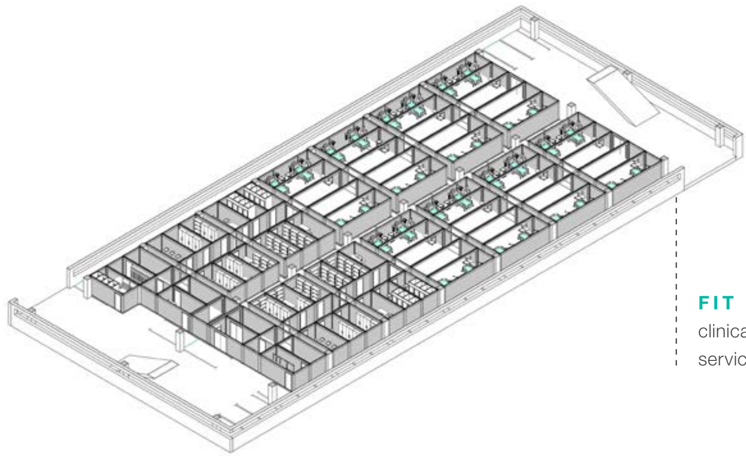
Module frames are fabricated off-site and assembled in-situ to suit the particular clinical and support services layout. Flooring is then laid out and a vinyl finish applied, prefabricated partition walls are positioned, and a light-weight, insulated ceiling installed to create an insulated space that is fit for clinical activity.



SURVEY the proposed space and **DESIGN** the ward using the modular approach.



BUILD modular frames, lay flooring, connect prefabricated walls and install ceiling. Install main services runs.



FIT OUT the space with required clinical equipment and building services.

CONSTRUCTION

Fit out

The height constraint faced in existing spaces presents a challenge for services distribution. A distribution philosophy that avoids running services above or below the clinical spaces has been developed.

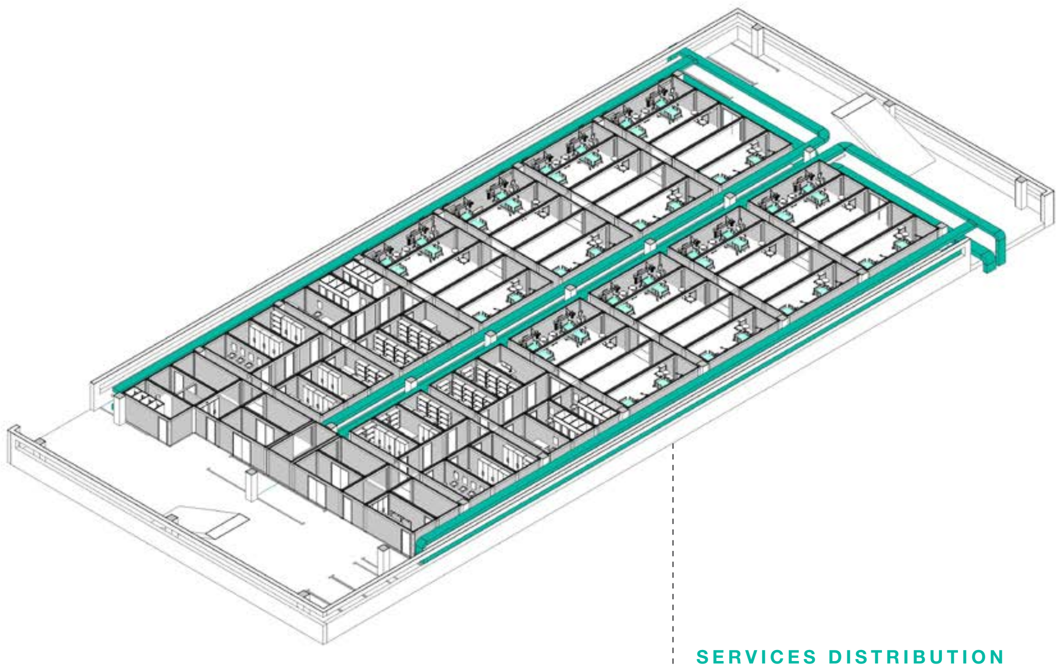
BUILDING SERVICES

Power, water, ventilation and heating are provided by temporary plant, which is independent of any existing hospital plant. Plant can be located on an adjacent floor, or on the same level if there is sufficient space. Distribution is via corridors down either side of the ward. Services then plug into the back of each space as required.

CLINICAL SERVICES

Clinical services follow the same distribution strategy as the building services. Sufficient space is provided around each bed to accommodate the necessary equipment and working room. The below services are provided in each 3,500 x 4,000 bed bay:

_ Medical Oxygen
_ Medical Air
_ Medical Vacuum (bedside unit)
_ Nurse Call
_ Data Points
_ Power
_ Overbed Light



SERVICES DISTRIBUTION
cannot pass above or below clinical spaces due to height restrictions. Dedicated service corridors are needed, which drives the philosophy of the layout.

Layout

Containment line: the whole ward is treated as an isolation area, with all staff remaining in full PPE when inside

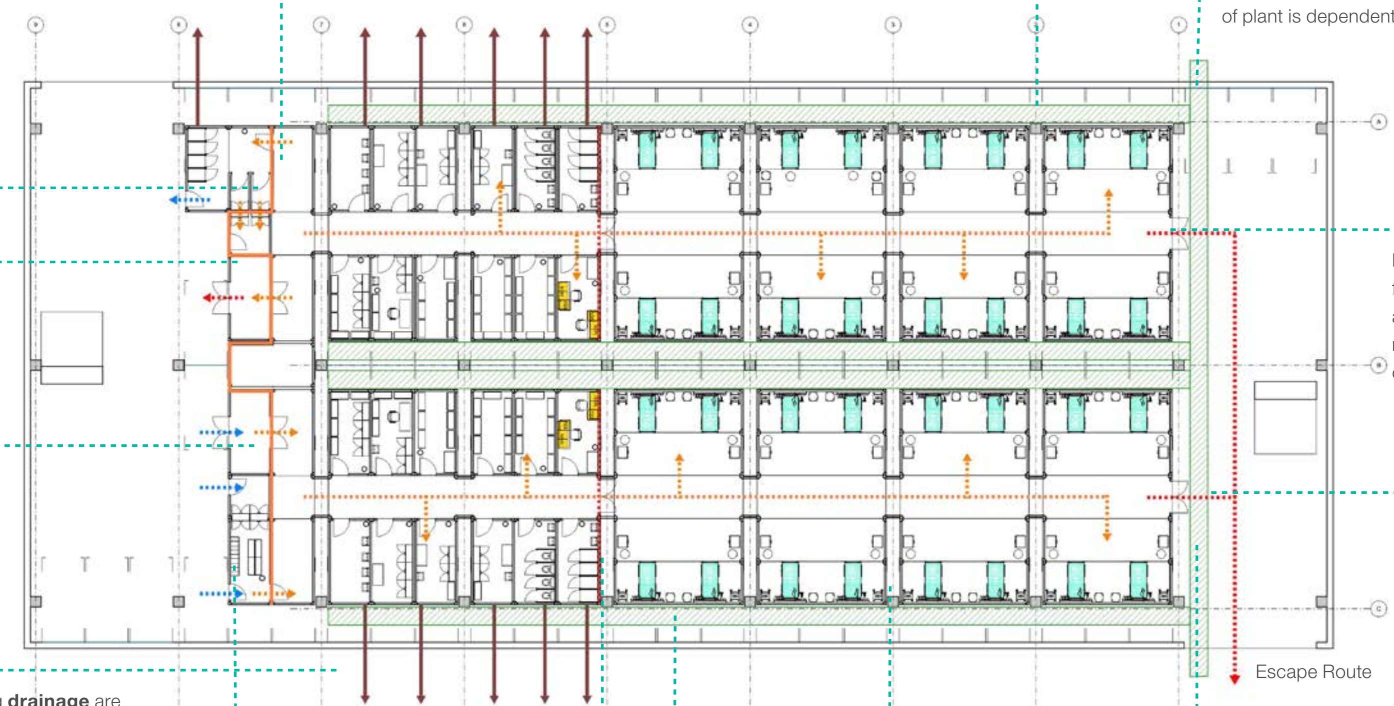
Building and medical services distributed behind wards and ancillary spaces, connecting in to rooms as required.

Service route connects to main plant, located in adjacent space or level. Location of plant is dependent on site constraints.

On exit, staff change out of dirty PPE, dropping it into the dirty PPE store. Shower and changing facilities are provided on exit

Exit airlock allows for dirty and contaminated items to be picked up without the need for an individual to enter the containment area

Entry airlock provides facility for deliveries to be dropped in a clean space, and then picked up by a fully protected staff member from the inside.



Door out of ward to be used for fire escape only. Patients and staff exit the building or move to adjacent level in event of fire.

Services run at high level above escape route and leave sufficient space for escape beneath.

Spaces requiring **drainage** are located close to the façade, so drainage runs can be taken out and dropped externally

Staff enter through PPE change (gowning). Clean PPE is accessed from the adjacent clean PPE store

Fire rated partition separates ward from ancillary spaces

1.2m clear access required for maintenance of services

Layout must work within the existing buildings structural grid and clear height. The layout will differ depending on site constraints.

7.2m wide modules used in ward spaces to allow space for two beds.

Requirements to bear in mind

The highlighted requirements have been developed in the following pages.

MEDICAL GASES
Critical gases such as oxygen and vacuum

ELECTRICITY
Power, distribution, control, safety

HVAC
Heating, air conditioning, HEPA filters

FIRE SAFETY
Prevention, mitigation, intervention, patient relocation, healthcare continuity

PLANT & UTILITIES
Medical gases, water treatment and storage, temporary generators

WATER & SEWAGE
Potable water, DHW, drainage, sewage

CIVIL & STRUCTURES
Ground capacity, foundations, structure

ACOUSTIC & LIGHTING
Comfort at the wards beyond temperature

MEDICAL EQUIPMENT
Required for patient treatment & control

CLINICAL PLANNING
All medical functions in place

WASTE MANAGEMENT
Removal of waste at every step

SUSTAINABILITY
Circular economy, energy saving

LOGISTICS
Ambulance access, air ambulance, general parking, mortuary

SUPPORT SERVICES
Catering, staff change, laundry, laboratory, triage, image diagnostic, etc.

Medical gases

Existing medical gas systems are under increased strain due to the Covid-19 pandemic. Any temporary wards need to be designed to have medical gas systems independent of existing systems in order to add capacity and reduce risk of disruption of supply during installation. Where possible, a piped solution using liquid oxygen is preferred, however, other solutions may be required to suit local available supply.

MEDICAL AIR (4 BAR)

A piped supplied of Medical air will be provided from central plant. A primary and secondary supply will be delivered by either:

- Duplex compressor system and automatic manifold system
- Triplex or quadruplex compressor system

A Reserve supply will be provided by either:

- Automatic manifold system
- Locally-based cylinder

MEDICAL VACUUM

Piped medical vacuum from a central packaged plant should not be provided to an infectious diseases unit, we recommend that portable suction be used to mitigate contamination in an infectious disease unit.

MEDICAL OXYGEN

A piped supply is provided from new central plant. The method of supply is dependent on geographic location and available space, a primary and secondary supply should be delivered by either:

- Bulk liquid oxygen plant (single Vacuum Insulated Evaporator (VIE)) and automatic manifold system
- Bulk liquid oxygen plant (2 No. VIE vessels) located together or apart
- Liquid oxygen cylinder manifold and automatic manifold system
- Pressure Swing Absorption (PSA) oxygen generation. (multiplex compressors and columns) and automatic manifold system

A reserve supply of medical oxygen should be provided by either:

- Automatic manifold system
- Local cylinders

Oxygen enrichment sensors will be located at regular intervals to alert staff to leaking oxygen. The ventilation rate for the wards is kept high to prevent a dangerous build-up of oxygen.

Electricity

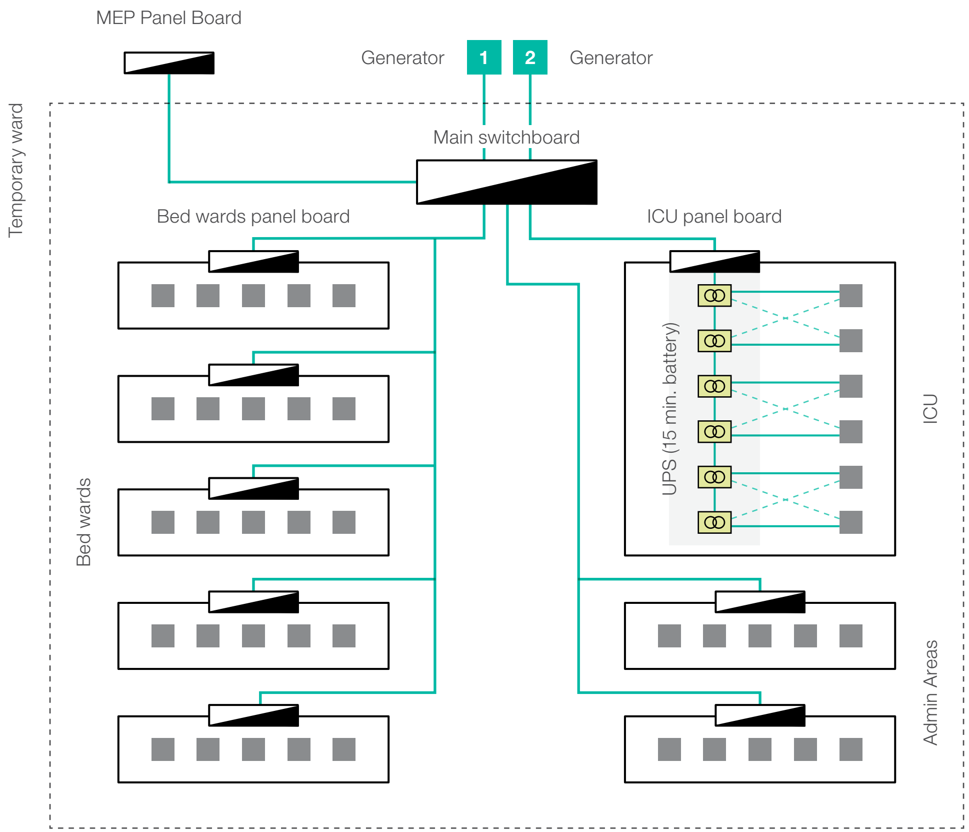
The ward and supporting area are to be supplied from a resilient electrical source. 2No generators are each sized to the accommodate the maximum electrical demand and designed to provide N+1 resilience.

Electrical distribution and low voltage protection systems (panelboards, distribution boards) are used to facilitate the electrical supply requirements.

The beds will require a number of 13A power socket outlets located on the bedhead trunking, providing sufficient supply to any medical devices and patient monitoring systems.

An isolated power supply (IPS) system will provide extra resilience and patient protection to the intensive care unit beds. The intensive care power outlets will be fed from individual supplies deriving from interleaved circuits of 2 individual UPS-backed IPS systems.

All electrical power systems should be provided with 20% spare spatial and electrical load capacity for future equipment installation.



ELECTRICAL SYSTEM
designed to provide resilient power to the ward

HVAC

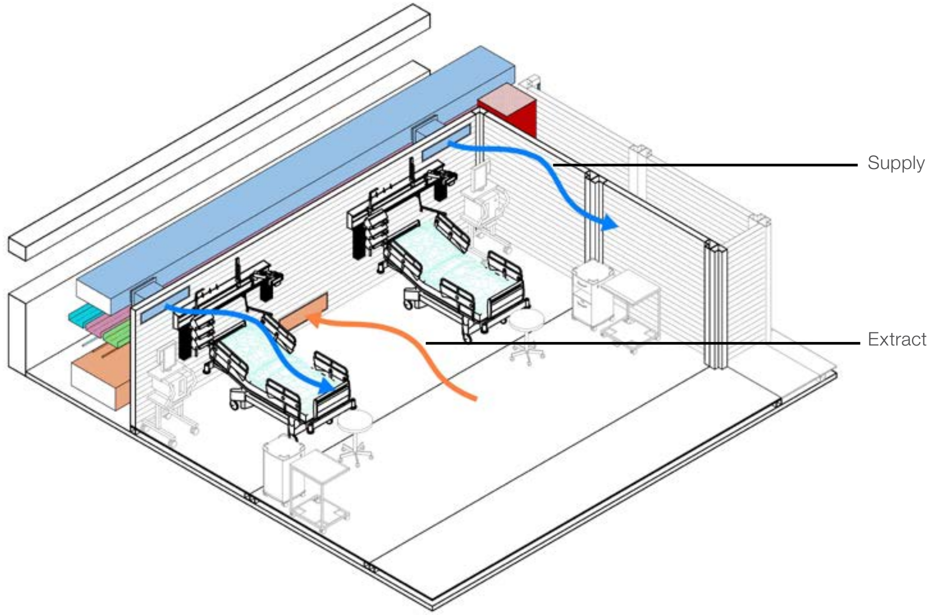
Ventilation is provided at a rate of 10 air changes per hour. This high rate of ventilation is critical to the control of levels of Covid-19 in the space, reducing the risk of infection to staff.

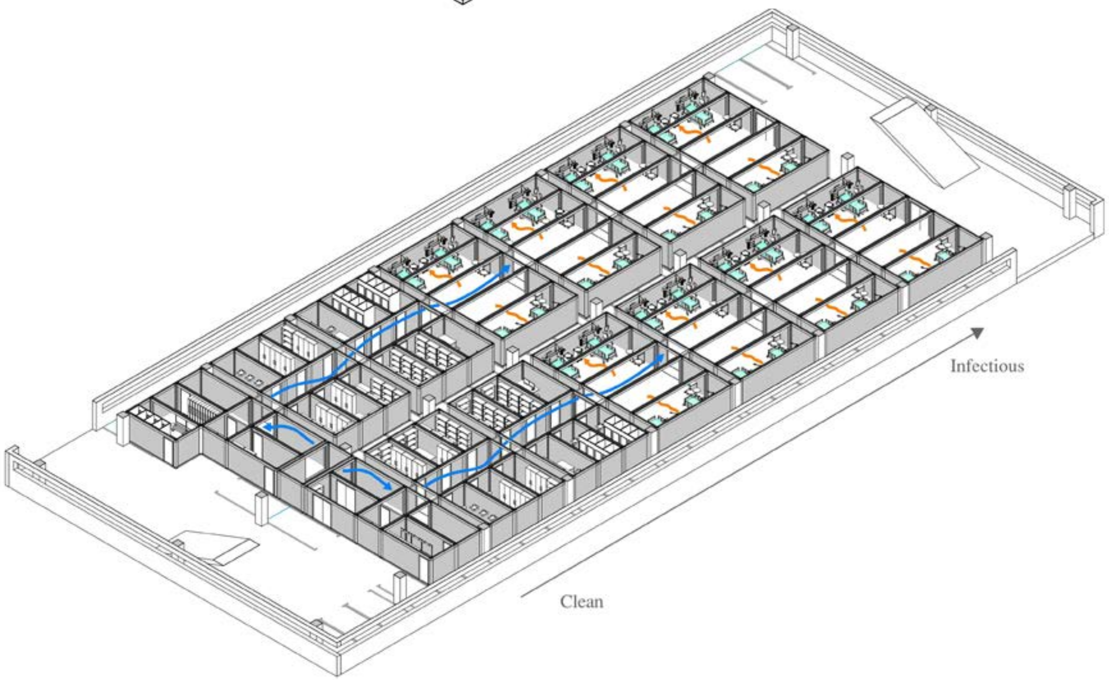
The placing of supply and extract points is also critical to infection control. Air will be supplied at high level and extracted at low level beside the beds, this is the most effective way of removing pathogens from the space. The extracted air should be filtered through a HEPA filter, with a 'safe change' bag-in bag-out facility, to remove pathogens before being discharged to atmosphere.

To reduce the risk of the spread of Covid-19 off the ward, there should be a net airflow from the clean spaces to the contaminated spaces. In the proposed layout, more air is supplied towards the entrance to the ward, and is extracted near the beds.

An airlock system should be implemented at the entrance to the wards, whereby deliveries can be brought into the airlock by one staff member, and picked-up by another staff member from within the ward. These airlocks should be kept positively pressurised by supply air only.

The ward is kept to temperature by the ventilation system, which will include direct expansion coils to heat or cool the fresh air so that internal conditions are maintained.





Fire safety

Fire presents a major risk to the life safety of patients and staff, and to the continuity of essential healthcare. Temporary Covid-19 healthcare facilities present unique challenges that must be assessed and addressed in the fire safety strategy.

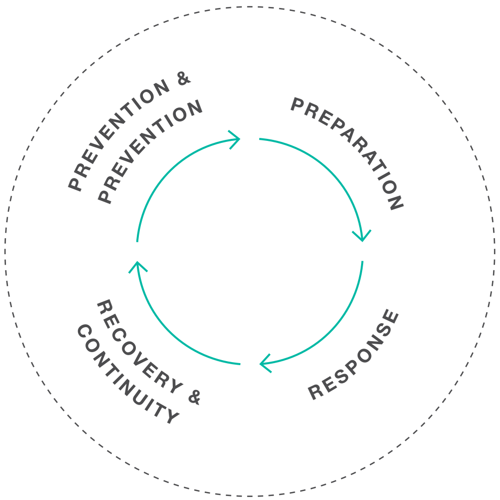
Many or all patients are likely to be high-dependency, bedbound and served by fixed O2 feeds. ICU patients will likely be intubated on ventilators and sedated. Relocation of a patient is usually protracted, requiring connection of a portable O2 bottle and multiple staff to move their bed and all associated equipment. As such, in the event of fire, patient evacuation or relocation should be avoided unless essential. Instead, to reduce the likelihood of significant fire occurring, the focus should be on prevention, mitigation and intervention as part of a crisis response framework.

Oxygen-enriched atmospheres increase the likelihood and potential severity of a fire. Rapid-build hospital construction also presents challenges sourcing non-combustible construction and installing passive and active fire protection measures.

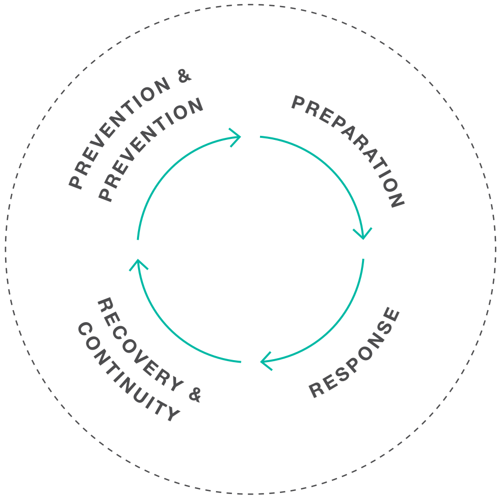
In the face of these challenges and the various other expected project constraints, the fire safety strategy must be based on risk-reduction and an ALARP approach (As Low As Reasonably Practicable). A range of potential fire safety measures may be appropriate, some of which are summarised on the following pages. To establish effective and suitable measures for a particular temporary hospital facility, the fire safety strategy must be developed in partnership with relevant stakeholders including the hospital operators and the local fire and rescue service.

Should a fire occur, early intervention to tackle the fire will be key. Prior to arrival of the local fire brigade, intervention will be via dedicated fire teams on site, preferably by retained firefighters or alternatively non-clinical staff trained in firefighting. Clinical staff should not be relied upon for firefighting intervention.

To support handover, daily fire safety management and emergency response, clear fire safety information must be developed, including on roles and responsibilities, emergency action plans, maintenance, monitoring and housekeeping protocols.



Fire safety



PREVENTION & MITIGATION

- **Electrical fires:** qualified electrical installers, robust residual circuit breakers, certified installations and portable appliances.
- **Stored combustibles & waste:** minimise and remove from wards ASAP.
- **Oxygen-enriched fire risk:** provide adequate ventilation; install oxygen enrichment sensors and alarms; train staff to cap all O2 feeds when connecting temporary O2 bottles (for daily movement and evacuation).
- **Ignition risk from static:** consider checkpoints for testing / discharging static from people / equipment; avoid clothing / PPE prone to static.
- **Construction:** non-combustible walls and ceilings (e.g. gypsum board, metal frame, mineral wool infill – avoid foam insulation, chipboard partitions, plastic canopies, etc.)
- **Linings:** non-combustible wall and ceiling linings.
- **Containment of fire & smoke:** sub-divide floor-plates with at least one 30-minute fire-resisting wall with fire doors (including smoke seals, door closers), fire-stopping (at joints, pipes, cables) & fire dampers (at grills, ductwork).

PREPARATION

- **Early warning:** smoke detection (throughout floors containing wards, any floor below wards and any other areas determined by risk assessment); manual call points; linked to nurses' monitoring stations; avoid widespread alarm which can cause panic and hinder healthcare.
- **Exits from rooms / bays:** doors / openings to be suitably sized for movement of beds + all required equipment, as well as space for staff re-entry simultaneously.
- **Exits from wards:** at least 2 exits to another ward / protected corridor / outside; exits to be remotely located to minimise single-direction travel distances; avoid dead-end corridors.
- **Fire exit doors:** double-doors, outward-opening to allow bed movement.
- **Signage:** clear, conspicuous, graphical emergency signage (back-lit or by lights).
- **Temporary O2:** keep sufficient bottles available to support patient relocation.
- **External exit routes:** weather protected; avoid steps (use ramps).
- **Emergency lighting:** all internal areas & external escape routes.
- **Fire extinguishers:** provide throughout (type appropriate to fire class and occupancy).
- **Fire blankets:** provide throughout.
- **On-site fire teams:** retained professional firefighters (preferably) or trained non-clinical staff.
- **Facilities for firefighters:** assess and retain / adapt existing hydrant network or alternatively deploy fire water truck continuously on site; temporary fire mains; hoses out and ready.
- **Information for firefighters:** floor plans showing firefighting facilities, access, key risks, etc.

RESPONSE

- **Investigation and intervention:** rapid attention by nearest clinical or non-clinical staff to confirm a fire and initiate response (e.g. fire blankets, fire extinguishers, patient relocation).
- **Patient relocation:** a phased approach is necessary to minimise disruption to essential healthcare:
  - Phase 1: move all occupants out of the room / bay of fire origin to the circulation outside the room; mobilise as many staff as possible to assist.
  - Phase 2: relocate the above evacuated occupants across a fire-separation line / to another ward / to outside.
  - Phase 3: if fire is not extinguished, relocate all other occupants of the ward across a fire-separation line / to another ward / to outside..
- **ICU patients:** should be relocated only as absolute last resort.
- **Contamination:** avoid relocating 'dirty' Covid-19 ward to 'clean' areas.

RECOVERY & CONTINUITY

- **Continuity:** relocate patients to other wards / areas with fixed O2.
- **Ward separation:** wards separated using 30-minute fire-resisting walls.
- **Overflow capacity:** provide sufficient space and O2 provisions, etc. in other temporary wards to house relocated patients + beds + equipment.
- **Ongoing care of ICU patients:** separate ICU from wards by fire-resisting walls with fire doors, fire-stopping and fire dampers; avoid routing ICU services through fire-resisting walls.
- **Post-fire smoke clearance:** via doors, vents and portable fans.

Fire safety

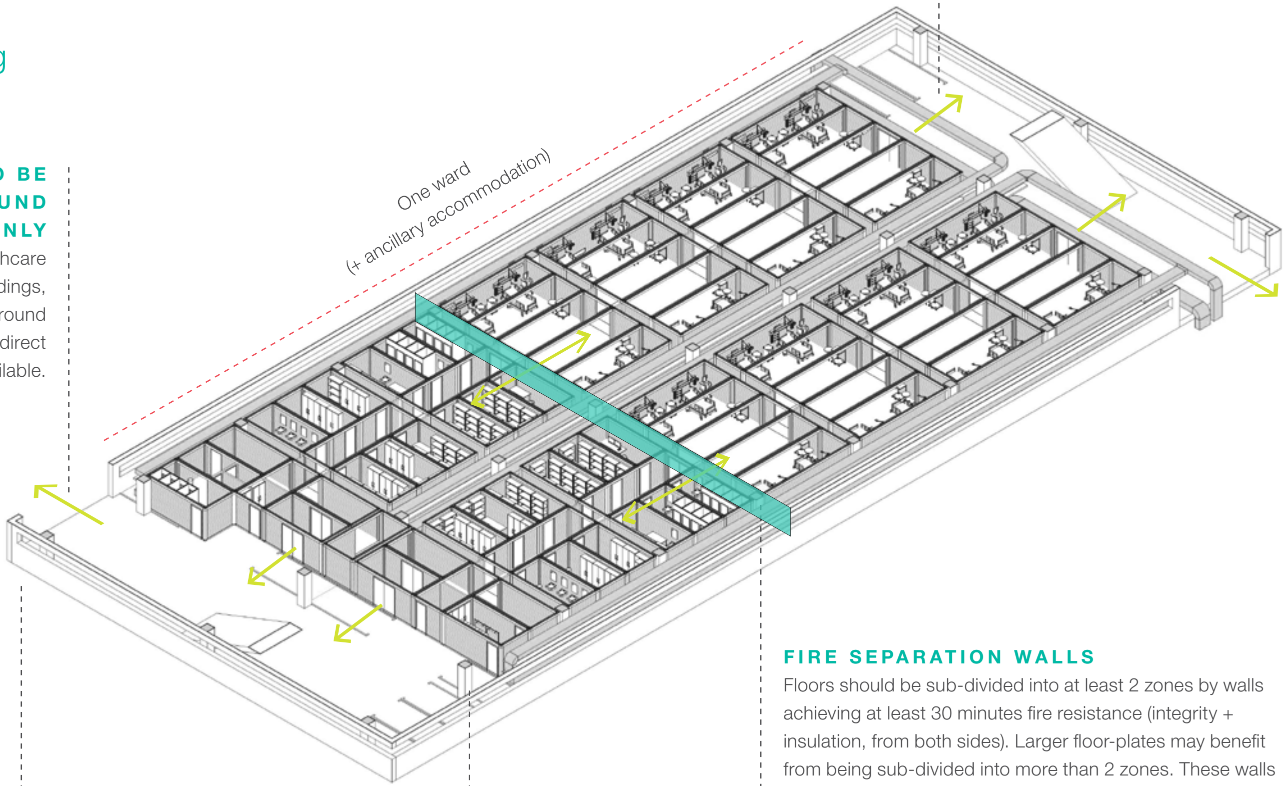
Installing temporary healthcare facilities in existing spaces presents unique challenges. Egress of bed-bound patients and achieving fire compartmentation are key issues that must be considered during detailed design.

MEANS OF EGRESS FROM WARDS

Multiple exits are required from all wards. To support movement of beds, all exits should have outward-opening, double-swing doors.

WARDS TO BE LOCATED ON GROUND FLOOR ONLY

In these temporary healthcare facilities within existing buildings, wards should be located at ground floor only, with multiple exits direct to outside available.



WARNING OF A FIRE ELSEWHERE IN THE BUILDING

Where the existing building does not have an automatic fire detection and alarm system, such a system should be installed throughout floors containing wards, any floor below wards and any other areas determined by risk assessment.

FIRE RESISTANCE OF EXISTING STRUCTURAL ELEMENTS

To support patient relocation and firefighting, the building structure should achieve at least 60 minutes fire resistance. Existing elements of structure and passive fire protection must be inspected and assessed for fire resistance (e.g. concrete cover, boarding, intumescent paint). Buildings with unprotected steel structure must not be used.

FIRE SEPARATION WALLS

Floors should be sub-divided into at least 2 zones by walls achieving at least 30 minutes fire resistance (integrity + insulation, from both sides). Larger floor-plates may benefit from being sub-divided into more than 2 zones. These walls should be full-height from existing building floor to soffit, and extend to the existing building elevations. The walls should include FD30S fire doors (with self-closers and smoke seals), fire-stopping at all joints and penetrations (cables, pipes) and fire dampers on any grills or non-fire-rated ductwork passing through (motorised dampers recommended where feasible; fusible link dampers otherwise).

REQUIREMENTS

Plant & Utilities

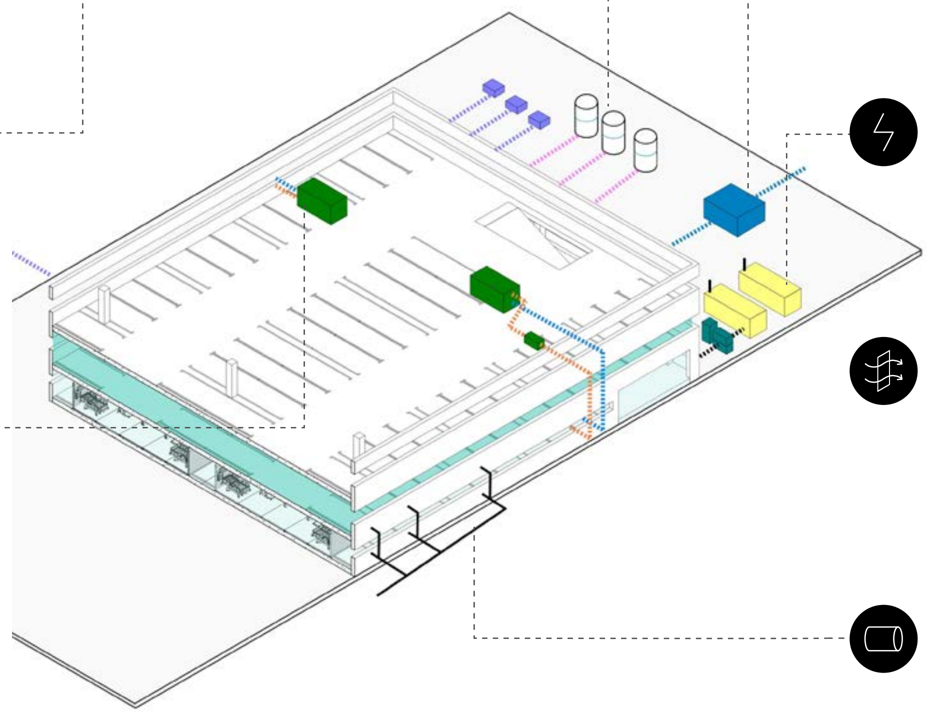
MEDICAL AIR
A specialist air compressor system and/or gas cylinder system will need to be provided for medical air. Plant to be packaged where possible to provide medical grade air to the facility. Configuration to be a primary, secondary and tertiary. Primary and secondary to be a compressor system, and tertiary system to be another compressor system or gas cylinders.

MEDICAL OXYGEN
The method of providing medical oxygen is dependant on location, a specialist should be consulted to advise the most appropriate positioning on central plant, which may need to be accessed for regular deliveries. Configuration to be a primary, secondary and tertiary. The plant could be Vacuum insulated Evaporator (VIE), Pressure Swing Adsorption (PSA) or gas cylinders.

HVAC
Packaged air handling units are used to ventilate, heat and cool the new ward. They should include direct expansion coils connected to condenser units, which will provide the necessary heating and cooling to the air stream.

DATA
A data connection is needed for communications and connectivity with existing hospital systems.

FIRE SUPRESSION
Depending on country code and building specific requirements, a fire supression system may be required.



WATER
A connection to the local potable water main is needed, feeding a water storage tank. A booster set is needed to supply water from the tank. Water treatment may be needed depending on location and the performance requirements of the facility.

ELECTRICITY
Delivered by two generators and an uninterruptible power supply, which must be located on or adjacent to the building. Consideration to the flue location should be given, to avoid fumes entering fresh air intakes.

FILTRATION
Extract air is HEPA filtered by central HEPA filter units on each ventilation system, or at the exit from each fire compartment. Filters should be located up stream of any equipment such as fire dampers. Bag-in, Bag-out safe change filters should be used.

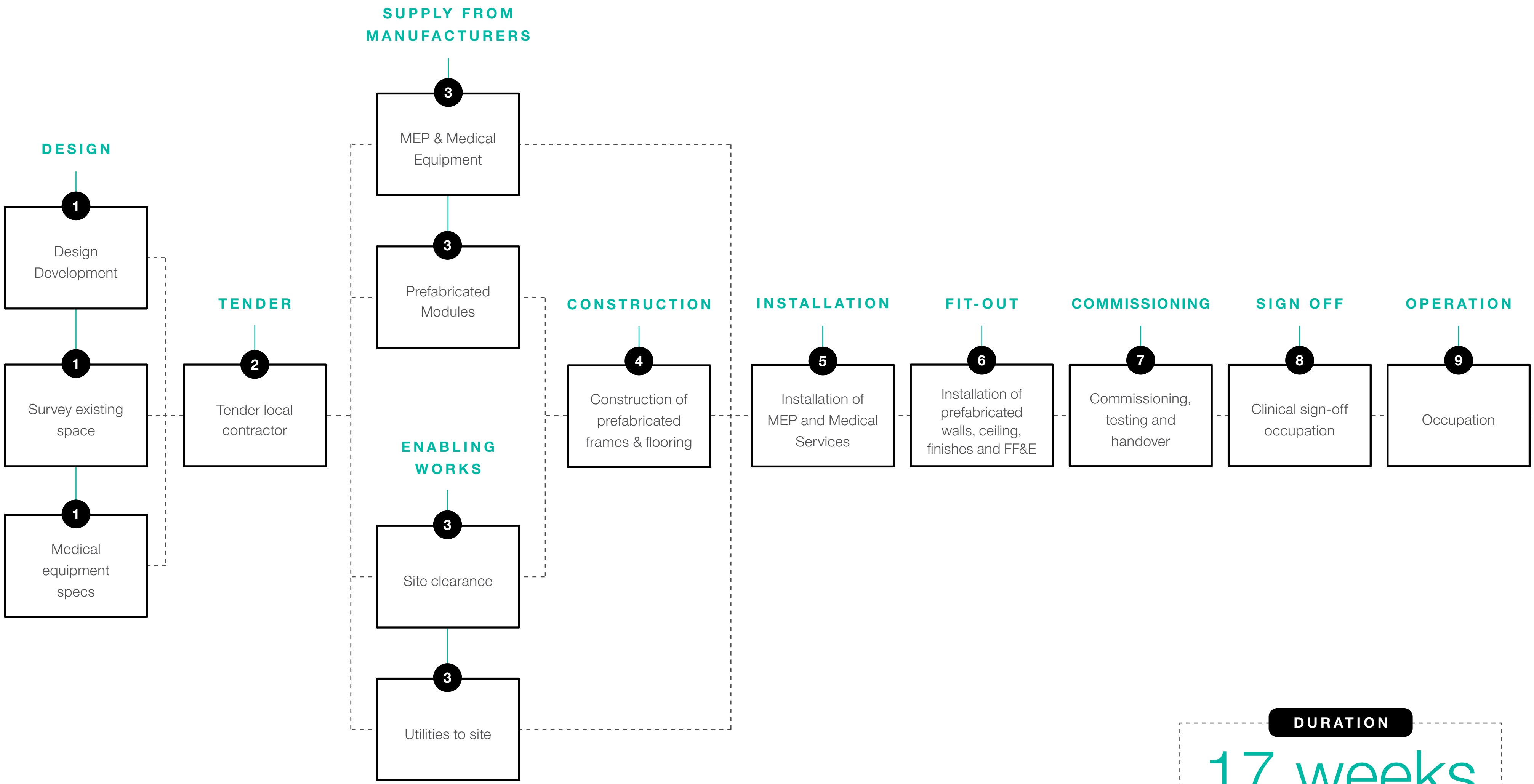
DRAINAGE
Drainage will need to be connected to the local sewer. Gravity drainage should be provided wherever possible. Wet areas that require drainage should be grouped together to limit the number of connections needed. Load calculations will need to be assessed in relation to the existing drainage system. Where new loads exceed the existing drain capacity, then sewerage attenuation tanks shall be incorporated into the design.

Health & Safety Warning

Safety distances to specific site hazards for medical air and oxygen plant will need to be adhered to. A certified structural engineer will need to be consulted on the positioning and associated loadings of all equipment. Breaking into live drains will require risk assessment and general load study of the existing drainage system.

NEXT STEPS

Flow chart



DURATION

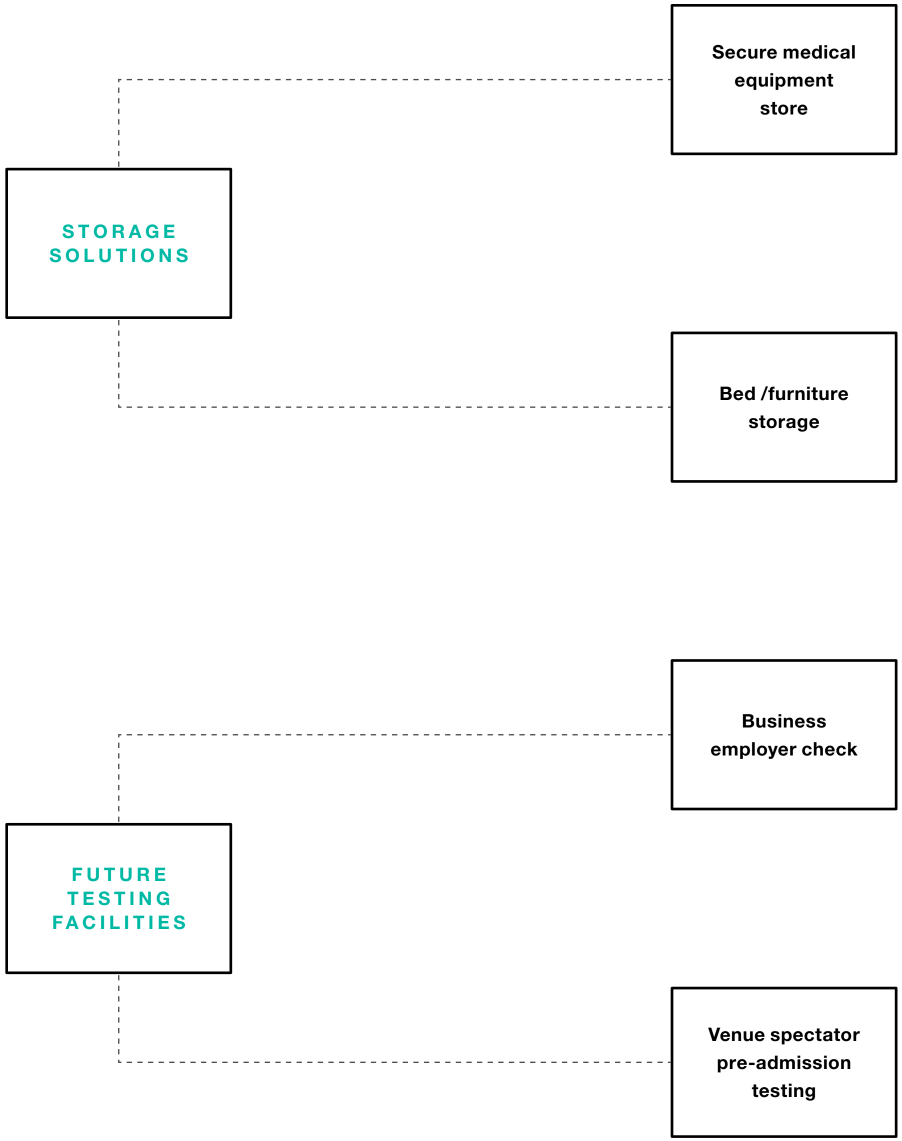
17 weeks

Post-lockdown

LOOKING FORWARD
as normal life resumes (post lockdown), it is likely temporary facilities will be required for checking and storage.

EVIDENCE SUGGESTS
the virus is likely to spread again and further lockdowns will be required. Having secure storage near previous hospital sites would enable these facilities to be quickly deployed and operational with minimal delay.

AS RESTRICTIONS ARE LIFTED
on people movement, it is likely that entry checks will be carried out, monitoring the health of people entering work and leisure facilities. These could be temporary 'check in' security points, outside of the buildings secure perimeter.



CareBox MULTI-STOREY

IMPORTANT NOTE

13 Fitzroy Street
London
W1T 4BQ
www.arup.com
carebox@arup.com

ARUP