ACT Government | Canberra Health Services

Our reference: **CHSFOI22-23.37**

[redacted]

Dear [redacted],

DECISION ON YOUR ACCESS APPLICATION

I refer to your application under section 30 of the *Freedom of Information Act 2016* (FOI Act), received by Canberra Health Services (CHS) on **Tuesday 10 January 2023**.

This application requested access to:

> *'Any documents, ministerial briefing notes and correspondence held by any relevant ACT government health agencies, including Canberra Health Services and ACT Health about ventilation at the Garran Surge Centre.*
>
> *This request includes but is not limited to:*
>
> - *Any documents or communications around ventilation at the Garran Surge Centre*
> - *A section J compliance report.'*

I am an Information Officer appointed by the Chief Executive Officer of Canberra Health Services (CHS) under section 18 of the FOI Act to deal with access applications made under Part 5 of the Act. CHS was required to provide a decision on your access application by **Wednesday 1 March 2023**.

I have identified 11 documents holding the information within scope of your access application. These are outlined in the schedule of documents included at Attachment A to this decision letter.

Decisions

I have decided to grant partial access to 11 documents.

My access decisions are detailed further in the following statement of reasons and the documents released to you are provided as Attachment B to this letter.

In reaching my access decision, I have taken the following into account:

- The FOI Act;
- The contents of the documents that fall within the scope of your request;
- The views of relevant third parties; and
- The *Human Rights Act 2004*.

Partial Access

Redactions have been made to documents at references 1-5 and 7-11 to information that I consider, on balance, to be contrary to the public interest to disclose under the test set out in section 17 of the Act. The information contained in these documents are partially comprised of email addresses, mobile numbers, signatures, and photos of ACT Government employees and non-ACT government employees.

Documents at references 4, 6 and 9 contain redacted information that may prejudice the security and business affairs of the agency.

Public Interest Factors Favouring Disclosure

The following factors were considered relevant in favour of the disclosure of the documents:

- Schedule 2, 2.1(a)(i) promote open discussion of public affairs and enhance the government's accountability; and
- Schedule 2, 2.1(a)(ii) contribute to positive and informed debate on important issues or matters of public interest.

Public Interest Factors Favouring Non-Disclosure

The following factors were considered relevant in favour of the non-disclosure of the documents:

- Schedule 2, Schedule 2.2 (a)(ii) prejudice the protection of an individual's right to privacy or any other right under the *Human Rights Act 2004*;
- Schedule 2, Schedule 2.2 (a)(iii) prejudice security, law enforcement or public safety; and
- Schedule 2, Schedule 2.2 (a)(ix) prejudice trade secrets, business affairs or research of an agency or person.

Following the considerations of the above factors I have decided the factor favouring non-disclosure outweighed the factors favouring disclosure. Therefore, I have determined the information identified is contrary to the public interest and I have decided not to disclose this information.

In reference to the scope '*A section J compliance report'*, the Garran Surge Centre was granted an exemption of Section J certification requirements. The instrument referencing the exemption can be accessed via the ACT Legislation Register: Building (General) Emergency Hospital Exemption 2020 (No 1) | Disallowable instruments (act.gov.au).

Charges

Processing charges are not applicable to this request.

Disclosure Log

Under section 28 of the FOI Act, CHS maintains an online record of access applications called a disclosure log. The scope of your access application, my decision and documents released to you will be published in the disclosure log not less than three days but not more than 10 days after the date of this decision. Your personal contact details will not be published. https://www.health.act.gov.au/about-our-health-system/freedom-information/disclosure-log.

Ombudsman review

My decision on your access request is a reviewable decision as identified in Schedule 3 of the FOI Act. You have the right to seek Ombudsman review of this outcome under section 73 of the Act within 20 working days from the day that my decision is published in ACT Health's disclosure log, or a longer period allowed by the Ombudsman.

If you wish to request a review of my decision you may write to the Ombudsman at:

The ACT Ombudsman
GPO Box 442
CANBERRA ACT 2601
Via email: ACTFOI@ombudsman.gov.au
Website: ombudsman.act.gov.au

ACT Civil and Administrative Tribunal (ACAT) review
Under section 84 of the Act, if a decision is made under section 82(1) on an Ombudsman review, you may apply to the ACAT for review of the Ombudsman decision. Further information may be obtained from the ACAT at:

ACT Civil and Administrative Tribunal
Level 4, 1 Moore St
GPO Box 370
Canberra City ACT 2601
Telephone: (02) 6207 1740
http://www.acat.act.gov.au/

Further assistance
Should you have any queries in relation to your request, please do not hesitate to contact the FOI Coordinator on (02) 5124 9831 or email HealthFOI@act.gov.au.

Yours sincerely,

Colm Mooney
Executive Group Manager
Infrastructure and Health Support Services
Canberra Health Services

27 February 2023

ACT Government | Canberra Health Services

FREEDOM OF INFORMATION SCHEDULE OF DOCUMENTS

Please be aware that under the *Freedom of Information Act 2016*, some of the information provided to you will be released to the public through the ACT Government's Open Access Scheme. The Open Access release status column of the table below indicates what documents are intended for release online through open access.
Personal information or business affairs information will not be made available under this policy. If you think the content of your request would contain such information, please inform the contact officer immediately.
Information about what is published on open access is available online at: http://www.health.act.gov.au/public-information/consumers/freedom-information

APPLICANT NAME	WHAT ARE THE PARAMETERS OF THE REQUEST	FILE NUMBER
[redacted]	*'Any documents, ministerial briefing notes and correspondence held by any relevant ACT government health agencies, including Canberra Health Services and ACT Health about ventilation at the Garran Surge Centre.* *This request includes but is not limited to:* • *Any documents or communications around ventilation at the Garran Surge Centre* • *A section J compliance report.'*	**CHSFOI22-23.37**

Ref Number	Page Number	Description	Date	Status Decision	Factor	Open Access release status
1.	1 – 9	Email – RE: COVID-19 ED – Mechanical Drawings	07 May 2020	Partial Release	Schedule 2, 2.2(a)(ii) Privacy	YES
2.	10 – 12	Email – RE: Garran Surge Centre Air Ventilation Assessment	08 September 2021	Partial Release	Schedule 2, 2.2(a)(ii) Privacy	YES
3.	13 – 131	Email and attachment – Garran Surge Centre Air Ventilation Assessment	29 September 2021	Partial Release	Schedule 2, 2.2(a)(ii) Privacy	YES
4.	132 – 186	Email and attachments – RE: Surge Centre: Request for Information	29 September 2021	Partial Release	Schedule 2, 2.2(a)(ii) Privacy, Schedule 2,	YES

		Attachment 1 Third party email and 2nd attachment (Attachment to email included @ ref 3) Attachment 2 Third party Attachment 3 Internal consult			2.2(a)(iii) Security, Schedule 2, 2.2(a)(xi) Business Affairs	
5.	187 – 189	Email – RE: Surge Centre: Request for Information	04 October 2021	Partial Release	Schedule 2, 2.2(a)(ii) Privacy	YES
6.	190 – 200	Document – COVID-19 Garran Surge Centre Infrastructure Review	05 October 2021	Partial Release	Schedule 2, 2.2(a)(iii) Security, Schedule 2, 2.2(a)(xi) Business Affairs	YES
7.	201 – 205	Email – FW: Surge Centre Garran Review	14 October 2021	Partial Release	Schedule 2, 2.2(a)(ii) Privacy	YES
8.	206 – 210	Email – FW: Review: Fire Report COVID-19 ED	14 October 2021	Partial Release	Schedule 2, 2.2(a)(ii) Privacy	YES
9.	211 – 254	Email and attachments – FW: Review: Fire Report COVID-19 ED	14 October 2021	Partial Release	Schedule 2, 2.2(a)(ii) Privacy, Schedule 2, 2.2(a)(iii) Security, Schedule 2, 2.2(a)(xi) Business Affairs	YES
10.	255 – 264	Email and attachments – Surge Centre – Design Assessment Comments by CHS Attachment 1 @ ref 1 Attachment 2 @ ref 9&10 Attachment 3 Internal consult email (Attachment to email included @ ref 1) Attachment 4 Internal consult email (Attachments to email @ ref 3&4) Attachment 5 @ ref 9 Attachment 6 @ ref 10	14 October 2021	Partial Release	Schedule 2, 2.2(a)(ii) Privacy	YES

11.	265 – 268	Email and attachments – COVID-19 Emergency Department – CHS Design Briefing Requirements Attachment 1 @ ref 3 Attachment 2 Out of scope Attachment 3 attached	15 October 2021	Partial Release	Schedule 2, 2.2(a)(ii) Privacy	YES
Total Number of Documents						
11						

From: Tarbuck, Chris (Health)
Sent: Thursday, 7 May 2020 11:42 AM
To: Gray, Sophie; Beswick, Kevin; Catanzariti, John
Cc: Brady, Vanessa (Health); Mooney, Colm (Health)
Subject: RE: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

Hi Sophie,
Thank you for the advice, I appreciate your position. If I can be of assistance, at any time, please let me know.

Regards,

Chris Tarbuck | Facilities Director, Infrastructure and Health Support Services
Phone: (02) 5124 3186 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
Facilities Management| Canberra Health Services | ACT Government
Level 1, Building 1, Canberra Hospital, Garran ACT 2605 | health.act.gov.au
RELIABLE | PROGRESSIVE | RESPECTFUL | KIND

From: Gray, Sophie
Sent: Thursday, 7 May 2020 11:27 AM
To: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>; Beswick, Kevin <Kevin.Beswick@act.gov.au>; Catanzariti, John <John.Catanzariti@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>; Mooney, Colm (Health) <Colm.Mooney@act.gov.au>
Subject: RE: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

UNCLASSIFIED

Hi Chris

The Territory has engaged AECOM as the FM Peer Review agent for this project. Aspen Medical have full responsibility for the operation of the facility and have appointed both their HVAC advisor and a clinical technical advisor to inform design against the specific requirements for a bespoke COVID-19 treatment centre. The prototype technical specification has been provided to the Territory by World Health Organisation to inform where the design is required to vary from the Australasian Health Facility Guidelines.

On this basis and noting the time within which the facility is required to be delivered (construction completion 15 May 2020), your detailed review is not required at present. The AECOM FM Peer Review report can be provided to you when this is available. Responses to your questions to date are being prepared and will be provided within the team's resourcing availability.

Your input has as always been useful and appreciated. We are at a critical period of the project and I have spoken to Vanessa Brady about how we best use the available resources to deliver the project to government expectations. If you have any queries about this process which I recognise is not consistent with our usual project protocols, could you speak to Vanessa who can provide further background.

Many thanks
Sophie

From: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Sent: Wednesday, 6 May 2020 5:21 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>; Gray, Sophie <Sophie.Gray@act.gov.au>
Subject: RE: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

Hi Kevin,
As requested below, have the final HVAC drawings and calculations been completed, if so can I please receive them for review.

Regards,

Chris Tarbuck | Facilities Director, Infrastructure and Health Support Services
Phone: (02) 5124 3186 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
Facilities Management| Canberra Health Services | ACT Government
Level 1, Building 1, Canberra Hospital, Garran ACT 2605 | health.act.gov.au
RELIABLE | PROGRESSIVE | RESPECTFUL | KIND

ACT Government | Canberra Health Services

From: Tarbuck, Chris (Health)
Sent: Sunday, 3 May 2020 7:07 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>; Gray, Sophie <Sophie.Gray@act.gov.au>
Subject: FW: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

Hi Kevin
There are several essential items, as indicated below in yellow, that we will require to complete an evaluation of the Mechanical design. Item 16 is particularly critical for our review.

Can I please request that when the mechanical drawings and calculations are finalised that a completely clean set of all current documents are forward to me in an email and that we do not access Red Hub for update documentation. This will ensure we are all on the same page, reviewing only once, the full set of finalised mechanical design documentation.

Item 21: Please ensure pressure regime alarms are installed. This will ensure that the required pressures are maintained, and if they do fail, immediate servicing can occur.

Can I please request that the final design documentation is forward by COB tomorrow.

I will respond tomorrow to the information provided by Matthew.

Regards,

Chris Tarbuck | Facilities Director, Infrastructure and Health Support Services
Phone: (02) 5124 3186 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
Facilities Management| Canberra Health Services | ACT Government
Level 1, Building 1, Canberra Hospital, Garran ACT 2605 | health.act.gov.au
RELIABLE | PROGRESSIVE | RESPECTFUL | KIND

ACT Government | Canberra Health Services

From: Matthew Gygi [redacted]
Sent: Sunday, 3 May 2020 6:35 PM
To: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Subject: Fwd: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

Hi Chris, answers to your comments can be found below.

Sent from my SAMSUNG Galaxy S7 on the Telstra Mobile Network

From: Matthew Gygi <[redacted]>
Sent: Friday, 1 May 2020, 5:22 pm
To: Beswick, Kevin
Cc: Donaldson, Ben
Subject: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

Hi Kevin, my responses are in RED

1. Please confirm if there is an intention to provide separated fire zones for the building. The area looks around 1,700 square meters. The building is a single fire zone with 4 smoke compartments. A fire engineering solution has been employed (and accepted by the Fire Brigade).
2. Please confirm if there is an intention to provide active smoke control for the building? Refer to fire engineers advice. None allowed for in the current mechanical design.
3. Please confirm if there is an intention to provide fire sprinkler protection for the building, I presume not? The Fire Engineering Solution excludes the installation of fire sprinklers.
4. Please confirm if it is intended to shut the plant down in fire mode? Yes
5. Please confirm if there has a pressure regime developed showing the direction of air flow at each door? The current regime is to have a -ve pressure in the wards, triage and resus bays and +ve pressure in other zones. Slight adjustments to our current drawings are being produced to clarify these regimes.
6. Please confirm if the red ward spaces will be negatively pressurised? Yes
7. Please confirm if the staff spaces will be positively pressurised? Yes
8. Please confirm how the pressure regime will be air balanced to achieve the desired outcome? The mechanical engineering calculations will be implemented by the mechanical contractor. Please forward these calculations to me.
9. The safety in design comment indicates that there are no unique risks with the design. This seems counter-intuitive given that the design is for an unprecedented pandemic response and the ventilation system designs can assist in mitigating or otherwise the COVID-19 risks to staff. Design is in accordance with the SARI treatment center manual. No further comment
10. Without airlocks between the wards and outside please confirm if it is anticipated that the negative pressure regime will draw untreated cold air into the ward spaces in winter and hot air in summer and generate problems with conditions. Staff corridors +ve pressure will balance the -ve pressure in wards, resus and triage. Slight adjustments to current design are being made to assist in this balance. Building overall pressure is to be +ve pressure.
11. No ventilation is shown to the following rooms, please confirm if that complies with the relevant standards?
    - Medical gas store, is an exhaust register appropriate for this room? Medical Gas room has been re-appropriated to storage, no exhaust
    - Dry store and food services no exhaust

- Data services Aspen data services has no ceiling and is open to the roof area. CHS Data has no exhaust and has not requested it, air conditioners only in CHS room
- Electrical. Is there a UPS? No UPS, all critical devices will have individual UPS to keep continuity until backup generator kicks in (20 seconds)
- Stores (confirm if these are sterile stores which require special treatment) HEPA? No

12. The design shows a mixing of toilet exhaust and general exhaust from the ward areas. Please confirm that this complies with the relevant standards? I would consider separating. The code requirement for this is purposed to stop contamination between zones if there is a failure of an exhaust system. Our design contains each zone to one system. If there is a failure of a system, it is to one zone of the building only.
13. FCU 13 is not shown with outside air. Please confirm how this will be resolved? Picked up and Included in Benmax shop drawings
14. The term FCU indicates heating hot water and/or chilled water coils will be provided. Please confirm if these units will be served by boiler and chiller. 4 pipe system? Yes, heating hot water and chilled water system. Refer to Benmax shop drawings for pipework and external plant
15. If direct expansion units are proposed and given that the ward areas are 100% outside air and no duct heaters are shown in the outside air ducts, please confirm how the de-ice modes will be offset in winter. Heating and chilled water system as per above. Some DX units for the equipment rooms are cooling only.
16. The exhaust air quantities from the ward areas are not shown and so the pressure regime cannot be reviewed. As discussed these will be forward when available. These will be forwarded when available.
17. The supply air, outside air ductwork and mixing boxes to the FCUs are shown as internally lined. Please confirm if this will this be faced with perforated linings? We normally do not allow this. Internally lined with NON-perforated lining as per standard
18. Supply air registers are nominated to have internally insulated cushion head boxes with rockwool and perforated sisolation. This seems inappropriate for clinical spaces, even for a temp arrangement. Please confirm compliance to the relevant standards. We normally do not allow this. Cushion head boxes as per standard NON-perforated lining.
19. No pipework for heating hot water, chilled water, condensate nor refrigerant is shown and so cannot be reviewed. Refer to Benmax Shop drawings for layout and schematic .
20. The Controls note 2 indicates “remote” set point adjustment. Please confirm the extent of building management system that is anticipated. Who will manage, and how? BMS will be managed by Control and Electric. Remote monitoring and alarms to nominated people via a 5G line provided by others.
21. Please confirm if there will be pressure monitoring and alarms to advise staff if there is equipment failure and the pressure regime has been compromised? I recommend this. This shall be proposed to the client.
22. Mechanical Plumbing note 5 indicates that condensate should be pumped to the closest tundish. A gravity drain system would be preferable if possible. Pump failure scenario would be an undesirable outcome? Please confirm. Pumps are required only where fall is insufficient and access difficult
23. Air Conditioning note 2 indicates that fresh air fans should continue to circulate when cooling is not required. Please confirm the control strategy for heating and cooling. Ventilation systems shall all operate continuously where required for the pressurization strategy noted above.
24. Filtration note 3 indicates HEPA filtration at 99.97% efficiency at 3 micron. Please confirm that this suitable for COVID-19. Does not seem right? HEPA filtration is no longer being proposed. There is no recirculation of air in the wards, resus or triage and all air shall be discharged in accordance with AS 1668.1, objectionable effluent.
25. Please confirm that the roof structure is capable of supporting the FCUs and associated ductworks systems. Has an engineer approved the locations? Confirmed.
26. Please confirm the air change rates for the ward areas? Wards 12AC/H, Triage 12AH/H, Resus 15AH/H
27. Please confirm the class of construction of the building? Class 9A

Kind regards

Matthew Gygi
Project Manager
[redacted]

[redacted]

Website | Facebook | Twitter | LinkedIn | YouTube

[redacted]

I respectfully acknowledge the Traditional Owners and Custodians of the Country on which I work

---

From: [redacted]
Sent: Friday, May 1, 2020 3:35 AM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Cc: Matthew Gygi [redacted]
Subject: RE: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

Kevin, Matt will respond by today (01/05/20)

[redacted]

From: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Sent: Thursday, 30 April 2020 3:15 PM
To: Matthew Gygi [redacted]
Cc: [redacted]
Subject: RE: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

HI All

Please can you confirm status of the response(s) to the comments below from Chris.

Thanks

Kevin Beswick | Project Manager
Social Infrastructure | Infrastructure Delivery Partners
Major Projects Canberra | ACT Government
M [redacted] T 02 5124 8660 | E Kevin.Beswick@act.gov.au
The Canberra Hospital, Garran, GPO Box 158, Canberra ACT 2601

www.act.gov.au

ACT Government
Major Projects Canberra

From: Beswick, Kevin
Sent: Thursday, 23 April 2020 10:35 AM
To: Matthew Gygi <[redacted]>
Cc: [redacted]
Subject: FW: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

UNCLASSIFIED

Hi Matt

Please see queries / comments from Chris T below on the building services. Please can you respond back urgently given the status of installation on site.

I have also Cc'd [redacted] and [redacted] – they may be able to assist with feedback on certain items.

Regards

Kevin Beswick | Project Manager
Social Infrastructure | Infrastructure Delivery Partners
Major Projects Canberra | ACT Government
M [redacted] **T** 02 5124 8660|**E** Kevin.Beswick@act.gov.au
The Canberra Hospital, Garran, GPO Box 158, Canberra ACT 2601

www.act.gov.au

ACT Government
Major Projects Canberra

From: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Sent: Wednesday, 22 April 2020 8:49 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Cc: Donaldson, Ben <Ben.Donaldson@act.gov.au>; Gray, Sophie <Sophie.Gray@act.gov.au>; Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>
Subject: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

Hi Kevin,

I have had a quick look at this design this evening, and the review raises the following questions concerning the mechanical and associated services. As discussed within the last meeting it's a complex, challenging installation:

1. Please confirm if there is an intention to provide separated fire zones for the building. The area looks around 1,700 square meters.
2. Please confirm if there is an intention to provide active smoke control for the building?
3. Please confirm if there is an intention to provide fire sprinkler protection for the building, I presume not?
4. Please confirm if it is intended to shut the plant down in fire mode?
5. Please confirm if there has a pressure regime developed showing the direction of air flow at each door?
6. Please confirm if the red ward spaces will be negatively pressurised?
7. Please confirm if the staff spaces will be positively pressurised?
8. Please confirm how the pressure regime will be air balanced to achieve the desired outcome?

9. The safety in design comment indicates that there are no unique risks with the design. This seems counter-intuitive given that the design is for an unprecedented pandemic response and the ventilation system designs can assist in mitigating or otherwise the COVID-19 risks to staff.
10. Without airlocks between the wards and outside please confirm if it is anticipated that the negative pressure regime will draw untreated cold air into the ward spaces in winter and hot air in summer and generate problems with conditions.
11. No ventilation is shown to the following rooms, please confirm if that complies with the relevant standards?
    - Medical gas store, is an exhaust register appropriate for this room?
    - Dry store and food services
    - Data services
    - Electrical. Is there a UPS?
    - Stores (confirm if these are sterile stores which require special treatment) HEPA?
12. The design shows a mixing of toilet exhaust and general exhaust from the ward areas. Please confirm that this complies with the relevant standards?I would consider separating.
13. FCU 13 is not shown with outside air. Please confirm how this will be resolved?
14. The term FCU indicates heating hot water and/or chilled water coils will be provided. Please confirm if these units will be served by boiler and chiller. 4 pipe system?
15. If direct expansion units are proposed and given that the ward areas are 100% outside air and no duct heaters are shown in the outside air ducts, please confirm how the de-ice modes will be offset in winter.
16. The exhaust air quantities from the ward areas are not shown and so the pressure regime cannot be reviewed. As discussed these will be forward when available.
17. The supply air, outside air ductwork and mixing boxes to the FCUs are shown as internally lined. Please confirm if this will this be faced with perforated linings? We normally do not allow this.
18. Supply air registers are nominated to have internally insulated cushion head boxes with rockwool and perforated sisolation. This seems inappropriate for clinical spaces, even for a temp arrangement. Please confirm compliance to the relevant standards. We normally do not allow this.
19. No pipework for heating hot water, chilled water, condensate nor refrigerant is shown and so cannot be reviewed.
20. The Controls note 2 indicates “remote” set point adjustment. Please confirm the extent of building management system that is anticipated. Who will manage, and how?
21. Please confirm if there will be pressure monitoring and alarms to advise staff if there is equipment failure and the pressure regime has been compromised? I recommend this.
22. Mechanical Plumbing note 5 indicates that condensate should be pumped to the closest tundish. A gravity drain system would be preferable if possible. Pump failure scenario would be an undesirable outcome? Please confirm.
23. Air Conditioning note 2 indicates that fresh air fans should continue to circulate when cooling is not required. Please confirm the control strategy for heating and cooling.
24. Filtration note 3 indicates HEPA filtration at 99.97% efficiency at 3 micron. Please confirm that this suitable for COVID-19. Does not seem right?
25. Please confirm that the roof structure is capable of supporting the FCUs and associated ductworks systems. Has an engineer approved the locations?
26. Please confirm the air change rates for the ward areas?
27. Please confirm the class of construction of the building?

Once I receive the design calculation data I can review further.

Thanks, I hope this is helpful, sorry there is a lot in the comments, however the air quality for this building is critical for a successful project outcome.

Regards,

Chris Tarbuck | Facilities Director, Infrastructure and Health Support Services
Phone: (02) 5124 3186 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
Facilities Management| Canberra Health Services | ACT Government
Level 1, Building 1, Canberra Hospital, Garran ACT 2605 | health.act.gov.au

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ACT Government | Canberra Health Services

From: Beswick, Kevin
Sent: Tuesday, 21 April 2020 4:27 PM
To: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Cc: Donaldson, Ben <Ben.Donaldson@act.gov.au>; Gray, Sophie <Sophie.Gray@act.gov.au>
Subject: FW: COVID-19 ED - Mechanical Drawings

UNCLASSIFIED

Hi Chris

Please find attached the mechanical drawings for your review as requested. Note that the design calculations have been requested and I will forward them on once I have them.

Please let me know if you have any concerns.

Regards

Kevin Beswick | Project Manager
Social Infrastructure | Infrastructure Delivery Partners
Major Projects Canberra | ACT Government
M [redacted] T 02 5124 8660 | E Kevin.Beswick@act.gov.au
The Canberra Hospital, Garran, GPO Box 158, Canberra ACT 2601

www.act.gov.au

ACT Government
Major Projects Canberra

From: Matthew Gygi [redacted]
Sent: Tuesday, 21 April 2020 4:01 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Cc: Donaldson, Ben <Ben.Donaldson@act.gov.au>; [redacted] Gray, Sophie <Sophie.Gray@act.gov.au>
Subject: COVID-19 ED - Mechanical Drawings

Attached are the COVID-19 ED Mechanical Drawings.

I've requested the calculations which I understand will be forthcoming shortly.

Kind regards

Matthew Gygi
Project Manager
[redacted]

[redacted]

Website | Facebook | Twitter | LinkedIn | YouTube

I respectfully acknowledge the Traditional Owners and Custodians of the Country on which I work

From: O'Neill, Cathie (Health)
Sent: Wednesday, 8 September 2021 9:28 AM
To: Mooney, Colm (Health); Tarbuck, Chris (Health)
Subject: RE: Garran Surge Centre Air Ventilation Assessment

OFFICIAL

Colm / Chris

Thank you for this information CHS and CHECC have decided not to progress in using Garran for infusions to positive cases as a result.

Could I ask that you provide further advice of the minimum works required for us to use safely for positive patients at all at Garran – ie in the event we would need to use it as a ED Surge capacity?

Thanks

Cathie O'Neill
Chief Operating Officer
Canberra Health Services

Phone: 61 (02) 512 47354
E-mail: Cathie.O'Neill@act.gov.au

EO: Michelle Ramsay 512 45804
Business Manager: Liza Marando 512 48688

Reliable | Progressive | Respectful | Kind

ACT Government | Canberra Health Services

From: Mooney, Colm (Health) <Colm.Mooney@act.gov.au>
Sent: Tuesday, 7 September 2021 7:08 AM
To: O'Neill, Cathie (Health) <Cathie.O'Neill@act.gov.au>
Subject: FW: Garran Surge Centre Air Ventilation Assessment
Importance: High

OFFICIAL

Cathie

See attached advice and below email received from IHSS about required modifications to COVID Surge Centre Pod 6 to ensure suitability for management of COVID19 infectious consumer undergoing infusion treatment.

I am unsure as to how long we will be providing the infusion option , however, the works required will take at least 6 weeks to complete before the space is rendered suitable.

Before progressing any further and costing the required works it would be good to know how many infusions will remain in 6 weeks time based on current demand?

Talk soon

Thanks

Colm

From: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Sent: Monday, 6 September 2021 6:26 PM
To: Mooney, Colm (Health) <Colm.Mooney@act.gov.au>
Subject: Garran Surge Centre Air Ventilation Assessment
Importance: High

OFFICIAL

Hi Colm,

BMM has had the opportunity to look at the ventilation systems in the Pod 6 within the surge centre.

The overview is that we don't think the systems installed make Pod 6 suitable for infectious patients without significant work being carried out.

Generally, BMM do not recommend the discharge of exhaust air from rooms where infectious patients are treated without the use of HEPA filtration. The fact that this is a single level (low level) building with higher ground adjacent to it exacerbates the problem.

BMM recommend a new exhaust system be provided with HEPA filtration along with other system modifications to ensure inward flowing air into the room.

The equipment required includes HEPA filters an exhaust fan, ductwork and dampers, controls and electrical work along with commissioning etc. Door and other room sealing may also be required.

The problems we see with the existing installation are as follows:

- Exhaust duct within the building is not under negative pressure;
- Air to air heat exchangers are not necessarily 100% sealed and there is some risk of air leaking from the exhaust path directly back into the supply air path. Note that on the Amcor (the heat exchanger manufacturer) website, they list a number of applications where these units are suitable but health care is not one of them;
- The exhaust discharge velocity is too low;
- There is no HEPA filtration of the exhaust prior to discharge.
- Low or no pressure differentials between Pod 6 and adjacent rooms.

These problems would be the same or similar for Pod 3 and the Palliative Care room. In the case of Pod 6, it makes sense to use the Palliative Care room as an ante-room for access in and out of Pod 6 by the patients. There would be some similar works required to that room to accommodate this.

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BMM are also concerned regarding the lack of negative pressure in the spaces throughout the building, and that there is limited pressure change between rooms.

To address concerns and make areas of the facility more appropriate for use, BMM recommend installation of further exhaust and HEPA filtration in areas where COVID positive patients would be treated.

Please advise if you would like us to plan any upgrades to improve the system. Depending on product and contractor availability works could take 4-6 weeks to design and undertake.

Regards

Chris Tarbuck | A/g Executive Group Manager, Infrastructure and Health Support Services
Phone: 02 512 49711 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
Facilities Management| Canberra Health Services | ACT Government
Level 1, Building 1, Canberra Hospital, Garran ACT 2605 | health.act.gov.au

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From: Brady, Vanessa (Health)
Sent: Wednesday, 29 September 2021 11:53 AM
To: Mooney, Colm (Health)
Cc: Tarbuck, Chris (Health)
Subject: Garran Surge Centre Air Ventilation Assessment
Attachments: SARI Treatment Centre manual draft V5.5.pdf

OFFICIAL

Hi Colm

The intent of the facility design was based on the '*World Health Organization Severe Acute Respiratory Infection Treatment Centre Manual*' drafted for healthcare facilities. The WHO collaborated with CHS to critique the facility architectural design, including the patient flow and zones. It is my understanding that the facility was custom designed to function as negative pressure compartments.

The electrical, mechanical, hydraulic services consultant engaged by Aspen Medical was Jones Nicholson Engineering (JN Engineering).

AECOM was engaged by MPC to peer review the services design and ICA role for witness testing and commissioning.

The Building Commissioning process was managed by a consultant, Jason Bills, engaged by Manteena to co-ordinate the witness testing processing, commissioning results and handover process with MPC.

Chris and I are in the process of contacting Sophie Gray to ascertain the following project records:

1. Design brief and technical specifications documents provided by MPC to Aspen Medical
2. Scope of requirements for the engagement of AECOM to conduct a peer review of the services design and act as the Territory's Independent Commissioning Agent
3. AECOM design peer review assessment advice/report
4. Witness Testing program and commissioning results
5. AECOM Peer Review Commissioning Report
6. Practical Completion handover documentation from Aspen Medical / Manteena
7. Operations & Maintenance Manuals

The Territory engaged Aspen Medical as a single select for the following services:

a. Facility design, construction and maintenance
b. Procurement of PPE, consumables, medications, FFE & MME
c. Workforce

Aspen Medical transferred the facilities management responsibility to CHS in August 2021. As part of this transfer process, MPC/CHS has been provided with the maintenance records.

Regards

Vanessa Brady
Project Director I Canberra Hospital Campus Modernisation

From: Mooney, Colm (Health) <Colm.Mooney@act.gov.au>
Sent: Monday, 27 September 2021 4:06 PM
To: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>
Cc: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Subject: FW: Garran Surge Centre Air Ventilation Assessment
Importance: High

OFFICIAL

Vanessa

Can you review the attached report and summary notes below and compare with your understanding of the original specification of the surge centre building.

In summary I understand that the surge centre was originally built, to a WHO informed specification, incorporating negative pressure compartments. The notes in this email indicate that we are not currently achieving the specification requested. Before we embark on any upgrade work can I get your understanding of what specification should exist and what was commissioned in 2020.

If the desired specification has not be achieved or maintained then I would like to understand what responsibility sits with Manteena/Aspen to rectify?

Please call me if you have any questions.

Best regards

Colm

From: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Sent: Monday, 6 September 2021 6:26 PM
To: Mooney, Colm (Health) <Colm.Mooney@act.gov.au>
Subject: Garran Surge Centre Air Ventilation Assessment
Importance: High

OFFICIAL

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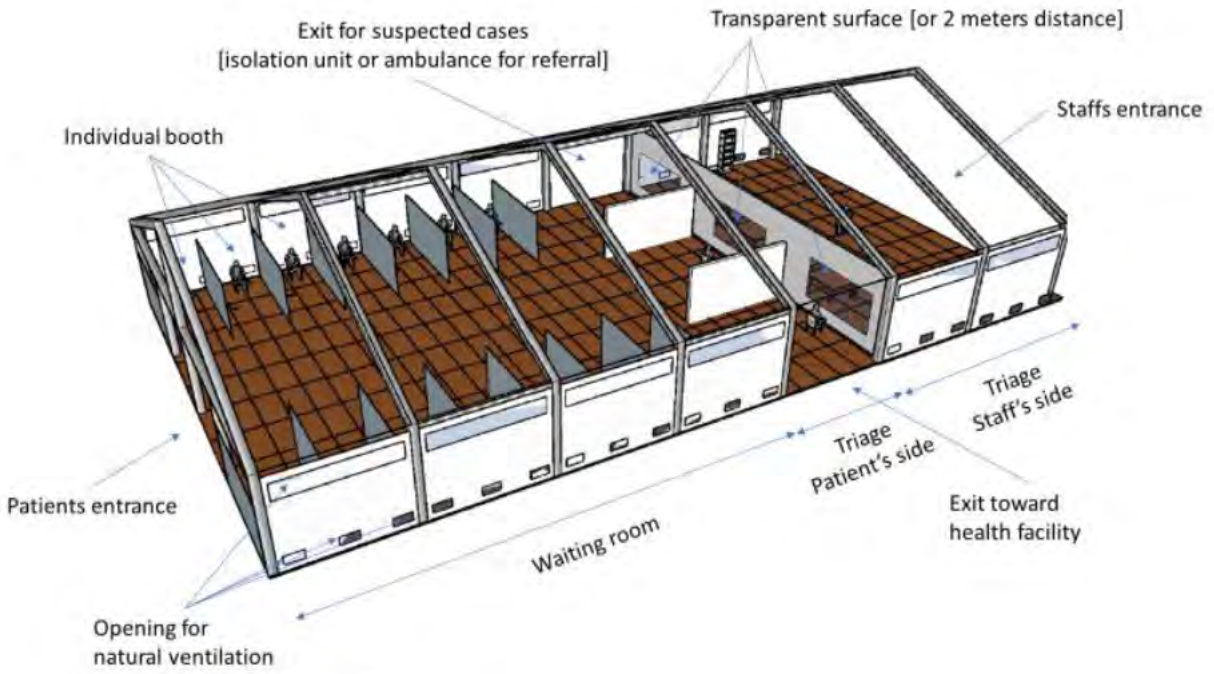
World Health Organization

Advanced Draft

Severe Acute Respiratory Infections Treatment Centre

Practical manual to set up and manage a SARI Treatment Centre and a SARI triage facility in health care facilities



DRAFT 3.0

March 2020

Contents

Table of figures

Foreword

Acknowledgements

Abbreviations Used in the Guideline

Acronym	Definition
ACH	Air Change per Hour
ARIs	Acute respiratory infections
CDC	United States Centers for Disease Control and Prevention
CoV	Coronaviruses
COID-19	Coronavirus disease
FFP2	filtering facepiece level of protection 2
HCW	HealthCare Worker
HEPA filter	High Efficiency Particulate Air filter
ICU	Intensive Care Unit
IHR	International Health Regulations
IPC	Infection Prevention and Control
LMIC	Low and middle-income countries
MERS-CoV	Middle East Respiratory Syndrome
NIOSH	National Institute for Occupational Safety and Health
PPE	Personal protective equipment
SARIs	Severe Acute Respiratory Infections
SARS-CoV	Severe Acute Respiratory Syndrome Coronavirus
SARS-CoV2	Severe Acute Respiratory Syndrome Coronavirus 2
UV	Ultraviolet
UVGI	Ultraviolet Germicidal Irradiation
WHO	World Health Organization

Introduction

Acute Respiratory Infection (ARI)

Acute respiratory infections (ARIs) are the leading cause of morbidity and mortality from infectious disease in the world. Almost four million people die from ARIs each year, with 98% of these deaths due to lower respiratory tract infections. Mortality rates are particularly high in infants, children, and the elderly, particularly in low-income and middle-income countries. ARIs are one of the most frequent causes of consultation or admission to health- care facilities, particularly in paediatric services [1].

Bacteria are a major cause of lower respiratory tract infection, with *Streptococcus pneumoniae* being the most common cause of bacterial community-acquired pneumonia in many countries. However, the pathogens that most often cause ARIs are viruses or mixed viral–bacterial infections. ARIs that have epidemic or pandemic potential, and may pose a public-health risk, warrant special precautions and preparedness [1].

The incidence of specific ARIs, their distribution and the outcome of disease varies according to several factors, including:

- Environmental conditions (e.g. air pollutants, household crowding, humidity, hygiene, season and temperature);
- Availability and effectiveness of medical care and infection prevention and control (IPC) measures to contain spread such as vaccines, access to health-care facilities, and isolation capacity;
- Host factors such as age, cigarette-smoking, host ability to transmit infection, immune status, nutritional status, prior or concurrent infection with other pathogens, and underlying medical conditions; and
- Pathogenic characteristics, including modes of transmission, transmissibility, virulence factors (e.g. genes encoding toxins) and microbial load (inoculum size) [1] .

Coronavirus

Coronaviruses (CoV) are a large family of viruses that cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV). A novel coronavirus (nCoV) is a new strain that has not been previously identified in humans. Coronaviruses are zoonotic, meaning they are transmitted between animals and people [2]. Detailed investigations found that SARS-CoV was transmitted from civet cats to humans and MERS-CoV from dromedary camels to humans. Several known coronaviruses are circulating in animals that have not yet infected humans. Common signs of infection include respiratory symptoms, fever, cough, shortness of breath and breathing difficulties. In more severe cases, infection can cause pneumonia, severe acute respiratory syndrome, kidney failure and even death [2].

Purpose, scope and audience

This document, Severe Acute Respiratory Infections Treatment Centre, Practical manual provide recommendations, technical guidance, standards and minimum requirement to setting up and operating a SARI treatment center in low and middle-income countries and limited resource setting, including the standards needed to reconvert existing building into a SARIs treatment center. Specifically, for ARIs that have the potential for rapid spread and may cause epidemics or pandemics. Some of the epidemic-prone ARIs may constitute a global public-health emergency. According to the International Health Regulations [3] (IHR), published in 2005, the respiratory disease events that may constitute a public health emergency of international concern include:

- Severe acute respiratory syndrome (MERS-CoV, SARS-CoV and SARS-CoV2);
- Human influenza caused by a new subtype, including human episodes of avian influenza;
- Pneumonic plague, and
- Novel ARIs that can cause large-scale outbreaks, or outbreaks with high morbidity and mortality.

This document also recommends in which situation the building of a SARI treatment center is indicated through defined thresholds, such as number of cases beyond the health care system capacity, inadequate installation of health facilities.

This document has been written for use by health managers and planners, architects, engineers, logistics, water and sanitation staff, clinical and nursing staff, carers and other health-care providers, and health promoters. It can be used to:

- develop specific national standards that are relevant to SARI outbreak preparedness, readiness and response in different contexts
- support the application of national standards and set specific targets in specific SARI treatment center settings
- assess the situation regarding environmental health and engineering standards in existing SARI treatment center to evaluate the extent to which they may fall short of national plans and local targets
- plan and carry out the improvements that are required
- ensure that the construction of new SARI treatment center is of acceptable quality
- prepare and implement comprehensive and realistic action plans so that acceptable conditions are achieved and maintained.

This technical guidance deal specifically with SARI treatment center design and flow, water supply (water quality, quantity and access), excreta disposal, health-care waste management, cleaning, building design (including ventilation), construction and management, and hygiene. It is designed primarily for use in health-care settings in precarious situations, and in situations where simple and affordable measures can improve hygiene and health significantly.

Principles of infection prevention and control [IPC] strategies associated with health care with suspected nCoV

IPC strategies to prevent or limit infection transmission in health-care settings include the following [4]:

- **Early recognition and source control**
- **Application of Standard Precautions for all patients regardless the suspected or known infection condition**
- **Implementation of empiric additional precautions (droplet and contact and whenever applicable airborne precautions) for suspected cases**
- **Administrative controls**
- **Environmental and engineering controls**

Ensuring triage, early recognition and source control

Clinical triage includes a system for assessing all patients at admission allowing early recognition of possible 2019-nCoV infection and immediate isolation of patients with suspected COVID-19 infection in an area separate from other patients (source control). For more information consult 'Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected', Interim guidance, WHO, January 2020 [4]

Application of Standard Precaution for all patients

Standard precautions include hand and respiratory hygiene, the use of appropriate personal protective equipment (PPE) according to risk assessment, injection safety practices, safe waste management, proper linens management, environmental cleaning and sterilization of patient-care equipment.

Specifically respiratory hygiene measures includes:

- **Ensuring that all patients cover their nose and mouth with a tissue or elbow when coughing or sneezing;**
- **Offering a medical mask to patients with suspected 2019-nCoV infection while they are in waiting/public areas or in cohorting rooms;**
- **Performing continual hand hygiene according to "My five moments for hand hygiene"[5] and after contact with respiratory secretions.**

HCWs should apply the WHO's My 5 Moments for Hand Hygiene approach before touching a patient, before any clean or aseptic procedure is performed, after exposure to body fluid, after touching a patient, and after touching a patient's surroundings [5].

- **Hand hygiene includes either the use of an alcohol-based hand rub (ABHR) product or washing with soap and water;**
- **Alcohol-based hand rubs are the preferred option if hands are not visibly soiled;**
- **Washing hands with soap and water whenever they are visibly soiled**

The rational[6], correct, and consistent use of PPE also helps to reduce the spread of pathogens. The use of PPE effectiveness strongly depends on adequate and regular supplies, adequate staff training, appropriate hand hygiene and specifically appropriate human behaviour [1 5 7].

It is important to ensure that environmental cleaning and disinfection procedures are followed consistently and correctly. Thoroughly cleaning environmental surfaces with water and detergent and applying commonly used hospital- level disinfectants (such as sodium hypochlorite) are effective and sufficient procedures[8]. Consider emphasising regular cleaning of high contact areas such as door handles, benches, gates, etc.

Contact and Droplet precautions for patient with suspected COVID-19

- In addition to standard precautions, all individuals, including family members, visitors and HCWs should apply Contact and Droplet precautions
- Place patients in adequately ventilated single rooms. For naturally ventilated general ward rooms this is considered to be 60 L/second/patient;
- When single rooms are not available, cohort patients suspected of COVID-19 infection together; do not cohort in the same room confirmed and suspected cases, do not cohort patients with respiratory infections caused by other pathogens
- Place patient beds at least 2 m apart;
- Where possible, cohort HCWs to exclusively care for cases to reduce the risk of spreading transmission due to inadvertent infection control breaches;
- Use a medical mask;
- Use eye/facial protection (i.e. goggles or a face shield);
- Use a clean, non-sterile, long-sleeved gown;
- Use single-use gloves;
- Use either single-use disposable equipment or dedicated equipment (e.g. stethoscopes, blood pressure cuffs and thermometers). If equipment needs to be shared among patients, clean and disinfect between each patient use (e.g. ethyl alcohol 70%);
- Refrain from touching eyes, nose or mouth with potentially contaminated hands;
- Avoid the movement and transport of patients out of the room or area unless medically necessary.
- Use designated portable X-ray equipment and/or other important diagnostic equipment. If transport is required, use pre-determined transport routes to minimize exposures to staff, other patients and visitors and apply medical mask to patient;
- If the transport is deemed necessary, notify the receiving area of necessary precautions as soon as possible before the patient's arrival;
- Ensure that HCWs who are transporting patients wear appropriate PPE as described in this section and perform hand hygiene;
- Routinely clean and disinfect patient-contact surfaces;
- Limit the number of HCWs, family members and visitors in contact with a patient with suspected COVID-19;
- Maintain a record of all persons entering the patient's room including all staff and visitors and purpose of visit [4].

Airborne precautions for aerosol-generating procedures for suspected nCoV infection

Some aerosol generating procedures have been associated with increased risk of transmission of coronaviruses (SARS-CoV and MERS-CoV) such as tracheal intubation, non-invasive ventilation, tracheotomy, cardiopulmonary resuscitation, manual ventilation before intubation and bronchoscopy. Ensure that HCWs performing aerosol-generating procedures [4]:

- Use a particulate respirator at least as protective as a NIOSH-certified N95, EU FFP2 or equivalent; when putting on a disposable particulate respirator, always perform the seal-check [see annexe 1. 'How to perform a particulate respirator seal check'] [9]. Note that if the wearer has facial hear (beard) this can prevent a proper respirator fit.
- Eye protection (i.e. goggles or a face shield);
- Clean, non-sterile, long-sleeved gown and gloves;
- If gowns are not fluid resistant, use a waterproof apron for procedures with expected high fluid volumes that might penetrate the gown;
- Perform procedures in an adequately ventilated room; i.e. at least natural ventilation with at least 160 l/s/patient air flow or negative pressure rooms with at least 12 air changes per hour (ACH) and controlled direction of air flow when using mechanical ventilation
- Limit the number of persons present in the room to the absolute minimum required for the patient's care and support.

A mechanically ventilated room is equivalent to the airborne infection isolation room described by the United States Centers for Disease Control and Prevention, which should have special features in air handling and airflow direction, including: (CDC, 2003) [10]:

- Negative pressure differential of >2.5 Pa (0.01-inch water gauge); an airflow differential >125-cfm (56 l/s) exhaust versus supply;
- Clean-to-dirty airflow;
- Sealing of the room, allowing approximately 0.5 square feet (0.046 m2) leakage;
- >12 ACH for a new building, and >6 ACH in existing buildings (e.g. equivalent to 40 l/s for a 4×2×3 m3 room) for an old building; and
- an exhaust to the outside, or a HEPA-filter if room air is recirculated.

The concept of natural ventilation for airborne precaution rooms was discussed in the recent World Health Organization interim guidelines (WHO, 2007). Natural ventilation can be used in airborne precaution rooms. The purpose of this document is to provide basic design guidance for the use of natural ventilation for infection control.

Definitions of three transmission models

Mode of transmission	Definition	Examples of the agents
Airborne	Transmission of disease caused by dissemination of droplet nuclei that remain infectious when suspended in air over long distance (>1 m) and time. Airborne transmission can be further categorized into obligate or preferential airborne transmission. Obligate airborne transmission refers to pathogens that are transmitted only by deposition of droplet nuclei under natural conditions. Preferential airborne transmission refers to pathogens that can initiate infection by multiple routes, but are predominantly transmitted by droplet nuclei.	Pulmonary tuberculosis, measles, chickenpox
Opportunistic airborne	Transmission of droplet nuclei at short range during special circumstances, such as the performance of aerosol-generating procedures associated with pathogen transmission.	SARS-Coronavirus, influenza
Droplet	Droplets are generated from an infected (source) person primarily during coughing, sneezing and talking. Transmission occurs when these droplets, containing microorganisms, are propelled a short distance (usually <1 m).	Adenovirus, respiratory syncytial virus, influenza, SARS-Coronavirus

SARS, severe acute respiratory syndrome.

Figure 1. The scope and definitions of three transmission models for the systematic review. Atkinson, J., Chartier, Y., Pessoa-silva, C. L., Jensen, P. & Li, Y. Natural Ventilation for Infection Control in Health-Care Settings Edited by : WHO Publ. (2009).

Sites identification, selection and surveys

The choice of a site will determine future problematic issues that could be encountered (infiltration, drainage, access, extension, acceptance, etc.). Take the necessary time to carefully choose the site the most adequate possible, rather than the first one seen.

It is important to define the potential scale (size, duration, etc.) expected of the outbreak from the beginning.

Location Criteria:

- Good access for patients, visitors, and staff where security can be guaranteed;
- Proximity to the outbreak epicentre;
- Proximity to existing healthcare facilities to facilitate external referral pathways for patient tested negative for COVID-19 but still requiring medical care for different medical condition;
- Avoid all flood areas and at least >30 meters away from rivers or other bodies of water.

Ground Characteristics:

- Flat and level;
- Geologically stable and consolidated, preferably without organic or stony material;
- Easy to dig, without the danger of landslides, and with the capacity for drainage;
- Avoid areas with a high groundwater table;
- Sufficient size of the plot of land to extend the center, if necessary.

Meteorological Characteristics:

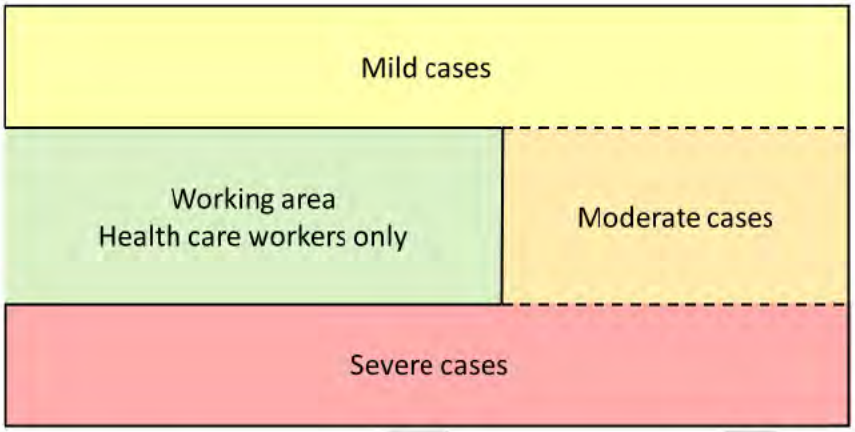
- Be aware of seasonal periods affecting the construction (rain/dry periods). Be able to adjust the design to accommodate different climatological conditions;
- Take into account prevailing winds for the control of smoke and odours;
- Take into account sun orientation for improved shadow zones.

Existing resources:

- Permanent buildings and/or existing hospital isolation or unused wards;
- Evaluate water resources in the area with special focus on the analysis of capacity, quality, and availability;
- If available, have the option to connect to local basic services of water, electricity, and communications;
- Before arrival of main supplies, prepare/identify a storage area.

Basic layout principle

The proposed layout is based on the clinical definition of patient with SARI, suspected of nCoV, the clinical syndromes associated with nCoV infection and related medical conditions: mild, moderate and severe illness.



The rationales behind this layout are:

- Medical care should be provided as soon as possible, even prior the laboratory confirmation, in order to avoid medical conditions worsening
- The different risk represented by patients with different medical condition such as the severe patients who might need an aerosol generating procedure.

The center will therefore be divided into 2 zone, staff's area, for health care workers, and patient's area. The high-risk area will be further divided into 3 zones according to the medical conditions of the patients, mild, moderate and severe. Patient categorization will follow the definition of clinical syndromes associated with nCoV infection as[12] [See Figure 2 below]:

SARI Treatment Center zones

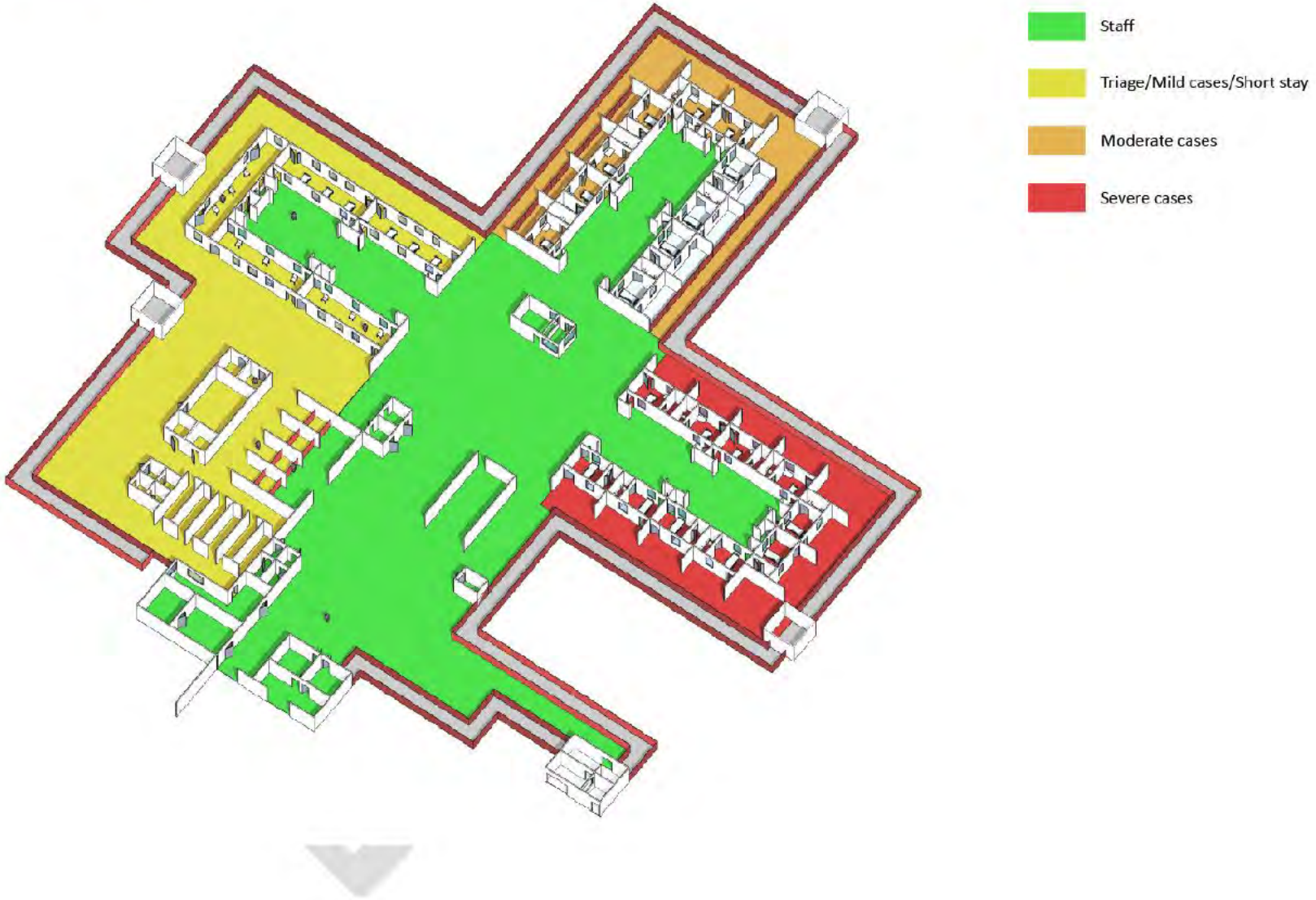


Figure 2. SARI Treatment Center zone categorization

Categorization

NOTE [13]: It's the case management department responsibility to decide to categorization.

Mild cases

Uncomplicated illness

Patients with uncomplicated upper respiratory tract viral infection, may have non-specific symptoms such as fever, cough, sore throat, nasal congestion, malaise, headache, muscle pain or malaise. The elderly and immunosuppressed may present with atypical symptoms. These patients do not have any signs of dehydration, sepsis or shortness of breath.

Mild pneumonia

Patient with pneumonia and no signs of severe pneumonia. Child with non-severe pneumonia has cough or difficulty breathing + fast breathing: fast breathing (in breaths/min): <2 months, ≥60; 2–11 months, ≥50; 1–5 years, ≥40 and no signs of severe pneumonia.

Moderate cases

Severe pneumonia

Adolescent or adult: fever or suspected respiratory infection, plus one of respiratory rate >30 breaths/min, severe respiratory distress, or SpO2 <90% on room air (adapted from [1]). Child with cough or difficulty in breathing, plus at least one of the following: central cyanosis or SpO2 <90%; severe respiratory distress (e.g. grunting, very severe chest indrawing); signs of pneumonia with a general danger sign: inability to breastfeed or drink, lethargy or unconsciousness, or convulsions. Other signs of pneumonia may be present: chest indrawing, fast breathing (in breaths/min): <2 months, ≥60; 2–11 months, ≥50; 1–5 years, ≥40.2 The diagnosis is clinical; chest imaging can exclude complications.

Severe cases

Acute Respiratory Distress Syndrome

Onset: new or worsening respiratory symptoms within one week of known clinical insult.

Chest imaging (radiograph, CT scan, or lung ultrasound): bilateral opacities, not fully explained by effusions, lobar or lung collapse, or nodules.

Origin of oedema: respiratory failure not fully explained by cardiac failure or fluid overload. Need objective assessment (e.g. echocardiography) to exclude hydrostatic cause of oedema if no risk factor present.

Oxygenation (adults):

- Mild ARDS: 200 mmHg < PaO2/FiO2 ≤ 300 mmHg (with PEEP or CPAP ≥5 cmH2O,7 or non-ventilated8)
- Moderate ARDS: 100 mmHg < PaO2/FiO2 ≤200 mmHg with PEEP ≥5 cmH2O,7 or non-ventilated8) •
- Severe ARDS: PaO2/FiO2 ≤ 100 mmHg with PEEP ≥5 cmH2O,7 or non-ventilated8)
- When PaO2 is not available, SpO2/FiO2 ≤315 suggests ARDS (including in non-ventilated patients)

Oxygenation (children; note OI = Oxygenation Index and OSI = Oxygenation Index using SpO2):

- Bilevel NIV or CPAP ≥5 cmH2O via full face mask: PaO2/FiO2 ≤ 300 mmHg or SpO2/FiO2 ≤264
- Mild ARDS (invasively ventilated): 4 ≤ OI < 8 or 5 ≤ OSI < 7.5
- Moderate ARDS (invasively ventilated): 8 ≤ OI < 16 or 7.5 ≤ OSI < 12.3 •
- Severe ARDS (invasively ventilated): OI ≥ 16 or OSI ≥ 12.3

Sepsis

Adults: life-threatening organ dysfunction caused by a dysregulated host response to suspected or proven infection, with organ dysfunction*. Signs of organ dysfunction include: altered mental status, difficult or fast breathing, low oxygen saturation, reduced urine output, fast heart rate, weak pulse, cold extremities or low blood pressure, skin mottling, or laboratory evidence of coagulopathy, thrombocytopenia, acidosis, high lactate or hyperbilirubinemia. Children: suspected or proven infection and ≥2 SIRS criteria, of which one must be abnormal temperature or white blood cell count.

Septic shock

Adults: persisting hypotension despite volume resuscitation, requiring vasopressors to maintain MAP ≥65 mmHg and serum lactate level >2 mmol/L. Children (based on [12]): any hypotension (SBP <5th centile or >2 SD below normal for age) or 2-3 of the following: altered mental state; tachycardia or bradycardia (HR <90 bpm or >160 bpm in infants and HR <70 bpm or >150 bpm in children); prolonged capillary refill (>2 sec) or warm vasodilation with bounding pulses; tachypnea; mottled skin or petechial or purpuric rash; increased lactate; oliguria; hyperthermia or hypothermia.

Minimum requirements for existing building reconverted into SARI treatment center

Existing building may be reconverted into SARI treatment center if the minimum requirements are met:

- **The minimum ventilation rate of 60 l/s/patient is met for mild and moderate cases wards,**
- **The minimum ventilation rate of 160 l/s/patient is met for severe cases ward and ICU,**
- **The airflow direction is from clean zones to dirty zones,**
- **Patient and staff' flow can be clearly defined and distances respected,**
- **All finishes, furniture, and patient care equipment can be effectively cleaned and are compatible with the facility disinfectant(s) [See ''Recommended characteristics for selecting finishes and furniture''].**

Recommended characteristics for selecting finishes and furniture

The recommended characteristics for selecting finishes and furniture are summarized in table underneath [14].

Characteristic	Selection guidance
Cleanable	– Avoid items with hard-to-clean features [e.g. crevasses] – Do not use carpet in patient care areas – Select material that can withstand repeated cleaning
Easy to maintain and repair	– Avoid materials that are prone to cracks, scratches or chips, and quickly patch/repair if they occur – Select materials that are durable and/or easy to repair
Resistant to microbial growth	– Avoid materials that hold moisture, such as wood or cloth, as these facilitate microbial growth – Select metals and hard plastics
Nonporous	– Avoid items with porous surfaces, such as cotton, wood and nylon – Avoid porous plastics, such as polypropylene, in patient care area
Seamless	– Avoid items with seams – Avoid upholstered furniture in patient care areas

Ventilation

Ventilation moves outdoor air into a building or a room, and distributes the air within the building or room. The general purpose of ventilation in buildings is to provide healthy air for breathing by both diluting the pollutants originating in the building and removing the pollutants from it [15].

Building ventilation has three basic elements [8]:

- ventilation rate — the amount of outdoor air that is provided into the space, and the quality of the outdoor air;
- airflow direction — the overall airflow direction in a building, which should be from clean zones to dirty zones; and
- air distribution or airflow pattern — the external air should be delivered to each part of the space in an efficient manner and the airborne pollutants generated in each part of the space should also be removed in an efficient manner.

There are three methods that may be used to ventilate a building: natural, mechanical and hybrid (mixed-mode) ventilation[16].

Natural ventilation

Natural forces (e.g. winds and thermal buoyancy force due to indoor and outdoor air density differences) drive outdoor air through purpose-built, building envelope openings. Purpose-built openings include windows, doors, solar chimneys, wind towers and trickle ventilators. This natural ventilation of buildings depends on climate, building design and human behaviour [16].

When wind strikes a building, it induces a positive pressure on the windward face and negative pressure on the leeward face. This drives the air to flow through windward openings into the building to the low-pressure openings at the leeward face [See figure 3]. It is possible to estimate the wind pressures for simple buildings.

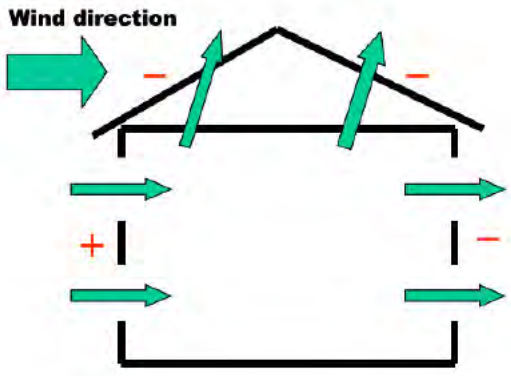


Figure 3. Wind-induced flow directions in a building. Natural Ventilation for Infection Control in Health-Care Settings. WHO. 2009

For single-sided ventilation with the rooms otherwise hermetically sealed, there is no contribution from mean wind pressures, only from the fluctuating components [See figure 4]. This is a common design;

however, over time, there becomes significant leakage around doors and other room penetrations. It must be remembered that just because a window is open, sufficient air changes per hour (ACH) may not necessarily be achieved [8].

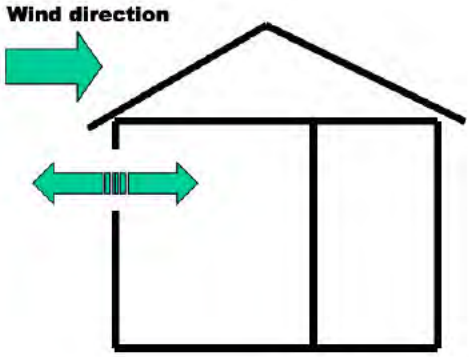


Figure 4. Fluctuating components contributing to single-sided airflow. Natural Ventilation for Infection Control in Health-Care Settings. WHO, 2009

Natural ventilation flow rate calculation

As a rule of thumb, wind-driven natural ventilation rate through a room with two opposite openings (e.g. a window and a door) can be calculated as follows [8]:

$$ACH = \frac{0{,}65\ x\ wind\ speed\ (m/s)\ x\ smallest\ opening\ area\ (m2) x\ 3600\ (s/h)}{room\ volume\ (m3)}$$

Ventilation rate (l/s) = 0.65 × wind speed (m/s) × smallest opening area (m^2) × 1000 l/m^3

The table below [See figure 5] provides estimates of the ACH and ventilation rate due to wind alone, at a wind speed of 1 m/s, assuming a ward of size 7 m (length) × 6 m (width) × 3 m (height), with a window of 1.5 × 2 m^2 and a door of 1 m2 × 2 m^2 (smallest opening) [8].

Openings	ACH	Ventilation rate (l/s)
Open window (100%) + open door	37	1300
Open window (50%) + open door	28	975
Open window (100%) + closed door	4.2	150

Figure 5. Estimated air changes per hour and ventilation rate for a 7 m × 6 m × 3 m ward. Natural Ventilation for Infection Control in Health-Care Settings. WHO, 2009

The wind speed refers to the value at the building height at a site sufficiently away from the building without any obstructions (e.g. at an airport).

NOTE: For general ward rooms with natural ventilation, adequate ventilation is considered to be 60 L/s per patient [4]

Mechanical ventilation

Mechanical fans drive mechanical ventilation. Fans can either be installed directly in windows or walls, or installed in air ducts for supplying air into, or exhausting air from, a room. The type of mechanical ventilation used depends on climate. For example, in warm and humid climates, infiltration may need to be minimized or prevented to reduce interstitial condensation (which occurs when warm, moist air from inside a building penetrates a wall, roof or floor and meets a cold surface). In these cases, a positive pressure mechanical ventilation system is often used. Conversely, in cold climates, exfiltration needs to be prevented to reduce interstitial condensation, and negative pressure ventilation is used. For a room with locally generated pollutants, such as a bathroom, toilet or kitchen, the negative pressure system is often used [16].

Hybrid or mixed-mode ventilation

Hybrid (mixed-mode) ventilation relies on natural driving forces to provide the desired (design) flow rate. It uses mechanical ventilation when the natural ventilation flow rate is too low.

When natural ventilation alone is not suitable, exhaust fans (with adequate pre-testing and planning) can be installed to increase ventilation rates in rooms housing patients with airborne infection. However, this simple type of hybrid (mixed-mode) ventilation needs to be used with care. The fans should be installed where room air can be exhausted directly to the outdoor environment through either a wall or the roof. The size and number of exhaust fans depends on the targeted ventilation rate, and must be measured and tested before use. Problems associated with the use of exhaust fans include installation difficulties (especially for large fans), noise (particularly from high-power fans), increased or decreased temperature in the room and the requirement for non-stop electricity supply. If the environment in the room causes thermal discomfort spot cooling or heating systems and ceiling fans may be added.

Figure 6. whirlybird. https://www.askthebuilder.com/roof-turbine-vents/

Another possibility is the installation of whirlybirds (whirligigs or wind turbines, figure 3) that do not require electricity and provide a roof-exhaust system increasing airflow in a building.

Summary of advantages and disadvantages of different types of ventilation system for hospital

	Mechanical ventilation	Natural ventilation	Hybrid (mixed-mode) ventilation
Advantages	Suitable for all climates and weather with air-conditioning as climate dictates	Suitable for warm and temperate climates — moderately useful with natural ventilation possible 50% of the time	Suitable for most climates and weather
	More controlled and comfortable environment	Lower capital, operational and maintenance costs for simple natural ventilation	Energy-saving
	Smaller range of control of environment by occupants	Capable of achieving high ventilation rate Large range of control of environment by occupants	More flexible
Disadvantages	Expensive to install and maintain	Easily affected by outdoor climate and/or occupant's behaviour	May be expensive
	Reported failure rate in delivering the required outdoor ventilation rate	More difficult to predict, analyse and design	May be more difficult to design
	Potential for noise from equipment	Reduces comfort level of occupants when hot, humid or cold	
		Inability to establish negative pressure in isolation areas, but may be provided by proper design; depends on situation	
		Potential for noise intrusion	
		High-tech natural ventilation shares some of the limitations and disadvantages of mechanical ventilation	

Figure 7. Summary of advantages and disadvantages of different types of ventilation systems for hospital. Atkinson, J., Chartier, Y., Pessoa-silva, C. L., Jensen, P. & Li, Y. Natural Ventilation for Infection Control in Health-Care Settings

Proposed hybrid ventilation system for severe patients' wards, ICU included

The decision whether to use mechanical or natural ventilation for infection control should be based on needs, the availability of the resources and the cost of the system to provide the best control to counteract the risks. However, considering the need to have a functioning SARI treatment center within a short delay, the difficulty of securing sealed chambers for negative pressure [except for concrete building] the importance of meeting the IPC requirements, this document advice to install a hybrid ventilation system [for severe patient' ward and ICU] as easier to install than a mechanical one and more flexible in term of ventilation rate than a natural one.

As previously defined, hybrid (mixed-mode) ventilation relies on natural driving forces to provide the desired (design) flow rate. It uses mechanical ventilation when the flow rate is lower than that required to produce natural ventilation. As it's unpredictable where the SARI treatment Center will be built, therefore the local environmental conditions may vary from setting to setting, a *Top down hybrid ventilation* is proposed.

Top-down ventilation (fan-assisted stack plus a wind tower) — when there is insufficient solar radiant loading on the stack (i.e. evenings and inclement days) the exhaust ventilation rate is supplemented by extraction fans while the supply ventilation rate is supplemented by the wind tower (wind scoop).

The air extractor will easily allow to control the ventilation rate, meet the ACH standard required and assuring a constant unidirectional top-down airflow.

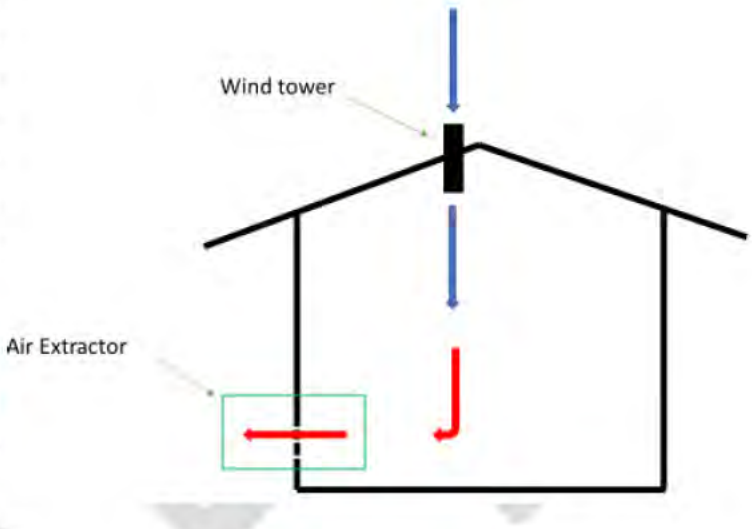


Figure 8. Top down hybrid ventilation

Extraction fan technical requirements

There are many extraction fans available on the market such as bathroom and kitchen extractor fans, silent extractor fans, wall fans and axial fans to remove fumes, smoke, heat and steam. In order to meet the IPC standards required for the SARI treatment center the following specification should be met:

- Wall mounted only: the airflow should be top-down, from the ceiling to the floor. For this reason, the extractor has to be installed on the wall [at about 20 cm above ground level in order to avoid damages due to splash while cleaning and disinfecting the floor].
- Back draught shutter: to direct the exhaust air flow.
- Power Rating: according to the country regulation and availability.
- Sound: 38dBA at 3m [or as quiet as possible]: to avoid constant noise which may disturb patients and staffs.
- Airflow [m^3/h or l/s]: according to the room's maximum bed capacity considering at least the minimum standard of 160 l/s/patient or 576 m^3/h/patient. The formula to calculate the extraction fan airflow needed given a specific bed capacity is:

Extractor airflow [l/s] = Maximum bed capacity x 160 l/s/patient

or

Extractor airflow [m^3/h] = Maximum bed capacity x 576 m^3/h/patient

Example. Calculate the extractor airflow needed for a 5 beds room:

Extractor airflow [l/s] = Maximum bed capacity x 160 l/s/patient

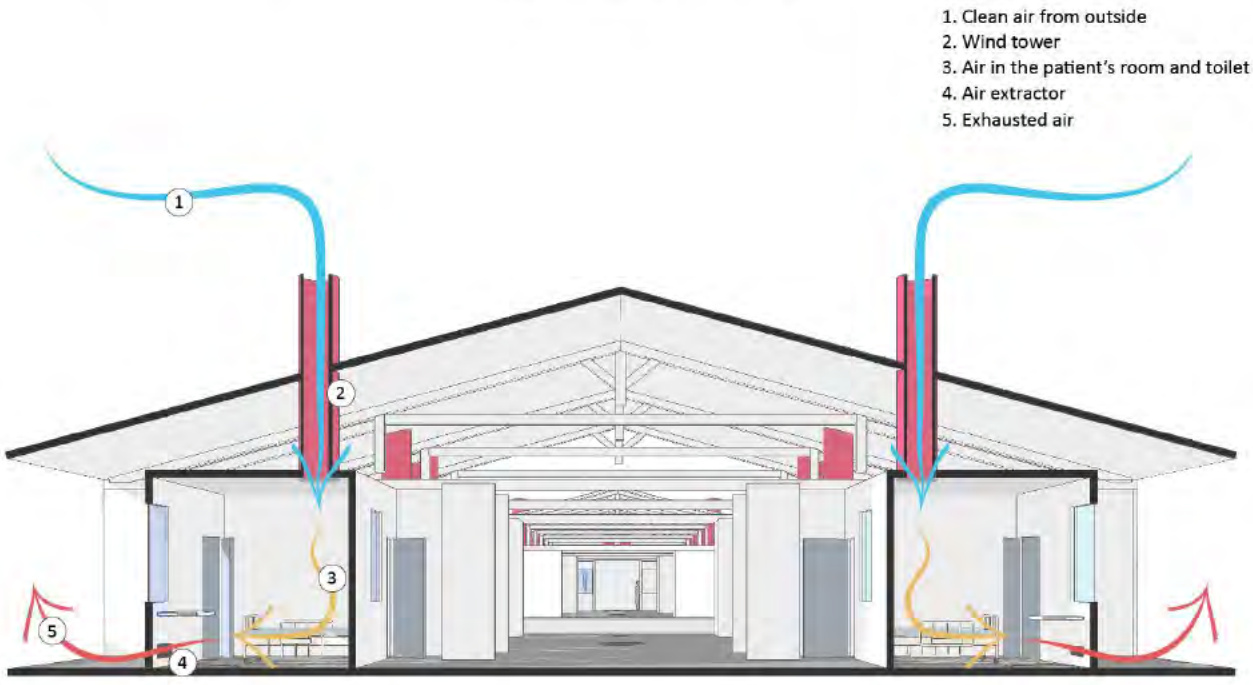
Extractor airflow [l/s] = 5 bed capacity x 160 l/s/patient

Extractor airflow [l/s] = 800 l/s

Figure 9. Air extractor models. https://www.pinterest.it/

How to install air extractor in patient's room

Air extractor should be properly installed in order to create the correct air flow. Air should always move from a "clean zone" to more a "dirty zone" and with a top-down direction to reduce nosocomial infections. Additionally, it's advisable to install the air extract at least 20 cm above the floor to avoid possible splash and damages while cleaning the room. As the



Exhausted air

Air from the room can be exhausted directly to the outdoors, where the droplet nuclei will be diluted in the outdoor air, or passed through a special high efficiency particulate air (HEPA) filter that removes most (99.97%) of the droplet nuclei before it is returned to the general circulation. If a HEPA filter is not used, the air should be exhausted directly to the outside away from air-intake vents, persons, and animals [17]

The layout here proposed doesn't allow simple air dilution and, in order to facilitate the implementation in different contexts, 3 different treatments for exhausted air are proposed.

HEPA filter

HEPA is a type of pleated mechanical air filter. It is an acronym for "high efficiency particulate air [filter]". This type of air filter can theoretically remove at least 99.97% of dust, pollen, mold, bacteria, and any airborne particles with a size of 0.3 microns (µm). The diameter specification of 0.3 microns responds to the worst case; the most penetrating particle size (MPPS). Particles that are larger or smaller are trapped with even higher efficiency. Using the worst-case particle size results in the worst-case efficiency rating (i.e. 99.97% or better for all particle sizes). All air cleaners require periodic cleaning and filter replacement to function properly. Follow manufacturer's recommendations on maintenance and replacement.

Minimum Efficiency Reporting Values, or MERVs, report a filter's ability to capture larger particles between 0.3 and 10 microns (µm).

- This value is helpful in comparing the performance of different filters
- The rating is derived from a test method developed by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) [see www.ashrae.org].
- The higher the MERV rating the better the filter is at trapping specific types of particles.

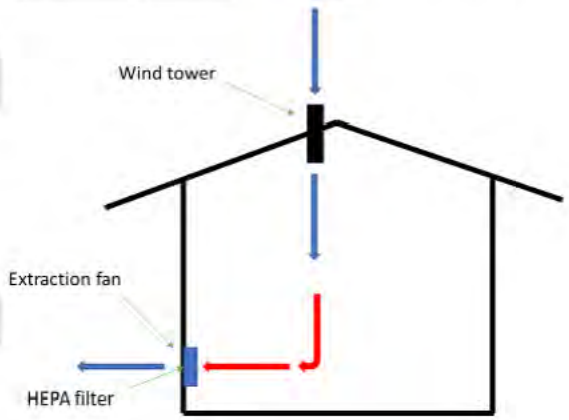


Figure 10. HEPA filter installation

HEPA filter after the air extractor could be a solution. However, availability and maintenance may be a problem.

Portable Air Filtration Systems

In order to simplify the installation, reducing the construction time and assuring proper air treatment, facilities may benefit from the use of a portable HEPA filter unit equipped with the proper fittings/ducting to exhaust air from a selected room to create the required ventilation flow rate and exhausted air treatment as well [18].

Placement of the unit in any area (sampling room, waiting room, patient's wards, etc.) must be done in consideration of the following [18]:

- The unit must not create an obstruction that would interfere with the proper delivery of health care.
- The unit should be placed as close to the expected source of the contamination as possible to increase effective capture of the infectious/hazardous agents. Capture ability decreases with the square of the distance from the intake, so the distance from the patient has an impact on the ability to filter out droplet nuclei.
- The air flowing out of the unit must not be directed in a way that would cause discomfort to patients, visitors and staff.
- If the portable air filtration unit has adjustable air flow, the air flow should be selected that is appropriate to the size of the room to give the desired air changes per hour. Unless other considerations (such as noise, discomfort of blowing air, etc) prevail, the unit should normally be run at the highest fan setting since this will provide the maximum filtration and air changes per hour. In smaller rooms the recommended minimum 12 air changes per hour may be achieved at a lower fan setting. Under these conditions, the users may opt to lower the fan settings.
- Keep all doors to the room closed as much as possible [19].
- Place the portable HEPA unit at maximum distance across the room from the door.
- Make sure that operating panel faces room and is unobstructed.
- Run the portable HEPA unit for at least 30 minutes after the patient leaves the room if that patient is still on aerosol generating procedure when they leave. During this time, respiratory protection should be worn by employees entering room. New patients should not be placed in the room[19].

Portable air filtration units require proper preventive maintenance for their effective continued operation.

- The procedure should specify recommended personal protective equipment (PPE) when performing maintenance on the unit.
- The maintenance procedure should be performed in an area safely away from any patient locations. It is recommended that it be done in some maintenance location that has appropriate ventilation including negative pressure, designated for such activities. The area should be a contained area and easily leaned/decontaminated.
- Based upon manufacturer's recommendation and any additional suggested protocol from facility maintenance, a standard routine maintenance procedure should be developed for the unit. Such maintenance should include items such as (but not limited to):
    - Changing of pre-filters (on a schedule or as needed per magnehelic gauge) Be sure to include details on "bag out" protocol and proper disposal of filters. Since these filters might be contaminated, they should be treated as medical waste and handled with appropriate PPE.

- Operational check for proper operation
- Interior cleaning of unit if needed (without disturbing seal on HEPA filter) d. changing of UV lamp per manufacturer recommendation (based on hrs of use) e. general safety check (electrical & mechanical).
- Lubrication where needed (Note: fans, etc should have sealed bearings and should not require lubrication)

– The HEPA unit must be leak tested and certified. This should be done initially and every time the HEPA filter is changed. The frequency of changing the HEPA filter should be based upon manufacturer's recommendation (e.g. annually or when indicated by the manometer (differential pressure gauge) across the HEPA filter.
– The portable filtration unit should be monitored regularly (e.g. weekly) for leaks. This can be done by simply having designated staff monitor the pressure drop across the filter by checking the gauge.

Different installation of a portable Air Filtration Systems

The portable air filtration system could be used as a mechanical fan with integrated HEPA filter to exhaust potential contaminated air directly outside as shown in the figure 11 below.

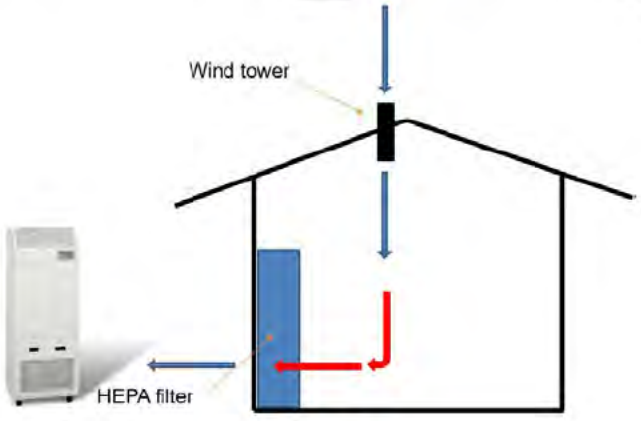


Figure 11. Portable air filtration system with air exhaustion

Alternatively, it could be used to assure required ACH and air recirculation in a closed environment as for figure 12 below.

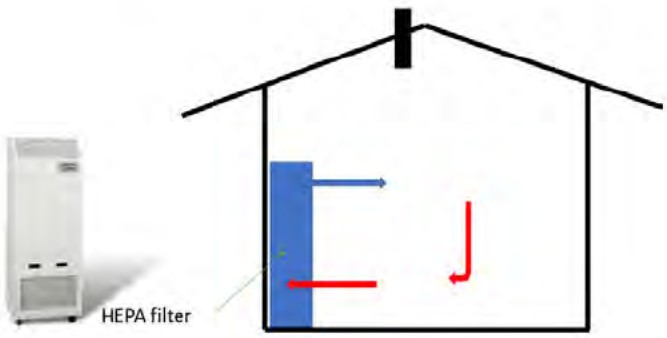


Figure 12. Portable air filtration system with air recirculation

Ultraviolet Germicidal Irradiation (UVGI)

Because the clinical effectiveness of UV systems may vary, UVGI is not recommended for air management prior to air recirculation from airborne isolation rooms. It is also not recommended as a substitute for HEPA filtration, local exhaust of air to the outside, or negative pressure [20].

	Conventional low-pressure UV tube	Amalgam low pressure UV tube	Medium pressure UV lamps
UV emission spectrum	Narrow band	Narrow band	Broad band
UV-C wavelength	254 nm	254 nm	200 – 280 nm
% of electrical input power converted in UV-C light	40 %	30 %	15 %
Surface temperature	40 Celsius degrees	100 Celsius degrees	600- 900 C degrees
Influence on ambient temperature	Large	Lower	Negligible
Electrical input power range	5 – 50 w	50 – 300 w	1 – 30 Kw

Ultraviolet Germicidal Irradiation (UVGI) is electromagnetic radiation that can destroy the ability of microorganisms to reproduce by causing photochemical changes in nucleic acids. Wavelengths in the UVC range are especially damaging to cells because they are absorbed by nucleic acids. The spectrum of ultraviolet light extends from wavelengths of about 100–400 nm [21]. The subdivisions of most interest include UVC (200–280 nm), and UVB (280–320 nm). The mechanisms of UVGI on microbes are uniquely vulnerable to light at wavelengths at or near 253.7 nm, because the maximum absorption wavelength of a DNA molecule is 260 nm [22]. Additionally, far-UVC light inactivation efficacy has been proved on airborne viruses carried by aerosols. For example, a very low dose of 2 mJ/cm2 of 222-nm light inactivates >95% of airborne H1N1 virus [23] while virus reduction factors ≥3.4 for SARS-CoV, have been achieved with the UVC-based system in platelet concentrates [24].

Effective room air disinfection depends on circulating maximal room air through the duct and the velocity at which it is circulated [25]. For this reason, is essential to well define the size [volume] of the air duct [sealed space] according to the air extractor capacity. Higher the contact time, more effective the disinfection.

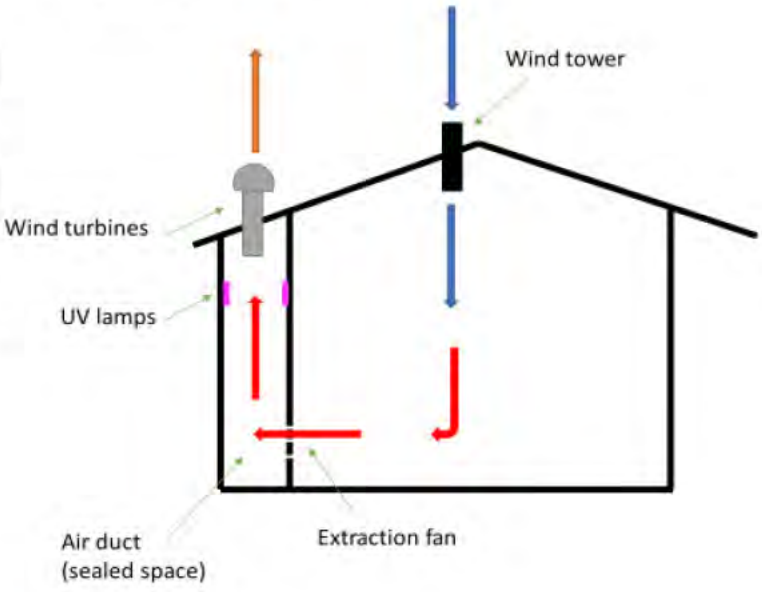


Figure 13. UV light duct

UVC lamp requirements

There are three different UV sources available providing the required wavelength of 254 nm.

The most important requirement is the UV wavelength as it directly affect the disinfection efficiency of the lamp. Only use lamp providing a wavelength of 254 nm or 0,254 µm.

However, electrical consumption should be taken into account as it will definitely drive the electrical supply choice.

Another important aspect is the surface temperature. Bearing in mind the centre will be a temporary structure, lamps reaching high surface temperature may become a serious threat as it could increase the likelihood of fire.

For the above reasons this manual advises the use of conventional low-pressure UV tube.

UV Lamp installation

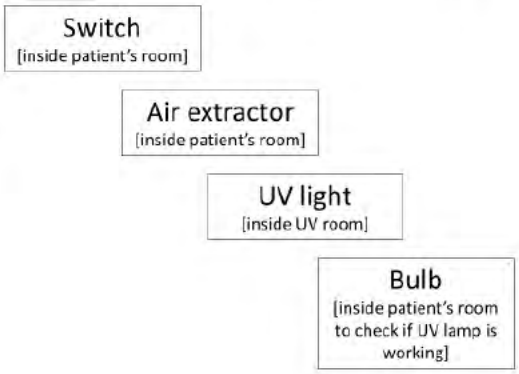
Always try to install the lamps in a way to avoid shaded areas and to assure that all the air volume is exposed to the light.

Consider an electrical installation as proposed below. It would reduce useless utilisation of the UV light and assuring a proper follow up in case of burnt out bulb.

UV light exposition risk

Ultraviolet (UV) radiation is a known cause of skin cancer, skin ageing, eye damage, and may affect the immune system. As UV radiation can neither be seen nor felt, it is important therefore that workers who have the potential to be exposed to intense levels of UV radiation are aware of the risks and are regularly reminded to take prompt, appropriate protective action [26].

All UV light disinfection rooms should be properly labelled and always locked in order to avoid any risk of exposition for staffs and patients.



Testing ventilation system

Purpose:

- To verify the volumetric flow rate(s)
- To check the performance of the system periodically
- To obtain specific information and compare with design data
- To set baseline for periodic maintenance checks
- Basis for design of future installations where satisfactory air contaminant control is currently being achieved
- To meet governmental or regulatory requirements for certain types of processes

The easiest and most convenient way to test air flow is to visualise it using safe smoke.

Other more sophisticate testing system are available on the market and described in the presentation available in following link.

http://www.aiha-carolinas.org/downloads/spring-12-meeting/testingAndTroubleshooting.pdf

Resume of proposed ventilation system and exhausted air treatment by area or service

Area or service	Proposed ventilation system	Proposed exhausted air treatment
Staff area	Natural ventilation	Dilution[1]
Triage	Natural ventilation	Dilution
Waiting room	Natural ventilation	Dilution
Sampling room	Natural ventilation Hybrid ventilation	Dilution HEPA filter or UV light
Short stay ward [mild cases]	Natural ventilation	Dilution
Moderate cases ward	Natural ventilation Hybrid ventilation	Dilution HEPA filter or UV light
Severe cases ward ICU included	Hybrid ventilation Mechanical ventilation	Dilution HEPA filter or UV light HEPA filter or UV light
Waste zone	Natural ventilation	Dilution
Morgue	Natural ventilation	Dilution

Description of proposed air exhausted treatment system

NOTE: Dilution should be the favoured method for air management whenever possible

[1] For a safe dilution the air should be exhausted directly to the outside away from air-intake vents, persons, and animals

	HEPA filter	Portable HEPA filter	UVGI
General characteristic			
Image			
Description	Pleated mechanical air filter. It is an acronym for "high efficiency particulate air [filter]". This type of air filter can theoretically remove at least 99.97% of dust, pollen, mold, bacteria, and any airborne particles with a size of 0.3 microns (µm).	A portable HEPA filter unit equipped with the proper fittings/ducting to exhaust air from a selected room to create the required ventilation flow rate and exhausted air treatment as well	Electromagnetic radiation that can destroy the ability of microorganisms to reproduce by causing photochemical changes in nucleic acids. Wavelengths in the UVC range are especially damaging to cells because they are absorbed by nucleic acids
Application	Air filtration in hospitals, isolation and laboratory facilities.	Ventilation and air filtration in hospitals, isolation and laboratory facilities.	Air-cleaning measure, UVGI is effective in reducing the transmission of airborne bacterial and viral infections in hospitals, military housing, and classrooms.
Air extractor needed	Yes	No	Yes
Efficiency	This type of air filter can theoretically remove at least 99.97% of dust, pollen, mold, bacteria, and any airborne particles with a size of 0.3 microns (µm). The diameter specification of 0.3 microns responds to the worst case; the most penetrating particle size (MPPS). Particles that are larger or smaller are trapped with even higher efficiency. Using the worst-case particle size results in the worst-case efficiency rating (i.e. 99.97% or better for all particle sizes).		UVGI is effective in reducing the transmission of airborne bacterial and viral infections, but it has only a minimal inactivating effect on fungal spores. UVGI is also used in air handling units to prevent or limit the growth of vegetative bacteria and fungi[27].
Suitable for air recirculatio	Yes	Yes	No

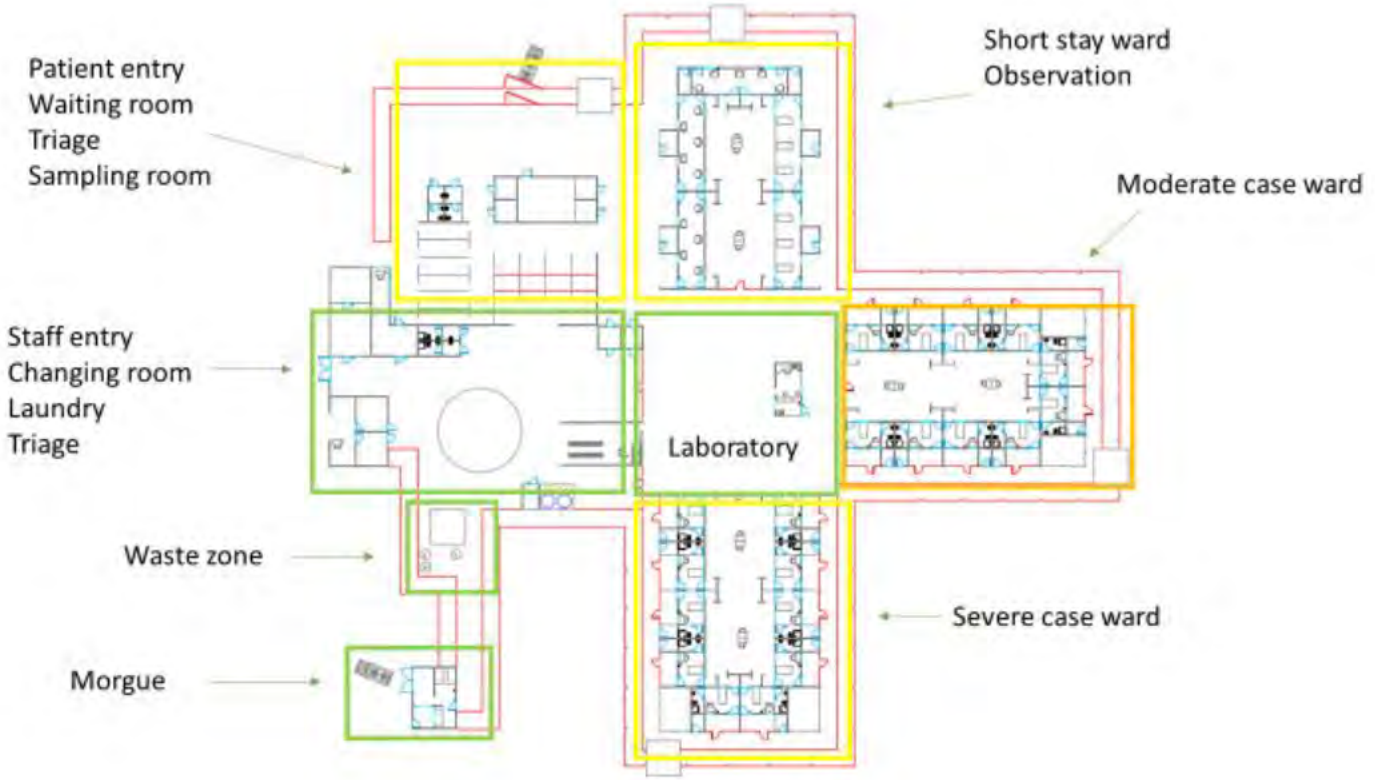
n			
Risk for healthcare workers	No	No	Yes, excess exposure may result in dermatosis and photokeratitis[28]
Electricity requirement	No	Yes	Yes
Initial cost	Moderate;	High	Minimal
Ongoing operating costs	Moderate; air extractor power consumption and filter replacement according to manufactory specification	Moderate; power consumption and filter replacement according to manufactory specification	Minimal; air extractor power consumption and filter replacement according to manufactory specification
Maintenance requirement	Moderate maintenance required by trained technicians.	Moderate maintenance required by trained technicians²⁹²⁸²⁸²⁸²⁸(World Health Organization, 2019)(World Health Organization, 2019), who could be in-house	Minimal maintenance required. Usually consists of keeping the bulbs free of dust and replacing old bulbs as necessary.
Merits	– High efficiency	– High efficiency – Ventilation system included	– Can be cost-effective for large facilities. – Minimal maintenance needed
Drawbacks	– Requires uninterrupted power. – Requires moderate maintenance	– High initial investment – Requires uninterrupted power. – Requires moderate maintenance	– Because the clinical effectiveness of UV systems may vary, UVGI is not recommended for air management prior to air recirculation from airborne isolation rooms – Requires uninterrupted power. – Needs adequate infrastructure.

Layout

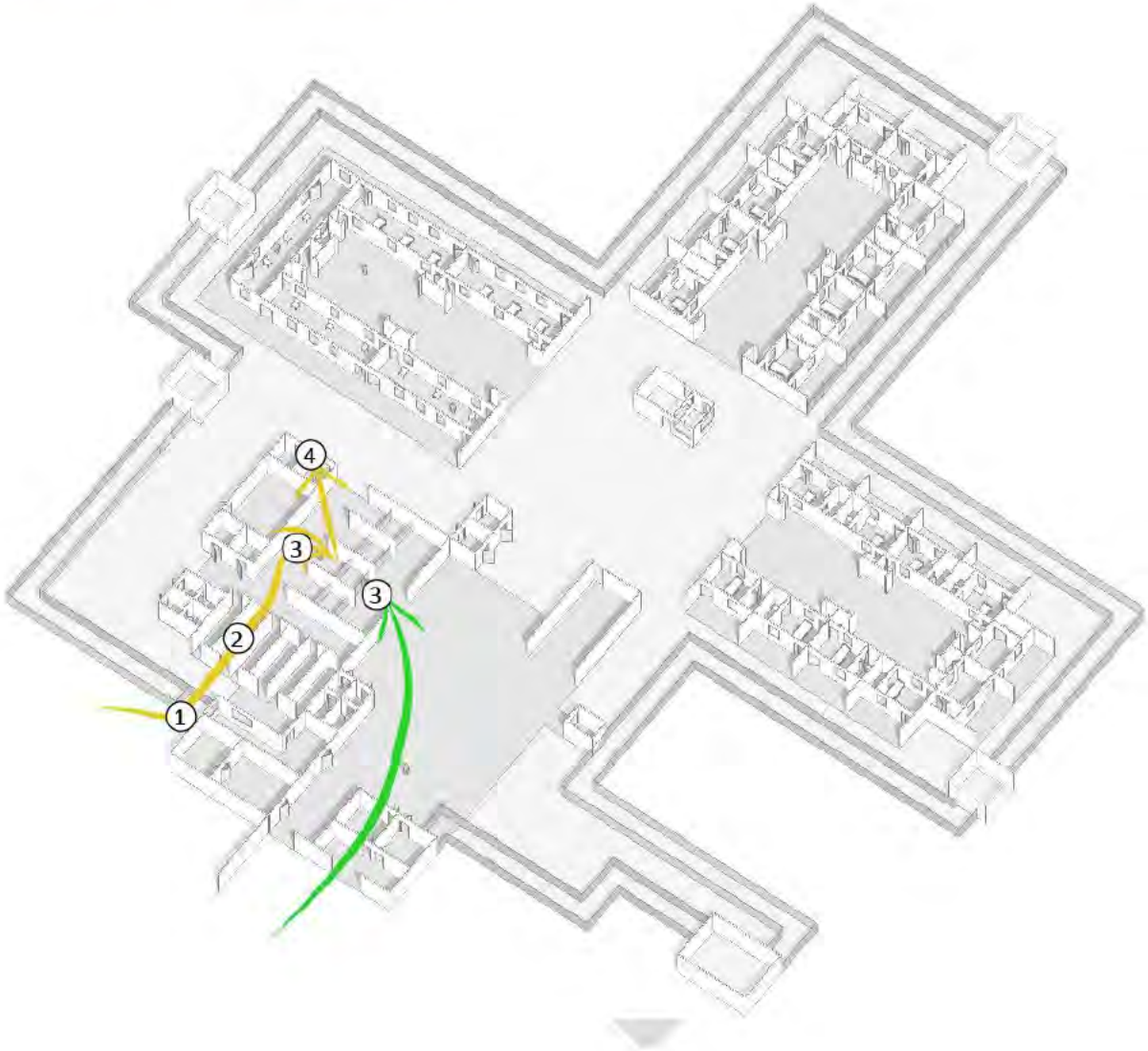
Consult annexe 2 and above

NOTE: STAFF IS NOT SUPPOSED TO WEAR MASK IN THE CENTER EXCEPT WHEN IN CONTACT WITH PATIENTS.

Services and facilities



Patient's Flow, from entry to sampling



1. Patient's entry.

NOTE: patients have already been triage in another medical facility and being referred to the SARI treatment center.
At this point all patients: Receive a mask,
Hand washing,
Addressed to a dedicate individual booth in the waiting room.

2. Waiting room

The waiting room is composed of different individual booths with separated entrance and exit.
This facility is completely open [no doors] to allow a proper natural ventilation and equipped with dedicate toilets.

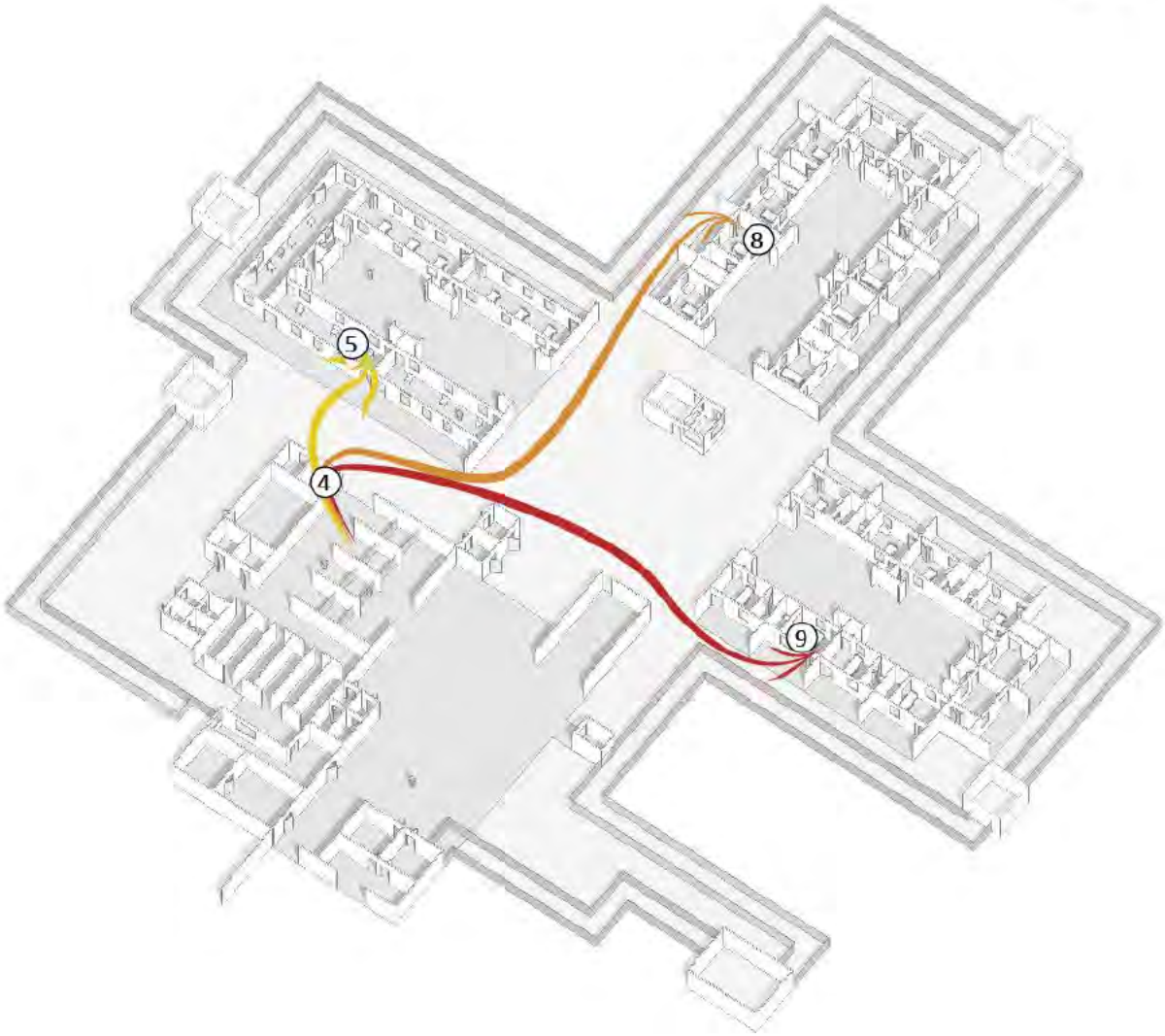
3. Triage

Patients are investigated in the individual triage booth. A two meter distance fence [1,2 m height] separate patients from staffs.
This facility is completely open [no doors] to allow a proper natural ventilation.

4. Sampling

NOTE: Not all the patients have to be tested, it's according to medical decision.
The sampling room is a 4 individual booth with hybrid ventilation

Patient's Flow, after sampling patients are divided by severity



4. Sampling

NOTE: Not all the patients have to be tested, it's according to medical decision.
The sampling room is a 4 individual booth with hybrid ventilation

5. Short stay ward

Patients are moved to the short stay ward where distances and hybrid ventilation assure IPC standards.
Patients can wait few hours for the laboratory results, receiving health promotion sessions and treatment

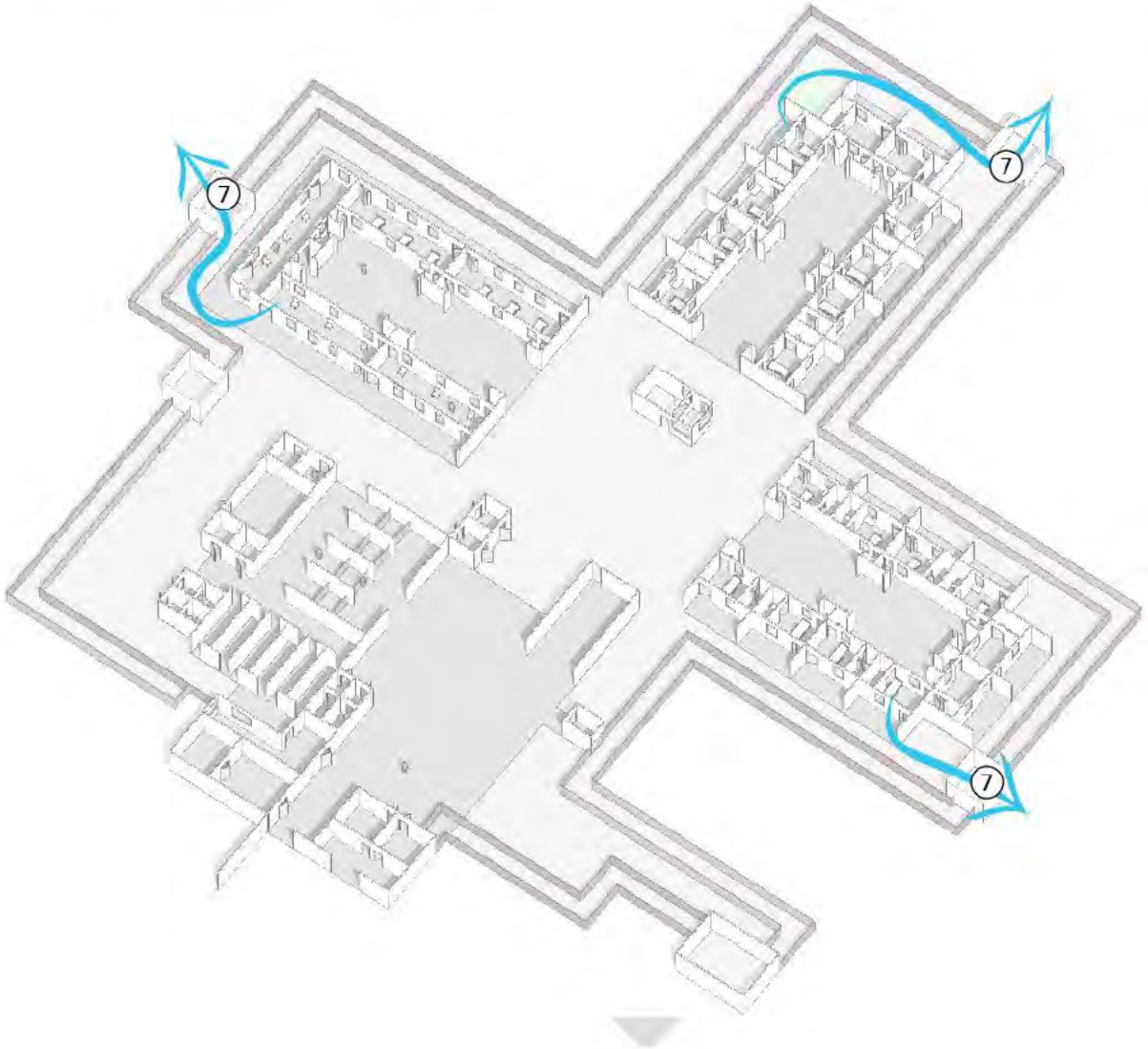
8. Moderate case

Moderate cases are moved directly to the moderate case ward.
Medical care will then be provided and the sample taken.
This ward is composed of individual self-contained rooms with hybrid ventilation.
Once recovered the patient will be discharged through the dedicated discharge room.

9. Severe case.

Severe cases are moved directly to the moderate case ward.
Medical care will then be provided and the sample taken.
This ward is composed of individual self-contained rooms with hybrid ventilation.
Once recovered the patient will be discharged through the dedicated discharge room.

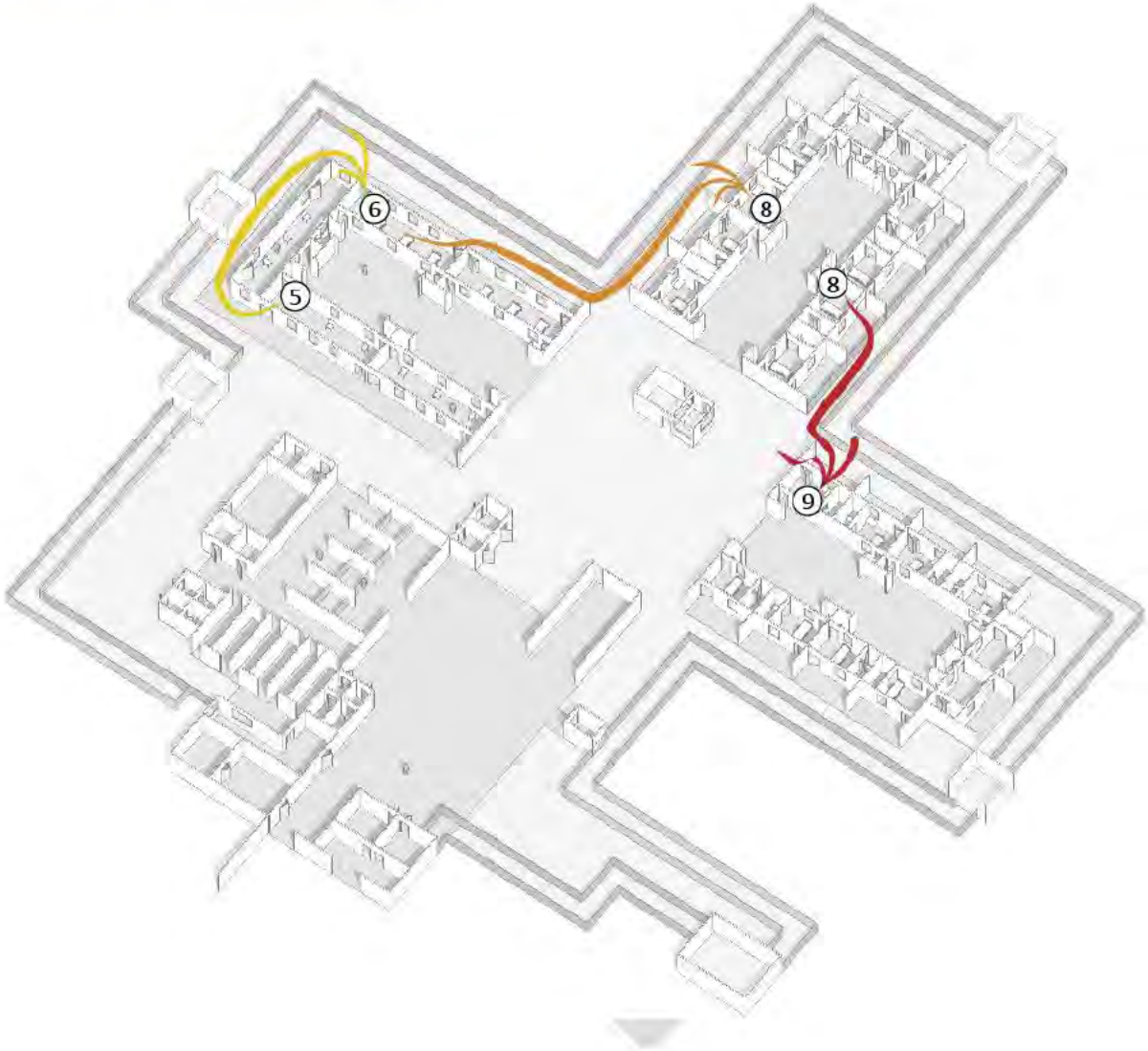
Patient's Flow, negative tested patients



4. Discharge

Patient can be referred to another health facility or at home for home based care.

Patient's Flow, worsened patients



5. Short stay ward

Patients are moved to the short stay ward where distances and hybrid ventilation assure IPC standards.
Patients can wait few hours for the laboratory results, receiving health promotion sessions and treatment

6. Short stay ward - observation

The patient is moved to the observation room only in case the medical department want to keep the patient under observation for few hour more.

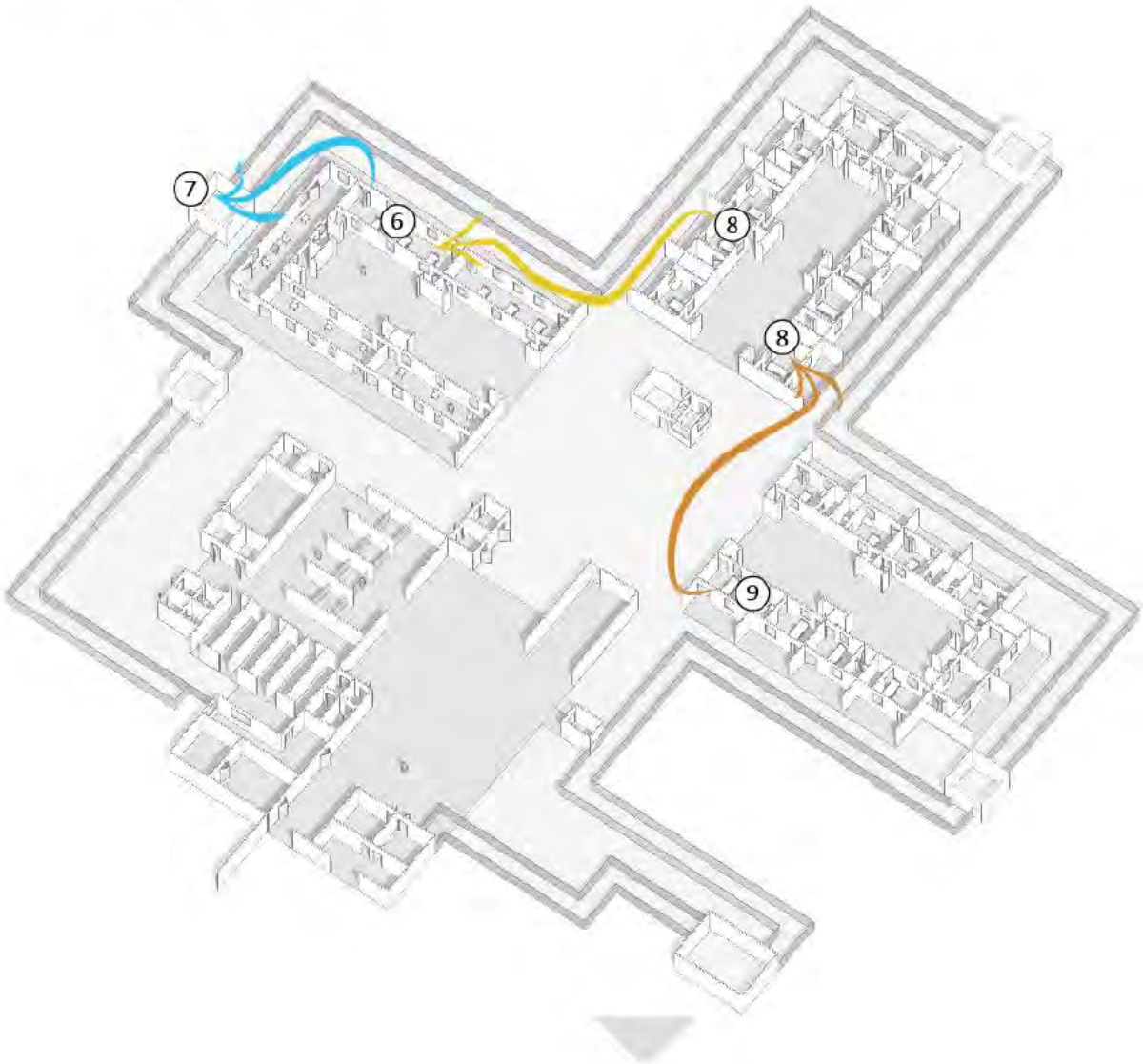
8. Moderate case

Moderate cases are moved directly to the moderate case ward.
Medical care will then be provided and the sample taken.
This ward is composed of individual self-contained rooms with hybrid ventilation.
Once recovered the patient will be discharged through the dedicated discharge room.

9. Severe case.

Severe cases are moved directly to the moderate case ward.
Medical care will then be provided and the sample taken.
This ward is composed of individual self-contained rooms with hybrid ventilation.
Once recovered the patient will be discharged through the dedicated discharge room.

Patient's Flow, healed patients



6. Short stay ward - observation

The patient is moved to the observation room only in case the medical department want to keep the patient under observation for few hour more.

7. Discharge

Patient can be referred to another health facility or at home for home based care.

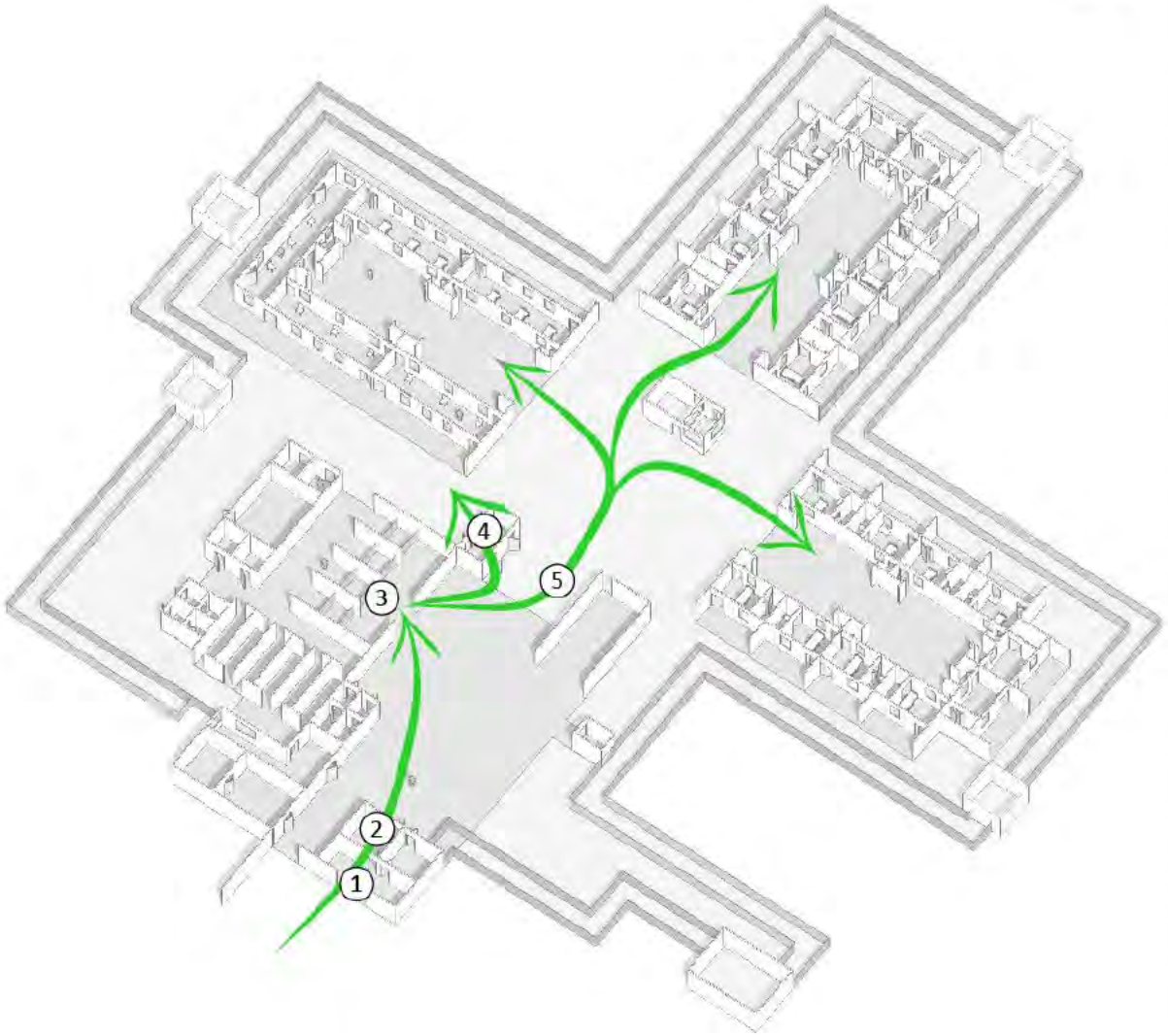
8. Moderate case

Moderate cases are moved directly to the moderate case ward.
Medical care will then be provided and the sample taken.
This ward is composed of individual self-contained rooms with hybrid ventilation.
Once recovered the patient will be discharged through the dedicated discharge room.

9. Severe case.

Severe cases are moved directly to the moderate case ward.
Medical care will then be provided and the sample taken.
This ward is composed of individual self-contained rooms with hybrid ventilation.
Once recovered the patient will be discharged through the dedicated discharge room.

Staff's flow



1.Staff entry

At this point all staffs: Receive a mask:
-Hand washing,
-Temperature check
-Presence record

2. Changing room

Male and female changing room to remove personal clothes and wear scrubs and boots [or closed shoes].
Staff toilets are available nearby.

3. Triage

Patients are investigated in the individual triage booth. A two meter distance fence [1,2 m height] separate patients from staffs.
This facility is completely open [no doors] to allow a proper natural ventilation.

4. Triage - Donning/Doffing

Staff can wear specific PPE before going to the patient at the triage.

5. Wards - staff area

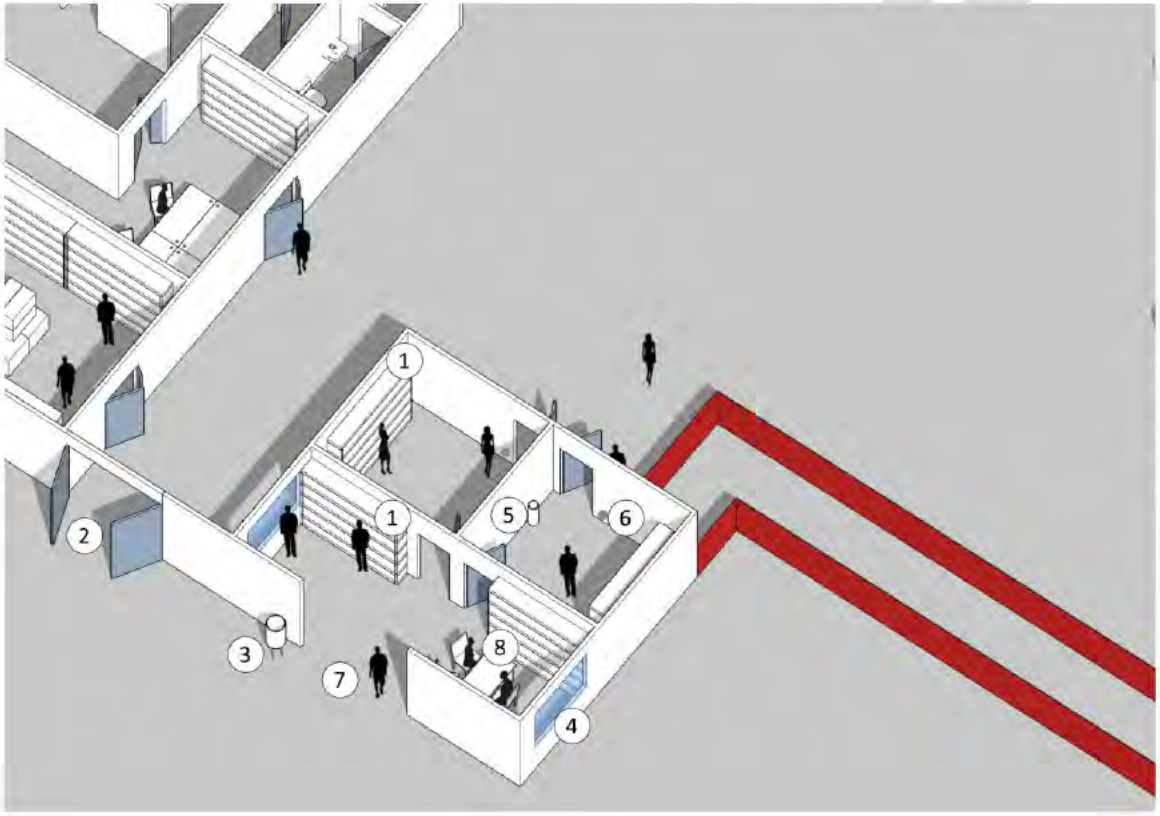
Each ward is equipped with a working space for staffs where patients are not allowed.
More information in the next chapter.

Facilities and services

Staff entrance and changing room

The staff entrance is the first IPC administrative control as allow staffs temperature screening. The receptionist should have good visibility to avoid unauthorized people from entering and ensure hand washing of all people entering. Hand hygiene points [alcohol hand rub] should be available in all rooms]. Spacious for potential overcrowding at certain hours (shift changes, etc.). Assure natural ventilation with wide open windows. Consider to install a shelf for staff's personal items.

Male and female changing rooms should be spacious enough to avoid overcrowding during shift changes and equipped with shelf for scrubs, boots or closed shoes for cleaners and personal clothes. Assure ventilation with air extractors and wind tower.

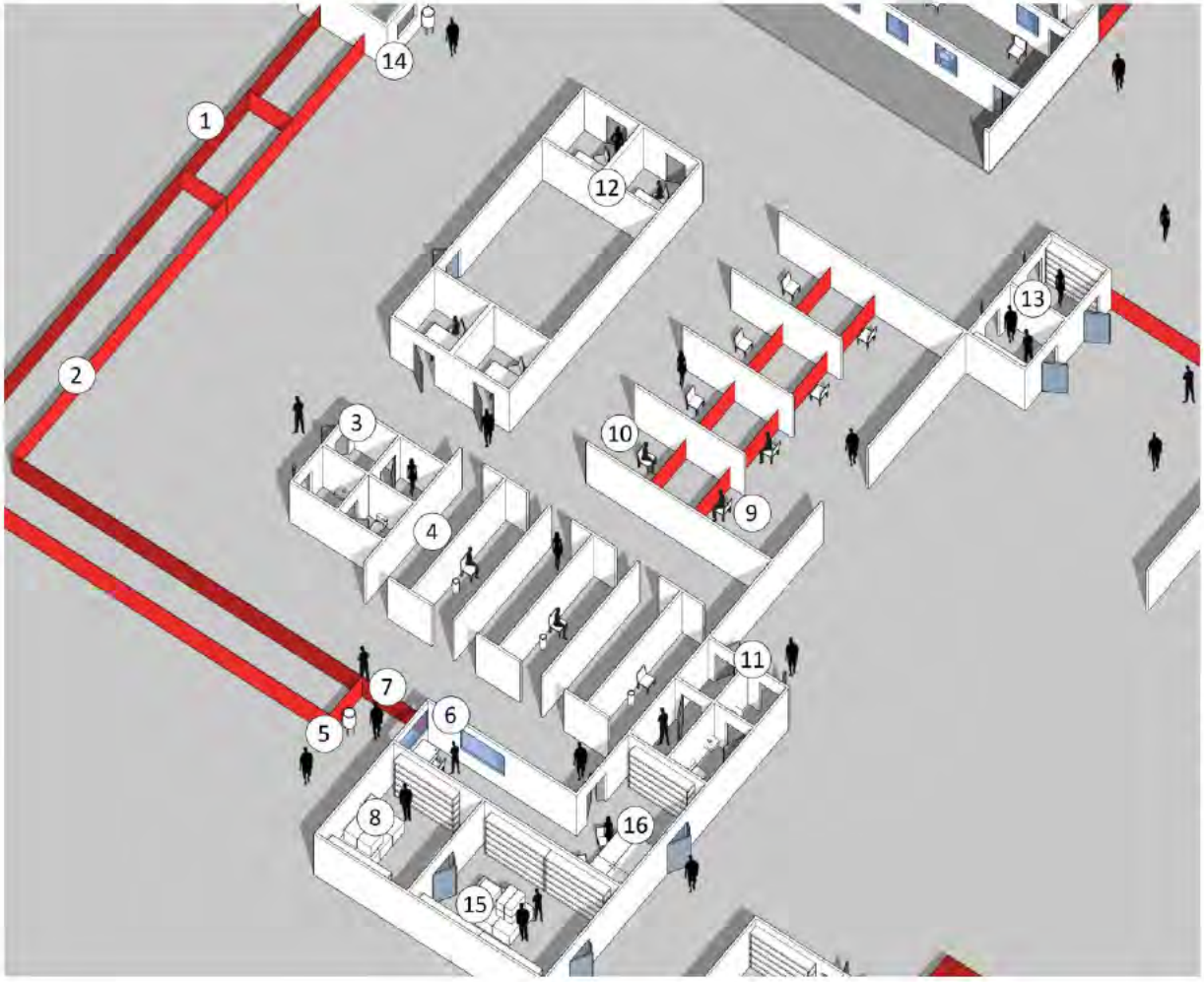


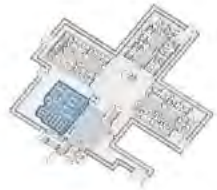
1. Shelf for private items
2. Supply entrance
3. Hand washing point [in and out]
4. Wide windows to assure natural ventilation
5. Bucket for used scrubs collection
6. Air extractors
7. Staff entrance
8. Temperature screening

Triage Area

Triage

Triage is divided in 2 distinctive zones: one zone for staff and high-risk zone for patients. A 2-meter distance between the staff and patient is required. Double fencing can be used for the separation or Plexiglas barrier. Separate hand washing points (soap/water) are available for patients and staff. A sloped board ('slide') can be placed between staff and patient zones to pass items (ORS, thermometer, etc.) from staff's area to patient's zone.





1. Ambulance entrance
2. Two meter distance fence [1.2m height]
3. Patient toilets
4. Waiting room. Individual booth
5. Hand washing point
6. Reception. Patient receive a mask
7. Patient entrance
8. Pharmacy
9. Triage - staff side
10. Triage - patient side
11. Staff toilet
12. Sampling room. Individual booths with hybrid ventilation. HEPA filter.
13. Donning/doffing for triage
14. Discharge room. Wide windows for natural ventilation
15. Logistic warehouse
16. Data manager office

Reception

Reception is a key service as the receptionist will have to address the patient to the correct waiting booth [empty, cleaned and disinfected]. A strong communication in between receptionist and triage staff is needed to assure a proper patient's flow.

Waiting room

The waiting room is composed of individual booths open on both sides to assure a proper natural ventilation. Each booth should be clearly identified and labelled to avoid any mistake and allow a proper patient's flow. Booths should be cleaned and disinfected after each patient to avoid nosocomial infections.

Sampling room

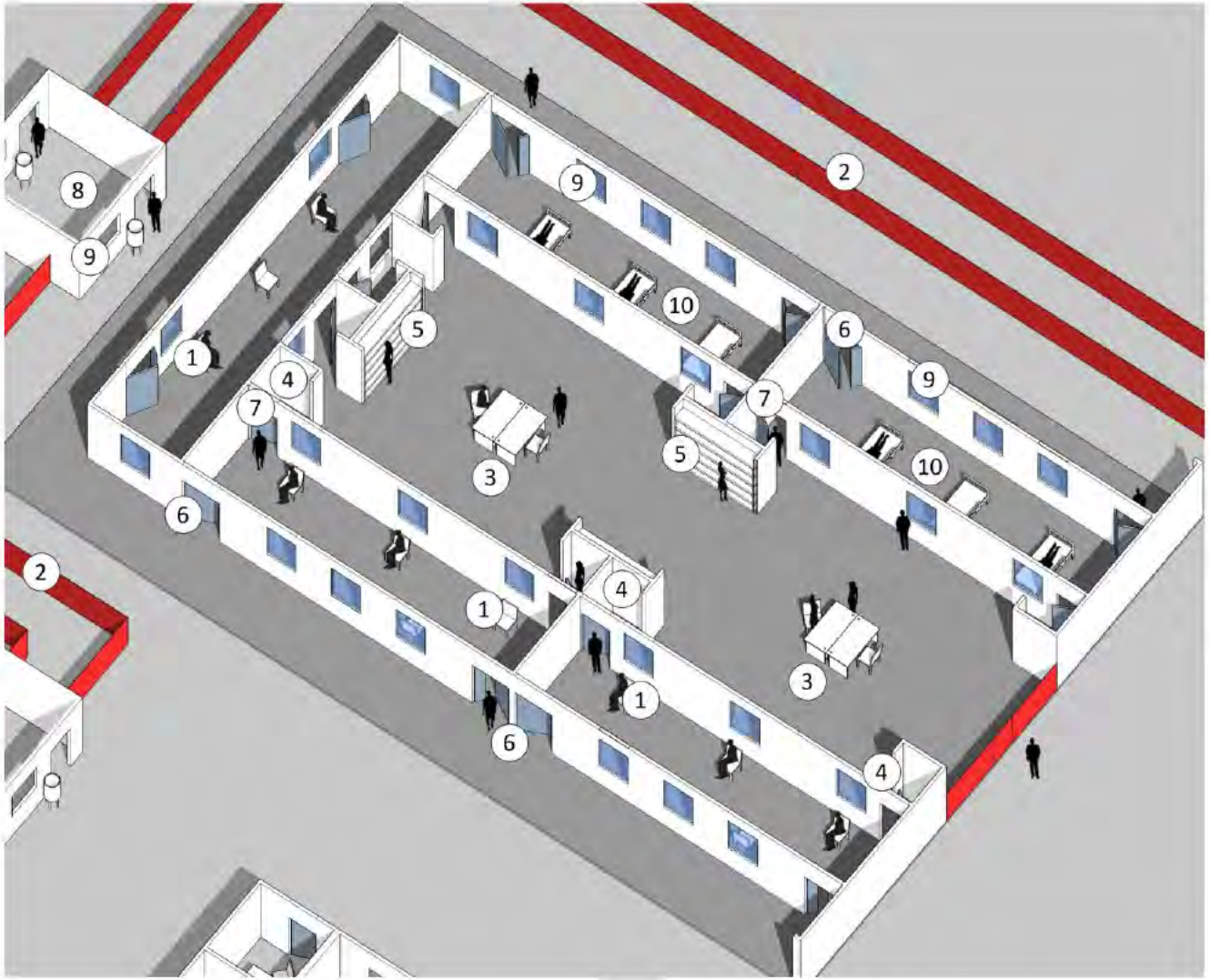
Where samples are taken for mild cases. Individual booth with hybrid ventilation and HEPA filter or UV disinfection for the exhaust air. Each booth should be clearly identified and labelled to avoid any mistake and allow a proper patient's flow. Booths should be cleaned and disinfected after each patient to avoid nosocomial infections.

NOTE: sampling a patient is based on case management decision.

Discharge room

For patients who don't fit the case definition or for mild cases referred to other health facilities or homecare. Wide window on both sides assure adequate natural ventilation and hand washing points are available at entrance and exit. A staff should be always present to control movements.

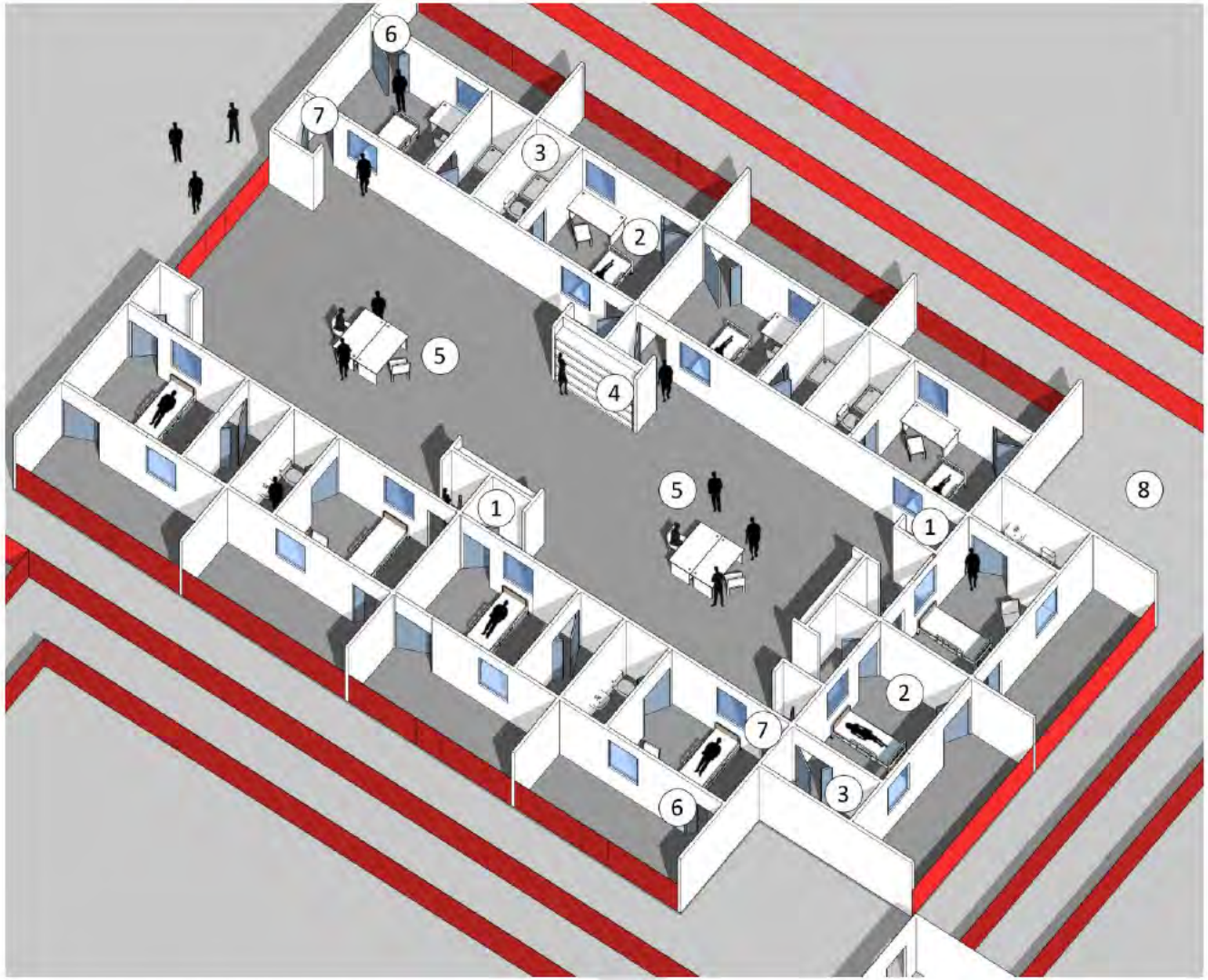
Short stay ward [and moderate ward]



1. Patients. [at least 1,5 m distance]
2. Two meter distance fence [1.2m height]
3. Working area. [staffs only]
4. Doffing space
5. Shelf for PPE
6. Patient entrance
7. Staff entrance only
8. Discharge room
9. Open window to assure natural ventilation
10. Short stay observation. Bed with proper distance in between

NOTE: windows are opened on the outside but closed with transparent material, such as Plexiglas, on the working area side.

Severe wards [ICU included] [and moderate ward]



1. Individual doffing. [one per room]
2. Self-contained room with individual terrace
3. Individual toilet/shower
4. Shelf for PPE
5. Working area [staffs only].
6. Patient entrance
7. Staff entrance only
8. Space for items cleaning and disinfection

NOTE: PATIENT'S ROOMS AND SHORT STAY WARD MUST HAVE A CEILING ON THE PATIENT'S SIDE TO ASSURE A PROPER AIRFLOW

Use of transparent surface

The use of transparent surfaces, window, in between the patient's room and the working area [nursing station] enable:

- **Visual contact with patient, therefore strengthening the bedside relationship, the anthropological approach and community engagement,**
- **Ease observation and monitoring therefore improve patient care through continuous patient observation and monitoring, and fast response,**
- **Installation of oxygen concentrator and ventilator, monitor, pulse oximeter not in the patient's room but in the working area, hence reducing the risk of nosocomial infections,**
- **Less PPE consumption as many medical activities may be performed directly from the working area.**

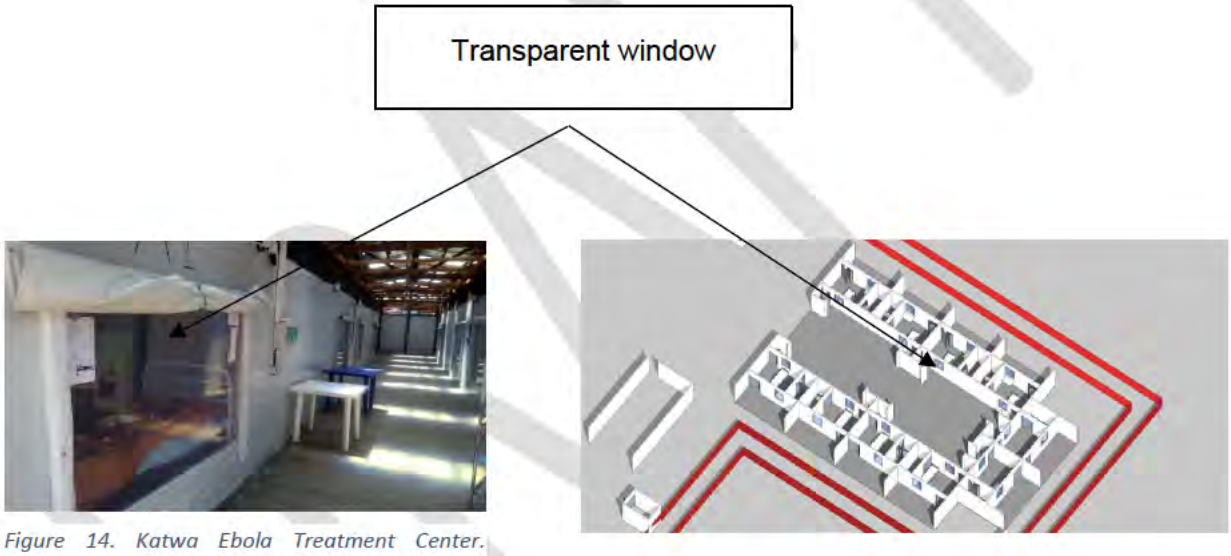


Figure 14. Katwa Ebola Treatment Center. Médecins Sans Frontières, 2018

Figure 15. Katwa Ebola Treatment Center. Transparent surface.

Example of transparent surface with oxygen concentrator and monitor installed outside patient's room.

Laboratory equipment and consumables

The recommended sources of information concerning the laboratory testing, and biosafety guidance to be followed during the 2019 novel coronavirus (2019-nCoV) are listed below:

- Laboratory biosafety guidance related to the novel coronavirus (2019-nCoV): https://www.who.int/publications-detail/laboratory-testing-for-2019-novel-coronavirus-in-suspected-human-cases-20200117

- Laboratory testing for 2019 novel coronavirus (2019-nCoV) in suspected human cases: https://www.who.int/docs/default-source/coronaviruse/laboratory-biosafety-novel-coronavirus-version-1-1.pdf?sfvrsn=912a9847_2

These documents function as a guide and are changing regularly as we learn more about the virus and its epidemiology. It is highly recommended that they are consulted on regular intervals.

As of the date of publication, the choice of laboratory diagnosis is limited to validated nucleic acid amplification protocols. As such, the choice of thermocycler and complementary consumable, in addition to reagents are restricted to the choices given in the selected protocol to be used and followed.

A general Nucleic acid amplification test (Real-Time Reverse-Transcriptase PCR) require the following components:

Essential material to perform the reaction

1- Primers and Probes
2- Real-Time RT-PCR reagent kit
3- Optical reaction reservoir in tube, strip-tube or plate format
4- Nucleic acid extraction kit

Complementary material

1- Biological Safety Cabinet Class II
2- Vortex mixer
3- Microcentrifuge
4- Micropipettes and aerosol barrier tips (P2, P20, P200 and P1000)
5- Disposable powder-free gloves
6- RNAse surface decontamination solution
7- Appropriate Personal Protective Equipment (PPE)

Managing the epidemic and surge Plan

Because new infectious disease threats usually start locally, it is important to understand their dynamics in order to deny them the opportunity to spread further among people and overwhelm health systems. The dynamics of epidemic and pandemic diseases typically occur in four phases, although not all epidemic diseases necessarily go through each phase. The first phase is the introduction in a community. The second phase is an outbreak with localized transmission, where sporadic infections with the pathogen occur. In the third phase, the outbreak amplifies into an epidemic or pandemic - the pathogen is able to transmit from human to human and causes a sustained outbreak in the community, threatening to spread beyond it. The fourth phase is reduced transmission when human-to-human transmission of the pathogen decreases, owing to acquired population immunity or effective interventions to control the disease [30].

The dynamics of epidemics, as described above, define the response and the sequence of interventions that then become necessary. Here, there are five crucial stages. First is the anticipation of new and re-emerging diseases to facilitate faster detection and response; followed by their early detection of emergence in animal and human populations; the third stage is the containment of the disease at the early stages of transmission; followed by the control and mitigation of the epidemic during its amplification; and fifth, the elimination of the risk of outbreak or eradication of the infectious disease [30].

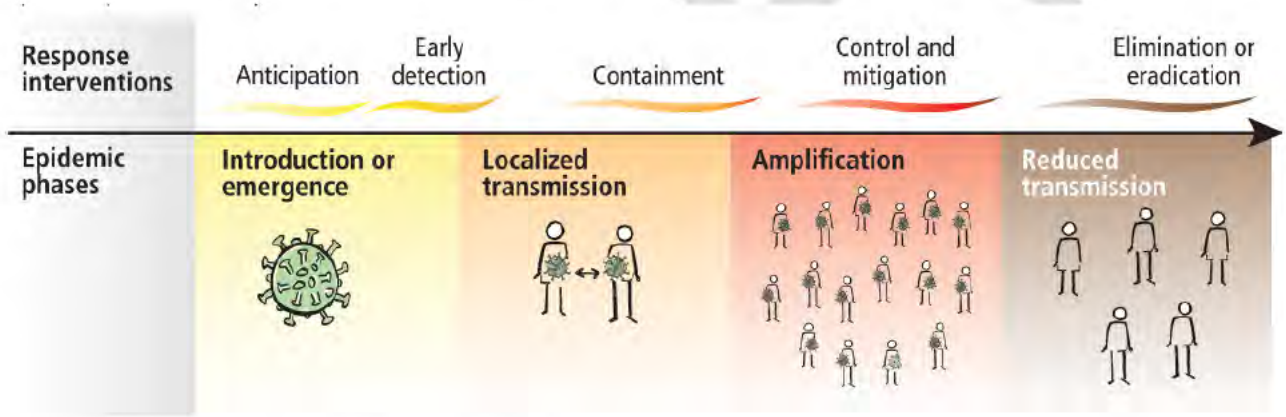


Figure 16. Epidemic phases and response interventions. Managing epidemics Key facts about major deadly diseases. WHO, 2018

The following chapters aim to propose different way to manage the outbreak according to specific phase. It does not pretend to be an exhaustive description but more a series of recommendations to be considered and adapted to the specific context.

Anticipation

In this first stage of response, introduction of the diseases cannot be predicted, but it can certainly be anticipated, and the anticipation of risks enables a focus on the most likely threats. Anticipation encompasses forecasting the most likely introduction point through risk analysis, and the quick identification of the drivers that will worsen the impact or facilitate the spread. Preparedness plans, based on lessons learned from past experiences, should contain a variety of scenarios to allow for a reactive response to the first imported cases.

Early detection

Early detection allows the rapid implementation of containment measures, which are the key to reducing the risk of amplification and potential international spread. Early detection begins at the health care setting, so health care workers must be trained to recognize potential suspected cases. Their role is also to reduce the risk of community transmission by isolating severely-ill patients; to prevent household transmission by protecting health care givers at home; and to reduce the mortality rate. Health care workers must also know how to protect themselves and employ infection prevention and control measures and how to avoid outbreaks amplified in health care facilities. In order to do so, the emergency referral system (control and command centre) should be put into place to be move suspected persons to the appropriate site/centre for diagnosis and treatment.

Containment

Effective and rapid containment of the disease is just as vital as early detection in order to avoid a large-scale epidemic. Rapid containment should start as soon as the first case is detected. It requires skilled professionals to safely implement the necessary countermeasures. Pre-training of these professionals is essential to guarantee the safety and efficiency of the operations.

For the anticipation, early detection and containment response, from the introduction to the localized transmission phase, is recommended to:

- Foreseen a proper triage system at all different levels of public health system to enable early detection of potential suspected cases. It should include temporary isolation capacity, trained staffs, protocols and all needed supplies.
- Designate health facilities able to provide the adequate level of care which most probably will be hospitals where intensive care units are available and setting up the correct IPC and engineering measures.
- Define a clear referral pathway for suspected and confirmed cases with dedicated ambulance service in order to facilitate referrals from primary health center to identified treatment facilities.
- Developing the control and mitigation plan

During these phases, the patient journey could be represented as for image below where primary health center, at triage level, identify suspect cases who subsequently are referred to the hospital level for testing or treatment.

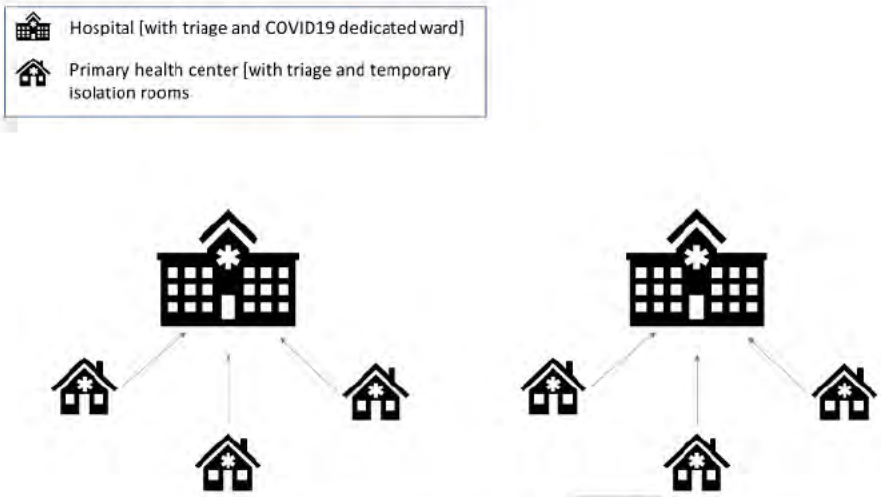


Figure 17. First phases patient's journey

Control and mitigation

Once the infectious disease reaches an epidemic or pandemic level with transmission at community level, the goal of the response is to mitigate its impact and reduce its incidence, morbidity and mortality as well as disruptions.

During this phase is necessary to protect the public health system from being overwhelmed and centralize the specific case management in order to simplify the referral pathway and reducing the risk of exposition for health care workers, patients and communities. This does not mean that new facilities have to be built as existing building might be reconverted into a SARI treatment center.

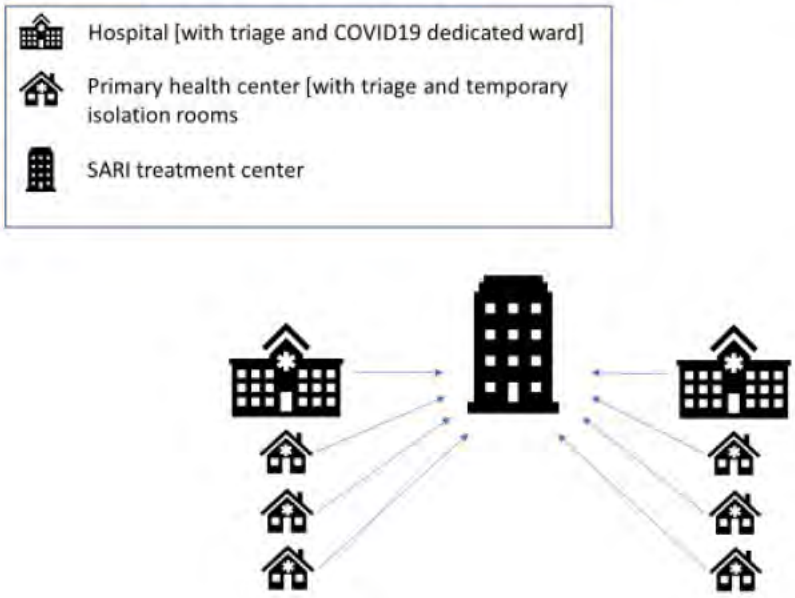


Figure 18. Control and mitigation phases, patient's journey

Base on the current experience, countries or sub-national areas will find themselves in one or more epidemiological scenarios. Currently, four transmission scenarios are observed:

1. Countries/areas with **no cases** [preparedness];
2. **Case**: sporadic cases [introduction];
3. **Cluster**: discrete groups of cases with epi-link [localized transmission] ;
4. **Community** transmission: areas experiencing outbreaks with local transmission, many without identifiable epidemiological link [amplification].

Countries will experience one or more of these situations at the sub-national level and must tailor their approach to the local context. Based on our current understanding of the natural history of disease, about 80% of patients with COVID-19 may have mild diseases, where treatment is largely symptomatic and does not require hospital interventions; 15% of patients will have severe disease where hospitalization is required for oxygen therapy; and about 5% have critical disease where care in intensive care with mechanical ventilation is necessary.

The different phases could be translated into specific operation strategies as resumed below.

Table 1. Key clinical and IPC considerations for different scenarios

	Sporadic cases Strategy 1	Clusters Strategy 2	Community Strategy 3
Space	Dedicated patient care spaces maximized	Patient care areas repurposed for COVID-19.	Non-traditional areas used for care. New hospitals set-up.
Staff	Additional staff called-in	Staff extension (supervision of larger number of staff), changes in responsibility, documentation	Insufficient ICU staff available, Expanded care team model. Emergency medical teams.
Supplies	On-hand supplies	Conservation, adaptation, selected re-use when safe.	Critical supplies lacking. Allocation of life-saving resources.
Standard of care Services?	Usual care	Minimal impact on usual patient care practices	Mass care must maintain minimal standards of IPC and oxygen therapy to be maintained.
Care areas expansion	Expand by 20%	Expand by 100%	Expand by 200%
Resources	Local	National	Global

Triage for health care facilities

Hospitals and other healthcare facilities play a critical role in national and local responses to emergencies, such as the COVID19 epidemics. This document provides information on how these facilities can fulfil this role. [31].

For the anticipation, early detection and containment response, from the introduction to the localized transmission phase, is recommended to[30]:

- Foreseen a proper triage system at all different levels of public health system to enable early detection of potential suspected cases. It should include temporary isolation capacity, trained staffs, protocols and all needed supplies.
- Designate health facilities able to provide the adequate level of care which most probably will be hospitals where intensive care units are available and setting up the correct IPC and engineering measures.
- Define a clear referral pathway for suspected and confirmed cases with dedicated ambulance service in order to facilitate referrals from primary health center to identified treatment facilities.
- Developing the control and mitigation plan.

This chapter, Triage for health care facilities, is composed of practical advises, recommendations, technical guidance and minimum requirement to setting up and operating a specific SARI triage and related waiting room, including the standards needed to repurpose existing building into a SARIs triage.

Triage sites identification, selection and surveys

The choice of a site will determine future problematic issues that could be encountered (infiltration, drainage, access, extension, acceptance, etc.). Take the necessary time to carefully choose the site the most adequate possible, rather than the first one seen.

NOTE: It is important to know the average daily patient influx in order to properly size the waiting room and avoid possible overcrowding [even during the daily influx peak] which may increase the risk of nosocomial infections.

Location Criteria:

- As close as possible to the main entrance of the health facility in order to centralize all entrances;
- Good access for patients, visitors, and staff where security can be guaranteed;
- Optimal to set up a unidirectional flow for all patients and visitors accessing the health facility;
- Avoid all flood areas and at least >30 meters away from rivers or other bodies of water.

Ground Characteristics:

- Flat and level;
- Geologically stable and consolidated, preferably without organic or stony material;
- Easy to dig, without the danger of landslides, and with the capacity for drainage;
- Avoid areas with a high groundwater table;

- Sufficient size of the plot of land to extend the waiting room and the triage, if necessary.

Meteorological Characteristics:

- Be aware of seasonal periods affecting the construction (rain/dry periods). Be able to adjust the design to accommodate different climatological conditions;
- Take into account prevailing winds for the control of smoke and odours;
- Take into account sun orientation for improved shadow zones.

Existing resources:

- Permanent buildings and/or existing, unused wards;
- Evaluate water resources in the area with special focus on the analysis of capacity, quality, and availability;
- If available, have the option to connect to local basic services of water, electricity, and communications;

Triage basic layout principle

The proposed layout is based on the standard triage setting endorsed with proper ventilation infection, prevention and control measures.

The assumption behind this layout are:

- Protocols for patient triage (including the designation of triage areas) and for patient traffic flow within and in the vicinity of the hospital are available.
- Provided staffing for newly designated hospital areas, such as the new triage area and isolation room.
- The hospital applies triage criteria with a view to admitting the most critically ill and treatable epidemic patients. In some circumstances, health authorities may require a health facility to focus on providing health services to non- epidemic patients and to refer epidemic patients elsewhere.

This document, despite providing standards for each service, aims to present different structural approach to set up waiting room and triage specifically adapted for COVID19:

- New construction, concrete building or semi-permanent structures. The standards here propose should be used to repurposed existing buildings as well.
- Big tent [>100 meter square: as commonly used in emergency setting by several humanitarian actors, institutions and UN agencies to set up warehouses and high capacity shelters.
- Standard size tent [~ 45 meter square]: as commonly used by several humanitarian actors, institution and UN agencies for all kind of emergency responses.

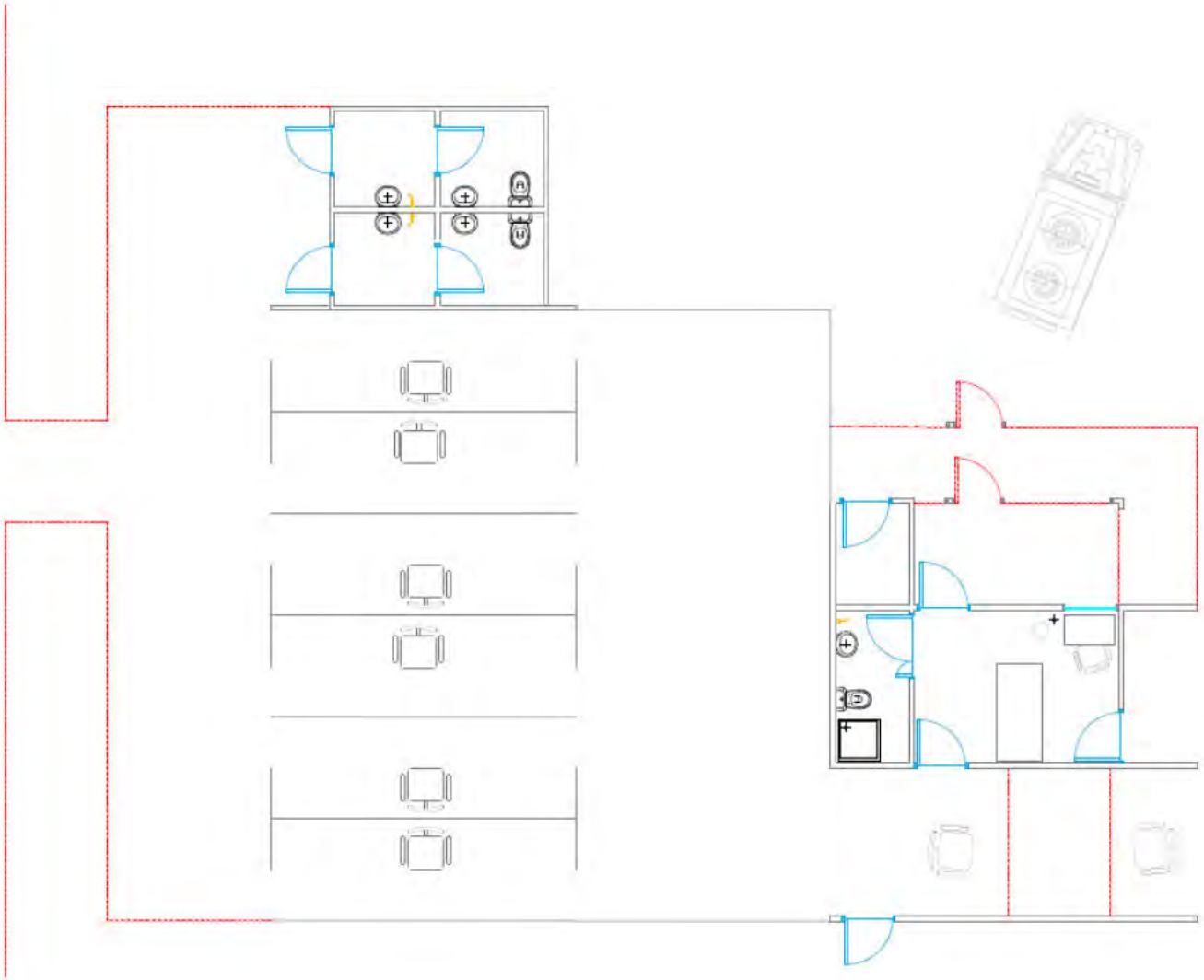
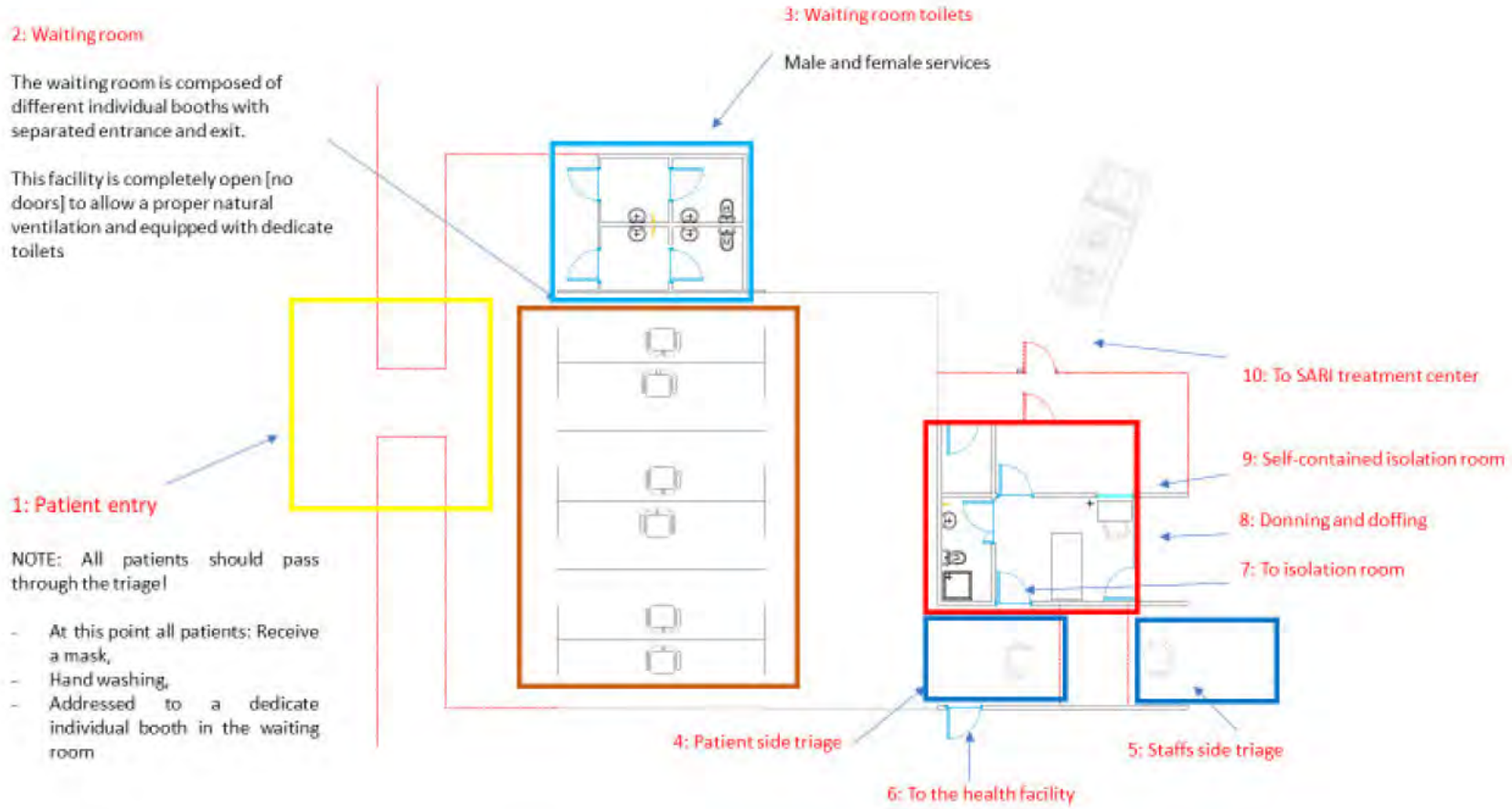


Figure 19. SARI Triage

NOTE: STAFF IS NOT SUPPOSED TO WEAR MASK IN THE TRIAGE EXCEPT WHEN IN CONTACT WITH PATIENTS.

Services and facilities



Patient's Flow

2: Waiting room

The waiting room is composed of different individual booths with separated entrance and exit.

This facility is completely open [no doors] to allow a proper natural ventilation and equipped with dedicate toilets

1: Patient entry

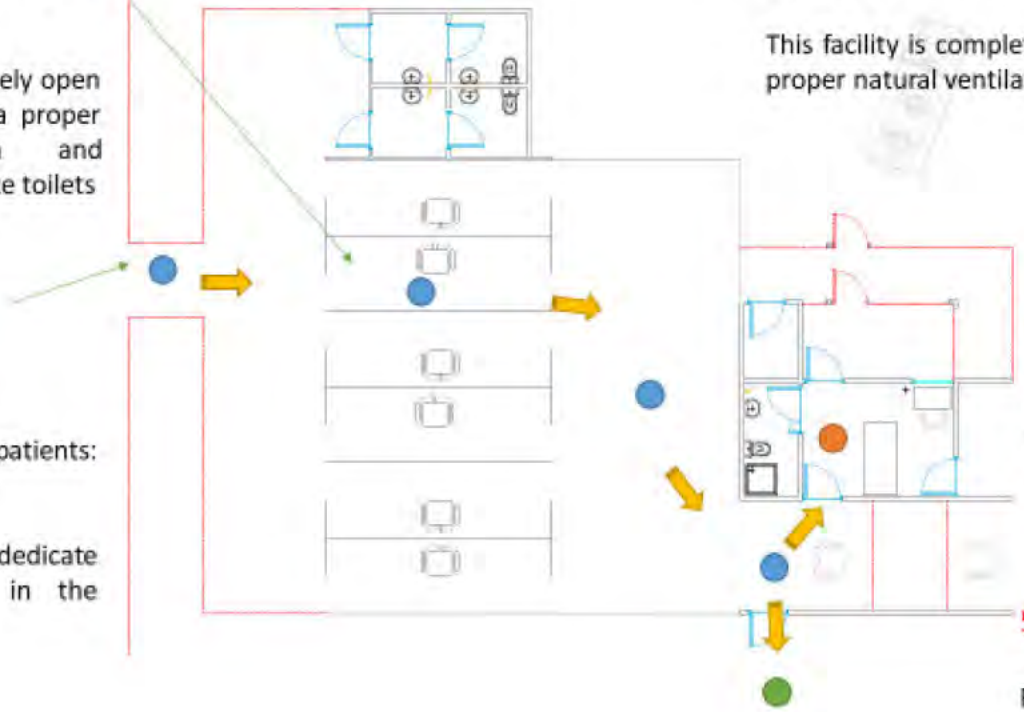
NOTE:

- At this point all patients: Receive a mask,
- Hand washing,
- Addressed to a dedicate individual booth in the waiting room

3: Triage

Patients are investigated in the individual triage booth. A two meter distance fence [1,2 m height] separate patients from staffs.

This facility is completely open [no doors] to allow a proper natural ventilation.



4: Suspected case

Patient move to the isolation room waiting to be referred to the specific treatment center

5: Non case

Patient move to the health facility

Triage for health facilities services

Triage

Triage is divided in 2 distinctive zones: one zone for staff and one for patients. A 2-meter distance between the staff and patient is required. Double fencing can be used for the separation or Plexiglas barrier. Separate hand washing points (soap/water) are available for patients and staff.

The triage building could be a temporary structure or an existing building repurposed. Additionally, a simple tent could be used. For more information see Annex 7: Tent for chapter ''Triage and waiting room in a tent''.

Natural ventilation and exhausted air dilution should be safely assured.

Waiting room

The waiting room is composed of individual booths open on both sides to assure a proper natural ventilation. Each booth should be clearly identified and labelled to avoid any mistake and allow a proper patient's flow. Booths should be cleaned and disinfected after each patient to avoid nosocomial infections. In case individual booths are not available assure 2 meters distance in between patients.

Isolation room

It's a temporary isolation room for the suspected case to wait the ambulance for the referral. In case there's no the isolation capacity, an ambulance could be hold in standby nearby the triage in order to allow a rapid referral.

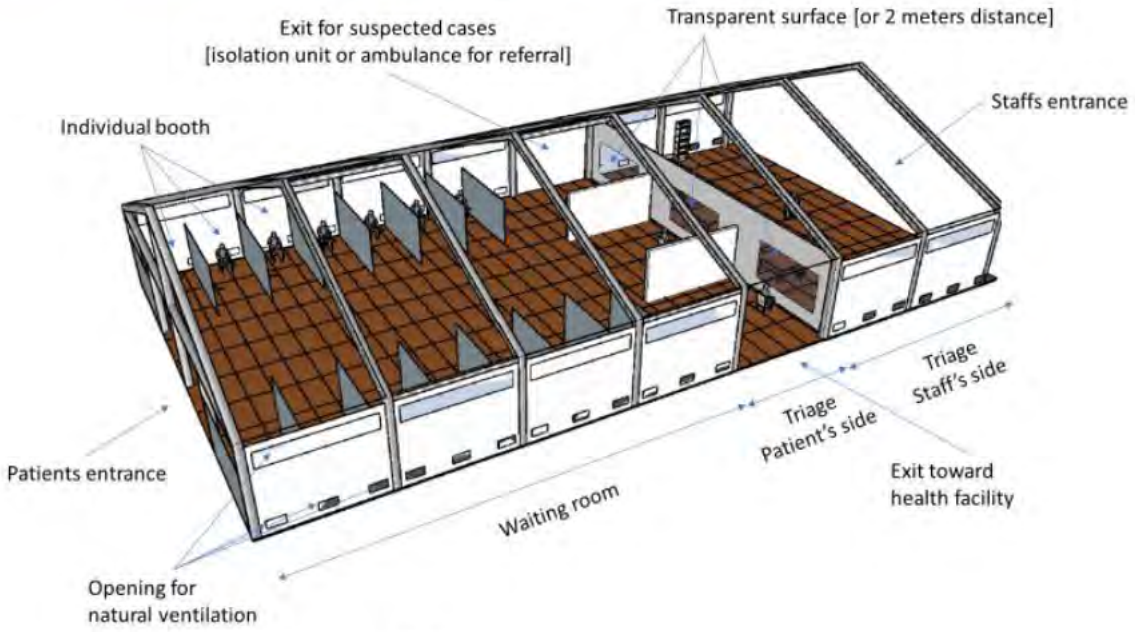
NOTE: if needed, sampling could be done in the temporary isolation room.

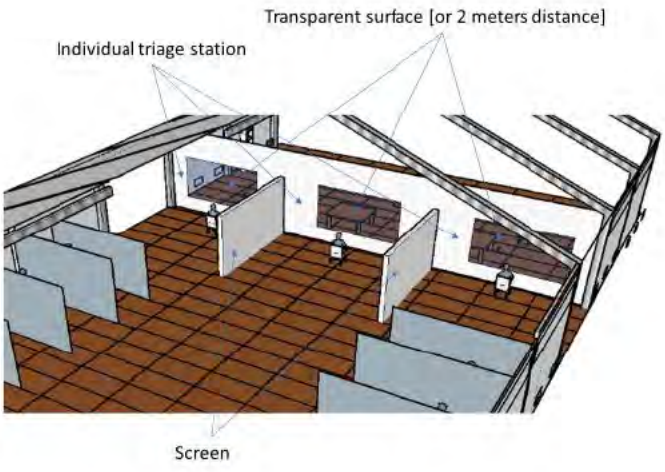
For technical specification on ventilation and exhausted air treatment for the isolation room see the Severe Acute Respiratory Infections Treatment Centre, Practical manual to set up and manage a SARI Treatment Centre in low and middle-income countries.

SARI Triage and waiting room in a tent

The lack of existing building to be repurposed or the need to set up a triage as quickly as possible may lead to using a tent as quicker than a semi-permanent structure and cheaper than a concrete building. In this case is essential to respect all the IPC requirements in term of spacial distance in between patients and proper flows. Underneath an example of how a tent could be used to set up a waiting room and triage. Different models are available on the market. If a single tent with a surface >100 m^2 is not available, several smaller tents could be used and the waiting room space defragmented in between several tents according to specific setting needs. Consider to install handwashing points at the patient's entrance and exit [both] as well as at staff's entrance. Dedicated toilets for patients in the waiting room should be foreseen with related handwashing point. For cold weather countries is possible to replace natural ventilation with a mechanical or hybrid system with specific exhausted air treatment or a portable air filtration system sized according to the waiting room capacity [60l/s/patient]. For more information see '' Severe Acute Respiratory Infections Treatment Centre, Practical manual to set up and manage a SARI Treatment Centre in low and middle-income countries''.

Example of waiting room and triage within a tent with a surface >100m^2

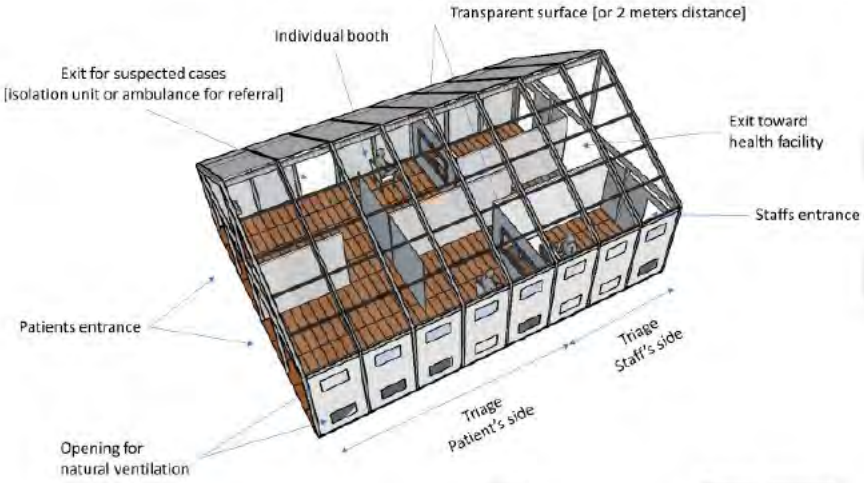




Example of waiting room and triage within a tent with a surface ~45m²

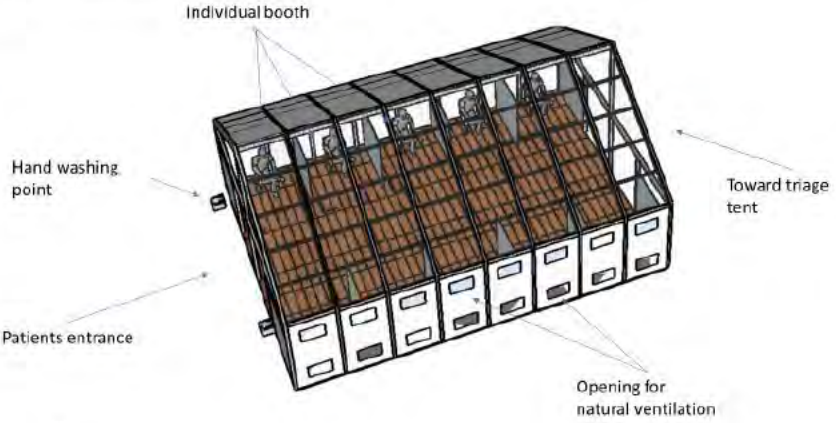
Small tents allow more flexibility in term of capacity as, if required by the epidemiological situation, installing more tents to increase the waiting room capacity or install a second triage tent could be easily done.

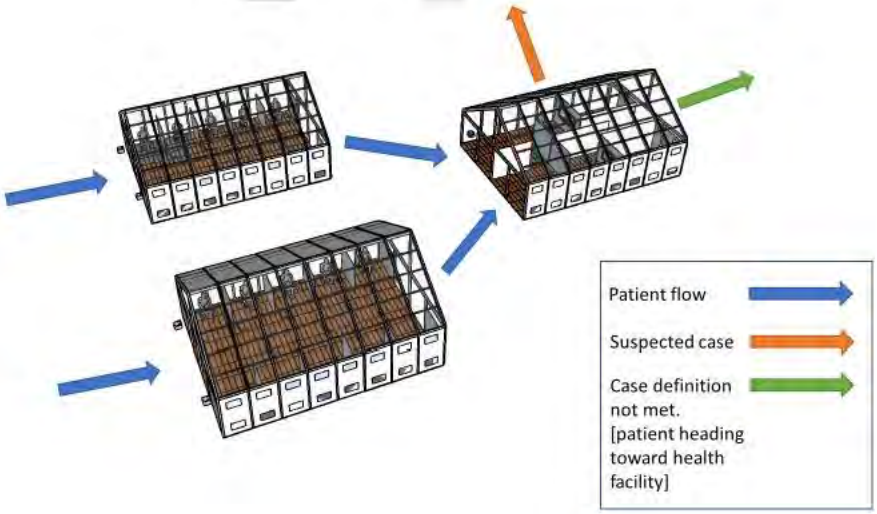
Internal separation, screens, could be easily done with wooden frames folded with washable plastic sheeting. The transparent surface for triage could be replace with a two-meter distance properly marked such as a double 1,1-meter-high fence.



Small tent can be used as well for waiting room as shows below where a standard 45 m² tent is divided into 10 individual booths for patients waiting to access the triage.

Triage and waiting room tents should then be installed in a proper way in order to allow a clear patient's flow like the one in the example below.





Surge capacity

Surge capacity—the ability of a health system to meet an increased demand for health services—is a cornerstone of the overall approach to managing health emergencies and it has implications for the functioning of the entire system[31]. The principles of surge capacity should be integrated into a health facility's preparedness and response capacities for all functions.

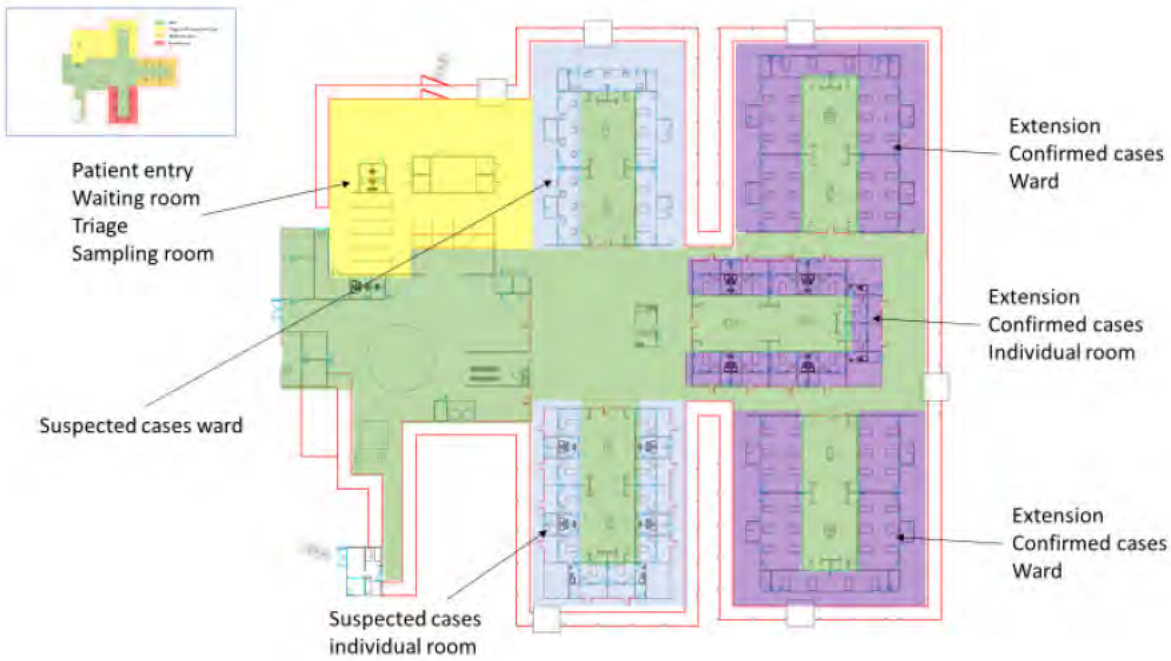
Surge capacity entails [31]:

- human resource management, especially staffing;
- supplies, equipment, logistics and resupply mechanisms;
- specific expertise for critical areas of care;
- overall management of hospital resources, such as expanding space and premises

Planning for surge capacity should allow for progressive scale-up of activities over several stages, with clearly defined activation thresholds for each stage [31].

SARI treatment center flexibility and extension plan should be an integral part of surge capacities. Moving from a severity categorization to a cohorting approach enables to quickly respond to change in the transmission dynamics. For instance, when facing contained and defined clusters the severity categorization could be used to better implemented IPC measures. However, as soon as the dynamic turn into a community transmission, the cohorting approach should be implemented in order to increase bed capacity. Patient cohorting means placing patients infected or colonized with the same laboratory-confirmed pathogens in the same designated ward[1], regardless availability of self-contained individual rooms but always considering 2 meters distance in between patients and adapted ventilation and exhausted air treatment.

An example below where the previous proposed set up with severity categorization is turned into a cohorting approach including two confirmed wards extensions.



Implementation of Infection Prevention and Control measures

To achieve the highest level of effectiveness in the response to a SARI outbreak, such as the 2019-nCoV outbreak, using the strategies and practices recommended, an IPC programme with a dedicated and trained team or at least an IPC focal point should be in place and supported by the national and facility senior management [32]. In countries where IPC is limited or inexistent, it is critical to start by ensuring that at least minimum requirements for IPC are in place as soon as possible, both at the national and facility level, and to gradually progress to the full achievement of all requirements of the IPC core components according to local priority plans [33].

Use of Personal Protective Equipment

Precautions to be implemented by healthcare workers caring for patients with SARI include using PPE appropriately; this involves selecting the proper PPE and being trained in how to put on, remove and dispose of it. PPE is only one effective measure within a package that comprises administrative and environmental and engineering controls, as described in WHO's *Infection prevention and control of epidemic- and pandemic-prone acute respiratory infections in health care* and proposed in this manual [6].

Strategies to optimize the availability of personal protective equipment (PPE)

In order to rationalise the use of PPE the following strategies should be implemented [6]:

Figure 20. Strategies to optimize the availability of personal protective equipment (PPE). Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19). WHO, 2020

Minimize the need for PPE

The following interventions can minimize the need for PPE while protecting healthcare workers and other individuals from exposure to the SARI virus in healthcare settings.

- Use physical barriers to reduce exposure to the virus, such as glass or plastic windows. This approach can be implemented in areas of the healthcare setting where patients will first present, such as triage areas, the registration desk at the emergency department or at the pharmacy window where medication is collected.
- Restrict healthcare workers from entering the rooms of SARI patients if they are not involved in direct care. Consider bundling activities to minimize the number of times a room is entered (e.g.,

check vital signs during medication administration or have food delivered by healthcare workers while they are performing other care) and plan which activities will be performed at the bedside.

Ideally, visitors will not be allowed but if this is not possible, restrict the number of visitors to areas where SARI patients are being isolated; restrict the amount of time visitors are allowed to spend in the area; and provide clear instructions about how to put on and remove PPE and perform hand hygiene to ensure visitors avoid self-contamination[6] [See Annexe 9. 'Donning and doffing'].

Ensure PPE use is rationalized and appropriate

PPE should be used based on the risk of exposure (e.g., type of activity) and the transmission dynamics of the pathogen (e.g., contact, droplet or aerosol). The overuse of PPE will have a further impact on supply shortages. Observing the following recommendations will ensure that the use of PPE rationalized.

The type of PPE used when caring for COVID-19 patients will vary according to the setting and type of personnel and activity [See Table 1 below]

Healthcare workers involved in the direct care of patients should use the following PPE: gowns, gloves, medical mask and eye protection (goggles or face shield).

Specifically, for aerosol-generating procedures (e.g., tracheal intubation, non-invasive ventilation, tracheostomy, cardiopulmonary resuscitation, manual ventilation before intubation, bronchoscopy) healthcare workers should use respirators (e.g. N95, FFP2), eye protection, gloves and gowns; aprons should also be used if gowns are not fluid resistant[1].

Respirators (e.g., N95, FFP2 or equivalent standard) have been used for an extended time during previous public health emergencies involving acute respiratory illness when PPE was in short supply (3). This refers to wearing the same respirator while caring for multiple patients who have the same diagnosis without removing it, and evidence indicates that respirators maintain their protection when used for extended periods. However, using one respirator for longer than 4 hours can lead to discomfort and should be avoided[6].

Table 1. Recommended type of personal protective equipment (PPE) to be used in the context of COVID-19 disease, according to the setting, personnel and type of activity

For more information see ''World Health Organization (WHO). Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19)''.

Setting	Target personnel or patient	Activity	Type of PPE or procedure
Health care facilities			
Inpatient facilities			
Patient room	Healthcare workers	Providing direct care to SARI patients.	Medical mask Gown Gloves Eye protection (goggles or face shield).
		Aerosol-generating procedures performed on SARI patients.	Respirator N95 or FFP2 standard, or equivalent. Gown Gloves

			Eye protection Apron
	Cleaners	Entering patient' room	Medical mask Gown Heavy duty gloves Eye protection (if risk of splash from organic material or chemicals). Boots or closed work shoes
	Visitors[2]	Entering patient' room	Medical mask Gown Gloves
Other areas of patient transit (e.g., wards, corridors)	All staff, including healthcare workers	Any activity that does not involve contact with patient	No PPE required
Triage	Healthcare workers	Any	Maintain spatial distance of at least 2 m.
	Patients with respiratory symptoms	Any	Provide medical mask if tolerated by patient.
Laboratory	Lab technician	Manipulation of respiratory samples.	Medical mask Gown Gloves Eye protection (if risk of splash)
Administrative areas	All staff, including healthcare workers.	Administrative tasks that do not involve contact with patients.	No PPE required
Outpatient facilities			
Consultation room	Healthcare workers	Physical examination of patient with respiratory symptoms.	Medical mask Gown Gloves Eye protection
	Healthcare workers	Physical examination of patient without respiratory symptoms.	PPE according to standard precautions and risk assessment.
	Patients with respiratory symptoms.	Any	Provide medical mask if tolerated
	Patients without respiratory symptoms.	Any	Provide medical mask if tolerated
	Cleaners	After and between consultations with patients with respiratory symptoms	Medical mask Gown Heavy duty gloves Eye protection (if risk of splash from organic material or chemicals). Boots or closed work shoes
Waiting room	Patients with respiratory symptoms.	Any	Provide medical mask if tolerated. Immediately move the patient to an isolation room or separate area away from others; if this is not feasible, ensure spatial distance of at least 2 m from other patients.
	Patients without respiratory symptoms.	Any	Provide medical mask if tolerated.
Administrative areas	All staff, including healthcare workers	Administrative tasks	No PPE required
Triage	Healthcare workers	Preliminary screening not involving direct	Maintain spatial distance of at least 1 m. No PPE required

[2] The number of visitors should be restricted. If visitors must enter a patient's room, they should be provided with clear instructions about how to put on and remove PPE and about performing hand hygiene before putting on and after removing PPE; this should be supervised by a healthcare worker.

		contact.	
	Patients with respiratory symptoms.	Any	Maintain spatial distance of at least 1 m. Provide medical mask if tolerated.
	Patients without respiratory symptoms.	Any	No PPE required

Surface cleaning and disinfection, materials and equipment for IPC at the facility level

A clean environment plays an important role in the prevention of HAI. Many factors, including the design and organization of the health care facility, availability and access to safe water, appropriate sanitation, laundry systems and air quality can significantly influence the transmission of infection [32].

Staffing element

Appropriate staffing levels (number of staff) and capacity (training, education) are key program elements [14].

- Cleaning staff should always be paid positions that have:
- written job descriptions or terms of reference
- structured, targeted training (e.g., pre-service, annual, when new equipment is introduced)
- defined performance standards or competencies
- access to an on-site supervisor to ensure they can safely perform their work (e.g., address supply shortage, safety concerns)

According to best practices, cleaning staff should [14]:

- be familiar with their job descriptions and performance standards
- be asked to perform duties only for which they were trained (e.g., cleaning staff should not be asked to clean high-risk wards (e.g., OR), unless they have received specific training for that patient care area)
- know the identities and hazards of the chemicals that they could be exposed to in the workplace
- have supplies and equipment, including PPE, to perform their duties
- have working shifts should be consistent with acceptable norms for the given context

Cleaning Supplies and Equipment

The selection and appropriate use of supplies and equipment is critical for effective environmental cleaning. There are different kinds of products available for environmental cleaning, which all have distinct properties and advantages and disadvantages to their potential use in healthcare [14].

Table 2. Products for environmental cleaning

Ideal Properties	**For all products used for healthcare environmental cleaning:** – Nontoxic: it should not be irritating to the skin or mucous membranes of the user, visitors, and patients. Everything being equal, choose products with the lowest toxicity rating. – Easy to use: directions for preparation and use should be simple and contain information about PPE as required. – Acceptable odour: it should not have offensive odours to users and patients. – Solubility: it should be easily soluble in water (warm and cold). – Economical/Low cost: it should be affordable.
Additional Ideal Properties	**For cleaning products:** – Efficacious: should remove dirt, soil and various organic substances. – Environmentally friendly: should not cause environmental pollution upon disposal; biodegradable. **For disinfectants:** – Broad spectrum: it should have a wide antimicrobial range, including those pathogens that are common causes of HAIs and outbreaks. – Rapid action: it should be fast acting and have a short contact time. – Remains wet: it should keep surfaces wet long enough to meet recommended contact times with a single application. – Not affected by environmental factors: it should be active in the presence of trace quantities of organic matter (e.g., blood) and compatible with cleaning supplies (e.g., cloths) and products (e.g., detergents) and other chemicals encountered in use. – Material compatibility: it should be proven compatible with common healthcare surfaces and equipment. – Persistence: it should have residual antimicrobial effect on the treated surface. – Cleaner: it should have some cleaning properties. – Non-flammable: it should have flash point of more than 65°C (150°F). – Stability: it should be stable in concentration and use dilution

Cleaning products include liquid soap, enzymatic cleaners, and detergents. They remove organic material (e.g., dirt, body fluids) and suspend grease or oil. This is done by combining the cleaning product with water and using mechanical action (i.e., scrubbing and friction). For most environmental cleaning procedures, select neutral detergents (pH between 6 and 8) that are easily soluble (in warm and cold water). There are also specialized cleaning products, which may provide advantages for specific areas or materials within the healthcare facility (e.g., bathroom/toilet cleaners, floor polishers, glass cleaners). However, consider

specialized products on a case-by-case basis, weighing the advantages and disadvantages (e.g., additional cost) and ability of the facility to ensure the correct storage, preparation, and use [14].

Disinfectants are only for disinfecting after cleaning and are not substitutes for cleaning, unless they are a combined detergent-disinfectant product. Before disinfecting, use a cleaning product to remove all organic material and soil [14]. Common low and intermediate-level disinfectants which can be used for environmental surfaces in healthcare settings include [for more information see ''CDC. Center for Disease Control and Prevention. Best Practices for Environmental Cleaning in Healthcare Facilities: in Resource-Limited Settings. 1–91 (2019)'']:

- quaternary ammonium compounds
- alcohol (ethyl or isopropyl)
- chlorine releasing agents (e.g., bleach, sodium or calcium hypochlorite)
- improved hydrogen peroxide

For a detail list of disinfectants see '' Disinfectants for Use Against the Ebola Virus'' , EPA's Registered Antimicrobial Products that Meet the CDC Criteria for Use Against the Ebola Virus [34].

Environmental cleaning services area

There should be at least one designated environmental cleaning services area within each ward and area for preparation, storage, and reprocessing of reusable cleaning equipment and supplies. This area should be a dedicated space that is not used for any other purposes.

NOTE: a separated area should be available for biomedical equipment reprocessing.

The designated environmental cleaning services area should:

- be well-ventilated and illuminated (lighting or window access)
- be labelled with a biohazard sign on the door
- have an appropriate water supply (hot and cold water access, if feasible)
- have a utility sink/floor drain for safe disposal of used solutions
- be designed so that, whenever possible, buckets can be emptied into utility sink/floor drains without lifting them or creating splashes
- have a dedicated handwashing sink, used only for handwashing
- have access to an eyewash station
- have appropriate PPE available
- be designed/have enough space to keep reprocessing (dirty areas) separate from storage areas for cleaned equipment
- be easily accessible in relation to the areas it serves (i.e., easily accessible throughout the facility)
- be appropriately sized to the amount of materials, equipment, and chemicals stored in the room/area
- have printed copies of the SDS for all environmental cleaning products, manufacturer's instructions, and
- never contain personal clothing or grooming supplies, food or beverages
- there should be a separate area for cleaning staff to store these items

- have safe chemical storage and access
- have locks fitted to all doors to restrict access only to cleaning staff
- be free from clutter to facilitate cleaning
- have washable surfaces (floors, walls, shelves)

General environmental cleaning techniques

For all environmental cleaning procedures, always use the following general strategies:

Conduct Visual Preliminary Site Assessment: Proceed only after a visual preliminary site assessment to determine if:

- there is any need for additional PPE and/or supplies (e.g., if there are any spills of o the patient(s) status could pose a challenge to safe cleaning blood/body fluids or if the patient is on transmission-based precautions)
- there are any obstacles (e.g., clutter) or issues that could pose a challenge to safe cleaning
- there is any damaged or broken furniture or surfaces to be reported to supervisor/management

Proceed from Cleaner to Dirtier: Proceed from cleaner to dirtier areas to avoid spreading dirt and microorganisms. Practical examples of this strategy include:

- During terminal cleaning, clean low- touch surfaces before high-touch surfaces.
- Clean patient areas (e.g., patient zone(s)) before patient toilets.
- Within a specified patient room, terminal cleaning should start with shared equipment and common surfaces, then proceed to surfaces and items touched during patient care that are outside of the patient zone, and finally with surfaces and items directly touched by the patient inside the patient zone. In other words, high-touch surfaces outside the patient zone should be cleaned before the high-touch surfaces inside the patient zone.
- Clean general patient areas not under transmission-based precautions before those areas under transmission-based precautions

Proceed from High to Low (Top to Bottom): Proceed from high to low (top to bottom) to prevent dirt and microorganisms from dripping/falling down and contaminating already cleaned areas. Practical examples of this strategy include:

- Cleaning bed rails before bed legs
- Cleaning environmental surfaces prior to cleaning floors
- Cleaning floors last to allow collection of dirt and microorganisms that may have fallen

Proceed in a Methodical, Systematic Manner: Proceed in a methodical, systematic manner to avoid missing areas—for example, left to right or clockwise. n a multi-bed area, clean each patient zone in the same manner—for example, starting at the foot of the bed and moving clockwise.

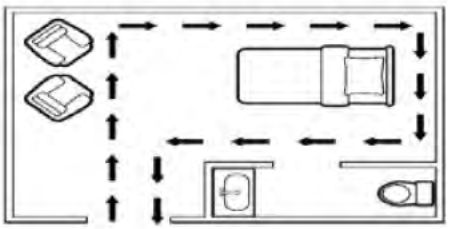


Figure 21. Example of a cleaning strategy for environmental surfaces, moving in a systematic manner around the patient care.

Environmental surface cleaning and disinfection

The environment must be thoroughly cleaned by applying the following general principles [32]:

- **Cleaning consists of the removal of dust, soil, and contaminants on environmental surfaces and ensures a dry, hygienic and healthy health care facility environment for patients, staff, and visitors.**
- **Cleaning is an essential step prior to any disinfection process as it removes dirt, debris and other materials, which decrease the effectiveness of chemical disinfectants.**
- **The use of neutral detergent solutions is essential for effective cleaning.**
- **Special attention should be given to sanitation or toilet facilities as these are often areas that are heavily contaminated and reservoirs for HAIs.**
- **Do not immerse electromechanical biomedical equipment in water. When cleaning the floor, be sure that equipment are disconnected.**
- **Routine bacteriological monitoring to assess the effectiveness of environmental cleaning is not required.**

Large-surface cleaning methods should be avoided because they produce mists or aerosols or disperse dust in patient- care areas (for example, dry sweeping, spraying or dusting)[32].

Laundry and surfaces in all environments in which COVID-19 cases receive care (treatment units, community care centres) should be regularly (at least once a day and when a patient is discharged) cleaned. There are many disinfectants, that are active against enveloped viruses, such as the COVID-19 virus, including commonly used hospital disinfectants. Currently, WHO recommends the use of[35]:

- **70% Ethyl alcohol to disinfect small areas e.g. reusable dedicated equipment (e.g., thermometers) between uses.**
- **Sodium hypochlorite at 0.5% (equivalent 5000ppm) for disinfection of surfaces**

Linen management

All individuals dealing with soiled bedding, towels and clothes from patients with COVID-19 should wear appropriate PPE, which includes heavy duty gloves, mask, eye protection (goggles/face shield), long-sleeved gown, apron (if gown is not fluid resistant), and boots or closed shoes before touching any soiled linen. They should perform hand hygiene after blood/body fluid exposure and after PPE removal. Soiled linen should be placed in clearly labelled, leak-proof bags or containers, carefully removing any solid excrement and putting in covered bucket to dispose of in the toilet or latrine. Washing by machine with warm water (60-90°C) with laundry detergent is recommended. If machine washing is not possible, linens can be soaked

in hot water and soap in a large drum, using a stick to stir, avoiding splashing. The drum should then be emptied, and linen soaked in 0.05% chlorine for approximately 30 minutes. Finally, rinse with clean water and let linens dry fully in the sunlight[35].

For more information related to water, sanitation, hygiene and waste management see the ''Water, sanitation, hygiene and waste management for COVID-19 Technical Brief'' WHO, 2020.

Biomedical devices cleaning and disinfection

Sterilization or decontamination of items, equipment and medical devices is a complex and highly specialized subject. All patient care surfaces, medical devices and equipment used in health care have the potential to become contaminated with microorganisms. Once contaminated, these items can pose a risk to patients, staff and visitors. As an essential component of IPC strategies, all health care facilities should implement a standardized operating procedure for the safe and effective decontamination of high-touch patient care areas and all reusable items/equipment to prevent cross- infection. It is essential that facilities have a dedicated area for the decontamination of reusable items/equipment [32].

The PAHO/WHO manual ''*Decontamination and reprocessing of medical devices for health-care facilities outlines the decontamination life cycle*'', includes cleaning, disinfection and sterilization specific methods applied to medical devices. Always follow the device manufacturer's instructions for decontamination so as to not cause any damage and ensure proper decontamination .

It is essential that facilities have a dedicated area for the decontamination of reusable biomedical devices [32]. Each device according to its designs (sharp corners, serrated edges, coils, etc.), the feasibility to be disassembly and its location inside the health facility (low, medium or high risk contaminated area) would require different treatment.

The procedure of cleaning needs to ensure that no cross-contamination of different components cleaned in the same clean-line happens. It is also important to avoid electrical, mechanical thermal or chemical damage. The two generic flows of the decontamination cycle for reusable devices are:

- Collection -> Cleaning -> Disinfection -> Drying -> Storing
- Collection -> Cleaning -> Disinfection -> Drying -> Sterilization -> Storing

It is important to notice that if the reusable device requires sterilization, that doesn't mean it won't pass through the previous steps!!!

For more information see '' Decontamination and Reprocessing of Medical Devices for Health-care Facilities'' WHO, 2016'' [36].

Equipment should not be transported until it has been decontaminated. Note that commonly used disinfectants are effective against the COVID-19 virus. In general, minimize the exposure of medical equipment, by removing any unessential equipment from the patient's area, and by protecting as much as possible the components that are not in contact with the patient. Always applied policies for proper hand hygiene.

Death body management

The burial process is very sensitive for the family and the community and can be the source of trouble or even open conflict. Before starting any procedure, the family must be fully informed about the process and their religious and personal rights to show respect for the deceased. Ensure that the formal agreement of the family has been given before starting the burial. No burial should begin until family agreement has been obtained [37].

Until more is known about how the COVID-19 spreads, is recommend using a combination of standard precautions, contact and droplet precautions to protect healthcare workers managing death body of suspected or confirmed COVID19 cases[38].

The responsible authority within the treatment center should organize and prepare a team for death body management. This team should have received appropriate training. They should have the necessary materials and PPE to prepare the body for burial.

Death body should be packed in a specific body bag[39] with absorbent pads and corresponding patient's identification marked on it. Before entering the patient's room, the team should have confirmation of death and the patient information from the medical team. The medical team should have already removed any sharps, biomedical devices and covered the body with a sheet. Patient's generalities should be written on the body bag in permanent marker (assure the person is correctly identified via identification number, name, etc.). If a swab is required at death, assure the sample has already been taken. The body bag procurement specifications [40]:

- Full-length U- or J-shaped zipper; runner large metal loops on the zip-runner.
- Leak-proof, during handling and transportation corpse,
- Highly tear-proof and puncture resistant,
- Seams heat-sealed, seal-width not less than 10 mm,
- Linear enforced PE, EVA or PEVA,
- Thickness: 300 to 400 µm,
- No chlorides (cremation),
- Non-degradable (bag disintegrates in soil 5 - 8 years),
- Carry capacity 120 kg (adult) / 50 kg (child),
- 4 to 6 integrated reinforced carry handles,
- Colour: white,
- Size 220 x 100 cm (l x w) and 120 x 80 cm (l x w),
- Integrated transparent label pocket for identification tag (optional).

In order to avoid risk of aerosol production, do not spray the body with chlorine or other disinfectant products. If it has been more than 24h since the person has died OR if a burial is not foreseen within the next 24-48h, use a second body bag.

Water supply

The main objective is to have large quantities of safe water easily accessible at all times. A reliable water supply is crucial, from the source to distribution points. If no water supply system is available, anticipate water trucking including installation of storage and distribution systems [41].

All equipment in contact with water or chlorine solutions must be made of plastic to avoid damage. All containers, pipes and taps should be clearly labelled or color coded to avoid confusion between clean water and chlorine solution. For example, blue for clean water and red for chlorine solution.

Water is required for the following care and IPC procedures:

- Drinking water and preparation of ORS;
- Hand washing (with soap/water or chlorine solution);
- Cleaning (floor, surfaces, fomites, buckets, utensils, etc.);
- Decontamination of materials, beds, buildings, and surfaces;
- Decontamination of reusable PPE;
- Showers and toilets;
- Laundry;
- Food preparation;
- Fire safety

Water Quality

Factors for water quality include turbidity, free residual chlorine (FRC) concentration, toxic compounds, and acceptance. For more detailed information see '' The Sphere Handbook Humanitarian Charter and Minimum Standards in Humanitarian Response''[42].

If turbidity is higher than 5 Nephelometric Turbidity Untis (NTU), change the source or pre-treat. In case of doubt and/or if possible, use rapid tests and/or perform laboratory analysis for chemical compounds. If changes appear after preparation of chlorine solutions (color, smell, etc.), perform analysis. Ensure systematic disinfection by proper chlorination of all water supplied with monitoring. For more information see ''Essential environmental health standards in health care'', WHO, 2008.

For effective centralized disinfection, there should be a residual concentration of free chlorine of ≥ 0.5 mg/l after at least 30 min contact time at pH < 8.016. A chlorine residual should be maintained throughout the distribution system.

In places where centralized treatment and safe piped water supplies are not available, a number of household water treatment technologies are effective in removing or destroying viruses, including boiling, high performing ultra- and nano-membrane filters, solar irradiation, and in non-turbid waters, UV irradiation and appropriately dosed, free chlorine[35]

Water quantity

Large quantities of water are required for cleaning/decontamination procedures, laundry, drinking, and hygiene. Water consumption depends more on the number of staff and size of the center than on the number of patients.

Recommended[43] daily estimate tools for a SARI treatment center:

- Estimation of 250L/staff[3]/day + 2 day back up
- Estimation of 100 to 200L/bed capacity/day + 2 days backup[4]

Target first the higher values and readjust after, if needed.

Waste zone

Consider as a normal health care facility waste zone. Cleaning and disinfection point, temporary waste storage, organic pit, sharp pit and incinerator with ash pit. For more information consult: ''*Safe management of wastes from health-care activities*'', World Health Organization, 2014, Second edition.

https://apps.who.int/iris/bitstream/handle/10665/85349/9789241548564_eng.pdf?sequence=1

NOTE: if laboratory facility present in the center, it's important to assess which kind of waste may be produced and, in case of needed, consider to install a high temperature incinerator able to reach 1200 Celsius degrees and 2 second smoke retention time or to assess cement kilns availability in the area.

Wastewater and/or faecal waste

All wastewater coming from patients' showers, sinks, handwashing points and laundry should be properly treated before infiltration. As part of an integrated public health policy, wastewater carried in sewerage systems should ideally be treated in well-designed and well-managed centralised wastewater treatment works. Each stage of treatment (as well as retention time and dilution) results in further reduction of potential risk. Waste stabilisation ponds (oxidation ponds or lagoons) are generally considered to be a practical and simple wastewater treatment technology that is particularly well-suited to the destruction of pathogens as relatively long retention times (20 days or more) combined with sunlight, elevated pH levels, biological activity and other factors serve to accelerate pathogen destruction. A final disinfection step may be considered if existing wastewater treatment plants are not optimized to remove viruses. Best practices for protecting the occupational health of workers at sanitation treatment facilities should be followed. Workers should wear appropriate personal protective equipment (PPE), which includes protective outer wear, gloves, boots, goggles or face shield, mask, perform frequently hand hygiene, and avoid touching eyes, nose and mouth with unwashed hands [35].

[3] Total hired staff working in the SARI treatment center (including administrative, logistic, cleaners and healthcare workers)

[4] The consumption will be much greater if based on the number of staff/day.

Treatment for wastewater should include a well sized grease trap, image below, properly maintained, follow by infiltration trench sized according to the ground characteristics. For more information see: "Public Health Engineering in Precarious Situations", Médecins Sans Frontiers, 2010, 2nd edition.

http://refbooks.msf.org/msf_docs/en/public_health/public_health_en.pdf

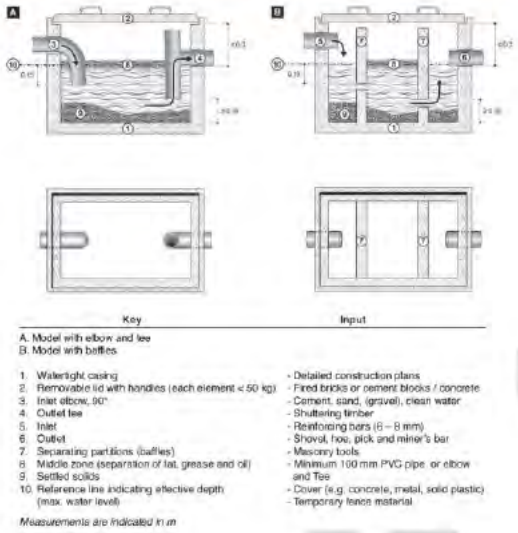


Figure 22. Public health engineering in precarious situations. Médecins Sans Frontiers, 2010 2nd edition

Excreta management

Safe sanitation is essential for health, from preventing infection to improving and maintaining mental and social well-being. In this specific case, excreta safe management is based on the key principle that the products generated from the toilet are retained within the containment technology and discharged to the local environment in a manner that doesn't expose anyone to the hazard [44].

Suspected or confirmed COVID-19 cases should be provided with separate flush toilets or latrines that have a door that closes from the patient room and are not used by neither non COVID-19 individuals nor other individuals with COVID-19. Flush toilets should be properly operating with functioning drain traps. When possible, flushing should occur with the lid down to prevent droplet splatter and aerosol clouds.

If separate toilets are not possible, the toilet should be cleaned and disinfected at least twice daily by a trained cleaner wearing PPE (gown, gloves, boots, mask and face shield/googles). Furthermore, consistent with existing guidance, staff and health care workers should have separate toilet facilities from all patients.

For smaller health care facilities in low resource settings, if space and local conditions allow, pit latrines may be the preferred option. Standard precautions should be taken to prevent contamination of the environment by excreta. These precautions include ensuring that, at least, 1.5 metres exist between the bottom of the pit and the groundwater table (more in coarse sands, gravels and fissured formations), and that the latrine(s) are located at least 30 metres horizontally from any groundwater source (including both shallow wells and boreholes)31. If there is a high groundwater table and/or lack of space to dig pits, excreta (faeces and urine) should be retained in impermeable storage containers and left as long as is feasibly possible to allow for reduction in virus levels before moving off-site for additional treatment and/or safe disposal. A two-tank system with parallel tanks would help to facilitate inactivation by maximising retention times, as one tank could be used until full, then allowed to sit while the next tank is being filled. Particular

care should be taken to avoid splashing and release of droplets during use, cleaning or emptying of the toilet [35].

If a bedpan is used after collection and disposal of the excreta from the bedpan, the bedpan should be cleaned with a neutral detergent and water, disinfected with a 0.5% chlorine solution, and then rinsed with clean water (disposing of the rinse water in drains or a toilet/latrine). Other effective disinfectants include commercially available quaternary ammonium compounds, such as cetylpyridinium chloride, used according to manufacturer's instructions and peracetic or peroxyacetic acids at concentrations of 500 to 2000 mg/L34.

Chlorine is an ineffective means to disinfect media containing large amounts of solid and dissolved organic matter. Therefore, there will be limited benefit to adding chlorine solution to fresh excreta, and possibly, may introduce risks associated with splashing [35].

In the context of waste inputs from suspected or confirmed COVID-19 cases, there is no reason to empty latrines and holding tanks unless they are at capacity. In general, best practices of safely managing excreta should be followed. Latrines or holding tanks should be designed to meet patient demand, considering potential sudden increases in cases and have a regular emptying schedule based on generated wastewater volumes. Appropriate PPE (i.e., long-sleeve gown, gloves, boots, masks, and googles/face shield) should be worn at all times when handling or transporting excreta off-site and great care should be taken to avoid splashing. For crews, this includes pumping out tanks or unloading pumper trucks. After handling, and once there is no risk of further exposure, individuals should safely remove PPE and perform hand hygiene before entering the transport vehicle. Where there is no off-site treatment, in-situ treatment can be done using lime. Such treatment includes using a 10% lime slurry added at a 1 part of 10% lime slurry per 10 parts of waste [35].

Energy

For the electrical installations of SARI center, one must keep in mind the following fundamental priorities:

- Safety of Individuals (Protection against electrocution and fire)
- Protection of Devices (Protection against fire, power instability and effects of lightning)
- Service Continuity (Protection against service breakdown, failure of power sources or effects of any other interruption)
- Cost Control and Environmental Care (Aspects that lead to the most accurate choice and sizing of the power sources, and control of the power demand).

Working on electrical installations

Technical interventions on electrical systems should only be performed by certified electricians.

IEC (International Electrotechnical Commission)

To ensure the reliability of electrical equipment, only equipment referring at least to IEC certification should be purchased and installed.

Rules and Recommendations for the Design of Installations:

- Use internationally recognized terms and symbols.
- Purchase only internationally certified electrical equipment
- Follow internationally authorized recommendations

Everything being compulsory or forbidden under the authority of local national regulations must be applied, even if not compliant to our internal regulations / recommendations. Before installing any electrical appliance, always read the specifications mentioned on the identification plate or into the user manual and check if it is fully compliant with the local standard.

Electrical standard

Electrical Panel:

The electrical panel is a safety and distribution device located upstream of the entire installation and all of electrical circuits. It is considered as the "brain of any installation. Each area of SARI center must be equipped with his own electrical panel. The size of panel will depend of the power need by area and surface.

Components of the electrical panel:

- the electricity meter, if necessary.
- the general circuit breaker,
- the distribution table for the different circuits with differential disjuncture.

Electrical installation: comply with standard of electricity

For perfect security, we will ensure that each circuit is wired and protected according to the power delivered. In addition, a circuit must be dedicated to a single application. The lighting, the 10-16 A sockets, , the washing machine, air conditioner are thus the subject of a circuit each.

The circuit dedicated to 10-16 A sockets must not have more than 8 distribution points. Similarly, the lighting circuit must not exceed 8 applications.

Remarks: During installation, space (20%) will be left on the electrical panel for future equipment installation.

The size of the electrical panel depends on the surface of the building to be electrified and as well as the number of modules to be integrated in the electrical box.

- We consider that an area of less than 35 m2 requires at least two rows.
- Between 35 and 100 m2, at least three rows must be provided.
- Above 100 m2, a minimum of four rows is required.

Plug type:

All electrical plugs fitted to fixed equipment must be fitted with a plug complying with the local standard.

Junctions:

No junction can be made outside of protective enclosures

Junctions made by twisting wires together (either with or without insulating tape) are forbidden.

Junction boxes should preferably be constructed from insulating material (PVC, PE).

Cable Protection:

Use of tubes and pipes for electrical conduits:

The minimum diameter of a round pipe used as electrical channel is 2cm (3/4")

The minimum diameter of a round pipe used as electrical channel should be at least twice the diameter of the wires or the cable passing through it. The distance between hose clips fixing straight smooth PVC tubes should not exceed 60cm.

Underground cables must be inserted into a flexible tube, or a PVC pipe. PVC pipes allow the placement of several cables inside of the same pipe, and facilitate the addition or replacement of cables.

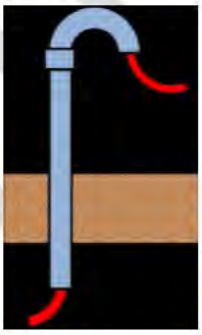
- When several cables are placed in the same trench, the horizontal distance between cables should be 3-5 cm.

- Do not over-tension buried cables. It is better that some slack remains in the cable in order to resist possible small-scale land movements
- The correct depth of a trench is 80cm and the correct depth for a cable is 60cm
- The warning tape is placed at a depth of 15-20 cm below the surface of the ground.

- At the site of each curve or junction, a manhole must be placed.
- On straight ways, a manhole must be placed at least every 25 meters.
- All sections between manholes are straight.
- Manholes are made with special PVC boxes, or in place, with bricks or concrete. They are protected against the rain.

Exiting of buried cables

When coming out of the ground, the electrical cables must be properly mechanically protected. If cables are coming vertically out of the ground, it must be beside a wall or a fixed structure. All vertical cable against a wall must be protected against shocks, specifically when installed outdoors. In such situations, cables must be protected by a thick steel pipe up to a height of 150cm. The top of the pipe should be fitted with an elbow to prevent rain water from entering.



Pipe arrangement to exit out of the ground

Other enclosure

It is preferable that electrical boards are manufactured from non-conductive materials (such as polycarbonate, polyester, PVC ,etc.). Closing systems (doors and covers), hinges and gaskets must be effective and in a good condition.

- Electrical boards in dry areas must be at least IP44.
- Electrical boards placed outdoors or in technical areas must be at least IP66.

The earth connection is a device which makes it possible to channel the fault current toward the earth and automatically cut the electrical installation in order to ensure the safety of people:

Ground Earth Rod component: Each building of SARI Center must be equipped with Ground earth component

- A ground connection consisting of a stake accessible by a manhole.
- An earth conductor (in an insulating conduit) or main earth pipe which connects the earth connection to the measuring / earthing bar also called the main earth terminal. This bar provides the connection between the earth conductor and the main protective conductor. It also makes it possible to measure the earth resistance.
- Protective conductors
- Equipotential links.

When the earth connection is made with one or more earth stakes, these stakes are driven below the permanent humidity level at a depth of at least 2 m to limit the increase in resistance of the earth case of frost or dryness of the ground.

Ground resistivity

The resistance of the earth electrode depends on:
• its dimensions;
• its shape

The resistivity of the terrain present, which varies from one terrain to another as well as in depth.

Indeed, the resistivity of a ground depends on its humidity rate and the temperature. The humidity rate itself depends on the granulation of the soil and its porosity. The resistivity of a ground increases when the humidity decreases. The frost increases the resistivity of the grounds as well as the drought. In case of risk of frost or drought, the lengths of the stakes are increase by 1 or 2 m:

The resistance can be improved by connecting several stakes in parallel, spaced at a distance at least equal to their length. Several stakes can be installed to lower the earth resistance. In the case of multiple earth connections, it is necessary to connect them to each other using a section conductor of 16 mm^2 in insulated copper.

Ground Earth Rod component :

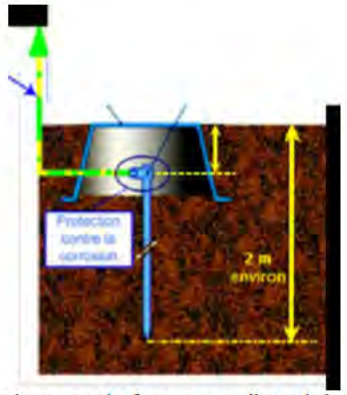
- galvanized steel tubes at least 25 mm in diameter;
- galvanized mild steel profiles at least 60 mm side;
- copper or steel bars (steel bars are coated with copper or galvanized) 15 mm or less in diameter

The connection must be accessible and protected against corrosion. Finally, the connection between an earth conductor and an earth connection must be made by a pressure connector or another fixing. Non-exothermic welding does not provide adequate mechanical strength.

The cross-section of the earth conductor must be:

- 16 mm² of copper or galvanized steel protected against corrosion;
- 25 mm² in copper or 50 mm² in galvanized steel not protected against corrosion.

Remarks: The connection of the earth conductor to the earth must be accessible. Metal pipes for the distribution of liquids or gases must not be used as earth connections. Earth connections must never be made up of a metal part simply submerged in water.



placement of an grounding stake

Electrical components identification:

As a basic requirement for every electrical installation, circuits should be clearly identified inside the breaker boards.

1. The power panel (PP), containing the commutation devices for the power
2. Main Distribution panel (DP)
3. Main distribution line (A, B, C. D, etc)

General Colour Coding for Electrical Cables:

The national standard colour coding system should be respected.

Final circuits out of the final boards: Use numbers rather than letters, as there could be more than 25 circuits out of a panel. Use the small letter 'c' to indicate that this is a final circuit, for example c1, c 2, c3, etc.

EQUIPMENT: QUALITY AND USAGE REQUIREMENTS

Electrical installations are only made up of cables, junctions, enclosures, switchgears, and protections.

Cables must be according to the situation and usage requirements. .

CABLES: All the electrical power supplied to sockets, lights and other user terminals is delivered through a network of cables and wires. Hence, cables and wires are the most important part of an electrical installation.

Use of tubes and pipes for electrical conduits

The minimum diameter of a round pipe used as electrical channel is 2cm (3/4")

The minimum diameter of a round pipe used as electrical channel should be at least twice the diameter of the wires or the cable passing through it.

Terminals: Use the following letters to identify the kind of terminal:

Power sockets: **P** Lights: **L** Switches: **S** Junctions: **J**

As the structures of the center are temporary it will be necessary to pay particular attention during the installation of the terminals (power sockets, lights, switches and Junction).All terminals and air extractor)must be fixed with wooden plate (20 x 20 x 2 cm)

Identification rules for the coronavirus center:

Each building, part of a building, or functional group of buildings is identified by a zone letter (for example A, B, C, etc.).

Each room inside of a zone is identified by a number following the identification letter of the zone (for example A1, A2, A3, B1, B2, B3, etc.).

Corridors, access areas and passages are identified by preceding the identification code with an 'X' (for example, XA1, XA2, XB1, XB2, etc.).

Outdoor spaces are identified by preceding the identification code by a 'Z' (for example ZA1, ZA2, ZB1, ZB2, etc.).

To aid clarity, all identification references should be written on the doors or door jambs of all rooms.

To choose the correct equipment

This choice is often limited by the availability of suppliers and manufacturers. Whilst local purchase is preferred for many good reasons, it is often a challenge to find the required quality.

Here are some tips to find the correct supplies:

- Look for the representatives and official suppliers of international brands.
- Look for national distributors and ask them who are their main clients and local suppliers.
- Look for consumers having similar needs and requirements and ask them where they found the right products, and the right services.
- When national distributors cannot meet your specific requirements (e.g. B curve breakers, etc.) the delivery time can be very long.
- Always make orders using the original reference code from the brand.
- If there is any doubt on the quality or authenticity of a supply, always prefer international purchase.

Energy consumption of each zone of Severe Acute Respiratory Infections Treatment Center:

Zone	Name	Consumption - KVA	Puissance - Kw	Main Line Cable section (240V)
A	Triage / reception	3.3	3	1,5 mm^2
B	Mild Case Ward	6.2	5	4 mm^2
C	Moderate Case Ward	25	20	35 mm^2
D	Laboratory	21.3	17	25 mm^2
E	Severe Case Ward	26.1	21	35 mm^2
F	Laundry/ Sterilization	16.2	13	16 mm^2
G	Morgue / WASH Area	3.9	3.5	1.5 mm^2
H	Staff Area	2.1	1.7	1.5 mm^2
	P (VA) max total	104.1	84	

P (VA) max total: is just a rough value that will only come into play for the generator characteristics

The main line is the one which links the generator (or energy source) to the specific area (ex: main line for laboratory will be D_1 line with 25 $mm^{2)}$ through electrical board.

Maximum Circuit breaker size:

Maximum Circuit breaker size (Amp)	Minimum Cable section(mm2)
10 Ampères	1.5 mm^2
16 Ampères	1.5 mm^2
20 Ampères	2.5 mm^2
25 Ampères	4 mm^2
32 Ampères	6 mm^2
40 Ampères	10 mm^2
50 Ampères	10 mm^2
63 Ampères	16 mm^2
80 Ampères	25 mm^2
100 Ampères	35 mm^2
125 Ampères	50 mm^2
160 Ampères	70 mm^2
200 Ampères	95 mm^2
250 Ampères	120 mm^2

Implementation of Electrical Project:

Before starting the implementation works:

- The supplies, materials and tools have been delivered and are stored into a dedicated warehouse, and an inventory has been made if the works or part of the works are done in-house,
- The Contractor has been designated and a contract for works has been signed if the works are outsourced,
- The phasing of the works has been prepared.
- The project supervision team has been identified, and the distribution of tasks and responsibilities is clear,
- Everything has been organized so that the people working / living into the place where the works have to be done is feeling comfortable,

When starting the works:

- All equipment and pieces of furniture that must be moved to free the space are moved, stored in a correct place, and protected as required, in accordance with the people living or working on the site of the works.
- Dedicated secure places must be found to store the supplies and tools on site.

When executing the works:

- Everything that must be removed or dismantled is removed and dismantled
- The exact position of all terminals and boards is clearly marked on site,
- All mounting blocks (empty plastic boxes that will hold the terminals) are put in place with their cable entries set in right number and position
- All boards (breaker boxes etc.) are prepared. Accorded to the size and weight of the boards different ways are possible: Empty boxes are installed at the same time as the mounting blocks of terminals are installed, or they can be prepared in advance, all modular devices being already put in place on their rails, and all internal wiring of the board being prepared in advance. Then, the boards will be put in place with all their equipment already set in place. But it is often easier to place empty boards first
- All junction boxes, channels, pipes, trunks are put in place between the board and all mounting boxes of terminals
- All cables and wires are put into the pipes and trunks
- All identifications of wires are always made along the progression of the works
- All terminals are installed and wired into their mounting boxes
- All wires entering the breaker board are connected to the modular devices
- All identifications are reported on the modular devices
- According to the situation, circuits can be tested one per one along the progress of the works or can be tested after that all wiring jobs have been made.

When completing the works:

- All identifications are updated
- All drawings and diagrams are updated
- A copy of the concerned updated position and electrical diagram is placed inside of each board. (These diagrams are only concerning the area and circuits supplied by the board)
- The site of the works is completely cleaned off and all remaining tools, supplies, accessories, and wastes are evacuated.
- While all remaining tools supplies and accessories are back into the warehouse a final inventory is established
- Same for the inventory of the tools. A listing of the tools that have been damaged or lost must be established. It is also the right time for those to be cleaned, controlled and maintained, even if this must also be made during the works.

Building Equipment and power need:

Global Estimation of electrical material and equipment for SARI						
N°	Equipment	Location	Qty	P/Watt	Price /Unit-$	Total
27	GENERATOR, 110 kVA prime, 220/380V diesel, 50Hz, canopy	Generator	2		25000	50000.00
28	Grunding Kit		2		180	360.00
29	Tool Kit		1		190	190.00
30	Spare Part Kit		2		10000	20000.00
31	Electrical panel equipped and pre-wired	General Needs	6		500	3000.00
32	Lighting Line 3 G 1.5 mm², 100 m /roll		16		50	800.00
33	Lamp		140	60 W	10	1400.00
34	Lamp		30	100 W	20	600.00
35	Outdoor Lamp		20	60 W	15	300.00
36	Lamp		10	40 W	10	100.00
37	Mural Switch		100		6.5	650.00
38	Ground Earth Cable, Fil H07VR 16 mm² - Green/Yellow		100		3.5	350.00
39	Power sockets		100	0 W	3.5	350.00
40	Main line ø 35 mm² (Câble RO2V U1000 R2V 4G35 mm²), m		300		8.5	2550.00
41	Power Sockets Line, Cable 3 G 2.5 mm², 100 m/Roll		16		73	1168.00
42	Junction Box, 80 x 80 x 35 mm		160		1.5	240.00
43	Ground Galvanized Earth Rod, 1.5 m		20		10	200.00
44	Lamp UVc		60	40 W	50	3000.00
45	Air Extractor		35	50 W	121	4235.00
Total Amount US$ (US dollars)						**89493.00**

Global Estimation for Laboratory and Medical Equipment for SARI						
N°	Equipment	Location	Qty	P/Watt	Price /Unit-$	Total
1	Printer	H. Staff Area	1	1,000 W	810	810.00
2	Computer		3	70 W	1067	3201.00
3	washing machine (30 kg)	Ste & Loundery	2	1,200 W	4500	9000.00
4	AUTOCLAVE, 39 L		1	1,500 W	362.01	362.01
5	MODULES CENTRAL STERILIZATION, TBM 90L		1	4,500 W	8700	8700.00
6	Electric ceramic hob		1	1,200 W	50	50.00
8	Table, resuscitation, neonate-Infant warmer Mobile	Severe case Ward	1	0 W		0.00
9	INFUSION PUMP (Agilia VP Z019510)		10	15 W	1470.99	14709.90
10	SUCTION PUMP, ELECTRICAL (Medela Vario 18)		10	90 W	795	7950.00
11	CONCENTRATOR O2 portable (Eclipse 5), 3L + acc.		10	145 W	2874.38	28743.80
12	VENTILATOR PATIENT Dräger Savina 300 Select		10	315 W	7222.23	72222.30
13	MONITOR PATIENT		10	150 W	9210.24	92102.40
14	Air conditionneur	Laboratory	1	4,000 W	450	450.00
15	Real-time PCR detection system		1	300 W	32000	32000.00
16	Biological Safety Cabinet, class 2		1	250 W		0.00
17	Vortex Mixer		1	45 W	245.48	245.48
18	Micro centrifugeuse		1	250 W	142.01	142.01
19	PCR Work Station		1	1,700 W	4756	4756.00
20	Refrgrator (Vestfrost) MK 144		1	144 W	697	697.00
21	Freezer MF 114 (Vestfrost)		1	210 W	464	464.00
22	CONCENTRATOR O2 (New Life Intensity) 10L	Moderate Case Ward	10	590 W	1486.44	14864.40
23	MONITOR PATIENT, NIBP, w/o ECG		20	120 W	2741	54820.00
24	ELECTROCARDIOGRAPH (Schiller AT-1 G2)		1	100 W	1384.82	1384.82
25	ULTRASOUND, SYSTEM, MOBILE (Mindray M7)	Short Stay Ward	1	600 W	18252.46	18252.46
26	ULTRASOUND, SYSTEM, MOBILE (SonoSite M-Turbo		1	100 W	18252.46	18252.46
	Total Amount US$					384180.04

Global Estimation

Global Estimation of electrical material , laboratory and medical equipment for SARI					
N°	Equipment	Qty	P/Watt	Price /Unit-$	Total
1	Printer	1	1,000 W	810	810.00
2	Computer	3	70 W	1067	3201.00
3	Washing machine (30 kg)	2	1,200 W	4500	9000.00
4	AUTOCLAVE, 39 L	1	1,500 W	362.01	362.01
5	MODULES CENTRAL STERILIZATION, TBM 90L	1	4,500 W	8700	8700.00
6	Electric ceramic hob	1	1,200 W	50	50.00
7	Ground Earth Repartitor	20		10	200.00
8	Table, resuscitation, neonate-Infant warmer Mobile	1	0 W		0.00
9	INFUSION PUMP (Agilia VP Z019510)	10	15 W	1470.99	14709.90
10	SUCTION PUMP, ELECTRICAL (Medela Vario 18)	10	90 W	795	7950.00
11	CONCENTRATOR O2 portable (Eclipse 5), 3L + acc.	10	145 W	2874.38	28743.80
12	VENTILATOR PATIENT Dräger Savina 300 Select	10	315 W	7222.23	72222.30
13	MONITOR PATIENT	10	150 W	9210.24	92102.40
14	Air conditionneur	1	4,000 W	450	450.00
15	Real-time PCR detection system	1	300 W	32000	32000.00
16	Biological Safety Cabinet, class 2	1	250 W	4756.85	4756.85
17	Vortex Mixer	1	45 W	245.48	245.48
18	Micro centrifugeuse	1	250 W	142.01	142.01
19	PCR Work Station	1	1,700 W	4756	4756.00
20	Refrgrator (Vestfrost) MK 144	1	144 W	697	697.00
21	Freezer MF 114 (Vestfrost)	1	210 W	464	464.00
22	CONCENTRATOR O2 (New Life Intensity) 10L	10	590 W	1486.44	14864.40
23	MONITOR PATIENT, NIBP, w/o ECG	20	120 W	2741	54820.00
24	ELECTROCARDIOGRAPH (Schiller AT-1 G2)	1	100 W	1384.82	1384.82
25	ULTRASOUND, SYSTEM, MOBILE (Mindray M7)	1	600 W	18252.46	18252.46
26	ULTRASOUND, SYSTEM, MOBILE (SonoSite M-Turbo	1	100 W	18252.46	18252.46
27	GENERATOR, 100kVA prime, 220/380V diesel, 50Hz,	2		25000	50000.00
28	Grunding Kit	2		180	360.00
29	Tool Kit	1		190	190.00
30	Spare Part Kit	2		10000	20000.00
31	Electrical panel equipped and pre-wired	6		500	3000.00
32	Lighting Line 3 G 1.5 mm² 100 m /roll	16		50	800.00
33	Lamp	140	60 W	10	1400.00
34	Lamp	30	100 W	20	600.00
35	Outdoor Lamp	10	60 W	15	150.00
36	Lamp	10	40 W	10	100.00
37	Mural Switch	100		6.5	650.00
38	Ground Earth Cable, Fil H07VR 16 mm² - Vert/Jaune	100		3.5	350.00
39	Power sockets	100	0 W	3.5	350.00
40	Main line ø 35 mm²	300		8.5	2500.00

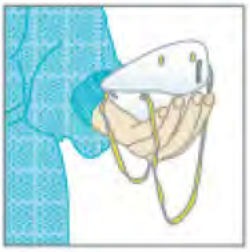
41	Power Sockets Line, Cable 3 G 2.5 mm², 100 m/Roll	16		73	1168.00
42	Junction Box, 80 x 80 x 35 mm	160		1.5	240.00
43	Ground Galvanized Earth Rod, 1.5 m	20		10	200.00
44	Lamp UVc	60	40 W	50	3000.00
45	Air Extractor	35	50 W	121	4235.00
Total Amount US $					**457930.04**

Annexe 1. 'How to perform a particulate respirator seal check'

HOW TO

World Health Organization

Perform a particulate respirator seal check



Step 1

- Cup the respirator in your hand with the nosepiece at your fingertips allowing the headbands to hang freely below your hand.

Step 2

- Position the respirator under your chin with the nosepiece up.

Step 3

- Pull the top strap over your head resting it high at the back of your head. Pull the bottom strap over your head and position it around the neck below the ears.

Step 4

- Place fingertips of both hands at the top of the metal nosepiece. Mould the nosepiece (USING TWO FINGERS OF EACH HAND) to the shape of your nose. Pinching the nosepiece using one hand may result in less effective respirator performance.

Step 5

- Cover the front of the respirator with both hands, being careful not to disturb the position of the respirator.

Step 5a: Positive seal check

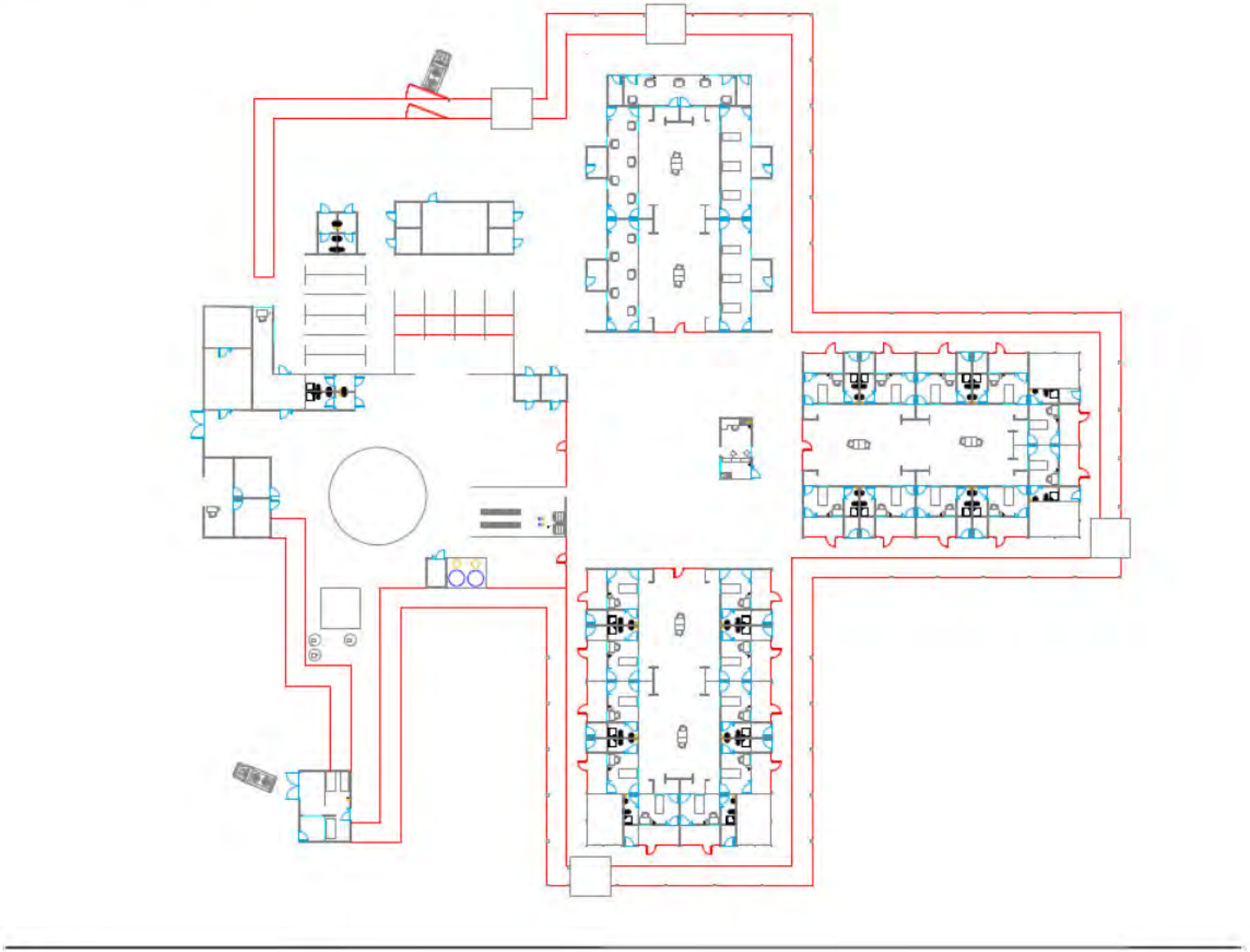
- Exhale sharply. A positive pressure inside the respirator = no leakage. If leakage, adjust the position and/or tension straps. Retest the seal. Repeat the steps until the respirator is secured properly.

Step 5b: Negative seal check

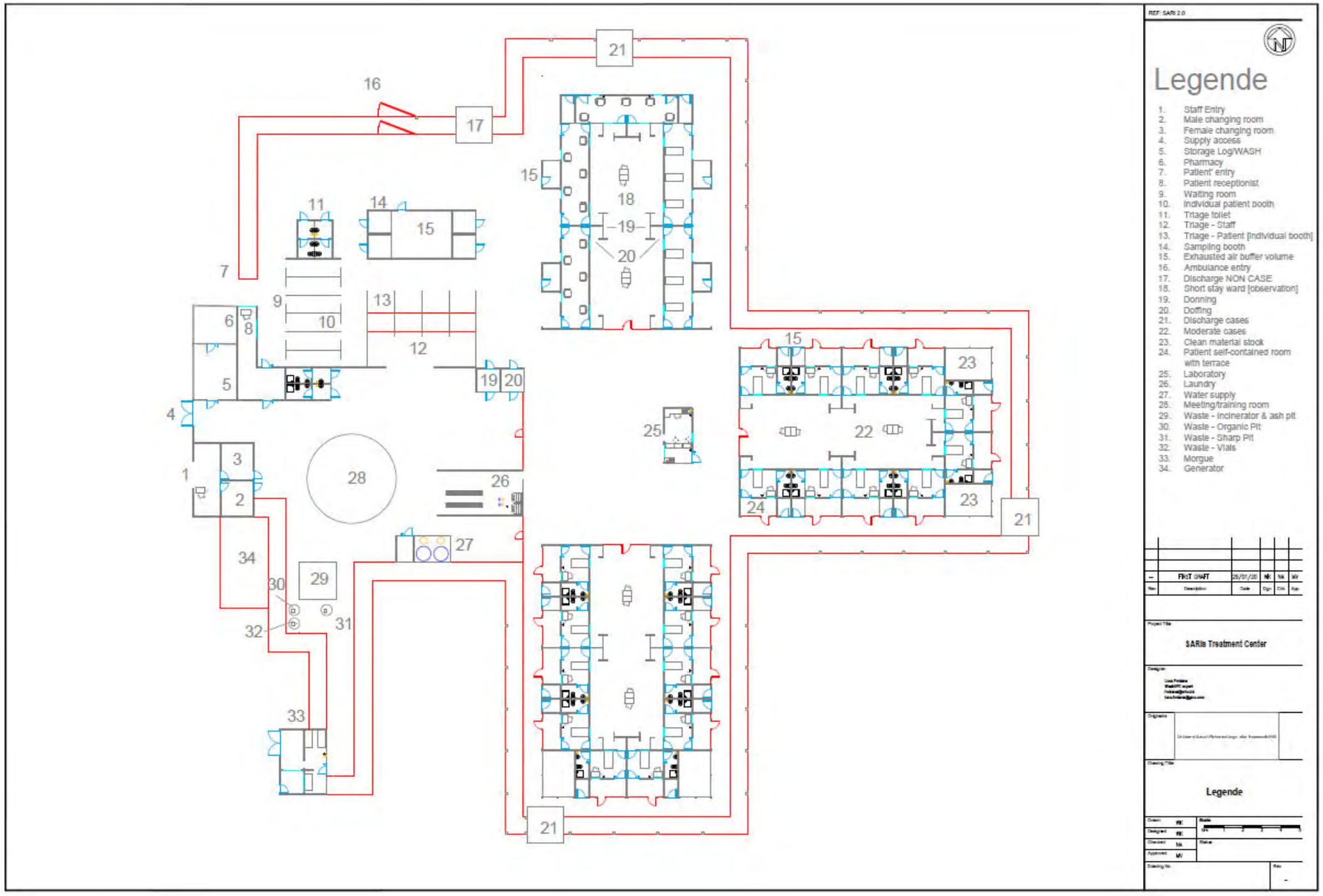
- Inhale deeply. If no leakage, negative pressure will make respirator cling to your face.
- Leakage will result in loss of negative pressure in the respirator due to air entering through gaps in the seal.

Reproduced from "Infection prevention and control of epidemic- and pandemic-prone acute respiratory diseases in health care - WHO Interim Guidelines" available at http://www.who.int/csr/resources/publications/WHO_CDS_EPR_2007_6/en/index.html

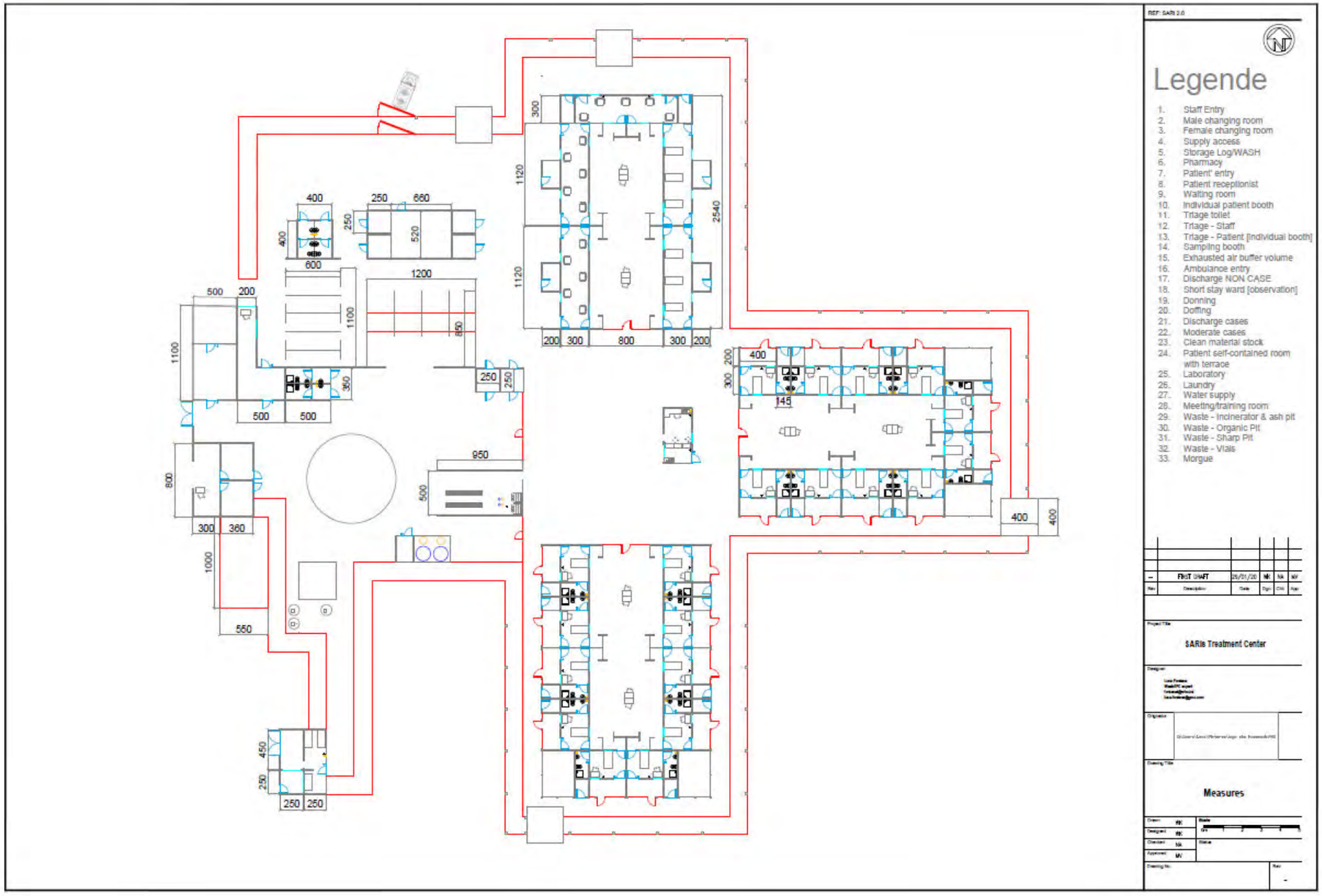
Annexe 2. 'SARI Treatment Center layout



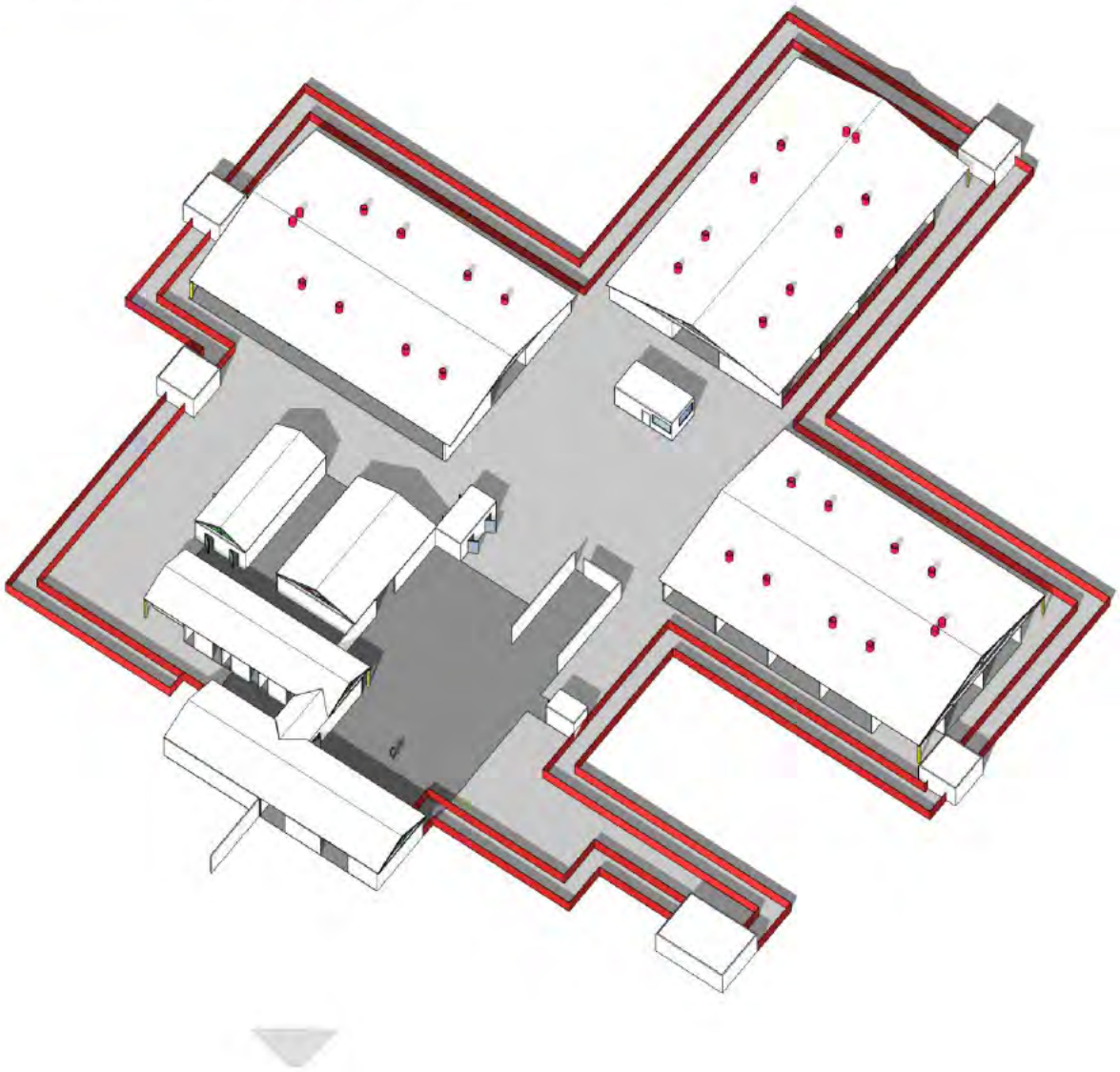
Annexe 3. 'SARI Treatment Center legend



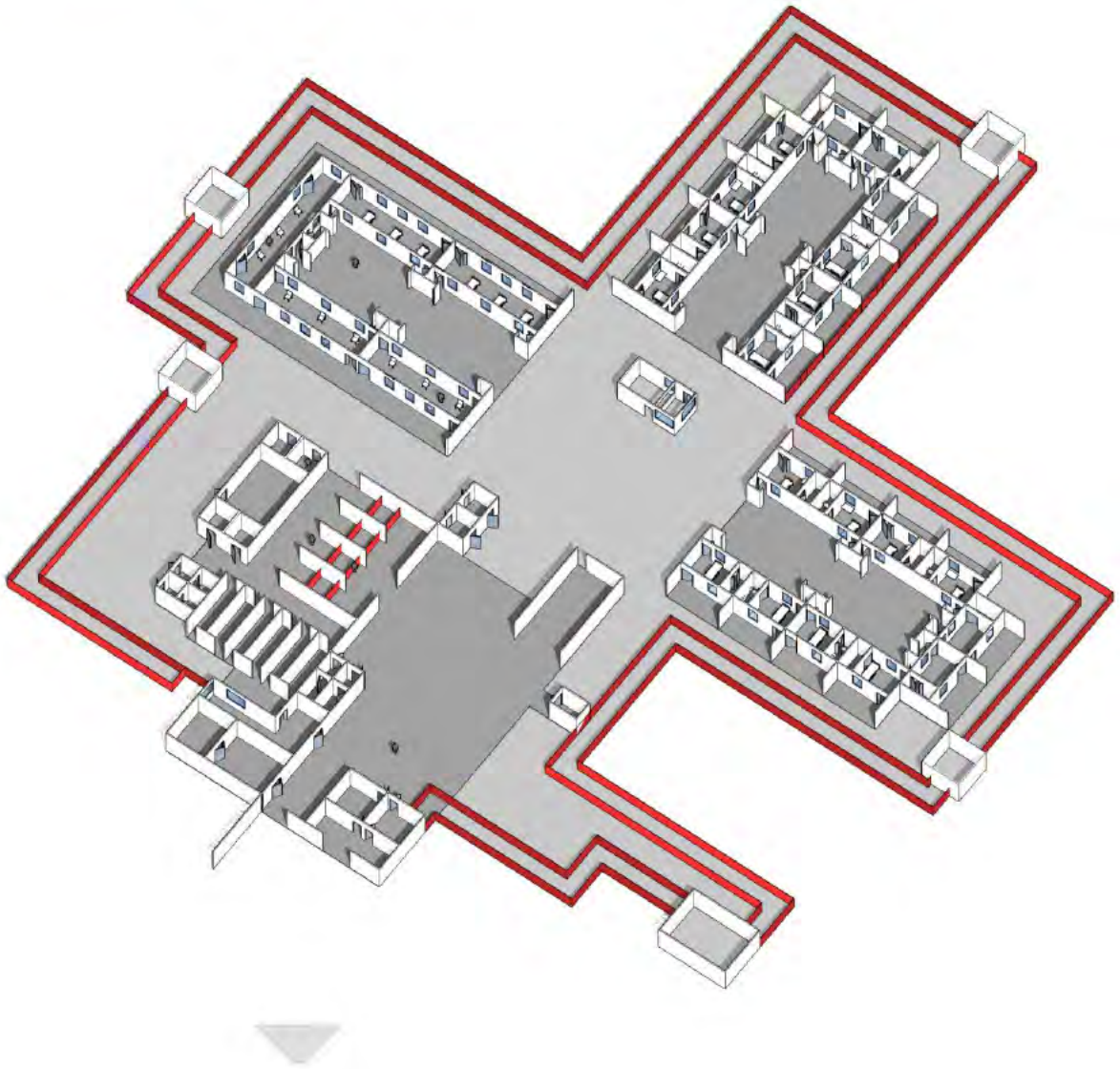
Annexe 4. 'SARI Treatment Center measures



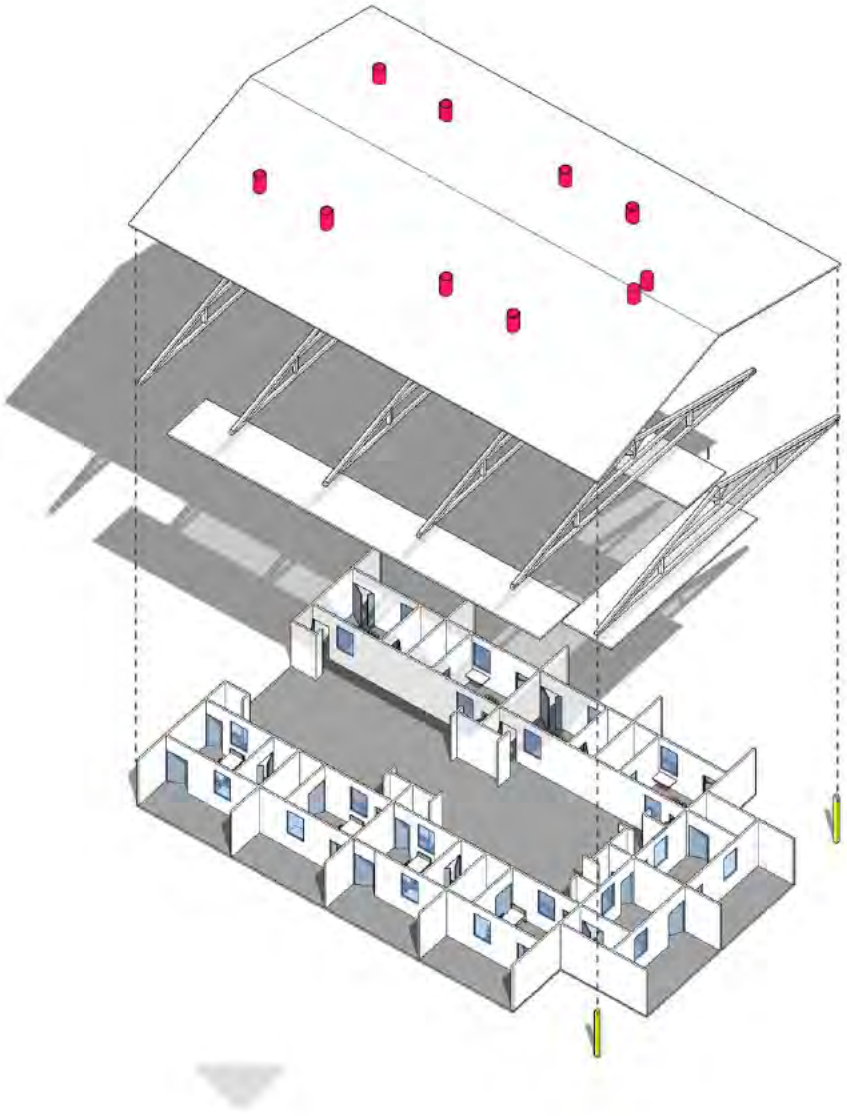
Annexe 5. 'Axonometric view of the treatment centre with roof



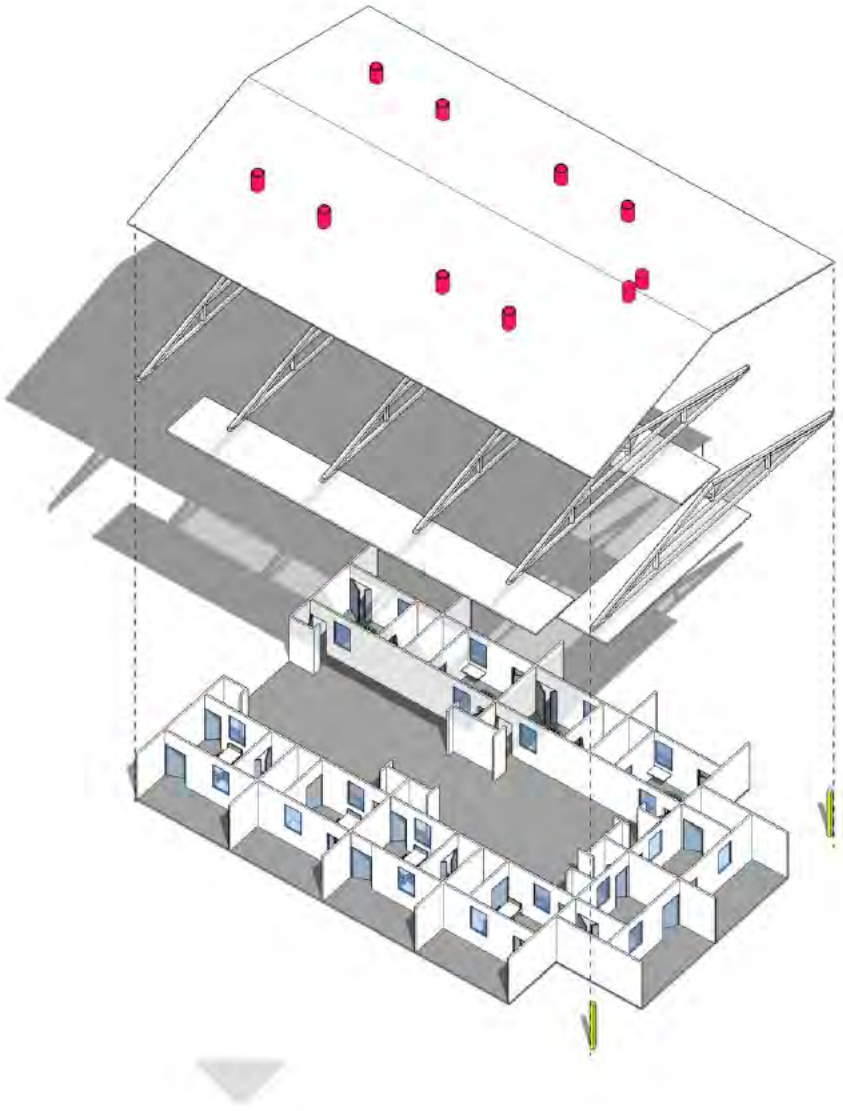
Annexe 6. 'Axonometric view of the treatment centre without roof



Annexe 7. 'Short stay ward



Annexe 8. 'Individual rooms wards



Annexe 9. 'Donning and doffing

HOW TO PUT ON AND TAKE OFF
Personal Protective Equipment (PPE)

World Health Organization

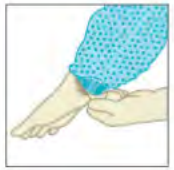
How to put on PPE (when all PPE items are needed)

Step 1
- Identify hazards & manage risk. Gather the necessary PPE.
- Plan where to put on & take off PPE.
- Do you have a buddy? Mirror?
- Do you know how you will deal with waste?

Step 2
- Put on a gown.

Step 3a OR **Step 3b**
- Put on face shield.
- Put on medical mask and eye protection (e.g. eye visor/goggles)

Note: If performing an aerosol-generating procedure (e.g. aspiration of respiratory tract, intubation, resuscitation, bronchoscopy, autopsy), a particulate respirator (e.g. US NIOSH-certified N95, EU FFP2, or equivalent respirator) should be used in combination with a face shield or an eye protection. Do user seal check if using a particulate respirator.



Step 4
- Put on gloves (over cuff).

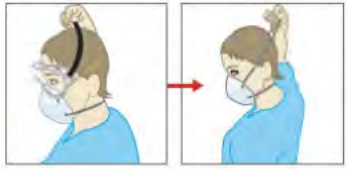
How to take off PPE

Step 1
- Avoid contamination of self, others & the environment
- Remove the most heavily contaminated items first

Remove gloves & gown
- Peel off gown & gloves and roll inside, out
- Dispose gloves and gown safely

Step 2
- Perform hand hygiene

Step 3a
If wearing face shield:
- Remove face shield from behind
- Dispose of face shield safely



Step 3b
If wearing eye protection and mask:
- Remove goggles from behind
- Put goggles in a separate container for reprocessing
- Remove mask from behind and dispose of safely

Step 4
- Perform hand hygiene

Annexe 10. 'Budget estimation and chronogram

SARI Treatment Center Draft 1.0	Budget estimation 02/02/2020

In order to facilitate the construction process [as most probably it will happen within an emergency response] the following budget estimation has been subdivided by blocks. Each block could be seen as an independent construction site with its own team. This should facilitate the management [as there won't be a big team but several smaller], share the workload in between different supervisors, facilitate the supply [easy to prioritize the purchase and materials delivering on the site] and allowing a better follow up for the administrative procedures.
The used of UV light rather than HEPA filter has been considered for this budget and chronogram

Budget resume

Code: 1	**Concrete construction:** foundations excavation and building, floor lining, rainwater drainage.	$68,799
Code: 2	**Upper structures construction**: building frame, roofing, doors, window, plastich sheeting covering.	$87,974
Code: 3	**Water and sanitation**:piping, water stations, toilets and shower, rainwater evacuation system	$54,850
Code: 4	**Electricity:** lighting, switches, sockets, UV-lights	$14,600
Code: 5	**Waste management:** incinerator, safety box	$10,800
Code: 6	Manpower	$52,980
Code: 7	**Reserve funds:** (unexpected expenses or delay)	$20,300
TOTAL		$310,303

Chronogram

The following chronogram is based on the fact that each block will be constructed independently and all the materials previously purchased and available. This system should shorten the time needed for the construction. However, it will require an intensive supervision and at least 3 OSL following the construction site plus additional support for the supply. The manpower is calculated as number of people per day at 15$/day rate.

Facility	Code	Description	Qty	Unit price US	Item Tot USD	Day	Day	Day	Day	Day	Day	Day	Day	Day	Da	Da	Da	Da	Da	Da	Da	Da	Da	Da	Da	Da	Da	Da	Da	Da	Da
Site	1	Site preparation [water availability, storage, electricity, tools, etc.]	ff	1500.00	$1,500	5	5																								
	1.1	EXCAVATION AND EARTHWORKS: leveling, trench for foundations, pits	ff	2000.00	$2,000	40	40	40	40	40	40	30	20	20																	
	1.2	Orange fence, 1,2 x 50M, Roll	36	50.00	$1,800		4	4																							
	1.6	Gravel (meter cubes) for covering the ground	500	25.00	$12,500																										
	3	rainwater drainage channels [linear meters] with concret lining	550	7.00	$3,850	10	10	10	10	10	10	10	10	10																	
	4	Lighting, switches and electrical outlets	ff		$2,000	2	2																								
	6	Manpower [seen as number of people x number of days]	422	15.00	$6,330																										
		Subtotal		$29,980																											
		Pharmacy, logistic storage, reception and data office, staff toilets																													
Block 1 surface 80 meter square	1.3	Reinfocement concrete [meter cubes]	18				10	10	10																						
	1.4	Sand (meter cubes)	7.2	25.00	$180																										
	1.5	Cement (sac 50kg)	110	12.00	$1,320																										
	1.6	Gravel (meter cubes)	15	25.00	$375																										
	1.7	Blinding concrete [meter cubes]	8.8						10	10																					
	1.4	Sand (meter cubes)	4.5	25.00	$113																										
	1.5	Cement (sac 50kg)	28	12.00	$336																										
	1.6	Gravel (meter cubes)	6	25.00	$150																										
	2	Wooden frame [boards, beams, rafter, studs, etc.] L x W x H							15	15	15	15	15																		
	2.1	Wooden boards 350 x 30 x 5 cm	150	4.00	$600																										
	2.2	Wooden beams 350 x 5 x5 cm	600	2.50	$1,500																										
	2.3	Rafter 300 x 15 x 10 cm	100	5.00	$500																										
	2.4	Shore plank	80	3.00	$240																										
	2.5	Plywood (meter square)	90	3.00	$270								4	4																	
	2.6	Roofing (meter square)	121	4.00	$484							6	6	6																	
	2.7	Plastic sheeting (Roll 4 x 60 meters)	3	140.00	$420								4	4	4																
	2.8	Window [plexiglas and frame]	4	150.00	$600									4																	
	2.9	Door [frame, door, handle and lock]	5	300.00	$1,500									6	6																
	2.9.1	Gate (supply entrance) 3 x 2,2 meter	1	800.00	$800									6																	
	3.1	Piping	ff		$1,000																										
	3.2	Toilets, showers, sink, grease trap, infiltration trench, septic tank, etc.	1	1000.00	$1,000					6	6	6	6	6	6																
	3.3	Rainwater evacuation system (gutters and piping)	ff		$1,800										6	6															
	4	Lighting, switches and electrical outlets	ff		$1,500										2	2															
	6	Manpower [seen as number of people x number of days]	237	15.00	$3,555																										
		Subtotal		$18,243																											
		Staff entrance, changing room																													
	1.3	Reinfocement concrete [meter cubes]	11				10	10																							
	1.4	Sand (meter cubes)	4.5	25.00	$113																										
	1.5	Cement (sac 50kg)	70	12.00	$840																										
	1.6	Gravel (meter cubes)	9	25.00	$225																										
	1.7	Blinding concrete [meter cubes]	5.3						10	10																					
	1.4	Sand (meter cubes)	2.8	25.00	$70																										
	1.5	Cement (sac 50kg)	17	12.00	$204																										
	1.6	Gravel (meter cubes)	4	25.00	$100																										
	2	Wooden frame [boards, beams, rafter, studs, etc.] L x W x H							15	15	15	15																			
Block 2 surface 53 meter square	2.1	Wooden boards 350 x 30 x 5 cm	80	4.00	$320																										
	2.2	Wooden beams 350 x 5 x5 cm	400	2.50	$1,000																										
	2.3	Rafter 300 x 15 x 10 cm	50	5.00	$250																										
	2.4	Shore plank	40	3.00	$120																										
	2.5	Plywood (meter square)	50	3.00	$150							4	4																		
	2.6	Roofing (meter square)	70	4.00	$280							6	6																		
	2.7	Plastic sheeting (Roll 4 x 60 meters)	2.5	140.00	$350							4	4	4																	
	2.8	Window [plexiglas and frame]	2	150.00	$300								4																		
	2.9	Door [frame, door, handle and lock]	4	300.00	$1,200								6	6																	
	3.3	Rainwater evacuation system (gutters and piping)	ff		$1,200									6																	
	4	Lighting, switches and electrical outlets	ff		$800									4																	
	6	Manpower [seen as number of people x number of days]	158	15.00	$2,370																										
		Subtotal		$9,892																											

Block 3 surface 82 meter square		Waiting room, patient toilets														
	1.3	Reinfocement concrete [meter cubes]	16.4				10	10	10							
	1.4	Sand (meter cubes)	7	25.00	$175											
	1.5	Cement (sac 50kg)	100	12.00	$1,200											
	1.6	Gravel (meter cubes)	13	25.00	$325											
	1.7	Blinding concrete [meter cubes]	8.2						10	10						
	1.4	Sand (meter cubes)	5	25.00	$125											
	1.5	Cement (sac 50kg)	26	12.00	$312											
	1.6	Gravel (meter cubes)	6	25.00	$150											
	2	Wooden frame [boards, beams, rafter, studs, etc.] L x W x H							15	15	15	15	15			
	2.1	Wooden boards 350 x 30 x 5 cm	40	4.00	$160											
	2.2	Wooden beams 350 x 5 x5 cm	400	2.50	$1,000											
	2.3	Rafter 300 x 15 x 10 cm	40	5.00	$200											
	2.4	Shore plank	60	3.00	$180											
	2.5	Plywood (meter square)	90	3.00	$270								4	4		
	2.6	Roofing (meter square)	105	4.00	$420							6	6	6		
	2.7	Plastic sheeting (Roll 4 x 60 meters)	4	140.00	$560								4	4	4	
	2.9	Door [frame, door, handle and lock]	4	300.00	$1,200									4		
	2.9.1	Gate (supply entrance) 3 x 2,2 meter	1	800.00	$800									6	6	
	3.1	Piping	ff		$1,000								4	4		
	3.2	Toilets, showers, sink, greas trap, infiltration trench, septic tank, etc	1	1000.00	$1,000					6	6	6	6	6	6	
	3.3	Rainwater evacuation system (gutters and piping)	ff		$1,800										6	6
	4	Lighting, switches and electrical outlets	ff		$1,500										2	2
	6	Manpower [seen as number of people x number of days]	239	15.00	$3,585											
		Subtotal		$15,962												

Block 4 surface 102 meter square		Triage + donning/doffing														
	1.3	Reinfocement concrete [meter cubes]	20.5				10	10	10							
	1.4	Sand (meter cubes)	8	25.00	$200											
	1.5	Cement (sac 50kg)	125	12.00	$1,500											
	1.6	Gravel (meter cubes)	17	25.00	$425											
	1.7	Blinding concrete [meter cubes]	10,2						10	10	10					
	1.4	Sand (meter cubes)	5.5	25.00	$138											
	1.5	Cement (sac 50kg)	31	12.00	$372											
	1.6	Gravel (meter cubes)	7	25.00	$175											
	2	Wooden frame [boards, beams, rafter, studs, etc.] L x W x H							15	15	15	15	15			
	2.1	Wooden boards 350 x 30 x 5 cm	40	4.00	$160											
	2.2	Wooden beams 350 x 5 x5 cm	500	2.50	$1,250											
	2.3	Rafter 300 x 15 x 10 cm	60	5.00	$300											
	2.4	Shore plank	50	3.00	$150											
	2.5	Plywood (meter square)	130	3.00	$390							4	4			
	2.9	Door [frame, door, handle and lock] (only wood frame and plastic sheeting)	26	100.00	$2,600							6	6	6		
	2.6	Roofing (meter square)	135	4.00	$540							4	4	4		
	2.7	Plastic sheeting (Roll 4 x 60 meters)	3	140.00	$420								4	4	4	
	3.3	Rainwater evacuation system (gutters and piping)	ff		$1,500								6	6		
	4	Lighting, switches and electrical outlets	ff		$1,000									6	6	
	6	Manpower [seen as number of people x number of days]	209	15.00	$3,135											
		Subtotal		$14,255												

Block 5 surface 25 meter square + 34 meter square without concrete floor		Sampling room														
	1.3	Reinfocement concrete [meter cubes]	5				8	8								
	1.4	Sand (meter cubes)	2	25.00	$50											
	1.5	Cement (sac 50kg)	30	12.00	$360											
	1.6	Gravel (meter cubes)	4	25.00	$100											
	1.7	Blinding concrete [meter cubes]	2,5						6	6						
	1.4	Sand (meter cubes)	2	25.00	$50											
	1.5	Cement (sac 50kg)	8	12.00	$96											
	1.6	Gravel (meter cubes)	3	25.00	$75											
	1.7	Gravel for UV light buffer space, 10 cm thickness (meter cube)	5	25.00	$125			8								
	2	Wooden frame [boards, beams, rafter, studs, etc.] L x W x H							10	10	10					
	2.1	Wooden boards 350 x 30 x 5 cm	30	4.00	$120											
	2.2	Wooden beams 350 x 5 x5 cm	400	2.50	$1,000											
	2.3	Rafter 300 x 15 x 10 cm	30	5.00	$150											
	2.4	Shore plank	40	3.00	$120											
	2.5	Plywood (meter square)	80	3.00	$240						6	6				
	2.6	Roofing (meter square)	70	4.00	$280							6	6			
	2.7	Plastic sheeting (Roll 4 x 60 meters)	2	140.00	$280							4	4			
	3.3	Rainwater evacuation system (gutters and piping)	ff		$1,000								4	4		
	4	Lighting, switches and electrical outlets	ff		$1,000									2	2	
	6	Manpower [seen as number of people x number of days]	110	15.00	$1,650											
		Subtotal		$6,696												

		Short stay ward (mild cases ward)																												
	1.3	Reinfocement concrete [meter cubes]	92							20	20	20	20																	
	1.4	Sand (meter cubes)	37	25.00	$925																									
	1.5	Cement (sac 50kg)	555	12.00	$6,660																									
	1.6	Gravel (meter cubes)	75	25.00	$1,875																									
	1.7	Blinding concrete [meter cubes]	46													10	10	10	10											
	1.4	Sand (meter cubes)	25	25.00	$625																									
	1.5	Cement (sac 50kg)	138	12.00	$1,656																									
	1.6	Gravel (meter cubes)	33	25.00	$825																									
	2	Wooden frame [boards, beams, rafter, studs, etc.] L x W x H						20	20	20	20	20	20	20	20															
	2.1	Wooden boards 350 x 30 x 5 cm	400	4.00	$1,600																									
Block 6 surface 460 meter square	2.2	Wooden beams 350 x 5 x5 cm	1200	2.50	$3,000																									
	2.3	Rafter 300 x 15 x 10 cm	350	5.00	$1,750																									
	2.4	Shore plank	300	3.00	$900																									
	2.5	Plywood (meter square)	300	3.00	$900															6	6	6	6							
	2.6	Roofing (meter square)	660	4.00	$2,640																									
	2.7	Plastic sheeting (Roll 4 x 60 meters)	8	140.00	$1,120											10	10	10	10											
	2.8	Window [plexiglas and frame]	20	150.00	$3,000																	6	6	6	6	6				
	2.9	Door [frame, door, handle and lock] (only wood frame and plastic sheeting)	26	100.00	$2,600																	6	6	6	6	6				
	3.1	Piping	ff		$3,000			6	6	6	6	6																		
	3.3	Rainwater evacuation system (gutters and piping)	ff		$2,000																					6	6	6		
	4	Lighting, switches and electrical outlets	ff		$2,000																					6	6	6		
	6	Manpower [seen as number of people x number of days]	470	15.00	$7,050																									
		Subtotal		$44,126																										
		Moderate cases ward																												
	1.3	Reinfocement concrete [meter cubes]	92							20	20	20	20																	
	1.4	Sand (meter cubes)	37	25.00	$925																									
	1.5	Cement (sac 50kg)	555	12.00	$6,660																									
	1.6	Gravel (meter cubes)	75	25.00	$1,875																									
	1.7	Blinding concrete [meter cubes]	46													10	10	10	10											
	1.4	Sand (meter cubes)	25	25.00	$625																									
	1.5	Cement (sac 50kg)	138	12.00	$1,656																									
	1.6	Gravel (meter cubes)	33	25.00	$825																									
	2	Wooden frame [boards, beams, rafter, studs, etc.] L x W x H						20	20	20	20	20	20	20	20															
	2.1	Wooden boards 350 x 30 x 5 cm	400	4.00	$1,600																									
Block 7 surface 460 meter square	2.2	Wooden beams 350 x 5 x 5 cm	2000	2.50	$5,000																									
	2.3	Rafter 300 x 15 x 10 cm	450	5.00	$2,250																									
	2.4	Shore plank	300	3.00	$900																									
	2.5	Plywood (meter square)	300	3.00	$900															6	6	6	6							
	2.6	Roofing (meter square)	660	4.00	$2,640																									
	2.7	Plastic sheeting (Roll 4 x 60 meters)	8	140.00	$1,120											10	10	10	10											
	2.8	Window [plexiglas and frame]	20	150.00	$3,000																	6	6	6	6	6				
	2.9	Door [frame, door, handle and lock] (only wood frame and plastic sheeting)	26	100.00	$2,600																	6	6	6	6	6	6	6		
	3.1	Piping	ff		$3,000			6	6	6	6	6																		
	3.2	Toilets, showers, sink, greas trap, infiltration trench, septic tank, etc.	10	600.00	$6,000			6	6	6											6	6	6	6	6					
	3.3	Rainwater evacuation system (gutters and piping)	ff		$2,000																					6	6	6		
	4	Lighting, switches and electrical outlets	ff		$1,500																					6	6	6	6	6
	6	Manpower [seen as number of people x number of days]	542	15.00	$8,130																									
		Subtotal		$53,206																										
		Severe cases ward																												
	1.3	Reinfocement concrete [meter cubes]	92							20	20	20	20																	
	1.4	Sand (meter cubes)	37	25.00	$925																									
	1.5	Cement (sac 50kg)	555	12.00	$6,660																									
	1.6	Gravel (meter cubes)	75	25.00	$1,875																									
	1.7	Blinding concrete [meter cubes]	46													10	10	10	10											
	1.4	Sand (meter cubes)	25	25.00	$625																									
	1.5	Cement (sac 50kg)	138	12.00	$1,656																									
	1.6	Gravel (meter cubes)	33	25.00	$825																									
	2	Wooden frame [boards, beams, rafter, studs, etc.] L x W x H						20	20	20	20	20	20	20	20															
	2.1	Wooden boards 350 x 30 x 5 cm	400	4.00	$1,600																									
Block 8 surface 460 meter square	2.2	Wooden beams 350 x 5 x5 cm	2000	2.50	$5,000																									
	2.3	Rafter 300 x 15 x 10 cm	450	5.00	$2,250																									
	2.4	Shore plank	300	3.00	$900																									
	2.5	Plywood (meter square)	300	3.00	$900															6	6	6	6							
	2.6	Roofing (meter square)	660	4.00	$2,640																									
	2.7	Plastic sheeting (Roll 4 x 60 meters)	8	140.00	$1,120											10	10	10	10											
	2.8	Window [plexiglas and frame]	20	150.00	$3,000																	6	6	6	6	6				
	2.9	Door [frame, door, handle and lock] (only wood frame and plastic sheeting)	26	100.00	$2,600																	6	6	6	6	6	6	6		
	3.1	Piping	ff		$3,000			6	6	6	6	6																		
	3.2	Toilets, showers, sink, greas trap, infiltration trench, septic tank, etc.	10	600.00	$6,000			6	6	6											6	6	6	6	6					
	3.3	Rainwater evacuation system (gutters and piping)	ff		$2,000																					6	6	6		
	4	Lighting, switches and electrical outlets	ff		$1,500																					6	6	6	6	6
	6	Manpower [seen as number of people x number of days]	542	15.00	$8,130																									
		Subtotal		$53,206																										

Block 9 surface 48 meter square		Laundry				
	1.3	Reinfocement concrete [meter cubes]	9.6			
	1.4	Sand (meter cubes)	4	25.00	$100	
	1.5	Cement (sac 50kg)	58	12.00	$696	
	1.6	Gravel (meter cubes)	8	25.00	$200	
	1.7	Blinding concrete [meter cubes]	5			
	1.4	Sand (meter cubes)	3	25.00	$75	
	1.5	Cement (sac 50kg)	15	12.00	$180	
	1.6	Gravel (meter cubes)	4	25.00	$100	
	2	Wooden frame [boards, beams, rafter, studs, etc.] L x W x H				
	2.1	Wooden boards 350 x 30 x 5 cm	40	4.00	$160	
	2.2	Wooden beams 350 x 5 x5 cm	120	2.50	$300	
	2.3	Rafter 300 x 15 x 10 cm	50	5.00	$250	
	2.4	Shore plank	60	3.00	$180	
	2.5	Plywood (meter square)	50	3.00	$150	
	2.6	Roofing (meter square)	80	4.00	$320	
	2.7	Plastic sheeting (Roll 4 x 60 meters)	2	140.00	$280	
	2.8	Window [plexiglas and frame]	1	150.00	$150	
	2.9	Door [frame, door, handle and lock] (only wood frame and plastic sheeting)	1	100.00	$100	
	3.1	Piping	ff		$3,000	
	3.4	Grease trap, infiltration trench,	1	800.00	$800	
	3.3	Rainwater evacuation system (gutters and piping)	ff		$500	
	4	Lighting, switches and electrical outlets	ff		$800	
	6	Manpower [seen as number of people x number of days]	218	15.00	$3,270	
		Subtotal		$11,611		

Block 10 surface 35 meter square		Morgue				
	1.3	Reinfocement concrete [meter cubes]	7			
	1.4	Sand (meter cubes)	3	25.00	$75	
	1.5	Cement (sac 50kg)	42	12.00	$504	
	1.6	Gravel (meter cubes)	6	25.00	$150	
	1.7	Blinding concrete [meter cubes]	3,5			
	1.4	Sand (meter cubes)	2	25.00	$50	
	1.5	Cement (sac 50kg)	11	12.00	$132	
	1.6	Gravel (meter cubes)	3	25.00	$75	
	2	Wooden frame [boards, beams, rafter, studs, etc.] L x W x H				
	2.1	Wooden boards 350 x 30 x 5 cm	30	4.00	$120	
	2.2	Wooden beams 350 x 5 x5 cm	120	2.50	$300	
	2.3	Rafter 300 x 15 x 10 cm	50	5.00	$250	
	2.4	Shore plank	60	3.00	$180	
	2.5	Plywood (meter square)	40	3.00	$120	
	2.6	Roofing (meter square)	60	4.00	$240	
	2.7	Plastic sheeting (Roll 4 x 60 meters)	2	140.00	$280	
	2.8	Window [plexiglas and frame]	2	150.00	$300	
	2.9	Door [frame, door, handle and lock] (only wood frame and plastic sheeting)	2	100.00	$200	
	2.9.1	Gate for burial team	1	300.00	$300	
	3.3	Rainwater evacuation system (gutters and piping)	ff		$500	
	4	Lighting, switches and electrical outlets	ff		$500	
	6	Manpower [seen as number of people x number of days]	150	15.00	$2,250	
		Subtotal		$6,526		

Block 11 surface 35 meter square		Waste zone				
	1.3	Reinfocement concrete [meter cubes]	7			
	1.4	Sand (meter cubes)	3	25.00	$75	
	1.5	Cement (sac 50kg)	42	12.00	$504	
	1.6	Gravel (meter cubes)	6	25.00	$150	
	1.7	Blinding concrete [meter cubes]	3,5			
	1.4	Sand (meter cubes)	2	25.00	$50	
	1.5	Cement (sac 50kg)	11	12.00	$132	
	1.6	Gravel (meter cubes)	3	25.00	$75	
	2.1.1	Metallic frame with roof				
	2.1.1	Metallic frame	1	1000.00	$1,000	
	2.1.1	Metallic roof	1	500.00	$500	
	5	Pits	4	600.00	$2,400	
	5.1	DeMontfort Incinerator	1	8000.00	$8,000	
	5.2	Safety box rebars	1	400.00	$400	
	3.1	Piping with grease trap and infiltration trench	1	1000.00	$1,000	
	3.3	Rainwater evacuation system (gutters and piping)	ff		$500	
	4	Lighting, switches and electrical outlets	ff		$500	
	6	Manpower [seen as number of people x number of days]	169	15.00	$2,535	
		Subtotal		$17,821		

		Water station			
Block 12	2	Wooden frame [boards, beams, rafter, studs, etc.] L x W x H			
	2.1	Wooden boards 350 x 30 x 5 cm	30	4.00	$120
	2.2	Wooden beams 350 x 5 x5 cm	60	2.50	$150
	2.3	Rafter 300 x 15 x 10 cm	100	5.00	$500
	2.4	Shore plank	40	3.00	$120
	2.5	Roofing (meter square)	50	4.00	$200
	3.5	Tanks (10.000 liter)	4	1000.00	$4,000
	3.5	Tanks (2.000 liter)	3	300.00	$900
	3.1	Piping	1	1500.00	$1,500
	6	Manpower [seen as number of people x number of days]	66	15.00	$990
		Subtotal	$8,480		
		Subtotal construction	**$290,003**		
	7	Reserve funds (unexpected expenses and delay)	$20,300		
Total			**$310,303**		

2				8	8	8	8	8	8																
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2.2																									
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2.5								3	3	3															
3.5																									
3.5																									
3.1									3	3	3														
6																									

Annexe 11. 'Furnitures and consumables [No PPE]

List of items and furniture to open the center plus one-month functioning consumables.					
Code	Description	Unit	Quantity	Unit cost	Total cost
1	CONTAINER + LID, 120 l	piece	40	$15.00	$600.00
1	BASIN, 40 liters, plastic	piece	20	$5.00	$100.00
1	MATTRESS COVER, washable, zipper, 220 cm, epidemics	piece	30	$20.00	$600.00
1	BED	piece	26	$150.00	$3,900.00
1	MATTRESS	piece	30	$50.00	$1,500.00
1	MIRROR, classic, 20 x 30 cm	piece	32	$20.00	$640.00
1	GARBAGE Bin, 100 liters, + lid, white	piece	60	$12.00	$720.00
1	Shelf [2 x 2 x 0,3 m]	piece	25	$120.00	$3,000.00
1	BUCKET + LID, 20 l, with tap	piece	80	$5.00	$400.00
1	BUCKET + LID, 20 l, food-grade plastic, stackable	piece	50	$5.00	$250.00
1	stretcher	piece	4		
1	wheelchair	piece	1		
1	Chairs, plastic	piece	120	$4.00	$480.00
1	Set posters of donning/doffing protocols	piece	30	$2.00	$60.00
1	Table, plastic	piece	50	$12.00	$600.00
2	BROOM, with handle	piece	30	$3.00	$90.00
2	CHLORINE, NaDCC granules, 1 kg, jar or HTH (KG)	Kg	500	$6.00	$3,000.00
2	Hexanios disinfectant [5 liter tank]	piece	3		
2	SPRAYER, 1 l	piece	10	$5.00	$50.00
2	FLOOR SQUEEGEE, with handle	piece	40	$3.00	$120.00
2	GARBAGE BAG, 100 liters, black, 70 microns	piece	1000	$0.02	$20.00
2	GARBAGE BAG, 40 liters,	piece	1000	$0.02	$20.00
2	Hand wash soap, 250ml bottle	piece	300	$0.50	$150.00
2	Safety box burnable 5l	piece	100	$3.00	$300.00
2	SOAP, 200 g, bar	bar	100	$2.00	$200.00
2	OMO soap (5kg) bag	Kg	300	$3.00	$900.00
2	Laundry brush plates (plastic)	piece	20	$3.00	$60.00
2	Laundry brush boots (wooden) piece	piece	20	$3.00	$60.00
2	White vinegar [1 liter bottle]	piece	10	$2.00	$20.00
2	BLACK packaging bag with handle 25X33cm,	piece	500	$0.03	$15.00
2	Kerosene [waste burning]	Liter	25	$2.00	$50.00
2	TAP, 3/4 "plastic	piece	120	$3.00	$360.00
2	Wata Test	piece	1	$20.00	$20.00
2	Tube for turbidity measurement 5 to 2000 NTU	piece	1	$50.00	$50.00
2	(pool Tester with Dpd Nº 1 / Rapid, 1000 tablets	piece	1	$50.00	$50.00
2	MORTUARY BAG, plastic, white, 300 microns, ad., 250x120c	piece	20	$20.00	$400.00
2	MORTUARY BAG, plastic, white, 300 microns, child, 150x100	piece	20	$20.00	$400.00
2	(body bag) ABSORBENT LAYER	piece	40	$3.00	$120.00
3	Disposable plastic PLATE	piece	3000	$0.20	$600.00
3	CUP, 250 ml, red, plastic, [patient]	piece	80	$2.00	$160.00
3	CUP, 250 ml, green, plastic [staff]	piece	100	$2.00	$200.00
3	Paper towel (roll)	piece	200	$2.00	$400.00
3	Sanitary napkin (Cotex),	piece	50	$2.00	$100.00
3	Diapers adults	piece	50	$2.00	$100.00

3	Children's diapers 6-10 kg	piece	50	$2.00	$100.00
3	adult blanket	piece	200	$5.00	$1,000.00
3	baby blanket	piece	100	$5.00	$500.00
3	Bed sheet	piece	300	$10.00	$3,000.00
3	body soap 100 gr	piece	150	$2.00	$300.00
3	Toilet paper (piece)	piece	400	$0.50	$200.00
3	Toilet slipper - flipflop -tong	piece	150	$4.00	$600.00
3	Toothpaste with Toothbrush	piece	150	$3.00	$450.00
3	men's sandal	piece	80	$5.00	$400.00
3	Girl's children's sandals	piece	40	$5.00	$200.00
3	Boy's children's sandals	piece	40	$5.00	$200.00
3	lady sandal	piece	80	$5.00	$400.00
3	Children's clothing from 0 to 5 years old	piece	30	$5.00	$150.00
3	Children's clothing from 5 to 12 years old	piece	30	$5.00	$150.00
3	Men's adult shirt	piece	80	$3.00	$240.00
3	Adult T-shirt	piece	80	$3.00	$240.00
3	Kids t-shirt	piece	40	$3.00	$120.00
3	Pentalon adult	piece	80	$5.00	$400.00
3	Pentalon child	piece	40	$5.00	$200.00
3	Jacket adult	piece	50	$8.00	$400.00
3	Child jacket	piece	20	$8.00	$160.00
3	Men's underwear	piece	80	$3.00	$240.00
3	Adult lady dress	piece	80	$8.00	$640.00
3	Women's underwear	piece	80	$3.00	$240.00
3	Child underwear	piece	40	$3.00	$120.00
3	Towel	piece	200	$4.00	$800.00
4	PEN, fine point, [50 pieces box]	piece	6	$5.00	$30.00
4	MARKER, indelible, large, chisel point, black	piece	20	$2.00	$40.00
4	MARKER, indelible, large, chisel point, red	piece	20	$2.00	$40.00
4	MARKER, indelible, large, chisel point, green	piece	20	$2.00	$40.00
4	Duracell AAA 2 battery (pair)	piece	100	$2.00	$200.00
4	Duracell AA 2 battery (pair)	piece	50	$2.00	$100.00
4	CR 2032 battery	piece	50	$2.00	$100.00
4	Clock / pendulum	piece	50	$6.00	$300.00
4	Rolls of scotch tape (5cm)	piece	10	$1.00	$10.00
4	NOTEBOOK, A4, squared, spiral, 180 pages	piece	50	$2.00	$100.00
4	Envelop, Plastic, Transparent, Perforated, A4 Open At The T	piece	100	$0.20	$20.00
4	10/12 folder-pack separation	piece	100	$0.20	$20.00
4	Hardcover Notebook, A4, Grid, 80g, 200 Pages	piece	100	$2.00	$200.00
4	Paper, A4, 210 X 297 Mm, White, For Photocopy, 80 G	Box	40	$15.00	$600.00
4	Notepad, A5, 210 X 140 Mm, Grid 5 Mm	piece	100	$2.00	$200.00
4	Punch, Paper, With Guide	piece	20	$5.00	$100.00
4	Marker, Erasable, Black, Round Point	piece	50	$2.00	$100.00
4	Marker, Green, Erasable, Round Point	piece	50	$2.00	$100.00
4	Marker, Blue, Erasable, Round Point	piece	50	$2.00	$100.00
4	Marker, Red, Erasable, Round Point	piece	50	$2.00	$100.00
Total					$34,815.00

Annexe 12. PPE Module – 100 patients

KMEDCOVK1----A1	KIT, nCoV, 100 PATIENTS
KMEDCOV1PPE1-A1	(kit nCoV 100 patients) MODULE, PPE

				$	15,957.24		986.27	0.006
WHO Code	WHO Description	Qtity	Unit Cost USD	Total cost (USD)		Estim. Unit Weight (kg)	Estim. Total Weight (kg)	Estim. Unit Volume (m3)
YMEQGLASWS1--A1	GOGGLES PROTECTIVE, wraparound, soft frame, indirect vent.	300	$ 13.00	$	3,900.00	0.86000	258.00	0.00005
PEXTALCO1G---A1	ALCOHOL-BASED HAND RUB, gel, 100mL, bottle	60	$ 1.29	$	77.28	0.12000	7.20	
EWASBAGBR007-A1	BAG BIOHAZARD, REFUSE, AUTOCLAVABLE, 30x50cm, yellow	100	$ 0.35	$	35.00	0.00500	0.50	
EWASYCHN5G1--A1	CHLORINE NaDCC, 45-55%, gran., 1kg, pot	8	$ 6.00	$	48.00	1.00000	8.00	
CPPEGOWI3L---A1	GOWN, AAMI level 3, non sterile, disp., size L	540	$ 0.80	$	432.00	0.11467	61.92	0.001125612
CPPEGOWI3M---A1	GOWN, AAMI level 3, non sterile, disp., size M	630	$ 0.80	$	504.00	0.11467	72.24	0.001125612
CPPEGOWI3XL--A1	GOWN, AAMI level 3, non sterile, disp., size XL	450	$ 0.80	$	360.00	0.11467	51.60	0.001125612
CPPEGOWI3XXL-A1	GOWN, AAMI level 3, non sterile, disp., size XXL	180	$ 0.80	$	144.00	0.11467	20.64	0.001125612
CMSUGLEN1L1--A1	GLOVE EXAMINATION, nitrile, pf, size L	2200	$ 0.07	$	145.20	0.00707	15.55	0.00003
CMSUGLEN1M1--A1	GLOVE EXAMINATION, nitrile, pf, size M	4200	$ 0.07	$	277.20	0.00707	29.69	0.00003
CMSUGLEN1S1--A1	GLOVE EXAMINATION, nitrile, pf, size S	4200	$ 0.07	$	277.20	0.00707	29.69	0.00003
CMSUGLEN1XL--A1	GLOVE EXAMINATION, nitrile, pf, size XL	1600	$ 0.07	$	105.60	0.00707	11.31	0.00003
CPPEMASS2RL--A1	MASK SURGICAL, type IIR, level 2, s.u, non sterile, earloop, size L	1100	$ 0.66	$	725.43	0.00421	4.63	0.00004
CPPEMASS2RM--A1	MASK SURGICAL, type IIR, level 2, s.u, non sterile, earloop, size M	1100	$ 0.66	$	725.43	0.00421	4.63	0.00004
CPPEMASS2RS--A1	MASK SURGICAL, type IIR, level 2, s.u, non sterile, earloop, size S	1100	$ 0.66	$	725.43	0.00421	4.63	0.00004
CPPEMASPF205-A1	RESPIRATOR, mask, FFP2/N95, type IIR, s.u., unvalved, noseclip	6000	$ 0.66	$	3,956.90	0.00421	25.23	0.00004
CPPEFSHIED02-A1	FACE SHIELD, clear plastic, disp.	2700	$ 0.43	$	1,156.25	0.01000	27.00	
CMSUTHERI01--A1	THERMOMETER, INFRARED, no contact, handheld	30	$ 25.00	$	750.00	0.02000	0.60	0.00005
CINSCONTC51--A1	SAFETY BOX, needles/syringes, 5l, cardboard for incineration	40	$ 0.82	$	32.87	0.33000	13.20	0.00074
OPACUN62BS1--A1	BOX, triple packaging, biological substance UN3373 +pouch	100	$ 6.18	$	617.75	2.00000	200.00	
OPACUN62IS1--A1	BOX, triple packaging, infectious substance UN2814	20	$ 30.28	$	605.69	2.00000	40.00	
CMSUBAGB4A04-A1	BAG BODY, 8 handles, U-shaped zip, white, 400 microns, adult, 230x100cm	20	$ 17.80	$	356.00	5.00000	100.00	
				$	-		0.00	

Annexe 13. Work uniform Module – 40 staffs/shift

NOTE: closed shoes are recommended, however, for low resources setting, it advisable to equip staff with scrubs and rubber boots [local purchases whenever possible]. Underneath the recommended quantities for 40 staffs per shift with 4 for shift, morning, afternoon, night and recovery.

(kit nCoV 40 staffs/shift x 4 shift) MODULE, Uniform

WHO Code	WHO Description	Qtity	Unit Cost USD	Total cost (USD)	Estim. Unit Weight (kg)	Estim. Total Weight (kg)	Estim. Unit Volume (m3)
YPPESTUTROSS-A1	SET, TUNIC + TROUSERS SURGICAL, woven, reusable, green, size [S]	40	$ 10.45	$ 418.16	0.541	21.64	0.2
YPPESTUTROSM-A1	SET, TUNIC + TROUSERS SURGICAL, woven, reusable, green, size [M]	70	$ 10.45	$ 731.78	0.541	37.87	0.35
YPPESTUTROSL-A1	SET, TUNIC + TROUSERS SURGICAL, woven, reusable, green, size [L]	60	$ 10.45	$ 627.24	0.541	32.46	0.3
YPPESTUTROSXLA1	SET, TUNIC + TROUSERS SURGICAL, woven, reusable, green, size [XL]	30	$ 10.45	$ 313.62	0.541	16.23	0.15
OLIFBOOTW38--A1	BOOTS, rubber, size [38], dark color (green or black), pair	25	$ 6.10	$ 152.50	1.437	35.91666667	0.100
OLIFBOOTW40--A1	BOOTS, rubber, size [40], dark color (green or black), pair	50	$ 6.10	$ 305.00	1.437	71.83333333	0.200
OLIFBOOTW42--A1	BOOTS, rubber, size [42], dark color (green or black), pair	40	$ 6.10	$ 244.00	1.437	57.46666667	0.160
OLIFBOOTW44--A1	BOOTS, rubber, size [44], dark color (green or black), pair	30	$ 6.10	$ 183.00	1.437	43.1	0.120
OLIFBOOTW46--A1	BOOTS, rubber, size [46], dark color (green or black), pair	15	$ 6.10	$ 91.50	1.437	21.55	0.060

Annexe 14. List of biomedical devices

Type	WHO Description
Equipment	MONITOR PATIENT, NIBP, w/o ECG
Equipment	MONITOR PATIENT, multiparameter. +acc.
Equipment	CONCENTRATOR O2 10L, 230V, 50 Hz + acc.
Equipment	CONCENTRATOR O2 portable 3L + acc.
Equipment	VENTILATOR PATIENT, adu/paed/neon., w/acc.
Equipment	SUCTION PUMP, ELECTRICAL, 100-230V, 50-60Hz
Equipment	INFUSION PUMP
Equipment	DEFIBRILLATOR, mobile, semi-auto., w/acc. + trolley
Equipment	Table, resuscitation, neonate
Equipment	ULTRASOUND SYSTEM MOBILE, w/transducer + trolley, 220V, w/ acc.
Equipment	ELECTROCARDIOGRAPH
Equipment	OXYMETER, PULSE, portable
Equipment	OXYMETER, PULSE, finger tip model, SpO2/PR, 2xAAA batt.
Equipment	INFANT/BABY SCALE, electronic, portable, 20kg-10g, remov. baby tray, AA batt.x4
Equipment	SCALE, mechanical, adult 0-150 kg, grad. 500 g

Medical Sets of Consumables for Case Management

*** Medical procedures: Intubation / Resuscitation / Oxygen therapy / Injection and Intravenous infusion**
* Is assumed that in every context will be the skills and complementary equipment needed for the set requested.

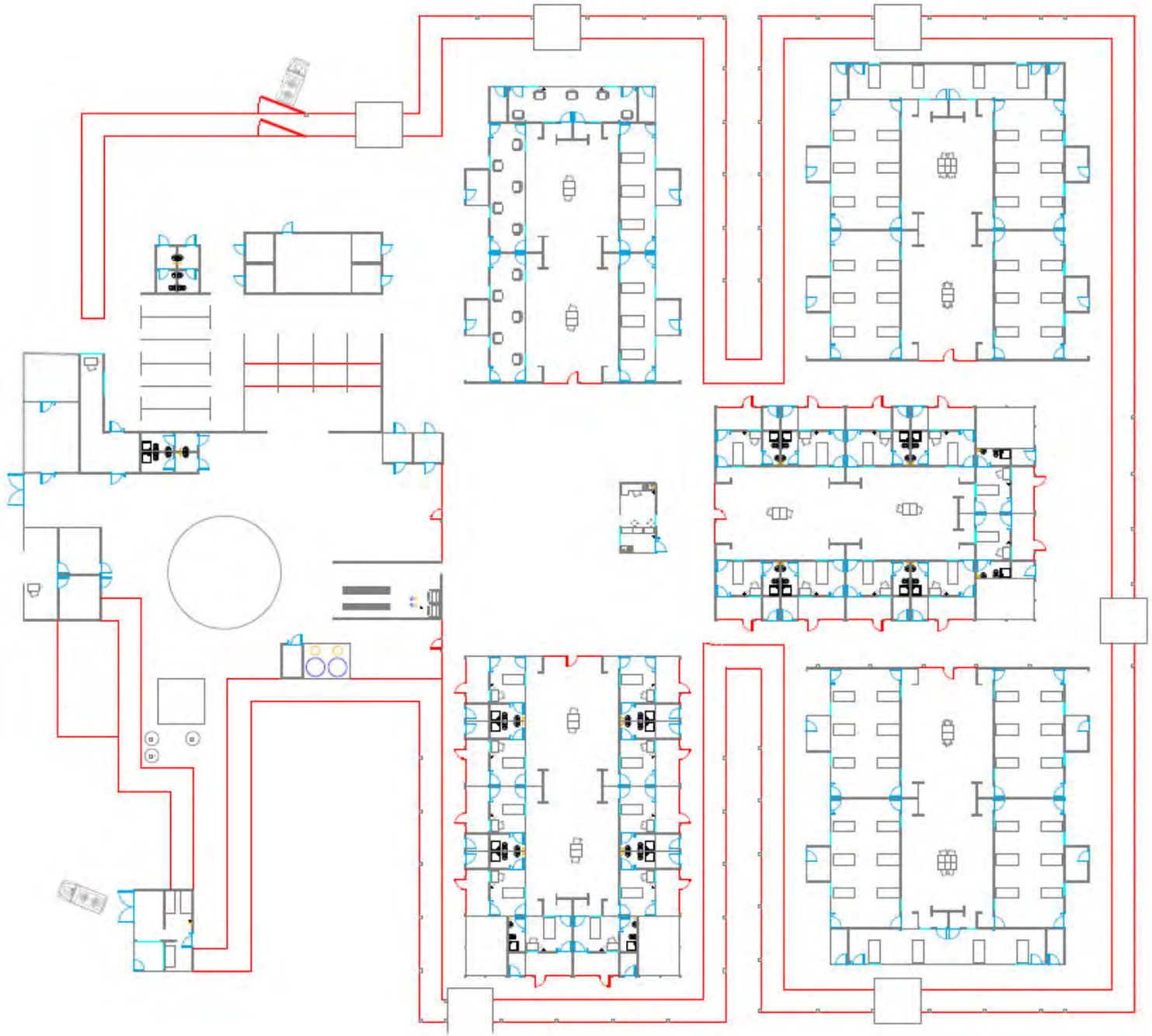
Medical procedure	WHO Description	Contents	Intended patient	Intended use
Intubation and Resuscitation	SET, CRICOTHYROIDOTOMY, emergency, complete, sterile, s.u.	1 - 6.0 mm, cuffed cricothyroidotomy tube 1 - cricothyroidotomy, tube holder 1 - dilator 1 - Scalpel blade, No. 15, for handle No. 3, sterile, single use 1 - Suture, surgical, synthetic, non-absorbable, monofilament, DEC 3.5 (0), 45 cm, with needle, 3/8 circle, 29.9 mm, cutting point 1 - Syringe, 10 mL, two or three pieces, Luer type, sterile, single use 1 - Thermovent T (HME)	Adult	Single Use
	Endotracheal Tube Introducer (Bougie), elastic, sterile, single use	-	All cases	Single Use
	Guide (Stylet), for endotracheal tube, size 1, autoclavable	-	Paediatric	Autoclavable
	Guide (Stylet), for endotracheal tube, size 2, autoclavable	-	Adult / Paediatric	Autoclavable
	Guide (Stylet), for endotracheal tube, size 3, autoclavable	-	Adult	Autoclavable
	Tube, endotracheal, No. 2, without cuff, sterile, single use	-	Neonate	Single Use
	Tube, endotracheal, No. 2.5, without cuff, sterile, single use	-	Neonate	Single Use
	Tube, endotracheal, No. 3, without cuff, sterile, single use	-	Paediatric	Single Use
	Tube, endotracheal, No. 3.5, without cuff, sterile, single use	-	Paediatric	Single Use
	Tube, endotracheal, No. 4, without cuff, sterile, single use	-	Paediatric	Single Use
	Tube, endotracheal, No. 5, without cuff, sterile, single use	-	Paediatric	Single Use
	Tube, endotracheal, No. 4, with cuff, sterile, single use	-	Paediatric	Single Use
	Tube, endotracheal, No. 5, with cuff, sterile, single use	-	Adult	Single Use
	Tube, endotracheal, No. 6, with cuff, sterile, single use	-	Adult	Single Use
	Tube, endotracheal, No. 7, with cuff, sterile, single use	-	Adult	Single Use
	Tube, endotracheal, No. 8, with cuff, sterile, single use	-	Adult	Single Use
	Tube, endotracheal, No. 9, with cuff, sterile, single use	-	Adult	Single Use
	Tube, tracheotomy, No. 4, without cuff, sterile, single use	-	Paediatric	Single Use
	Tube, tracheotomy, No. 6, with cuff, sterile, single use	-	Adult	Single Use
	Tube, tracheotomy, No. 7, with cuff, sterile, single use	-	Adult	Single Use
	Tube, tracheotomy, No. 8, with cuff, sterile, single use	-	Adult	Single Use
	Tube, tracheotomy, No. 9, with cuff, sterile, single use	-	Adult	Single Use
	Bite block, for patient intubation, single use (MOUTH GAG)	-	Adult / Paediatric	Single Use
	Syringe, 10 mL, two pieces, Luer type, sterile, single use	-	All cases	Single Use
	Needle, hypodermic, Luer type, 21 G, green, sterile, single use	-	All cases	Single Use
	Airway, nasopharyngeal, 20 Fr, sterile, single use	-	Paediatric	Single Use
	Airway, nasopharyngeal, 22 Fr, sterile, single use	-	Paediatric	Single Use

	Airway, nasopharyngeal, 24 Fr, sterile, single use	-	Paediatric	Single Use
	Airway, nasopharyngeal, 26 Fr, sterile, single use	-	Adult	Single Use
	Airway, nasopharyngeal, 28 Fr, sterile, single use	-	Adult	Single Use
	Airway, nasopharyngeal, 30 Fr, sterile, single use	-	Adult	Single Use
	Airway, nasopharyngeal, 32 Fr, sterile, single use	-	Adult	Single Use
	Airway, nasopharyngeal, 34 Fr, sterile, single use	-	Adult	Single Use
	Airway, nasopharyngeal, 36 Fr, sterile, single use	-	Adult	Single Use
	Airway, oropharyngeal, Guedel, neonate, size 00 (40mm), autoclavable	-	Neonate	Autoclavable
	Airway, oropharyngeal, Guedel, paediatric, size 0 (50mm), autoclavable	-	Neonate	Autoclavable
	Airway, oropharyngeal, Guedel, paediatric, size 1 (60mm), autoclavable	-	Paediatric	Autoclavable
	Airway, oropharyngeal, Guedel, child, size 2 (70mm), autoclavable	-	Paediatric	Autoclavable
	Airway, oropharyngeal, Guedel, adolescent, size 3 (80mm), autoclavable	-	Adult	Autoclavable
	Airway, oropharyngeal, Guedel, adult, size 4 (90mm), autoclavable	-	Adult	Autoclavable
	Airway, oropharyngeal, Guedel, adult, size 5 (100mm), autoclavable	-	Adult	Autoclavable
	LUBRICATING JELLY, 42 g, tube	-	All cases	Consumable
	FORCEPS, CATH. INTRODUCING, MAGILL, 16cm, child extra small	-	Neonate	Reusable instrument
	FORCEPS, CATH. INTRODUCING, MAGILL, 19cm, child small	-	Paediatric	Reusable instrument
	FORCEPS, CATH. INTRODUCING, MAGILL, 24cm, adult	-	Adult	Reusable instrument
	Laryngoscope, adult/child, with handle diameter 28 mm and blades	* Blades, Macintosh type (curved): No. 2, length 90 - 110 mm, for child. No. 3, length 110 - 135 mm, for small adult. No. 4, length 135 - 155 mm, for adult. * Blades, Miller type (straight): No. 1, length 100 mm. * Heavy-walled plastic or metal case. * Supplied with six compatible batteries in total. * Four extra halogen bulbs.	Adult / Paediatric	Reusable equipment
	Laryngoscope, neonate, with handle diameter 19 mm and blades	* Blades, Macintosh type (curved): No. 0, length 55 mm, for newborn. No. 1, length 70 mm, for infant. No. 2, length 90 mm, for child. * Heavy-walled plastic or metal case. * Instruction of use, troubleshooting and maintenance (English, French, Spanish). * Supplied with six compatible batteries in total. * Four extra halogen bulbs.	Neonate	Reusable equipment
	Resuscitator, hand-operated, adult, w/valve+ reservoir bag+mask, autoclavable	Compressible self-refilling ventilation bag, capacity: 1475-2000mL. Oxygen reservoir bag complete. Non-rebreathing patient valve with pressure limiting valve, patient connector outside/inside diameter: 22/15 mm. Inlet valve with nipple for 02 tubing. Masks, silicon, in 3 sizes (adult small, adult medium and adult large).	Adult	Reusable equipment

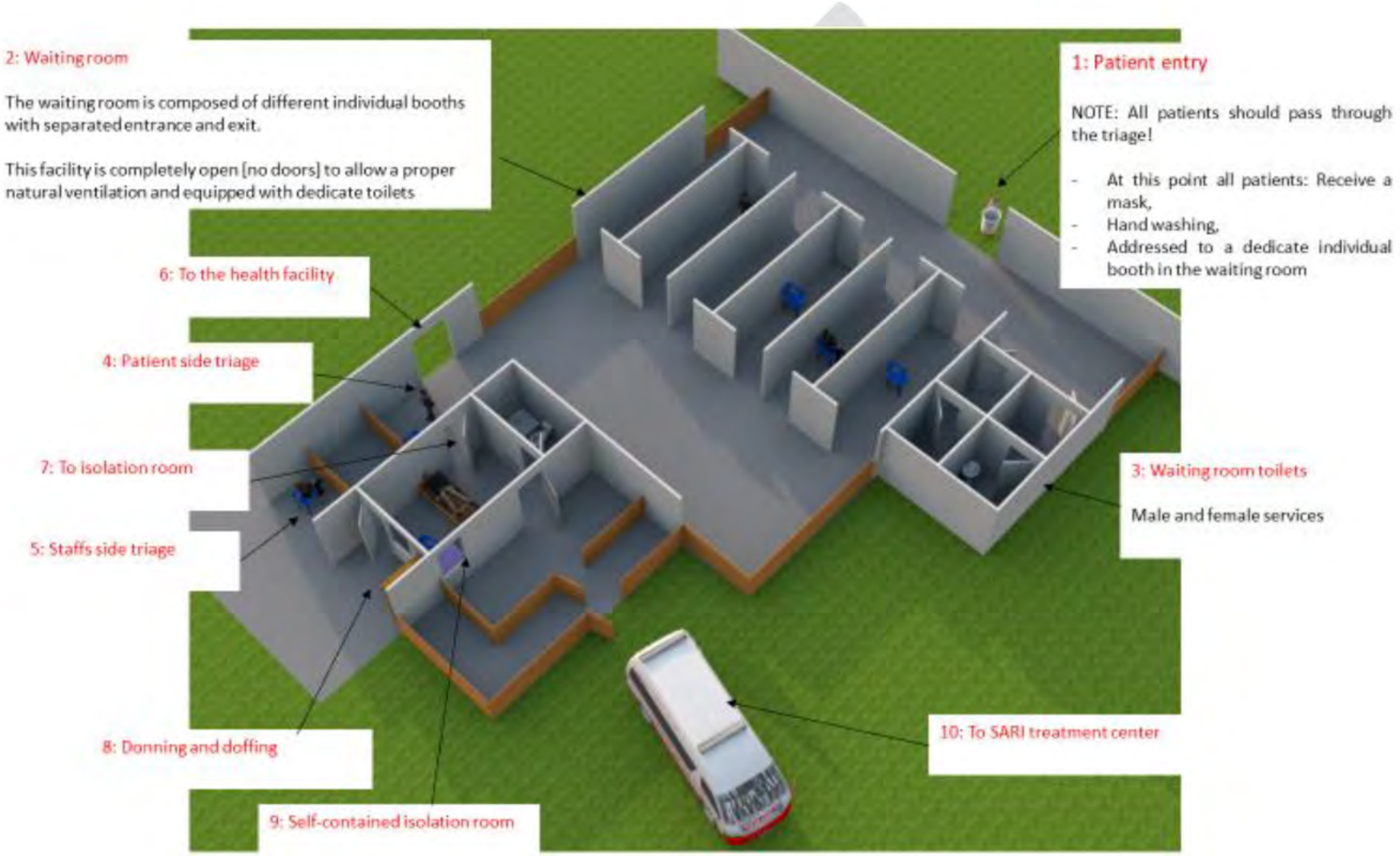
	Resuscitator, hand-operated, neonate, w/valve+ reservoir bag+mask, autoclavable	Compressible self-refilling ventilation bag. Oxygen reservoir bag complete. Non-rebreathing patient valve, patient connector. Inlet valve with nipple for 02 tubing. Masks, silicon, for neonates.	Neonate	Reusable equipment
	Resuscitator, hand-operated, paediatric, w/valve+ reservoir bag+mask, autoclavable	Compressible self-refilling ventilation bag, child, capacity: 500-700mL. Oxygen reservoir bag complete. Non-rebreathing patient valve with pressure limiting valve, patient connector outside/inside diameter: 22/15 mm. Inlet valve with nipple for 02 tubing. Masks, silicon, for infants.	Paediatric	Reusable equipment
	Suction bulb, for newborn, reusable, autoclavable	-	Neonate	Reusable equipment
	SUCTION PUMP, MECHANICAL (Twin Pump) + collection bottles	Set with collection bottles		Reusable equipment
	TUBE, silicone, autoclavable, int. diam.8 mm, 10 m (for suction device)	-	All cases	Consumable
Oxygen therapy - BASIC	NASAL OXYGEN CANNULA, 2 prongs + tube, neonate	-	Neonate	Single Use
	NASAL OXYGEN CANNULA, 2 prongs + tube, paediatric	-	Paediatric	Single Use
	NASAL OXYGEN CANNULA, 2.1m, 2 prongs + tube, adult	-	Adult	Single Use
	Filter, heat and moisture exchanger (HMEF), high efficiency, with connectors, adult, single use	-	Adult	Single Use
	Filter, heat and moisture exchanger (HMEF), high efficiency, with connectors, paediatric, single use	-	Paediatric	Single Use
Oxygen therapy - COMPLEMENTARY (Verify compatibility with source of oxygen)	HUMIDIFIER, autoclavable (FLOWMETER TR200)	-	All cases	Autoclavable
	(humidifier CH200/TR200) HOSE CONNECTOR 9/16, 920020050	-	All cases	Autoclavable
	(concentr.O2) FLOW SPLITTER paediat., 5 flowmeters 0-2L/min (Sureflow FM069-2)	-	All cases	Reusable equipment
Injection and Intravenous infusion	Infusion giving set, with air intake, with injection port, with burette, sterile, single use	-	Paediatric	Single Use
	Infusion giving set, with air intake, with injection port, sterile, single use	-	Adult	Single Use
	Cannula, IV, safety, short, with injection port, 16 G, 1.7 x 50 mm, sterile, single use	-	All cases	Single Use
	Cannula, IV, safety, short, with injection port, 18 G, 1.3 x 45 mm, sterile, single use	-	All cases	Single Use
	Cannula, IV, safety, short, with injection port, 20 G, 1.1 x 33 mm, sterile, single use	-	All cases	Single Use
	Cannula, IV, safety, short, with injection port, 22 G, 0.9 x 25 mm, sterile, single use	-	All cases	Single Use
	Cannula, IV, safety, short, with injection port, 24 G, 0.7 x 19 mm, sterile, single use	-	All cases	Single Use
	Scalp vein, needle 21 G, sterile, single use	-	Paediatric	Single Use
	Scalp vein, needle 23 G, sterile, single use	-	Paediatric	Single Use
	Scalp vein, needle 25 G, sterile, single use	-	Paediatric	Single Use
	Stopcock, 3-way, for infusion giving set, with connection line, sterile, single use	-	All cases	Single Use
	Gloves, examination, nitrile, powder-free, large, non-sterile, single use	-	All cases	Single Use
	Gloves, examination, nitrile, powder-free, medium, non-sterile, single use	-	All cases	Single Use
	Gloves, examination, nitrile, powder-free, small, non-sterile, single use	-	All cases	Single Use
	Needle, hypodermic, Luer type, 18 G, pink, sterile, single use	-	All cases	Single Use
	Needle, hypodermic, Luer type, 19 G, cream, sterile, single use	-	All cases	Single Use
	Needle, hypodermic, Luer type, 21 G, green, sterile, single use	-	All cases	Single Use
	Needle, hypodermic, Luer type, 22 G, black, sterile, single use	-	All cases	Single Use

	Needle, hypodermic, Luer type, 23 G, blue, sterile, single use	-	All cases	Single Use
	Syringe, 20 mL, two pieces, Luer type, sterile, single use	-	All cases	Single Use
	Syringe, 5 mL, two pieces, Luer type, sterile, single use	-	All cases	Single Use
	Syringe, 2 mL, two pieces, Luer type, sterile, single use	-	All cases	Single Use
	Syringe, 10 mL, two pieces, Luer type, sterile, single use	-	All cases	Single Use
	Tourniquet, cotton strap with buckle, 50 cm	-	All cases	Reusable
	Safety box, for puncture material, foldable carton, 5 L	-	All cases	Consumable
	Tape, adhesive, zinc oxide, 2.5 cm x 5 m	-	All cases	Consumable
	Cotton, wool, interleaved, hydrophilic, 500 g, non-sterile, single use	-	All cases	Consumable
	SWAB, cellulose, 4x5cm /12 folds, 1000 pcs (2 roll of 500)	-	Disinfectant	Consumable
	IODINE POVIDONE, 10%, solution, 1L, btl.	-	Disinfectant	Consumable
	DEXTROSE, 5%, 1L	-	Infusion	Single Use
	RINGER LACTATE, 1L	-	Infusion	Single Use
	SODIUM CHLORIDE, 0.9%, 100ml	-	Infusion	Single Use
	SODIUM CHLORIDE, 0.9%, 1L, plastic bottle	-	Infusion	Single Use

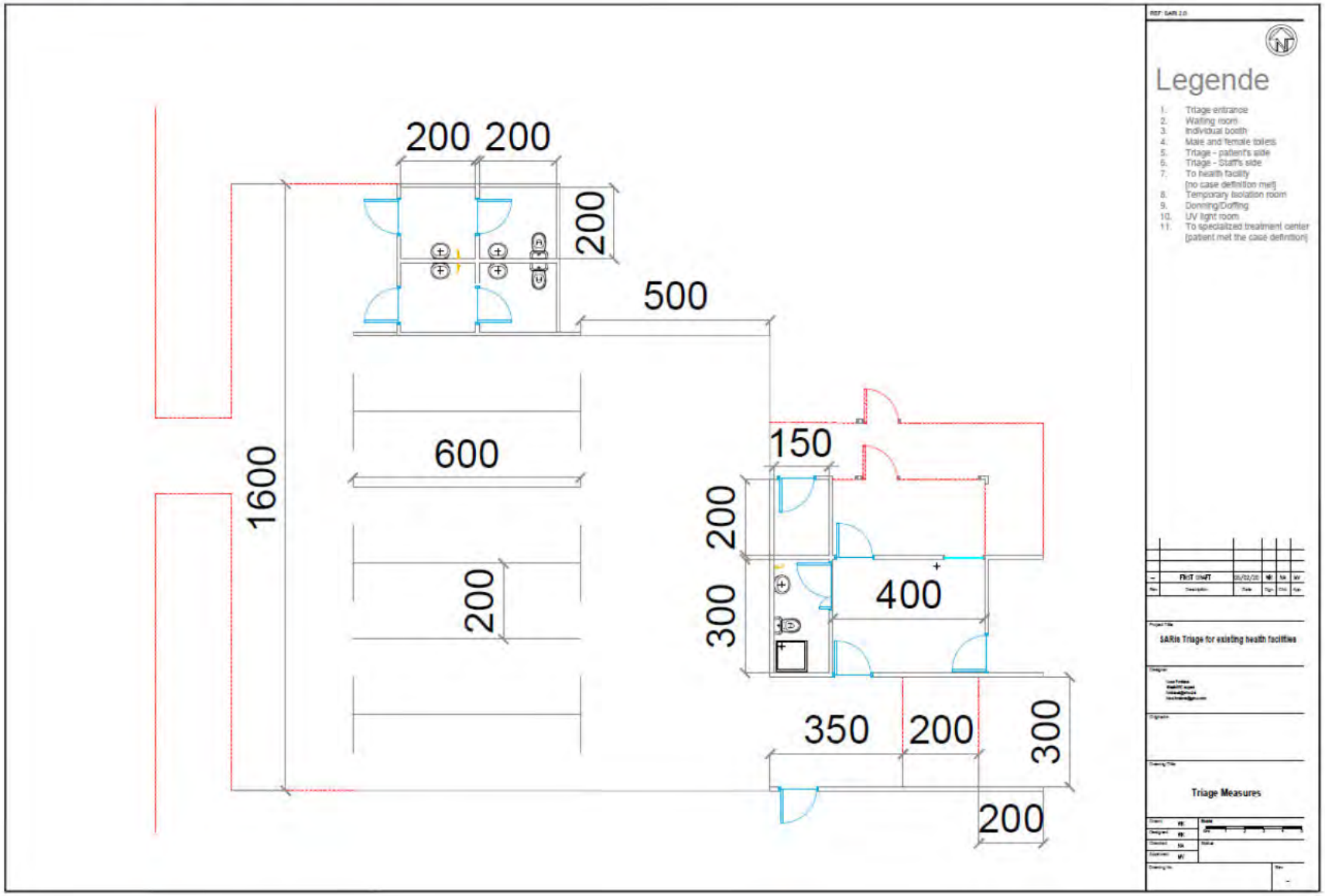
Annexe 16. SARI treatment center extension plan [cohorting approach]



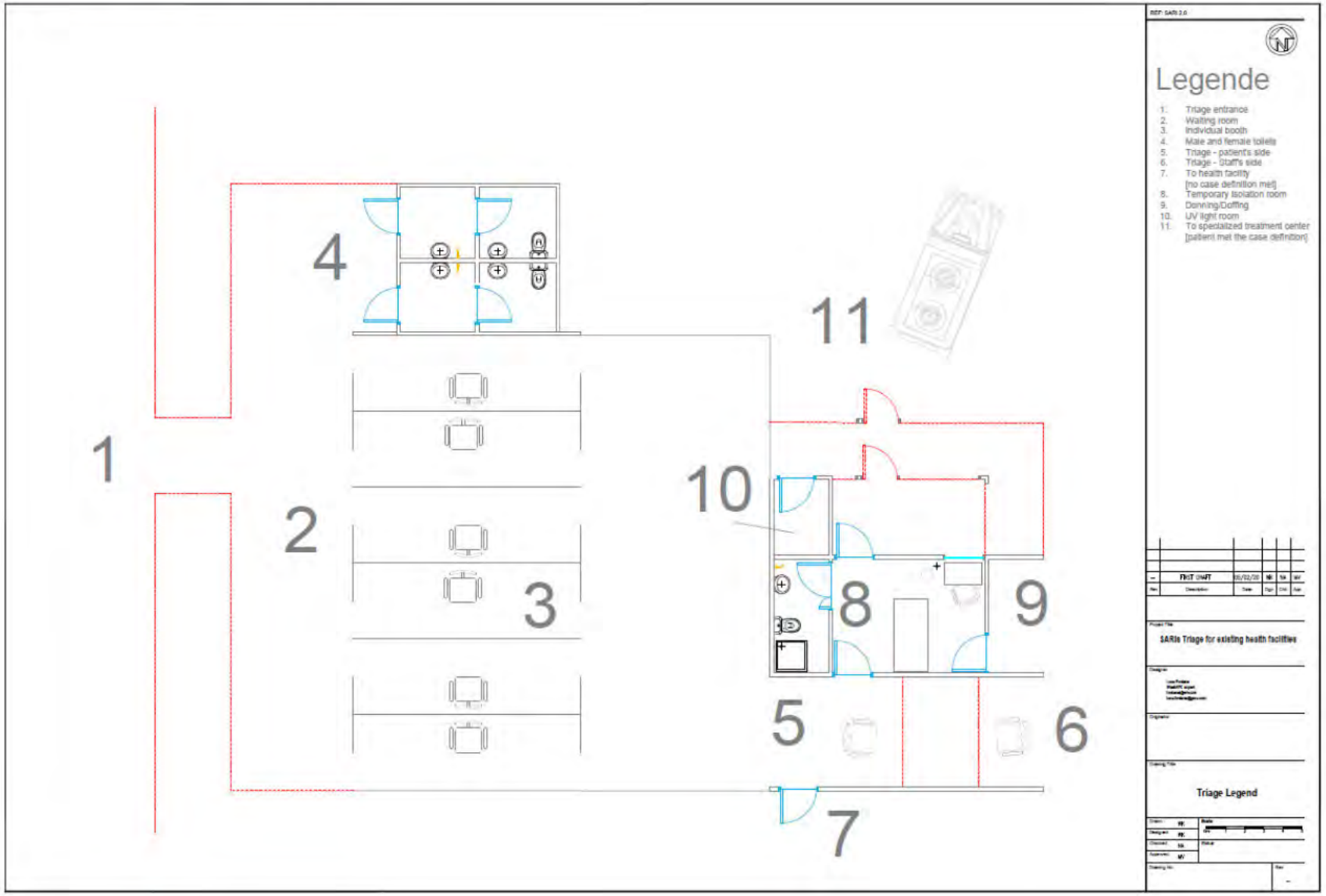
Annexe 17. Triage for health facilities description



Annexe 18. Triage for health facilities measures



Annexe 19. Triage for health facilities legend



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From: Beswick, Kevin
Sent: Wednesday, 29 September 2021 6:28 PM
To: Catanzariti, John; Donaldson, Ben
Cc: Gray, Sophie
Subject: RE: Surge Centre: Request for Information
Attachments: RE: Mechanical Design Review and return correspondence [SEC=UNCLASSIFIED]; TCH Covid19 Clinic - Peer Review Report - Rev 02.pdf; COVID-19 ED - FM Peer Review SoR.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

UNOFFICIAL

Hi John / Sophie – it appears that a lack of negative pressure and/or airflow in (one of?) the exhaust duct (ducts?) has prompted a fully enquiry into the testing, commissioning and handover of all the Services of the facility?!

In the first instance, can I suggest that Benmax (Mechanical Subcontractor) conduct a site visit with BMM (and CHS?) to understand BMM's concerns on the Mechanical exhaust. There may be a simple explanation regarding the exhaust concerns. I.e.: Also, is this just the Mechanical Exhaust or does the concern extend to all Services?

Please also refer to attached e-mail sent to Chris 1 May 2020.

Further comments below in Blue which will need to be vetted, please.

Regards

Kevin Beswick | Project Manager
M [redacted] **|E** Kevin.Beswick@act.gov.au
Infrastructure Delivery Partners | Major Projects Canberra | ACT Government
Callam offices, Level 3, Pod B, 50 Easty Street, Woden ACT 2606 | GPO Box 158, Canberra ACT 2601
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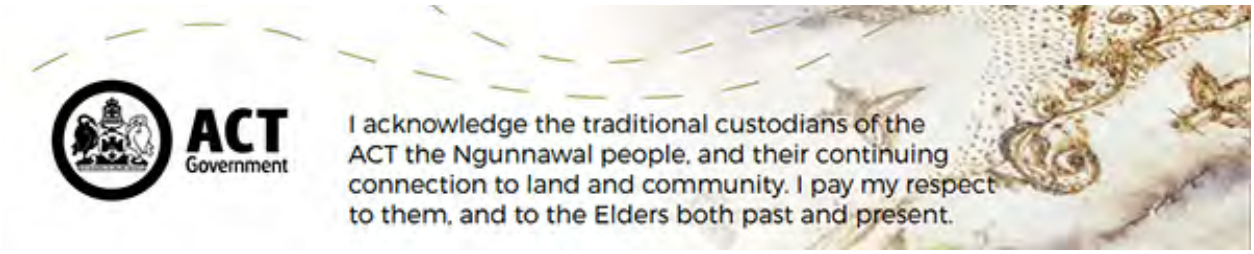

From: Catanzariti, John <John.Catanzariti@act.gov.au>
Sent: Wednesday, 29 September 2021 2:34 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>; Donaldson, Ben <Ben.Donaldson@act.gov.au>
Cc: Gray, Sophie <Sophie.Gray@act.gov.au>
Subject: FW: Surge Centre: Request for Information

UNOFFICIAL

Kevin / Ben,

Are you able to provide responses to the questions below?

Regards,

John

From: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Sent: Wednesday, 29 September 2021 2:25 PM
To: Gray, Sophie <Sophie.Gray@act.gov.au>; Agius, Philip <Philip.Agius@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>; Mooney, Colm (Health) <Colm.Mooney@act.gov.au>; Catanzariti, John <John.Catanzariti@act.gov.au>
Subject: Surge Centre: Request for Information

UNOFFICIAL

Hi Sophie

CHS is undertaking a review of the Surge Centre to inform a decision about the Territory's ongoing health response to the COVID situation.

CHS has recently engaged BMM to undertake a peer review of the Surge Centre building services and performance metrics, which has raised some concerns that we are now required to investigate. BMM will issue a formal report on the initial review of the facility 8 October. Some of the early concerns raised are as follows:

- Exhaust duct within the building is not under negative pressure; KB 29/9: Is the exhaust fan on? If yes, then where was the pressure reading taken from? If downstream of the fan, then pressure will be positive. Suggest a balance be conducted and/or exhaust quantities be checked via Benmax. Any filters in the system will likely need replacement.
- Air to air heat exchangers are not necessarily 100% sealed and there is some risk of air leaking from the exhaust path directly back into the supply air path. Note that on the Amcor (the heat exchanger manufacturer) website, they list a number of applications where these units are suitable but health care is not one of them; KB 29/9: Refer to Aspen response at item 10 of table 2 in the attached Peer Review Report. Benmax may be able to provide further comment.
- The exhaust discharge velocity is too low; KB 29/9: Suggest Benmax conduct a site visit and check exhaust ventilation system(s).
- There is no HEPA filtration of the exhaust prior to discharge. Adjacency of exhaust to air intakes. AS1668 Type A effluent discharge concerns; KB 29/9: Please detail the AS1668 effluent concerns. My understanding is the facility meets distance requirements for discharge / OA. Also note the design of the mechanical system for this facility was based on the advice in the SARI Treatment Centre Manual and did not require HEPA filtration of the exhaust. Refer attached e-mail for further information.
- Lack of negative pressure in the spaces throughout the building, and that there is limited pressure change between rooms; and KB 29/9: Suggest Benmax attend site to investigate.
- Operating Manuals and As installed drawings are a poor reflection of the installation detail. KB 29/9: Please elaborate on this – is this comment for mechanical only?

The information request below will inform this investigative process:

1. Design brief and technical specifications documents provided by MPC to Aspen Medical KB 29/9: Aspen were responsible for the facility design. Jones Nicholson undertook Services Design on behalf of Aspen. I'm not aware of any design or performance requirements handed from MPC to Aspen?
2. Scope of requirements for the engagement of AECOM to conduct a peer review of the services design and act as the Territory's Independent Commissioning Agent KB 29/9: Attached.
3. AECOM design peer review assessment advice/report KB 29/9: Attached.
4. Witness Testing program and commissioning results KB 29/9: Attached.
5. AECOM Peer Review Commissioning Report KB 29/9: Attached.
6. Practical Completion handover documentation from Aspen Medical / Manteena KB 29/9: Please confirm exactly what is required. This documentation has previously been handed to CHS.
7. Operations & Maintenance Manuals (already received, however we would like confirm version control) KB 29/9: Please confirm what is required. Do you need all the versions of all the OMM's?

Aspen Medical transferred the facilities management responsibility to CHS in August 2021. As part of this transfer process, MPC/CHS have been provided with the maintenance records. KB 29/9: John Catanzariti – I don't recall seeing these maintenance records?

We will need to receive the requested information in a timely manner to address the concerns raised in the BMM report and systematically resolve any issues that confirm a divergence of the design with the facility construction.

Thanks Sophie, please call to discuss if required.

Regards

Chris Tarbuck | A/g Executive Group Manager, Infrastructure and Health Support Services
Phone: 02 512 49711 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
Facilities Management| Canberra Health Services | ACT Government
Level 1, Building 1, Canberra Hospital, Garran ACT 2605 | health.act.gov.au

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ACT Government | Canberra Health Services

Our vision *is creating exceptional healthcare together*

Our role *is to be a health service that is trusted by our community.*

Our values *are Reliable, Progressive, Respectful, Kind*

From: Beswick, Kevin
Sent: Friday, 1 May 2020 5:35 PM
To: Tarbuck, Chris (Health)
Cc: Brady, Vanessa (Health); [redacted]; Matthew Gygi; Gray, Sophie
Subject: RE: Mechanical Design Review and return correspondence [SEC=UNCLASSIFIED]
Attachments: SARI Treatment Centre manual draft V5.5.pdf; Building Service Summary.pdf

Hi Chris

I understand Matt Gygi will have a response by later tonight to your queries. I will forward them on to you as soon as I can. Please note that due to the facility's bespoke nature, unique operational and functional requirements and extremely tight build deadlines, we have not had the luxury of typical 30, 50 and 100% PSP and FSP design phases and reviews, and resources have been and are currently very busy so please forgive us on the protracted nature of the response to your queries.

I note that AECOM has been engaged to verify the services design and will also assist with commissioning plans, witness testing, etc.

Regarding the design, I understand that:

- JN provided a mechanical design based on a building load calculation done in-house and the WHO SARI Treatment Centre guidelines (attached) which discussed airflow rates and direction;
- The DX design from JN was changed by Benmax to a Boiler / Chiller arrangement to avoid the defrost cycle experienced here in Canberra;
- Benmax then sized the FCU's, Boiler, Chiller, ductwork to suit the recommended ACH's and Building load to arrive at the equipment selections;
- The Design Report from JN dated 19 April 2020 (attached) is still generally correct with the exception of the HEPA filtration which has been removed; and
- I understand that lengthy discussions were held with and agreement provided by Ian Norton from WHO on the mechanical design.

Please confirm any additional design data you require.

I can confirm that all mechanical shop drawings and equipment schedules have been uploaded to RedHub for your review.

Full O&M Manuals including As-Builts will be provided at the end of the project and Scott from Benmax has re-confirmed his understanding of this.

Regards

Kevin Beswick | Project Manager
Social Infrastructure | Infrastructure Delivery Partners
Major Projects Canberra | ACT Government
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ACT Government
Major Projects Canberra

From: Tarbuck, Chris (Health)
Sent: Friday, 1 May 2020 3:13 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>
Subject: Mechanical Design Review and return correspondence [SEC=UNCLASSIFIED]

Hi Kevin,
Just following up on the expected return comments on our initial design review, we still are yet to receive anything. It's getting a little protracted.

Additionally, we have not received the design data for the mechanical system.

Regards,

Chris Tarbuck | Facilities Director, Infrastructure and Health Support Services
Phone: (02) 5124 3186 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
Facilities Management| Canberra Health Services | ACT Government
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ACT Government | Canberra Health Services

From: Beswick, Kevin
Sent: Thursday, 30 April 2020 4:48 PM
To: [redacted]
Cc: [redacted] Greg Chambers [redacted] Matthew Gygi [redacted]; Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>; Abraham, Robin (Health) <Robin.Abraham@act.gov.au>
Subject: FW: Electrical compliance [SEC=UNCLASSIFIED]

Hi [redacted]

Thanks for your help today in getting us all onto RedHub.

Please could I get your help with the following outstanding items:

1. Response to the queries from Chris Tarbuck sent 23/4;
2. Response to the attached queries from AECOM on the Electrical installation;
3. Provision of all shop drawings onto RedHub – note that Alan from AECOM has requested Electrical drawings below but we will need all trades;
4. Response to Samuel Lewin's mechanical queries also attached but which I'll also forward separately; and
5. Mechanical Equipment schedules – I have already requested Scott to upload these to RedHub to allow a review of capacities, equipment selections, etc.

Given our opportunity to change anything is dwindling based on the pace of installation, please could you expedite these items.

Thanks [redacted]

Regards

Kevin Beswick | Project Manager

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From: Schmierer, Alan [redacted]
Sent: Thursday, 30 April 2020 4:19 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>; [redacted]
Cc: Matthew Gygi [redacted] Greg Chambers [redacted]; Doctor, David (Canberra) [redacted]
Subject: RE: Electrical compliance [SEC=UNCLASSIFIED]

Hi Kevin,

Your email was timely. Dave has reviewed the Consultant drawings from Redhub and the Comments Log attached has his queries included.

Can we get copies of any electrical shop drawings so Dave can review those, which might resolve some of the queries.

R

Alan

Alan Schmierer
Technical Director
[redacted]

AECOM
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PO Box 1942 Canberra City 2601
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From: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Sent: Thursday, 30 April 2020 3:56 PM
To: [redacted]
Cc: Matthew Gygi [redacted] Greg Chambers [redacted]; Schmierer, Alan [redacted]
Subject: [EXTERNAL] Electrical compliance [SEC=UNCLASSIFIED]

Hi [redacted] One of the concerns CHS raised around compliance of the building was AS3003 Electrical Installations – Patient areas. Can you please confirm Shepherd Electrical have incorporated all requirements into the facility. If there are any deviations, please can these be documented.

Alan – just wondering if your team have been able to carry out a review of the Electrical installation? Do you have any comments or do you need a site review similar to the mech / fire site visit recently?

Thanks

Kevin Beswick | Project Manager
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The Canberra Hospital, Garran, GPO Box 158, Canberra ACT 2601

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19 April 2020

Responsive Engineering

Our Ref: MEPLTR- N0200347

Canberra Hospital Covid-19 Temporary Hospital

Building Services Design Summary

Electrical

The electrical system has a 500 Amp submain supply form the Hospital to a new Main Switchboard. The Main Switchboard also has a connection to a back up generator through an automatic transfer switch.

From the Main Switchboard, submains supply a patient switchboard, Lighting Switchboard, General Power Switchboard, Fire indicator panel and a mechanical switchboard. The Main Switchboard also has 3 spare circuit breakers for future expansion. The expected maximum demand for the electrical consumption is in the order of 300 Amps and the Main Switchboard has a rating of 630 Amps to allow for future increases in load.

The general power and lighting switchboards have spare circuits cabled to junction boxes so that the addition of a circuits does not need the switchboard to be shut down and interrupt the operation of the hospital.

The reticulation of power and data cables is on cable trays mount under the raised floors.

6 power outlets on each patient bed head are provided with a dedicated 10mA RCD for patient protection as per AS 3003.

Lighting is provided to all spaces with motion sensors used for small rooms such as toilets and store rooms. Lights to patient beds are switched at the bed head to allow beds not in use, or non critical patients to have a lower light level to sleep. Lighting has been designed around fittings that are available off the shelf or on very short lead times. All lights are surface mounted to enable installation below the insulated ceiling panels.

Emergency and exit lighting is provided to AS 2293.

Hydraulic

The hydraulic design reticulates hot and cold water to all wet areas, as well as sewer drainage.

The hot water system is a flow and return pumped, gas hot water system using bottled LPG gas for ease of infrastructure and ability to quickly change the hot water supply rate depending upon the use within the building.

Thermostatic mixing valves are provided to all bathroom areas to ensure the temperature of the hot water is appropriate as per AS 3500.

Back flow protection is provided to the Pan Rooms in accordance with Icon Water requirements.

Mechanical

The design generally follows the SARITC guidelines, and as such in some cases is not following the relevant state guidelines and Australian standards.

Please note the following 2 departures from the SARITC guidelines.

1. Top down delivery and removal of air is not provided in any spaces. This has been discussed with our infectious control expert. From our discussions it was agreed that air movement from the center of the rooms to the heads of the bed was a sufficiently appropriate method of air movement for the Isolation and Resus spaces.
2. Controlled pressure within rooms. Due to the layout of the building with both Resus and isolation rooms adjacent to each other without a positive pressure room separating them, pressure control within these rooms would cause the systems to fight against each other with air moving between the two zones. As air movement from one dirty space to another dirty space is not allowed, these rooms will be provided without pressure control.

Below is a description of air conditioning and ventilation for each space.

Isolation Rooms

- Cooling and Heating, with chilled and heated water FCU's.
- 12 AC/H supply air into space.
- Greater than 12AC/H exhaust air out of space (additional flow through toilets and the like). When doors are closed this additional air will flow from the clean corridors to the Isolation rooms. In some cases when doors are opened between resus and the isolation rooms, air may flow from the Resus rooms to the isolation rooms.
- 100% outside air (no recirculated air).
- 100% exhaust to outside, through HEPA filtration and discharged as an objectionable exhaust.
- Energy recovery ventilators providing sensible only energy recovery of return air into outside air.
- Air movement flow of air from center of room to the head of the isolation beds.
- Return / exhaust grilles located over the head of the bed,
- Both supply and return grilles in ceiling (therefore not a top down air movement path)
- No pressure control. Therefore a -2.5 Pa pressure difference can not be guaranteed.

RESUS Rooms

- Cooling and Heating, with chilled and heated water FCU's.
- 15 AC/H supply air into space.
- 15AC/H exhaust air out of space. (Balanced air flow to this space)
- 100% outside air (no recirculated air).
- 100% exhaust to outside, through HEPA filtration and discharged as an objectionable exhaust.
- Energy recovery ventilators providing sensible only energy recovery of return air into outside air.
- Air movement flow of air from center of room to the head of the RESUS beds, and to the outer walls of the room, where no beds are present.

- Return / exhaust grilles located over the head of the bed,
- Both supply and return grilles in ceiling (therefore not a top down air movement path)
- No pressure control. Therefore a -2.5 Pa pressure difference can not be guaranteed.

Triage Rooms

- Cooling and Heating, with chilled and heated water FCU's.
- 12 AC/H supply air into space.
- 12AC/H exhaust air out of space. (Balanced air flow to this space)
- 100% outside air (no recirculated air).
- 100% exhaust to outside, through HEPA filtration and discharged as an objectionable exhaust.
- Energy recovery ventilators providing sensible only energy recovery of return air into outside air.
- Air movement flow of air from center of room to the outer walls of the room,
- Return / exhaust grilles located at the outer walls.
- Both supply and return grilles in ceiling (therefore not a top down air movement path)
- No pressure control. Therefore a -2.5 Pa pressure difference can-not be guaranteed.

Palliative Care Room

- Cooling and Heating, with chilled and heated water FCU's.
- 12 AC/H supply air into space.
- 12AC/H exhaust air out of space. (Balanced air flow to this space)
- 100% outside air (no recirculated air).
- 100% exhaust to outside, through HEPA filtration and discharged as an objectionable exhaust.
- Air movement flow of air from center of room to the outer walls of the room,
- Return / exhaust grilles located over the bed head.
- Both supply and return grilles in ceiling (therefore not a top down air movement path)
- No pressure control. Therefore a -2.5 Pa pressure difference can not be guaranteed.

Staff areas and corridors

- Cooling and Heating, with chilled and heated water FCU's.
- 6 AC/H supply air into spaces.
- Outside air
    - 10 l/s per person in offices.
    - 10 l/s per person on DON.
    - 2 AC/H in corridors.

- Recirculating air through FCU with basic G4 filtration.
- Positive pressure in these spaces with air leakage available to go through to isolation rooms.
- Air movement flow as per standard office style air conditioning practice.
- No pressure control.

AECOM Imagine it. Delivered.

Peer Review Report

Canberra Hospital Temporary COVID-19 Surge Facility

Peer Review Report

Canberra Hospital Temporary COVID-19 Surge Facility

Client: ACT Government - Major Projects Canberra

ABN: 66 676 633 401

Prepared by

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			Name/Position	Signature
A	15-May-2020	Draft for client review	Alan Schmierer Team Lead/Project Manager	
1	06-Aug-2020	Final for Issue	Alan Schmierer Team Lead/Project Manager	
2	24-Aug-2020	Item numbers added to queries in Table 2	Alan Schmierer Team Lead/Project Manager	

Table of Contents

Executive Summary

The ACT Government is constructing a new standalone clinic to provide an expanded capacity to treat Canberrans with suspected or confirmed cases of COVID-19. The clinic is being constructed on Garran Oval, adjacent the Canberra Hospital campus, and comprises six resuscitation bays, 32 acute non-admitted treatment bays, 12 short-stay overnight beds and supporting staff accommodation. We understand Aspen Medical has been contracted by the ACT Government (the Territory) to construct and operate the facility.[1]

AECOM have been engaged to undertake a Services Peer Review consisting of a Design Review, construction phase inspections, witness testing of commissioning activities and review of available completion documentation.

Given the fast track nature of the project, the Design Review was undertaken during the construction phase and at this time the design was still being completed. A completed set of design documents was not available at the Witness Testing, which was our final activity on this project. As a result, not all items were closed out during our commission and we note the following outstanding items and recommendations:

1. A list of Design Queries has been created and is provided within this report. Additional queries were raised during the Witness Testing and are also included in the relevant section of the report. Not all queries were able to be closed out at the time of writing.

   It is our recommendation that these queries be closed out to the satisfaction of the Territory.

2. It is understood that the facility has been commissioned by the Territory via a contract with Aspen Medical and that Aspen will operate the facility.

   Given that the facility has been designed without a formal Return Brief and the basis of design may have evolved during the design process it is our additional recommendation that the Territory obtain assurance from Aspen Medical that the facility is fit for its intended purpose.

[1] https://www.act.gov.au/our-canberra/latest-news/2020/may/temporary-covid-19-surge-centre, accessed 13 May 2020.

1.0 Introduction

1.1 Project overview

The ACT Government is constructing a new standalone clinic to provide an expanded capacity to treat Canberrans with suspected or confirmed cases of COVID-19. The clinic is being constructed on Garran Oval, adjacent the Canberra Hospital campus, and comprises six resuscitation bays, 32 acute non-admitted treatment bays, 12 short-stay overnight beds and supporting staff accommodation. We understand Aspen Medical has been contracted by the ACT Government to construct and operate the facility.[2]

AECOM have been engaged to undertake a Services Peer Review consisting of a Design Review, construction phase inspections, witness testing of commissioning activities and review of available completion documentation.

1.2 Basis of review

The Peer Review included the following systems:

- Medical Gases
- Hydraulic services
- Fire protection
- Electrical services
- Mechanical services
- Nurse call
- Security

Fire engineering was not peer reviewed but the Fire Engineering Report (FER) was referenced in the review of relevant disciplines.

Civil engineering was not reviewed as these works were delivered under a separate contract.

Structural drawings were not available for review, but an experienced structural engineer participated in the site inspections.

It is understood that the starting point for the facility design was the Severe Acute Respiratory Infections (SARI) Treatment Centre Manual Draft V5.5. It is further understood that a Return Brief was not developed to document departures from this initial document, how it was interpreted in the context of compliance with Australian Standards and ACT Authority requirements, dispensations that were utilised to achieve the compressed construction program and departures relating to the temporary nature of the facility.

1.3 Codes and Standards

The applicable codes and standards include, but are not limited to, those provided in Table 1.

Table 1: Design standards

Type	Definition
National	National Construction Code
AS 1158	Lighting for roads and public spaces
AS/NZS 1170.0-2002	Structural design actions, Part 0: General principles

[2] https://www.act.gov.au/our-canberra/latest-news/2020/may/temporary-covid-19-surge-centre, accessed 13 May 2020.

Type	Definition
AS/NZS 1170.1-2002	Structural design actions, Part 1: Permanent, imposed and other actions
AS/NZS 1170.2-2011	Structural design actions, Part 2: Wind actions
AS 1170.4-2007	Structural design actions, Part 4: Earthquake actions in Australia
AS 1668.1-2015	The use of ventilation and air conditioning in buildings – Fire and smoke control in multi-compartment buildings
AS 1668.2-2012	The use of ventilation and air conditioning in buildings – Mechanical ventilation in buildings
AS 1668.4-2012	The use of ventilation and air conditioning in buildings – Natural ventilation of buildings
AS 1670-2018	Fire detection, warning, control and intercom systems
AS 1680-2009	Interior lighting
AS 1851-2012	The routine service of fire protection systems and equipment
AS 2293.1-2005	Emergency escape lighting
AS 2419.1-2017	Fire hydrant installations
AS 2444-2001	Portable fire extinguishers and fire blankets
AS 2896-2011	Medical gas systems
AS 3000-2018	Electrical installations
AS 3003-2018	Electrical installations – Patient areas
AS 3017-2001	Electrical installations – Testing and inspection guidelines
AS 3500-2018	Plumbing and drainage
AS 3600-2018	Concrete structures
AS 3666.1-2011	Air handling and water systems for buildings
AS 4100-1998	Steel structures
AS 4332-2004	Storage and handling of gases in cylinders
AS 4600-2005	Cold formed steel structures
AS 4678-2002	Earth retaining structures
AS 5601-2004	Gas installations
NSW Health Engineering Services Guidelines Aug 2016	
SARI Treatment Centre Manual Draft V5.5	
VicHealth HTA-2020-001 HVAC System Strategies to Airborne Infectious Outbreaks	

1.4 This report

This report summarises the three main peer review activities undertaken – review of design information, site inspection and witnessing of commissioning activities. Each of these activities are summarised in the following sections of this report:

- Section 2 details the peer review comments on the design documentation provided
- Section 3 details the observations made during commissioning activities and comments arising from this process
- Section 4 details the observations made during site inspection(s) and comments arising from these activities
- Section 5 summarises the design information provided.

Review comments and observations are included throughout this report and so it must be read in its entirety.

2.0 Review of design information

The comments register from the initial review of the design documentation is included overleaf at **Table 2**.

It is acknowledged that the design and documentation was proceeding during the period of the Peer Review so some of the queries were being resolved in parallel with the Review.

In addition, a number of the queries remain open pending completion of the Work As Executed drawings and Operations and Maintenance Manuals.

There are a number of design queries that relate to compliance with Australian Standards and/or published guidelines for designing similar facilities.

There are a number of design queries which were not subject to responses from Aspen or the design team and therefore remain unresolved.

Table 2 Peer review comments register

Item	Service	Area/System	Comment	Date	Aspen / Design Team Response & Status		AECOM Further Comments & Status	
1	Health Planning	-	Negative pressure isolation rooms for intubation, cardio-pulmonary resuscitation etc recommended (refer VicHealth HTA-2020-003).	28-Apr-2020	Aspen Response 04 May 2020: MG: 3/5/20 The building design has been informed by the SARITC document which identified points of positive and negative pressure as well as ventilation points relative to patients JN: 4/5/20: All isolation rooms are -ve pressure. Balanced, but not controlled to a specific pressure rating.	Closed		
2	Health Planning	-	3m between beds in open plan wards. 3.6m recommended (refer VicHealth HTA-2020-003).	28-Apr-2020	Aspen Response 04 May 2020: MG: 3/5/20 3m x 3m bays is the design	Closed		
3	Health Planning	-	Centralised staffing facility not separate facilities per patient cohort. Physical segregation is ideal to prevent transmission via staff. May need more detail though as current architectural drawings aren't complete detail. (Extension from VicHealth HTA-2020-003, p2 comments)	28-Apr-2020	Aspen Response 04 May 2020: MG: 3/5/20 The building has been designed to be an emergency department for those with COVID-19 symptoms, hence 1 patient cohort.	Closed		
4	Health Planning	-	Compliance with SARI Treatment Centre Draft 3 document prepared by WHO: Mechanical extraction of 160l/s/bed not met Air extraction at floor level to provide top-down ventilation has not been achieved	-	-	Open		
5	General	-	During the inspection it was noted that access for maintenance is via the ceiling crawl space. What provisions (lighting, emergency lighting, directional signage) is being provided to this space to facilitate egress. Are alternative exit points available?	29-Apr-2020	Aspen Response 04 May 2020: MG: 3/5/20 There will be lighting as required in the ceiling space. Additionally, in an emergency it is expected that an individual can rip off the flex duct and exit the space from any of the airflow points throughout the building.	Closed	Diffuser faces are (should be) clamped to the cushion head box - and so won't be able to be removed from within the ceiling void to permit access. It is recommended a clear access and egress strategy and associated SWMS be developed for this space.	Open
6	General	-	The FER (rev B 27.04.2020) inconsistently refers to four or five smoke compartments (including or excluding the ceiling void as a compartment). Clarification is required as to whether smoke compartmentation is expected between the occupied spaces below the ceiling and the ceiling void, or only between the occupied spaces; our reading is the former is the intent. If the former, and considering the maintenance strategy is personnel access to the ceiling void as a crawl space, has risk to these maintenance personnel been assessed?		(no response provided)	-	Awaiting response and/or revised documentation.	Open
7	General	-	The FER (rev B 27.04.2020) refers to separate fire isolated (not fire compartments) within the building to separate uses. Please provide detail as to these separated areas.		(no response provided)	-	Awaiting response and/or revised documentation.	Open
8	Mechanical	Resus bays	Resus bays are physically separated but are not isolation rooms. High level exhaust will draw substances at staff caring for the patient in resus (eg. during intubation). (refer VicHealth HTA-2020-003).	28-Apr-2020	Aspen Response 04 May 2020: JN: 4/5/20 Comment is noted. Supply and exhaust regime has been co-ordinated through Aspen and their infections control advisor.	Closed		

Item	Service	Area/System	Comment	Date	Aspen / Design Team Response & Status		AECOM Further Comments & Status	
9	Mechanical	Ventilation rates	Increased ventilation rates to keep oxygen enriched atmosphere below 23.5%. ACH to be confirmed to allow review of dilution rates. (refer VicHealth HTA-2020-003, p2 and NHS Design Note: COVID-19 ward for intubated patients, v1.0)	28-Apr-2020	Aspen Response 04 May 2020: JN: 4/5/20 Resus areas is 15 AC/h. Triage is 12 AC/H. Wards are 12 AC/H	Closed		
10	Mechanical	HRVs	The HRVs will need to be selected to confirm they achieve no air-crossover between the exhaust air stream and the OA. Air-to-air heat exchanges are not usually 100% perfectly airtight, which may lead to small contamination of incoming outside air.	28-Apr-2020	Aspen Response 04 May 2020: SP: Yes- The HRV units have aluminium heat exchangers and are leak tested to 700Pa.	Closed		
11	Mechanical	Exhaust air - outside air intake separation	Supply air and exhaust both appear to be from the roof. This is a potential risk as while separation has been done considering AS 1668.2 the quantities mean that for almost any prevailing wind direction the exhaust will blow towards some air intakes. Consider: Raising the exhausts to be well above the building Consolidating the exhausts to create a centralised plume Moving air intakes to lower level at the sides of the building	28-Apr-2020	Aspen Response 04 May 2020: SP: Current arrangement complies. Please send instruction should you wish the extension	Closed	It is noted that exhaust discharges have been extended approximately 3m above roof level, providing further separation.	
12	Mechanical	Exhaust air treatment	Consider the use of UV sterilisation of the exhausts for maximum protection. While not yet proven against COVID-19, there is good evidence that UV-C will destroy similar viruses (see: https://doi.org/10.1016/j.jviromet.2004.06.006). HEPA filters are good for >0.01 um particles but does still allow some viruses to pass through. [ASHRAE HVAC Design Manual for Hospitals and Clinics, 2nd Edition (2013 + addenda), 10.4.4 Biological Disaster Response, p216] It is noted the JN drawings (legend sheet) indicate HEPA filtration to exhaust air streams, however this is not reflected on the Benmax drawings.	28-Apr-2020	Aspen Response 04 May 2020: JN: 4/5/20 Recommendation is noted. The current design and agreed process does not have allowance for UV, or HEPA filtration.	Closed		
13	Mechanical	Pressure balance	Overall building pressure regime to be clarified, overall building appears negative with no obvious positive/negative separation. 28.04.2020 - Benmax noted this was under review, with pressure balance diagram being developed.	28-Apr-2020	Aspen Response 04 May 2020: JN: 3/05/20 Building shall be of an overall balanced air flow. Refer to Air Schematic, saved in Redhub.	Closed	Revised drawings provided showing revised air flows. A pressure regime diagram has not been made available. We recommend that such a document is prepared to guide the commissioning process.	Open
14	Mechanical	Smoke compartmentation	The design does not incorporate for any smoke compartmentation, however building is to be divided to five compartments per Draft FER.	28-Apr-2020	Aspen Response 04 May 2020: SP: 14 off smoke dampers added following release of FER Wednesday. Mechanical drawing being updated GC: 28.04.2020 - Benmax noted this was under review, with pressure balance diagram being developed. JN: 3/05/20 Building shall be of an overall balanced air flow. Refer to Air Schematic, saved in Redhub.	Closed	Revised drawings provided showing smoke dampers.	Closed

Item	Service	Area/System	Comment	Date	Aspen / Design Team Response & Status		AECOM Further Comments & Status	
15	Mechanical	Storerooms	No ventilation is provided to some storerooms and some rooms along the service (north) end of the building; including switch room, comms room, medical gas store, palliative care airlock, suspected cases overflow airlock, etc. Unclear how these rooms are being treated.	28-Apr-2020	Aspen Response 04 May 2020: JN: 4/5/20 Clean stores with no occupancy and no odour creating items are not being ventilated. Switch room and TCH electrical room are cooled in accordance with the clients requirements. Med gas store is no longer used for med gas. There is no palliative care air lock, or overflow air lock.	Closed	Internal spaces should be provided with ventilation. Stores between pairs of wards provide path for air transfer between these spaces, eg. from severe to moderate cases. Stores and service rooms should also be provided with ventilation. Palliative care - noted system is now provided as shown on updated drawings. Overflow air lock - noted air lock door has been removed on updated architectural drawings.	
16	Mechanical	Building net air flow	Overall building balance is negative, unclear how air flow is intended to be made up (infiltration?) and if the fan coil units have been sized for this additional load.	28-Apr-2020	Aspen Response 04 May 2020: JN: 4/5/20 Revised air flow rates are providing an overall balanced air flow in the building. Refer to Air Schematic, saved in Redhub.	Closed	Revised drawings provided showing revised air flows.	Closed
17	Mechanical	Chilled water	Chilled water pumping arranged as primary / secondary however no decoupler line is shown. 28.04.2020 - Benmax noted this was now provided and also a tank included.	28-Apr-2020			Awaiting response and/or revised documentation.	Open
18	Mechanical	Smoke control	Please provide details of fire mode operation of the system and assessment of detection requirements (eg. concealed space adjacent equipment, in-duct detection).	29-Apr-2020	Aspen Response 04 May 2020: SP: All plant stop	Closed	We understand the strategy has further developed as part of the fire engineering process. Provision of a fire matrix is recommended to clearly document the operation of all systems.	Open
19	Mechanical	Maintenance	The FER (rev B 27.04.2020) references the need for "Establishment and enforcement of cleaning regimes, including regular cleaning and inspection of air conditioning ductwork and associated equipment to prevent accumulation of combustible residual material.". Are access panels required in ductwork to facilitate this process.	29-Apr-2020	Aspen Response 04 May 2020: SP: The facility is operational for 6 months, is this really required?	Closed	The FER requires, and so should be provided.	Open
20	Electrical	Point of supply	No drawing to detail point of supply (B11), sub-main cable route (length), installation method, physical protection, etc. Check on fault levels and VD required.	28-Apr-2020	Aspen Response 04 May 2020: SP: Check on fault levels and VD required. MG: 20/05/02 Drawings are not intended to show cable routes, installation method, nor physical protection but rather coordinated in the field and shown on the as builts.	Closed	To ensure compliance with AS3000, the electrical network must be assessed from the point of supply. The designer must consider items such as voltage drop along with installation compliance and suitable cable protection.	Open
21	Electrical	Power	No details provided on the PDUs to the comms racks	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Agreed to supply 2 x 15Amp outlets in meeting with IT	Closed	Who is supplying the PDUs within the racks and is there a UPS requirement?	Open

Item	Service	Area/System	Comment	Date	Aspen / Design Team Response & Status		AECOM Further Comments & Status	
22	Electrical	Power	Ensure outlet face plates are coloured to the requirements of AS/NZS3003 and AS2500, where required under these standards	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Outlet faceplates on site are as per AS 3003	Closed	Confirm if AS2500 is applicable	Open
23	Electrical	Power	Check if the medical gas storage area classified as a hazardous area and consequently the necessary considerations taken for the power outlet provided there-in.	28-Apr-2020	Aspen Response 04 May 2020: MG: 20/05/01 Medgas room has been re-appropriated to storage. No hazardous goods are scheduled to be stored in this room.	Closed	Noted	Closed
24	Electrical	Power	RCBO protection has been shown to the communications rack - has use of an RCBO vs an MCB for the communications rack been discussed with SSICT. (refer drawing E030)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 No it hasn't.	Closed	Suggest further review with client IT team, noting potential nuisance tripping issues associated with the use of RCD protection.	Open
25	Electrical	Power	Drawings provided no details on the fault rating, IP rating and form factor of the Main Switchboard and DBs. (refer drawing E030)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Refer to the workshop drawings for information	Closed	Awaited. Can AECOM please be provided with copy.	Open
26	Electrical	Power	The 20A three phase isolators shown in the pan room are not on the Power DB schematic. (refer drawing E030)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 A second Power Db has been installed for additional power requirements.	Closed	Please update drawings accordingly.	Open
27	Electrical	Power	Only one circuit shown for the comms rack however the power layout drawing shows two separate 15A outlets noted as being served from different DBs. (refer drawing E030)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 One circuit from the power DB and one circuit from the 2nd power DB	Closed	Please update drawings accordingly.	Open
28	Electrical	Power	If the FIP has battery backup and the exception from being treated as a safety service (as per AS/NZS3000 7.2.1.2) applied, why is the submains to it fire rated, noting no fire rated tray has been provided to the FIP from the switchroom. (refer drawing E030)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 FIP design wasn't progressed when electrical design was completed and there is no harm in having a fire rated cable.	Closed	Noted	Closed
29	Electrical	Power	It is not clear whether the ATS is 3 pole or 4 pole. No earth neutral diagram has been provided. (refer drawing E030)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Refer to the workshop drawings. 3 pole ATS installed.	Closed	Awaited. Can AECOM please be provided with copy.	Open
30	Electrical	Power	Check metering to the MSB and MSSB - should be CT type not direct wired as shown? (refer drawing E030)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Refer to the workshop drawings. CT meter included in the MSB.	Closed	Awaited. Can AECOM please be provided with copy.	Open
31	Electrical	Power	No details provided on the BMS interfacing for the meters installed. (refer drawing E030)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 No BMS interface for meters included.	Closed	Client should note this status.	Closed
32	Electrical	Power	No separate circuiting shown for cleaner outlets as required by AS/NZS3003 noting that these outlets will need to be beige coloured and appropriately marked. (refer drawing E030)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 GPO circuit on DB Power for cleaners outlets.	Closed	Please update drawings accordingly.	Open

Item	Service	Area/System	Comment	Date	Aspen / Design Team Response & Status		AECOM Further Comments & Status	
33	Electrical	Lighting	No lighting control schematics or control methodology provided	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Small rooms have motion sensors, bed lights are switched at bed head, ward corridors are switched, Staff corridor and public areas are 24 hours due to the operation of the building.	Closed	Has proposed arranged been reviewed by the clinical operations team?	Open
34	Electrical	Luminaires	Are the luminaires DALI type and do they have dimming capability for day and night time adjustment	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 No Dali functionality. What is the purpose of Dimming lights when there are no windows?	Closed	Night time operation could be dimmed to increase patient comfort/aid sleep.	Closed
35	Electrical	Luminaires	Check requirement for the T1 luminaire in the patient bed area to a clean room type and/or any specific cyanosis requirements. Also, check UGR. (refer drawing E001)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/04. Light fitting selected to meet the requirements of surface mounted and available off the shelf and as such full range of fittings was not available. UGR of installed fitting is very low (and meets requirements). Fitting also provides good cyanosis colour rendering.	Closed	Noted.	Closed
36	Electrical	Luminaires	No luminaire details provided on the LED batten. Does the batten luminaire have an integral emergency component as no standalone emergency lighting has been shown in the comms room and electrical switch room? (refer drawing E001)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 No emergency to batten.	Closed	Noted. Details should be provided. Please also confirm emergency lighting provisions to switchroom etc.	Open
37	Electrical	Generator	Temporary / portable generator connection point not shown. (refer drawing E200)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Generator 10A connection shown on layout. Infrastructure to generator including trenching part of Shaw documentation.	Closed	See notes below. Layout/details required if further review is required.	Open
38	Electrical	Generator	The outlet face plates of the medical services panels is shown as red inferring essential outlets. From the SLD, only a generator connection point is provided rather than a permanent one (as discussed on site). For the outlets to be classified as essential under AS2500 and AS/NZS3003 the generator would need to be permanent not temporary (refer drawing E200)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 The generator is permanent	Closed	Update documentation to reflect permanent generator arrangement to ensure compliance with this standard.	Open
39	Electrical	Security Panel	Query the security panel been located in the switchroom room rather than the comms room as typically required by SSICT? (refer drawing E200)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Location as agreed with the Hospital	Closed	Noted	Closed
40	Electrical	Comms	No details provided on any UPS backup requirements to the comms rack (refer drawing E200)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 UPS by others	Closed	UPS details required to ensure compliance.	Open
41	Electrical	Comms	Check outlets for the racks - typically need to be captive type to SSICT requirements (refer drawing E200)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Outlets provided.	Closed	Confirm outlet type on drawing/agreement with client on this.	Open
42	Electrical	Power	The extent of the body protect zones to AS/NZS3003 requirements has not been shown to review compliance against section 2.4.1 of AS/NZS30003. Noting that this will require separate independent accreditation (refer drawing E200)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Body protection zones to all patient areas.	Closed	Please make clear protected areas on drawings.	Open

Item	Service	Area/System	Comment	Date	Aspen / Design Team Response & Status		AECOM Further Comments & Status	
43	Electrical	Power	Check egress and maintenance access within switchroom per standards. (refer drawing E200)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Egress provided	Closed	Please demonstrate compliance showing egress paths and statutory maintenance. Shepherd Electrical: space per standards.	Open
44	Electrical	Lighting	Certain rooms like the staff facilities have no light switch or PIR and is unclear how the lighting is controlled in this room. (refer drawing E201)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 These rooms are expected to be 24 hours given the operation of the building and rooms.	Closed	Check compliance with building code.	Open
45	Electrical	Lighting	Noted - no bedside/examination lighting and night lighting provided - recommend check requirement. (refer drawing E201)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Not provided	Closed	Suggest review by the clinical operations team?	Open
46	Electrical	Lighting	Check illumination levels in each of the patient entry areas (to avoid possible dark spot in the corner). (refer drawing E201)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Suitable lighting provided to all areas.	Closed	Are calculation available?	Open
47	Electrical	Lighting	In some cases there seems to be no emergency lighting within 2m of change in direction of travel - check compliance. (refer drawing E201)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Emergency lighting provided to AS 2293	Closed	Query compliance as previously noted.	Open
48	Electrical	Lighting	No lighting shown to disabled toilet pods, confirm that this is to AS1428 requirements (refer drawing E201)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 Lighting to pods provided as part of the pod.	Closed	Compliance is still required.	Open
49	Electrical	Lighting	Clause 20 of the FER notes additional emergency lighting over and above AS2293 requirements to allow for equipment operation and evacuation of patients, however the lighting layouts only seems to show standard AS2293 minimum provisions. Please clarify. (refer drawing E201)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 The emergency lighting is overlapping and providing coverage above the minimum required by AS 2293.	Closed	Suggest further review by the FER author. Illumination calcs may help understand provisions are over and above code compliance.	Open
50	Electrical	Lighting	Check if external lighting requires a particular level under AS1158.3.1 to meet CPTED requirements. (refer drawing E201)	28-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 External lighting by Shaw to AS 1158		Awaited. Can AECOM please be provided with copy.	Open
51	Communications	ICT	Schematics now provided.	28-Apr-2020				
52	Nurse Call	Nurse Call	Schematics now provided.	28-Apr-2020				
53	Electrical	Lighting	No emergency light provided adjacent FDCIE. Required under FER (rev B 27.04.2020) section 5.4 item 10 and typical ACTF&R requirements.	29-Apr-2020	Aspen Response 04 May 2020: JN: 20/05/01 We will review with Fahrenheit Global	Open		
54	Other	Medical Services Panel	Check requirement/provision of germ resistance coating. (refer drawing E001)	28-Apr-2020	(no response provided)	-	Awaiting response and/or revised documentation.	Open
55	Fire Services	External Plantroom	Not yet included in the fire services drawings - this area will require fire alarm detection, occupant warning system as a separate zone and connected to the FIP. Also will require strobes, portable fire extinguishers and control interlocks with the mechanical services. If the plantroom has an undercroft this area will also require fire detection / alarm system	28-Apr-2020	(no response provided)	-	Awaiting response and/or revised documentation.	Open
56	Fire Services	Main Facility Undercroft	There is no drawing showing this area and the fire protection services - example fire alarm detection system on a separate zone	28-Apr-2020	(no response provided)	-	Awaiting response and/or revised documentation.	Open
57	Fire Services	Main Facility	No mention of the scope of works on the provision of portable fire extinguishers on drawing 2020.056.000 although these are indicated in the Legend and ground floor plan. AS 2444 and current edition is required.	28-Apr-2020	(no response provided)	-	Awaiting response and/or revised documentation.	Open

Item	Service	Area/System	Comment	Date	Aspen / Design Team Response & Status		AECOM Further Comments & Status	
58	Fire Services	Site	It is recommended that the fire trade seeks water supply data from the Water Authority and undertake fire hydraulic calculations to confirm that the design fire water supply demand can be achieved without the assistance of additionally on-site pumps.	28-Apr-2020	(no response provided)	-	Awaiting response and/or revised documentation.	Open
59	Fire Services	Site	It is recommended that an additional external fire hydrant be provided in the vicinity of the bulk LP Gas tanks but at a safe distance for use by the fire authority	28-Apr-2021	(no response provided)	-	Awaiting response and/or revised documentation.	Open
60	Fire Services	Site	The Bulk Oxygen storage and the LPG facilities, Elec Generator, etc will need to have fire protection complying with the relevant codes and suppliers recommendations (example AS 1596, etc)	28-Apr-2022	(no response provided)	-	Awaiting response and/or revised documentation.	Open
61	Fire Services	Site and Facility	The various trades will be required to undertake relevant fire protection tests (dry and wet fire) and certified by the trades and relevant Certifier and Authorities	28-Apr-2023	(no response provided)	-	Awaiting response and/or revised documentation.	Open
62	Fire Services	Site and Facility	Relevant documentation and Log Books are required to service and maintain the services in accordance with AS1851 and manufacturer's other special requirements.	28-Apr-2024	(no response provided)	-	Awaiting response and/or revised documentation.	Open
63	Structural	Building Frame	The building will require a Structural Certificate for Design and another for Inspection. It is understood that the design has been completed by Austruss. It is not clear who is undertaking inspections during construction and who is providing certification for the completed structure.	-	(no response provided)	-	Awaiting response and/or revised documentation.	Open

3.0 Review of commissioning activities

AECOM representatives attended witness testing of commissioning activities:

- Medical gas systems: 12 May 2020.
- Hydraulic services: 12 May 2020.
- Fire protection services: 13 May 2020.
- Electrical services: 15 May 2020.
- Mechanical services: 13 May 2020.
- Nurse call systems: 14 May 2020.
- ACT F&R inspection / full function fire test: 13 May 2020 and 14 May 2020.
- Integrated systems test: 14 May 2020.

Observations from these witness tests and the supplied commissioning results are summarised in the following sections, by discipline.

3.1 Medical gas systems

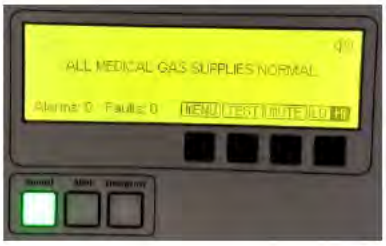
Observations from medical gas system witness testing are summarised in Table 3. Key residual items where further review or action is recommended are:

i. A simultaneous flow test had not been noted as being undertaken (AS 2896 s.5.5.3.2) – considering the nature of the facility and the high usage of O2, the system should be tested as being suitable to deliver supply to the number of beds expected to require O2 supply simultaneously (which might be higher than typical AS 2896 diversities).

ii. No drawings of the installation and handover have been sighted (AS 2896 s.5.7 and 5.8).

Table 3 Commissioning observations – medical gas systems

Test/System	Observations
Commissioning records	Provided following the test.
Alarms – suction plant	The following alarms were initiated at the suction plant and annunciation observed at the alarm panel within the staff facilities. • Main fail initiated by closing the valves located on the manifold. Accordingly, an alarm was witnessed within the staff facilities as shown below. • Low vacuum initiated by disconnecting the vacuum sensor located on vacuum pump 2. Accordingly, an alarm was witnessed within the staff facilities as shown below. • Suction common initiated by shutting of the common supply valve located on the manifold. Each alarm presented at the alarm panel with a text notification, alarm light (alert or emergency) and audible alarm.  Supplies normal (start of test)

Test/System	Observations
	 Main fail
	 Low vacuum alarm
Alarms – oxygen plant	The following alarms were initiated at the suction plant and annunciation observed at the alarm panel within the nurse station. • Cylinder changeover initiated by operating the valve on the manifold which shut off cylinder banks. • Supply exhausted initiated by cutting the top valve located on the manifold connected to all oxygen cylinder banks. Each alarm presented at the alarm panel with a text notification, alarm light (alert or emergency) and audible alarm.
	 Supplies normal (start of test).
	 Changeover alert (note alarm light did illuminate however photograph did not capture (flashing light)).
	 Supply fail alarm.

Test/System	Observations
Performance – suction	Pressure and flow were observed at two suction outlets. Results observed were as follows: Outlet: Pod 1 Bed 7 — Static – Pressure (kPa): ~-83 — Dynamic – Flow (L/s): > 40 — Dynamic – Pressure (kPa): ~ -10 Outlet: Resus 1-1 — Static – Pressure (kPa): ~-80 — Dynamic – Flow (L/s): > 40 — Dynamic – Pressure (kPa): ~ -10
Performance - oxygen	Pressure, flow, gas concentration and particulate tests were observed at two oxygen outlets. Results observed were as follows: Outlet: Pod 5 Bed 6 — Purity: 100% — Static – Pressure (kPa): 430 — Dynamic – Pressure (kPa): 380 — Particulate: Clear Outlet: Resus 2-1 — Purity: 100% — Static – Pressure (kPa): 420 — Dynamic – Pressure (kPa): 380 — Particulate: Clear Note: Dynamic pressure readings were at a flow of 250 L/s. Note: Pod 5 Bed 6 reading at first test was ~80%. Retested at 100% after re-calibration of instrument.

3.2 Hydraulic services

Observations from hydraulic services witness testing are summarised in Table 4 for initial testing undertaken on 12 May 2020 and Table 5 for additional re-testing undertaken on 14 May 2020. Key residual items where further review or action is recommended are:

i. Dispensation document from ACT Health regarding permitting an outlet water temperature range between 41°C - 43°C via the TMV's as stated during the witness test.

ii. Temperature records for each TMV in the commissioning results.

iii. Labelling of equipment that requires periodic service such as but not limited to TMV's, RPZDs and HWU.

Table 4 Commissioning observations – hydraulic services 12 May 2020

Test/System	Observations
Commissioning records	Commissioning records were provided. It was noted that in the commissioning results there were not water temperatures listed for each TMV. The results did not indicate the pressure drop achieved across the RPZD.
RPZD	Witnessing for the RPZD was not conducted as there was no tester available.
TMV	The outlet water temperature through a sample set of thermostatic mixing valves was found to be higher than the required temperature. This was noted as potentially due to the system shutdown that occurred while attending to a leak on one of the basins.
HWU	The heating water unit located on the plant deck was witnessed to be

Test/System	Observations
	operating at 61°C which is below the required outlet temperature of 65°C. This reportedly due to shutting down the system to attend to a leak on one of the basins.
Chilled and heated water sink units	The Chilli Billi located under the sink was witnessed to produce heated water at 89°C. When changed over to the cold water it was witnessed to produce chilled water.

Table 5 Commissioning observations – hydraulic services 14 May 2020

Test/System	Observations
TMV	The operation of the TMV in the "Pan room" located on the western end of the building was tested. It was noted that the water temperature was 43°C. A second TMV located in the "Ens Acc" on the eastern end of the building was selected; the outlet water temperature was measured to be 42°C. It was noted by the hydraulics contractor that the hospital has a requirement for outlet water temperature between 41°C - 43°C. This dispensation is to be provided as a written record for future reference.  
HWU	The heating water plant was witnessed to be operating with a ring main water temperature of 65°C and a return temperature of 65°C. 

Test/System	Observations
	
Other	The extension of the shower head in relation to the toilet was tested in the "Ens Acc" rooms on the eastern and western end of the building. There was no contact between the shower head and the toilet water with the fully extended length. 
RZPD	The reduced zone pressure device for the "Pan room" located on the eastern end of the building was witnessed to have an upstream pressure of 35 kPa for the cold water and 14 kPa for the relief test. There was no discharge. The upstream pressure was increased, and the discharge was witnessed to flow out as intended.  

Test/System	Observations
	 The reduced zone pressure device for the hot water was witnessed to have an upstream pressure of 55 kPa and a relief pressure of 20 kPa with no discharge. 

3.3 Fire protection services including ACT F&R test

Observations from ACT F&R inspection witness testing are summarised in Table 6 for initial testing undertaken on 13 May 2020 and Table 7 for additional re-testing undertaken on 14 May 2020. Key residual items where further review or action is recommended are:

i. No sound level readings in decibels were provided for the OWS.

ii. There was no indication of the assembly point on the emergency evacuation plans.

iii. Fire matrix was not available on site during the witness test.

iv. It was noted that there was a four-minute delay to the evacuation. This is longer than usual therefore, ensure the appropriate dispensation document was been provided to allow for a longer delay time.

v. Commissioning records for the fire protection installation have not been sighted.

vi. Fire fan control panel indication of smoke vent status was observed to be indicating incorrectly (indicating vents closed when they were observed as open).

Table 6 Commissioning observations – ACT F&R inspection / full function fire test 13 May 2020

Test/System	Observations
Commissioning records	Commissioning records were not provided. The fire engineering report had not been provided to reference.
Fire Matrix	Fire matrix document was not provided. The fire installation contractor described that, in the event of fire detection via smoke detector, an alert tone would be triggered and a four-minute delay before the evacuation

Test/System	Observations
	tone. In the instance that two detectors are triggered at the same time, this would trigger Stage 1 whereby all systems shut down in accordance with the fire engineering report.
Fire Detection	A smoke detector was triggered in the staff corridor and an alert tone was triggered. The FIP indicated that the trigger was initiated by L2D57. This corresponded to the block plans.  A sample set of thermal detectors were observed to operate as intended. Strobes were observed to be flashing during the activation of an alarm.
Noise levels	Noise levels were audible across all points of the building. Note that no sound level readings were provided in the commissioning results.
Fire Extinguishers	A sample set of fire extinguishers were observed to be installed as shown in the design drawings. 
Fire Hydrant	The fire hydrant located outside the building was observed to have been installed.
Evacuation Plan	Evacuation plans were found on site. It was observed that the evacuation plans did not have an assembly point.

Test/System	Observations
	
Other	It was noted by the Brigade that external egress paths on the southern end of the building were to be illuminated with lighting wired via an emergency circuit. Electrical mains were switched off and it was observed that the emergency lighting turned on in response to the mains failure. The break glass alarm was observed to be operational. However, it was observed that the alert tone did not automatically engage the evacuation tone. It was observed by the Brigade that there was no switch permitting post event smoke clearance on the FIP. The fire brigade requested it would be acceptable for a 'cheat sheet' to be installed in the FIP enclosure to instruct the user to disengage the isolator post event to enable smoke clearance. The operation of the smoke vents along with the motorised smoke damper was not witnessed.

Table 7 Commissioning observations – ACT F&R inspection / full function fire test 14 May 2020

Test/System	Observations
Commissioning records	No commissioning records or cause and effect diagram were provided at the time of witness testing. The final fire engineering report had not been provided to reference.
Concealed ceiling space fire detection.	The smoke vents were witnessed to be initially in the closed position. Upon the activation of the first smoke detector the smoke vent was not activated. However, upon the activation of a second smoke detector within the ceiling space, the smoke vents were witnessed to open. A smoke machine was used to simulate the presence of smoke within the ceiling space and the smoke vents were witnessed to open permitting the smoke within the ceiling space to exit via the vents.

Test/System	Observations
	 Detectors L2D29, L2D31 were observed to have been triggered via the FDCIE log. The detectors from the log correspond to the area tested. At the time of the test the indication of the smoke and heat vent position was incorrect on the FDCIE (FFCP) – indicated vents as closed however, a sample were observed as open.

3.4 Electrical services

Observations from electrical services witness testing are summarised in Table 8. Key residual items where further review or action is recommended are:

i. The electrical main switch room has no ceiling and is therefore part of the same smoke compartment as the ceiling void. This does not appear to be reflected in the Fire Engineering Report and should be confirmed with the Fire Engineer.

ii. The external lighting installation should be completed. Consideration should be given to external access and plant areas.

iii. The emergency lighting installation should be completed, including all testing, certification and updates to O&M information.

Table 8 Commissioning observations – electrical services

Test/System	Observations
Commissioning records	The following commissioning records were provided on 12th May 2020: Shepherd Electrical: Aspen Medical ICU – ITP 001 Main Switchboard Inspection and Test Plan Shepherd Electrical: Aspen Medical ICU - ITP 006 – Test and Commission Form Shepherd Electrical: Aspen Medical ICU - ITP 008 - Switchboard Installation, Termination and Testing Shepherd Electrical: Aspen Medical ICU - ITP 010 Circuit Functional Verification Shepherd Electrical: Aspen Medical C-19 ICU - ITP 011 Generator Installation Shepherd Electrical: Aspen Medical C-19 ICU - ITP 012 ATS Site Test Procedure Class Power Systems: 11834 – 1984 – Preventative Maintenance Report (Generator)
Generator	A simulated mains failure/return to mains test procedure was carried out. The ATS within the main switchboard was observed to be in automatic mode with only the mains supply available. The mains supply isolator within the main switchboard was isolated to simulate the loss of supply. After ~11 seconds the generator supply became available at the ATS and the load was immediately transferred to generator. The generator operation was observed. The mains supply was re-energised and was observed to be available at the ATS. After a period of 120 seconds the ATS performed an open transition of the load back to the mains supply. The ATS displayed the generator remained available for a further 180 seconds before the generator set entered its' cooldown sequence. Observations: • The simulated test was considered successful, with the system acting as expected. • There is no automatic monitoring of the system operation via the BMS or dedicated controls system. • The generator bulk fuel tank does not have a low limit fuel level switch, hence the tank could be run dry under operation. It is understood this is to be fitted with a local connection to generator set to enable a safe shutdown under low fuel condition. • There was no evidence of a fuel spill kit but the bulk tank fill point does include a small spill bund. • There was a lack of service lighting around the generator plant. • There was no physical protection provided to the generator

Test/System	Observations
	installation – suggest vehicular traffic risk is considered.
Emergency Lighting	A simulated mains failure/return to mains test procedure was carried out. The isolator within the lighting distribution board was switched off. It is noted that key switch test facilities are provided to avoid complete isolation of all lighting circuits. Following an inspection of the facility, the isolator as switched back on and the mains supply was reinstated. Observations: • The simulated test was considered successful, with the system acting as expected. • SE confirmed a full duration discharge test had taken place. Certification should be provided on this basis. • There was no emergency luminaire provided within the electrical main switch room. Review with respect to high risk task area lighting requirements within the standard. • SE advised that a number of additional emergency luminaires have been provided and will be installed. These should be fully tested (full duration discharge, local circuit failure and test key switch operation) following installation. • It was noted that, in a number of instances, the adjacent surface mounted luminaires are obstructing the direct component of the emergency luminaires. • Given the external access to the building (including extensive walkways and ramped access areas), consideration should be given to emergency lighting to address the changes in direct and level. Suggest general lighting should be provided, at a minimum, to the ramp to the nominated P category under AS1158.3.1 • The extent of provisions 'over and above the Australian standard', as required in the fire engineering report, is unclear and should be validated by the fire engineer.
Fixed Wiring (Power Final Circuits)	A representative sample of fixed wiring testing was undertaken, which generally comprised 'trip' testing of the residual current devices across each of the distribution boards (DB). Testing of the Patient DB included CB23 and CB14, which were tested at the 10mA setting and 0- and 180-degree phase angles. Results observed: CB23 (RCD 6.4) = 13.6ms and 13.6ms; CB14 (RCD 4.4) = 17.6ms and 8.1ms. Testing of the General Power DBs included P1/CB26 and P2/CB27, which were tested at the 30mA setting and 0- and 180-degree phase angles. Results observed: P1/CB26 = 28.8ms and 19.3ms; P2/CB27 = 28.6ms and 19.5ms. Observations: • The simulated tests were considered successful, with the system acting as expected. • The results were generally in line with the test results provided. • Visual inspection confirmed the correct RCBO had acted based on the field labelling (for general power DBs).
General Notes/Observations/Queries	• It was noted that the Main Switchboard includes an MEN connection. Query if the installation upstream already has an MEN present and recommend provision of a single line diagram / framed schematic to clarify adjacent to MSB. • It is understood a local earth spike has been provided as the means of earth to the MSB and that the generator installation is

Test/System	Observations
	bonded to the same. An earth-neutral schematic for the complete installation should be provided to demonstrate compliance/assist future maintenance operations. • The electrical main switch room has no ceiling and is therefore part of the same smoke compartment as the ceiling void. AM confirmed this was in line with the fire engineering report. • There was a lack of service lighting around the gas storage cylinder. • External lighting installation was incomplete at the time of inspection. • Following mains failure, it was noted that the automatic lighting control devices (sensors) had to be triggered twice before returning to normal operation. • SE confirmed all lighting control sensors had been commissioned to a five-minute delay to off. • Consider AS 3017 earth resistivity testing to verify the local earth.

3.5 Mechanical services

Observations from mechanical services witness testing are summarised in Table 9. Key residual items where further review or action is recommended are:

i. A final 'trim' balance is recommended to be undertaken to finalise the air distribution, set up air flow gradients between spaces and commission the barometric dampers. It was noted this had not been undertaken at the time of witness testing, due to other works in progress on site.

ii. The systems with flow rates below design should be reviewed.

iii. The systems where the witnessed values invert the supply-exhaust flow rate differential should be reviewed.

iv. Results for controls, mechanical electrical, airflow gradient, and the balance of air balancing results should be prepared and included in the handover documentation.

Table 9 Commissioning observations – mechanical services

Test/System	Observations
Commissioning records	Results were made available for air and water balancing. Results for controls, mechanical electrical or air flow gradient commissioning have not been sighted. The air balance results provided did not include all systems. Filter pressure drops (F8 filters) at commissioning noted as being quite low (eg. 35Pa, 55Pa) on some units. FCU-16 air flows were below the design values.
Water balance – chilled and heating water	It was observed one chiller was installed on site therefore the chilled water flow did not meet the design flow. It was noted that there were provisions for a second chiller if it was required. It was witnessed that the graphic indicated that the chiller was operating at 72.28kPa and the field indicated a pressure of 68.8kPa.

Test/System	Observations
	  (Note the flowrate value in the above photo is to be disregarded.) A 5% variance between the field reading and BMS reading indicated on the graphics was witnessed. The chilled water flow through FCU-16 was witnessed to be 0.118l/s, 13% variance with the actual reading provided in the commissioning result and 21% variance from the design flow. Variance to the commissioning results was reportedly due to change in pump speed. The heating water was witnessed to be consistent with the design heating water.

Unit #	Design (L/s)	Actual Flow (L/s)	Witnessed (L/s)	Variance to Design (%)
FCU-3-CHW	0.300	0.273	0.238	79%
FCU-3-HHW	0.110	0.115	0.119	107.5%
FCU-16-CHW	0.150	0.138	0.115	21%
FCU-16-HHW	0.170	0.174	0.170	0%

Controls and mechanical electrical	These subsystems were not presented for witness testing.
Air balance – FCU-3 & HRV-3	Some variances from the balancing results and design figures were observed including some terminals measured at below design flow rate, as outlined in the results summary below. The differential between exhaust and supply flows is in the same direction as the design flows (higher exhaust flow).

Outlet	Design (L/s)	Balanced Flow (L/s)	Witnessed (L/s)	Variance to Design (%)
S-01	168	180	164	98%
S-02	168	179	176	105%
S-03	168	177	160	95%
S-04	168	174	168	100%
S-05	168	172	150	89%
S-06	168	179	169	101%

Test/System	Observations				
	S-07	50	52	48	96%
	E-01	60	63	63	105%
	E-02	60	62	63	105%
	E-03	60	62	65	108%
	E-04	60	64	66	110%
	E-05	110	114	117	106%
	E-06	110	113	116	105%
	E-07	110	115	116	105%
	E-08	110	112	117	106%
	E-09	110	118	117	106%
	E-10	110	119	115	105%
	E-11	110	116	115	105%
	E-12	110	114	108	98%
	Total supply	1058	1113	1035	98%
	Total exhaust	1120	1172	1178	105%

Air balance – FCU-4 & HRV-4

One variance between the balancing results and design figures were observed with one terminal measured at below design flows, as outlined in the results summary below.
The differential between exhaust and supply flows is in the same direction as the design flows (higher exhaust flow).

Outlet	Design (L/s)	Balanced Flow (L/s)	Witnessed (L/s)	Variance to Design (%)
S-01	179	185	182	102%
S-02	179	185	179	100%
S-03	179	185	185	103%
S-04	179	183	181	101%
S-05	179	188	188	105%
S-06	179	181	191	107%
E-01	120	130	130	108%
E-02	120	128	131	109%
E-03	99	105	105	106%
E-04	99	105	104	105%
E-05	99	103	106	107%
E-06	99	100	96	97%
E-07	99	101	100	101%
E-08	99	106	114	115%

Test/System	Observations				
	E-09	99	106	107	108%
	E-10	99	100	101	102%
	E-11	99	102	111	112%
	Total supply	1074	1107	1106	103%
	Total exhaust	1131	1186	1205	107%

Air balance – FCU-9 & HRV-9

The flows measured were consistent with the design figures, as outlined in the results summary below.
The differential between exhaust and supply flows is in the same direction as the design flows (higher exhaust flow).

Outlet	Design (L/s)	Balanced Flow (L/s)	Witnessed (L/s)	Variance to Design (%)
S-01	209	-	215	103%
S-02	209	-	216	103%
S-03	209	-	215	103%
S-04	209	-	211	101%
E-01	289	-	293	101%
E-02	289	-	300	104%
E-03	289	-	297	103%
Total supply	836	-	857	103%
Total exhaust	867	-	890	103%

Note – Balancing results for this unit were not present in the package of information provided.
Note – Second reading of supply terminal results reported.

Air balance – FCU-10 & HRV-10

The differential between exhaust and supply flows has reversed from the design flows (supply flow higher than exhaust flow).

Outlet	Design (L/s)	Balanced Flow (L/s)	Witnessed (L/s)	Variance to Design (%)
S-01	181	-	193	107%
S-02	181	-	203	112%
S-03	181	-	181	100%
S-04	116	-	121	104%
S-05	77	-	86	112%
S-06	100	-	100	100%
E-01	433	-	439	101%
E-02	433	-	435	101%
Total supply	836	-	884	106%
Total exhaust	866	-	874	101%

<table>
<tr><th>Test/System</th><th>Observations</th></tr>
<tr><td></td><td>Note – Balancing results for this unit were not present in the package of information provided.</td></tr>
<tr><td>Air balance – FCU-14</td><td>Some variances from the balancing results and design figures were observed including one terminal measured at below design flow rate, as outlined in the results summary below.

<table>
<tr><th>Outlet</th><th>Design (L/s)</th><th>Balanced Flow (L/s)</th><th>Witnessed (L/s)</th><th>Variance to Design (%)</th></tr>
<tr><td>S-01</td><td>167</td><td>175</td><td>184</td><td>110%</td></tr>
<tr><td>S-02</td><td>167</td><td>171</td><td>170</td><td>102%</td></tr>
<tr><td>S-03</td><td>83</td><td>84</td><td>94</td><td>113%</td></tr>
<tr><td>S-04</td><td>83</td><td>84</td><td>79*</td><td>95%</td></tr>
<tr><td>R-01</td><td>280</td><td>288</td><td>NR</td><td>-</td></tr>
<tr><td>Supply total</td><td>500</td><td>514</td><td>527</td><td>105%</td></tr>
</table>

*Diffuser double-fed. Value shown is 50% of the measured flow.</td></tr>
<tr><td>Air balance – FCU-15</td><td>Some variances from the balancing results and design figures were observed including some terminals measured at below design flow rate, as outlined in the results summary below.

<table>
<tr><th>Outlet</th><th>Design (L/s)</th><th>Balanced Flow (L/s)</th><th>Witnessed (L/s)</th><th>Variance to Design (%)</th></tr>
<tr><td>S-01</td><td>167</td><td>173</td><td>158</td><td>95%</td></tr>
<tr><td>S-02</td><td>167</td><td>170</td><td>175</td><td>105%</td></tr>
<tr><td>S-03</td><td>83</td><td>84</td><td>82</td><td>99%</td></tr>
<tr><td>S-04</td><td>83</td><td>86</td><td>80*</td><td>96%</td></tr>
<tr><td>R-01</td><td>280</td><td>290</td><td>255</td><td>91%</td></tr>
<tr><td>Supply total</td><td>500</td><td>513</td><td>495</td><td>99%</td></tr>
</table>

*Diffuser double-fed. Value shown is 50% of the measured flow.
Note – Values as reported above are the results from the second reading. At the first readout, the smoke dampers to terminal S-04 were found to be closed and read 5 l/s. The dampers were opened and the system re-read.</td></tr>
<tr><td>Air balance Pitot Measurements -HRV 4</td><td>Pitot measurements were witnessed for HRV-4. The design flow was 1131l/s and the results from the commissioning results indicated an actual flow of 1168l/s. The witness test results were 1134l/s, 102% greater than the design flow.</td></tr>
</table>

Test/System	Observations
	Pitot reading in (m/s) 4.82 4.7 4.6 4.22 3.65 5.02 4.72 4.36 4.1 3.98 4.42 4.44 4.42 4.08 3.8 A total of 15 pitot traverse readings were recorded corresponding to an average velocity of 4.36m/s. The duct was noted to be a 650 x 400mm duct therefore the airflow through the duct was calculated to be 1134l/s.

3.6 Nurse call systems

Observations from nurse call system witness testing are summarised in Table 10. Key residual items where further review or action is recommended are:

i. During fire mode operation the nurse call systems were operational however the display required reprogramming to be able to display multiple messages. Suggestion may be to toggle through messages every 3 seconds to be able to display the fire message as well as the nurse call message.

Table 10 Commissioning observations – nurse call systems

Test/System	Observations
Commissioning records	No commissioning records were provided for the nurse call systems
Operation of oxygen and extraction during fire mode	During fire mode operation POD 1 Bed 5 was witnessed to have a oxygen supply and extraction.

3.7 Integrated systems tests

Observations from integrated system test witness testing are summarised in Table 11. Key residual items where further review or action is recommended are:

i. The underfloor space was not tested as part of the witness testing as the area has been closed off. Access should be provided for maintenance of the detectors.

ii. Nurse call message could not be seen during a fire alarm. Suggested programming the annunciation to rotate through the fire alarm and nurse call message.

iii. The door in the services rooms did not close during the double knock test within the ceiling. It is understood that the services room forms part of the compartmentation for the ceiling space. Therefore, it would be expected that the door would close.

Table 11 Commissioning observations – integrated systems test

Test/System	Observations
Commissioning document	The IST document was provided on the 14th May 2020.
General fire alarm	A general fire alarm was activated via triggering a smoke detector within the occupiable area. All equipment continued to be operational during this phase. Doors D.28, D.30 and D.07 remained locked during the general fire alarm, however all other doors were unlocked. We witnessed that, the four-minute delay was not tested as this had been tested in previous fire systems test and was established to be operational.
Second knock fire alarm	A second knock was activated via triggering a second alarm in a different zone of the occupiable space. • A sample set of airside mechanical equipment was witnessed to shut down in response to the fire mode. The motorised smoke dampers were also observed to shut down in response to the fire alarm. The fan coil unit in the comms room continued to operate. Smoke vents remained in the closed position. • Plant equipment continued to operate. It was noted that the chiller turned off because the building load was not sufficient to keep the chiller operational. • The electrical systems continued to operate as intended with the addition of emergency lighting operating. • The operation of the SSICT network connection was not witnessed. • All doors unlocked except for D.28, D.30 and D.07 which house the medicine enclosures and communications room. • Medical gases remained operational during the fire alarm. • Nurse call operations were operational however, the display unit could not toggle between multiple messages. • A sample set of hydraulic services were witnessed to remain operational during the fire alarm.
Double knock fire alarm above ceiling	A double knock fire alarm within the ceiling space was activated via triggering two smoke detectors. • A sample set of airside mechanical equipment was witnessed to shut down in response to the fire mode. The motorised smoke dampers were also observed to shut down in response to the fire alarm. The fan coil unit in the comms room continued to operate. A sample set of smoke vents were witnessed to open in response to the fire alarm. • The electrical systems continued to operate as intended with the addition of emergency lighting spit fires operating. • The operation of the SSICT network connection was not witnessed.

Test/System	Observations
	• All doors unlocked except for D.28, D.30 and D.07 which house the medicine enclosures and communications room. • Medical gases remained operational during the fire alarm. • Nurse call operations were operational however, the display unit could not toggle between multiple messages. • A sample set of hydraulic services were witnessed to remain operational during the fire alarm.
Clear fire alarm	The fire alarm was cleared and the following was observed • A sample of airside mechanical equipment was witnessed to be operational. However, it is worth noting that the plant equipment had to cycle through the heating calls and progressively turn on equipment. This delay is approximately 5mins between a heating or cooling call being actioned to provide cooling or heating to a space. • A sample of the smoke vents were witnessed to closed. • The electrical systems continued to operate as intended. • The operation of the SSICT network connection was not witnessed. • A sample set of secure doors were witnessed to return back to the locked state. Doors D.28, D.30 and D.07 were witnessed to remain in the locked state.
Black out	A black test was simulated, and the following was witnessed; • The generator started based on a signal from the automatic transfer switch, which had detected that the mains power was unavailable. • Mechanical plant equipment was witnessed to shut down, then after a delay, the mechanical plant was witnessed to return back online. The unit serving the communications rooms was witnessed to be non-operational then returned to being operational. • Electrical systems returned back to operation along with all lighting and power. • The SSICT network connection was not witnessed. • A sample set of secure doors witnessed remained secure • Hydraulics plant returned back into operational after a momentary shut down. • Medical gas and suction equipment was witnessed to be operational when witnessed from Pod 1 Bed 5. • Nurse call was witnessed to be operational based on the test on Pod 1 Bed 5.
GFA on Generator power	A general fire alarm was activated via triggering a smoke detector within the occupiable area. All equipment continued to be operational during this phase. All doors except D.28, D.30 and D.07 remained locked with internal failsafe to permit exiting from the rooms. We witnessed that, the four-minute delay was not tested as this had been tested in previous fire systems test and was established to be operational.
Second knock on Fire Alarm	A second knock was activated via triggering a second alarm in a different zone of the occupiable space. • A sample set of airside mechanical equipment was witnessed to shut down in response to the fire mode. The motorised smoke dampers were also observed to shut down in response to the fire alarm. The fan coil unit in the comms room continued to operate. Smoke vents remained in the closed position. • Plant equipment continued to operate as intended. It was noted that the chiller turned off because the building load was not sufficient to keep the chiller operational. • The electrical systems continued to operate as intended with the addition of emergency lighting spit fires operating.

Test/System	Observations
	• The operation of the SSICT network connection was not witnessed. • All doors unlocked except for D.28, D.30 and D.07 which house the medicine enclosures and communications room. • Medical gases remained operational during the fire alarm. • Nurse call operations were operational however, the display unit could not toggle between multiple messages. • A sample set of hydraulic services were witnessed to remain operational during the fire alarm.
Double knock fire alarm – ceiling space	A double knock fire alarm within the ceiling space was activated via triggering two smoke detectors. • A sample set of airside mechanical equipment was witnessed to shut down in response to the fire mode. The motorised smoke dampers were also observed to shut down in response to the fire alarm. The fan coil unit in the comms room continued to operate. A sample set of smoke vents were witnessed to open in response to the fire alarm. • The electrical systems continued to operate as intended with the addition of emergency lighting spit fires operating. • The operation of the SSICT network connection was not witnessed. • All doors unlocked except for D.28, D.30 and D.07 which house the medicine enclosures and communications room. • Medical gases remained operational during the fire alarm. • Nurse call operations were operational however, the display unit could not toggle between multiple messages. • A sample set of hydraulic services were witnessed to remain operational during the fire alarm.
Clear GFA on generator power	The fire alarm was cleared while on generator power and the following was observed: • A sample of airside mechanical equipment was witnessed to be operational. However, it is worth noting that the plant equipment had to cycle through the heating calls and progressively turn on equipment. This delay is approximately 5mins between a heating or cooling call being actioned to provide cooling or heating to a space. • A sample of the smoke vents were witnessed to closed. • The electrical systems continued to operate as intended. • The operation of the SSICT network connection was not witnessed. • A sample set of secure doors were witnessed to return back to the locked state. Doors D.28, D.30 and D.07 were witnessed to remain in the locked state.
Mains restoration	Mains restoration was witnessed by the momentary black out. The mains supply was witnessed to be back online. The generator continued to operate for period of three minutes as intended then went into cooldown mode for an additional three after establishing a stable mains connection. The generator enclosure was not witnessed during this time however, it was heard running.

4.0 Site inspection observations

AECOM representatives carried out a visual non-intrusive site inspection during the progress of the works on 28 April 2020. At the time of inspection, works on site were well advanced:

- the structure and enclosure had predominantly been completed
- the services installation was progressing with the majority of major in-ceiling plant and wiring having been installed
- the internal ceiling panels had been installed across approximately two-thirds of the facility and
- the external plant and equipment had not yet been installed.

Our observations from the site inspection are summarised in Table 12.

Table 12 Site inspection observations - 28 April 2020

Discipline / Area	Observation	Photograph
Electrical	Penetrations to below floor to be suitably protected and sealed.	
Electrical	Suggest floor void is sealed to prevent possible cable damage by vermin, etc. It is noted that mesh has been installed, however it is of a large gauge and will still permit access to the void by smaller animals and birds.	
Electrical	There was a lack of service and emergency lighting around the mechanical plant.	
Mechanical	Heat recovery units – nil vibration isolation installed at hangers. It is noted that the fans internal to the unit may be isolated at their connection to the unit casing.	

Discipline / Area	Observation	Photograph
Mechanical	Flexible ductwork supports not fitted with load spreaders to AS 4254.1, some flexible ducts resting on steel elements.	
Mechanical	Sensor sampling pipework installed in ceiling void for differential pressure – review need for insulation to prevent condensation occurring.	
General	Consider providing sheeting / covering to underfloor insulation to prevent insulation becoming displaced, water-logging and infestation.	
General	Consider vermin-proof enclosure to perimeter of under croft to eliminate risks associated with nesting (such as fouling). Noting access for egress also needs to be considered. It is noted that mesh has been installed, however it is of a large gauge and will still permit access to the void by smaller animals and birds.	
General	General installation progress – wall framing, ceilings, ceiling fittings.	
General	General installation progress – services, southern end of facility.	
General	Ensure ceiling support beams are correctly oriented and of adequate capacity	

During witness testing activities held week commencing 11 May 2020, AECOM was also able to observe the completed installation. While not a formal inspection, items of note are recorded on a 'by exception' basis in Table 13.

Table 13 Site inspection observations – commissioning / witness testing w/c 11 May 2020

Discipline / Area	Observation	Photograph
Electrical	Location of security rack obstructs AS/NZS 3000 clearances to distribution board DB-LIGHT.	
Fire	The locations of the main electrical switch board and mechanical switchboard indicated on the block plan do not match the installed positions of this equipment.	
Medical gas	The medical suction discharge is made at low level. Is this discharge location considered a risk to passers-by? Consider also provision of vermin mesh. [AS 2896 s2.10.2.3(f)]	
Medical gas	Ensure appropriate protection and clearance is provided to external oxygen store and vacuum pump system is provided to protect it from damage and vandalism. The arrangement of cages is such that an unauthorised person could tamper with the installation (eg. close suction valve) – is this considered a risk to facility operations? It is noted caged enclosures have been provided to the general area, consider more robust enclosures around sensitive components to prevent bird roosting and the like. Consider insulation to underside of tin roof	

Discipline / Area	Observation	Photograph
	over oxygen store to prevent condensation.	
Medical gas	Recommend review of O_2 store against the requirements of AS 2896 and AS 4332 including: • Protection of control panels and equipment from the weather. • Protection of cylinders from direct sunlight. • Signage requirements. • Protection from vehicle impact. [AS 2896 s.2.13, AS 4332 s4.2]	
Medical gas	An available vacuum gauge should be provided. [AS 2896 s.2.10.2.3(j)]	
Fire	The evacuation plan does not have the assembly area shown. Assembly area is to be shown in the evacuation plan.	[redacted]
Mechanical	UPS units noted as installed within communications and security racks. Have these UPS units been assessed against the ventilation requirements of AS 1668.2 and AS 2676 (series).	
Mechanical	Ensure smoke dampers are sealed to their connecting ductwork such that there is no flanking leakage path.	

Discipline / Area	Observation	Photograph
Mechanical	The insulation for the heating water pipework should be re-instated.	

5.0 Design information provided

The initial design information made available for review is listed in Table 14. This was received on April 24th 2020.

Updates were downloaded from Redhub until mid-May 2020. Drawings for Nurse Call, Security, Fire Engineering and Signage were included in these updates.

The "Project Brief" consisted of the SARI Treatment Centre Manual Draft V5.5. It is understood that a Return Brief was not developed to document departures from this initial document, how it was interpreted in the context of compliance with Australian Standards and ACT Authority requirements, dispensations that were utilised to achieve the compressed construction program and departures relating to the temporary nature of the facility.

Table 14 Design information provided

Discipline	Document Title	Revision / Date
Architectural	A-100-Ground Floor General Arrangement Plan	11
	A-101-Ground Floor Partition Plan	11
	A-011-External Ramps	6
	A-130-Ground Floor Prefab System Plan	4
	A-140-Ground Floor Furniture Plan	11
	A-500-Door Schedule	3
	A-600-Type1 WC	5
	A-601-Type 2 WC	3
	A-602-Type 3 WC	3
Mechanical	N0200347 M200 Ground Mechanical Plan	1
	N0200347 M01 Notes and Legend	1
	BX2011-MGR-01-100 Mechanical Overall	A
	BX2011-MGR-02-Mechanical-Zone-A1	D
	BX2011-MGR-03-Mechanical-Zone-A2	C
	BX2011-MGR-04-Mechanical-Zone-B1	C
	BX2011-MGR-05-Mechanical-Zone-B2	B
	BX2011-MGR-06-Mechanical-Zone-C1	B
	BX2011-ME-MWS-Mechanical Water Schematic	5
Electrical	E001_Notes and Legend	C
	E030_Schematics	B
	E200_Ground Power Plan	C
	E201_Ground Lighting Plan	B
Hydraulic	H001_Notes and Legend	A
	H200_Ground Sanitary Plan	A
	H201_Ground Pressure Plan	A
Fire	CH-A01 Site Plan	B
	2020.056-000-Legend Notes & Specifications	B
	2020.056-001-Ground Floor Layout Plan	B

Discipline	Document Title	Revision / Date
	2020.056-002-Concealed Space Layout Plan	B
Background	SARI Treatment Centre Manual Draft	V5.5

It is noted that at the time of the design review the following documentation was outstanding:

- Pressure regimes
- Fire mode operation (fire matrix)
- HVAC system controls / building management system
- Mechanical electrical installation.
- Medical gas installation

COVID-19 EMERGENCY DEPARTMENT

Consultancy Services for FM Peer Review – Statement of Requirements

---

1. Background

Major Projects Canberra (MPC) are currently in the construction phase for the temporary COVID-19 Emergency Department located at the existing Garran Oval bounded by Kitchener Street and Gilmore Crescent

The project objective is the delivery of a turnkey emergency response solution to meet the anticipated increase in demand for health care services and infrastructure to respond to the COVID-19 pandemic. The solution includes provision of clinical staff and a temporary Emergency Department facility that meets the health care needs of the ACT and surrounding region, as best as can be anticipated.

The project consists of two key components being an infrastructure solution and a workforce with the requisite capacity and capability to respond to the anticipated increase in Emergency Department presentations related to the COVID-19 pandemic.

The intention is for the Territory to enter into a single contract with Aspen Medical to cover both the infrastructure and workforce requirements.

One or a number of small value contracts with local industry contractors may be required to undertake the mobilising works.

2. Project Infrastructure

The Project requirement is the delivery of a dedicated COVID-19 Emergency Department that provides five resuscitation beds, and 45 treatment bays – all with associated equipment. In addition, 50 ventilators will be supplied to increase capacity for ventilated beds in the Territory.

The facility will also be equipped with diagnostic imaging equipment that may include a CT scanner and portable or fixed X-Ray and point of care ultrasound.

A separate enabling works package has been developed that includes electrical supply provision, temporary hardstand, lighting, signage, traffic management and other works to make the site ready for the temporary Emergency Department and for other infrastructure require to support the Project.

3. Scope of Engagement

It is anticipated that the FM Peer Review Consultant will be involved in four key phases of the project in relation to building engineering service:

a. Design review;
b. On site construction inspections;
c. Participation in witness testing and commissioning of building engineering services;
d. Review of completion documentation (operation & maintenance manuals as-built documentation etc).

4. Deliverables

Reports from the FM Peer Review Consultant will be required for the four key phases of the project as noted above:

a. Design review reports for compliance with relevant codes and standards as well as the Principal Provided Documentation listed in Section 6 below;
b. On site construction inspection reports for compliance with relevant codes and standards as well as the Principal Provided Documentation listed in Section 6 below;
c. Report on witness testing and commissioning of building engineering services ;
d. Report completion documentation (operation & maintenance manuals as-built documentation etc).

5. Project Timeline

The initial requirement is that the COVID-19 Emergency Department is to be operational by 15 May 2020. Refer Attachment B for the contract programme with a Facility go-live date of 18 May 2020.

6. Reference Documentation

- Attachment A - Site plan Option 1 Revision 2
- Attachment B - Programme 15/04/2020
- The Australasian Health Facility Guidelines (not attached to this Statement of Requirements)
- NSW Health Infrastructure Engineering Services Guideline (not attached to this Statement of Requirements)

It is noted that the documents listed above have been developed for the design and construction of permanent healthcare facilities. Consideration must be given to the fact that the design and construction of this particular COVID-19 Emergency Department is temporary. On that basis, the following supplementary documentation must be considered when performing the FM Consultancy Review Services:

- Attachment C - The World Health Organisation Reference Design and Reference Technical Specification
- Attachment D – Australasian College for Emergency Medicine – Clinical Guidelines for the Management of COVID-19 in Australasian Emergency Departments v1.0

From: Gray, Sophie
Sent: Monday, 4 October 2021 5:58 PM
To: Tarbuck, Chris (Health); Catanzariti, John
Cc: Brady, Vanessa (Health)
Subject: RE: Surge Centre: Request for Information

UNOFFICIAL

Chris

Thanks for your email, we are putting together the documentation that you have requested.
As a priority, can you send through the brief that was provided to BMM for their engagement to understand the scope, basis and methodology for their review.
I have put some time in our calendars for tomorrow afternoon to regroup on the approach to responding to the review that CHS have commissioned, programme and critical dates for utilisation of the Surge Centre potentially for its original intent.

regards
Sophie

Sophie Gray | Project Director
Canberra Theatre Project | City Projects Unit
Major Projects Canberra
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ACT Government
Major Projects Canberra

Executive Champion for Aboriginal and Torres Strait Islander Engagement and the Aboriginal and Torres Strait Islander Procurement Policy

From: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Sent: Thursday, 30 September 2021 8:35 AM
To: Catanzariti, John <John.Catanzariti@act.gov.au>; Gray, Sophie <Sophie.Gray@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>
Subject: RE: Surge Centre: Request for Information

UNOFFICIAL

Hi John,

We have plans to arrange the suggested meetings once the desk top analysis is completed.

Please forward all the requested material as a matter of importance.

Regards

Chris Tarbuck | A/g Executive Group Manager, Infrastructure and Health Support Services
Phone: 02 512 49711 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
Facilities Management| Canberra Health Services | ACT Government
Level 1, Building 1, Canberra Hospital, Garran ACT 2605 | health.act.gov.au

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***Our role** is to be a health service that is trusted by our community.*

***Our values** are Reliable, Progressive, Respectful, Kind*

From: Catanzariti, John <John.Catanzariti@act.gov.au>
Sent: Thursday, 30 September 2021 7:25 AM
To: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>; Gray, Sophie <Sophie.Gray@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>; Mooney, Colm (Health) <Colm.Mooney@act.gov.au>
Subject: RE: Surge Centre: Request for Information

UNOFFICIAL

Chris,

See attached response from Kevin.

Can I suggest that BMM make contact with Benmax and Kevin to discuss further and maybe also arrange a site inspection.

Regards,
John

From: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Sent: Wednesday, 29 September 2021 2:25 PM
To: Gray, Sophie <Sophie.Gray@act.gov.au>; Agius, Philip <Philip.Agius@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>; Mooney, Colm (Health) <Colm.Mooney@act.gov.au>; Catanzariti, John <John.Catanzariti@act.gov.au>
Subject: Surge Centre: Request for Information

UNOFFICIAL

Hi Sophie

CHS is undertaking a review of the Surge Centre to inform a decision about the Territory's ongoing health response to the COVID situation.

CHS has recently engaged BMM to undertake a peer review of the Surge Centre building services and performance metrics, which has raised some concerns that we are now required to investigate. BMM will issue a formal report on the initial review of the facility 8 October. Some of the early concerns raised are as follows:

- Exhaust duct within the building is not under negative pressure;
- Air to air heat exchangers are not necessarily 100% sealed and there is some risk of air leaking from the exhaust path directly back into the supply air path. Note that on the Amcor (the heat exchanger manufacturer) website, they list a number of applications where these units are suitable but health care is not one of them;
- The exhaust discharge velocity is too low;
- There is no HEPA filtration of the exhaust prior to discharge. Adjacency of exhaust to air intakes. AS1668 Type A effluent discharge concerns;
- Lack of negative pressure in the spaces throughout the building, and that there is limited pressure change between rooms; and
- Operating Manuals and As installed drawings are a poor reflection of the installation detail.

The information request below will inform this investigative process:

1. Design brief and technical specifications documents provided by MPC to Aspen Medical
2. Scope of requirements for the engagement of AECOM to conduct a peer review of the services design and act as the Territory's Independent Commissioning Agent
3. AECOM design peer review assessment advice/report
4. Witness Testing program and commissioning results
5. AECOM Peer Review Commissioning Report
6. Practical Completion handover documentation from Aspen Medical / Manteena
7. Operations & Maintenance Manuals (already received, however we would like confirm version control)

Aspen Medical transferred the facilities management responsibility to CHS in August 2021. As part of this transfer process, MPC/CHS have been provided with the maintenance records.

We will need to receive the requested information in a timely manner to address the concerns raised in the BMM report and systematically resolve any issues that confirm a divergence of the design with the facility construction.

Thanks Sophie, please call to discuss if required.

Regards

Chris Tarbuck | A/g Executive Group Manager, Infrastructure and Health Support Services
Phone: 02 512 49711 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
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COVID-19
Garran Surge Centre
Infrastructure Review

Mechanical Services and Associated Fire Engineering Components

THE CANBERRA HOSPITAL

Prepared By
Barmco Mana McMurray Pty Limited
5th October 2021

Revision Control

Revision	Details	Date Issued
1.0	For TCH review	05/10/21
2.0	Updates for TCH review	11/10/21
3.0	Further updates for TCH review	14/10/21

Author: _____
Steve Wheelhouse
Director

Checked by: _____
Hamish McMurray
Director

Table of Contents

1 Introduction

Barmco Mana McMurray Pty Ltd (BMM) has been engaged by Canberra Health Services (CHS) to review some of the building components for the Surge Centre Facility at the Garran oval.

The nature of this review is to assess the facility for issues that may prevent the building from being used as a COVID-19 infectious patient “ward area”.

Note that BMM has not carried out a full review of the building designs and has been provided some of the documentation in relation to the project. BMM has relied on some documents that are dated April and May 2020. BMM are unaware of updates to those documents and so have continued to rely to them.

The issues that BMM are currently aware of generally relate to mechanical services and fire engineering. They have been broken into those categories below. BMM can provide further review on other issues if required.

Note that BMM are not clinical hygienists, health planners, building certifiers nor fire engineers and the issues raised in this report may require input from parties with those skills to be fully resolved.

2 Executive Summary

BMM were engaged to do review the Garran Surge Centre infrastructure and provide advice relating to the infrastructure and whether the building has been designed and built in accordance with appropriate standards and best practice and the buildings preparedness for COVID-19 patients.

Based on the review undertaken, BMM have concerns relating negative pressures in the facility, use of outside air and the impacts on client comfort, treatment of exhaust and fire compliance in regard to usage as a ward area.

2.1 Mechanical Services

The following are the mechanical issues that BMM are aware of. See the BMM opinion for each item below.

a) Exhaust duct within the building is not under negative pressure;
The exhaust fans are not outside the building. They have a reasonably long run of duct in the ceiling space within the building between the fan and the discharge point. Due to the system configuration, all duct between the fan (in the heat exchanger) and the discharge point is under positive pressure. Any leakage from this duct will leak into the building. For some examples of this, refer to the pink shaded sections of duct on the markup drawing in Appendix A for Pods 1, 2, 3 and 4. Note not all of these ducts have been marked up. This is not best practice for a ward area intended to treat infectious patients. BMM do not believe that this is an operational issue but a design issue.

b) Air to air heat exchangers are not necessarily 100% sealed;
There is some risk of air leaking from the exhaust path directly back into the supply air path. Note that on the Amcor (the heat exchanger manufacturer) website, they list a number of applications where these units are suitable but health care is not one of them. The mechanical services O&M manual provided to BMM does not contain technical data for these units. BMM recommend that further review of the units and their testing procedures be undertaken to confirm their suitability for use in COVID-19 treatment areas.

c) The exhaust discharge velocity is too low;
BMM only carried out a small sample check of five discharges and the velocities were calculated from the cowl discharge open area and the actual air flow from the commissioning data developed in May 2020. It does not take into account any changes to the systems since then.

AS1668.2 - 2012 requires a number of things for Type A Effluent discharge. The velocity at discharge required by AS1668 for Type A effluent is 5 m/s. The sample check included HRV-02, HRV-03, HRV-04, HRV-05 and HRV-06 exhaust discharge velocities. The velocities are 4.6m/s, 4.7m/s, 3.26m/s, 3.2m/s and 4.0m/s, respectively. Please see Appendix A for details. All of these discharge velocities are non-compliant to the AS1668 requirements.

BMM was advised by the contractor's project commissioning technician that the air volumes of some FCU's and the associated HRVs were reduced after the initial commissioning to minimise the amount of untreated air that was being drawn into the facility last winter. These reductions did not include FCUs 5 and 6 which serve Pods 3 and 6. BMM understand that the issue of drawing in untreated air was raised by CHS in April last year but has not been effectively addressed. Further reducing the already low exhaust air flow rates is not an acceptable solution in an infectious ward area. Refer to item 2.1 e) below.

BMM measured HRV-6 exhaust discharge height on site and confirmed that the height complies with 3 metre height requirements in September 2021. The heights of other exhaust discharge points were not checked. Further investigations can be done if required.

In addition to that requirement, AS1668.2 – 2012 section 3.10.3 (d) and the associated Note 1, states that there is a requirement "…. *to reduce the concentration of contaminants when necessary"*. The most common way to treat infectious contaminants is with the use of HEPA filtration. We note that the project originally included HEPA filtration, but it was subsequently removed from the project. BMM understand that this was based on financial considerations only. If there were any engineering validations for this deletion, BMM would be happy to review those and provide comment.

The point of discharge from the exhaust cowls is still at a relatively low level despite the discharges generally being 3 meters above the roof line as the facility is only a single level. Given that the WHO acknowledge that COVID-19 is airborne, there is concern over the risks generated by unfiltered Type A effluent being discharged to atmosphere from a COVID-19 treatment area.

d) There is no HEPA filtration of the exhaust prior to discharge. Adjacency of exhaust to air intakes. AS1668 Type A effluent discharge concerns;
Refer to item (c) above. BMM understand that the centre was designed in accordance with The SARI Treatment Centre Manual. That manual sets out its purpose is to provide recommendations etc for "(*SARI) treatment centres in* ***low and middle-income countries and limited-resource settings, including the standards needed to repurpose an existing building into a SARI treatment centre,*** *and specifically for acute respiratory infections that have the potential for rapid spread and may cause epidemics or pandemics*". See the following extract where it goes on to say that "*It can be used to:*
…….

- ***support the application of national standards*** *and set specific targets in specific SARI treatment center settings*".

The basis of the document seems to be to apply some minimum standards in those low and middle-income countries that do not have the standards needed. It also aspires to support the application of national standards, presumably in countries that already have them. It does not suggest to re-write nor to lower those national standards. Australia has such standards with the NCC and AS1668.2 – 2012 and so these standards should still be followed when using the SARI Treatment Centre Manual.

e) Lack of negative pressure in the spaces throughout the building, and that there is limited pressure change between rooms;
The air pressure observed by BMM at one of the doors in Pod 6 was negligible. It was not a sophisticated test but the inward flowing air should be easily detected. Note that BMM only looked at a few doors. The review of Pod 6 showed that there is not a significant amount of exhaust when compared to the incoming outside air. BMM understands that this pod did not have air quantities reduced post handover. BMM would expect to see around 1,085 l/s of exhaust for this room to provide 15 Pa pressure drop at the door thresholds given the room configuration and the amount of outside air being delivered. The design contains only 673 l/s of exhaust air and so this appears to be a design related issue. Similar reviews have been carried out for Pods 1, 2, 3 and 4 with similar results.

BMM has been provided with the pressure readings at door thresholds from the contractor's original commissioning figures for the building prior to any air flow reductions. See the attached markup in Appendix A for details. Generally, the pressure drops at the door thresholds of the Pods range from -5 Pa to + 0.8 Pa. This is well below the -15 Pa that is

expected. BMM have calculated the expected exhaust air volumes for HRV-02, HRV-03, HRV-04, HRV-05 and HRV-06 to achieve 15 Pa negative pressure difference. Please refer to Appendix A for those expected exhaust air quantities. The expected exhaust air quantities are all well above those included in the design for the Surge Centre with shortfalls ranging between 27% and 55% for the five pods reviewed.

f) Operating Manuals and As Installed drawings do not reflect the installation detail;
The WAE drawings do not show the roof duct layout including the riser ducts to the discharge cowls.

BMM believe that due to the non-compliant exhaust discharges for type A effluent as required by AS1668 and low pressure differentials between spaces that the facility is generally not suitable for treatment of COVID-19 infected patients as it is. BMM has only reviewed the 5 exhaust systems within the facility and so this general statement is made on that basis and assumes the same design philosophy has been used throughout the facility.

2.2 Fire Engineering

There are a number of questions in relation to fire engineering components of the facility.

a) The first concern is that the fire engineering report (FER) makes an assumption that the areas within the facility are “treatment areas” not “ward areas”.

   The fact that the facility has not been delivered as a “ward area”, provides limitations to the functionality. This seems like a fundamental problem for the effective use of this facility as a COVID-19 surge centre and it seems that the expectation of how the facility can be used has not been met by the end product. This also seems to contradict the WHO SARI Treatment Center Manual that clearly sets out the need for short stay, moderate and severe critical wards.

   The design implications of this assumption are:

   - The building is a single fire zone rather than 2 x fire zones which is required by the National Construction Code for a building of this size if used as a “ward area”.
   - The smoke zones also need to be smaller if being used as a “ward area”.
   - The timber floor structure is inappropriate for a building that has 2 fire zones.

b) No intercommunications has been provided in the building and so it is more difficult for staff know where the fire is and therefore the most relevant evacuation route.

c) There are 3 different types of extinguishers included in the design which staff need to understand when and how to use and select the appropriate one as staff are to provide the first attack on a fire.

d) The smoke walls only go to ceiling height and not to the underside of the roof. This may allow faster spread of smoke through the facility.

In addition to the above items, the high use of ventilators that could be expected in a “ward area” for COVID-19 patients the environment could be oxygen enriched increasing the fire risks and so places extra emphasis fire related systems.

The fire evacuation process in a hospital sometimes relies on the horizontal movement of patients to an adjacent fire zone to provide a place of safety while the fire is being addressed. This strategy would have the evacuated patients still within the building envelope rather than outside in the elements. This facility has only one fire compartment and so the evacuation process would need to be to take the patients outside. There are obvious difficulties with that particularly as there is no covered area outside and that some patients could be intubated.

While the FER for the project sets out that a “treatment area” is “an area within a patient care area such as an operating theatre and rooms used for recovery, minor procedures, resuscitation, intensive care and coronary care from which patient may not be readily moved” there are limitations to this. A “treatment area” is not a “ward area” as they have different functional usages and different fire engineering requirements for compliance.

A recent “treatment area” acceptance by the ACT Fire Brigade in a Canberra hospital included the following clarification of the area usage.

For a treatment area, its usage generally follows the following rules:

- Principally triage;
- Small area of administration;
- Public waiting areas;
- No long-term bed occupation;
- No intensive care in the long term, and
- The majority of the patients will not be incapacitated.

BMM believe that in relation to the definition of “treatment areas” set out in the NER for the project and as defined in the NCC that the Garran Surge Centre could be used for these types and similar functions. It cannot be used as a ward area.

3 Appendix A BMM Markups and Calculations

From: Walsh, James (Health)
Sent: Thursday, 14 October 2021 11:25 AM
To: Tarbuck, Chris (Health)
Subject: FW: Surge Centre Garran Review

OFFICIAL: Sensitive

Hi Chris,

I have spoken to BMM, the updated Garran report expected to be available by COB today.

In relation to the below I have confirmed with BMM some of the details below in relation to acronyms and scope.

HRV – Heat Exchange Unit (currently in place)
EDH – Electric Duct Heater
FCU – Fan Coil Unit

BMM have provided the below proposed scope option in relation to the organisations question about can we just install additional exhaust in the POD to create negative pressure.

The proposed scope below would see elements of the current system decommissioned and new assets installed to provide appropriate HEPA filtration, and allow for a combination of recycled air and outside air to be used to provide appropriate climate comfort in the space and provide better control of the negative pressure. The proposed works would see the space meet compliance requirements in terms of exhaust, air pressure and air exchange rates.

By simply installing additional exhaust we would not be addressing other issues associated with bringing in 100% outside air (e.g. temperature control when the outside elements are extreme) and the current compliance issues in terms of exhausting contaminated air. The current arrangement, with provision of further exhaust, would also make management of negative pressure challenging.

I will provide the updated report from BMM when I have had a chance to review and ensure its suitability for wider distribution.

Regards,
James

From: Steve Wheelhouse [redacted]
Sent: Wednesday, 13 October 2021 9:30 AM
To: Walsh, James (Health) <James.Walsh@act.gov.au>
Cc: Hamish McMurray [redacted]; Dhimendra Singh [redacted]
Subject: RE: Surge Centre Garran Review

James,

We have been through the modifications that could be made to Pod 6 to make it suitable for use as a short stay Covid-19 treatment area. There is a bit of design review that still needs to be done but it looks possible at the moment.

See the following list of changes that BMM would consider to do this:

- Disable the existing heat exhanger HRV-06, O/A fan and exhaust fan;
- Provide new O/A cowl, duct and EDH for FCU;
- Provide new exhaust grille, duct, exhaust fan and HEPA filter;
- New motorised dampers x 4 to isolate the old system and bring on line the new components (for discussion);
- New ductwork to reconfigure FCU-06 for R/A rather than full O/A. (This will still provide compliant O/A air changes at 2 ACH);
- Rebalance air systems to achieve -15 Pa delta P;
- Review and rebalance HHW and CHW valves;
- BMS works to suit;
- New electrical feed for the new exhaust fan;
- Design works.

This concept is still new and we will need to spend a bit more time with it to knock of the rough edges. This would include a review of the adjacent palleative care room which we assume would be the access point for patients to the Pod 6 Covid-19 treatment area.

The approximate budget for the works is between $60 and $75 K. Hopefully we can reduce that with some more detailed design work. I am unsure about time frame at the moment but around 2 to 3 weeks depending on equipment availability etc.

Let me know if you would like us to continue with the design work. We can confirm delivery timeframe once the design is more mature.

On other matters, it would be good to go over the report to confirm what you need. When suits you for that?

Regards

Steve Wheelhouse
Director

BARMCO MANA MCMURRAY

"Pursuing Engineering Excellence"

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From: Walsh, James (Health) <James.Walsh@act.gov.au>
Sent: Tuesday, October 12, 2021 6:06 PM
To: Steve Wheelhouse [redacted]
Cc: Hamish McMurray [redacted]
Subject: RE: Surge Centre Garran Review

OFFICIAL: Sensitive

Sorry Steve, marked up report attached this time.

Regards,
James

From: Walsh, James (Health)
Sent: Tuesday, 12 October 2021 5:32 PM
To: Steve Wheelhouse [redacted]
Cc: Hamish McMurray [redacted]
Subject: RE: Surge Centre Garran Review
Importance: High

OFFICIAL: Sensitive

Hi Steve,

I reviewed the report in further detail with Chris, and he has asked for the report to be modified/tidied up to be more formal. The information itself is very good, just needs to be restructured please. I have provided some comments in the attached.

Report needs to have a Exec Summary, Introduction/Purpose, Detailed Sections for each disciplined reviewed (E.g. Mech and Fire), and a Summary sections reinforcing the major concerns.

The report needs to be structed in a way that just presents concerns identified by BMM and what you have done to validate them or understand them further.

We do not want to reference comments provided back from Kevin Beswick, just include the facts based on your observations and reviews.

As per our discussion earlier today as a priority can you also provide some commentary to me in a return email regarding what issues could remain if we simply just installed an additional, or larger exhaust fan into an area (say POD 6) to create increased negative pressure, e.g. supply air concerns, the fact it is all 100% outside and temperature can't be controlled appropriately, plant/duct sizes, HEPA filtration, etc.

Chris just needs something urgently to talk to in response to why we just can't install a exhaust fan into the space to create more negative pressure.

Updating of the report can be done over the next few days. I'm happy to work with you on this to get it right, as it will be provided to senior members of CHS/Government, and will no doubt create some controversary.

Regards,
James

From: Steve Wheelhouse [redacted]
Sent: Monday, 11 October 2021 6:14 PM
To: Walsh, James (Health) <James.Walsh@act.gov.au>
Cc: Hamish McMurray [redacted]>
Subject: RE: Surge Centre Garran Review
Importance: High

James,

I am sorry for the delay. Tony did some work on it Friday and I did on Saturday but I needed today to close it out. See the updated report attached.

It would be good to discus it when you can.

Regards

Steve Wheelhouse
Director

BARMCO MANA MCMURRAY

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Website www.bmm.engineering
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From: Steve Wheelhouse
Sent: Tuesday, October 5, 2021 5:57 PM
To: Walsh, James (Health) <James.Walsh@act.gov.au>
Cc: Hamish McMurray [redacted]
Subject: Surge Centre Garran Review

James,

See the review attached. It would be good to talk it through when you have a chance.

Regards

Steve Wheelhouse
Director

BARMCO MANA MCMURRAY

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Website www.bmm.engineering
LinkedIn www.linkedin.com/company/barmco-mana-mcmurray

From: Brady, Vanessa (Health)
Sent: Thursday, 14 October 2021 2:49 PM
To: Bale, Natalie (Health)
Cc: IHSS; Tarbuck, Chris (Health)
Subject: FW: Review: Fire Report COVID-19 ED [SEC=UNCLASSIFIED]

Importance: High

Hi Nat

Please note the email below on file for the Surge centre and CHS assessment of the design for fire and mechanical services.

Regards

Vanessa Brady
Project Director I Canberra Hospital Campus Modernisation

From: Gray, Sophie <Sophie.Gray@act.gov.au>
Sent: Tuesday, 5 May 2020 10:07 AM
To: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>
Subject: RE: Review: Fire Report COVID-19 ED [SEC=UNCLASSIFIED]
Importance: High

UNCLASSIFIED

Hi Vanessa

While it is appreciated that CHS Infrastructure and Health Support Services staff have taken the time to provide a detailed review of the fire engineering solution, I am concerned that this activity is diverting CHS resources onto activities that the Territory has engaged Aspen Medical technical consultants, the Independent Building Certifier and AECOM the Independent FM Peer Review consultant to deliver. A fire engineering strategy has been developed by a Fire Engineering consultant, reviewed by the independent Building Certifier and FM Peer Review agent, and reviewed and accepted by the ACT Fire Brigade with additional review and input from Access Canberra.

Can I ask that Chris and Michael be requested to stand down today from the detailed review that they are undertaking. Their efforts are appreciated but not required at present and they are diverting project delivery efforts into collating and preparing responses at a time when the focus of the small team needs to be on building commissioning activities. My concern is that the dilution of review responsibilities across many stakeholders will compromise the technical work and effort to date and it will become a risk to the project objectives.

I can provide this instruction directly, but I think it is more appropriate from yourself or Colm. Let me know how you would like to manage this.

Regards
Sophie

Sophie Gray | Project Director
COVID19 Surge Centre
Major Projects Canberra
Mobile [redacted] | sophie.gray@act.gov.au
Callam Offices, Level 3, 50 Easty Street, Phillip ACT
GPO Box 158, Canberra ACT 2601

ACT Government
Major Projects Canberra

From: Warylo, Michael (Health) <Michael.Warylo@act.gov.au>
Sent: Tuesday, 5 May 2020 9:27 AM
To: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>; Beswick, Kevin <Kevin.Beswick@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>; Gray, Sophie <Sophie.Gray@act.gov.au>; Mooney, Chris (Health) <Chris.Mooney@act.gov.au>
Subject: RE: Review: Fire Report COVID-19 ED [SEC=UNCLASSIFIED]

UNCLASSIFIED

Good Morning Chris

I support your comments. The determination of treatment vs ward area will have a significant direct impact on how building emergencies are managed. The absence of fire compartments under a treatment area means that in the event of a uncontrolled fire, building occupants have no option but undertake a full evacuation. Internal fire compartments, supported by fire sprinkler protection and active smoke control allow the Emergency Control Organization the option to shelter in place and or horizontally evacuate to adjoining fire compartments and have up to 120 minutes of separation from a fire, allowing further time to evacuate non ambulant clients.

I acknowledge the NCC definition of a Treatment and Ward area, however in reality evacuating a patients defined as treatment is no easier than those defined as Ward.

On a side note, I have asked Kevin for Fire Panel and EWS/OWS panel types. I want to know how the EWS/OWS is configured to respond in a Fire Alarm and does it allow staff the ability to manually control Alert/evacuation tones. Evacuating such a facility in the middle of winter, will have negative patient outcomes.

Thanks.

Michael Warylo | Assistant Director, Fire Safety & Transport

Operational Support Services | Infrastructure and Health Support Services | Canberra Health Services | ACT Government

T: 02 512 49797| **M:** [redacted] | **E:** Michael.Warylo@act.gov.au

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ACT Government | Canberra Health Services

From: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Sent: Monday, 4 May 2020 10:15 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>; Warylo, Michael (Health) <Michael.Warylo@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>; Gray, Sophie <Sophie.Gray@act.gov.au>
Subject: Review: Fire Report COVID-19 ED [SEC=UNCLASSIFIED]

Hi Kevin,

On review of the responses provided by Aspen, and my review of the attached Fire Engineer report, I require further clarification on the following items extracted from the Aspen response:

Item 1: Please confirm if there is an intention to provide separated fire zones for the building. The area looks around 1,700 square meters. The building is a single fire zone with 4 smoke compartments. A fire engineering solution has been employed (and accepted by the Fire Brigade).

- The FER has assumed that the facility is a "Treatment Area" rather than "Ward Area". This determination has promoted the design allowance of the fire zone and smoke zone sizes being more substantial than they would be for a "Ward Area".
- Fire compartments have been increased from 1,000 sqm to 2,000 sqm. The smoke zone requirement set out in the FER has had a similar increase from 500 sqm to 1,000 sqm. Note that the largest smoke compartment is 691 sqm which complies with the 1,000 sqm requirement for a "Treatment Area", but not for a designated Ward area which is a maximum of 500 sqm. See the attached extracts of the NCC pages C2.5 72 part and 73 part.
- Interestingly, the FER refers to the areas as *Ward Areas* within the Table: section 3.4, Fuel Sources, and again in the Table in section 5.1, page 19.
- See attached NCC definition of Ward and Treatment areas. In consideration of the planned overnight accommodation of the majority of the patient cohort, an interpretation of a "Ward Area" would not be unreasonable, and this is my interpretation. If patients are sleeping overnight in this facility, how does one interpret this definition otherwise?
- This facility may have, at times, scenarios that may lead to enriched oxygen levels, significantly increasing the spread of fire in the event of such. I am yet to review the exchange rate of airflow, however, risk will be designed into this facility regardless of exhaust and fresh air exchange rates.
- By design and function, this facilities layout congests the ease and flow of staff and patients. Evacuation of non-ambulant patients and very unwell patients connected to equipment will undoubtedly be cumbersome and slow.
- Fuel loads exist in high numbers of linen and clothing.
- No hose reels will are to be supplied within this facility, with reliance solely on fire extinguishers.

Item 3: Please confirm if there is an intention to provide fire sprinkler protection for the building, I presume not? The Fire Engineering Solution excludes the installation of fire sprinklers.

- As I interpret the report, the only specific reference to the sprinkler system in the FER is item 19 in section 5.5 on page 21, which states: "The automatic fire sprinkler system and smoke detection and alarm system shall be interfaced with the fire brigade panel (FBP). They shall be linked to third party monitoring via Alarm Signalling Equipment".
- Please provide further clarification on the requirement for a sprinkler system. As I interpret the report, the facility requires a sprinkler system.

Item 2: Please confirm if there is an intention to provide active smoke control for the building? Refer to fire engineers advice. None allowed for in the current mechanical design.

- In the absence of fire sprinklers and sandwich pressurisation (active smoke control), and hose reels, can you please confirm the efficient and effective control strategy.

Please provide clarification as to who determined the designated classification "Treatment Area" and additionally who from CHS endorsed the facility as a "Treatment area"?

In consideration of the risks of potentially enriched oxygen levels, high levels of human occupation, non-ambulant patients, the absence of fire hose reels, and the high volume of inpatient cohort; the lack of fire compartmentalisation, active smoke control, and fire sprinklers should be discussed further with CHS as a matter of importance.

Michael: I would appreciate your review and response to my comments.

Regards,

Chris Tarbuck | Facilities Director, Infrastructure and Health Support Services
Phone: (02) 5124 3186 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
Facilities Management| Canberra Health Services | ACT Government
Level 1, Building 1, Canberra Hospital, Garran ACT 2605 | health.act.gov.au
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From: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Sent: Wednesday, 22 April 2020 8:49 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Cc: Donaldson, Ben <Ben.Donaldson@act.gov.au>; Gray, Sophie <Sophie.Gray@act.gov.au>; Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>
Subject: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

Hi Kevin,

I have had a quick look at this design this evening, and the review raises the following questions concerning the mechanical and associated services. As discussed within the last meeting it's a complex, challenging installation:

1. Please confirm if there is an intention to provide separated fire zones for the building. The area looks around 1,700 square meters.
2. Please confirm if there is an intention to provide active smoke control for the building?
3. Please confirm if there is an intention to provide fire sprinkler protection for the building, I presume not?
4. Please confirm if it is intended to shut the plant down in fire mode?
5. Please confirm if there has a pressure regime developed showing the direction of air flow at each door?
6. Please confirm if the red ward spaces will be negatively pressurised?
7. Please confirm if the staff spaces will be positively pressurised?
8. Please confirm how the pressure regime will be air balanced to achieve the desired outcome?
9. The safety in design comment indicates that there are no unique risks with the design. This seems counter-intuitive given that the design is for an unprecedented pandemic response and the ventilation system designs can assist in mitigating or otherwise the COVID-19 risks to staff.
10. Without airlocks between the wards and outside please confirm if it is anticipated that the negative pressure regime will draw untreated cold air into the ward spaces in winter and hot air in summer and generate problems with conditions.
11. No ventilation is shown to the following rooms, please confirm if that complies with the relevant standards?
    - Medical gas store, is an exhaust register appropriate for this room?
    - Dry store and food services
    - Data services
    - Electrical. Is there a UPS?
    - Stores (confirm if these are sterile stores which require special treatment) HEPA?
12. The design shows a mixing of toilet exhaust and general exhaust from the ward areas. Please confirm that this complies with the relevant standards?I would consider separating.
13. FCU 13 is not shown with outside air. Please confirm how this will be resolved?
14. The term FCU indicates heating hot water and/or chilled water coils will be provided. Please confirm if these units will be served by boiler and chiller. 4 pipe system?

15. If direct expansion units are proposed and given that the ward areas are 100% outside air and no duct heaters are shown in the outside air ducts, please confirm how the de-ice modes will be offset in winter.
16. The exhaust air quantities from the ward areas are not shown and so the pressure regime cannot be reviewed. As discussed these will be forward when available.
17. The supply air, outside air ductwork and mixing boxes to the FCUs are shown as internally lined. Please confirm if this will this be faced with perforated linings? We normally do not allow this.
18. Supply air registers are nominated to have internally insulated cushion head boxes with rockwool and perforated sisolation. This seems inappropriate for clinical spaces, even for a temp arrangement. Please confirm compliance to the relevant standards. We normally do not allow this.
19. No pipework for heating hot water, chilled water, condensate nor refrigerant is shown and so cannot be reviewed.
20. The Controls note 2 indicates “remote” set point adjustment. Please confirm the extent of building management system that is anticipated. Who will manage, and how?
21. Please confirm if there will be pressure monitoring and alarms to advise staff if there is equipment failure and the pressure regime has been compromised? I recommend this.
22. Mechanical Plumbing note 5 indicates that condensate should be pumped to the closest tundish. A gravity drain system would be preferable if possible. Pump failure scenario would be an undesirable outcome? Please confirm.
23. Air Conditioning note 2 indicates that fresh air fans should continue to circulate when cooling is not required. Please confirm the control strategy for heating and cooling.
24. Filtration note 3 indicates HEPA filtration at 99.97% efficiency at 3 micron. Please confirm that this suitable for COVID-19. Does not seem right?
25. Please confirm that the roof structure is capable of supporting the FCUs and associated ductworks systems. Has an engineer approved the locations?
26. Please confirm the air change rates for the ward areas?
27. Please confirm the class of construction of the building?

Once I receive the design calculation data I can review further.

Thanks, I hope this is helpful, sorry there is a lot in the comments, however the air quality for this building is critical for a successful project outcome.

Regards,

Chris Tarbuck | Facilities Director, Infrastructure and Health Support Services
Phone: (02) 5124 3186 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
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From: Brady, Vanessa (Health)
Sent: Thursday, 14 October 2021 2:58 PM
To: Bale, Natalie (Health)
Cc: IHSS; Tarbuck, Chris (Health)
Subject: FW: Review: Fire Report COVID-19 ED [SEC=UNCLASSIFIED]
Attachments: NCC 2019 BCA Volume One Amendment 1 C2.5 page 72 part.pdf; NCC 2019 BCA Volume One Amendment 1 C2.5 page 73 part.pdf; NCC 2019 BCA Volume One Amendment 1 Ward Area & Treatment Area definitions page 668.pdf; FER2020.056 A.pdf

Hi Nat

Another email on file in relation to Chris's feedback on the Surge Centre mechanical design.

Regards

Vanessa Brady
Project Director I Canberra Hospital Campus Modernisation

From: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Sent: Monday, 4 May 2020 10:15 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>; Warylo, Michael (Health) <Michael.Warylo@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>; Gray, Sophie <Sophie.Gray@act.gov.au>
Subject: Review: Fire Report COVID-19 ED [SEC=UNCLASSIFIED]

Hi Kevin,

On review of the responses provided by Aspen, and my review of the attached Fire Engineer report, I require further clarification on the following items extracted from the Aspen response:

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- The FER has assumed that the facility is a "Treatment Area" rather than "Ward Area". This determination has promoted the design allowance of the fire zone and smoke zone sizes being more substantial than they would be for a "Ward Area".
- Fire compartments have been increased from 1,000 sqm to 2,000 sqm. The smoke zone requirement set out in the FER has had a similar increase from 500 sqm to 1,000 sqm. Note that the largest smoke compartment is 691 sqm which complies with the 1,000 sqm requirement for a "Treatment Area", but not for a designated Ward area which is a maximum of 500 sqm. See the attached extracts of the NCC pages C2.5 72 part and 73 part.
- Interestingly, the FER refers to the areas as *Ward Areas* within the Table: section 3.4, Fuel Sources, and again in the Table in section 5.1, page 19.
- See attached NCC definition of Ward and Treatment areas. In consideration of the planned overnight accommodation of the majority of the patient cohort, an interpretation of a "Ward Area" would not be unreasonable, and this is my interpretation. If patients are sleeping overnight in this facility, how does one interpret this definition otherwise?
- This facility may have, at times, scenarios that may lead to enriched oxygen levels, significantly increasing the spread of fire in the event of such. I am yet to review the exchange rate of airflow, however, risk will be designed into this facility regardless of exhaust and fresh air exchange rates.

- By design and function, this facilities layout congests the ease and flow of staff and patients. Evacuation of non-ambulant patients and very unwell patients connected to equipment will undoubtedly be cumbersome and slow.
- Fuel loads exist in high numbers of linen and clothing.
- No hose reels will are to be supplied within this facility, with reliance solely on fire extinguishers.

Item 3: Please confirm if there is an intention to provide fire sprinkler protection for the building, I presume not? The Fire Engineering Solution excludes the installation of fire sprinklers.

- As I interpret the report, the only specific reference to the sprinkler system in the FER is item 19 in section 5.5 on page 21, which states: "The automatic fire sprinkler system and smoke detection and alarm system shall be interfaced with the fire brigade panel (FBP). They shall be linked to third party monitoring via Alarm Signalling Equipment".
- Please provide further clarification on the requirement for a sprinkler system. As I interpret the report, the facility requires a sprinkler system.

Item 2: Please confirm if there is an intention to provide active smoke control for the building? Refer to fire engineers advice. None allowed for in the current mechanical design.

- In the absence of fire sprinklers and sandwich pressurisation (active smoke control), and hose reels, can you please confirm the efficient and effective control strategy.

Please provide clarification as to who determined the designated classification "Treatment Area" and additionally who from CHS endorsed the facility as a "Treatment area"?

In consideration of the risks of potentially enriched oxygen levels, high levels of human occupation, non-ambulant patients, the absence of fire hose reels, and the high volume of inpatient cohort; the lack of fire compartmentalisation, active smoke control, and fire sprinklers should be discussed further with CHS as a matter of importance.

Michael: I would appreciate your review and response to my comments.

Regards,

Chris Tarbuck | Facilities Director, Infrastructure and Health Support Services
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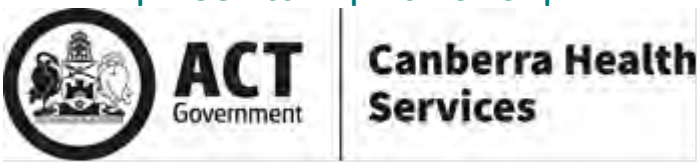

From: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Sent: Wednesday, 22 April 2020 8:49 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Cc: Donaldson, Ben <Ben.Donaldson@act.gov.au>; Gray, Sophie <Sophie.Gray@act.gov.au>; Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>
Subject: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

Hi Kevin,

I have had a quick look at this design this evening, and the review raises the following questions concerning the mechanical and associated services. As discussed within the last meeting it's a complex, challenging installation:

1. Please confirm if there is an intention to provide separated fire zones for the building. The area looks around 1,700 square meters.
2. Please confirm if there is an intention to provide active smoke control for the building?
3. Please confirm if there is an intention to provide fire sprinkler protection for the building, I presume not?
4. Please confirm if it is intended to shut the plant down in fire mode?
5. Please confirm if there has a pressure regime developed showing the direction of air flow at each door?
6. Please confirm if the red ward spaces will be negatively pressurised?
7. Please confirm if the staff spaces will be positively pressurised?
8. Please confirm how the pressure regime will be air balanced to achieve the desired outcome?
9. The safety in design comment indicates that there are no unique risks with the design. This seems counter-intuitive given that the design is for an unprecedented pandemic response and the ventilation system designs can assist in mitigating or otherwise the COVID-19 risks to staff.
10. Without airlocks between the wards and outside please confirm if it is anticipated that the negative pressure regime will draw untreated cold air into the ward spaces in winter and hot air in summer and generate problems with conditions.
11. No ventilation is shown to the following rooms, please confirm if that complies with the relevant standards?
    - Medical gas store, is an exhaust register appropriate for this room?
    - Dry store and food services
    - Data services
    - Electrical. Is there a UPS?
    - Stores (confirm if these are sterile stores which require special treatment) HEPA?
12. The design shows a mixing of toilet exhaust and general exhaust from the ward areas. Please confirm that this complies with the relevant standards?I would consider separating.
13. FCU 13 is not shown with outside air. Please confirm how this will be resolved?
14. The term FCU indicates heating hot water and/or chilled water coils will be provided. Please confirm if these units will be served by boiler and chiller. 4 pipe system?
15. If direct expansion units are proposed and given that the ward areas are 100% outside air and no duct heaters are shown in the outside air ducts, please confirm how the de-ice modes will be offset in winter.
16. The exhaust air quantities from the ward areas are not shown and so the pressure regime cannot be reviewed. As discussed these will be forward when available.
17. The supply air, outside air ductwork and mixing boxes to the FCUs are shown as internally lined. Please confirm if this will this be faced with perforated linings? We normally do not allow this.
18. Supply air registers are nominated to have internally insulated cushion head boxes with rockwool and perforated sisolation. This seems inappropriate for clinical spaces, even for a temp arrangement. Please confirm compliance to the relevant standards. We normally do not allow this.
19. No pipework for heating hot water, chilled water, condensate nor refrigerant is shown and so cannot be reviewed.
20. The Controls note 2 indicates "remote" set point adjustment. Please confirm the extent of building management system that is anticipated. Who will manage, and how?
21. Please confirm if there will be pressure monitoring and alarms to advise staff if there is equipment failure and the pressure regime has been compromised? I recommend this.
22. Mechanical Plumbing note 5 indicates that condensate should be pumped to the closest tundish. A gravity drain system would be preferable if possible. Pump failure scenario would be an undesirable outcome? Please confirm.
23. Air Conditioning note 2 indicates that fresh air fans should continue to circulate when cooling is not required. Please confirm the control strategy for heating and cooling.
24. Filtration note 3 indicates HEPA filtration at 99.97% efficiency at 3 micron. Please confirm that this suitable for COVID-19. Does not seem right?
25. Please confirm that the roof structure is capable of supporting the FCUs and associated ductworks systems. Has an engineer approved the locations?
26. Please confirm the air change rates for the ward areas?

27. Please confirm the class of construction of the building?

Once I receive the design calculation data I can review further.

Thanks, I hope this is helpful, sorry there is a lot in the comments, however the air quality for this building is critical for a successful project outcome.

Regards,

Chris Tarbuck | Facilities Director, Infrastructure and Health Support Services
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C2.5 Class 9a and 9c buildings

(a) A Class 9a *health-care building* must comply with the following:

(i) *Patient care areas* must be divided into *fire compartments* not exceeding 2000 m^2.

(ii) A *fire compartment* must be separated from the remainder of the building by *fire walls* and—

(A) in Type A construction—floors and roof or ceiling as *required* in Specification C1.1; and

(B) in Type B construction—floors with an FRL of not less than 120/120/120 and with the openings in *external walls* bounding *patient care areas* being vertically separated in accordance with the requirements of C2.6 as if the building were of Type A construction.

(iii) *Ward areas*—

(A) where the *floor area* exceeds 1000 m^2, must be divided into *floor areas* not more than 1000 m^2 by walls with an FRL of not less than 60/60/60; and

(B) where the *floor area* exceeds 500 m^2, must be divided into *floor areas* not more than 500 m^2 by smoke-proof walls complying with Specification C2.5; and

(C) where the *floor area* is not more than 500 m^2, must be separated from the remainder of the *patient care area* by smoke-proof walls complying with Specification C2.5; and

(D) where division of *ward areas* by *fire-resisting* walls under (i) or (iii)(A) is not *required*, any smoke-proof wall

Deemed-to-Satisfy Provisions

required under (iii)(B) or (C) must have an FRL of not less than 60/60/60.

(iv) *Treatment areas*—

(A) where the *floor area* exceeds 1000 m^2, must be divided into *floor areas* not more than 1000 m^2 by smoke-proof walls complying with Specification C2.5; and

(B) where the *floor area* is not more than 1000 m^2, must be separated from the remainder of the *patient care area* by smoke-proof walls complying with Specification C2.5.

(v) Ancillary use areas located within a *patient care area* and containing equipment or materials that are a high potential *fire hazard*, must be separated from the remainder of the *patient care area* by walls with an FRL of not less than 60/60/60.

(vi) The ancillary use areas referred to in (v) include, but are not limited to, the following:

(A) A kitchen and related food preparation areas having a combined *floor area* of more than 30 m^2.

(B) A room containing a hyperbaric facility (pressure chamber).

(C) A room used predominantly for the storage of medical records having a *floor area* of more than 10 m^2.

(D) A laundry, where items of equipment are of the type that are potential fire sources (e.g. gas fire dryers).

(vii) A wall *required* by (v) to separate ancillary use areas from the remainder of the building must extend to the underside of—

(A) the floor above; or

(B) a *non-combustible* roof covering; or

(C) a ceiling having a *resistance to the incipient spread of fire* to the space above itself of not less than 60 minutes.

(viii) Openings in walls *required* by (iii) and (v) to have an FRL must be protected as follows:

(A) Doorways—*self-closing* or *automatic* closing –/60/30 fire doors.

(B) Windows—*automatic* or permanently fixed closed –/60/– fire windows or –/60/– *automatic* fire shutters.

(C) Other openings—construction having an FRL not less than –/60/–.

Treatment area means an area within a *patient care area* such as an operating theatre and rooms used for recovery, minor procedures, resuscitation, intensive care and coronary care from which a patient may not be readily moved.

Uncontrolled discharge means any unintentional release of fluid from a *plumbing* and *drainage* system and includes leakage and seepage.

Unique wall, for the purposes of FV1.1 in Volume One and V2.2.1 in Volume Two, means a wall which is neither a *cavity wall* nor a *direct fix cladding wall*.

Unobstructed opening, for the purposes of Part 3.6 in Volume Two, means a glazed area that a person could mistake for an open doorway or clearway and walk into the glazed panel.

Unreinforced masonry means masonry that is not reinforced.

Vapour pressure means the pressure at which water vapour is in thermodynamic equilibrium with its condensed state.

Ventilation opening means an opening in the *external wall*, floor or roof of a building designed to allow air movement into or out of the building by natural means including a permanent opening, an openable part of a *window*, a door or other device which can be held open.

Verification Method means a test, inspection, calculation or other method that determines whether a *Performance Solution* complies with the relevant *Performance Requirements*.

Vessel, for the purposes of Volume One and Part 3.8.1 in Volume Two, means an open, pre-formed, pre-finished concave receptacle capable of holding water, usually for the purpose of washing, including a basin, sink, bath, laundry tub and the like.

Visibility means the maximum distance at which an object of defined size, brightness and contrast can be seen and recognised.

Voltage means a difference of potential, measured in Volts (V) and includes *extra-low voltage* and *low voltage*.

Waffle raft means a stiffened raft with closely spaced ribs constructed on the ground and with slab panels supported between ribs.

Wall-glazing construction, for the purposes of Section J in Volume One, means the combination of wall and *glazing* components comprising the *envelope* of a building, excluding—

(a) *display glazing*; and

(b) opaque non-glazed openings such as doors, vents, penetrations and shutters.

Ward area means that part of a *patient care area* for resident patients and may contain areas for accommodation, sleeping, associated living and nursing facilities.

Water control layer means a *pliable building membrane* or the exterior cladding when no *pliable building membrane* is present.

WaterMark Conformity Assessment Body (WMCAB) means a conformity assessment body registered with and accredited by the *JAS-ANZ* to conduct evaluations leading to *product* certification and contracted with the *administering body* to issue the *WaterMark Licence*.

WaterMark Certification Scheme means the ABCB scheme for certifying and authorising *plumbing* and *drainage products*.

WaterMark Licence means a licence issued by a *WaterMark Conformity Assessment Body*.

WaterMark Schedule of Excluded Products means the list maintained by the *administering body* of *products* excluded from the *WaterMark Certification Scheme*.

WaterMark Schedule of Products means the list maintained by the *administering body* of *products* included in the *WaterMark Certification Scheme*, and the specifications to which the *products* can be certified.

Explanatory Information:

The *WaterMark Schedule of Products* and the *WaterMark Schedule of Excluded Products* can be viewed on the ABCB website at www.abcb.gov.au.

Waterproof means the property of a material that does not allow moisture to penetrate through it.

Water resistant means the property of a system or material that restricts moisture movement and will not degrade under conditions of moisture.

Water sensitive materials means materials that have an inherent capacity to absorb water vapour and include timber, plasterboard, plywood, oriented strand board and the like.

Watertight means will not allow water to pass from the inside to the outside of the component or joint and vice versa.

Wet area means an area within a building supplied with water from a water supply system, which includes bathrooms, showers, laundries and *sanitary compartments* and excludes kitchens, bar areas, kitchenettes or domestic food and beverage preparation areas.

FAHRENHEIT GLOBAL
AN INTERNATIONAL FIRE ENGINEERING CONSULTANCY

FIRE ENGINEERING ASSESSMENT REPORT

TEMPORARY HEALTH CLINIC

GARRAN OVAL

KITCHENER STREET

GARRAN

ACT 2605

FER2020.056A

APRIL 2020

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TEMPORARY HEALTH CLINIC

GARRAN OVAL
KITCHENER STREET

GARRAN, ACT 2605

AUTHORISATION

Report	Name	Signature	Date
Developed by	Daniel Cimmino		22nd April 2020
Authorised by	Doron Levy Fire Safety Engineer (Accredited)		22nd April 2020

REVISION/VERIFICATION HISTORY

Revision	Remarks	Issue Date
FER2020.056A	Draft FER for stakeholders' review	22nd April 2020

This document contains commercial information which has been prepared for the attention of the Client on this project. It is confidential and no information contained in this document shall be released in part of whole to any third party without the approval of the client or Fahrenheit Global Pty Ltd.

1. Executive Summary

This fire engineering report (FER) outlines the fire safety strategy that has been developed and proposed for the new Temporary Health Clinic, located at Garran Oval, Kitchener Street, Garran, ACT 2605. The report demonstrates that the performance-based design for the building complies with the relevant Performance Requirements of the National Construction Code (NCC), Volume One, Building Code of Australia 2019[1] (BCA) [ABCB, 2019-1].

The temporary clinic is a new single storey 50 bed, Health Care facility, that for patient care and ancillary auxiliary use. The proposed building design does not achieve full compliance with the BCA DtS provisions and is therefore considered a "performance-based building design".

The non-compliances with the BCA DtS provisions that require assessment, where identified along the preliminary assessment of the proposed development, by the client and other stakeholders, involved in the design of the facility. The major departure from the BCA Dts provision are detailed in following Table 1.

Table 1: Deviations from the BCA DtS provisions subject to the Performance Solutions

No	Description of the BCA DtS Non-compliance	DtS Provisions	Performance Requirements
1	**The initial attack on a fire in the building is facilitated with the use of portable fire extinguishers in lieu of fire hose reels**	**E1.4**	**EP1.1**
2	**The emergency warning and intercommunication system is not provided with intercommunication phones. A Building Occupant Warning System is proposed in alternative.**	**E4.9**	**EP4.3**

Fahrenheit Global Pty Ltd (Fahrenheit Global) developed this Fire Engineering Assessment Report (FEAR) generally in accordance with the recommendations set out in the International Fire Engineering Guidelines (IFEG) [ABCB, 2005].

1 **Building Code of Australia**: The BCA is a uniform set of technical provisions for the design and construction of buildings and other structures throughout Australia. The BCA is given legal effect by building regulatory legislation in each State and Territory. Any provision of the BCA may be overridden by, or subject to, State or Territory legislation. The BCA must therefore be read in conjunction with that legislation.

1. Table of Contents

2. Table of Figures

2. Introduction

Fahrenheit Global has been engaged to carry out a fire safety engineering assessment to evaluate the performance-based design for the new Canberra Hospital, Temporary Health Clinic, located at Garran Oval, Kitchener Street, Garran, ACT 2605, that does not achieve full compliance with the "Deemed-to-Satisfy" (DtS) provisions of the National Construction Code (NCC), Volume One, Building Code of Australia 2019 (BCA) [ABCB, 2019-1].

This FEAR has been completed in accordance with the recommendations set out in Chapter 1.2 of the IFEG. The assessment that has been undertaken shows compliance of the performance-based design with the relevant Performance Requirements of the BCA. The method of meeting the Performance Requirements of the BCA adopted for this project is in accordance with BCA Clause A0.2(c), i.e. compliance with the Performance Requirements is achieved by a combination of "Performance Solutions" and "Deemed-to-Satisfy Solutions".

The purpose of this report was to analyse the identified non-compliances with the BCA DtS provisions and to develop a fire safety strategy that would allow the building to achieve compliance either with the relevant BCA DtS provisions or the relevant Performance Requirements of the BCA.

In line with the BCA objectives, the minimum scope of the fire safety strategy is to ensure the life safety of the occupants and to facilitate ACT Fire & Rescue (ACTFR) operations. The findings and recommendations included in this fire engineering report have been based on the Australian and International Fire Protection Standards, the Fire Brigade Intervention Model (FBIM), the Building Code of Australia and the relevant Guidelines (where appropriate).

2.1. Objectives

Fire safety objectives for the development must satisfy the community expectations (legislative objectives) and relevant stakeholders' expectations (design objectives). The fire safety objectives for the development are summarized below.

2.1.1. Legislative Objectives

The following are the fire and life safety objectives of the BCA:

1. Safeguard people from illness or injury due to a fire in a building;
2. Safeguard occupants from illness or injury while evacuating a building during a fire;
3. Facilitate the activities of emergency services personnel;
4. Avoid the spread of fire between buildings;
5. Protect other property from physical damage caused by structural failure of a building as a result of fire.

2.1.2. Design Objectives

The client requested that a fire safety engineering assessment is provided to support the performance-based building proposed. The main fire safety design aspect proposed are outlined in Section 5– "Fire Safety Strategy" of this report.

Objectives such as protection of property; protection of furnishings; protection of reputation and ensuring business continuity; safety other than fire safety are not in part of the objective and they shall be considered by the relevant stakeholder and may be identified as design objectives outside the scope of this assessment. If protection of property and equipment are not identified as design objectives, by satisfying the core fire safety objectives however some of the above objectives may also be satisfied.

2.2. Assumptions

This section outlines the main assumptions used within this report. All assumptions are based on the practices detailed in the IFEG and practical simplifications have been incorporated to maintain a conservative element to the fire engineering assessment.

The assumptions include the following:

- It is assumed the temporary Health Clinic is a "Treatment Area" as defined within the BCA, that is *"an area within a patient care area such as an operating theatre and rooms used for recovery, minor procedures, resuscitation, intensive care and coronary care from which patient may not be readily moved"*
- It is assumed that all fire safety measures will be designed correctly, properly installed and maintained in accordance with the relevant Australian Standards, legislative requirements or requirements otherwise listed in the final FER as a direct result of evaluation of the assessment outcomes.
- All fire safety measures within the building when installed are assumed to comply with the relevant Australian and/or International Standards and are assumed to operate in accordance with the provisions of these Standards unless specifically stated otherwise.
- This FEAR provides an assessment of the non-compliances with the BCA DtS provisions. The non-compliances addressed are shown in Table 1 of this report and reflect non-compliant issues highlighted during the fire engineering brief consultation with the client, the project manager, the PCA and the other relevant stakeholders. Fahrenheit Global is not aware of any other BCA DTS non-compliances in relation to the subject building at the time of the assessment.

2.3. Regulatory framework

This FEAR was prepared generally in accordance with the methodologies set out in the International Fire Engineering Guidelines (IFEG). The IFEG have been developed to assist fire engineers involved in building design and approval on fire safety matters.

The analysis contained within this report determines whether compliance with the Performance Requirements of the BCA is achieved. The assessment methodology adopted will demonstrate that the Performance Solution complies with the relevant Performance Requirements, or is at least equivalent to the DtS provisions of the BCA, or a combination of the two methods, as outlined and described in Clause A2.1 and Figure 1 of the BCA. Where compliance with the Performance Requirements could not be demonstrated, an appropriate BCA DtS fire safety strategy was developed.

In addition to the requirements of the Building Code of Australia, the following regulatory documents are pertinent to the project:

- ACT Building Act, 2004 (with amendments);
- ACT Building Regulations, 2008 (with amendments);
- International Fire Engineering Guidelines;
- Australian / NZ Standards;
- Australian Capital Territory Emergencies Act 2004;
- Other regulatory requirements (as applicable).

2.4. Limitations & Exclusions

The following limitations apply to this assessment:

- This report has been developed generally in accordance with standards, guidelines, practices, and review procedures that are accepted in the building design and construction, and fire safety engineering communities.
- The fire engineering design and the subsequent recommendations reflect the reasonable and practical efforts of Fahrenheit Global. The extent to which the fire safety requirements are implemented will affect the probability of achieving adequate fire safety margins. It is important to note, however, that Fahrenheit Global cannot guarantee that fire ignition and fire damage will not occur.
- Details regarding access for people with disabilities have been assessed to the extent of the DtS provisions of the BCA only. An assessment against AS 1428 is outside the scope of this report; however, this matter is addressed by other stakeholders. This assessment does not address the requirements for people with disabilities under the provisions of the Disability Discrimination Act 1992.

2.4.1. Contractual and legal context and the limitations

This FEAR specifically addresses the non-compliances listed in Table 1 of this report. At practical completion, the building, constructed in accordance with the design plans and the fire safety strategy documented in this FER, will comply with the Performance Requirements of the BCA.

The issues addressed and discussed in this report are taken as being the primary concern for the subject project; and reflect the effort to achieve a reasonable level of safety. The conclusions reached in the assessments will not apply to any other parts of the building or to other building projects.

The fire safety strategy relates to the final state of the building. The assessment and subsequent report do not address any issues of non-compliance and occupant safety that may arise as a result of partial completion and partial occupation of the building. The fire safety strategy is based on the assumption of a single ignition and fire source which is the expectation of a “natural” fire. It does not cover multiple fire initiation scenarios arising from arson or other such events. Analysis of emergency incidents such as bomb threats or other such occurrences requiring the evacuation of the building does not form part of the assessment.

This FER shall not be relied upon by others without the consent of the client and/or Fahrenheit Global.

2.5. Disclaimer

This fire engineering report was prepared for the purpose set out herein. Whilst this report is accurate to the best of our knowledge and belief, Fahrenheit Global cannot guarantee completeness or accuracy of any descriptions or information supplied to us during the fire engineering brief process by the client and/or the relevant stakeholders.

2.6. Relevant stakeholders

This FER has been developed by Fahrenheit Global in collaboration with the following stakeholders:

- Client – ASPEN Medical
- Project management – Manteena Group of Companies
- Principal Certifying Authority – TBC
- BCA Consultant – CBS Certifiers
- ACT Fire & Brigade

2.7. Consultation with ACT Fire & Rescue

Prior to developing the fire engineering within this report a design meeting was carried out with the ACTFB to nominate possible acceptable performance solutions. The fire safety strategy was outlined in the minutes of the meeting issued Friday 17 of April 2020, and considered part of the fire engineering brief process. ACTFR, acknowledged the meeting and provided comments on 21th April 2020 in regards to the FEB discussion. A copy of the minutes of the meeting is provided in Appendix A – of this report.

In their acknowledgment the ACTFR noted that they supported the proposed building performance solutions.

3. Building Design and Occupant Characteristics

3.1. General

The following descriptions are provided so that the building's design and occupants' characteristics are considered and assessed during normal mode of function. By defining principle characteristics associated with hazards and fire safety issues a fire safety strategy may be established.

3.2. Building Description

The new health clinic building is a new single storey, temporary health clinic, designed to cater for circa 50 patients. The building includes an office and staff section as well as auxiliary services electrical and data rooms.

Due to the envisaged usage of the building we have assumed the building consist mainly of a "treatment area" as defined within the BCA Treatment Area as defined within the BCA, that is

"an area within a patient care area such as an operating theatre and rooms used for recovery, minor procedures, resuscitation, intensive care and coronary care from which patient may not be readily moved"

The development is located on the Garran Oval, on the eastern side of Kitchener Street. The structure is considered temporary to address emergency health planning.

Figure 1: Site plan for THC Temporary Clinic

The building block is surrounded by Kitchener Street on the West side and new access road and parking facility will be provided to facilitate the building operations.

With respect to the Building Code of Australia, the new clinic is described as follows:

Table 2: Building Characterisation

Building Classification	Class 9a (Hospital) Class 5 (offices)
Rise in Storeys	1
Number of Storeys Contained	1
Effective Height	3.5 m (approximate)
Type of Construction	Type C Construction
Large-isolated Building	No

3.2.1. Fire Brigade Access

ACT Fire & Rescue (ACTFR) vehicle and pedestrian access to THC clinic is available from 2 opposite sides: North East and South East.

The ACTFR likely response station to THC clinic is expected to be from Phillip Fire Station located approximately 1.8 km away of the clinic (5 minutes travel). Additional fire station located in proximity of the development include South Tuggeranong and Kambah Fire stations, both located approximately 6.9 KM away from the site.

The fire stations mentioned above are manned by ACTFR personnel 24/7.

3.2.2. Structure

The Temporary Health Clinic consist of steel structure with load-bearing internal walls. The building is lays on a piers and includes a wood floor structure. The roof is profiled steel sheeting supported by metal frame.

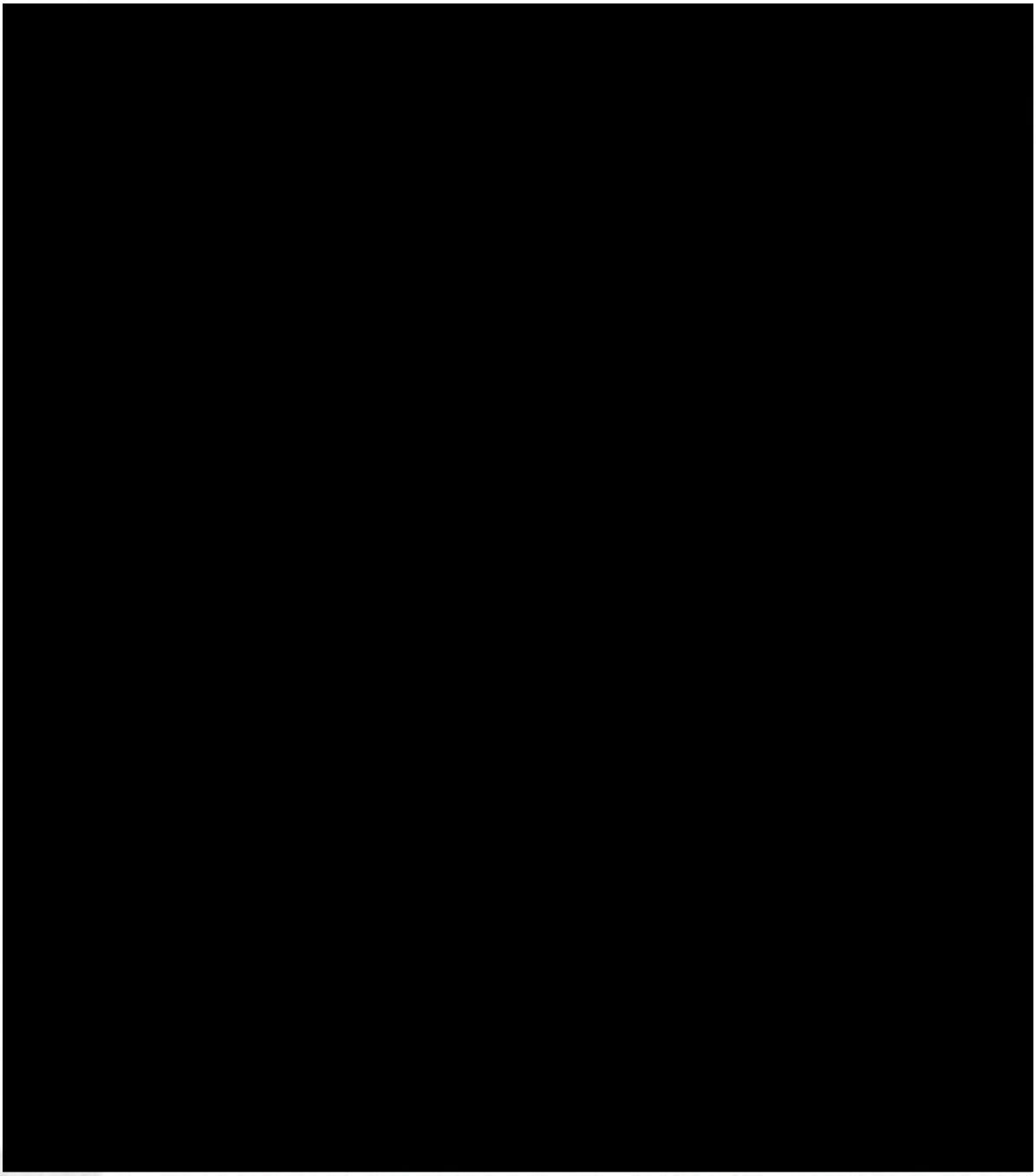
Figure 2: Structural Sections of THC Temporary Clinic

3.2.3. Size and Compartmentation

The temporary structure clinic consists of a square shaped building, single storey, that contains three majors sections, being Acceptance (triage), Patient areas and Staff Area.

The total area of the building is circa 1750 m^2 . The building according to BCA Clause C2.2 can be of Type C construction that allow a maximum size of fire compartment of 2000 m^2.

Figure 3: Proposed Floor Plan of THC Temporary Clinic



The building is considered a single fire compartment and will divided into 4 smoke compartments. Additionally, in different parts of the building rooms and spaces that present high fire hazards are fire-separated from the rest of the building, albeit these rooms and spaces are not considered separate fire compartments.

The proposed smoke compartments are summarised in Table 3 below.

Table 3: Location and floor area of smoke compartments

Smoke Compartment	Area	Smoke compartment floor area
Patients Acceptance	Entrance and Triage area (south)	461 m^2
Treatment area -West Wing	Patient Treatment area (Confirmed Cases)	591 m^2
Treatment Area - East Wing	Patient treatment area (Suspect Cases)	532 m^2
Core central area	Service Corridors	151 m^2

The four (4) smoke compartments proposed, should be constructed as per BCA Clause C2.5 and specification C2.5 for smoke compartment, with the inclusion of smoke doors and smoke wall partition up to the roof of the building or to the underside of a ceiling capable to resist to the incipient stage of fire.

According to the approximate measurements performed all the compartment are within the limit of 1000 m^2 required by the BCA Clause C2.5 (iv) for treatment areas. The largest smoke compartments proposed is the West Wind section that is circa 591 m^2 area that is within the size limit for smoke compartments within a treatment area.

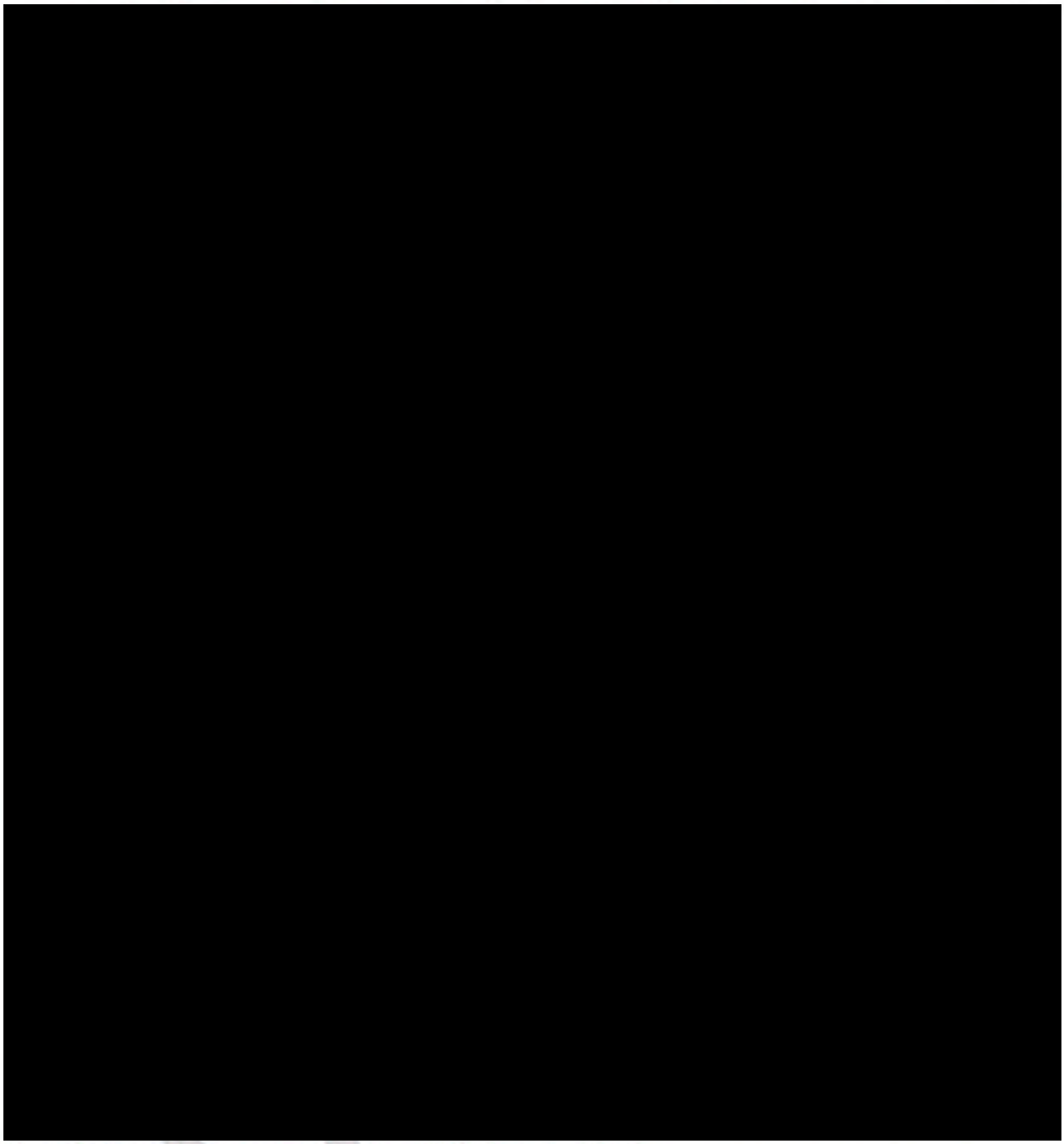


Figure 4: Proposed smoke compartmentation of THC Temporary Clinic

3.2.4. Egress Provision

Access to THC clinic is provided from two internal driveways, located at North East and South West of the structure.

The designated Entry point for Emergency personnel (i.e. Fire Brigade) and building staff has been proposed to be on the North side of the building (Clean Area) meanwhile the patient acceptance is on the South East side of the Building (Infected area).

The building is provided with multiple Exits distributed along the perimetral walls. The north and south façade include each four (4) exits along a 39 m length of wall. The Eastern and Western external walls each have two exits. The total number of exit and their distributions is substantially superior to the minimum requirements, and travel distance of a Deemed to Satisfy Buildings. The number of exit and their location indeed represent the key point of the proposed fire safety strategy, consisting in provide an early warning to occupants and evacuate the building in the minimum amount of time.

Each smoke compartment is served by at least to point of exit and the maximum travel distance to any Exit from any point in the building is less than 30 m in the worst-case scenario. Typical distance to a point of choice to an alternative exit is circa 12 m.

3.3. Preventive and Protective Measures

The fire preventive and protective measures for THC Clinic involve passive and active fire protection measures. The IFEG indicate that to assist in analysing a fire safety system, it is convenient to consider the overall safety system as comprising six 'sub-systems' [ABCB, 2005a]. Preventive and protective measures, detailed in Table 4 are therefore grouped in accordance with the different 'sub-systems' recommended by the IFEG.

Table 4: Preventive and Protective Measures

Sub-System	Comment
Sub-System A Fire Initiation and Development and Control	Management measures includes a strict enforcement of the "No-Smoking" policy to be implemented throughout the building (including the surrounding areas such as car park. Strict enforcement of the housekeeping measures to ensure rubbish is not accumulated adjacent to potential ignition sources. Establishment and enforcement of cleaning regimes, including regular cleaning and inspection of air conditioning ductwork and associated equipment to prevent accumulation of combustible residual material. Strict enforcement of cleaning regimes for the entire facility, including regular cleaning and inspection to prevent accumulation of linen; general and medical waste. Rubbish is to be removed at regular interval and is not to be stored inside the facility. Regular maintenance and inspection of all plant, electrical equipment and appliances shall be enforced in accordance with the relevant regulations.

Sub-System	Comment
Sub-System B Smoke Spread and Control	The facility is divided into 4 smoke compartments. This smoke compartmentation is expected to prevent smoke migration between different smoke compartments. All air-handling systems shall comply with the DtS provisions of BCA Part E2.2 and, if they do not form part of the smoke hazard management system, shall shut-down on fire trip, which shall minimise the risk of smoke spread between different fire compartments.
Sub-System C Fire Spread and Impact and Control	Potential fire spread shall be controlled by the initial fire attack by occupant if safe to approach. Minimum training shall be provided to the staff in the use of Fire Extinguishers. The floor and lining of wall as well partition wall shall be compliant with DtS provision of the BCA, and have a spread of flame index equal to zero.
Sub-System D Fire Detection, Warning and Suppression	A smoke detection and alarm system shall be provided throughout the building, in accordance with Clause 4 of BCA Specification E2.2a and AS1670.1-2018. To anticipate the occupant warning, the smoke detectors spacing shall be reduced from 10 m apart (ie. 1670 spacing0 to 7 m apart). Activation of the fire detection and alarm system must automatically shut down any air-handling system which does not form part of a zone smoke control system (other than individual room units with a capacity not more than 1,000 L/s, systems serving critical treatment areas and miscellaneous exhaust air systems installed in accordance with Sections 5 and 11 of AS/NZS 1668.1). The automatic fire detection and alarm systems shall be monitored in accordance with Clause 8 of Specification E2.2a of the BCA. Portable fire extinguishers shall be installed where appropriate in accordance with the DTS provisions of the BCA.
Sub-System E Occupant Evacuation	Emergency lighting and exit signage shall be provided in accordance with Part E4 of the BCA. A Building Occupant Warning System (BOWS) shall be provided in accordance with Clause 7 of Specification E2.2a of the BCA throughout the building. The building occupant warning system shall include Visual alarm devices to limit the distress of patients.
Sub-System F Fire Services Intervention	Professional fire service (ACTFR) available 24/7. A fire hydrant system shall be provided to provide coverage of the entire building in accordance with BCA Clause E1.3 and AS 2419.1-2005. Fire hydrant protection shall be provided from eternal "attack" fire hydrants if capable to achieve coverage. Additional internal hydrant shall be provided is necessary.

3.4. Hazards

Identification of hazards that are expected to affect life safety of building occupants is crucial to undertaking a fire safety engineering assessment. Special attention must be paid to those hazards that are not commonly associated with the type of the occupancy.

Hazards associated with the general layout and activities as well as the ignition and fuel sources are identified in Table 5 below.

Table 5: Hazards sources

Sub-System	Comment
General Layout	Alternative exits are available from each area of the building providing a redundant means of escape. The simplified layout and number of exit provide for point of choice to alternative exit that are within 12 m in worst case instance and maximum travel distance to the nearest exit in the order of 30 m. The general layout of the building does not present any unusual hazards.
Activities	The activities within the building are considered to be of low to medium hazard, and are considered not to promote any additional hazards to those typical of this type of occupancy. In most types of occupancies arson is not considered one of the major hazards; however, unsupervised and unauthorised use of open flames by residents (setting fire to bedding and other combustible materials using matches and/or lighters) or arson perpetrated by staff cannot be completely discarded.
Ignition Sources	Strict enforcement of the "No-Smoking" policy throughout the building, except for the designated staff smoking areas, should reduce the likelihood of discarded smoking materials or use of open flames, such as matches and/or lighters; becoming an ignition source. In the Class 9 parts of the building the main ignition source is expected to be faulty electrical equipment. There is a potential for a fire occurring within the electrical and data rooms as a result of equipment overheating. In the Class 6 retail part of the building the main ignition sources are expected to be faulty electrical equipment, overheating cooking appliances and naked flames. Potential for arson attack while remote is still possible.
Fuel Sources	In the Class 9a parts of the building the main fuel source within the ward areas is considered to be bedding material, linen and combustible personal items, such as clothes, mementos, etc. In the offices and at nurses' stations the main fuel source is considered to be work stations, electrical equipment and archives. The main fuel source within other parts of the building is considered to be combustible stock and materials in storage areas and cleaner rooms.

3.5. Occupant Characteristics

The characteristics of the occupant groups expected to be present at the facility are detailed below:

- Facility Management, Staff and Security – Staff must be fully trained in emergency procedures and are expected to have good familiarity with the building and the fire safety systems. This occupant group is expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. This occupant group is expected to be awake and fully conscious at all times when inside the facility. This occupant group, staff in particular, shall be facilitating occupant evacuation during a fire emergency.

- Residents – This occupant group is not likely to have good familiarity with the whole building layout, but may be familiar with the areas they are located. Members of this occupant group can be under the effects of prescription drugs not capable to evacuate to at any given time while on the premises. Members of this occupant group may not be able to take cohesive decisions and/or evacuate without the assistance from staff.

- General Public– The clinic is a not generally accessible to public. Visitors or eternal staff could pay a visit to the facility, however they will be in presence of staff that is familiar with the building layout. This occupant group is expected to be limited if any, to have mobility, hearing and visual abilities in line with the general population. With the simple layout of the floors and provision of appropriate exit signage occupants in this group are considered to be able to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency.

- External Maintenance Contractors – This occupant group is expected to have a reasonable familiarity with the building and contractors will be required to undergo emergency training prior to commencing work in any portion of the building. This occupant group is also expected to be mobile with normal hearing and visual abilities and occupants in this group are considered to take and implement decisions independently and require minimal assistance during evacuation in a fire emergency. The contractors are expected to be awake and aware of their surroundings at all times when inside the building.

- ACT Fire & Rescue Personnel – This occupant group will be equipped with personal protective and safety equipment and are considered expert in firefighting activities and the dangers associated with fire incidents. This occupant group would be expected to be in a position to assist other occupants requiring assistance to evacuate. It is not expected that this occupant group would be present in the building at the time of fire ignition; however, they are expected to enter the building at a later stage to assist with the evacuation of occupants, if required.

An Emergency Management Plan in accordance with AS 3745-2010 shall be developed and endorsed by the building management, so that staff are familiar with the fire safety systems management policies and the egress provisions from the building for an efficient evacuation of the facility during a fire emergency.

4. Summary of the Performance Solutions

The table below provides a summary of the Performance Solutions, including the description of the non-compliances with the BCA DTS provisions, the BCA Performance Requirements and the proposed assessment methods.

Table 6: BCA requirements associated with the Performance Solutions

Performance Solution No	Description of the BCA DTS Non-compliance	DtS Provisions	Performance Requirements	Assessment Method
1	The initial attack on a fire in the Class 6 part of the building is facilitated with the use of portable fire extinguishers in lieu of fire hose reels	E1.4(b)(i)	EP1.1	A2.2(2)(b)(ii)
2	Emergency Warning and Intercommunication system is not provided with Intercommunication phones. A building occupant warning system is proposed.	E4.9	EP4.3	A2.2(2)(b)(ii)

5. Fire Safety Strategy

5.1. General

The Canberra Hospital Temporary Health Clinic, at Garran Oval, Kitchener Street, Garran, ACT 2605 shall comply with the Deemed-to-Satisfy (DTS) Provisions of BCA 2019, except for the specific non-compliances identified in table 1.

Should a change in use or building alterations and/or additions occur in the future a reassessment will be needed to verify consistency with the analysis contained within this brief.

The requirements listed in this Section are Essential Services and, as with all fire safety measures, shall be identified as requiring maintenance and certification at appropriate intervals as per AS1851.

5.2. Fire Resistance, Fire Compartmentation and Separation.

1. The THC clinic has been assessed as a health care building development containing Class 9a, and Class 5 (office) with a rise-in-storeys of one(1) prescribed to be of Type C construction.

2. The building is considered overall a "patient treatment area" as defined by the BCA. According to Clause C2.5 of the BCA the maximum smoke compartment shall be less than 1000 m^2. The proposed smoke compartment of the building are listed in the table below.

Smoke Compartment	Area	Smoke compartment floor area
Patients Acceptance	Entrance and Triage area (south)	461 m^2
Ward West Wing	Patient Ward area (Confirmed Cases)	591 m^2
Ward East Wing	Patient Ward area (Suspect Cases)	532 m^2
Core corridors /central area	Service Corridors	151 m^2

3. Fire resistance and stability, compartmentation and separation, and protection of openings provisions shall comply with the DTS provisions of Part C1, Part C2 and Part C3 of the BCA, and specification C2.5 for the construction of smoke walls.

4. Doors separating the smoke compartment shall be provided with smoke seals that have been tested in accordance with AS1905.1-2015 and met the leakage performance requirements detailed in Section 2.4 of AS 6905-2007 (i.e. achieve 25 m^3/h at 200°C for a period of 30 minutes for single leaf doors and 40 m^3/h at 200°C for a period of 30 minutes for double leaf smoke doors, when tested in accordance with AS 6905-2007 and AS 1530.7-2007).

5. The doorways to the comms rooms and the opening to the comms cabinet nominated in Item **Error! Reference source not found.** shall be protected with self-closing doors with smoke seals.

6. Doors nominated in Item 4 shall be self closing. Alternatively a magnetic door holder with fail safe device shall be activated and close the doors in fire mode.

5.3. Provision for Escape; Construction of Exits

7. Egress provisions from the building shall comply with the DTS provisions of Part D1 and Part D2 of the BCA.af

    a. Travel distance to the nearest of the alternative exits from any point on the floor shall be not more 20 m, or not more than 40 m if a point of choice to alternative exit path is available within 20m.

5.4. Fire Fighting Equipment

8. The building shall be provided with an external fire hydrant system in accordance with BCA Clause E1.3 and AS 2419.1-2005.

9. Fire hydrant system block plan (minimum size of block plan shall not be less than A3 size) shall be provided at the fire hydrant system booster assembly and at the fire indicator panel (FIP). The block plan must be in accordance with Section 7.11 of AS 2419.1-2005.

10. The booster assembly shall be provided with an emergency light, as per ACTFR requirements.

11. Fire hose reels may not be provided in the building.

12. Portable fire extinguishers (PFE) shall be provided in accordance with BCA Clause E1.6 and AS 2444-2001.

13. Additional to Item13, each fire extinguisher point, shall include a CO2 type (3.5 Kg) and 9 L water type extinguisher, in lieu of fire hose reels. The use of dry powder (ABE) type of extinguishers is not allowed within the patient care areas of the building.

14. Additional to Item 12, 1 x PFE shall be provided inside each comms rooms, and 1 x PFE shall be provided outside or inside and within 3 m of each comms room and the comms cabinet. The PFEs for the comms rooms shall be 3.5 kg agent capacity CO_2 PFEs (rating 5B:E).

5.5. Smoke Hazard Management

15. A smoke detection and alarm system shall be provided throughout the building in accordance with Clause 4 of BCA Specification E2.2a and AS 1670.1-2018. The smoke detection system shall be addressable and include concealed space protection.

16. Spacing of smoke detectors shall be reduced to 7 m in lieu of 10m as permitted by the reference standard.

17. Activation of the fire detection and alarm system must automatically shut down any air-handling system which does not form part of a zone smoke control system (other than individual room units with a capacity not more than 1,000 L/s, systems serving critical treatment areas and miscellaneous exhaust air systems installed in accordance with Sections 5 and 11 of AS/NZS 1668.1).

18. A Building Occupant Warning System (BOWS) shall be provided throughout the building in accordance with Clause 7 of Specification E2.2a of the BCA and AS 1670.1-2018. Activation of the automatic smoke detection system shall activate BOWS. The occupant warning system shall include visual alarm devices to alert impaired people and minimise distress in the patients.

19. The automatic fire sprinkler system and smoke detection and alarm system shall be interfaced with the fire brigade panel (FBP) and shall be linked to third party monitoring via Alarm Signalling Equipment (ASE).

5.6. Visibility in an Emergency, Exit Signs and Warning Systems

20. Emergency lighting shall be located and installed in accordance with Clauses E4.2, E4.3 and E4.4 of the BCA and AS/NZS 2293.1.

21. Exit signs shall be located and installed in accordance with Clauses E4.5, E4.6 and E4.8 of the BCA and AS/NZS 2293.1.

5.7. Management in use Procedures

22. Storage of items unrelated to the comms rooms/cabinet shall be strictly prohibited. This measure shall be included in the Emergency Management Plan for the facility and shall be enforced with regular inspections.

23. An emergency management system in line with AS 3785 “Emergency control organization and procedures for building, structures and workplace” shall be developed and implemented in the structures. Training and drills shall be performed on a regular basis and in accordance with the reference standard.

24. Daily removal of rubbish and minimisation of waste storage.

25. Training to staff and security in the use and operation of fire extinguishers.

26. It is recommended that the comms rooms and the comms cabinet (if practical) are provided with temperature and humidity control. These are the reasons why these measures may reduce fire incidence:

    a. Temperature control should prevent overheating of equipment, which may lead to short circuits or other faults that could result in a fire;

    b. Humidity control should prevent dry air from creating static electricity in systems.

5.8. Maintenance frequency

27. The above fire safety measures shall be listed in the Schedule of Fire Safety Measures and shall be maintained regularly in accordance with the requirements of AS 1851 and AS 2293.2.

28. The ongoing maintenance of the fire safety measures shall be carried out by a Competent Fire Safety Practitioner (CFSP). It is recommended that the contractors be selected on the basis of their performance record and the professional qualifications of their personnel.

Table 7: Additional Essential Fire Safety Measure

Measure	Standard of Performance
Fire Engineering Report	A copy of the final and approved Fahrenheit Global Engineering Report FER2020.056 shall be retained within the building.

6. Performance Solution No. 1 – Performance-based Attack on a Fire by Occupants

6.1. Introduction

BCA Clause E1.4(b)(i) states that a fire hose reel system must be provided to serve the whole building where one or more internal fire hydrants are installed or within fire compartment larger than 500 m^2.

The health care building has multiple smoke compartments and an area that exceed 500 m^2 , and fire hose coverage to the building is provided from external attack fire hydrants; therefore, fire hose reels are prescribed to be installed.

The initial attack on a fire by occupants is facilitated by the use of portable fire extinguishers (PFEs) in the building in lieu of fire hose reels (FHRs), which does not comply with the DTS provisions of Clause E1.4(b)(i) of the BCA.

The Performance Requirement of the BCA associated with the performance-based initial attack on a fire by occupants has been identified as EP1.1.

A fire safety engineering assessment was undertaken to analyse this non-compliance and determine whether the performance-based design provides a level of fire safety required to achieve compliance with Performance Requirement EP1.1 of the BCA using an absolute qualitative deterministic analysis, in accordance with BCA Assessment Method A2.2(2)(b)(ii).

The BCA requirements associated with the Performance Solution are summarised in table below.

Table 8: BCA requirements associated with the Performance Solution

No	Description of the Performance Solution	DtS Provisions	Performance Requirements	Performance Solution	Assessment Method
1	The initial attack on a fire in the building is facilitated with the use of portable fire extinguishers in lieu of fire hose reels	E1.4(b)(i)	EP1.1	Complies with Performance Requirements A2.2(1)(a)	Verification Method A2.2(2)(b)(ii)

6.2. Intent of the BCA

The intent of Performance Requirement EP1.1 is to allow occupants to fight fire in the initial stages of its development, which "may reduce the hazard, allow more time for evacuation and prevent structural damage". The Guide to the BCA also indicates that fire hose reels "must be installed when necessary, and be appropriate to a number of factors, including:

- "the size of the fire compartment which is a measure of the size of any potential fire";
- "the function of the building will affect the fire load in the building";
- "the fire-safety systems which can affect the rate of fire spread (e.g. if a sprinkler system is installed in a building, it should extinguish the fire or reduce its growth rate)"; and
- "the fire hazard which means the danger in terms of potential harm and degree of exposure arising from the start and spread of fire, and the smoke and gases generated by a fire".

The Guide to the BCA stresses that compliance with BCA Clause E1.4 is not compulsory if alternative means can be found to satisfy the appropriate authority that Performance Requirement EP1.1 is satisfied.

From the above discussion it is evident that fire hose reels are provided for occupants to commence the initial attack on a fire. The above notwithstanding, the design must adequately address occupant safety. It is therefore reasonable to conclude that if the deployment of a fire hose reel could potentially compromise occupant safety alternative means of initial attack on a fire may be more appropriate.

6.3. Methodology

The assessment undertaken is an absolute qualitative deterministic analysis involving the following IFEG sub-system:

- Sub-system D – Fire Detection, Warning and Suppression.

The methodology adopted for this assessment is as follows:

- Develop a fire safety strategy to facilitate occupants' initial attack on a fire in Class 6 part of the building that is not provided with FHR coverage and address the following aspects of provision of PFEs:

    1. Class of fire risk that PFEs are suitable for and the typical fire risks expected to be present in the building.
    2. Usability of PFEs with regards to approaching the fire.
    3. The risk of users of PFEs impeding their own egress or the egress of others.

6.4. Acceptance criteria

The acceptance criterion for this assessment is:

1. Occupants shall be provided with adequate fire safety measures that would facilitate their initial attack on a fire.

6.5. Assessment

Fire hose reels are provided to facilitate occupant attack on a fire in the initial stages of fire development, potentially prior to the commencement of emergency evacuation, but most certainly before it is completed. Fire hose reels are only suitable for Class A fire risks, i.e. ordinary combustibles such as wood, paper, cloth, rubber and plastic. Inside a building FHR are prescribed to be installed either within 4 m of exits (Clause E1.4(e)(ii) of the BCA) or in paths of travel to exits, if system coverage is not achieved from FHRs installed adjacent to exits (Clause E1.4(e)(iii) of the BCA).

Most occupants do not know how to operate a FHR, as FHR training is seldom provided, and may not be comfortable in using it. However, if an untrained occupant decides to use a FHR they could be exposed to and could be exposing others to several hazards.

It is noted in our analysis that according to the BCA, the FHRs are not required to be provided for building of class 2 (i.e. residential) and class 9c – Residential aged care.

The exemption for such type of building is justified within the Guide to the BCA, that it is considered that the provision of portable extinguishers in a residential care building provides adequate means for staff and visitors to attack the fire. The additional level of fire safety associated with the provision of fire hose reels is not considered necessary on the basis that it is not expected that the number of staff available in a residential care building will be adequate to both fight a growing fire with fire hose reels and evacuate residents.

For these type of building portable fire extinguishers are considered more appropriate and necessary for initial fire attack.

Most people are generally familiar with portable fire extinguishers (PFEs) and many are comfortable with using them. The type of PFE proposed is suitable for Class A (ordinary combustibles), Class B (flammable liquids) and E (energized electrical equipment) fire risks.

Portable fire extinguishers are considered safer to use and superior to fire hose reels for a number of reasons, including the following:

1. FHRs are only suitable for Class A fire risks and should not be used on energized electrical equipment. A modern building is generally provided with multiple items of electrical equipment and to minimize the risk of electrocution, all power points are generally protected with residual current devices (RCD). When a FHR is used, large areas are likely to be wetted and after a few moments water is likely to start pooling on the floor.

2. Generally, people could overestimate how safe they are when operating a FHR due to the continuous supply of water from the hose. Hence, they may be tempted to continue the attack on a fire even when it is not safe to do so and they otherwise would have attempted to evacuate the building. This may lead to the operator and occupants being exposed to an increased risk.

   PFEs are provided with a limited quantity of extinguishing medium and people tend to evacuate the area as soon as the extinguisher is depleted or they realise that their effort is not having an impact on the fire;

3. After being coiled on the drum for a prolonged period of time, when deployed, the rubber hose often does not lay flat on the floor, but tends to spiral or undulate and this can increase the difficulties encountered when attempting to use a FHR. Approaching a fire and maneuvering with a FHR is considered potentially difficult as the FHR must be unfurled and potentially dragged around corners or through doors to reach the fire location. The friction may be considerable and the FHR user may therefore experience difficulties, be forced to concentrate on navigating to the fire and take a relatively long time to approach the fire.

   A PFE is generally easier to lift and manoeuvre to the fire location;

It is considered that PFEs placed in clearly marked and easily accessible locations (adjacent to exits or in paths of travel to exits) will provide occupants who decide to commence an initial attack on a fire with more efficient and safe firefighting measures than a fire hose reel system would.

Based on the above discussion it is reasonable to conclude that provision of portable fire extinguishers in lieu of fire hose reels in the Class 6 part of the facility on the Ground Floor facilitates initial occupants' attack on a fire.

6.6. Conclusion

This assessment demonstrates that the acceptance criterion for the analysis is met as the occupants have been provided with alternative measures to fight the incipient stage of fire. Therefore, the Performance Solution achieves compliance with the relevant Performance Requirement, as demonstrated in Section 8.

7. Performance Solution No. 2 – Performance-based Emergency warning and Intercommunication system

7.1. Introduction

BCA Clause E4.9 (d) states that a class 9a building having a floor area of more than 1000 m^2 or a rise in storey of more than 2 requires an emergency warning and intercommunication system complying where applicable to AS 1670 part four (i.e. AS 1670.4 – Emergency warning and intercommunication systems)

These type of emergency warning system requires a separate amplifier for each fire compartment and include the installation of Intercommunication phones to be used by the emergency personnel and trained staff wardens to facilitate the evacuation of building and manage other type of emergencies.

The performance solution proposed include an emergency warning system that does not include the intercommunication phones and instead is more similar to an Occupant warning system, that will be automatically activated by the fire detection system.

A fire safety engineering assessment was undertaken to analyse the non-compliance and determine whether the performance-based building design achieves compliance with the relevant Performance Requirements of the BCA. An absolute qualitative deterministic analysis, in accordance with BCA and IFEG Assessment Method A2.2(b)(ii), was used to assess the performance-based building that includes the provision of emergency warning speakers and visual alarm.

The BCA requirements and methods of assessment of the performance solution are indicated in the table below:

Table 9: BCA requirements associated with the Performance Solution

No	Description of the Performance Solution	DtS Provisions	Performance Requirements	Performance Solution	Assessment Method
9	An occupant warning system will be provided in lieu of an Emergency warning and intercommunication system.	E4.9 (d)	EP4.3	Complies with Performance Requirements A2.2(1)(a)	Verification Method A2.2(2)(b)(ii)

7.2. Intent of the BCA

The intent of Performance Requirement EP4.3 is principally to facilitate building evacuation and ensure that the building occupants receive a sufficient early warning of a fire and proceed to evacuate the building before conditions become untenable.

As indicated within the guide to the BCA "The intent of performance requirement EP4.3 is to maximise the opportunities for occupants to evacuate". This may include giving them as early a warning as possible and providing means of communicating both the need for evacuation and the process of evacuation.

Emergency evacuation requires that the evacuation maximises the opportunity for occupants to reach a place of safety. The guide continues explaining that "Since the BCA relates to the construction of a building it can only require the installation of a system. It cannot require: training, so that the evacuation process is undertaken automatically; allocation of staff to assist with evacuation, particularly if the building is likely to contain occupants who have been unable to benefit from prior training; or a detailed evacuation plan."

7.3. Methodology

The assessment undertaken is an absolute qualitative deterministic analysis involving the following IFEG sub-systems:

- Sub-system A – Fire Initiation and Development.
- Sub-system B – Smoke Spread.
- Sub-system C – Fire Spread and Impact and Control.
- Sub-system E – Occupant Evacuation and Control.

The methodology adopted for this assessment is as follows:

- Determine the requirement for emergency warning to occupants,
- Address the requirement for intercommunication system
- Determine whether the lack of intercommunication phones may contribute to a delay in the evacuation procedures or to a disordered evacuation, such that smoke or fire spread could endanger the life of occupants or emergency personnel.

7.4. Acceptance criteria

The acceptance criterion for this assessment is:

1. The occupants shall receive an automatic early warning of the presence smoke or fire.
2. The emergency warning system without intercommunication system shall not compromise the safe evacuation of occupants.
3. The emergency warning system without intercommunication system must not adversely affect fire brigade intervention.

7.5. Assessment

The proposed building consists of a single fire compartment with four (4) internal smoke compartments. The building will be equipped with an emergency warning system automatically activated by a modified smoke detection and includes emergency warning speakers and visual alarms.

In case of fire emergency, the fire detection system will most likely activate and send a signal to the building occupant warning systems, providing and early warning to all occupants of the building. The fire detection system will also automatically initiate a call to the fire monitoring services to alert Fire Brigades of the presence of fire emergency.

The reduced space of the proposed smoke detection system from 10 m to 7 m will furtherly reduce the time of activation and anticipate the general fire alarm signal, providing additional time for the staff and occupant to investigate the fire and initiate the evacuation procedures. In this fire scenario the lack of an intercommunication system is neglectable and uninfluential. The use of intercommunication system is generally useful for the coordination of occupants evacuation for large and complex buildings, where it could be beneficial in the early stage of the emergency for trained staff or Fire Brigades to manage the emergency and coordinated the evacuation. It is indicative that Clause E4.9 of the BCA requires

such system for more complex buildings, such as building with an effective height of more than 25 m and other multistorey and public building of class 9b such as theatres and similar large complex with many unfamiliar occupants that could find difficult to find an exit.

The building subject of this assessment has a total floor area of 1750 m^2, it is a single storey building and it is sub-dived in 4 smoke compartments. Each compartment has direct access to an exits and the need to coordinate the evacuation is minimal and will not benefit by the presence of an intercommunication system. There is no need for a staged evacuation as for example in a multistorey/high rise building, where exit routes (i.e. fire stairs) could be clogged in case of simultaneous evacuation of all occupants.

For the same reason of simple layout and small footprint of the building, the consideration above are also applicable to the Fire Brigades intervention that will be concentrate on initial search and rescue and can rely if required on their radio communication system.

The above discussion clearly demonstrates that a performance-based solution that include and emergency warning system without intercommunication part, will not compromise the safety of the occupants and their coordinated evacuation, that should rely on procedures established within an emergency evacuation plan. The proposed emergency warning system will still be capable to provide an early warning to occupant and will prejudicated the safe evacuation of building occupants and as such achieve compliance with the relevant Performance Requirements of the BCA.

7.6. Conclusion

This assessment demonstrates that the acceptance criteria for the analysis are met. Therefore, the Performance Solution achieves compliance with the relevant Performance Requirements, as demonstrated in assessment above.

8. Compliance with Performance Requirements of the BCA

The fire safety strategy detailed in Section 5 achieves compliance with the relevant Performance Requirements of the BCA as documented in the following sections.

8.1. Performance Requirement EP1.1 – Fire Hose Reels

Table 10: Compliance with Performance Requirement EP1.1

Performance Requirement EP1.1		
A fire hose reel system must be installed to the degree necessary to allow occupants to safely undertake initial attack on a fire appropriate to—		
(a)	The size of the fire compartment	The fire compartment where the initial attack on a fire is facilitated with the use of portable fire extinguishers has a floor area of 1,750 m² and is further sub-divided into 4 smoke compartments. The larger smoke compartment where portable fire extinguishers are provided in lieu of fire hose reels has a floor area of circa 691 m². Provision of portable fire extinguishers in lieu of fire hose reels is considered appropriate for the size of the fire compartments.
(b)	The function or use of the building	The smoke compartment where portable fire extinguishers are provided in lieu of fire hose reels is Class 9 (health care building). Provision of portable fire extinguishers in lieu of fire hose reels is considered appropriate for the function and use of the building.
(c)	Any other fire safety systems installed in the building	The building is protected throughout with an automatic fire detection system with reduced spacing. These systems are interfaced with the building occupant warning system and with the alarm signalling equipment that shall transmit an automatic alarm to ACTFR. Provision of portable fire extinguishers in lieu of fire hose reels is considered appropriate for the other fire safety systems installed in the building. Portable fire extinguishers provided are of two types. Water for type A fire risk (carbonaceous fire) and CO_2 or type E for electric fire risk
(d)	The fire hazard	The fire hazard is consistent with the type of occupancy under assessment and not considered different from a Residential aged care where fire hose reel are not required. Provision of portable fire extinguishers in lieu of fire hose reels is appropriate for the fire hazard.

8.1. Performance Requirement EP4.3 – Emergency Warning and Intercom Systems

Table 11: Compliance with Performance Requirement EP4.3

Performance Requirement EP4.3		
To warn occupants of an emergency and assist evacuation of a building, an emergency warning and intercom system must be provided, to the degree necessary—		
(a)	The floor area of the building.	The building is a single storey building, with a total area of 1750 m^2. The building is separated into four different smoke compartments each compartment with multiple exits.
(b)	*The function and use of the building*	The building is a health care building equipped with an emergency warning system complete with visual warning devices.
(c)	*The height of the building*	The building is a single storey building equipped with emergency warning system automatically activated by a fire detection system. The fire strategy does not include a staged evacuation to be coordinated via Intercom phones.

9. REFERENCES

- ABCB, 2005: "International Fire Engineering Guidelines, Edition 2005", Australian Building Codes Board, Canberra, Australia.
- ABCB, 2019-1: "National Construction Code, Volume One, Building Code of Australia 2019"; Australian Building Codes Board, Canberra, Australia.
- ABCB, 2019-2: "National Construction Code, Guide to Volume One, 2019", Australian Building Codes Board, Canberra, Australia.
- AFAC, 2004: "Fire Brigade Intervention Model (FBIM)", Australasian Fire and Emergency Service Authorities Council, 2004.
- Buchanan, A.H., 2001: "Fire engineering design guide, Second edition", Centre for Advanced Engineering, Christchurch, New Zealand.

Appendix A – Notes of meeting held with ACT Fire & Rescue

The following is a copy of the meeting held with representative of the ACTFR considered part of the FEB.

FAHRENHEIT GLOBAL
AN INTERNATIONAL FIRE ENGINEERING CONSULTANCY

MINUTES					
Project Name:		Canberra Hospital COVID-19 Health Clinic		Minutes	001
Project No:		N/A			
Client:		Canberra Hospital		Issued for:	Information
Doc. Reference:		Min2020.056A		Date:	17 April 2020
From:		Doron Levy [redacted]			Page 0 of 2
To:	Cc:	Company	Person	Email	
☒	☐	ACT FB	Brendan Scott	actfbfireengineer@act.gov.au	
☒	☐	ACT FB	Paul Owens	Paul.owens@act.gov.au	
☐	☒	Arcus Consulting	Matthew Gygi	[redacted]	
☐	☒	Manteena	Rod Mitton	[redacted]	
	☒	Fahrenheit Global	Daniele Cimmino	[redacted]	
SUBJECT: Canberra Hospital COVID-19 Health Clinic Fire Engineering Requirements					

Dear Brendan and Paul,

In continuation with our zoom meeting/conversation held earlier today 17/04/2020 on the proposed development of the Canberra Hospital COVID-19 Health clinic , please find below the main key point discussed today as record of our discussion.

Please do not hesitate to correct or modify any of the below strategies should it be required. Please also find attached the preliminary mark up plans and concept design for further comments or approval.

We discussed the following topics and proposed possible fire engineered solutions to meet the requirements of the National Construction Code/ Building Code of Australia (NCC/BCA2019). Due to the type of development, and the time frame in which design and building of the clinic is required we agreed that a performance based fire engineering approach is considered the most suitable.

The fire safety strategy for the clinic will be based on early warning and evacuation of patients in minimum time. To do this we discussed the following measures.

1. The building is to be deemed as one fire compartment with a total area of circa 1750 m². In accordance with the BCA requirements Type C construction is permitted.

2. The building will be sub-divided into four (4) smoke compartments. See attached plan. This in order to minimise the fire risk of smoke spreading within the clinic.

3. Additional exits to minimum requirement are incorporated within the design to allow for quick and appropriate evacuation of patients on beds, if required, as well as to minimise travel distances within the building.

4. A smoke detection to AS 1670.1- 2018 with reduced spacing between detectors (7 m in lieu of 10 m minimum requirement) is proposed to be installed within the building. The fire detection will have

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admin@fahrenheitglobal.com
www.fahrenheitglobal.com
Westfield Office Tower Level 5, Suite 506
152 Bunnerong Rd, Eastgardens 2036

a dedicated a direct link to the monitoring services and ACTFB. Manual call point will be proposed in line with Specification E2.2a along main corridors in proximity of exit doors.

5. A Building occupant warning system (BOWS) in lieu of an EWIS is proposed to be installed within the building. The occupant warning system will include Visual Alarms (i.e. strobes) in patient areas and throughout the building to minimise trauma and provide warning to impaired occupants. Non patient areas and main corridors will include alarm speakers.

6. External on-site fire hydrants are to be provided. A block plan showing the location of the hydrant valves in the vicinity of the building to be installed at the entrance to the building and FIP location.

7. Fire Extinguishers will be installed throughout the facility in lieu of Fire hose reels. Fire Extinguishers will be suitable for Type A and Type E risk.

We will issue ACTFB design plans of the above fire safety measures early next week (Monday or Tuesday), and the Fire Safety Assessment Report will be issued Wednesday.

Doron D Levy

Fire Safety Engineer

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK

From: Brady, Vanessa (Health)
Sent: Thursday, 14 October 2021 3:02 PM
To: Bale, Natalie (Health)
Cc: IHSS; Tarbuck, Chris (Health)
Subject: Surge Centre - Design Assessment Comments by CHS
Attachments: RE: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]; RE: Review: Fire Report COVID-19 ED [SEC=UNCLASSIFIED]; RE: Mechanical Design Review and return correspondence [SEC=UNCLASSIFIED]; RE: Mechanical Design Review and return correspondence [SEC=UNCLASSIFIED]; FW: Review: Fire Report COVID-19 ED [SEC=UNCLASSIFIED]; FW: Review: Fire Report COVID-19 ED [SEC=UNCLASSIFIED]

UNOFFICIAL

Hi Nat

Attached is a consolidated record of the emails I have in relation to CHS's assessment of the Surge Centre mechanical and fire design.

Regards

Vanessa Brady
Program Director
Campus Modernisation Program
Level 3, Building 8, Canberra Hospital

Infrastructure & Health Support Services I Canberra Health Services
M: [redacted] I E: Vanessa.Brady@act.gov.au

From: Beswick, Kevin
Sent: Monday, 4 May 2020 9:11 AM
To: Tarbuck, Chris (Health)
Cc: Brady, Vanessa (Health); [redacted]; Matthew Gygi; Gray, Sophie; Abraham, Robin
Subject: RE: Mechanical Design Review and return correspondence [SEC=UNCLASSIFIED]
Attachments: COVID-19 ED - Mechanical Drawings [SEC=UNCLASSIFIED]

Good morning Chris

Find attached Matt's e-mail detailing responses to your queries.

Regards

Kevin Beswick | Project Manager
Social Infrastructure | Infrastructure Delivery Partners
Major Projects Canberra | ACT Government
M [redacted] |**T** 02 5124 8660|**E** Kevin.Beswick@act.gov.au
The Canberra Hospital, Garran, GPO Box 158, Canberra ACT 2601

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ACT Government
Major Projects Canberra

From: Tarbuck, Chris (Health)
Sent: Sunday, 3 May 2020 6:27 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>; [redacted]; Matthew Gygi [redacted] Gray, Sophie <Sophie.Gray@act.gov.au>; Abraham, Robin (Health) <Robin.Abraham@act.gov.au>
Subject: RE: Mechanical Design Review and return correspondence [SEC=UNCLASSIFIED]

Hi Kevin,
I'm yet to receive a response, can you please ensure that I do by COB tomorrow.

Regards,

Chris Tarbuck | Facilities Director, Infrastructure and Health Support Services
Phone: (02) 5124 3186 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
Facilities Management| Canberra Health Services | ACT Government
Level 1, Building 1, Canberra Hospital, Garran ACT 2605 | health.act.gov.au
RELIABLE | PROGRESSIVE | RESPECTFUL | KIND

ACT Government | Canberra Health Services

From: Beswick, Kevin
Sent: Friday, 1 May 2020 5:35 PM
To: Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>
Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>; [redacted]; Matthew Gygi [redacted] Gray, Sophie <Sophie.Gray@act.gov.au>
Subject: RE: Mechanical Design Review and return correspondence [SEC=UNCLASSIFIED]

Hi Chris

I understand Matt Gygi will have a response by later tonight to your queries. I will forward them on to you as soon as I can. Please note that due to the facility's bespoke nature, unique operational and functional requirements and extremely tight build deadlines, we have not had the luxury of typical 30, 50 and 100% PSP and FSP design phases and reviews, and resources have been and are currently very busy so please forgive us on the protracted nature of the response to your queries.

I note that AECOM has been engaged to verify the services design and will also assist with commissioning plans, witness testing, etc.

Regarding the design, I understand that:

- JN provided a mechanical design based on a building load calculation done in-house and the WHO SARI Treatment Centre guidelines (attached) which discussed airflow rates and direction;
- The DX design from JN was changed by Benmax to a Boiler / Chiller arrangement to avoid the defrost cycle experienced here in Canberra;
- Benmax then sized the FCU's, Boiler, Chiller, ductwork to suit the recommended ACH's and Building load to arrive at the equipment selections;
- The Design Report from JN dated 19 April 2020 (attached) is still generally correct with the exception of the HEPA filtration which has been removed; and
- I understand that lengthy discussions were held with and agreement provided by Ian Norton from WHO on the mechanical design.

Please confirm any additional design data you require.

I can confirm that all mechanical shop drawings and equipment schedules have been uploaded to RedHub for your review.

Full O&M Manuals including As-Builts will be provided at the end of the project and Scott from Benmax has re-confirmed his understanding of this.

Regards

Kevin Beswick | Project Manager
Social Infrastructure | Infrastructure Delivery Partners
Major Projects Canberra | ACT Government
M [redacted] | **T** 02 5124 8660 | **E** Kevin.Beswick@act.gov.au
The Canberra Hospital, Garran, GPO Box 158, Canberra ACT 2601

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From: Tarbuck, Chris (Health)
Sent: Friday, 1 May 2020 3:13 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>

Cc: Brady, Vanessa (Health) <Vanessa.Brady@act.gov.au>
Subject: Mechanical Design Review and return correspondence [SEC=UNCLASSIFIED]

Hi Kevin,
Just following up on the expected return comments on our initial design review, we still are yet to receive anything. It's getting a little protracted.

Additionally, we have not received the design data for the mechanical system.

Regards,

Chris Tarbuck | Facilities Director, Infrastructure and Health Support Services
Phone: (02) 5124 3186 | Mobile: [redacted] | Email: chris.tarbuck@act.gov.au
Facilities Management| Canberra Health Services | ACT Government
Level 1, Building 1, Canberra Hospital, Garran ACT 2605 | health.act.gov.au
RELIABLE | PROGRESSIVE | RESPECTFUL | KIND

ACT Government | Canberra Health Services

From: Beswick, Kevin
Sent: Thursday, 30 April 2020 4:48 PM
To: [redacted]
Cc: [redacted] Greg Chambers [redacted] Matthew Gygi [redacted] Tarbuck, Chris (Health) <Chris.Tarbuck@act.gov.au>; Abraham, Robin (Health) <Robin.Abraham@act.gov.au>
Subject: FW: Electrical compliance [SEC=UNCLASSIFIED]

Hi [redacted]

Thanks for your help today in getting us all onto RedHub.

Please could I get your help with the following outstanding items:

1. Response to the queries from Chris Tarbuck sent 23/4;
2. Response to the attached queries from AECOM on the Electrical installation;
3. Provision of all shop drawings onto RedHub – note that Alan from AECOM has requested Electrical drawings below but we will need all trades;
4. Response to Samuel Lewin's mechanical queries also attached but which I'll also forward separately; and
5. Mechanical Equipment schedules – I have already requested Scott to upload these to RedHub to allow a review of capacities, equipment selections, etc.

Given our opportunity to change anything is dwindling based on the pace of installation, please could you expedite these items.

Thanks [redacted]

Regards

Kevin Beswick | Project Manager
Social Infrastructure | Infrastructure Delivery Partners
Major Projects Canberra | ACT Government
M [redacted] |**T** 02 5124 8660|**E** Kevin.Beswick@act.gov.au

The Canberra Hospital, Garran, GPO Box 158, Canberra ACT 2601

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ACT Government
Major Projects Canberra

From: Schmierer, Alan [redacted]
Sent: Thursday, 30 April 2020 4:19 PM
To: Beswick, Kevin <Kevin.Beswick@act.gov.au>; [redacted]
Cc: Matthew Gygi [redacted]; Greg Chambers [redacted] Doctor, David (Canberra) [redacted]
Subject: RE: Electrical compliance [SEC=UNCLASSIFIED]

Hi Kevin,

Your email was timely. Dave has reviewed the Consultant drawings from Redhub and the Comments Log attached has his queries included.

Can we get copies of any electrical shop drawings so Dave can review those, which might resolve some of the queries.

R

Alan

Alan Schmierer
Technical Director
[redacted]

AECOM
L4, Civic Quarter, 68 Northbourne Ave, Canberra, ACT 2601
PO Box 1942 Canberra City 2601
T +61 2 6100 0551
www.aecom.com

From: Beswick, Kevin <Kevin.Beswick@act.gov.au>
Sent: Thursday, 30 April 2020 3:56 PM
To: [redacted]
Cc: Matthew Gygi [redacted] Greg Chambers [redacted] Schmierer, Alan [redacted]
Subject: [EXTERNAL] Electrical compliance [SEC=UNCLASSIFIED]

Hi [redacted] One of the concerns CHS raised around compliance of the building was AS3003 Electrical Installations – Patient areas. Can you please confirm Shepherd Electrical have incorporated all requirements into the facility. If there are any deviations, please can these be documented.

Alan – just wondering if your team have been able to carry out a review of the Electrical installation? Do you have any comments or do you need a site review similar to the mech / fire site visit recently?

Thanks

Kevin Beswick | Project Manager
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M [redacted] **T** 02 5124 8660|**E** Kevin.Beswick@act.gov.au
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Sent: Friday, 1 May 2020 5:35 PM
To: Tarbuck, Chris (Health)
Cc: Brady, Vanessa (Health); [redacted]; Matthew Gygi; Gray, Sophie
Subject: RE: Mechanical Design Review and return correspondence [SEC=UNCLASSIFIED]
Attachments: SARI Treatment Centre manual draft V5.5.pdf; Building Service Summary.pdf

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Major Projects Canberra | ACT Government
M [redacted] **T** 02 5124 8660|**E** Kevin.Beswick@act.gov.au
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ACT Government
Major Projects Canberra

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Regards

Kevin Beswick | Project Manager

Social Infrastructure | Infrastructure Delivery Partners
Major Projects Canberra | ACT Government
M [redacted] **T** 02 5124 8660|**E** Kevin.Beswick@act.gov.au
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Alan

Alan Schmierer
Technical Director
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To: [redacted]
Cc: Matthew Gygi [redacted]; Greg Chambers [redacted]; Schmierer, Alan [redacted]
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Kevin Beswick | Project Manager
Social Infrastructure | Infrastructure Delivery Partners
Major Projects Canberra | ACT Government
M [redacted] **T** 02 5124 8660|**E** Kevin.Beswick@act.gov.au
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From: Brady, Vanessa (Health)
Sent: Friday, 15 October 2021 10:33 AM
To: Tarbuck, Chris (Health)
Subject: COVID-19 Emergency Department - CHS Design Briefing Requirements
Attachments: SARI Treatment Centre manual draft V5.5.pdf; Attachment A - Clinical Division between CHS ED and Aspen Medical Emergency Departments.pdf; 200401 Aspen Design Peer Review.pdf

Hi Chris

Please note the documents attached which were the CHS briefing documents to Aspen Medical.

Regards

Vanessa Brady
Project Director I Canberra Hospital Campus Modernisation

From: Brady, Vanessa (Health)
Sent: Wednesday, 1 April 2020 5:20 PM
To: Gray, Sophie <Sophie.Gray@act.gov.au>
Cc: Donaldson, Ben <Ben.Donaldson@act.gov.au>; Beswick, Kevin <Kevin.Beswick@act.gov.au>; Catanzariti, John <John.Catanzariti@act.gov.au>; Hollis, Gregory (Health) <Gregory.Hollis@act.gov.au>; [redacted]
Subject: COVID-19 Emergency Department - CHS Design Briefing Requirements

UNCLASSIFIED Sensitive

Hi Sophie

The following email serves as a consolidated refence email to Aspen capturing our feedback on the design to date.

Canberra Health Services briefing documents:

1. WHO SARI Treatment Centre Manual draft V5.5 - please note specific reference to pages 17, 18, 45 and 46.
2. CHS Clinical Division between CHS ED and Aspen Medical Emergency Departments
3. Peer review notes of the Aspen design dated 31/3/20.

The next design layout from Aspen must include the following details:

- Identification of zones - red; orange and green.
- A functionality summary of each space type – triage, resus, treatment room, suspect treatment bay; confirmed treatment bay etc.
- A workforce profile aligned with the operational requirements the design layout.
- A description of default systems used by Aspen – ICT, patient records; security; nurse call.

The design process should be to:

- Agree the patient flow and designation of zones.
- Internal layout.
- Internal layout overlaid with mechanical, electrical, sanitation/water and ICT.

Regards

Vanessa Brady
Project Director

Canberra Hospital Campus Modernisation Program

Infrastructure & Health Support Services I Canberra Health Services
M: [redacted] I E: Vanessa.Brady@act.gov.au

Dr. Ian Norton, Global Response - Peer review notes of Aspen design dated 31/3/20

To assist Canberra Health Services in design process, we have received a peer review from the Ian Norton of the World Health Organisation who has provided a number of observations on the layout of the proposed Aspen concept design dated 31/3/20.

The Division of the facility into suspected and confirmed cases is the correct methodology however these areas may require individual strategies for layout and operation.

The following comments were provided by the WHO following review of the proposed layout:

Whole Facility:

a. Mechanical design to pull air from corridors into and through each individual treatment space to avoid cross contamination.

b. Layout to be 'fishbowl' approach not lineal corridors. This will improve observation lines of site and reduce changing of PPE.

c. Corridors to be appropriately sized to accommodate mobile medical equipment.

d. Paper generated by and/or used within the facility cannot leave the facility. Paper must stay within the "red zone" and treated as a contaminated material.

e. Electronic devices must not transfer between suspected and confirmed areas.

f. No carers will be able to progress past the point of triage with the patient.

g. Where are the hand basin sink locations?

Triage

h. Triage will need chairs for rapid assessment and staff working within this space should be separated from patients by perspex. No touch policy.

i. Triage is a "red"zone.

Resus Bays

j. Elongated (longer) resus bays works more effectively than a square shaped configuration and aids in separation of patients/treating clinicals and assisting staff who stand behind a 3m line marking on the floor.

k. Exit directly from Resus required.

l. Each Resus bay to have perspex wall divider and negative pressure.

Suspected Case Area

m. Risk of cross contamination/infection much greater in this area.

n. Floor to ceiling clear perspex partitions between each treatment bay; curtains to front of treatment spaces preferred.

o. Higher ratio of ensuites to treatment bays. Cleaners must decontaminate and clean the bathrooms after each patient attendance.

p. Additional exit points required to enable confirmed 'negative' patients to be discharged from the suspected treatment bay without having to transfer through the length of the dirty corridor to exit - potential contamination transfer risk.

Workforce

q. Aspen workforce profile should include cleaning services.
r. One cleaner required per corridor per shift.

PPE

s. In the suspected case area:
    i. Two layers of PPE are worn – 2 x gowns; 2 x gloves.
    ii. Process of treating a "suspect" patient (no fluid transfer)
        - Top layer gown removed.
        - Second layer gloves removed.
        - Hand hygiene with fist layer of gloves ON.
        - New second layer gown and second layer gloves on before treating next patient.
    iii. Process of treating a "suspect" patient (fluid transfer)
        - Full PPE doffing.
        - Full double layer PPE donning.
t. The PPE exchange in the "confirmed" case area is less.
        - One layer of PPE are worn – 1 x gown ; 1 x gloves.
        - Glove change and hand hygiene between patients.
        - Change the full PPE if there is a fluid transfer.

Executive Director, CHS Critical Care

Palliation

u. How would a deceased person be discreetly removed?
v. Separate enclosed room for a patient to be palliated for short period of time. One carer to be allowed to don PPE and be with this patient.