

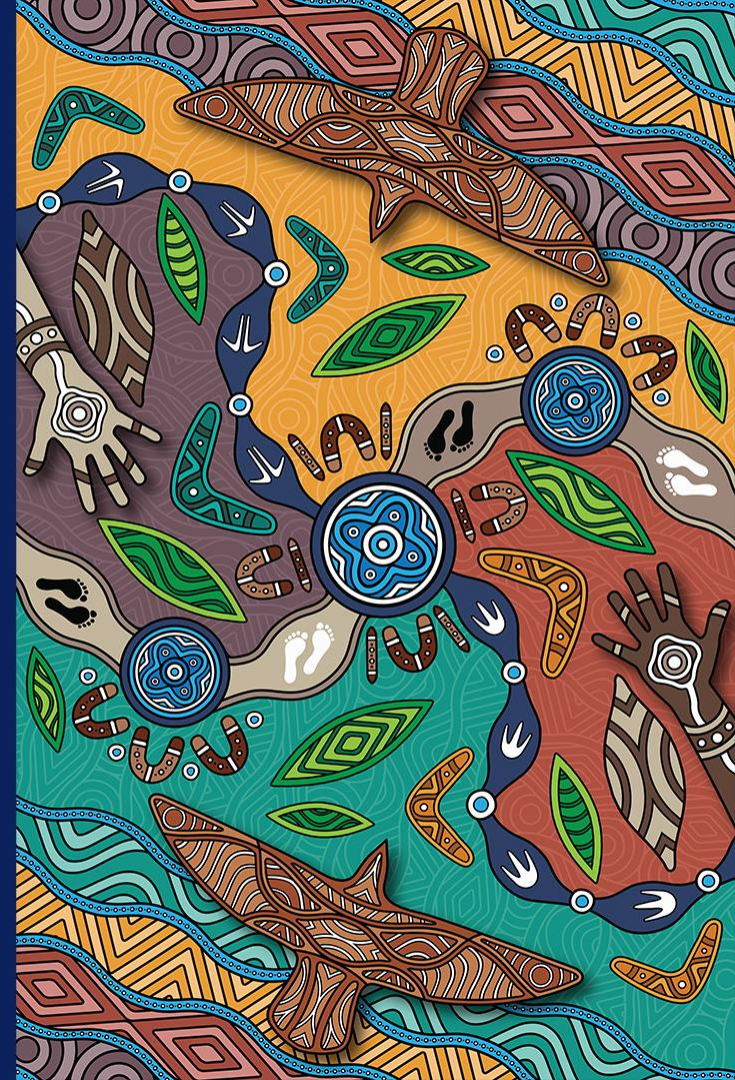
# Thinking outside the box. Converting single patient rooms into bespoke negative pressure rooms in a hospital with aged infrastructure.

**Liz Orr**

Manager Infection Prevention and Surveillance Service  
Royal Melbourne Hospital – 4kms over the Yarra river

- The Royal Melbourne Hospital acknowledges the Wurundjeri people of the Kulin Nations as the Traditional Custodians of the land we are meeting on today and pay our respects to Elders past, present and emerging.
- No conflict of interest to declare

*Walk Together*  
by Dixon Patten  
Gunnai and Yorta Yorta  
Bayila Creative



# Background

## Royal Melbourne Hospital

### Ageing infrastructure

- The Royal Melbourne Hospital (RMH) began in 1848 as Victoria's first public hospital as a 10 bed facility
- Moved to its present location in Parkville in 1944



# Royal Melbourne Hospital – through the years



## 1930s to 1940s: Planning for Parkville and World War Two

Increasing overcrowding led to the Committee of Management's decision to build a new hospital on the Cow and Pig Market site at Parkville

- A Government Order-in-Council on 30 July 1929 had reserved an area of a little over 10 acres



## RMH – Royal Park Campus

### 1840s to 1920s

Used for various purposes such as farming, schooling, infirmary before becoming a hospital.

Some building still there were built in 1875.

1930s and 1940s building works were undertaken.

1957 rehab unit built.



# RMH in 2024

"Great place to work and receive care"

## 600 acute bed facility (City Campus)

- 9 storeys (10 including cooling towers/plant room)
- 3 main buildings
  - Main block – built 1940s
  - South block – built 1990s
  - B block - ED, CCU and theatres
    - 2016
      - 7B haematology/BMT and ICU 100% single rooms
      - CSSD built to the former AS/NZ:4187
    - 2019
      - 8B stroke unit with 75% single rooms



# RMH City Campus single and negative room capacity in 2020

| Ward | Speciality                           | Bed number | Single rooms | Negative pressure |
|------|--------------------------------------|------------|--------------|-------------------|
| AMU  | Acute Medical Unit                   | 32         | 14           | 1                 |
| 2SE  | Cardiac day procedures               | 12         | 0            | 0                 |
| 2W   | General ortho, plastics ENT          | 21         | 1            | 0                 |
| 3E   | Day and night surgery 23 hour ward   | 17         | 0            | 0                 |
| 3S   | Emergency general surgery            | 28         | 0            | 0                 |
| 3SW  | Colorectal, hepatobiliary and trauma | 20         | 2            | 0                 |
| 4S   | Vascular, ophthalmology, urology     | 25         | 2            | 0                 |
| 4SW  | Neurosurgery                         | 30         | 4            | 0                 |
| 5N   | General medical                      | 20         | 5            | 0                 |
| 5SE  | General medical                      | 30         | 4            | 0                 |
| 5SW  | General medical                      | 30         | 4            | 0                 |
| 5DMC | Day Medical                          | 27         | 3            | 0                 |
| 6SE  | Cardiothoracics and respiratory      | 32         | 4            | 0                 |

| Ward              | Speciality                | Bed number | Single rooms     | Negative pressure |
|-------------------|---------------------------|------------|------------------|-------------------|
| 6SW               | Renal                     | 28         | 4                | 0                 |
| 6W                | Dialysis                  | 13         | 1                | 0                 |
| 7SE               | Trauma                    | 30         | 4                | 0                 |
| 7SW               | Ortho                     | 30         | 4                | 0                 |
| 7W                | Palliative care           | 19         | 4                | 0                 |
| 9E                | VIDS                      | 20         | 14               | 20                |
| 9W                | Acute care of the elderly | 25         | 4                | 0                 |
| 2B & CCU          | Cardiac and CCU           | 33         | 7                | 0                 |
| ICU               | Med/surg/trauma           | 42         | 42               | 7                 |
| 7B                | Haem/BMT                  | 32         | 32               | 0                 |
| 8B                | Stroke                    | 31         | 19               | 0                 |
| <b>Total beds</b> |                           | <b>627</b> | <b>178 = 28%</b> | <b>28</b>         |

# Single and negative pressure room capacity in 2020

| Ward | Speciality                           | Bed number | Single rooms | Negative pressure |
|------|--------------------------------------|------------|--------------|-------------------|
| AMU  | Acute Medical Unit                   | 32         | 14           | 1                 |
| 2SE  | Cardiac day procedures               | 12         | 0            | 0                 |
| 2W   | General ortho, plastics ENT          | 21         | 1            | 0                 |
| 3E   | Day and night surgery 23 hour ward   | 17         | 0            | 0                 |
| 3S   | Emergency general surgery            | 28         | 0            | 0                 |
| 3SW  | Colorectal, hepatobiliary and trauma | 20         | 2            | 0                 |
| 4S   | Vascular, ophthalmology, urology     | 25         | 2            | 0                 |
| 4SW  | Neurosurgery                         | 30         | 4            | 0                 |
| 5N   | General medical                      | 20         | 5            | 0                 |
| 5SE  | General medical                      | 30         | 4            | 0                 |
| 5SW  | General medical                      | 30         | 4            | 0                 |
| 5DMC | Day Medical                          | 27         | 3            | 0                 |
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| 6SW               | Renal                     | 28         | 4                | 0                 |
| 6W                | Dialysis                  | 13         | 1                | 0                 |
| 7SE               | Trauma                    | 30         | 4                | 0                 |
| 7SW               | Ortho                     | 30         | 4                | 0                 |
| 7W                | Palliative care           | 19         | 4                | 0                 |
| 9E                | VIDS                      | 20         | 14               | 20                |
| 9W                | Acute care of the elderly | 25         | 4                | 0                 |
| 2B & CCU          | Cardiac and CCU           | 33         | 7                | 0                 |
| ICU               | Med/surg/trauma           | 42         | 42               | 8                 |
| 7B                | Haem/BMT                  | 32         | 32               | 0                 |
| 8B                | Stroke                    | 31         | 19               | 0                 |
| <b>Total beds</b> |                           | 627        | <b>178 = 28%</b> | <b>29</b>         |

## Royal Park Campus 2020

| Ward  | Speciality        | Bed number            | Single room        | Negative pressure |
|-------|-------------------|-----------------------|--------------------|-------------------|
| AC1   | Sub acute         | 20 (4 bed rooms)      | 4                  | 0                 |
| AC2   | Sub acute         | 21 (4 bed rooms)      | 2                  | 0                 |
| AC3   | Sub acute         | 24 (some 5 bed rooms) | 1                  | 0                 |
| AC4   | Sub acute         | 25                    | 21                 | 0                 |
| TCP   | Transitional care | 32                    | 32 shared ensuites | 0                 |
| Rehab | Rehab             | 40                    | 14                 | 0                 |
|       | <b>Total beds</b> | <b>162</b>            | <b>74 = 46%</b>    |                   |

## Royal Park Campus 2020

| Ward  | Speciality        | Bed number            | Single room        | Negative pressure |
|-------|-------------------|-----------------------|--------------------|-------------------|
| AC1   | Sub-acute         | 20 (4 bed rooms)      | 4                  | 0                 |
| AC2   | Sub-acute         | 21 (4 bed rooms)      | 2                  | 0                 |
| AC3   | Sub-acute         | 24 (some 5 bed rooms) | 1                  | 0                 |
| AC4   | Sub-acute         | 25                    | 21                 | 0                 |
| TCP   | Transitional care | 32                    | 32 shared ensuites | 0                 |
| Rehab | Rehabilitation    | 40                    | 14                 | 0                 |
|       | <b>Total beds</b> | <b>162</b>            | <b>74 = 46%</b>    |                   |

# Single room and negative pressure room capacity - 2022

## Caring for patients in the right place

- Moving all COVID positives to 9 East (VIDS) or ICU was not sustainable, or patient centered
- Needed a solution for trauma, surgical, stroke and other specialties
- Royal Park Campus had the largest outbreak in Australia
  - Closed AC1, AC2, AC3 and TCP due to poor and inadequate ventilation (lost 97 bed capacity)
  - Opened a 16-bed ward in City Campus - 4SE
  - 23 TCP beds purchased in a private RACF

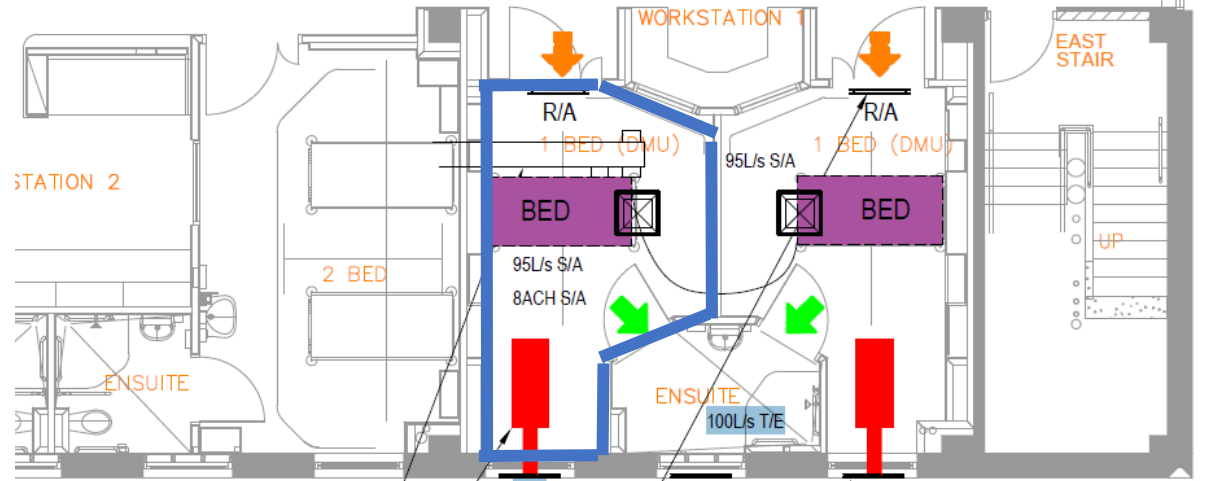
## Negative pressure options

|  |  |
|--|--|
| <b>Install N class negative pressure rooms</b> | Very expensive<br>Ward design prohibitive and we have no space<br>No space for anterooms<br>Not enough space in the current plant room |
| <b>Retrofit old ICU rooms</b>                  | Decommissioned and expected to cost “over one million”<br>Currently used for Clinical Trials   |
| <b>7B positive pressure rooms</b>              | ?Change a few rooms from positive pressure to negative pressure<br>Not without risk  |
| <b>Retrofitting previously used rooms</b>      | During renovations some wards had temporary negative pressure<br>Engineering and Infection Prevention not happy with the solution      |

# Retrofitting previous used rooms

## Issues

- Floor mounted unit in the general medical ward
  - No space
  - Risk of falls
- Noisy 53dBA (max 45dBA)
- Return air grille needed to be closed
  - If this fails it would become positive pressure
- \$85,000 for 4 rooms –may be inaccurate



Common supply air system for the ward. Risk of cross infection.

### ASTRO PURE 850

Floor mounted unit will restrict circulation space around bed. (two options shown)  
Unit 30 - 53 dBA. (Patient Room recommended 45 dBA Max)

Return air grille into ceiling space. (ie ceiling is a return air plenum). Grille to be blanked off to achieve a negative pressure and to avoid dust being drawn from the ceiling space into the bed room.

Note: if grille is blanked off and exhaust air fails room will become positive pressure. Recommend duty/standby fans.

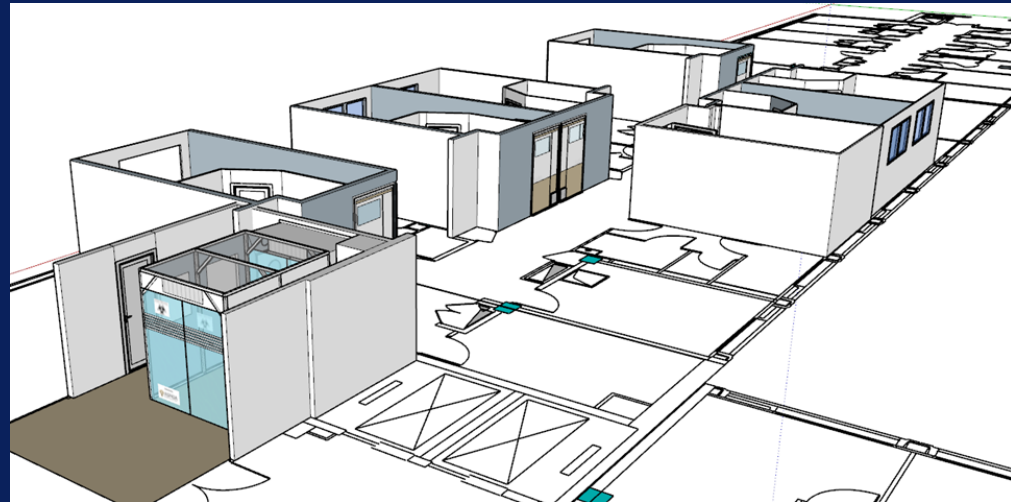
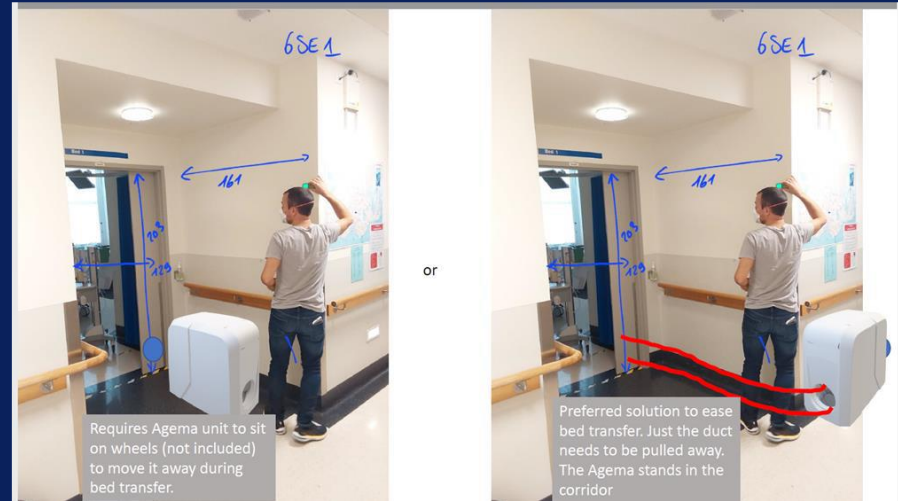
## Other options

### Agema solution - France

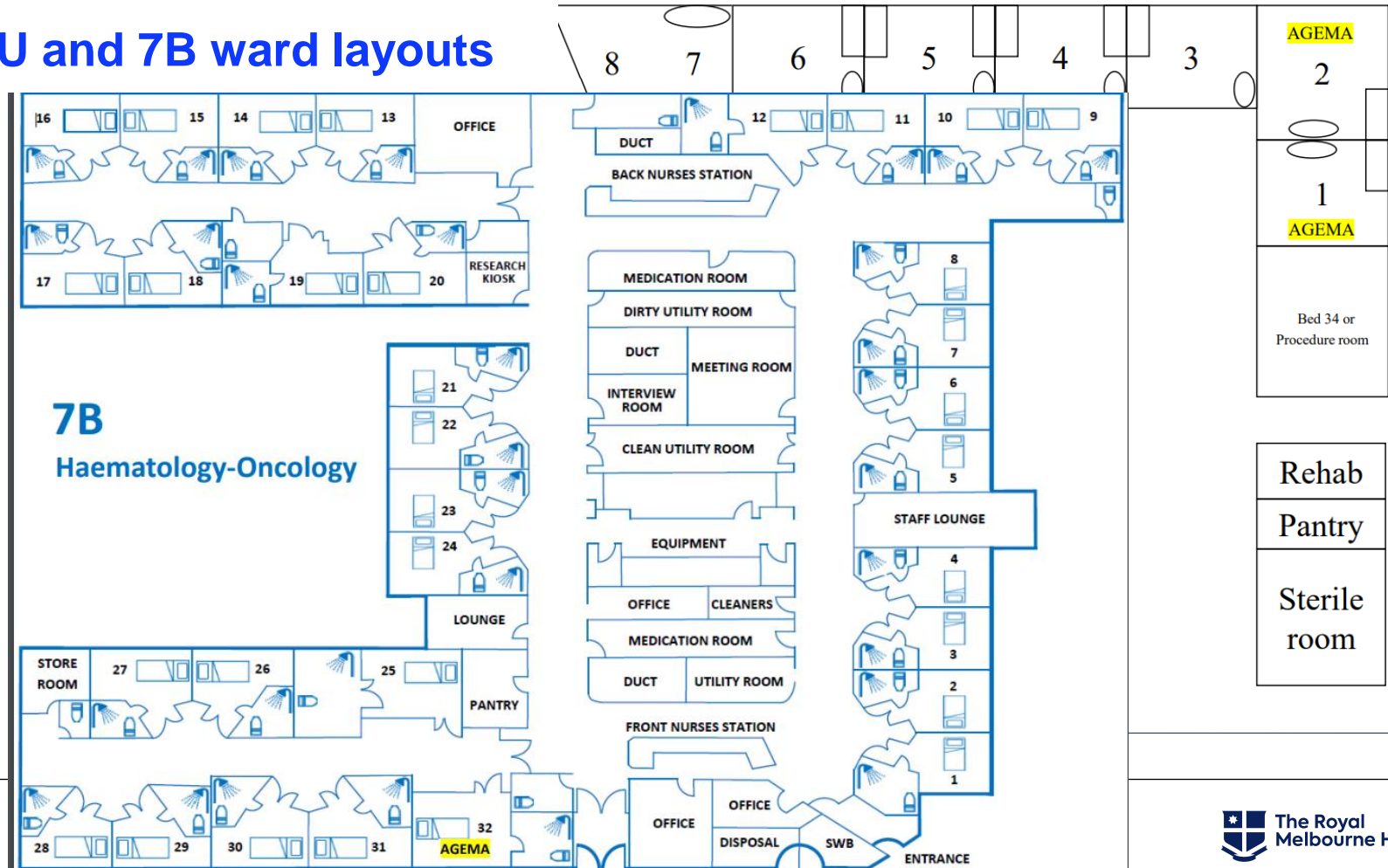


## Agema room

- Designed to create negative pressure from the corridor into the patient room
- Can be used with or without an anteroom
- Function like a normal N class negative pressure room with the door lock, air flow direction and HEPA filtration
- Min 12 air changes per hour or 160 l/s/patient at constant flow
- Very low noise level: NFS90-351:2015 compliance. Noise level at patient bed 40dBa.
- Very low energy consumption: 70W on average per unit
- Fast installation in a day
- **Retrofitted to existing infrastructure**

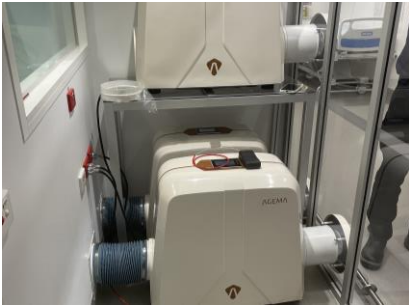


# CCU and 7B ward layouts



# 7B Haematology and BMT ward – bespoke unit

## Installation 13<sup>th</sup> December 2022



# Agema units – bespoke in CCU

## 2 single rooms with shared anteroom



# Agema units – bespoke in CCU

## 2 single rooms with shared anteroom



Bed 1

## Inside the anteroom



Bed 2



Inside looking out

## 7B Haematology and BMT ward Present day



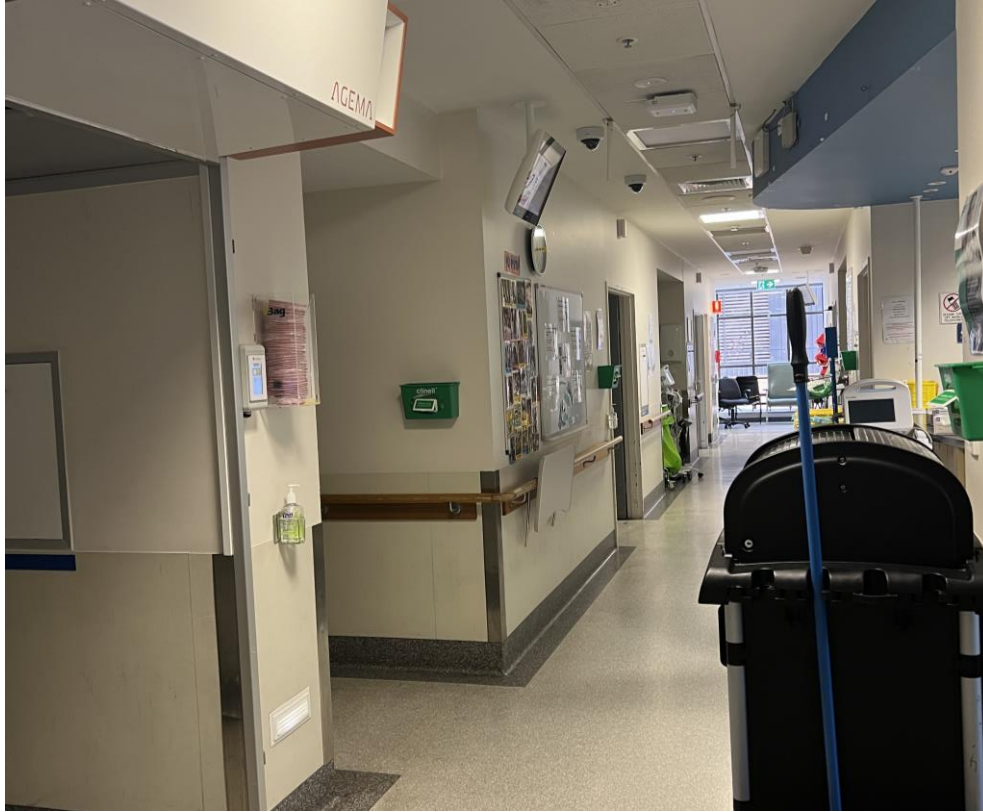
# Wards that received an Agema unit

| Ward                        | Specialty  |
|-----------------------------|--|
| 3SW                         | Colorectal, hepatobiliary and trauma                             |
| 4SE                         | Vascular, ophthalmology, urology (was acute care of the elderly) |
| 5SW - 3 Agema Units         | General Medicine   |
| 6SE                         | Cardiothoracic (now plus respiratory)                            |
| 6SW                         | Renal  |
| 7SE                         | Trauma   |
| 7SW                         | Orthopaedics   |
| 8B                          | Stroke   |
| 7B                          | Haematology and BMT  |
| CCU - 2 Bespoke Agema Units | Coronary Care Unit   |

RPC wards were closed at this time

# Agema units – commercially available



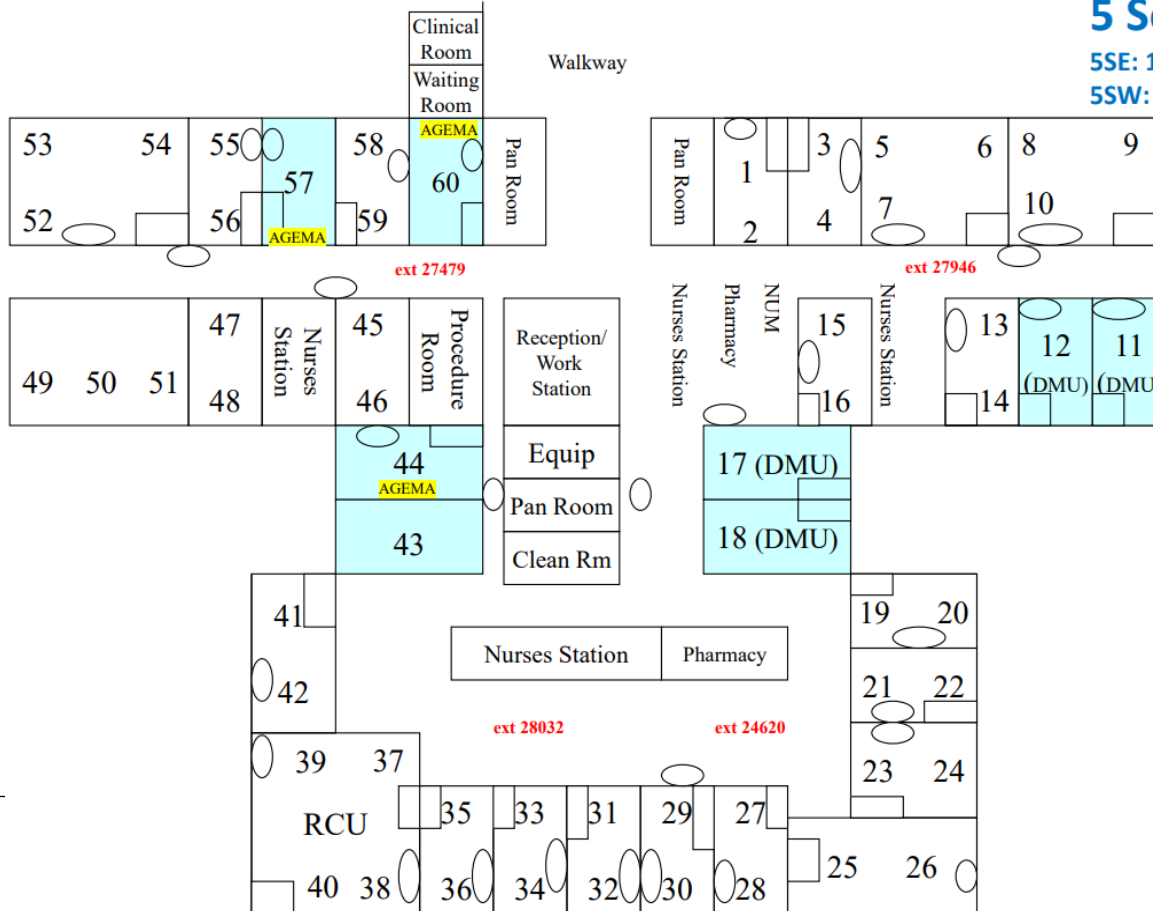


# South block layout

## 5 South

5SE: 1-30

5SW: 31-60

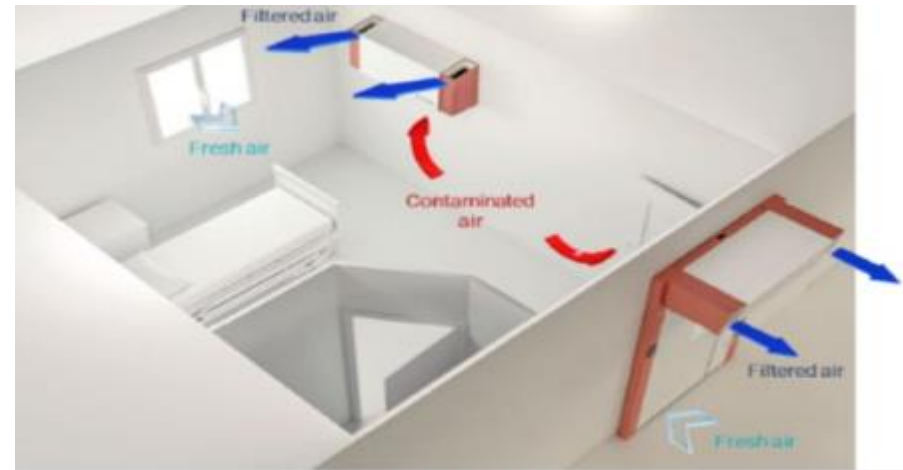


# Ward manual and procedure

- Procedure for prioritisation of Agema rooms
- Clinical operations manual
  - 7B and CCU
  - Other wards
  - Troubleshooting and pressure monitoring
- The Agema unit above the door draws contaminated air from within the patient's room, via the grille above the door. The air passes through the Agema unit and the HEPA filter therein, then expels clean (i.e., filtered) air into the corridor.
- Agema rooms are in constant negative pressure compared to the corridor (unless door open) at  $-15$  pascals

## 5.2. Agema Unit patient prioritisation:

| Agema Unit Prioritisation Table |  |
|---------------------------------|--|
| Priority 1                      | <ul style="list-style-type: none"><li>• COVID-19 – confirmed infection takes priority over other infections</li><li>• High risk suspected COVID (symptomatic household contact, while waiting for initial PCR result)</li><li>• Confirmed influenza A or B</li></ul> |
| Priority 2                      | <ul style="list-style-type: none"><li>• COVID household contact (asymptomatic or symptomatic) if initial PCR negative</li><li>• RSV</li><li>• Parainfluenza</li><li>• Human Metapneumovirus</li><li>• Adenovirus</li></ul>   |
| Priority 3                      | <ul style="list-style-type: none"><li>• Rhinovirus (6SW or 7B patients only)</li><li>• Non COVID/MERS coronavirus (6SW or 7B patients only)</li></ul>  |



# Agema room utilisation from 13th December 2022 to 30th September 2024

## Data Source

1. Health Intelligence report, “Inpatients by ward and date range” – used to identify patients in each ward
2. Health Intelligence report, “Inpatients by UR and date range” – used to identify all inpatient locations, based on UR numbers
3. EMR report “Find Patient Isolations” – list of all patients for data period and type of precaution (if any)
4. VICNISS COVID monitoring line list
5. ICNet COVID positive line list

# Results

Number of patients admitted to AGEMA room and bed days, by ward

| Ward         | Bed number | Time period        | Number of episodes (patients admitted to AGEMA room*) | Total bed days | COVID positive^ at time of occupying AGEMA room |
|--------------|------------|--------------------|---|----------------|---|
| <b>3SW</b>   | 43         | 2/8/23 – 30/9/24   | 184   | 391            | 43  |
| <b>4SE</b>   | 3          | 2/8/23 – 30/9/24   | 229   | 374            | 41  |
| <b>5SW</b>   | 44, 57, 60 | 2/8/23 – 30/9/24   | 396   | 1111           | 91  |
| <b>6SE</b>   | 1          | 2/8/23 – 30/9/24   | 221   | 403            | 32  |
| <b>6SW</b>   | 44         | 2/8/23 – 30/9/24   | 160   | 392            | 24  |
| <b>7SE</b>   | 1          | 2/8/23 – 30/9/24   | 186   | 381            | 33  |
| <b>7SW</b>   | 44         | 2/8/23 – 30/9/24   | 171   | 361            | 28  |
| <b>8B</b>    | 3          | 2/8/23 – 30/9/24   | 179   | 382            | 39  |
| <b>7B</b>    | 32         | 13/12/22 – 30/9/24 | 119   | 624            | 19  |
| <b>CCU</b>   | 1, 2       | 13/12/22 – 30/9/24 | 834   | 1045           | 85  |
| <b>Total</b> |            |                    | <b>2679</b>   | <b>5464</b>    | <b>435</b>                                      |

\*Contains duplicate patients, as the same patient could have been admitted to the same AGEMA room more than once during their inpatient stay. Other scenario includes patient admitted to AGEMA room, moved to another bed and then admitted back to the AGEMA room. This counts as 2 patient admissions to the AGEMA room.

^COVID positive or within 7-day isolation period.

# Results

- AGEMA rooms across 10 wards
- On average, there were 206 patients admitted per AGEMA room between 2/8/2023 and 30/4/2024
- CCU had the highest number of patients admitted to their two AGEMA rooms
  - 326/834 (85%) patients were admitted to an AGEMA room in CCU for <24 hours
- 744/2679 (28%) patient admissions to an AGEMA room with any type of precaution order set in place (respiratory/droplet/airborne)
- Wards very happy to have their home patients on their wards
- Staff reported minor teething issues
- No COVID transmissions or outbreaks where Agema rooms were used

**Thank you**

