



SURGE IN NUMBERS: CONVERTIBLE WARDS & EXPANSION

The lessons from SARS in 2003 left a deep impact on healthcare in Singapore, and from then, measures were put in place to prepare the country for the next outbreak.

When SARS hit Singapore, Er. Goh Mia Siang was at the forefront of the battle at TTSH, rapidly innovating solutions to meet the needs of the SARS patients.

With the current pandemic, Er. Goh and his team got into action to race against time, converting the National Centre of Infectious Diseases (NCID) cohort wards to isolation rooms, using a pre-fabricated demountable wall, and other works to ensure the safety and comfort of patients and staff.

With the experience gained during SARS, Er. Goh and his team were able to convert and scale up isolation facilities.

Flexibility in Design of NCID

NCID was designed using SARS (which had 238 cases of infections) as a planning parameter. It has adopted a set of design principles that fused connectivity, convertibility, capability, safety, capacity and scalability to manage outbreaks.

“However, COVID-19, with well over 20,000 cases of infections to date, and more than 1,000 hospitalisations, demands on infra capacity is far more than NCID can accommodate; And these infra expansion has to be delivered fast, effective, and cost efficient,” said Er. Goh.



Walkway tentage has been widened as waiting area at the NCID SC.

Expansion of Screening Centre

The purpose-built NCID Screening Centre (SC) has a capacity of 200 seats. This was inadequate for the daily attendance of more than 500 patients.

To support the SC, fast track SC expansion projects were implemented. This included a 780 sqm SC tentage extension for 60 screening patients. It had an X-ray room, 2 pharmacies and 4 consultation rooms, all with duty and standby air-conditioning units. It was divided into 4 zones; each zone has its own nurse station.

The self-sufficient SC extension, delivered within 6 days, was well ventilated and was equipped with RFID patient tracking system, IT capability, CCTV and PA system. Even the wastewater from its toilets and washbasin were chemically treated before disposal by licensed collector.



The SC tentage extension was complemented with a 138 sqm tentage Discharge Area (Lounge), complete with recliners and chairs for 40 patients at the Ambulance Bay; plus a 323 sqm tentage Transport Waiting Area with seats for 70 patients waiting for results or transfer to CIF on the slope in front of SC. Over 70 power socket outlets were provided in the tentages for patients to charge their phones while waiting. These were completed within 4 days.

The Inpatient Conversions

Four of NCID's Natural Ventilated Cohort Wards could be converted into Air Conditioned Isolation Wards. Each of the 4-bedded cohort cubicle could be converted into two 2-bedded isolation rooms.

With the surge in number of COVID-19 cases, the team would have to convert the general inpatient areas into isolation areas as soon as possible.

Even with convertibility, renovation would take a lengthy 10 days per ward, a total of 40 days to complete the conversion which was way too long. Through streamlining and close collaboration with the installers, Er. Goh and his team took one week to complete the conversion of all four cohort wards in NCID.

The history of convertible wards dated back to 2008, when inpatient areas at the main hospital building was retrofitted with features to enable them to be convertible.

Each 4-bedded cubicle in could be converted into two single/twin isolation rooms plus a common anteroom. The conversion time would be one day per ward.

Conversion of one Natural Ventilated Cohort

Cubicle into two Single/Twin Isolation Rooms To make sure that the converted isolation rooms met isolation room guidelines after the conversion, the team had to take the following steps:

- Install polycarbonate panels on all windows in the cubicle
- Install demountable wall to cover opening, and apply construction sealant to all gaps
- Conduct smoke test
- Switch to air conditioning mode, and reconnect isolated ductwork and accessories
- Programme the Building Energy Management System (BEMS), and the Venturi Valve (VV), a system for controlling the airflow in and out of the containment, maintaining its negative pressure
- Check pressure regime, temperature, relative humidity and air change rate

Conversion of one Normal HDU Cubicle into two Single/Twin Isolation ICU Rooms

Over at the main TTSH building, the team was faced with the need to create isolation ICU rooms. To ensure that the converted isolation ICU rooms meet isolation room guidelines, the conversion involves:

- Close all collapsible partitions. Apply special cleanroom antimicrobial sealing tape to all gaps.
- Conduct smoke test.
- Energize the HEPA filtered exhaust system. Check differential pressure regime and air change rate for compliance to design.
- Check temperature and relative humidity and make the necessary adjustment.
- Check all accessories including kill tank equipped washbasins for proper function.



Completed works in ICU at main hospital. Upgraded existing exhaust system and reduced leakage through the wall and doors, thereby increasing the differential pressure between the internal corridor and the patient cubicles.

Conversion of Acute Wards and Short Stay Ward for COVID Patient Care

To cope with the increasing number of patients, exhaust fans were deployed out for retrofitting at the main TTSH Wards and Sub Acute wards at Ren Ci Community Hospital for COVID patient care. These exhaust fans were originally deployed during 2003 SARS outbreak, and have been stored and maintained for use in a pandemic situation. The retrofitting works include:

- Install fan and timber panels at designated cubicles/rooms and connect the electrical supply
- Activate the fans to create negative pressure, unidirectional airflow and single pass air change of at least 20 air change per hour
- Modify air conditioning system to minimize condensation and other problem.
- Apply printed vinyl stickers to soften the look and feel

This allowed us to convert 12 acute wards to accommodate infected patients in less than 2 weeks.



Rapid retro fitting completed in TTSH wards

Challenges & Solutions

Delivering the required needs within an extreme timeline in a pandemic especially during a 'circuit breaker' (where materials and external contractors are unavailable), called for special considerations and solutions.

For Er. Goh, the challenges were met with some ease by the camaraderie of colleagues and a strong "Kampung Spirit", true to the culture of TTSH. He shared some of the challenges he faced:



Time Pressure & Rapidly Evolving Situation

In outbreaks, the situation would change rapidly. To respond effectively to the evolving needs, deliverables would have to be completed within a compressed timeline. While the number of patients were low initially, the numbers shot up exponentially when the surge happened.

Soon, there was a volley of requests to convert/create facilities to cope with this surge.

Examples were the expansion of the Screening Centre (SC), the conversion of general acute wards, MAC and ICUs into Infectious Disease (Covid-19) wards and ICUs, enhancement of ventilation in Enhanced Pneumonia Surveillance wards@CDC2, and the creation of Short Stay Wards.

To overcome this challenge, the team took a LEAN approach, spreading the team's manpower thinly, and everyone have to worked onsite for a minimum of 6 days per week.

"As leaders, we have to practice Go-and-See, as there is no room for error and no time for a hierarchy reporting structure; the solution and decision had to be made there and then," Er. Goh said.

Lack of External Resources

Due to the implementation of circuit breaker measures, many contractors and vendors were unable to come to TTSH/NCID to provide the manpower and material needed.

As TTSH/NCID were seen as the "epicentre" of COVID-19, other contractors and vendors were reluctant to take on jobs in TTSH/NCID.

Faced with this hurdle, the team sourced and used whatever materials and contractors available. Er. Goh also appealed to the government agencies for release of willing contractors under lockdown to continue to work in TTSH/NCID.

Er. Goh shared, "We have to think out of the box and use whatever resources available to do whatever we can. For example, the Nursing Department needed an intercom system and Panic Button system, but there was no vendor nor material to build one; so we acquired walkie-talkie sets and mounted some at fixed locations for use as an intercom system, other walkie-talkie sets were carried by staff as mobile panic buttons."

Lessons Learnt

While it is technically possible to convert (repurpose) and expand the existing facility further, such additions and alterations would be subjected to the availability of time, budget, whitespace and spare capacity in infrastructural services.

With experience in both SARS and now COVID-19 crisis management, Er. Goh took away lessons that would strengthen the resilience of the healthcare system even further.

He advised that in outbreaks, provisions for a surge in number of infections must be made to future proof the healthcare system.

When it came to the design and construction stage of a new development project, it was also important to prioritise modularity, scalability, coupled with reliability, resiliency, maintainability, efficiency, and effectiveness over aesthetic and cost.

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