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LETTER TO THE EDITOR

The fight against COVID-19: disinfection protocol and turning over of CleanSpace® HALO™ in a Singapore Hospital

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To the Editor-in-Chief,

The COVID-19 pandemic has infected more than a 3 million patients, caused > 230,000 deaths, and have greatly impacted the lives of millions [1]. Singapore was one of the first countries outside China to be affected by the virus. Aggressive contact tracing and isolation with national legislations have helped limit the spread of the virus to just over 1400 people over the last 10 weeks of the pandemic. Nonetheless, there has been increasing community spread with a high number of unlinked cases detected. This has necessitated a partial lockdown to enforce distancing measures. Healthcare workers (HCW) meanwhile are rapidly ramping up capabilities and preparing for a worsening of the crisis.

COVID-19 has been well established to spread through droplets and potentially, aerosol-generating procedures (AGP) [2]. The protection of the health of HCW is of paramount importance. One of the few protective measures is the strict compliance to personal protective equipment (PPE). On top of the utility of surgical face masks and N95 respirators, powered air-purifying respirators (PAPR) is another tool in our armamentarium. Of significant importance is the worldwide shortage of disposable N95 respirators due to production and supply chain cuts. Protectionist policies and stockpiling have also greatly reduced availability [3].

Sengkang General Hospital was a newly opened 1400 bed hospital in August 2018. To date, we have managed 748 COVID-19 positive cases in a "mixed COVID" hospital. Currently, 0% of the hospital's HCW have been infected by COVID-19. As routine stocks for disaster and emergency preparedness, we had purchased 686 CleanSpace® HALO™ (CleanSpace Technology Pte Ltd, Artarmon, NSW, Australia) PAPR. In the pandemic outbreak, these PAPRs were provisioned to clinical areas with COVID patient contact or had a risk of exposure to AGP—Operating Theatre (OT), Endoscopy Centre, Emergency Department (ED), Intensive Care Unit (ICU) and isolation wards.

Each CleanSpace® HALO™ consists of a detachable reusable mask (half/full), HEPA filter, the power system, reusable harness and neck support. When compared to the HAZMAT suits and 3 M™ Jupiter™ PAPR Helmet, which were used commonly during the SARS-CoV-2003 outbreak, the CleanSpace® HALO™ is marketed as the lightest PAPR, potentially offering doctors better manoeuvrability and comfort. This PAPR with face-pieces also has a higher Assigned Protection Factor (workplace level respiratory protection) of 50 compared to hooded PAPR with loose-fitted PAPR which has an APR of 25 [4].

The utility, disinfection and turnover of these PAPR are critical in ensuring the availability of the device during high risks procedures. To date, there has been limited knowledge of the processes and recommendations for such PAPR. This is especially pertinent as COVID-19 pandemic is likely to be protracted and traditional N95 respirators will continue to be restricted supply.

Our hospital's Central Sterile Supply Unit (CSSU) has advised for the surface disinfection of individual parts of the PAPR upon its removal, using Isopropyl Alcohol 70% wipes in keeping with UK guidelines.[5] While bleach may reduce contaminants more, handling of bleach in the clinical area is not as common as compared to the alcohol wipes [6]. The masks and harnesses of the CleanSpace® HALO™ are then collected in biohazard-waste-bags-lined containers before being dispatched to the CSSU 3 times a day (8 a.m., 2 p.m., 8 p.m.), to ensure a full-load disinfection is performed each time. When masks and harnesses are dropped off with a dispatch form (Fig. 1), they would be exchanged with the same

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Sengkang General Hospital
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CleanSpace HALO Mask & Harness

Dispatch Form

Unit :

Contact Number :

Contact Person :

Dispatch Timings:
8am, 2pm, 8pm

Put this form into a clean plastic bag, and staple above the cable tie on the biohazard bag.

1 Wipe PAPR (Mask/Harness/Power Blower) after use.

Mask & Harness

Power Blower

Use the above disinfectant wipes available in unit.

2 Bag the Mask & Harness

Bag the Mask as shown using the following items:

x2 Biohazard Bag

x1 Cable Tie

Place x1 Dispatch Form in a *clean plastic bag*, and staple above the cable tie on the biohazard bag.

3 Store at individual unit

DO NOT SEND TO CSSU

4 Indicate Quantity DISPATCHED to CSSU

		Size S	Size M	Size L
Half Mask, CleanSpace®	:			
Harness	:			
CSSU Staff Received	:			
Date & Time	:			

5 Indicate Quantity RETURNED to Unit

		Size S	Size M	Size L
Half Mask, CleanSpace®	:			
Harness	:			
CSSU Staff Returned	:			
Date & Time	:			
Porter Name	:			

**Dispatch form is kept in respective ward*

Fig. 1 PAPR dispatch form with pictorial instructions on surface disinfection and packaging before thermal disinfection by CSSU

number of cleaned masks and harnesses and sent back to facilitate quick turnover and sustained availability of PAPR in clinical areas.

In the CSSU, further thermal disinfection, which was found to be superior to surface alcohol disinfection, would be performed for the masks and harnesses. This includes a 25 min wash cycle, followed by a 1-min thermal disinfection at 90 °C. The masks have been validated to tolerate up to 30 such cycles up to a maximum of 90 °C. To safeguard against silicone degradation, the drying cycle of the disinfection, which is at a temperature > 90 °C, has been replaced by blow drying by pressurized air-guns. A total of 45 min is required for this entire process.

Random adenosine triphosphate (ATP) test swabs, especially around the exhalation valves where most contamination are expected, are conducted to ensure quality control of the cleaning efficacy before the parts are repackaged. The mean Relative Light Unit (RLU) before and after the disinfection process is 430.9 and 23.6. (Figure S1) Masks and harnesses are tagged digitally, and upon completion of 30 cleaning cycles, would be identified and discarded.

The fight against COVID-19 will be protracted [7]. The protection of HCW and thereby the preservation of the workforce cannot be further emphasized. The proper utility and cleansing of PAPR are but just 1 crucial element in the cog. We hope that by sharing the rationale and method of reprocessing of CleanSpace® HALO™, hospitals who are making use of this PAPR would be able to use this as a springboard to facilitate readily available PAPR to the HCW participating in high-risk procedure during the pandemic.

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Compliance with ethical standards

Conflict of interest The author declares that they have no conflict of interest.

Research involving human participants and/or animals The study does not involve any human/animal subjects.

Informed consent Informed consent is not necessary for this type of study.

Code availability NA.

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