



Figure Complete operating room workflow for a coronavirus disease 2019 (COVID-19) case. CD = controlled drugs; ICU = intensive care unit; NM = nurse manager; OR = operating room; PAPR = powered

air-purifying respirator; PC = personal computer; PPE = personal protection equipment; pre-op = preoperative



What we do when a COVID-19 patient needs an operation: operating room preparation and guidance

Lian Kah Ti, MBBS, MMed, FAMS · Lin Stella Ang, MBBS, MMed, FANZCA, EDIC ·
Theng Wai Foong, MBBS, MMed · Bryan Su Wei Ng, MBBS, FRCA

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To the Editor,

We read with interest the recent review in the *Journal* by Wax and Christian¹ on coronavirus disease 2019 (COVID-19). The first case of COVID-19 in Singapore was confirmed on 23 January 2020.² In the week of February 13–19, the World Health Organization reported that Singapore had more cases of COVID-19 than any other country outside of mainland China.³ We wish to share the protocol that we use in our hospital in preparing an operating room (OR) for confirmed or suspected COVID-19 patients coming for surgery.

An OR with a negative pressure environment located at a corner of the operating complex, and with a separate access, is designated for all confirmed (or suspected) COVID-19 cases. The OR actually consists of five interconnected rooms, of which only the ante room and anesthesia induction rooms have negative atmospheric pressures. The OR proper, preparation, and scrub rooms all have positive pressures (eFig. 1 in the Electronic Supplementary Material [ESM]). Understanding the

airflow within the OR is crucial to minimizing the risk of infection.

The same OR and the same anesthesia machine will only be used for COVID-19 cases for the duration of the epidemic. An additional heat and moisture exchanger (HME) filter is placed on the expiratory limb of the circuit. Both HME filters and the soda lime are changed after each case. The anesthetic drug trolley is kept in the induction room. Before the start of each operation, the anesthesiologist puts all the drugs and equipment required for the procedure onto a tray to avoid handling of the drug trolley during the case. Nevertheless, if there is a need for additional drugs, hand hygiene and glove changing are performed before entering the induction room and handling the drug trolley.

A fully stocked airway trolley is also placed in the induction room. As far as possible, disposable airway equipment is used. The airway should be secured using the method with the highest chance of first-time success to avoid repeated instrumentation of the airway, including using a video-laryngoscope.⁴ Equipment in limited supply, such as bispectral index monitors or infusion pumps, may be requested but need to be thoroughly wiped down after use.

The Figure details the roles and responsibilities of each OR team member. Hospital security is responsible for clearing the route from the ward or intensive care unit (ICU) to the OR, including the elevators. The transfer from the ward to the OR will be done by the ward nurses in full personal protective equipment (PPE) including a well-fitting N95 mask, goggles or face shield, splash-resistant gown, and boot covers. For patients coming from the ICU, a dedicated transport ventilator is used. To avoid aerosolization, the gas flow is turned off and the endotracheal tube clamped with forceps during switching

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L. K. Ti, MBBS, MMed, FAMS (✉)
Department of Anaesthesia, National University Health System,
Singapore, Singapore
e-mail: lian_kah_ti@nuhs.edu.sg

Department of Anaesthesia, Yong Loo Lin School of Medicine,
National University of Singapore, Singapore, Singapore

L. S. Ang, MBBS, MMed, FANZCA, EDIC
T. W. Foong, MBBS, MMed · B. S. W. Ng, MBBS, FRCA
Department of Anaesthesia, National University Health System,
Singapore, Singapore

of ventilators. The ICU personnel wear full PPE with a powered air-purifying respirator (PAPR) for the transfer.

In the induction room, a PAPR is worn during induction and reversal of anesthesia for all personnel within 2 m of the patient. For operative airway procedures such as tracheostomy, all staff keep their PAPR on throughout the procedure. For other procedures, regional anesthesia is preferable, but if general anesthesia is required, the principles of management are similar to those previously published.^{1,4}

During the procedure, a runner is stationed outside the OR if additional drugs or equipment are needed. These are placed onto a trolley that will be left in the ante room for the OR team to retrieve. This same process in reverse is used to send out specimens such as arterial blood gas samples and frozen section specimens. The runner wears PPE when entering the ante room.

Personnel exiting the OR discard their used gowns and gloves in the ante room and perform hand hygiene before leaving the ante room (ESM, eFig. 2). Any PAPR will be removed outside the ante room. Patients who do not require ICU care postoperatively are fully recovered in the OR itself. When the patient is ready for discharge, the route to the isolation ward or ICU is again cleared by security.

A minimum of one hour is planned between cases to allow OR staff to send the patient back to the ward,

conduct through decontamination of all surfaces, screens, keyboard, cables, monitors, and anesthesia machine. All unused items on the drug tray and airway trolley should be assumed to be contaminated and discarded. All staff have to shower before resuming their regular duties. As an added precaution, after confirmed COVID-19 cases, a hydrogen peroxide vaporizer will be used to decontaminate the OR.

In summary, as healthcare workers are at increased risk of coronavirus infection, a comprehensive and robust infection control workflow has been put into place.⁵

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