
Peri-operative Care for Suspected or Confirmed COVID-19 Cases: A major Concern for the Public Health: A Review Article

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ABSTRACT

Background: Personal Protective Equipment (PPE) including gown, shoe cover, face mask, eye goggles, cap, face shield and gloves for health-care professional in operation theatre is a must in order to contain COVID-19 pandemic. It is imperative to mention that a surgical patient whether suspected or confirmed cases of COVID-19 must receive peri-operative care as it is the mainstay in care of surgical patient which cannot be denied to anyone. If we look at the incidences and the trend of spreading the COVID-19 infection, any breach in the personal and professional preventive steps to this infection in peri-operative care imposes greater risk to the public health as it affects the health care workers. Anesthesiologist and other staffs and health care workers (HCWs) in the operating room are in close proximity to patients. They are always in events of increased aerosol production from an infected patients, whether it is intubation, Bag and mask Ventilation or suctioning of the airway and life saving procedures. The major route of spread is contact transmission. Cross-infection is the major hindrance to seamless healthcare service to Covid-19 patients. Hand-washing is the universal viral transmission containment step. But it will not suffice to the preventive goal of these HCWs. Though operation rooms are maintained with negative pressure atmosphere which is ideal to minimize infection risk but this is the time to rehearse and practice other aspects too.

Conclusion: The peri-operative care providers' face several challenges in operation theatre and during per-operative care while treating suspected or confirmed cases of COVID-19 and thus pose a greater risk to the society. We tried to summarise these vital points and practices, dissemination of which is of utmost importance at this pandemic scenario.

Keywords: COVID-19, Operation Room, Perioperative Care.

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BACKGROUND

The virus SARS-CoV-2 infection originated in Hubei province, Wuhan city, China ([Ruan, et al, 2020](#)) Zoonotic origin (Bats) of SARS-CoV-2 has been confirmed. Molecular investigation revealed the virus to be genetically related to SARS-Cov-1. The major route of spread is droplet and contact transmission. Incubation period of SARS-CoV-2 in healthy host has been confirmed at 14 days ([Zhang, et al, 2020](#)). Almost every country in the world has been affected by COVID-19 ([D'Adamo, et al, 2020](#)). The early and mild symptoms of COVID-19 involve dry cough to fever, and at later stages acute respiratory failure or multi-organ failure. The casualty index of COVID-19 is very high ([Baud D, et al, 2020](#)). Higher-age groups have been reported very susceptible to COVID-19. On other side, paediatric population showed relative resistance against COVID-19 ([Lee, et al, 2020](#)).

Pandemicity: The novel SARS-CoV-2 (COVID-19) has been confirmed in large number of countries. Hence, on 11th March 2020, World Health Organization (WHO) declared COVID-19 as pandemic. As on 28th April 2020, this ongoing pandemic has affected more than 185 countries. COVID-19 is responsible for more than 216,000 deaths worldwide. First confirmed death in China, outside China and Europe was reported on 09th January 2020, 01st February 2020 and 14th February 2020, respectively. The first case of COVID-19 reported in India was on 30th January 2020 ([Sun, et al, 2020](#)). As on 28th April 2020, the Ministry of Health and Family Welfare have confirmed a total of 29,974 active infections and 937 deaths ([Singhal, 2020](#)). Almost every country is facing severe socioeconomic disruption due to COVID-19 pandemic ([Adhikari, 2020](#)).

Operation Theatre, Anaesthesia and Surgery

Operations on confirmed COVID-19 cases should be undertaken in an airborne infection isolation room (AIIR). AIIR is an advanced version of operation theatre (OT) wherein the OT is modified to maintain negative pressure with an adequate seal. Regular and time-bound careful inspection of the AIIR by safety engineers is mandatory. A dedicated infection controls team should draft protocols, guidelines, monitor staff movements. Protocols for safety and handling of AIIR must be rigorously followed by all the concerned health-care operators. This team must ensure timely notification to anaesthesiologists, nurses and surgeons taking care of the operation. This team must also establish protocols for decontamination of OT after the surgery ([Sohrabi, 2020](#)).

Perioperative Care: Peri-operative care is the most critical activity for comprehensive management of COVID-19 patients. Both, the infected patient and the front-line healthcare worker require peri-operative care. Anaesthesiologist and other peri-operative care provide are at higher risk while providing respiratory care and during tracheal intubation ([Greenland, 2020](#)).

Hospital Set up: Management of COVID-19 warrants collaborated efforts. There should be minimum number of people in the operating room during induction. The hospital set-up must maintain airway patency, to avoid coughing and must promote compulsory hand hygiene ([Liang, 2020](#)), conducting trainings to provide information about the disease transmission and prevention ([Liang, 2020](#); [Wu, 2020](#)).




Personal Protective Equipment (PPE):

All the healthcare professionals must use PPE for the management of COVID-19 infected patients. PPE includes Gown, shoe cover, face mask, eye goggles, cap, face shield and gloves ([WHO, 2020](#)).

Gowns: Gowns are important when taking care of patients especially when a contagious disease is suspected or confirmed. Gowns protect the wearer from contracting and spreading of the infectious disease from liquid and solid material. Long length, full-sleeved gown and

shoe covers that are water resistant are essential which provide protection from any spillage of oral, nasal secretions or vomitus ([Feng, et al, 2020](#)).

Table 1: List of gowns for managing blood-borne pathogens

SN	Name of gown	Features
1	<p>Surgical gown</p> 	Surgical gowns are mandatory for all levels of risk. It is categorized by FDA as a Class II medical device
2	<p>Surgical isolation gown</p> 	Surgical isolation gowns are mandatory for high microbial risk procedures. It is categorized by FDA as a Class II medical device
3	<p>Non-surgical gown</p> 	Non-surgical gown is categorised by FDA as Class I device. It is used for general purpose and low risk procedures. They should not be used for surgery purposes.

Various Gowns have been illustrated in table-1(above) and table-2 below.

Full-face shield or mask

Full-face shield or respirator mask provides adequate protection to healthcare professional against SARS-CoV-19 transmission. It is essential to assess the proper fit of mask because improperly fitted shield/mask will expose frontline healthcare worker ([Feng, et al, 2020](#)).

Eye protection



Protection of eyes by goggles, surgical mask with integrated visor, polycarbonate safety spectacles or full-face visor is important. Also, it is essential to avoid close eye examination and ophthalmoscopy of suspected/confirmed COVID-19 patients ([Ng, et al, 2020](#)).

Gloves

Wearing sterile, disposable latex, rubber or nitrile gloves is mandatory for all the healthcare professionals. Peri-operational care providers should wear double gloves when treating the airway, blood, urine, and other body fluid of patients to prevent cross-contamination. After procedure, the outer glove should be used to replace cap, shoe cover and face shield while the inner glove should be removed as soon as possible and disposed of in a double-zip plastic

container with all other supplies. Any suggestion that the glove is soiled also reproaches its removal and replacement with fresh pair of gloves (Ng, et al, 2020).

Table 2: List of gowns for managing air-borne pathogens

SN	Name of gown	Features
1	Coverall gown 	Coverall gown provides protection against liquid splashes. Such gowns should not be used in high-temperature or inflammable conditions.
2	Nuclear protective 	Nuclear protective gown provides complete protection against nuclear contamination and radioactive leakages.

Operation Theatre (OT)-A new Set up for COVID-19

To prevent the spread of infection, all known or suspected COVID-19-positive patients needing surgical intervention in the OT must be treated as positive unless proven otherwise Health care workers (HCWs) who care for these patients must have protocol-guided and clearly defined pathways. To mitigate COVID-19 distribution, the allocation of committed senior staff to key management positions is critical. Both staff must be specifically qualified to collect, doff and dispose off personal protective equipment (PPE). Inside the COA filter area, the patient's receiving staff must conduct hand hygiene and wear full PPE. Operator with a beard should pay special attention to the mask fit to ensure adequate safety. Increased corona virus transmission has associated these procedures likely to produce aerosolized particles: tracheal intubation, non-invasive ventilation, tracheostomy, cardiopulmonary resuscitation, manual ventilation prior to intubation and bronchoscopy. Therefore, operators operating closer to the patient during such procedures will wear an FFP3 mask. Given the susceptibility of the conjunctiva to viral transmission, it is necessary to wear visors or goggles to protect the eyes against potential exposure to viral particles (Willan, 2020).

Anaesthesia Equipment

We suggest effective preparation to avoid any possible infection. One must be aware of the procedures which can pose risk for aerosol production. These procedures have been summarised in Table3.

Table 3: List of procedures performed in operation theatre that are considered aerosol generating

Sr.no	Procedure
1	Surgical
2	Tracheostomy
3	Surgery involving high-speed drilling
4	Anaesthetic
5	Mask ventilation
6	Intubation and extubation

7	Oxygenation through High flow nasal cannula
8	Non-invasive ventilation
9	Sputum suctioning
10	Cardiopulmonary resuscitation (CPR)

Airway equipment which is available should be preferred. During laryngoscopy and intubation medical and nursing personnel must be wearing FFP3 masks. To prevent repeated instrumentation of airway, intubation methods with the highest chance of first-time success should be chosen.

Intubation box: The Intubation Box is a cost-effective and reusable safety system originally developed in Taiwan by Dr. Hsien Yung Lai to protect HCWs.

The intubation box (**Fig.1**) operates by sitting over a Covid-19 patient's head and neck. The acrylic box serves as a protective shield between the patient and the HCW, with the goal of minimizing exposure to Corona virus (COVID-19). Though most of the literatures ask for the acrylic box to be washed with a solution of bleach or alcohol after each intubation but experience from the ground zero at Nodal center for COVID patients show that bleach or alcohol deface the Boxes. So we have started practicing disinfecting the acrylic boxes with detergent solution instead.

Figure 1: Intubation Box



Fiberscope intubation should be avoided as it can produce aerosolisation, unless explicitly stated. To prevent manual ventilation and possible aerosolisation, rapid sequence intubation (RSI) should be considered. Whenever practicable, disposable equipments should be used to prevent cross contamination. A dedicated anaesthesia machine should be earmarked for use in positive or suspected positive COVID-19 patients in the operation theatre. A HME Viral filter should be attached to the patient end of the breathing circuit if a general anaesthetic is needed, and another between the expiratory limb and the anaesthetic machine ([Ti, et al, 2020](#)).

Preparation of OT

Operation theatres with negative pressure atmosphere are ideal to minimize infection risk. A high rate of air exchange (around 25 cycles / h) effectively decreases the viral load in operating theatres. In a hospital where negative pressure operating rooms are unavailable, the positive pressure system and air conditioning must be turned off. Temporary conversion of otherwise positive pressure ORs to negative pressure should be preferred with independent provision of air conditioning and humidification. A separate air-conditioning and humidification systems is essential ([Huh, 2020](#)).

Equipment kept and used on a case-by-case basis must be reduced and used when appropriate. Normal anaesthetic trolleys with limited but sufficient stock should be replaced with dedicated prepared trolleys. All appropriate surgical material (i.e., stitches, scalpel blades) must be stored preventively in a sterilizable basket of steel wire. Dedicated infectious risk health waste (IRHW) containers should be used for devices which are contaminated and sharp disposable. Alcohol containing solution should be used for hand hygiene. Disposable material in general should be preferred, including linen ([Chen, 2020](#)).

Disinfection/Sterilization

Hand washing is the universal viral transmission containment step. Before wearing, before and after touching any infected area, anaesthesia trolley, airway cart or other instruments and after removing gloves, everyone must strictly follow the basic nine steps of hand-washing with alcohol-based hand rubs ([Cheung, 2020](#)).

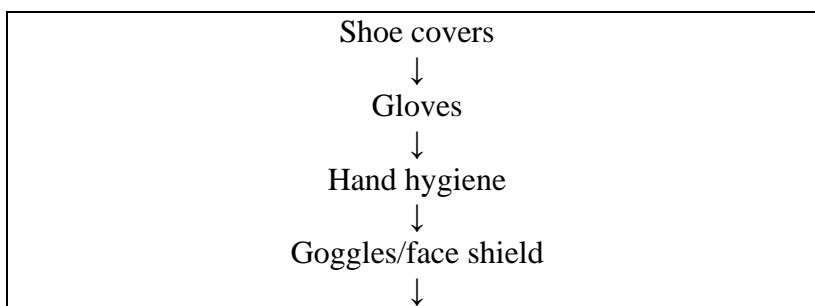
Biomedical waste management ([WHO, 2020](#))

Management of Biomedical waste is an extremely important transmission containment step. The biomedical waste must be double-bagged and labelled ‘COVID-19’ with the credentials of the identity like the name of the Institute, name of the department, date of the biomedical waste, time of the biomedical waste and the category of the biomedical waste. In a special rigid plastic tub the sharps used in the operating rooms must be disposed off. Dedicated well-identifiable containers for health waste at infectious risk (IRHW) should be used for disposables that are potentially contaminated. Any containers that are clearly damaged shall be replaced promptly. Containers should be closed and sealed until they are moved to the point of collection. To dispose of all infected discarded material and PPEs easily, the collection point with a dedicated container for hazardous medical waste must be located right outside the operating room. All HCW involved in the project shall remove their PPE and place the PPE in a designated waste bag in an anteroom. PPE should be removed in the order summarised in **Fig.2**.

Non-disposable personal protective equipment should be packed into medical waste bags and placed in a designated area. Before being taken out of the contaminated area, all the packing bags should be sealed and sprayed with chlorinated disinfectant or covered with an additional bag and sealed.

Pre Op Preparation

Emergency Surgery: Covid-19 infected patients require emergency operations under anaesthesia. PCR tests should be conducted twice with separate specimens preoperatively in COVID-19 infected patients needing an immediate or emergency procedure, to compensate for asymptomatic Covid-19 infected patients. The surgical procedures for patients contaminated with COVID-19 should be completed as far as possible in the last order of the day ([Spinelli, 2020](#)).



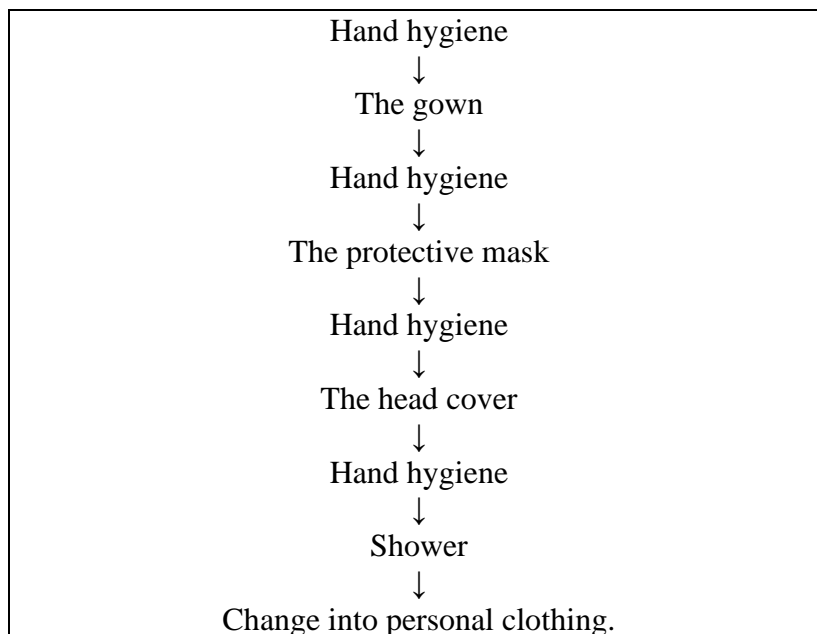


FIG. 2: Steps of PPE Removal

Elective Surgery: Elective surgery in COVID-19 patients should be delayed until symptom resolution while an emergency operation should be performed with due consent, as this is a completely new clinical scenario for anaesthesia and operation ([Spinelli, 2020](#)).

Pre Anaesthetic Check up: Along with routine and disease specific pre-op laboratory findings, investigations of COVID-19 is also essential. Epidemiological and clinical studies may be paired with case isolation and quarantine of near contacts would be beneficial. RT-PCR and serological testing to diagnose cases of COVID-19 will help to establish links between clusters ([Tian, et al, 2020](#)). Several healthcare facilities have initiated COVID-19 testing for all patients coming to the hospitals and some outpatient clinics for scheduled surgeries, procedures and emergency department treatment. This is a change from previous practice of testing only those with illness symptoms and recommended by their primary care doctors.

Intra-Operative Period

Identification of high-risk procedures in the operating theatre is essential and enlisted ([Tian, et al, 2020](#)) in **Table 3**.

Anaesthesia

General Anaesthesia: General anaesthesia has been recommended for suspected/confirmed COVID-19 patients. General anaesthesia mitigates the chances of COVID-19 patients coughing and bucking, which can generate airborne material and droplets. Certain other types of anaesthesia can be chosen depending on the form of operation and the needs of the particular patient ([Ti, et al, 2020](#)).

Airways management (Innovations during airways management): As per the recommendations of the Consensus Guidelines on the prevention of healthcare workers', the choice of personnel engaged in airway management, the training needed and the selection of equipment are addressed. In these settings, the basic principles of airway management are defined for: emergency tracheal intubation; anticipated or unforeseen difficult tracheal intubation; cardiac arrest; anaesthetic care; and tracheal extubation. Nebulized local anesthetic should be avoided. Tran tracheal injection of local anesthetic should also be

avoided, as it is likely to generate a cough. Sedation should be administered sparingly during 'awake intubation' and titrated to effect, to minimize the need for supplemental oxygen or airway manipulation ([Cook, et al, 2020](#)).

Regional Anaesthesia: Regional anaesthesia, most commonly Spinal anaesthesia is still recommended as the primary choice of anaesthesia. The patient with COVID-19 should always wear a surgical mask or N95 mask. In case supplementary oxygen is needed, the oxygen mask is applied over the surgical mask or N95 mask. General anaesthesia can be used as a backup plan in case spinal anaesthesia fails or intraoperative conversion to general anaesthesia is indicated ([Lie, et al, 2020](#)).

Ultrasound and COVID-19:

Several studies have shown that lung ultrasound is effective in the identification of pulmonary diseases, from bacterial and viral pneumonia to acute respiratory distress syndrome. The use of ultrasound is now necessary for the safe management of COVID-19 outbreaks, as it can enable the same doctor to conduct clinical examination and pulmonary imaging at the bedside. Lung ultrasound may have some benefits compared with stethoscope use (such as decreased sensitivity of health staff to infected patients, repeatability during follow-up, low costs and simpler use in low-resource settings). Lung ultrasound has been shown to be non-inferior to x-ray chest. Several clinicians therefore recommend that COVID-19 would facilitate ultrasound in the lung ([Baud, 2020](#)).

Cardiopulmonary resuscitation during perioperative period

Cardiopulmonary resuscitation was reported as a cause of the spread of SARS infection among HCW. CPR's dynamic nature comes with high risk of airborne transmission ([Maier, et al, 2020](#)).

When handling COVID-19, it will be helpful to consider apnoeic oxygenation instead of providing breaths through bag valve mask to preserve airway patentability and ventilation. Early intubation can help reduce the aerosol generation during resuscitation. Temporarily holding chest compressions during intubation will reduce the intuitive Clinician's risk of inhaling infective aerosols. Use the LUCAS chest compression device to provide automatic compressions, if available, reduces the number of healthcare workers required close to the patient ([Brewster, 2020](#)).

Postoperative management

Transfer of patients: During the intra-hospital settings, the transfer of patients from operation theatre to COVID operating area (COA) and/or vice versa must be maintained to minimum, if possible. If essential, this transfer should be swift. A designated and dedicated passageway/corridor between operation theatre (maintained at negative-pressure) to COA must be maintained. A dedicated elevator ideally covered by disposable plastic material, which can be disposed of immediately and lift sanitized after the transfer can be useful. Where any unforeseen contamination occurs during transportation (i.e. vomiting of the patient or otherwise), sufficient dedicated sanitization will occur. A dedicated 24/7 cleaning team specially trained from the local contract cleaning company could prove a valuable resource. Care must be taken, wherever and whenever possible to transfer the infected patients while keeping them away from other patients and other healthcare resource personnel within the area of the hospital. This step will help to limit the chances of infection. During the transfer of patients contaminated with Covid-19, all patients must wear waterproof gloves, disposable hat, and shoe covers with an operating mask. This surgical mask will help to contain infected droplet transmission. To reduce aerosol-generation, it is important to maintain the lowest possible oxygen flow to maintain oxygenation. Transfer-

responsible health care staff should use droplet and touch safety, and should limit patient interaction with the switch. The transporting nurse and doctor must carry all PPEs. Use of a stretcher as the medium of transport also entails all the precautionary measures for booth patient and the health-care personnel responsible for the transfer. After successful transfer completion, the stretcher must be immediately sanitized.

Prior to shifting to the operation theatre, all the infected COVID-19 patients should be administered with necessary antiviral medicines. All intubated and on assisted ventilation must be transferred with HME viral filter via special Bain circuit (connected to a drain). The filter location must be between the endotracheal tube connector and Y-limb to avoid the movement of aerosol from the patient to the portable ventilator, and vice versa. HFNC or Bi-PAP therapy should be avoided because of the increased aerosol production. Until transfer, the patient must be provided intravenous sedation and muscle relaxation to avoid any coughing and agitation that could lead to tube disconnection and droplet dispersion.

During the inter-hospital settings, the transfer of Covid-19 infected patient a dedicated transport vehicle. Specifically qualified driver who is fitted with PPEs must drive this transport vehicle. In the transport vehicle the patient's compartment is preferably kept separate from the driver. The protocol for Covid-19 patient safety and health personnel safety remain same as intra-operative transfers.

If COVID-19 patient is stable after surgery and does not meet the criteria for admission to the ICU, he or she should be transferred directly back to the negative-pressure ward or isolation ward after extubation in the operating room. During transfer, the circulating nurse and anaesthesiologist should wear proper personal protective equipment outside the operating room. The patient should be covered with one disposable operating sheet and then transferred to the negative-pressure or isolation ward through a dedicated lobby and elevator. During transfer, the patient must wear a surgical mask or N95 mask. Surfaces of passageways and the elevator should be cleaned and covered. If the patient is kept intubated, a single-patient-use respiratory bag must be used during transfer. It is not recommended to use a ventilator during transfer ([Shen, 2020](#)).

FUTURE IN PERI OPERATIVE MANAGEMENT

Peri-operative care providers face major difficulties when caring for patients with the COVID-19 in ICU or peri-operative environments. As part of the effort to cope with the current pandemic, all hospitals will coordinate dedicated protocols and work force preparation. As many aspects of COVID-19 are changing, our management plan is preliminary, and future changes will be needed. This article suggests the creation of clinical mechanisms for patients COVID-19-positive who need urgent, non-deferrable surgical treatment.

CONCLUSION

The COVID-19 is a highly contagious disease which imposes an enormous burden on the health care system. It is also our responsibility to protect healthcare staff and other patients from contracting the disease in delivering adequate peri-operative treatment to patients. We discussed peri-operative problems in this post, and suggested strategies for overcoming possible obstacles. Disease transmission can be reduced with proper preparation and implementation of steps to prevent infection.

REFERENCES

- Ruan Q, Yang K, Wang W, Jiang L, Song J. Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China. *Intensive care medicine*. 2020 Mar 3:1-3.
- Zhang T, Wu Q, Zhang Z. Probable pangolin origin of SARS-CoV-2 associated with the COVID-19 outbreak. *Current Biology*. 2020 Mar 19.
- D'Adamo H, Yoshikawa T, Ouslander JG. Corona virus Disease 2019 in Geriatrics and Long-term Care: The ABCDs of COVID-19. *Journal of the American Geriatrics Society*. 2020 Mar 25.
- Baud D, Qi X, Nielsen-Saines K, Musso D, Pomar L, Favre G. Real estimates of mortality following COVID-19 infection. *The Lancet infectious diseases*. 2020 Mar 12.
- Lee PI, Hu YL, Chen PY, Huang YC, Hsueh PR. Are children less susceptible to COVID-19?. *Journal of Microbiology, Immunology, and Infection*. 2020 Feb 25.
- Sun P, Lu X, Xu C, Sun W, Pan B. Understanding of COVID-19 based on current evidence. *Journal of medical virology*. 2020 Feb 25.
- Singhal T. A review of corona virus disease-2019 (COVID-19). *The Indian Journal of Pediatrics*. 2020 Mar 13:1-6.
- Adhikari SP, Meng S, Wu YJ, Mao YP, Ye RX, Wang QZ, Sun C, Sylvia S, Rozelle S, Raat H, Zhou H. Epidemiology, causes, clinical manifestation and diagnosis, prevention and control of corona virus disease (COVID-19) during the early outbreak period: a scoping review. *Infectious diseases of poverty*. 2020 Dec; 9(1):1-2.
- Sohrabi C, Alsafi Z, O'Neill N, Khan M, Kerwan A, Al-Jabir A, Iosifidis C, Agha R. World Health Organization declares global emergency: A review of the 2019 novel corona virus (COVID-19). *International Journal of Surgery*. 2020 Feb 26.
- Greenland JR, Michelow MD, Wang L, London MJ. COVID-19 Infection Implications for Perioperative and Critical Care Physicians. *Anesthesiology: The Journal of the American Society of Anesthesiologists*. 2020 Mar 19.
- Liang T. Handbook of COVID-19 prevention and treatment. The First Affiliated Hospital, Zhejiang University School of Medicine. Compiled According to Clinical Experience. 2020.
- Wu Z, McGoogan JM. Characteristics of and important lessons from the corona virus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *Jama*. 2020 Feb 24
- World Health Organization. Rational use of personal protective equipment for corona virus disease (COVID-19): interim guidance, 27 February 2020. World Health Organization; 2020.
- Feng S, Shen C, Xia N, Song W, Fan M, Cowling BJ. Rational use of face masks in the COVID-19 pandemic. *The Lancet Respiratory Medicine*. 2020 Mar 20.
- Ng K, Poon BH, Puar TH, Quah JL, Loh WJ, Wong YJ, Tan TY, Raghuram J. COVID-19 and the risk to health care workers: a case report. *Annals of internal medicine*. 2020 Mar 16.
- Willan J, King AJ, Jeffery K, Bienz N. Challenges for NHS hospitals during covid-19 epidemic.
- Ti LK, Ang LS, Foong TW, Ng BS. What we do when a COVID-19 patient needs an operation: operating room preparation and guidance. *Canadian Journal of Anesthesia/Journal canadien d'anesthésie*. 2020 Mar 6:1-3.
- Huh K, Shin HS, Peck KR. Emergent strategies for the next phase of COVID-19. *Infection & Chemotherapy*. 2020 Mar 1; 52(1):105-9.

- Chen X, Shang Y, Yao S, Liu R, Liu H. Perioperative care provider's considerations in managing patients with the COVID-19 infections. *Transl Perioper Pain Med.* 2020 Feb 15; 7:216-4.
- Cheung JC, Ho LT, Cheng JV, Cham EY, Lam KN. Staff safety during emergency airway management for COVID-19 in Hong Kong. *The Lancet. Respiratory Medicine.* 2020 Apr;8(4):e19.
- World Health Organization. Water, sanitation, hygiene, and waste management for the COVID-19 virus: interim guidance, 23 April 2020. World Health Organization; 2020
- Spinelli A, Pellino G. COVID-19 pandemic: perspectives on an unfolding crisis. *Br J Surg.* 2020 Mar 19;10.
- Tian H, Liu Y, Li Y, Wu CH, Chen B, Kraemer MU, Li B, Cai J, Xu B, Yang Q, Wang B. An investigation of transmission control measures during the first 50 days of the COVID-19 epidemic in China. *Science.* 2020 Mar 31.
- Ti LK, Ang LS, Foong TW, Ng BS. What we do when a COVID-19 patient needs an operation: operating room preparation and guidance. *Canadian Journal of Anesthesia/Journal canadien d'anesthésie.* 2020 Mar 6:1-3.
- Cook TM, El-Boghdady K, McGuire B, McNarry AF, Patel A, Higgs A. Consensus guidelines for managing the airway in patients with COVID-19: Guidelines from the Difficult Airway Society, the Association of Anaesthetists the Intensive Care Society, the Faculty of Intensive Care Medicine and the Royal College of Anaesthetists. *Anaesthesia.* 2020 Mar 27.
- Lie SA, Wong SW, Wong LT, Wong TG, Chong SY. Practical considerations for performing regional anesthesia: lessons learned from the COVID-19 pandemic. *Canadian Journal of Anesthesia/Journal canadien d'anesthésie.* 2020 Mar 24:1-8.
- Maier GW, Newton Jr JR, Wolfe JA, Tyson Jr GS, Olsen CO, Glower DD, Spratt JA, Davis JW, Feneley MP, Rankin JS. The influence of manual chest compression rate on hemodynamic support during cardiac arrest: high-impulse cardiopulmonary resuscitation. *Circulation.* 1986 Dec 1; 74(6 Pt 2):IV51-9.
- Brewster DJ, Chrimes NC, Do TB, Fraser K, Groombridge CJ, Higgs A, Humar MJ, Leeuwenburg TJ, McGloughlin S, Newman FG, Nickson CP. Consensus statement: Safe Airway Society principles of airway management and tracheal intubation specific to the COVID-19 adult patient group. *Med J Aust.* 2020 Mar 16;16.
- Shen C, Wang Z, Zhao F, Yang Y, Li J, Yuan J, Wang F, Li D, Yang M, Xing L, Wei J. Treatment of 5 critically ill patients with COVID-19 with convalescent plasma. *Jama.* 2020 Mar 27.