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**Infection control of operating room and anesthesia for cesarean section during pandemic Coronavirus disease-19 (COVID-19) outbreak in Daegu, the republic of Korea – 8 cases report**

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**Running title:** Cesarean section during COVID-19

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# **Infection control of operating room and anesthesia for cesarean section during pandemic Coronavirus diseases-19 (COVID-19) outbreak in Daegu, the republic of Korea – 8 cases report**

## **Abstract**

Background: Since the Coronavirus diseases-19 (COVID-19) was reported in Wuhan, China, Korea has also been exposed to the virus. In Korea, COVID-19 screening guidelines have been established in each hospital, trying to prevent the spread of infection. A case of successful Cesarean section from confirmed mother has been reported, but there are no guidelines for suspected mothers. Cesarean section can be operated urgently without sufficient evaluations of the infection.

Case: Our hospital, located in Daegu, Korea, was designated as quarantine and delivery facility for suspected mother, and Cesarean section was done to seven suspected mothers and one confirmed mother.

Conclusions: This case report suggests the guideline for infection control of surgery and anesthesia in emergent cesarean section of COVID-19 suspected mother by preparing operating room and protection strategy.

Keywords: Cesarean section; SARS-COV-2; COVID-19; Pregnancy; Guideline; Pandemic ; Personal protective equipment

In 2019, novel Coronavirus diseases-19 (COVID-19) was reported in Wuhan, and since then, it has spread not only in China but also worldwide, and Korea has been exposed to COVID-19 [1, 2]. Our hospital's medical staffs have established and followed guidelines to prevent the spread of the virus in the operating room and to prevent exposure of medical staffs from virus. In particular, uninfected fetus was successfully delivered from COVID-19 confirmed mothers through the cesarean section (C-sec) in the risk of the viral infection, and this showed the possibility of safe delivery despite COVID-19 confirmed mother [3]. However, since C-sec can be performed urgently because the life of the mother or fetus may be at risk, so surgeons must proceed with the surgery without waiting for the result of COVID-19 reverse transcription-polymerase chain reaction (RT-PCR). Here, we would like to discuss the management of confirmed patients through the cases report, as well as the guidelines of perioperative management for surgery and anesthesia preparation and patient management of suspected COVID-19 patients.

## Case Report

In our hospital, located in Daegu where the largest number of infected patients was developed among the cities in Korea, a total of twelve COVID-19 related mothers were admitted for delivery from February 26<sup>th</sup> to April 3<sup>rd</sup> 2020. Four mothers with symptom of fever gave birth through normal vaginal delivery. After the consultation of obstetric doctor, eight COVID-19 related c-sec mothers were treated, including one confirmed and seven suspected. (Table 1) Three of them were in preeclampsia, two were premature rupture of membranes (PROM) with dystocia, one is PROM with fetal distress, one is dystocia due to cephalopelvic disproportion (CPD), and another one is preterm labor with fetal distress. Five of the seven suspected patients had fever, one had dyspnea, and one had both fever and dyspnea. Because of the symptoms of the patients, COVID-19 could not be excluded; they were transferred through exclusive passage and elevator from the hospital entrance triage without going through a gynecology outpatient clinic in our hospital. They were admitted to the negative pressure-quarantine room in the delivery center. For preoperative evaluation, preoperative laboratory tests, chest x-ray, electrocardiogram, and COVID-19 RT-PCR were performed. Case #4 was previously confirmed as COVID-19 infection and had been isolated by herself at home. She was admitted for emergency c-sec due to obstructed labor caused by cephalopelvic disproportion. In the case of seven suspects, COVID-19 RT-PCR was performed due to suspicious symptoms, but urgent c-sec was inevitably required without waiting for the PCR result. All seven suspected patients were prepared for surgery and anesthesia in accordance with our hospital's guidelines for COVID-19 patients (Fig. 1A).

Preparations for caesarean section were performed in the operating room, which was designed temporarily in the delivery center – this room was under negative pressure during the period of the

hospital policy for COVID-19 related c-sec. The instruments that were not necessary for the surgery were all moved out, and built-in instruments in the operating room were covered with plastic paper. Fluids, drugs, and other equipment required for surgery and anesthesia were prepared in sufficient quantities. The equipment and unused drugs and fluids were wiped off with sodium dichloroisocyanate (NaDCC) solution, immediately after surgery and once again before storage. We firstly considered spinal anesthesia, but also prepared equipment of general anesthesia for the situation of failed spinal anesthesia; ventilator, breathing circuit, video laryngoscope (McGRATH™, Medtronic), high efficiency particulate air (HEPA) filter and drugs. All health care workers (HCWs) wore the enhanced personal protective equipment (PPE) such as N95 mask, full body impermeable suit, double gloves, shoe covers, hood with surgical cap and a powered air purifying respirator (PAPR) before the patient arriving at the operating room (Fig. 2A).

After anesthesiologist, surgeon, nurses, and the set-up of the operating room were ready, the patients were transferred from quarantine room in delivery center to operating room in delivery center. Once the patient entered the operating room, the door was not allowed to open. All patients underwent the monitoring of electrocardiogram, non-invasive blood pressure and SpO<sub>2</sub>. Spinal anesthesia was performed to the seven of the eight patients, general anesthesia to the other. For this procedure, one well-experienced anesthesiologist and one nurse were participated in the operating room, and one more anesthesiologist was on call for unexpected situation. For spinal anesthesia, a 25-gauge Pencan spinal needle was used to enter the lumbar 3<sup>rd</sup> - 4<sup>th</sup> intervertebral space, and 0.5% heavy bupivacaine 9 mg / 1.8 cc with fentanyl 20 µg / 0.4 cc was injected intrathecally. After 5 minutes, it was confirmed that neuraxial blockade reached the T4 level. The patient wore an N95 mask during anesthesia, surgery and recovery. On the patient case #2, general anesthesia was performed because regional anesthesia failed due to severe edema. A HEPA filter was applied between the breathing circuit and the face mask, and the patient was

preoxygenate for 5 minutes. Then rapid sequence intubation (RSI) without manual ventilation was performed to prevent the spread of aerosolized virus in the room. Then video laryngoscope was used to increase the success rate of intubation. After the operation was completed, extubation was performed after confirming establishing regular breathing, adequate spontaneous ventilation, eye opening, and obeying commands. 100% O<sub>2</sub> 2L was supplied as nasal cannula, and N95 mask was applied on it.

After completion of the surgery, the patients recovered in the operating room without going through the postanesthesia care unit. The anesthesiologist and nurse who had participated c-sec were also involved in the patient's postoperative recovery. In the cases of spinal anesthesia, the patients recovered until the blockage level had decreased to T8-T10. For general anesthesia, a post anesthetic recovery score (PAR score) of 9 or higher was required for recovery. When the patient complained of pain, previously prepared analgesic agents such as opioid and, non-steroidal anti-inflammatory drugs were administered intravenously. We followed post-anesthesia care unit (PACU) discharge criteria as possible, but considering the fatigue of HCWs, recovery time was limited until 1 hour. After recovery, the confirmed patients were transferred to the COVID-19 ward, and the suspected patients were transferred to the COVID-19 suspect ward through the exclusive passage and elevator for COVID-19 patients. On the day after the surgery, all eight patients were negatively confirmed by RT-PCR and were transferred to the general ward for postoperative treatment.

## Discussion

COVID-19 is a virus that spreads very quickly, and therefore, it is important to prevent the spread of the virus in the operating room against surgical patients, who is vulnerable to infection, and to prevent exposure of HCWs to the virus. Therefore, it is not enough to manage the operating room by isolating only the confirmed patients, but also suspected patients. To the patient who has any suspected symptoms, the strict guidelines for isolation and management of operation rooms are necessary [4]. Jinag et al. reported that the clinical manifestation of COVID-19 are fever (> 90%), cough (around 70%), dyspnea (up to 50%), myalgia or fatigue(31-44%), sputum production(20-28%), headache(6.5-16%), and diarrhea(2-14%)[5]. 81% of patients show mild symptoms, but 14% can be severe and 5% can progress critically. Fatality reaches 2.3% and increases with age [6]. Therefore, early diagnosis and early treatment are necessary even for a mild symptom [7]. In case of emergency c-sec patient with suspected symptoms, the further evaluation and follow-up for diagnosis of COVID-19 are essential even after the operation is completed.

According to emergency surgery guideline for COVID-19 of our hospital, radiologic findings, RT-PCR, clinical symptom are main diagnostic tools for COVID-19. Among radiologic imaging tools, Chest CT is reported as highly helpful tool to detect the infection early and access the disease course of COVID-19 pneumonia.[15] If there is any suspected symptom of COVID-19, even though there is no significant abnormal finding in chest imaging, the guidelines for confirmed patient should be followed. All eight mothers were not outpatient of our hospital, but transferred from other hospital by following the policy. Therefore, the mothers needed urgent C-sec that could not wait for the result of COVID-19 RT-PCR. HCWs should apply enhanced PPE and the surgery should be done in the negative pressure operating room according to emergency surgery guideline for COVID-19 (Fig.1A). However, an urgent C-sec had difficulty following the emergency surgery guideline. First of all, it took more than 6 hours to confirm the RT-PCR result, and it was

necessary to urgently perform emergency c-sec without waiting for the result. Second, chest CT took a short time of 5minutes, but it could not be applicable to all mothers due to avoidance of radiation exposure of the fetus. To the cases of these eight patients, we followed the Figure 1A guideline, so that we needed to wear enhanced PPE in all cases. However, reflecting these difficulties, we decided to remove chest CT from the guideline and are now following the changed emergency c-sec guideline (Fig. 1B).

After the COVID-19 outbreak in Daegu, our institution was designated as a hospital for the delivery of suspected or confirmed mothers of COVID-19, and a number of delivery cases were expected. Therefore, the entire delivery center was replaced with a negative pressure environment. In order not to interfere with other elective surgeries, c-sec was performed in a delivery center located differently from main operating room. Fortunately, since our hospital was designated for C-sec of COVID-19 confirmed and suspected mother, mothers with no symptom of COVID-19 were not admitted during this period. Since it was not originally designed as an operating room, it was impossible to measure the exact negative pressure, so the smoke test was able to confirm the negative pressure in the C-sec operating room [8].

We have two options in anesthesia; general anesthesia and regional anesthesia. In the case of general anesthesia, intubation should be performed. Endotracheal intubation and extubation are considered as a high risk aerosol generating procedure [9]. Therefore, all HCWs especially anesthesiologists should wear enhanced PPE with PAPR. In the aerosol state, COVID-19 exists in a viable state for more than 3 hours, where there is a possibility of aerosol transmission [10]. Therefore, in case of suspicious patients, the operation should be performed in a negative pressure room on the assumption that the virus can spread through aerosol. And sufficient time after intubation or extubation should be provided to remove airborne contaminants. According to Centers for Disease Control and Prevention (CDC), when air changes / hour (ACH) is 12 times, 99% of

airborne-contaminant removal efficiency takes 23 minutes and 99.9% takes 35 minutes [11]. ACH of our hospital is 12-16 times. Therefore, the guideline is not to open the door for at least 30 minutes after extubation, and is informed to all HCWs who participating the surgery. For the reasons mentioned above, we preferred regional anesthesia than general anesthesia. For regional anesthesia, the N95 mask was provided to the mother to minimize the possibility of transmission of the virus.

Of the seven mothers we suspected of COVID-19 infection, six accompanied fever; two of them were born with stillborn babies, two with preterm labor, and two with PROM. The fever focus was not clear except for the stillborn, and the fever of suspected patients was subsided after the childbirth. Two of seven suspected patients complained dyspnea and improved after child-birth. Dyspnea is common during pregnancy and may occur during severe labor pain[12]. All suspected patients had no additional symptoms after child-birth, and the COVID-19 was negative several hours after the surgery was over. Despite the results described above, in the current pandemic situation, it is difficult to differentially diagnose the presence or absence of COVID-19 even with mild symptoms. Therefore, when COVID-19 results cannot be awaited in symptomatic patients, strict guidelines for managing the operating room are needed. In addition, there have been reports of presymptomatic (silent) patients[13] and Song et al. reported that presymptomatic patients reached 10%(3 of 28 patients)[14]. The guidelines for elective surgery patients in pandemic situations are also used in managing the operation room to distinguish presymptomatic patients from uninfected patient (Fig. 1C).

In conclusion, it is essential to isolate the management of confirmed patients according to institutional perioperative COVID-19 infection prevention. Moreover, what we want to emphasize in these cases is to suggest a perioperative management guideline for suspected COVID-19 infections to prevent the transmission of the virus. We operated on one confirmed patient and 7

suspected patients. Eventually, all suspected patients were confirmed with COVID-19 negative, but performed the same isolation as confirmed patient. Because of the special situation of emergency cesarean section, surgery was inevitable without result COVID-19 RT-PCR. Therefore, suspected patients with symptoms need to be managed in a strict guideline, that is, the same guideline of COVID-19 confirmed patients.

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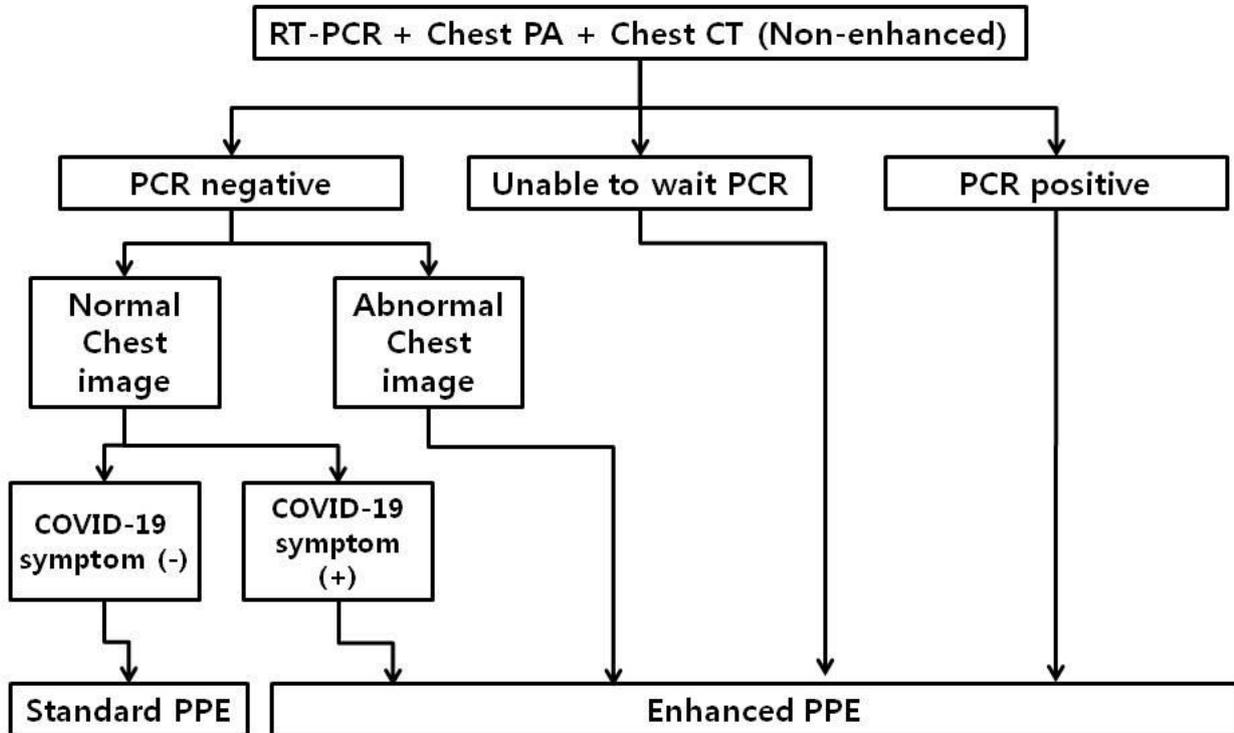
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**Table 1. COVID-19 related patient for cesarean section.**

Patient	Age	Operation date	Gestational age	Obstetric Underlying disease	SARS-COV-2 related symptoms	SARS-COV-2 PCR	Newborn state (APGAR score 1min→5min)	Type of anesthesia	Chest X-ray image	Chest CT image
1	39	February 26	37+3	Preeclampsia	Dyspnea SpO <sub>2</sub> : 94%	Negative	Good (9→10)	Spinal	U-R	-
2	30	February 27	25+3	Preeclampsia	Fever : 37.6°C	Negative	Still birth (0)	General	U-R	-
3	29	February 28	40+0	Preeclampsia	Fever : 38.1°C	Negative	Still birth (0)	Spinal	Increased vascular marking	-
4	28	March 6	37+6	Cephalopelvic disproportion	none	Converted to negative before surgery	Good PCR (-) (9→10)	Spinal	Consolidation in LLL	r/o pneumonia
5	25	March 8	38+4	PROM	Fever : 38.8°C	Negative	Cyanosis→ good (6→8)	Spinal	Increased vascular marking	U-R
6	33	March 9	33+5	Preterm labor	Fever : 37.8°C Dyspnea SpO <sub>2</sub> : 92%	Negative	RDS→ Good (6→8)	Spinal	r/o pneumonia	r/o pneumonia (DDx : viral infection, less likely)
7	30	March 29	38+1	PROM	Fever : 37.6°C	Negative	Good (9→10)	Spinal	No active lesion	-
8	34	April 3	22+4	PROM	Fever : 37.8°C	Negative	RDS→expired (5→7)	Spinal	No active lesion	U-R

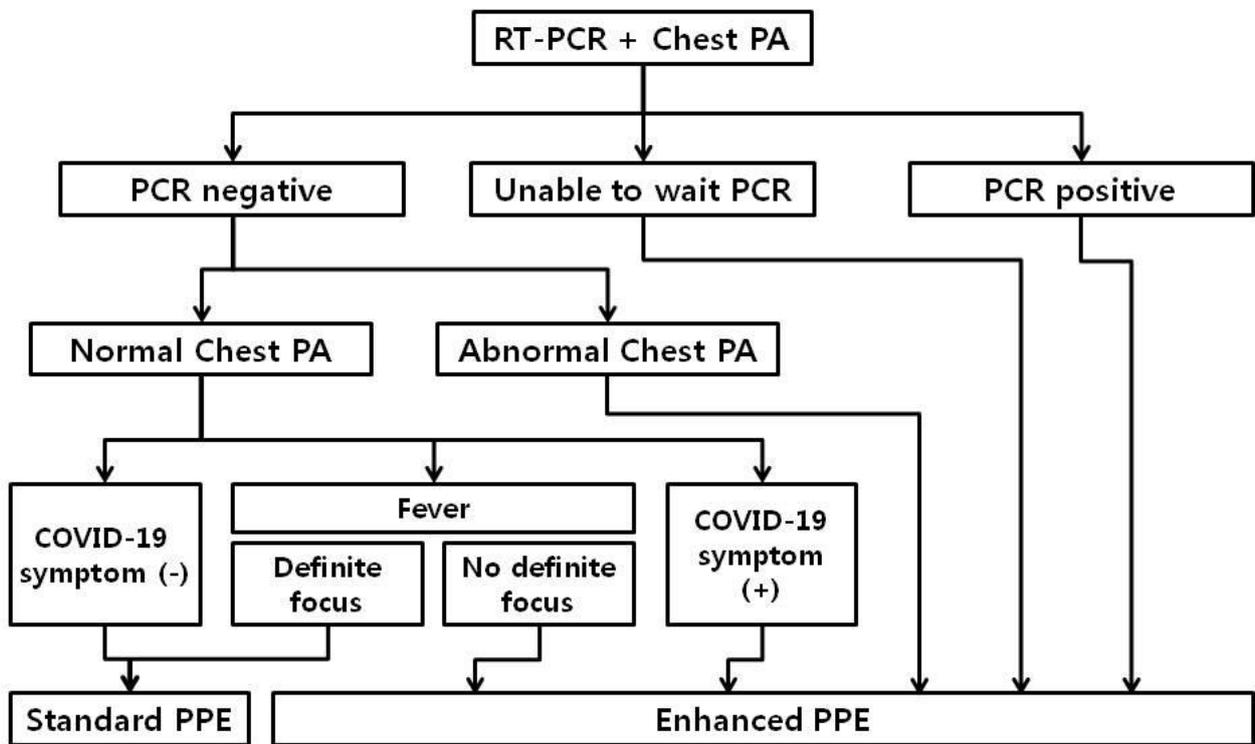
## Figure legends

### A. Guideline for Emergent Surgery



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## B. Modified Guideline for Emergent Cesarean Section



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### C. Guideline for Elective Surgery

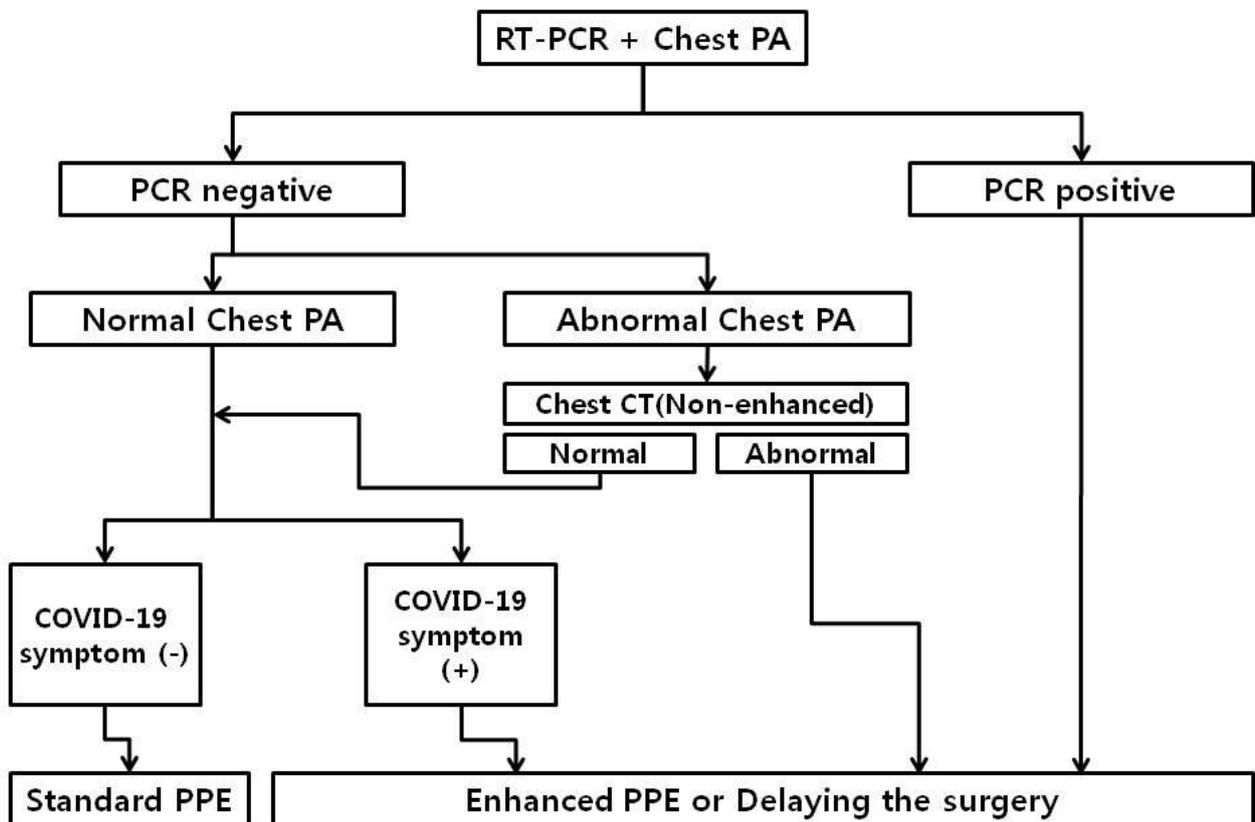


Figure 1. Guidelines for operation pandemic Coronavirus disease-19 (COVID-19) outbreak. Enhanced personal protective equipment (PPE) includes N95 mask, full body impermeable suit, double gloves, shoe covers, and hood with surgical cap. Standard personal protective equipment (PPE) includes goggles, N95 mask, plastic gown, and disposable surgical gloves. A) Guideline for emergent surgery. B) Modified Guideline for Cesarean section. C) Guideline for Elective Surgery. Symptoms of COVID-19 include fever, cough, dyspnea, myalgia or fatigue, sputum production, headache, and diarrhea.



Figure 2. Personal protective equipment. A) Enhanced PPE and B) standard PPE.