

MINI REVIEW

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What are the best methods of airway management in COVID-19 patients?**Adel Hamed Elbaih^{1,2}, Moaaz Khaled Mohammed²**¹Suez Canal University, Faculty of Medicine, Department of Emergency Medicine, Ismailia, Egypt²Emergency Medicine, Sulaiman Al-Rajhi University, Clinical Medical Science, College of medicine, Saudi Arabia.

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**Abstract**

COVID-19 (Corona Virus Disease-2019) is a viral contagious disease that spread through droplets and direct contact. although medical staff are equipped with personal protection gear but still there are increasing incidence of covid-19 among health care providers and airway management specialists in order to reduce this incidence it is Important to follow a special criterion when managing airway with covid-19 patients including staff distribution, equipment's preparing and intubation techniques Targeted Population: Adult patients COVID-19 who are in need endotracheal intubation to manage the airway at Emergency Department (ED), the hospital wards, or in the Intensive Care Units (ICU). Targeted End User: ER, ICU Physicians and all paramedics deals with COVID-19. this review article aims to provide the Doctors that are dealing with confirmed or suspected cases of COVID-19 with needed to maintain the airway with an organized method to manage the airway of those patients in the ED, isolation rooms in the wards or even in ICU, to secure the health of those physicians, optimize their efficiency, and increase the odds of achieving a successful airway maintenance from the first time. Collection of all possible available data about COVID-19 airway management in ED. By many research questions to achieve these aims so a midline literature search was performed with the keywords "critical care", "emergency medicine", "principals of COVID-19 airway management ", "COVID-19 and infections". All studies introduced that the initial airway management is a serious condition that face patients of the emergency and critical care departments. Literature search included an overview of recent definition, causes and recent therapeutic strategies. All studies introduced that initial airway management of COVID-19 in ER and ICU is a serious condition that face patients and physicians which may lead to death in both. Airway management in COVID-19 patients requires specific measurements to assure safety of the medical staff. Accuracy is crucial, and the physician must avoid ineffective techniques through the procedure of airway management, which will enable it to be safe, accurate and timely controlled.

Keywords: Airway management, COVID-19, physicians**Introduction**

Since the appearance of the novel corona virus (2019-CoV) in Wuhan city, in China, it has been spreading in an accelerating pattern all over China and the whole world.

The Clinical data collection has been showing that. The incubation period is known to be from one day up to fourteen days, The World Health Organization (WHO) called this virus the new coronavirus 2019 (2019 – nCoV). On January 30, 2020, the WHO declared the 2019-nCoV as an epidemic, On February 11, 2020, the WHO announced a new name for the 2019-nCoV epidemic disease: coronavirus disease (COVID-19) [1].

On March 11 the WHO declared COVID-19 as pandemic. The numbers of people infected with this disease has reached 10,835,257 people around the world with 519,601 deaths and 6,054,119 recovered cases around the world the most infected countries are USA, Brazil, Russia and Spain which express that this pandemic disease has been [2].

All over the world and hitting all countries despite the wealth of the country or the level of the health care system More than half of the Emergency Department (ED) visits are non-urgent and do not require emergency care. [1] The increasing numbers of patients visiting the ED lead to crowdedness, long waiting time and a negative impact on patients' satisfaction. [2] Yet, more importantly, it results in unnecessary costs and wastes the resources of the institution and the time of physicians that would be otherwise directed to more serious cases. [3] Thus, Emergency Physicians (EP) need to follow a systematic approach in order to prioritize the care of patients based on their clinical urgency and highly infectious to hospital community.

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Triage is defined as the process of sorting patients based on the acuity of their condition. When patients are sorted according to their immediate presentation this ensures that severely ill or highly infectious patients rapidly isolated before their condition gets worse or spreading to all. [4, 5]

Coronaviruses are a large family of viruses, which may cause illness in animals or humans. In humans, several coronaviruses are known to cause respiratory infections ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). The most recently discovered coronavirus causes coronavirus disease COVID-19 [7].

The most common symptoms of COVID-19 are fever, tiredness, and dry cough. Some patients may have aches and pains, nasal congestion, runny nose, sore throat or diarrhea. These symptoms are usually mild and begin gradually. Some people become infected but do not develop any symptoms and do not feel well. Most people (about 80%) recover from the disease without needing special treatment. Around 1 out of every 6 people who gets COVID-19 becomes seriously ill and develops difficulty breathing. Older people, and those with underlying medical problems like high blood pressure, heart problems or diabetes, are more likely to develop serious illness. People with fever, cough and difficulty breathing should seek medical attention [8].

People can catch COVID-19 from others who have the virus. The disease can spread from person to person through small droplets from the nose or mouth which are spread when a person with COVID-19 coughs or exhales. These droplets land on objects and surfaces around the person. Other people then catch COVID-19 by touching these objects or surfaces, then touching their eyes, nose or mouth. People can also catch COVID-19 if they breathe in droplets from a person with COVID-19 who coughs out or exhales droplets. This is why it is important to stay more than 1 meter away from a person who is sick [9].

While we are still learning about how COVID-2019 affects people, older persons and persons with pre-existing medical conditions (such as high blood pressure, heart disease, lung disease, cancer or diabetes) appear to develop serious illness more often than others do. The mortality of critically ill patients with SARS-CoV-2 pneumonia is considerable. The survival time of the non-survivors is likely to be within 1–2 weeks after ICU admission. Older patients (>65 years) with comorbidities and ARDS are at increased risk of death. The severity of SARS-CoV-2 pneumonia poses great strain on critical care resources in hospitals, especially if they are not adequately staffed or resourced [8].

While some western, traditional or home remedies may provide comfort and alleviate symptoms of COVID-19, there is no evidence that current medicine can prevent or cure the disease. WHO does not recommend self-medication with any medicines, including antibiotics, as a prevention or cure for COVID-19. However, several ongoing clinical trials include both western and traditional medicines. WHO will continue to provide updated information as soon as clinical findings are available. Not yet. To date, there is no vaccine and no specific antiviral medicine to prevent or treat COVID-2019. However, those affected should receive care to relieve symptoms. People with serious illness

should be hospitalized. Most patients recover thanks to supportive care [7].

The most effective ways to protect yourself and others against COVID-19 are too frequently clean your hands, cover your cough with the bend of elbow or tissue, and maintain a distance of at least 1 meter from people who are coughing or sneezing.

Call your doctor: If you think, you have been exposed to COVID-19 and develop a fever and symptoms, such as cough or difficulty breathing, call your healthcare provider for medical advice these symptoms may appear 2-14 days after exposure [9].

If you develop emergency warning signs for COVID-19 get medical attention immediately. Emergency warning signs include*:

- Difficulty breathing or shortness of breath
- Persistent pain or pressure in the chest
- New confusion or inability to arouse
- Bluish lips or face

Early information out of China, where COVID-19 first started, shows that some people are at higher risk of getting very sick from this illness. This includes:

- Older adults
- People who have serious chronic medical conditions like:

Heart disease

Diabetes

Lung disease

If you are sick with COVID-19 or suspect you are infected with the virus that causes COVID-19, you should take steps to help prevent the disease from spreading to people in your home and community [7].

The ED is one of the busiest departments at these hospitals, providing care for all kind of cases, including road traffic accidents (RTA) and patients with medical, surgical, obstetrics or pediatrics emergencies. Therefore, it is usually crowded with patients and their families these increase incidence of infections. The increasing number of patients presenting to ED necessitates applying an efficient triage system in order to stop wasting our resources and provide the best care for patients in need within the ideal time without harmful infectious hazards. Furthermore, it helps to attain patients trust and boosts patients' satisfaction.

Therefore, out of the above-mentioned reasons, this study provides the Doctors that are dealing with confirmed or suspected cases of COVID-19 with needed to maintain the airway with an organized method to manage the airway of those patients in the ED, isolation rooms in the wards or even in ICU, to secure the health of those physicians, optimize their efficiency, and increase the odds of achieving a successful airway maintenance from the first time.

Definition of the pathogen and identifying the problem

Severe acute respiratory syndrome-corona virus-2 (SARS-CoV-2), which causes

COVID-19 is a single-stranded ribonucleic acid -encapsulated

corona virus and is highly contagious.

The virus is primarily spread between people during close contact most often via small droplets produced by coughing sneezing, and talking. The droplets usually fall to the ground or onto surfaces rather than travelling through air over long distances. However, research as of June 2020 has shown that speech-generated droplets may remain airborne for tens of minutes. Less commonly, people may become infected by touching a contaminated surface and then touching their face. It is most contagious during the first three days after the onset of symptoms, although spread is possible before symptoms appear, and from people who do not show symptoms, common symptoms include fever, cough, fatigue, shortness of breath, and loss of sense of smell [8].

Complications may include pneumonia and acute respiratory distress syndrome which require urgent medical intervention and quick airway management or introducing endotracheal tube

Although the virus spread through droplets but aerosol producing measures that stimulate coughing and promote the generation of aerosols can convert the method from droplet spread into air borne which increase the risk for health care providers who are dealing with airway management procedures, in the following are ranked airway procedures in descending order of risk as:

1. Endotracheal intubation approach.
2. Cricothyroidotomy approach.
3. Tracheotomy approach.
4. Bi-level positive airway pressure.
5. High Flow Nasal Oxygen therapy
6. Bag valve mask.

Incidences of covid-19 in health care providers in some countries

Increased numbers of sick people specially those who went into hospitals cause the illness to spread faster during the hospital staff and environment. doctors then have a higher chance of exposure and acquiring the infection. For example In China, there was more than 3,300 physicians got the disease (4% of the 81,285 reported infections). On the side of the world Spain reported, nearly 6,500 health care provider got infected and (13.6%) of the country's 47,600 total cases – 1% of the health system's workforce [9].

Indication of intubation which exacerbate the problem

despite that most of patients are going to have mild symptoms and will not come to the hospital, the prognosis of the disease for those who may develop severe symptoms and end up with severe respiratory distress are relatively slow (9-10 days). Those patient may have severe symptoms throughout the isolation that end up requiring emergency intubation. such as the following:

- Elevated breathing effort
- Patient developed acute hypoxia indicating respiratory failure that is not responding to high flow nasal oxygen therapy or bi-level positive airway pressure for two hours.
- Patient with hypoxia and losing consciousness or control of

his/her airway.

- Hypoxic patient with huge amount of secretions that block the airway.
- Patient with hypercapnia respiratory failure which is not responding to high flow nasal oxygen therapy or the bi-level positive airway pressure therapy.
- Patient with Hemodynamic instability.
- Patient on high flow nasal oxygen therapy or bi-level positive airway pressure therapy that needs transferring by ambulance [10].

Contraindications

Any patient that does not have any of the indication is considered as contraindicated for intubation due to the lack of benefit and increase of harm.

Rationale and description of the problem

Covid-19 is a highly contagious respiratory infection that spread throughout droplets and direct contact.

It is found that the highest viral load of the Severe Acute Respiratory Syndrome of Coronavirus 2 (covid-19) present in the patient sputum and saliva. Then why the general infectious measurements and precautions is not sufficient to protect the Health Care Workers Specially Airway management specialists? Because endotracheal intubation is a risky way of managing the airway due to high percentage of exposure to viral load. And also it is believed that intubation and ventilation can change the mode of transmission from droplets into air-borne and for this matter, health care workers whom provide airway management must take special measurements and precautions that is made for this specific disease and not the general precautions for other infectious diseases. And here comes the importance of this article explaining not only the method of securing the airway, providing the appropriate way of controlling the environment to reduce risk of contamination and also to demonstrate the proper way of wearing and disposing the personal protective equipment [11].

The study question

What is the best guideline to prevent the increased incidence of Covid-19 in Airway? Management specialists and healthcare providers, despite the use of personal

Protective equipment?

Why this study is necessary?

During covid-19 epidemic, health care system is already overwhelmed due to the rapid transmission of the disease an increase of the infection among health care providers will increase the problem and will exacerbate and speed up the failure of the health care systems and this why we need to protect the doctors by equipment and guidelines.

Methods

This paper was done by reviewing over 20 research papers,

excluding the un-matched Papers and summarizing the included studies

Inclusion criteria

1-researches discussing the airway management in covid-19 patients

2-papers must be in English

3-Papers must be recent (last 4 months)

Collection of all possible available data about COVID-19 airway management in ED. By many research questions to achieve these aims so a midline literature search was performed with the keywords "critical care", "emergency medicine", "principals of COVID-19 airway management", "COVID-19 and infections". All Literature search included an overview of recent definition, causes and recent therapeutic strategies.

Discussion of the research question

In order to reduce the incidence a complete set of actions must be done and specific guidelines must be followed along the process of approaching the patient, approaching the intubation and during the process of before and after care process [12-14] (Figure1,2,3).

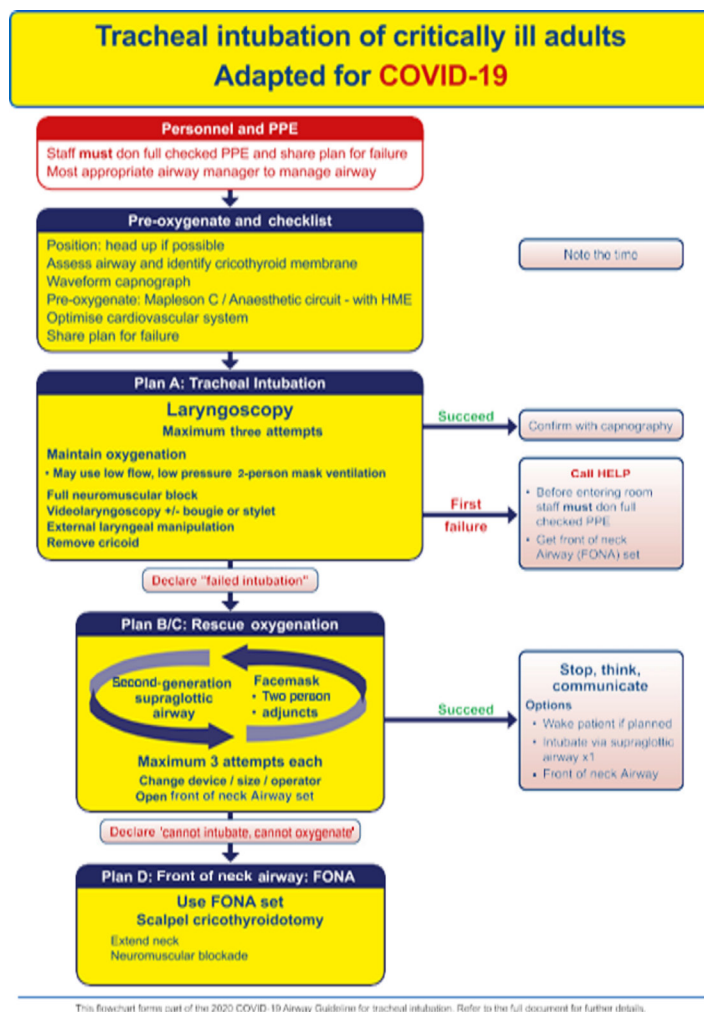


Figure 1. Approach to Covid-19 patient

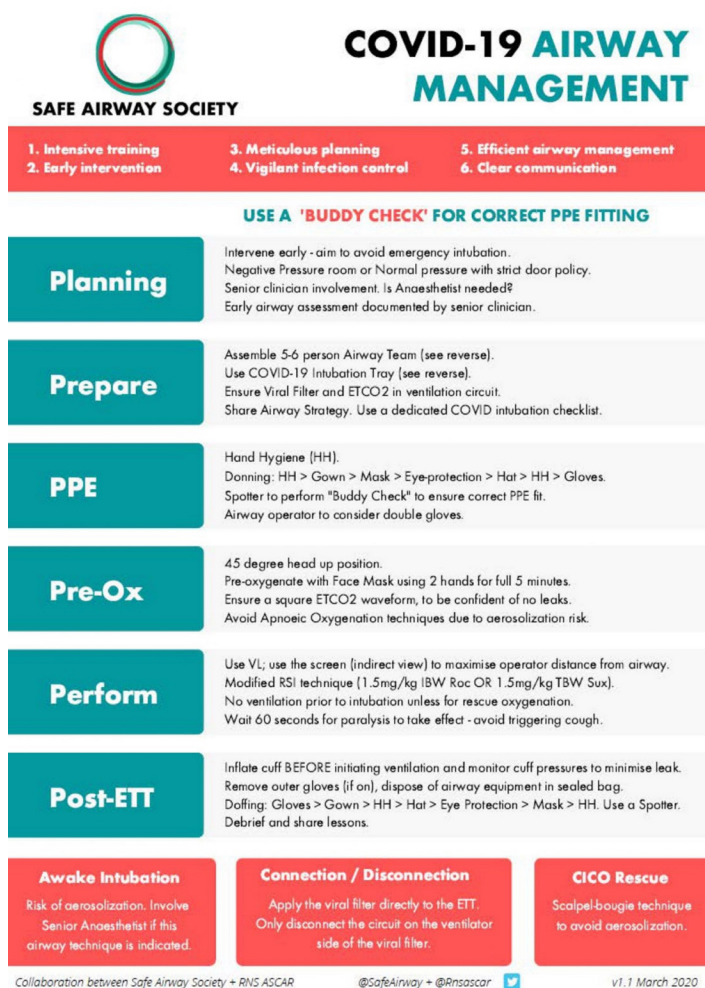


Figure 2. Criteria of intubation in Covid-19 patient

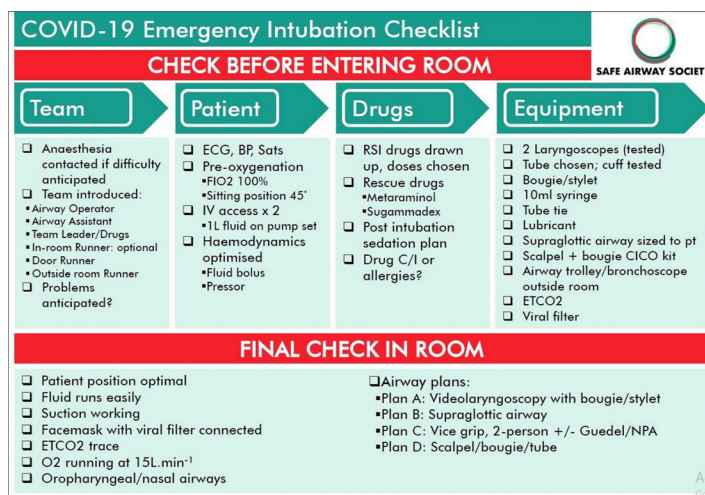


Figure 3. Check list for covid-19 intubation

If the intubation failed

1. Secure the airway by applying an oral airway,
2. Apply oxygen via your Bag Valve Mask using both hands
3. Ask for co-worker help if available with full personal protective equipment
4. The risk of controlled ventilation (6-10 breaths over 1 minute)

must be balanced against worsening hypoxemia that results in cardiac arrest.

5. If you are able to maintain saturations than you have to consider whether a second attempt
6. try to use bi-level positive airway pressure ventilation
7. If you cannot keep level of oxygenation by the previous methods perform an emergency cricothyrotomy [15].

The best method to prevent or reduce the environmental contamination

- Always prepare your equipment and the use the appropriate ones [16] (Figure 4).

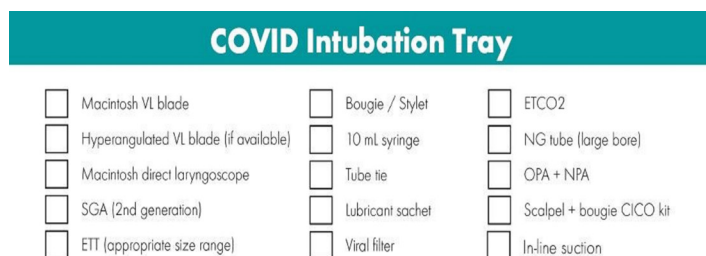


Figure 4. COVID intubation tray

Drugs needed during intubation (Table 1,2).

Table 1. Sedative drug to help introduce endotracheal tube

Name	Dose (IV)	Advantages	Disadvantages
Etomidate	0.3mg/kg	Rapid onset, ultrashort duration, reduced ICP, no effect on hemodynamics	nausea and vomiting, adrenal insufficiency (rare)
Propofol	1- 1.5mg/kg	Rapid onset, short duration, reduced ICP, anti-nausea, anti- seizure	Lower BP, pain at site of administration (use large bore cannula in large peripheral veins), allergy (very rare and in people with anaphylaxis secondary to Eggs)
Ketamine	1- .5mg/kg	Rapid onset, duration 10-15 min, analgesic effect, bronchodilators, no effect on hemodynamics, improved CPP	Masseter muscle spasm, urgency hallucination
Midazolam	0.05- 0.1mg/kg	Rapid onset, short duration, antiseizure	Negative inotropic effect, variable effect
Fentanyl	1-2mcg/kg	Analgesic, fast onset, duration 30- 60 min, decrease sympathetic stimulation	Negative inotropic effect, acute chest rigidity syndrome

Table 2. Paralytic Agent for Intubation

Name	Dose (IV)	Advantages	Disadvantages	Antidote
Etomidate	0.6-1mg/kg	No side effects	Longer action (30-60 sec). Duration (30-60 min).	Sugammadex (16mg/kg IV)
Propofol	1-1.5mg/kg	Rapid Onset (10-15 sec) Short duration (6-10 min)	Hyperkalemia. Malignant hyperthermia. Cardiac dysrhythmias	Not found

- Reduce the contamination by distributing the staff in an appropriate way (Figure 5).

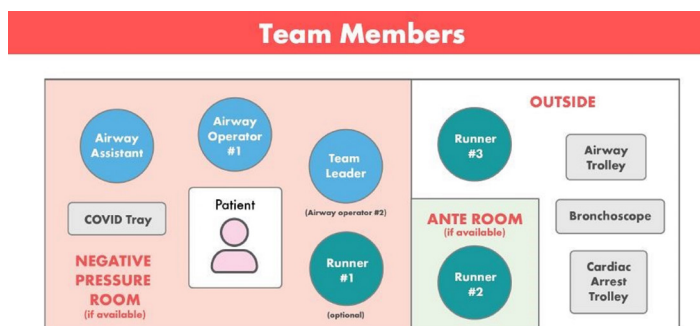


Figure 5. Team members

- Reduce the contamination by controlling the equipment involved [17] (Figure 6).

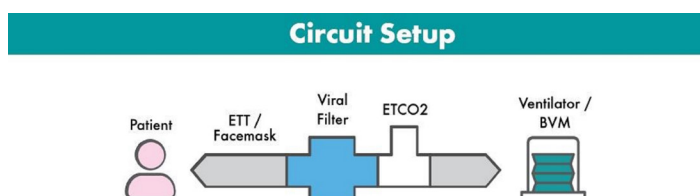


Figure 6. The Controlling Circuit setup

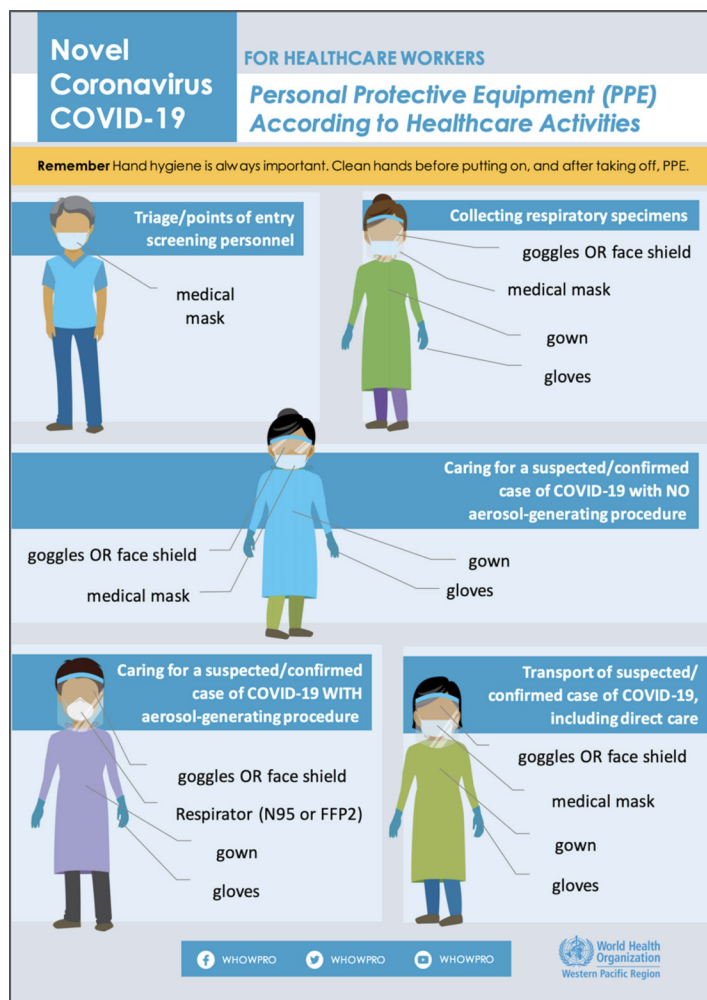


Figure 7. Personal protective equipments needed for contact with Covid-19 patients

Recommendations

Because of the new structure and clinical features of novel corona virus (covid-19), there are very few amount of information about the disease, and no available vaccines or specific medications yet. So at the moment the guidelines are mainly concentrated and concerned on stopping the spread of the disease (primary prevention). The Health care providers whom are responsible of airway management in infected patients should be aware of the following recommendations to reduce the risk of getting the infection.

- Always Follow the 6Ps rules
- Always Use the criteria that is found for covid-19 not general infectious diseases
- Practice on wearing the personal protective equipment in the best way
- Practice on performing efficient airway management while wearing the personal protective equipment
- Although there is lack of evidence it is better for doctors with chronic diseases such as hypertension, diabetes, or above 60 years old to avoid airway management areas

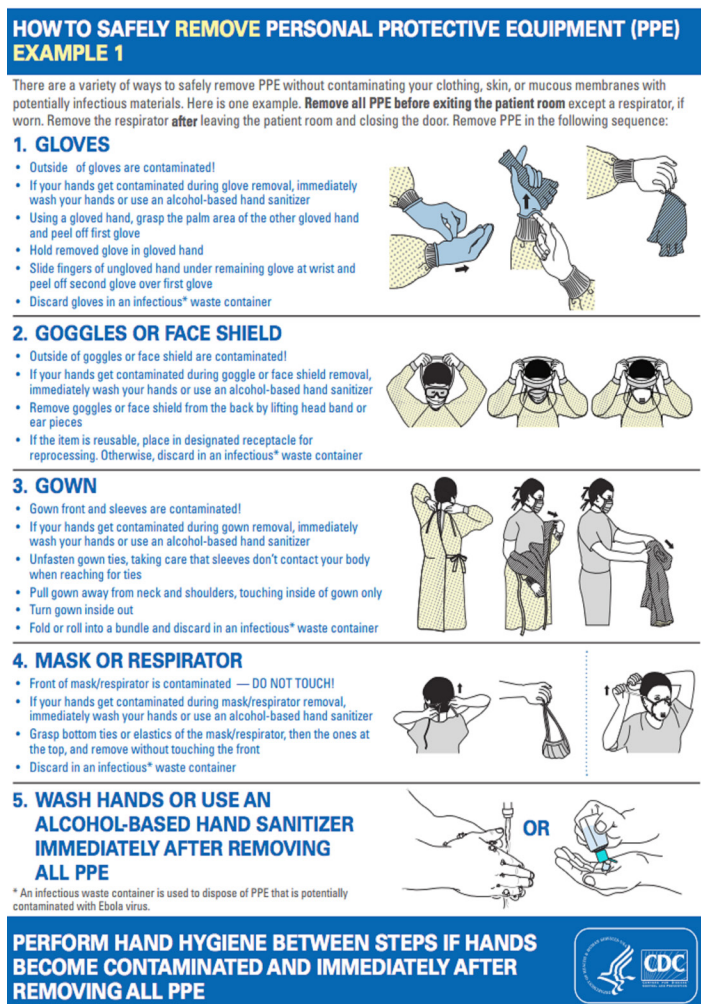


Figure 8. Personal protective equipments needed for contact with Covid-19 patients

Conclusion

Airway management in COVID-19 patients requires specific measurements to assure safety of the medical staff. Accuracy is crucial, and the physician must avoid ineffective techniques through the procedure of airway management, which will enable it to be safe, accurate and timely controlled. We have highlighted principles that may achieve these goals such as the 6Ps, the distribution of the medical team and the appropriate equipment and depending on only one aspect will not be enough rather it is essential to follow and obey to all these measures, all details of these methods may change as new information may appear to the surface.

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

All authors declare no financial support.

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