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Overview and Preventive Strategies of Coronavirus Among Healthcare Communities

K. Sheela Kannuchamy¹, Dhanasekhar Kesavelu²

¹MDS, Senior Lecturer, Dr. M.G.R. Educational and Research Institute, Thai Moogambigai Dental College and Hospital; ²M.B.B.S., MRCPCH (UK), FRCPCH (UK), Consultant Paediatrician and Paediatric Gastroenterologist, Apollo Children Hospital, Chennai, India.

ABSTRACT

Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. It is considered to be a pandemic disease of the year 2019-2020. The pandemic has caused the severe global socioeconomic disruption, including the largest global recession and the great depression. The virus that causes COVID-19 is mainly transmitted through droplets generated when an infected person coughs, sneezes, or exhales. The health care providers, work to save the lives of many people affected by coronavirus by fighting against the dreadful virus and become helpful in preventing the spread of infection in society. Thus it is very essential to reduce the role of fomites, virus and other micro-organisms that might play a role in the transmission of coronavirus in healthcare and non-healthcare settings which can be overcome by adapting proper sterilization and disinfection protocol. This article gives an overview of preventive measures to be undertaken in various healthcare fields which is mandatory in the current COVID 19 situation.

Key Words: Coronavirus, Prevention, Transmission

INTRODUCTION

In the past twenty years, several viral epidemics such as the severe acute respiratory syndrome coronavirus (SARS-CoV) from 2002 to 2003, and H1N1 influenza in 2009, have been recorded. Most recently, the Middle East respiratory syndrome coronavirus (MERS-CoV) was first identified in Saudi Arabia in 2012. In December 2019, a cluster of patients with a novel coronavirus was identified in Wuhan, China¹. As they were unable to identify the causative agent, the first cases were classified as “pneumonia of unknown etiology.” On February 11, 2020, the WHO Director-General, Dr TedrosAdhanomGhebreyesus, announced that the disease caused by this new CoV was a “COVID-19,” which is the acronym of “Coronavirus Disease 2019”. Initially tentatively named 2019 novel coronavirus (2019-nCoV), it has now been named as SARS-CoV-2 by the International Committee of Taxonomy of Viruses (ICTV)² as it is very similar to the one that caused the SARS outbreak (SARS-CoVs).

The spread of the virus was initially from animals especially bats infected pangolins to humans, but due to the widespread nature of the disease through contact, it has now turned into

a man-to-man transmission. General health care workers and healthcare professionals were at higher risk of infection and sometimes subjected as carriers of this infection without any symptoms. Hence there is a great need to reinforce the Universal Standard Precautionary guidelines suggested by the Centre for Disease Control and Prevention³.

DISCUSSION

COVID 19

CoVs are positive-stranded RNA viruses giving a crown-like appearance under an electron microscope (corona is the Latin term for crown) due to the presence of spike glycoproteins on the envelope. Coronaviruses belong to the family Coronaviridae in the order Nidovirales^{4,5}. They can be classified into four genera such as Alpha coronavirus, Betacoronavirus, Gammacoronavirus, and Deltacoronavirus. Alpha and beta coronaviruses infect mammals, gammacoronaviruses infect avian species, and delta coronaviruses infect both mammalian and avian species. The representatives of these viruses are mentioned in the table-1 below,

Corresponding Author:

Dr. K. Sheela Kannuchamy, MDS, Senior Lecturer, Dr. M.G.R. Educational and Research Institute, Thai Moogambigai Dental College and Hospital; Email: sheela_bds@yahoo.co.in

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Table 1: Virus and their Representatives⁶

S. No	Genera of Virus	Representatives
1.	Alphacoronavirus	Include human coronavirus NL63 (HCoV-NL63), porcine transmissible gastroenteritis coronavirus (TGEV), and porcine respiratory coronavirus (PRCV)
2.	Betacoronavirus	SARS-CoV, MERS-CoV, bat coronavirus HKU4, mouse hepatitis coronavirus (MHV), bovine coronavirus (BCoV), and human coronavirus OC43
3.	Gammacoronavirus	Avian infectious bronchitis coronavirus (IBV)
4.	Deltacoronavirus	Porcine delta coronavirus (PdcV)

In general, estimates suggest that 2% of the population are healthy carriers of a CoV and that these viruses are responsible for about 5% to 10% of acute respiratory infections⁷. Other human CoVs are SARS-CoV, SARS-CoV-2, and MERS-CoV (beta CoVs of the B and C lineage, respectively). These cause epidemics with variable clinical severity featuring respiratory and extra-respiratory manifestations. SARS-CoV, MERS-CoV, showed the mortality rates up to 10% and 35%, respectively.

Transmission

Human-to-human transmission of SARS-CoV-2 occurs mainly between family members, including relatives and friends who intimately contacted with patients or incubation carriers. It is reported that 31.3% of patients recent travelled to Wuhan and 72.3% of patients contacting with people from Wuhan among the patients of nonresidents of Wuhan⁸. As per the results produced by the National Health Commission of China on 14 February 2020 revealed that transmission between healthcare workers occurred from 3.8% of COVID-19 patients. By contrast, the transmission of SARS-CoV and MERS-CoV is reported to occur mainly through the nosocomial transmission. Data revealed that 33–42% of health care workers were affected by SARS cases and transmission between patients (62–79%) was the most common route of infection in MERS-CoV cases^{9,10}. Direct contact with intermediate host animals or consumption of wild animals was suspected to be the main route of SARS-CoV-2 transmission. Medical surgeons, as well as dental surgeons, are at higher risk of infection since they are exposed to aerosol-generating procedures where they are infected via contact transmission through the oral, nasal, eye, mucous membrane and other body fluids. Transmission can also be direct through cough, sneezing and droplet inhalation. Also, Salivary viral load cannot be ignored especially which is highest during the first week of symptom onset.

Pathogenesis

ACE -2(Angiotensin Converting Enzyme-2) which is found in the lower respiratory tract of humans is known as cell receptor for SARS CoV which is responsible for a human to human transmission. ACE-2 is a type I transmembrane Metallo-carboxypeptidase with homology to ACE, an enzyme which plays an important role in the Renin-Angiotensin system (RAS) and a target for the treatment of hypertension¹¹. A study conducted on the expression of ACE2 in healthy liver tissues using single-cell RNA sequence data and found specific expressions in cholangiocytes. They concluded that the virus might directly bind to ACE2 positive cholangiocytes but not necessarily hepatocytes¹². This finding suggested the liver abnormalities of SARS and 2019-nCoV patients may not be due to hepatocyte damage, but cholangiocyte dysfunction and other causes such as drug-induced and systemic inflammatory response induced liver injury. Higher ACE2 expression was also found in type II alveolar cells of lungs¹³, myocardial cells, kidney proximal tubule cells, and bladder urothelial cells, oesophagus upper and stratified epithelial cells, absorptive enterocytes from ileum and colon. These findings indicate that those epithelia with high ACE2-expressing cells should be considered as a potentially high risk for 2019-nCoV infection¹⁴.

In some cases, a reaction labelled as ‘cytokine storm’ takes place which produces extensive tissue damage. The protagonist of this storm is interleukin 6 (IL-6). IL-6 is produced by activated leukocytes and acts on a large number of cells and tissues. It can promote the differentiation of B lymphocytes, promotes the growth of some categories of cells, and inhibits the growth of others. It also stimulates the production of acute-phase proteins and plays an important role in thermoregulation, in bone maintenance and the functionality of the central nervous system. IL-6 is identified to show both pro-inflammatory and anti-inflammatory effects. In turn, IL-6 increases during inflammatory diseases, infections, autoimmune disorders, cardiovascular diseases and some types of cancer. It leads to complications such as Cytokine Release Syndrome which is an acute systemic inflammatory syndrome and has the signs and symptoms of fever and multiple organ dysfunction.

Clinical characteristics

The dominant clinical features of COVID-19 were fever, cough, and fatigue, myalgia, while congestion, rhinorrhea, sore throat, haemoptysis and diarrhoea are rare^{15,16,17,18}. The most frequently reported laboratory abnormalities were reduced lymphocyte count, elevated C-reactive protein, and elevated lactate dehydrogenase, all of which are generally consistent with previous reports of patients with COVID-19. Chinese CDC report divided the clinical manifestations of the disease based on their severity. Mild disease is categorized under symptoms of non-pneumonia and

mild pneumonia which was evident in 81% of cases. The severe disease having the symptoms of dyspnea, respiratory frequency $\geq 30/\text{min}$, blood oxygen saturation (SpO_2) $\leq 93\%$, $\text{PaO}_2/\text{FiO}_2$ ratio or P/F [the ratio between the blood pressure of the oxygen (partial pressure of oxygen, PaO_2) and the percentage of oxygen supplied (fraction of inspired oxygen, FiO_2)] < 300 , and/or lung infiltrates $> 50\%$ within 24 to 48 hours which occurred in 14% of cases. Critical disease are cases of respiratory failure, septic shock, and/or multiple organ dysfunction (MOD) or failure (MOF) which occurred in 5% of cases¹⁹.

Treatment

Corticosteroids were widely used for the treatment of SERS-CoV and MERS-CoV and even in the current pandemic COVID 19 infections. The interim guideline proposed by WHO prohibited the use of corticosteroids since the reports from researchers and clinical trials have shown delayed clearance of viral RNA in cases of MERS and SERS and also it resulted in severe side effects such as psychosis²⁰

On 16th June, 2020 World Health Organization appreciated and recognized the initial clinical trial results from the United Kingdom (UK) that show dexamethasone, a corticosteroid, can be the lifesaving drug for patients who critically stage with COVID-19. The results showed that, for patients on ventilators, the treatment was shown to reduce mortality by about one third, and for patients requiring only oxygen, mortality was cut by about one fifth, according to preliminary findings shared with WHO²².

Mechanical ventilation may be necessary in cases of respiratory failure refractory to oxygen therapy, whereas hemodynamic support is essential for managing septic shock. Drugs such as Lopinavir/Ritonavir (400/100 mg every 12 hours), Chloroquine (500 mg every 12 hours), and Hydroxychloroquine (200 mg every 12 hours) have been proposed. Alpha-interferon (e.g., 5 million units by aerosol inhalation twice per day) is also used. Improvement of host-related factors such as immune response, viral replication is dealt with by host-related therapies²¹. Many research on reverse vaccinology was also going on to put an end to this pandemic situation. Convalescent plasma therapy which involves blood transfusion from a patient who has recovered from Covid-19 was used to treat severely ill COVID patients which have aided their recovery.

General preventive measures

Preventive strategies are focused on the isolation of patients and careful infection control, including appropriate measures to be adopted during the diagnosis and the provision of clinical care to an infected patient. Social distancing and self-isolation are recommended by the world health organisation. The most important strategy to undertake is to frequently wash the hands

and use portable hand sanitizer and avoid contact with the face and mouth after interacting with a possibly contaminated environment. Immunocompromised patients should avoid public exposure and public gatherings.

Preventive measures among health care areas:

Social distancing at health facilities is important to prevent the spread of infection. An adequate amount of running water taps with proper outlets and liquid soap should be available at the entrance of all hospitals. Pre-check triage to measure and record the temperature of all staffs and patients using a non-touch infrared thermometer is mandatory. Health information of COVID 19 symptoms and respiratory etiquette and hygiene should be displayed at appropriate places. Individuals seating with at least one-metre distance should be made available in all areas of institution and hospitals including hospital canteens.

In the Operatory room, 2M distance should be maintained to limit close contact between triage staff and potentially infectious patients. Usage of PPE (Personal protective equipment) is mandatory when dealing with surgical and complicated cases and it comprises of usage of goggles/face shields, triple-layer surgical mask, N95 respirator during surgical procedures, FFP3-standard mask should be used during treatment of COVID19 positive patients. Proper donning and doffing procedure (Figure 1 and 2)^{23,24} should be followed by health care professionals. Use of hand sanitizers and frequent hand washing must be followed after each patient. Designate a separate clinical area for aerosol and non-aerosol control procedures since aerosols are a major source of infection. Sodium hypochlorite is available commercially in various concentration which also proves to be an effective disinfectant. To achieve the desired concentration, it is necessary to prepare sodium hypochlorite by diluting the basic aqueous solution with a given proportion of clean, non-turbid water to produce the final desired concentration. Inpatient and outpatient ward to be disinfected with 5% lysol (1 litre of Lysol in 9 litres of water) using a knapsack sprayer.

After cleaning, the following disinfectants with defined concentrations can be used on environmental surfaces which will prevent coronavirus contamination on surfaces and they are also effective against other clinically relevant pathogens in the health-care setting. Ethanol 70-90%, chlorine-based products (e.g., hypochlorite) at 0.1% (1000 ppm) for general environmental disinfection or 0.5% (5000 ppm) for blood and body fluids large spills, hydrogen peroxide $>0.5\%$ ²⁵

Hospital vehicles including ambulance should be cleaned with 2.5% Lysol (1 litre of Lysol in 19 litres of water). Disinfectants like Lysol and sodium hypochlorite should be present at all times in the hospital set up. Biomedical waste should be disposed of according to the World Health Organisation protocols. Proper instrument sterilization, as well

as clinical surface disinfection including the doors and handles and frequent fumigation of the hospitals, are advised. DRDO (Defence Research And Development Organisation) also developed an ultraviolet disinfection tower for rapid and chemical-free disinfection of high infection-prone areas. HEPA filter (High-Efficiency Particulate Air Filter) was recommended by and it can capture at least 99.97% of particles with a diameter greater than or equal to 0.3 microns

CONCLUSION

Self-monitoring of temperature and respiratory symptoms after exposure to the critically ill patient is mandatory for the health care professional. It is also essential to maintain the risk assessment exposure form which is one of the tools issued by WHO to maintain the risk categorization of health-care workers. Many different treatment options both traditional and novel are being explored to combat the infection. Apart from these preventive measures, there is a lot of published data available in the public domain, but new evidence is coming up every day. Hence, there is still a lot more that we need to know about the virus to tackle the challenges posed by the COVID-19 infection

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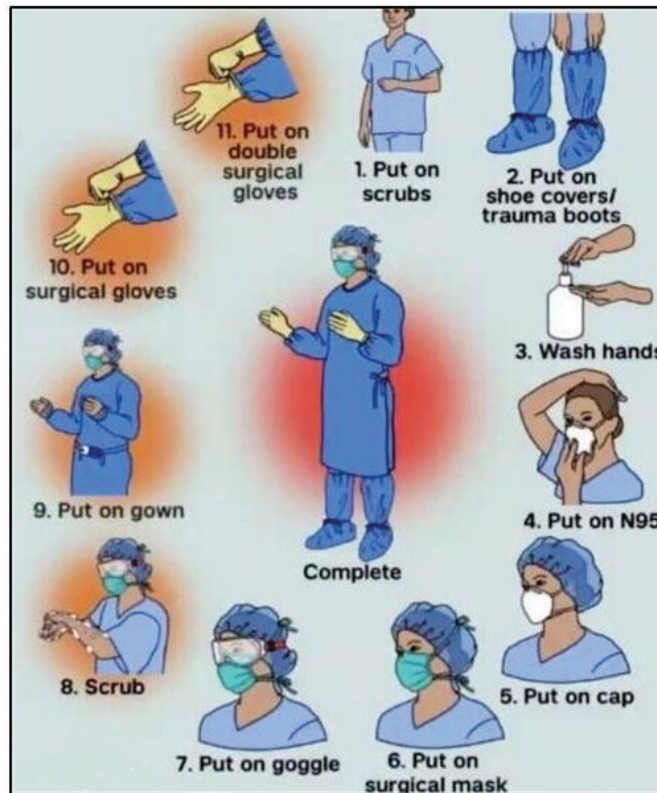


Figure 1: Donning Procedure^{E23}

Source: Adapted from Weil Cornell Medicine(Procedure of donning).

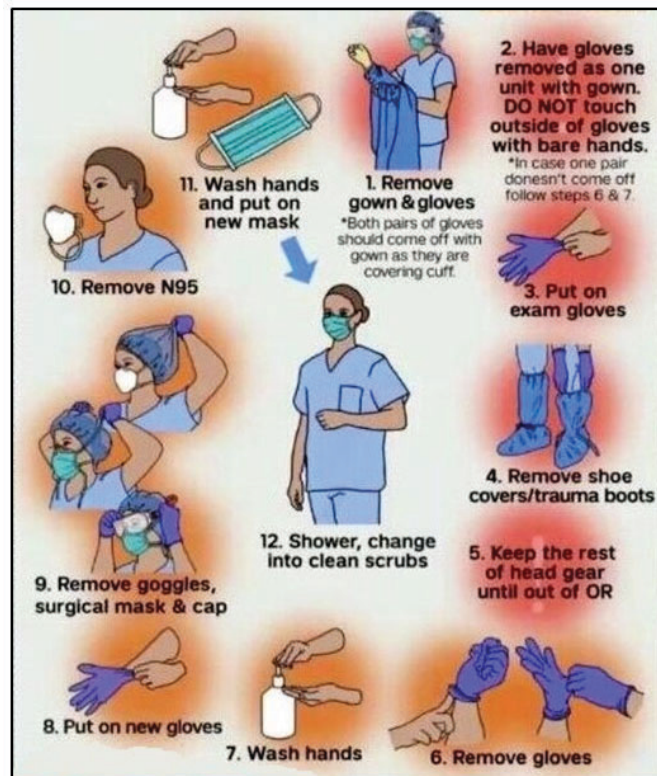


Figure 2: Doffing Procedure^{E24}

Source: Adapted from Weil Cornell Medicine(Procedure of Doffing).