



Safeguarding from COVID-19: educating healthcare workers about the available protective equipment

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Abstract

Aim Coronavirus disease 2019 (COVID-19) is a viral illness which is transmitted through droplet spread and possibly the aerosol method. Older individuals are at higher risk compared with younger adults and children due to the presence of weaker immune functions. Healthcare workers are also at higher risk due to close proximity with the infected cases. Proper precautions and hand hygiene techniques can prevent the transmission of the disease. There is a dearth of evidence on how to manage the disease; therefore, protective measures might help to reduce the spread of infection. This article aimed to evaluate the preventive measure and use of protective equipment among healthcare workers and community settings.

Subjects and methods Various recent literature searched in the following databases—Medline/PubMed, CINAHL, Scopus—recommendations from centre for disease control and prevention (CDC) and World Health Organization (WHO) reports on preventive measures of COVID-19 were included.

Results After reviewing the previous literature, we summarized proper precautions and hygiene techniques, use of PPE and applicability of surgical and N95 (can block 95% small particles but not resistant to oil) masks to prevent the transmission of disease.

Conclusion This viewpoint can be considered as a unique example of information on infection control and protective measures. However, due to the lack of evidence, further research is required to compare the effectiveness of medical masks and N95 masks.

Keywords COVID-19 · Hand hygiene · Health personnel · Humans · Personal protective equipment

Introduction

The coronavirus disease 2019 (COVID-19) pandemic outbreak, to date, is ongoing worldwide with 3,588,773 reported confirmed cases globally, including 247,503 deaths as of 06 May 2020. In India, 49,391 cases have been reported, with 1694 deaths (WHO 2020). COVID-19 causes severe

respiratory infection with a relatively high fatality rate in the most vulnerable populations. Until now, seven subgroups of coronavirus are known (Patrick et al. 2012). The 2019 outbreak of COVID-19 in the world caused by the novel coronavirus is the largest outbreak to date. COVID-19 can be transmitted to the healthy individuals by direct contact, indirect contact, and droplet method or aerosol mode. Several

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healthcare professionals also might also become infected with COVID-19. Additionally, people who recently travelled to China and other western countries and have fever and other symptoms have been evaluated for possible COVID-19 (Graham and Baric 2010; Li et al. 2020b). The novel coronavirus belongs to the family coronaviridae, and is a large enveloped positive strand, RNA virus with high mutation rate. It is present in animals as well as humans and leads to mild to severe infections with respiratory, gastrointestinal, hepatic and neurological symptoms. The purpose of this viewpoint was to explore the knowledge of preventive measures and protective equipment to prevent the infection and transmission of disease.

Search strategy

Literature were searched in the following databases: Medline/PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Scopus with keywords such as, ‘preventive measures’, ‘personal protective equipment’, ‘coronavirus disease’, ‘COVID19’, ‘control measures’ and combined using the Boolean terms such as, OR, AND, NOT. All published articles in the English language from inception to April 2020 were included in this viewpoint.

Pathogenesis and transmission

COVID-19 is transmitted via contact, respiratory droplets and possibly the aerosol method. The virus enters the body, replicates in the upper respiratory tract, with further replication in the lower respiratory tract, gastrointestinal tract, and might reach the brain. The incubation period is usually 14 days with onset of the disease to death from 6 to 41 days. The period depends on the age and health status of an individual. COVID-19 is highly transmissible by direct connect with infected individuals. Transmission via an indirect method and contaminated objects is possible (World Health Organization 2020). The principle mode of transmission in human outbreak is person-to-person transmission through direct contact and droplets. However, transmission through aerosols or from mothers to baby remain to be documented (Wang and Du 2020).

The outbreak of virus transmission in human remains unknown; however, according to reports, the first patient was infected through direct contact with an infected animal (Decaro et al. 2020). Person-to-person transmission followed and has affected a large number of people. Infection from humans can spread in several ways, including direct contact or through droplets spread by coughing or sneezing from an infected individual. Air borne transmission may be possible in specific circumstances during aerosols procedure performed such as intubation, open suctioning, turning a patient to the prone position, manual ventilation and tracheostomy (Wang and Du 2020). Studies showed an increased number of

leukocyte and cytokine in abnormal respiratory findings of infected patients (Li et al. 2020a); in liver biopsy, moderate microvascular steotosis and mild portal activity and in heart tissue, interstitial mononuclear inflammatory infiltrates have been seen (Xu et al. 2020). In a case report of a patient infected with COVID-19, massive mucus secretions were seen in both the lungs (Lippi and BM 2020). Laboratory findings showed leukopaenia with a leukocyte count of 2.91×10^9 cells/L of which 70.0% of cell were neutrophils (Li et al. 2020a). In addition, increased C-reactive protein, erythrocyte sedimentation rate and D-dimer might be observed (Qiu et al. 2020). Human angiotensin converting enzyme (ACE-2) is broadly expressed in nasal mucosa, lung, heart, kidney, stomach, brain, etc. The first step of viral infection is the binding of receptor with host cells followed by fusion with cell membrane. Binding between the domains of virus spikes and cellular receptor of ACE-2 receptor suggested the entry of COVID-19 into the host via ACE-2 (Jin et al. 2020).

Clinical features

The onset of the disease is abrupt after an incubation period of 14 days. The most common symptoms have included fever, cough, shortness of breath and sore throat. Other symptoms such as malaise, respiratory distress, fatigue, sputum production, multiorgan dysfunction, anosmia and ageusia have also been described. Blood test showed a reduced number of white blood cell counts and lymphopenia while radiological finding showed bilateral ground glass opacity and subsegmental areas of consolidation (Jin et al. 2020; Rothan and Byrareddy 2020).

Diagnosis

Early laboratory confirmation is essential to implement appropriate infection control measures. Definitive diagnosis of a

Table 1 Level of risk of infection

High risk	<ul style="list-style-type: none"> • People 65 years and older • Close contact with patients or infected person • Healthcare workers • Family members of infected patients • Have underlying medical condition • Respiratory disease asthma, heart condition • Immunocompromised patients, obesity • Diabetes, smoking • Kidney, liver disease
Low risk	<ul style="list-style-type: none"> • Children and younger adults • Ocular transmission • Mild fever but do not feel ill • From faeces of an infected person

Table 2 Level of risk for transmission

Low risk	• Contact with asymptomatic individuals
High risk	• Direct contact with any material touched with body fluids from a probable or confirmed case • Mucosal exposure to body fluids of confirmed case

suspected case of COVID-19 is usually made by nucleic acid detection test based on detection of viral sequence by reverse transcription polymerase chain reaction (RT-PCR) testing (Lan et al. 2020). Additional laboratory diagnostic tests, including serologic diagnosis combined with an immunochromatography, Cas-13 based SHERLOCK (Specific high sensitivity enzymatic reporter unlocking) system remain to be verified. Imaging technology chest radiography and CT are an important tools for COVID-19 which show features of bilateral distribution of patchy shadows and ground glass opacity (Jin et al. 2020; Zhai et al. 2020).

Treatment

No proven COVID-19 specific treatment presently exists; however, there are measures that can be taken that will improve a patient’s chance of survival. Use of broad-spectrum antiviral drugs ribovirin, lopinavir/ritonavir, remdesivir, nelfinavir, abidol and chloroquine have proven effective and are recommended for control of COVID-19 (Savarino et al. 2003; Wenzel and Edmond 2003; Chu et al. 2004; Yamamoto et al. 2004; Agostini et al. 2018; Deng et al. 2020). Furthermore, there are a number of other compounds in development. Because COVID-19 is generally considered as a potential biologic weapon, it is urgent to develop effective antiviral drugs and vaccines.

Control measures

The cornerstone for controlling an outbreak of COVID-19 is to interrupt the virus transmission chain. Extensive measures

are required to control an outbreak of COVID-19. Reducing transmission requires several strict public health measures to be implemented as quickly as possible, including social distancing, infection control measures, restricting public transportation, postponing social events and delaying educational and academic activities.

COVID-19 and PPE

Personal protective equipment (PPE) is protective gear designed to protect the health of individuals by minimizing the exposure to a biological event. There are six components of PPE to use: face shield and goggles, mask, gloves, gowns, shoe covers and head covers (World Health Organization (WHO) 2020).

1. **Face shields and goggles** – These are to be made of clear plastic, provide good visibility, be fog resistant, and may be reusable. They provide protection to the mucous membrane of eyes/nose/mouth from contaminated hands.
2. **Masks** – Use of masks minimizes the dispersal of larger respiratory droplets to protect against transmission. To protect the airways from particulate matter (PM), such as dust, pollution, smoke, mist and droplets/aerosols, using a mask is crucial for healthcare workers while dealing with a suspected or confirmed case of COVID-19. People who are at very low risk can wear non-medical masks (cloth masks) or disposable masks and high-risk people should wear surgical masks or disposable masks. It has been recommended that to prevent spread of respiratory infections affected patients should wear masks

Table 3 Do’s and Dont’s by the healthcare workers

Do’s	Follow 5 C’s 1. C (Clean) – clean your hands frequently, with soap and water for at least 30 s or use alcohol-based hand rub 2. C (Cover) – cover your mouth and nose with tissues/flexed elbow during coughing or sneezing 3. C (Call) – call the healthcare professionals, if you feel unwell or having flu-like sign/symptoms 4. C (Contact) – stay at home, limit the contact with others 5. C (Care) – Provide care to the needy people and older people
Dont’s	1. Do avoid spiting in public places and home 2. Avoid using public transport cab, bus, train and flight 3. Avoid close contact with anyone 4. Avoid touching your mouth, face and eyes 5. Avoid counter medicines

Table 4 Prevention of transmission of virus

1.	Maintain hand hygiene
2.	Use disposable gloves, when in contact with infected individuals
3.	Cover your mouth while sneezing and coughing and wash your hands afterwards
4.	Regular disinfections of frequently touched objects such as door knobs, handrails, restroom surfaces, medical instruments, phone, computer, official objects and children toys, etc.
5.	Use personal protective equipment
6.	Disinfectant the medical equipment used with different patients
7.	Isolation of infected patients
8.	Wear gown, mask and eye protection or face shield during close contact procedures and patient care activities
9.	Cleaning and disinfection of environmental surfaces
10.	Maintaining physical distance

(Feng et al. 2020). Usually two types of masks are recommended to the individuals who are working in community or hospital settings. Triple layer, medical masks or surgical masks might provide barrier protection against large droplets and prevent hand to face contact, provide 94% (0.3 μm) of filtering efficiency and usually they are loose fittings (Neupane et al. 2019). Whereas an N95 respirator mask is high filtration efficiency to airborne particles and designed to closely fit and provide a much tighter seal to the face, have high fluid resistance, good breathability and protect the individual from inhaling airborne particles during aerosol procedures. However, there is a lack of evidence that use of N95 masks can protect the individuals from COVID-19 virus infection (Bartoszek et al. 2020). The average diameter of a virus particle is approximately 125 nm (0.125 μm), whereas N95 (can block 95% small particles but not resistant to oil) is efficient for filtering a mean particle size up to 100 to 300 nm (0.075 \pm 0.020 μm) that means a respirator might be able to stop the particles if worn perfectly (Bar-on et al. 2020; Bałazy et al. 2006). Prolonged use of N95 masks might be problematic and feel uncomfortable to the wearer. Carbon dioxide (CO_2) that is exhaled can get trapped in the chamber of the mask and re-enter in the body and might lower oxygen delivery into the body. Re-entered CO_2 might cause hypercapnea and lead to symptoms of dizziness, fatigue, headache and disorientation (Sinkule et al. 2013). The effectiveness of wearing a facemask to protect you from contracting the virus is thought to be limited.

3. **Gloves** – Gloves should be used while holding objects or touching surfaces potentially contaminated by a confirmed case of COVID-19. Nitrile gloves are preferred mostly because they resist chemicals, including disinfectant such as chlorine. If not available latex gloves can be used.
4. **Gowns** – Use of gowns is to protect professionals from contact with blood or body fluids, organisms in the environment or from infected patients.

5. **Shoe covers** – Use of shoe covers facilitates personal protection and decontamination. Disposable shoe covers are widely used, as they guard against some of the most unhygienic particles bacteria collected from the personnel's feet.
6. **Head covers** – Use of head covers protect the hair and scalp from possible contamination when airborne exposure is anticipated. Head covers should be worn as part of full barrier precautions.

Conclusion

The COVID-19 pandemic constitutes a significant public health concern globally and specific treatment is needed for the world. From this viewpoint after reviewing recent databases, we found that limited evidence is available regarding the protective measures for COVID-19. Large clinical trials are needed to provide high quality evidence that can be used to form a systematic review and unique conclusions. Until that is accomplished, use of proper PPE when in contact with suspected and confirmed cases is recommendable to the community and healthcare workers. Take precautions, maintain hygiene and follow social distancing to prevent infection. The early detection and isolation of patients with COVID-19 might decrease the risk for the transmission in the community (Tables 1, 2, 3 and 4).

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