



Review

Art of prevention: Life in the time of coronavirus

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ABSTRACT

The novel coronavirus disease 2019 (COVID-19) has continued to progress since its discovery in December 2019. A cluster of patients with atypical pneumonia identified in Wuhan, China, served as the epicenter of this recent epidemic. This family of viruses is responsible for the common cold along with the infamous severe acute respiratory syndrome epidemic in 2002 and Middle East respiratory syndrome in 2012. The Southern China Wholesale Market reportedly has connections to the original 27 cases in Wuhan, China. The worldwide confirmed case total has eclipsed 1,450,000, with more than 83,000 deaths. Patient presentation ranges from mild respiratory illness to acute respiratory distress syndrome and subsequent death. Early epidemiologic studies of viral spread support the hypothesis that COVID-19 can remain latent with an extended and infectious incubation period. The U.S. government has issued level 3 precautions for most international travel, along with prohibiting entry to foreign nationals traveling from China, Iran, the United Kingdom, the Republic of Ireland, and the European Schengen area (e.g., France, Italy, Germany). Prevention remains the mainstay in treating and defeating the COVID-19 epidemic. Anyone infected or suspected of being infected should self-quarantine at home or admit themselves to a specified hospital with infrastructure to handle the situation. The combination of prevention and containment provides the best opportunity to stall the spread of COVID-19.

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The coronavirus (CoV) is a single-stranded, positive sense, RNA virus that has an envelope, which confers it the ability to replicate in the cytoplasm of infected cells and remain infectious even when

its capsid is compromised. This family of viruses is responsible for the common cold, along with the infamous severe acute respiratory syndrome (SARS) epidemic in 2002 and the Middle East respiratory syndrome in 2012 (Brian and Baric, 2005). These enzootic viruses have a propensity to infect birds, bats, and other mammals (Schoeman and Fielding, 2019). Traditionally, most human infections by CoVs were thought to be zoonotic in nature; however,

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recent literature has identified CoVs that primarily infect human hosts.

In late December 2019, Dr. Li Wenliang and colleagues identified a cluster of patients in Wuhan, Hubei Province, China, with atypical pneumonia with severe features (European Centre for Disease Prevention and Control, 2020). The original four cases identified outside of Wuhan were in Thailand, Japan, and South Korea. Two of those four cases reportedly had no contact with the hospital or market, suggesting that the infection can remain latent with an extended but infectious incubation period (Rothe et al., 2020). Dr. Li himself contracted the virus and suffered from severe respiratory distress that eventually took his life. The original cases in Wuhan Central Hospital had sputum, blood, stool, and bronchoalveolar lavage fluid cultures sent for diagnostic testing with reverse transcriptase polymerase chain reaction and next-generation sequencing (Wu et al., 2020). The bronchoalveolar lavage studies led to the discovery of the novel coronavirus, which is now known as SARS CoV-2.

To date, the original source of the viral outbreak remains unknown (European Centre for Disease Prevention and Control, 2020). The Southern China Wholesale Market reportedly has connections to the original 27 cases in Wuhan, China. The facility is said to house live wildlife ready to be sold for consumption. Bats are understood to be the main host of this beta-coronavirus; however, an intermediate host has not been elucidated.

One of the devastating abilities of the virus is to remain in a latent state within human hosts. Researchers suspected this after investigating the early cases discovered in other countries. By the end of January 2020, 614 cases of the 2019 coronavirus disease (COVID-19) had been confirmed in Wuhan with laboratory testing. To date, more than 190 countries, spanning six continents, have confirmed cases of COVID-19 (World Health Organization [WHO], 2020a, 2020b). The worldwide confirmed case total as of April 8, 2020 eclipsed 1,450,000, with more than 83,000 deaths (Dong et al., 2020). The United States surpasses China in total number of cases at >400,000, including a death toll surpassing 13,000 (Centers for Disease Control and Prevention [CDC], 2020a, 2020b, 2020c, 2020d). The current case fatality rate is calculated at approximately 2% (Fauci et al., 2020).

Patient presentation ranges from mild respiratory illness to acute respiratory distress syndrome and subsequent death. Most patients identified early in this epidemic did not present with rhinorrhea, pharyngitis, or sinusitis. Researchers believe this can be a product of the virus homing in on the lower respiratory epithelium for attachment and infection (Huang et al., 2020). Chest computed tomography is often normal in patients with early symptoms (0–2 days), but may demonstrate characteristic findings in later presentations (6–12 days), including bilateral lung involvement with linear opacities, a crazy-paving pattern, and reverse halo sign (Bernheim et al., 2020). The gold standard diagnostic testing of COVID-19 remains the real-time reverse transcriptase polymerase chain reaction diagnostic panel, which amplifies RNA and allows for the detection of specific viral genes (WHO, 2020a, 2020b).

At this point, the literature cannot confirm whether COVID-19 is transmitted vertically in pregnant mothers. A study of 10 newborns born to mothers with COVID-19 showed a less dramatic presentation compared with the CoV SARS-1 epidemic. Neonates and pregnant women are still considered high risk and should avoid public spaces and implement extra precautions. At this time, it is recommended that infected pregnant mothers avoid breastfeeding until cleared of infection (Qiao, 2020).

Current treatment remains supportive care, primarily for respiratory distress. Limited information is available regarding effective treatment for COVID-19 infection. Researchers have looked to the treatment strategies for Middle East respiratory syndrome and SARS to get an understanding of possible therapeutic regimens.

Previous trials of corticosteroids to address the high cytokine load did not improve mortality and instead caused a delay in viral clearance (Arabi et al., 2018; Stockman et al., 2006). This has not discouraged a Chinese-based pharmaceutical group from starting a new clinical trial of methylprednisolone for COVID-19 (Harrison, 2020).

Some another promising and emerging area of investigation is the use of convalescent plasma in patients with severe COVID-19 presentations. Early results suggest that this therapy may clear viremia by way of neutralizing antibodies from recovered donors (Duan et al., 2020). Officials suggest a trial of antiviral medications. Both ritonavir and lopinavir are currently in clinical trials as potential therapeutic agents (Shionogi, Toyama Chemical, Osaka, Japan). In recent news, hydroxychloroquine, a disease-modifying antirheumatic drug, is being reviewed for its potential to decrease the host response in those infected with COVID-19 (Schrezenmeier and Dörner, 2020). A nonrandomized clinical trial combining azithromycin and hydroxychloroquine showed promising therapeutic benefit (Gautret et al., 2020). Another company is exploring the novel use of a monoclonal antibody to IL-6 known as tocilizumab in hopes of attenuating severe respiratory distress through cytokine inhibition (Chugai Pharma, Tokyo, Japan). No vaccine has yet been created to prevent infection.

The top priority of prevention remains containment (Table 1). The U.S. government has issued level 3 precautions for most international travel and effectively prohibited entry to foreign nationals traveling from China, Iran, the United Kingdom, the Republic of Ireland, and the European Schengen area (e.g., France, Italy, Germany) in efforts to reduce the globally growing rate of infection. Multiple instances of cruise-lines and other tourist activities being held for quarantine have been reported after a single individual has been found positive for the virus. These precautions are justified and deemed necessary to reduce widespread disease and contain infections within an isolated and controlled area (Table 2).

Practical intervention pearl

Prevention remains the mainstay in treating and defeating the COVID-19 epidemic (Table 1). Prior to understanding the cause of illness, clinicians in Wuhan, China, isolated suspected patients with respiratory precautions and fit-tested N-95 masks (Huang et al., 2020). These N-95 masks are known to prevent up to 95% of small particles, including viruses, from entering the respiratory tract (Kirby, 2020). All health care personnel working with infected patients should have their serum tested before and after exposure to ensure there is no asymptomatic infection that can increase transmission to others. Protocols are being implemented to establish (when possible) serum pretesting and posttesting in personnel working with known infected patients.

Prevention begins with frequent handwashing with soap and warm water (U.S. Food and Drug Administration, 2020). Hand sanitizer is an effective alternative if soap and water is not readily available, such as in public places. Next is avoidance of touching the mouth, nose, or eyes to prevent the spread of viral particles to at-risk areas of the body (Fig. 1). Given that the average person touches their face up to 2000 times per day, guidelines recommend judicious handwashing to prevent self-inoculation (Kwok et al., 2015). Commonly used household areas should be cleaned and disinfected with 70% alcohol or chloride-containing wipes. This is true for doorknobs, taps, and children's toys that can easily be placed in children's mouths. Avoiding crowded locations, such as amusement parks and hospitals, can help reduce the risk of transmission (Fig. 2). This is especially true for areas with a high level of tourism, such as airports and cruise ships.

Table 1

Standard precautions and recommendations to prevent coronavirus disease 2019 (adapted from the Centers for Disease Control and Prevention).

- Avoid close contact with ill persons (recommend >6 ft) when possible
- Wear personnel protective equipment (face shield, mask, gown, gloves, and closed-toed shoes) when evaluating persons at risk
- Avoid well persons when you are ill
- Cover all coughs/sneezes with a tissue and then throw the tissue away (req original Kleenex ad)
- Routinely clean/disinfect frequently touched objects and surfaces with household cleaning spray and use a wipe or tissue when handling (e.g., door knobs, sink taps, water fountain handles, elevator buttons, cross-walk buttons, shopping carts)
- Wear mask at all times if taking care of persons with respiratory illness (patient, child, partner, parent)
- Use paper towel to turn on tap and then wash hands with soap and water for at least 30 seconds after going to the bathroom, before eating, and after a cough/sneeze/or nose blow
- Carry travel size hand sanitizer whenever at a public venue
- Activate community-based interventions (e.g., cancel sporting events, dismiss from school, practice social distancing, create employee plans to work remotely)
- Create household ready plan
- Containment in travel (cancel any nonessential travel from an area with no index cases to an area with index cases)

Table 2

Risk assessment questions to ask (adapted from Dr. Michael Ing lecture slides, Loma Linda University, Loma Linda, California).

1. Have you had any recent travel to any of the following countries: China, Italy, South Korea, Iran, or Japan?
2. Have you had any recent travel to an international airport?
3. Have you recently been exposed to anyone with diagnosed or suspected COVID-19?
4. Have you had any recent unexplained fever?
5. Have you had any recent unexplained and worsening cough?
6. Have you had any recent shortness of breath?
7. Do you have a medical condition that suppresses your immune system?
8. Do you currently live in or work in a confined and populated area, such as a military barracks, nursing home, or hospital?

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- 1 HANDS** Wash them often
- 2 ELBOW** Cough into it
- 3 FACE** Don't touch it
- 4 FEET** Stay more than 3ft apart
- 5 FEEL** sick? Stay home

Fig. 1. Do the 5 to help stop coronavirus disease 2019 (reproduced with permission from Google).



Fig. 2. Ultraviolet protection scarves used as masks during a sporting event.



Fig. 3. Empty shelves after consumers purchase all masks for protection against coronavirus.

Many citizens have taken to purchasing surgical masks to help reduce the transmission risk while outside (Fig. 3). Exactly how effective surgical masks are is unknown, but at minimum they provide a direct barrier and should be worn by individuals who test

positive for COVID-19 to reduce spread to others. Current guidelines do not recommend the use of surgical masks for healthy persons >6 feet from an infected individual; social distancing is the best defense against infection (CDC, 2020a, 2020b, 2020c, 2020d).

Following these guidelines saves personal protective equipment for health care workers and caregivers. For caregivers, a surgical mask is required if within 3 to 6 feet of an infected individual (CDC, 2020a, 2020b, 2020c, 2020d). An N-95 respirator should be used if there is a need to be within 3 feet of an infected person or in a room during a procedure such as intubation that can cause aerosolization of the virus (World Health Organization, 2020).

Anyone infected or suspected of being infected should self-quarantine at home or admit themselves to a specified hospital with infrastructure to handle the situation (Shen et al., 2020). Appropriate hospital infrastructure includes negative pressure rooms, planned routes to evaluation areas, and properly staffed facilities with infectious disease and critical care support (American Medical Association, 2020). Individuals suspected of illness are to make contact with the hospital prior to entry into the facility. The designated health care official will then guide the patient to a contained triage area to have a noninduced sputum or nasopharyngeal swab collected for COVID-19 diagnostic testing. This reduces the chance of infecting those already critically ill in the hospital. Similar precautions are performed for suspected measles cases (Centers for Disease Control and Prevention, 2019).

Quarantine can be emotionally and mentally taxing, especially in the adolescent population who are accustomed to socializing at school and outdoors. CDC guidelines suggest keeping a watchful eye for signs of stress in youths, which can present as excessive sadness, agitation, or disruptive behavior (CDC, 2020a, 2020b, 2020c, 2020d). Addressing the current COVID-19 situation in an age-appropriate, supportive manner may alleviate anxiety. Brief periods of outdoor exercise, such as walks, can help reduce stress and are encouraged as long as physical social distancing rules are followed (CDC, 2020a, 2020b, 2020c, 2020d).

Health care providers need to remain cognizant that many adults on home quarantine are potentially facing social isolation, the burden of unemployment, and/or home schooling of children, adding further strain to an already overwhelming situation. Simply reducing daily news exposure can help with coping and improve mental health (CDC, 2020a, 2020b, 2020c, 2020d). If significant mental distress is identified, including thoughts of self-harm or harm to others, intervention is warranted. Community-referral, 24-hour/7-day-a-week hotlines, such as the Disaster Distress Helpline at 1-800-985-5990, are also available.

The CDC recommends maintaining household plans in case of emergency, including preparation in case of school and work cancellations. The combination of prevention and containment provides the best opportunity to stall the spread of COVID-19.

Conflict of interest

None.

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Study Approval

The author(s) confirm that any aspect of the work covered in this manuscript that has involved human patients has been conducted with the ethical approval of all relevant bodies.

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