Coronaviruses and Recurring Outbreaks: **Back to the Future?**

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What do the years 2002, 2012, and 2019 have in common? The answer is that during each of these years, the first human cases occurred in what subsequently became lethal, global infectious disease outbreaks. All 3 of these widespread pandemics was/is caused by newly emergent, virulent strains of coronaviruses.

Severe Acute Respiratory Syndrome (SARS) was the first epidemic, with early undiagnosed cases occurring in late 2002 in Chinese hospitals and families. These were eventually traced back to food handlers in live animal markets in China's Guangdong province. The first reported, diagnosed cases were detected after an infected man traveled to Hong Kong and stayed at the Metropole Hotel. Others who came into contact with the man at the hotel were infected with the new coronavirus, and they subsequently spread the disease to multiple countries where it continued to spread in 2003. The last known case occurred in 2004.

The 2012 epidemic, called Middle East Respiratory Syndrome (MERS), was first reported in Saudi Arabia, and spread throughout many Arabian countries and to over 25 others. The origins of MERS pathogenic coronavirus were initially traced to bats, but later laboratory and epidemiologic studies showed that camels in the Middle East and Africa were secondary hosts capable transmitting viral infection to humans. Additional information about SARS and MERS will be included below as they relate to the current coronavirus epidemic. For now it is worth noting that the human toll from these 2 diseases resulted in thousands of disease cases and over a thousand deaths *(Table 1)*.

Table 1.

Name	Outbreak Start Date	Infections	Deaths (% Rate)	Infections
SARS	2002	8,098	774 (9.6%)	29
MERS	2012	2,494	858 (35%)	28

WHO and CDC Summaries of SARS and MERS Coronavirus Epidemics (as of July 23, 2020)

Unfortunately, another respiratory disease outbreak was reported by the Chinese Health Agency on December 31, 2019. What started as several cases of pneumonia in the city of Wuhan located in Hubei province, has become a widespread pandemic in only a few weeks. The etiologic agent was identified in early January as previously unidentified coronavirus. Because the virus was not known before the first human infections, it was given the designation 2019 novel coronavirus, or 2019-nCoV. Since then the World Health Organization (WHO) has changed the official name to COVID-19.

Coronaviruses – Epidemiology and Diseases

Fortunately, as the COVID-19 outbreak continues to spread in China and other countries, WHO, governments, and other global health agencies are using accrued scientific and clinical knowledge pertaining to coronaviruses to hopefully slow and eventually control the epidemic. Coronaviruses are large family of zoonotic viruses, meaning they primarily infect mammals and birds. These single-stranded RNA viruses can also jump between animal species and humans and cause a variety of illnesses. These can range from the common cold to severe, potentially fatal respiratory diseases.

Coronaviruses that infect humans are all respiratory pathogens and have been found to commonly cause mild respiratory infections. While coronavirus respiratory infections have been found throughout the world, illness in temperate climates occurs more frequently in winter and spring. It may come as a surprise to some people, but about 15% of the common colds suffered by humans are caused by coronaviruses.

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As mentioned above, coronaviruses have the potential to be highly pathogenic in host animal species causing a wide variety of diseases. It is also characteristic of these viruses to mutate frequently and cross-infect new species. Subsequent accidental infection in humans unfortunately has been well-documented in 2 previous global outbreaks —Severe Acute Respiratory Syndrome (SARS) caused by SARS-CoV and Middle East Respiratory Syndrome (MERS) caused by MERS-CoV. SARS was first reported in the winter of 2002-2003.

This new, fatal coronavirus disease was initially reported in Hong Kong. It was given the name Severe Acute Respiratory Syndrome (SARS) and resulted in over 8,000 global cases and 774 deaths. In a similar situation with the current outbreak, epidemiological investigation into the origins of SARS showed that the disease originated in Guangdong Province in China. The etiologic viruses had passed most probably from bats through multiple animal species (i.e. civet cats), and then into humans.

The epidemic was controlled only through an intensive global effort at case identification and containment. The last case was reported in mid-2004. More recently in 2012, a different coronavirus variant emerged in the Middle East. Result respiratory infection from camels to humans was widespread, with the etiologic virus identified as a new MERS-CoV that was closely related to those found in bats. Table 1 shows the most recent toll of MERS is humans.

As for the ongoing epidemic caused by COVID-19, recent outbreaks of multiple cases in countries like South Korea and Singapore without a direct link to China suggest that the virus may be spreading more extensively than previously thought. As of July 7th, over 11 million people have been sickened and over 535,000 have died of the coronavirus since the start of January, according to WHO and the CDC.

Fortunately, most infected persons (80%) have recovered. However, approximately 14% of disease cases are severe (i.e. pneumonia and shortness of breath), and about 5% of those infected have critical disease. This later severe illness is characterized by respiratory failure, septic shock, multi-organ failure, possibly causing patient death. The overall case fatality rate appears to be 2-3% with the majority of deaths occurring in patients age 60 and older or those with underlying medical conditions. Unfortunately, an increasing number of hospitalizations is also occurring in persons 18-40 years of age.

By comparison, SARS had a mortality rate of 9.6% during the 2003 outbreak, while MERS is much higher with a case fatality of 35%. Even though the death rate is much lower than seen with the previous outbreaks, a recent comprehensive study by Chinese scientists showed that COVID-19 is more contagious than the related viruses which caused SARS and MERS. Even though the current mortality rate for COVID-19 disease is not as high, its greater spread has already led to more deaths than its related coronaviruses.

Table 2.

Cases of COVID-19 Reported in the US
as of July 22, 2020 (CDC)

Total **Cases**	3,882,167
Total **Deaths**	141,677

CDC: https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html

Situation in Numbers by WHO Region
as of July 22, 2020

AMERICAS
7,811,127 **cases**
313,809 **deaths**

AFRICA
623,851 **cases**
10,157 **deaths**

EASTERN MEDITERRANEAN
1,414,462 **cases**
35,628 **deaths**

GLOBALLY
14,765,256 **cases**
612,054 **deaths**

WHO Risk Assesment
Global Level: **Very high**

EUROPE
3,124,701 **cases**
208,469 **deaths**

SOUTH-EAST ASIA
1,520,780 **cases**
35,891 **deaths**

WESTERN PACIFIC
269,594 **cases**
8,087 **deaths**

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Coronavirus Transmission in Humans

Human coronaviruses are most commonly transmitted human-to-human of of three modes: **1)** respiratory via coughing or sneezing; **2)** close person contact (i.e. touching, shaking hands); and **3)** touching a virus-contaminated surface, and then touching your mouth nose, or eyes, before washing hands. Since there is no vaccine to prevent COVID-19 as of yet, the best protection is to avoid being exposed to this virus:

- Avoid close contact with sick people.
- Avoid touching with eyes, nose, and mouth with unwashed hands.
- Stay at home when sick.
- Cover up when sneezing or coughing.
- Frequently disinfect after touching surfaces and other objects.
- Wash hands often with soap and water or use a waterless alcohol-based hand antiseptic.

Basic Infection Control Precautions for Health Care Professionals

Some healthcare personnel in Chinese hospital and emergency clinics were infected with COVID-19 via droplet and contact transmission, particularly during the early days of the epidemic before people realized the extent of the outbreak. In the U.S. initial guidance for healthcare professionals was published on February 12th. These infection prevention recommendations are based on current data related to the severity of COVID-19 disease, efficiency of viral transmission in health care facilities, and the length of time virus may be shed from an infected person *(Table 3).*

Table 3.

Recommendations for Healthcare Personnel
A. Minimize chance for Exposure
B. Adherence to Standard, Contact, and Airborne Precautions, Including the Use of Eye Protection
C. Manage visitor Access and Movement Within the Facility
D. Implement Engineering Controls
E. Monitor and Manage Ill and Exposed Healthcare Personnel
F. Train and Educate Healthcare Personnel
G. Implement Environmental Infection Control

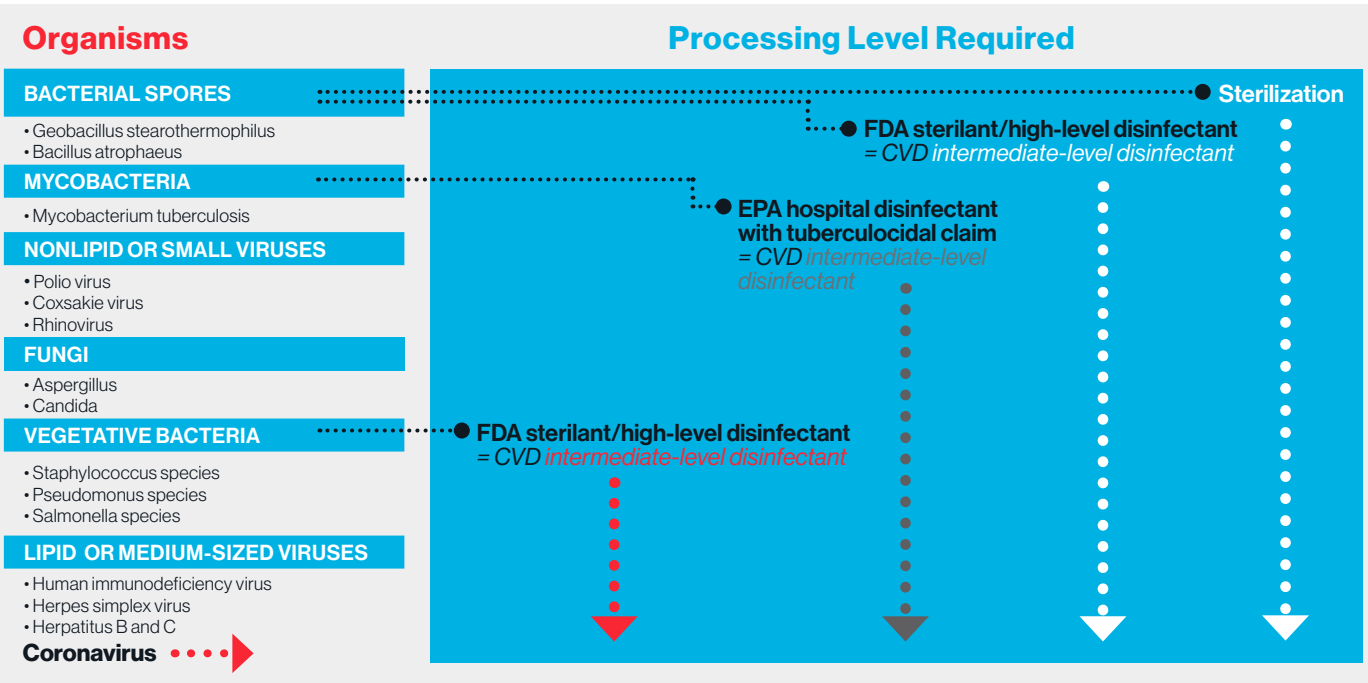
Interim Infection Prevention & Control Recommendations for Healthcare Personnel
During the Coronavirus Disease 2019 (COVID-19) Pandemic | CDC. June 19, 2020.

A key section of these recommendations serves as a reinforcement of what dental professionals should be doing with all persons who come for treatment – compliance with Standard, Contact, and Airborne Precautions, including use of EYE Protection. As more information becomes available determining the length of time a person infected with COVID-19 can be infectious without showing any symptoms, he basic principle of Standard Precautions by dental remains applicable. Treat every patient as if they are infectious!

Environmental Surface Infection Control Precautions

Characteristics of different virus groups include the presence or absence of a lipid envelope. Enveloped (hydrophobic) and non-enveloped (hydrophilic) viruses demonstrate different susceptibilities to chemical disinfectants. The hydrophobic viruses are much more susceptible to these chemical preparations than the hydrophilic ones. This was shown to be due to the presence of essential lipids in the viral envelope. Coronaviruses are enveloped viruses. Table 4 illustrates the susceptibility of representative human bacterial and viral pathogens to chemical disinfectants. Coronaviruses are enveloped viruses and therefore, are inactivated by low-level chemical agents.

Table 4.



Adapted from: CDC. Guidelines for infection control in dental health-care settings- 2003. Morbidity and Mortality Weekly Report. 2003; 52 (RR-17)1-66.

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Since the discovery and emergence of this novel coronavirus, questions have been asked by healthcare professionals about the virus' susceptibility to currently available disinfectants. In their February 12th interim recommendations, the CDC stated:

> "Routine cleaning and disinfection procedures (e.g., using cleaners and water to pre-clean surfaces prior to applying an EPA-registered, hospital-grade disinfectant to frequently touched surfaces or objects for appropriate contact times as indicated on the product's label) are appropriate for SARS-CoV-2 in healthcare settings, including those patient-care areas in which aerosol generating procedures are performed."

This recommendation reinforces the efficacy of the intermediate-level (i.e. tuberculocidal) disinfectants dental practices are routinely as environmental surface disinfectants. They are able to inactivate CD-19.

Dr. John A. Molinari is Professor Emeritus at the University of Detroit Mercy, where he served for 32 years in the School of Dentistry as Professor and Chairman of the Department of Biomedical Sciences and Director of Infection Control. He also has been Infection Control Director for THE DENTAL ADVISOR in Ann Arbor, Michigan. Dr. Molinari is a founding member and Past-President of OSAP. He has published over 500 scientific articles, text chapters, and abstracts in the areas of microbiology and immunology, and lectures nationally and internationally on topics dealing with infectious diseases and infection control. Dr. Molinari is also co-author of the text Cottone's Practical Infection Control in Dentistry.

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