Dissecting MERS and SARS

<table>
<thead>
<tr>
<th>MERS</th>
<th>SARS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infectious dose</strong></td>
<td>Unknown</td>
</tr>
<tr>
<td><strong>Incubation period</strong></td>
<td>1 to 14 days (5 to 7 days typically) for 2 to 4 weeks.</td>
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<tr>
<td><strong>Reservoir</strong></td>
<td>African bats, and then subsequently infected dromedary camels, both of which display little to no overt symptoms of infection.</td>
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<tr>
<td><strong>Natural host(s)</strong></td>
<td>Camels and Goats (Fig 3).</td>
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<tr>
<td><strong>Zoonosis</strong></td>
<td>From dromedary camels to humans.</td>
</tr>
<tr>
<td><strong>Drug susceptibility</strong></td>
<td>Unknown.</td>
</tr>
<tr>
<td><strong>Diagnosable markers</strong></td>
<td>5-minute contact with household bleach, ice-cold acetone (90 seconds) or acetonmethanol mixture (40-60, 10 minutes), 70% ethanol (10 minutes), 100% ethanol, paraformaldehyde (2 minutes), and glutaraldehyde (2 minutes). Commonly used for viral decontamination to 30 minutes.</td>
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**Survival outside host**

- **Human** Can persist in the environment for 24 to 48 hours under(3) conditions of temperature and relative humidity (RH) 
- **Virus** Viability of aerosolized virus at 20% and 40% RH decreases slightly by 7%, but has been shown to drop by 99% at 70% RH. The virus is stable in camel breast milk for at least 72 hours at 4°C, but viral titers rapidly lose infectivity when stored at 22°C for 48 hours.
- **Blood, urine, feces** Can survive for 4 days in diarrheal stool samples with an alkaline pH, more than 7 days in respiratory secretions at room temperature, for at least 4 days (a) or undated urine, feces and human serum at room temperature, up to 9 days in suspension, 60 hours in soil/water, more than a day on hard surfaces such as glass and metal, up to 48 hours on plastic surfaces, and 6 days in dried state.

**First aid/treatment**

- **Supportive care** is used for patients. No specific therapies currently exist.
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- **Vaccines** There are no vaccines currently approved for human use.
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- **Prophylaxis** No known post-exposure prophylaxis.
- **Prophylaxis** No known post-exposure prophylaxis.
- **Laboratory-acquired infections** There are no known cases of laboratory-acquired infections.
- **Laboratory-acquired infections** Four incidents have been reported to date.
- **Sources/specimens** Respiratory tract, nasal discharge, serum, blood, urine, vomit, saliva, feces, and urine.
- **Sources/specimens** Respiratory secretions, nasal discharge, feces, blood, urine, lung, biopsy tissue, and tears of infected individuals.

**Primary hazards**

Inhalation of airborne or aerosolized infectious material, either from infected humans or animals. Exposure to infectious material on fomites. Large droplets or fomite transmission. 

**Risk group** Risk Group 3 Human Pathogen and Risk Group 3 Animal Pathogen.

**Containment** BSL3 for all in vitro propagation and in vivo activities. Diagnostic or clinical activities can be conducted at BSL2 with additional measures.

2020 COVID-19 outbreak in Bangladesh

**Human and Animal Coronaviruses**

Bangladesh is included among the nine new countries/territories/areas (with Bulgaria, Costa Rica, Faroe Islands, French Guiana, Maldives, Malta, Martinique, and Republic of Moldova) that have reported cases of novel coronavirus that causes coronavirus disease 2019 or COVID-19 [1]. Over 100 countries have so far been reported laboratory-confirmed cases of COVID-19. Coronaviruses infect both animals and humans. Human coronaviruses (hCoVs) were first described in the 1960s for patients with the common cold. Since then, more hCoVs have been discovered. Since the early 1970s, a variety of pathological conditions in domestic animals have been attributed to CoV infections. With the exception of infectious bronchitis virus (IBV), which causes avian infectious bronchitis in chickens, canine respiratory coronavirus (CrCoV), which causes respiratory disease in dogs, and mouse hepatitis virus (MHV), which can cause a progressive demyelinating encephalitis in mice, other CoV infections typically result in gastrointestinal symptoms. For instance, transmissible gastroenteritis coronavirus (TGEV), bovine coronavirus (BCV), feline coronavirus (FeCoV), canine coronavirus (CoCoV), and turkey coronavirus (TCoV) are known to cause enteritis in their respective hosts. Many CoVs are simultaneously maintained in nature, allowing for genetic recombination, resulting in novel viruses. Recombination of CoV in camels has resulted in a dominant MERS lineage that caused human outbreaks in 2015 [2]. CoVs are separated into four genera based on phylogeny: alpha-CoV (group 1), beta-CoV (group 2), gamma-CoV (group 3) and delta-CoV (group 4). While the alpha and beta genera are derived from the bat gene pool, the gamma and delta genera are derived from the avian and pig gene pools. Within the beta-CoV genus, four lineages (A, B, C, and D) are recognized. Distinct from other beta-CoV lineages, lineage A viruses also encode a smaller protein called hamagglutinin esterase (HE), which is functionally similar to the S protein [2].

In humans, CoV infections primarily involve the upper respiratory tract and the gastrointestinal tract, and vary from mild, self-limiting disease, such as the common cold, to more severe manifestations, such as bronchitis and pneumonia with renal involvement. The first human coronavirus (HCoV) was isolated during 1965 from the nasal discharge of patients with the common cold and termed B814. Currently, seven different CoV strains are known to infect humans. These include: HCoV-229E (229E), HCoV-OC43 (OC43), HCoV-NL63 (NL63), HCoV-HKU1 (HKU1) (Fig 1), severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV) (Fig 1) and SARS-CoV-2 [3]. 229E and OC43 are the prototype viruses from the two main HCoV lineages (Alpha and Beta, respectively) that cause 15–29% of all common colds, and are the best characterized. SARS-CoV is the etiological agent that was behind an outbreak of severe respiratory disease through China during 2002–2003, and MERS-CoV is the responsible pathogen for an ongoing outbreak of severe respiratory disease centered in the Middle East since 2012 [2].

Figure 1: Global Distribution of Human Coronaviruses. (A) Green, blue, brown, and purple represent the global distribution of the NL63, NL43, OC43, and 229E human coronaviruses, respectively. (B) Red and yellow represent the global distribution of MERS-CoV and SARS-CoV, respectively.

**Structure of CoVs**

The family Coronaviridae, are enveloped viruses with a single-strand, positive-sense RNA genome approximately 26–32 kilobases in size, which is the largest known RNA virus for a virus. The virion shape is spherical (Fig 2), with an average size of 125 nm. The term ‘coronavirus’ refers to the appearance of CoV virions when observed under electron microscopy, in which spike projections from the virus membrane give the semblance of a crown, or corona in Latin. All coronaviruses share similarities in the organization and expression of their genome, in which 16 nonstructural proteins (nsp1 through nsp16), encoded by open reading frame (ORF) 1a/b at the 50 end, are followed by the structural proteins spike (S), envelope (E), membrane (M), and nucleocapsid (N), which are encoded by other ORFs at the 30 end [4].

https://www.sciencephotolibrary.com/media/249509/line/coronavirus-life-cycle

Figure 2: Life cycle of coronavirus.
COVID-19 pneumonia in Wuhan, China:

According to a recent report, patients with 2019-ncov or SARS-CoV-2 pneumonia 49% had a history of exposure to the Huanan seafood market. The average age of the patients was 55-5 years, including 68% men and 32% women. SARS-CoV-2 was detected in all patients by real-time RT-PCR. 50 (51%) patients had chronic diseases. Patients had clinical manifestations of fever (83%), cough (82%), shortness of breath (31%), muscle ache (11%), confusion (9%), headache (8%), sore throat (5%), rhinorhea (4%), chest pain (2%), diarrhea (2%), and nausea and vomiting (1%). 17% patients developed acute respiratory distress syndrome and, among them, 11% patients worsened in a short period of time and died of multiple organ failure.

Origin of SARS-CoV-2

The origin SARS-CoV-2 remains largely unknown. Most of early infected patients were linked to Huanan seafood wholesale market in Wuhan, China. However, there were 13 of the 41 cases had no link to the marketplace. Most importantly, in the earliest case, the patient became ill on the 1st December 2019 and had no reported access to the seafood market. And no epidemiological link was found between the first patient and later cases. It seems that the seafood market is not the only origin of the virus. The virus probably came into the marketplace first then it went out from there. Analyses of blood samples in China from people and animals from other animal markets may reveal a clear picture of where the SARS-CoV-2 originated.

Spreading SARS-CoV-2

The SARS-CoV-2 outbreak started from a local seafood market in winter, which is a similar environment as SARS. Two-thirds of the first 41 confirmed cases were found to have a link with the Huanan Seafood Wholesale Market. This fact suggests that SARS-CoV-2 can be transmitted between animals and people. Early reports indicated that human-to-human transmission of the virus is nonexistent or limited; however, it has now become clear that efficient human-to-human transmission exists. Transmission from animal to human can be achieved in a variety of ways. 

More recently, the virus has been found in asymptomatic individuals, such as those who have travelled to Huanan seafood market.

Information presented above is collected from Pathogen Safety Data Sheets - [https://www.canada.ca/en/public-health/services/laboratory-biosafety/biosecurity/pathogen-safety-data-sheets-risk-assessment.htm](https://www.canada.ca/en/public-health/services/laboratory-biosafety/biosecurity/pathogen-safety-data-sheets-risk-assessment.htm). Readers are requested to visit the link for all the valuable information about the pathogen of interest for biorisk assessment and developing policies and procedures as needed.
COVID-19 Outbreaks Around Bangladesh

Figure 4: Many countries around Bangladesh are now experiencing COVID-19 outbreaks in addition to pneumonia, H1N1, cholera, chikungunya, dengue, malaria, etc.

WHO has confirmed that the SARS-CoV-2 is likely to spread to most, if not all, countries! This latest coronavirus epidemic is now seeing larger increases in cases outside China. On 8 March, 105,586 confirmed (3656 new) cases of COVID-19 have been reported over 100 countries. The outbreak in northern Italy, which has seen 11 towns officially locked down and residents threatened with imprisonment if they try to leave that shocked European political leaders. Their shock turned to horror as Italy became the epicenter of further spread across the continent. Countries are now taking initiatives to implement appropriate measures to delay spread of the virus. However, the actions have been slow and insufficient. There is now a real danger that countries have done too little, too late to contain the epidemic [14].

WHO has issued a consolidated package of existing preparedness and response guidance for countries to ensure them to slow and stop COVID-19 transmission and save lives. According to that critical preparedness, readiness and response actions, WHO has defined four transmission scenarios for SARS-CoV-2 [15]:

1. Countries with no cases (No cases);
2. Countries with 1 or more cases, imported or locally detected (Sporadic cases);
3. Countries experiencing cases clusters in time, geographic location and/or common exposure (Clusters of cases);
4. Countries experiencing larger outbreaks of local transmission (Community transmission).

WHO is urging all countries to prepare for the potential arrival of COVID-19 by readying emergency response systems, increasing capacity to detect and care for patients, ensuring hospitals have the space, supplies and necessary personnel, and developing life-saving medical interventions [14,15,16].

Bangladesh reported three cases COVID-19 on March 9, 2020 (Figure 4). There are all released guidance for health-care professionals; however, published advice alone is insufficient. Guidance on how to manage patients with COVID-19 must be delivered urgently to healthcare workers in the form of workshops, online teaching, smart phone engagement, and peer-to-peer education. All the guidance documents are available on https://bhibiosafety.org/.

Equipment such as personal protective equipment, ventilators, oxygen, and testing kits must be made available and supply chains strengthened. So far, evidence suggests that the huge public health efforts of the Chinese government have saved thousands of lives. High-income countries, now facing their own outbreaks [8], must take reasoned risks and act more decisively. We must abandon our fears of the negative short-term public and economic consequences that may follow from restricting public freedoms as part of more assertive infection control measures [14,15,16].

Microbiological testing

Analyses of nasopharyngeal swab or sputum samples of patients revealed higher viral loads in the lower respiratory tract. Stool and respiratory specimens were also tested positive for the presence of virus. Serum samples from severely infected may also contain the virus [12].

COVID-19 management strategy

Blocking transmission: Person-to-person transmission is the major efficient way of spreading in public gathering places. The severity of disease is an important indirect factor helps to identify those who had been infected. If infection does not cause serious disease or asymptomatic infection, infected people would go to work and travel, thereby potentially spreading the virus to their contacts. Person-to-person transmission in family homes or hospital, and intercity spread of SARS-CoV-2 are occurring, and therefore vigilant control measures are warranted at the whole stage of the epidemic [6].

Isolation: Isolating cases as identified, tracing the contact, extended travel restrictions to affected areas, banning inter-districts buses and cancelling tour group travel abroad. It is crucial to isolate patients, trace and quarantine contacts as early as possible because asymptomatic infection began to appear. Most importantly, the extent of interhuman transmission needs to be determined. Transmission of SARS-CoV and MERS-CoV occurred to a large extent by means of superspreading events. Superspreading events have also been implicated in SARS-CoV-2 transmission, so educate the public on both food and personal hygiene, and compliance to infection isolation to prevent super-spreading events deserves high level attention [6].

Protection: Transmission of SARS-CoV-2 probably occurs through spreading airborne and contact. Aerosol and fecal–oral transmissions are unclear. Public health measures, including quarantining in the community as well as timely diagnosis and strict adherence to universal precautions in health care settings, is critical, in reducing the transmission of the virus. For healthcare personnel, to minimize the chance of exposures to virus needs to follow the standard of contact and airborne precautions, personal protection including gloves, gowns, respiratory protection, eye protection, and hand hygiene. Some procedures performed on SARS-CoV-2 infected patients could generate infectious aerosols, e.g. nasopharyngeal specimen collection, sputum induction, and open suctioning of airways should be performed cautiously. If performed, these procedures should take place in an airborne infection isolation room, and personnel should use respiratory and eye protection, and hand hygiene. In addition, management of environmental infection control including laundry, food service utensils, and medical waste should also be performed [6].

References

2. Trends in Microbiology, June 2016, Vol. 24, No. 6