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SYNOPSIS

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# COVID-19 – What We Know So Far About… Routes of Transmission

## Introduction

"What We Know So Far" documents are intended to provide an overview of some of the published and unpublished reports related to emerging issues with respect to coronavirus disease 2019 (COVID-19). As this is a rapidly evolving situation, the information will only be current as of the date the document was written, with further updates as needed.

## Key Points

- COVID-19 is transmitted via droplets during close, unprotected contact.
- Airborne spread has not been documented for COVID-19.
- There is no specific evidence documenting transmission through fomites. However, the virus has been detected on surfaces in the patient environment and this is a likely source of transmission based on experience with other coronaviruses.
- While the virus has been detected in the stool and the blood, the roles of fecal-oral and bloodborne transmission remain uncertain.

## Background

The purpose of this document is to outline what is known about how COVID-19 is transmitted from person-to-person, based on a review of the scientific literature. The virus responsible for COVID-19 is genetically similar to other coronaviruses. In particular, it shares a high degree of genetic similarity (79% identity),[1] with the coronavirus (CoV) responsible for Severe Acute Respiratory Syndrome (SARS -CoV. Therefore, in instances of limited evidence for COVID-19, it is reasonable to extrapolate existing data from other coronaviruses, in particular SARS-CoV.

## Droplet and Contact Transmission

Current evidence suggests that the mode of transmission of COVID-19 is through direct contact and respiratory droplets that have the potential to be propelled for up to two meters.[2-4]

- The majority of cases have been linked to person-to-person transmission through close direct contact to someone with respiratory symptoms[3,5-6] or close contact with a case in the incubation period who was later confirmed to have COVID-19.[7-9]

- A recent report by the World Health Organization (WHO) Joint Mission on Coronavirus Disease 2019 (COVID-19) in China, summarizes the experience with 75,465 cases and indicates that the route of transmission is droplet during close unprotected contact.[10]

# Conjunctiva

Transmission through the ocular surface is considered a possible route of transmission for COVID-19 based on a recent case report and evidence of virus detection from the eye among cases with conjunctivitis.

- In a case report, the authors describe a healthcare worker who became infected with COVID-19 after visiting a patient wearing an N95 respirator, but no eye protection. The healthcare worker developed eye redness and then pneumonia.
- In one study of 30 confirmed COVID-19 cases with pneumonia, tear and conjunctival secretions were collected twice from each patient and tested using reverse transcription polymerase chain reaction (RT-PCR) assays. Only one patient had conjunctivitis with one of two samples yielding a positive RT-PCR result. The remaining 58 samples from all other patients were negative.[11]
- In a cross-sectional study of 72 laboratory-confirmed cases of COVID-19, two patients (2.8%) had conjunctivitis. Viral RNA fragments were identified in ocular discharges using a RT-PCR assay in one patient with conjunctivitis.[12]
- In another cross-sectional study, conjunctival RT- PCR assays were conducted on 14 confirmed cases and 16 suspect cases of COVID-19. All results were negative.[13]

# Airborne Transmission

- There is currently no evidence that COVID-19 is transmitted through the airborne route. As more epidemiological data emerge on cases globally, information is becoming available that suggest that airborne transmission is not occurring:
    - A recent report from the WHO China Joint Mission on COVID-19 summarizing 75,465 cases indicates that airborne spread has not been reported.[10]
- This report states that the majority of COVID-19 transmission in China is occurring within families. Of all of the infection clusters investigated, 78-85% were within families, with a household secondary attack rate of 3-10%. The absence of significant clusters in other settings suggests that the mode of COVID-19 transmission is not airborne.
- An article describing the active follow-up of individuals exposed to first ten cases of COVID-19 in the United States describes secondary transmission only to close household contacts. In this article, 445 persons who had contact with one of the cases were identified. Of these, 19 (4%) were household members, 104 (23%) were community members who spent at least 10 minutes in close proximity to the case, 100 (22%) were community members exposed in a healthcare setting and 222 (50%) were healthcare workers. Two persons who were household members of cases of COVID-19 tested positive, for a symptomatic secondary attack rate of 0.45% (2/445) among all contacts and a symptomatic secondary attack rate for all household contacts of 10.5% (2/19).[6] The absence of transmission to contacts outside the household setting suggests that the mode of COVID-19 transmission is not airborne. Of note, five household members who were continuously exposed to a case did not become infected.

- Healthcare workers caring for COVID-19 patients in other jurisdictions, including British Columbia, have not acquired COVID-19 while using Droplet and Contact Precautions recommended in the province.[14]
- The lack of transmission to passengers seated nearby cases who have travelled on airplanes, does not support an airborne transmission route of COVID-19.[15]
- In two studies conducting air sampling around confirmed cases, COVID-19 has not been detected.[16,17]

# Airborne Transmission During AGMPs

While airborne transmission has not been documented under routine circumstances (i.e. in community settings and in routine patient care), it may be possible for it to occur when an aerosol-generating medical procedure (AGMP) is performed.

- This is supported by the recent report from WHO, which states that airborne transmission could theoretically occur during an aerosol-generating medical procedure, although there were no documented occurrences in the report.[10]
- During the SARS-CoV outbreak in 2003, infections disproportionately occurred among healthcare workers, with those involved in aerosol-generating procedures and manipulation of the airway (i.e. at the time of intubation) were at greatest risk.[18] An investigation into a nosocomial outbreak of SARS in Toronto concluded that the epidemiological links described in their investigation support the theory that SARS is transmitted primarily through respiratory droplets and direct contact, but noted that transmission occurred during high risk procedures (i.e. intubation) when only a surgical mask was utilized, in the absence of protective eyewear.[19]
- More information on what is currently known about COVID-19 and the risks to healthcare workers can be found in the WWKSF document on the Risks to Health Care Workers.

# Fomite Transmission

There is currently no data on the ability of COVID-19 to survive or be transmitted through surfaces. However, there is indirect evidence to support that this is a possible source of transmission:

- A recent study has documented the presence of virus on surfaces in the environment of patients who have tested positive for COVID-19.[17]
- Other coronaviruses have been observed to remain viable for days to weeks on environmental surfaces. Survival is enhanced at low temperatures (i.e., 4 °C vs 20 °C).[20,21]
- The relative importance of indirect contact transmission (i.e. droplets spreading from a patient to an environmental surface to another individual) for the coronaviruses responsible for SARS and Middle East Respiratory Syndrome (MERS) is also uncertain.[22]
    - Two field studies have evaluated SARS-CoV surface contamination:
    - In a study involving hospitals in Bangkok, Thailand, Taipei, and Taiwan, 24/63 (38%) of surfaces (patient rooms, nursing stations, emergency department, and public spaces) had viral RNA detected by PCR. However all were culture negative (i.e. viable virus could not be grown from the samples) raising uncertainty of the viability of the detected virus and its ability to cause human infection.[23]
    - During the 2003 SARS outbreak in Toronto, 85 swabs were taken from 19 patient rooms in Toronto hospitals. A total of 3 (3.5%) were positive (bed table, tv remote, fridge handle in

nursing station), however none were culture positive, raising similar questions about the risk for human infection.[24]

## Fecal-oral Transmission

While the virus has been detected in the stool, the roles of fecal-oral transmission remains uncertain..

- As part of early investigations of the outbreak, the virus responsible for COVID-19 has been detected and isolated in the intestinal tissues of animals challenged with the virus.[10]
- Tissues in the oral cavity express angiotensin-converting enzyme 2 (ACE2) receptors that are believed to be used by COVID-19 to enter cells.[25]
- It has been reported that a small proportion of patients experience diarrhea and vomiting during COVID-19 infection.[26-28]
- COVID-19 RNA has been detected in stool in various studies for up to 4-5 weeks in moderate cases. Live virus has reportedly been cultured from stool, in some cases.[10,29,30]
- The WHO-China Joint Mission Document notes that viral RNA has been detected in feces in up to 30% of patients from day 5 following onset of symptoms and in some cases has been detected for up to 4-5 weeks.[10]
- More information on fecal-oral transmission can be found in the What We Know So Far (WWKSF) document on fecal-oral transmission.

## Bloodborne Transmission

While the virus has been detected in the blood, the role of bloodborne transmission remains uncertain.

- Several studies have reported detection of COVID-19 RNA, in either plasma or serum.[31,32]
- More information on bloodborne transmission can be found in the WWKSF document on bloodborne transmission.

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