Characteristics of SARS-CoV-2, as a water contaminant

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Human coronavirus

HCoV-OC43, HCoV-HKU1, HCoV-229E, HCoV-NL63, SARS-CoV and MERS-CoV; SARS-CoV-2 is the seventh member of the coronavirus family that infects humans.

Coronaviridae, Betacoronavirus, SARS-CoV

Strain: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)
COVID-19, a Public Health Emergency of International Concern (PHEIC)

• Primarily spreads through the respiratory tract, by droplets, respiratory secretions, and direct contact.

• Incubation period is 1–14 days, mostly 3–7 days. Median age of patients is 47–59 years.

• Patients above 80 years of age had an alarmingly high fatality rate of 14.8%.

SARS-CoV-2 excretion during COVID-19

✓ SARS-CoV-2 is excreted in stools also in absence of gastrointestinal symptoms.
  ▪ Duration of viral excretion may be in some cases more than 5 weeks in stool samples. Careful hand and toilet disinfection is required.
  ▪ Disease severity was not neither associated with extended duration of faecal sample viral RNA positivity.

✓ Live virus have been isolated in stool samples.
  ▪ From patients who did not have diarrhea.
  ▪ However most virus in feces may be no longer infectious based on the failure of all attempts to isolate the virus from positive RT-PCR specimens collected in convalescent patients in other studies.

(Wu et al. Prolonged presence of SARS-CoV-2 viral RNA in faecal samples
www.thelancet.com/gastrohep https://doi.org/10.1016/S2468-1253(20)30083-2)
Examples of viruses with lipid envelope detected in feces

- **Influenzavirus**
- **Herpesvirus**
- **Respiratory Syncitial virus**
- **Coronavirus, Sars-CoV-2**

CDC
Stability in water

✓ **Human coronavirus 229E** were found to be very stable at 4°C in tap water comparable to poliovirus 1, however poliovirus 1 was more stable at higher temperatures and in wastewater.

✓ **SARS-CoV-2 remained viable in aerosols** throughout the duration of a experiment (3 hours), similar to that observed with SARS-CoV-1.

✓ **SARS-CoV-2 highly stable in a wide-range of pH** values at room temperature, 60 min, pH3-10.


SARS-CoV-2 in sewage

1. SARS-CoV-2 has been detected in urban sewage

2. SARS-CoV was detected in sewage from hospitals although there was no live SARS-CoV detected. In seeded sewage, SARS-CoV could survive for 14 days at 4 °C, 2 days at 20 °C.

3. The hydrophobicity of the viral envelope makes coronaviruses less soluble in water and with higher tendency to adhere to the solids.
Viruses in a wastewater treatment plant producing reclaimed water (wetland)

Human Adenovirus  JCPyV  MCPyV  NoV GGI  NoV GGI

1, E+00  1, E+01  1, E+02  1, E+03  1, E+04  1, E+05  1, E+06  1, E+07  1, E+08

Raw  Sec  Tert  Raw  Sec  Tert  Raw  Sec  Tert  Raw  Sec  Tert  Raw  Sec  Tert  Raw  Sec  Tert

GC or MPN/100ml

Enterovirus  HEV  E.coli  Intestinal Enterococci
## Viruses in urban sewage by Target Enrichment Metagenomics

<table>
<thead>
<tr>
<th>Viral species</th>
<th>Viral sequence reads</th>
<th>Viral read count</th>
<th>Breadth genome coverage (%)</th>
<th>Target Enrichment</th>
<th>High Throughput</th>
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Enveloped viruses are not detected in urban sewage using VirCapSeq-VERT, the probe library included oligonucleotides (1,993,176 oligonucleotides) that selectively hybridize to genomes of vertebrate viruses.
Conclusions

- Fecal excretion, environmental contamination, and fomites might contribute to viral transmission.

- SARS-CoV-2 infectious particles in sewage could survive, if similar to SARS-CoV-1, about 14 days in sewage at 4 °C, and 2 days at 20 °C.

- Aerosol contamination from fecal wastes of COVID-19 must be controlled, specially at low temperatures.

- The available information indicates that infectious SARS-CoV-2 would be less abundant in sewage than other known enteric viruses and less resistant in water treatments in WWTP or DWTP.

- Available international guidelines for water treatment and reuse considering viral pathogens should be efficient for protecting against SARS-CoV-2.