

SARS-CoV-2 and the Role of Orofecal Transmission: Evidence Brief

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Table of 35 Included Studies.

Main findings of 35 studies on orofecal transmission of SARS-CoV-2	Study (link to summary)
Using samples collected between February and April 2020 from sewage treatment plants in Queensland, Australia, SARS-CoV-2 was detected by RT-qPCR assay, confirmed by sequencing.	Ahmed 2020
A descriptive review of 14 studies looking at fecal excretion of COVID-19 to 15th March 2020 found that COVID-19 may be transmitted oro-fecally, but the number of studies with findings of viable virions in the faeces is small, making this mode of transmission uncertain.	Amirian 2020
A short review of available evidence of the orofecal transmission and its possible relation to wastewater management indicated that recreational water could have concentration of SARS-CoV-2 agent via faulty wastewater management.	Cahill 2020
Testing of 24-h composite raw sewage samples from two large wastewater treatment plants in Spain showed that SARS-CoV-2 was detected in sewage 41 days (15th January 2020) before the declaration of the first COVID-19 case (25th February 2020) in Spain, and in frozen samples dating back to 12th March 2019. If these results are confirmed, they suggest SARS CoV-2 has been around longer than first thought.	Chavarria-Miro 2020
This retrospective study of 133 hospitalised COVID-19 patients identified 22 whose sputum or fecal samples tested positive, after their pharyngeal swabs became negative.	Chen 2020
This study analysed stool samples from a cohort of 59 patients with COVID-19 in Hong Kong during February 2020 and additionally did a	Cheung 2020

meta-analysis of data from 11 studies on the prevalence of gastrointestinal symptoms and stool excretion of viruses. Fecal discharge continues long after respiratory shedding of COVID-19 has ceased.	
This study reviewed literature on the potential of SARS-CoV-2 to infect the human gastrointestinal tract, and shed via the fecal route to generate orofecal transmission. Various observational and mechanistic evidence supports that SARS-CoV-2 can infect and be shed from the human gastrointestinal tract.	Ding S 2020
This study randomly sampled in rooms and areas in the COVID-19 designated infectious diseases hospital Nanjing, China. 4/107 surface samples tested positive: two ward door door-handles, one bathroom toilet toilet-seat cover and one bathroom door door-handle. Three were weakly positive from a bathroom toilet seat, one bathroom washbasin tap lever and one bathroom ceiling exhaust louvre. 1/46 corridor air samples tested weakly positive.	Ding Z 2020
This short review reported that in children, the orofecal route is an alternative route of transmission, regardless of presenting COVID 19 symptomatology. Exclusion of SARS-CoV-2 infection by single time point nasopharyngeal swabs should not be used in children.	Dona 2020
This review of 26 studies reported that there is a high rate of PCR positive persistence of SARS-CoV-2 in faecal samples of patients with COVID-19.	Gupta 2020
Among a group of hospitalised patients with low severity COVID-19, digestive symptoms were present in 57%. Patients with digestive symptoms were more likely to be fecal virus-positive than those with respiratory symptoms.	Han C 2020
SARS-CoV-2 RNA was detected in serum, urine or stool samples in 20% of patients hospitalised with COVID-19. However, the virus could not be isolated from these samples and therefore the risk of transmission via these media is not established.	Kim J-M 2020
This systematic review concluded that extensive uncertainty on the ecology of SARS-CoV-2 makes it hard to make specific recommendations on handling and prevention of transmission. CoV are susceptible to heat, surfactants and low pH.	Kingsbury 2020
This systematic review showed that Coroviridae have been isolated in different types of liquids from waste to surface water, but in general, they appear to be unstable. Chlorination and higher temperatures lead to their	La Rosa 2020

inactivation.	
An environmental surveillance study based on twelve influent sewage samples, collected between February and April 2020 from wastewater treatment plants in Milan and Rome, Italy showed SARS-CoV-2 RNA fragments have been identified in sewage in Italy, and suggest a novel RT-PCR test for screening of waters.	La Rosa 2020a
SARS-CoV-2 was detected in the sewage of five sites a week after the first COVID-19 case in the Netherlands. Even at low COVID-19 prevalence sewage surveillance could be a sensitive tool to monitor the viral circulation.	Medema 2020
This review reports that the gastrointestinal tract supports the growth of SARS-CoV-2 to an extent similar to previous SARS infections and that gastric symptoms are frequently experienced in COVID-19.	Parasa 2020
A systematic review of 4 case series including 36 children with mild COVID-19 found that fecal shedding in children with COVID-19 occurs on average nine days longer than by the respiratory route.	Santos 2020
This pilot study in India found SARS-CoV-2 RNA in fecal samples from 12 symptomatic and asymptomatic COVID-19 patients.	Senapati 2020
Combining in vitro data, pollution analysis and a virus survivability model, based on data from 39 countries, SARS-CoV-2 can remain stable within water for up to 25 days. Country-specific risk of infection posed by faecal contaminated water is environment-dependent, with water flow and temperature as important variables.	Shutler 2020
Reviewed GI features of, and faecal test results in, COVID-19 from case reports and retrospective clinical studies: Gastrointestinal symptoms are common in COVID-19 patients and were observed with increased prevalence as the epidemic progressed in China. SARS-CoV-2 enters GI epithelial cells, and the faeces of COVID-19 patients are potentially infectious.	Tian 2020
In this case series from China, 2 stool specimens out of 44 positives contained live virus, suggesting that orofecal transmission is possible. Transmission of the virus by respiratory and extra respiratory routes may help explain the rapid spread of disease.	Wang W 2020

<p>No live SARS-CoV was found in any sewage samples from two hospitals receiving COVID-19 patients. SARS-CoV RNA was detected in sewage concentrates of two hospitals receiving SARS patients prior to disinfection, and occasionally after disinfection.</p>	<p>Wang XW 2020</p>
<p>In 98 hospitalized COVID-19 cases, patients' faecal samples remained positive for SARS-CoV-2 for a mean of 11 days (maximum 5 weeks) after respiratory tract samples became negative.</p>	<p>Wu Y 2020</p>
<p>An increase of SARS-CoV-2 genome units in raw wastewaters in and around Paris, France accurately followed the increase of human COVID-19 cases observed at the regional level.</p>	<p>Wurtzer 2020</p>
<p>Assessing viral RNA in feces from 71 patients with SARS-CoV-2 infection during their hospitalizations, and examining the viral RNA and viral nucleocapsid protein in gastrointestinal tissues from one of the patients, suggests SARS-CoV-2 may both infect the gastrointestinal system and transmit via an orofecal route. Detection of some viral nucleocapsid protein in rectal epithelial cells of COVID-19 patients suggests that some infectious viral particles may survive the harsh gastrointestinal environment.</p>	<p>Xiao 2020</p>
<p>This case series of 28 hospitalised patients for whom faeces samples were available indicated that infectious virus was present in faeces from two cases who also tested positive for viral RNA by RT-PCR.</p>	<p>Xiao 2020b</p>
<p>This study of 10 children with COVID-19 found that symptoms among children were nonspecific and relatively mild; rectal swabs tested positive among 8/10 cases even once nasopharyngeal tests became negative.</p>	<p>Xu Y 2020</p>
<p>Live virus has been isolated from the stools of one severe pneumonia case, pointing to a possible oro-fecal spread.</p>	<p>Yong Z 2020</p>
<p>A retrospective case note survey of 2,138 paediatric patients with suspected SARS-CoV-2 infection in Wuhan Children's Hospital from January to March 2020 suggested that in some children, fecal shedding may be a sign of prolonged mildly asymptomatic infection and represent the final phase of the disease.</p>	<p>Yuan 2020</p>
<p>This laboratory study showed that human enterocytes expressing high ACE2 receptor levels could support infection with SARS-CoV-2. However, the virus is rapidly inactivated in the GI tract, and no infectious virus was obtained from stool samples from COVID-19 patients.</p>	<p>Zang 2020</p>

<p>A small pilot sample of 14 cases indicated agreement for the presence of COVID-19 between oropharyngeal samples and fecal samples.</p>	<p>Zhang J 2020</p>
<p>Three children with mild symptoms who were SARS-CoV-2 throat swab specimen negative on discharge from hospital were stool positive 10 days post-discharge.</p>	<p>Zhang T 2020</p>
<p>A small study of hospitalised COVID-19 patients indicated that RNA of SARS-CoV-2 may be shed via multiple bodily routes, and highlights that COVID-19 is found in anal swabs sometimes when oral swabs show no viral RNA.</p>	<p>Zhang W 2020</p>
<p>This laboratory study showed that SARS-CoV-2 can infect bat intestinal cells, and demonstrated SARS-CoV-2 replication in human intestinal organoids, suggesting that the human intestinal tract might be a transmission route of SARS-CoV-2.</p>	<p>Zhou J 2020</p>