# Evidence Search Service Results of your search request

## How long do COVID-19 patients remain infectious?

**ID of request:** 30568  
**Date of request:** 13th July, 2021  
**Date of completion:** 23rd July, 2021

If you would like to request any articles or any further help, please contact:  Lucy Sinclair at [lucy.sinclair1@nhs.net](mailto:lucy.sinclair1@nhs.net)

Please acknowledge this work in any resulting paper or presentation as: Evidence search: How long do COVID-19 patients remain infectious?. Lucy Sinclair. (23rd July, 2021). BRIGHTON, UK: Brighton and Sussex Library and Knowledge Service.

**Sources searched**  
Cochrane Library (0)  
EMBASE (16)  
EUROPE PMC (0)  
Google Advanced Search (1)  
KnowledgeShare (1)  
MEDLINE (50)  
NICE Evidence Search (9)  
PubMed (3)  
TRIP Database (1)  
UpToDate (2)

**Date range used** (5 years, 10 years): 2019-current   
**Limits used** (gender, article/study type, etc.): none   
**Search terms and notes** (full search strategy for database searches below):

Relevant natural language and controlled vocabulary terms were selected and combined. Thesaurus terms were adapted for different databases. Medline and Embase searched on Ovid. Results were reviewed for relevance and de-duplicated in EndNote. Full search strategy below.

**Search terms:**

UpToDate - COVID-19 infectious period

NICE Evidence - COVID-19 infectious period, COVID-19 incubation period, viral shedding, prolonged COVID-19 infection

Cochrane Library - Coronavirus infection, coronavirus infectious period, coronavirus incubation, viral shedding, COVID-19

PubMed - COVID-19 Viral Shedding, COVID-19 infectious period

Google (Advanced) - COVID-19 viral shedding

TRIP - COVID-19 viral shedding, long covid-19 infection period

EUROPE PMC - (("COVID-19" or COVID19 or 2019nCoV or "Corona Virus" or Coronavirus or "CoV 2" or CoV2 or COVID or nCoV or SARS2 or SARSCoV or "SARS-CoV") AND (("viral shedding" OR "prolonged infection" or "long infection"))) AND (SRC:PPR)

For more information about the resources please go to: <https://www.bsuh.nhs.uk/library/>.

## Summary of Results

This evidence search report includes results on prolonged viral shedding and longer infection periods in COVID-19 patients. There is some high level evidence about viral shedding. Results also include reviews and summaries about COVID-19 infectious period.

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## A. Synopses or Summaries

#### Journal of public health

**Incubation period for COVID-19: a systematic review and meta-analysis** (2021)

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=327038099702d0c68d86b3ebf00a7bf2)

This review provides sufficient evidence for the incubation period of COVID-19 through various studies, which can be helpful in planning preventive and control measures for the disease. The pooled estimate from the meta-analysis is a valid and reliable estimate of the incubation period for COVID-19.

#### UpToDate

**COVID-19: Clinical features** (2021)

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=7cb32940b5ab5adef72de024c286c05c)

Incubation period — The incubation period for COVID-19 is generally within 14 days following exposure, with most cases occurring approximately four to five days after exposure [4,96,97]. In a study of 1099 patients with confirmed symptomatic COVID-19, the median incubation period was four days (interquartile range two to seven days) [97]. Using data from 181 confirmed cases in China with identifiable exposure, one modeling study estimated that symptoms would develop in 2.5 percent of infected individuals within 2.2 days and in 97.5 percent of infected individuals within 11.5 days [98]. The median incubation period in this study was 5.1 days. However, determinations of the incubation period can be imprecise and may differ by the method of assessing exposure and the specific calculations used for the estimate. Another study estimated incubation period using data from 1084 patients who had traveled or resided in Wuhan and were subsequently diagnosed with COVID-19 after leaving Wuhan [99]. This study suggested a longer median incubation period of 7.8 days, with 5 to 10 percent of individuals developing symptoms 14 days or more after exposure.

**COVID-19: Epidemiology, virology, and prevention** (2021)

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=288d5aa83d9c6ec74e047d55e1abe882)

Period of infectiousness – Individuals with SARS-CoV-2 infection are most infectious in the earlier stages of infection (starting a few days prior to the development of symptoms). Transmission after 7 to 10 days of illness is unlikely, particularly for otherwise immunocompetent patients with nonsevere infection. Prolonged viral RNA shedding after symptom resolution is not clearly associated with prolonged infectiousness.

## B. Systematic Reviews

#### BMC Infectious Diseases

**Serial interval and incubation period of COVID-19: a systematic review and meta-analysis** (2021)

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=d1e1562fd153fcd8e850d34fc9fdf28e)

This systematic review and meta-analysis showed that the weighted pooled mean serial interval and incubation period of COVID-19 were 5.2, and 6.5 days, respectively. In this study, the average serial interval of COVID-19 is shorter than the average incubation period, which suggests that substantial numbers of COVID-19 cases will be attributed to presymptomatic transmission.

**Serial interval and incubation period of COVID-19: a systematic review and meta-analysis** (2021)

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=5b9010b678e0a764fff77c75b5d686dd)

This systematic review and meta-analysis showed that the weighted pooled mean serial interval and incubation period of COVID-19 were 5.2, and 6.5 days, respectively. In this study, the average serial interval of COVID-19 is shorter than the average incubation period, which suggests that substantial numbers of COVID-19 cases will be attributed to presymptomatic transmission.

#### Frontiers in Public Health

**Characteristics of Viral Shedding Time in SARS-CoV-2 Infections: A Systematic Review and Meta-Analysis** (2021)

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=be9ef8e7d6fdbe05c97bcb32986df888)

A longer VST was found in symptomatic infections, infected adults, persons with chronic diseases, and stool specimens.

#### JAMA Network

**Prevalence of Gastrointestinal Symptoms and Fecal Viral Shedding in Patients With Coronavirus Disease 2019: A Systematic Review and Meta-analysis** (2020)

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=990544908876ffc049d31147645fa58a)

Of 1484 records reviewed, 23 published and 6 preprint studies were included in the analysis, with a total of 4805 patients (mean [SD] age, 52.2 [14.8] years; 1598 [33.2%] women) with COVID-19. The pooled rates were 7.4% (95% CI, 4.3%-12.2%) of patients reporting diarrhea and 4.6% (95% CI, 2.6%-8.0%) of patients reporting nausea or vomiting. The pooled rate for aspartate aminotransferase levels outside reference ranges was 20% (95% CI, 15.3%-25.6%) of patients, and the pooled rate for alanine aminotransferase levels outside reference ranges was 14.6% (95% CI, 12.8%-16.6%) of patients. Fecal tests that were positive for SARS-CoV-2 were reported in 8 studies, and viral RNA shedding was detected in feces in 40.5% (95% CI, 27.4%-55.1%) of patients. There was high level of heterogeneity (I2 = 94%), but no statistically significant publication bias noted.

#### Revista clínica española

**Incubation period of COVID-19: A systematic review and meta-analysis** (2021)

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=2568b8b71d84f12324aa330e405a3f60)

Based on the published data reporting the incubation period of COVID-19, the mean time between exposure and onset of clinical symptoms depended on the statistical model used, and the 95th percentile depended on the mean age of the patients. It is advisable to record sex and age when collecting data in order to analyze possible differential patterns.

#### Systematic Reviews

**The incubation period during the pandemic of COVID-19: a systematic review and meta-analysis** (2021)

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=b8411875cf11b381561bf742e0ab42a2)

This work provides additional evidence of incubation period for COVID-19 and showed that it is prudent not to dismiss the possibility of incubation periods up to 14 days at this stage of the epidemic.

#### The Lancet

**SARS-CoV-2, SARS-CoV, and MERS-CoV viral load dynamics, duration of viral shedding, and infectiousness: a systematic review and meta-analysis** (2021)

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=61ed379f8757ae22262e7ec78fbe5d74)

Although SARS-CoV-2 RNA shedding in respiratory and stool samples can be prolonged, duration of viable virus is relatively short-lived. SARS-CoV-2 titres in the upper respiratory tract peak in the first week of illness. Early case finding and isolation, and public education on the spectrum of illness and period of infectiousness are key to the effective containment of SARS-CoV-2.

#### Urology Journal

**Urinary Viral Shedding of COVID-19 and its Clinical Associations: A Systematic Review and Meta-analysis of Observational Studies** (2020)

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=b9b2fdd1e7bedd04c214129f0cc0c233)

While COVID-19 is rarely detected in urine of infected individuals, infection transmission through urine still remains possible. In adult patients, infected urine is more likely in the presence of moderate or severe disease. Therefore, caution should be exerted when dealing with COVID-19 infected patients during medical interventions like endoscopy and urethral catheterization especially in symptomatic adult patients while in children caution should be exerted regardless of symptoms.

## C. Original Research

1. **A case of COVID-19 with long duration of viral shedding**  
   Wang Changtai Journal of microbiology, immunology, and infection = Wei mian yu gan ran za zhi 2021;54:152-153.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=113bf9e71b5a99b07c50d31924dd14f1)

1. **A case of extremely prolonged viral shedding: Could cell cultures be a diagnostic tool to drive COVID-19 patient discharge?**  
   Mileto Davide International journal of infectious diseases : IJID : official publication of the International Society for Infectious Diseases 2021;104:631-633.

This study addressed the case of a patient with prolonged COVID-19 viral shedding, reported by Real-Time PCR, until 71 days from symptom onset. However, viral culture received negative results after 30 days from symptom onset. Therefore, viral culture may be a worthwhile test for patients requiring discharge, in particular for those presenting prolonged viral shedding. Copyright © 2020 The Authors. Published by Elsevier Ltd.. All rights reserved.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=669762f8adc9b63928297e652611dc39)

1. **Analysis of a persistent viral shedding patient infected with SARS-CoV-2 by RT-qPCR, FilmArray Respiratory Panel v2.1, and antigen detection**  
   Hirotsu Yosuke Journal of infection and chemotherapy : official journal of the Japan Society of Chemotherapy 2021;27:406-409.

Various diagnostic tests utilizing different principles are currently under development for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). However, these tests can occasionally produce discrepant results, causing confusion in their interpretation. Here, we evaluated the performance and features of three diagnostic assays: quantitative reverse transcription polymerase chain reaction (RT-qPCR), FilmArray Respiratory Panel (RP) v2.1, and the LUMIPULSE antigen test. Twenty-seven serial nasopharyngeal swabs were collected from a prolonged viral shedding patient who had been hospitalized for 51 days. We examined the SARS-CoV-2 detection rates of the three tests. The overall agreement rate was 81% between RT-qPCR and FilmArray RP v2.1, 63% between the antigen test and FilmArray RP v2.1, and 59% between the antigen test and RT-qPCR. We obtained concordant results in samples with high viral loads (low threshold cycle values) by all three tests. RT-qPCR and FilmArray RP v2.1 accurately detected SARS-CoV-2 at the early to intermediate phases of infection, but the results varied at the late phase. The antigen test also produced a positive result at the early phase but varied at the intermediate phase and consistently produced negative results at late phase of infection. These results demonstrated FilmArray RP v2.1 could detect SARS-CoV-2 with accuracy comparable to RT-qPCR. Further, there were discrepant results using different types of diagnostic tests during the clinical course of prolonged viral shedding patient. We provided insights into how to utilize different types of kits to assess and manage SARS-CoV-2 infections. Copyright © 2020 Japanese Society of Chemotherapy and The Japanese Association for Infectious Diseases. Published by Elsevier Ltd. All rights reserved.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=46e42d5de1501591a6e6a1789a53a197)

1. **Assessing the potential impact of transmission during prolonged viral shedding on the effect of lockdown relaxation on COVID-19**  
   Tepekule Burcu PLoS computational biology 2021;17:e1008609.

A key parameter in epidemiological modeling which characterizes the spread of an infectious disease is the generation time, or more generally the distribution of infectiousness as a function of time since infection. There is increasing evidence supporting a prolonged viral shedding window for COVID-19, but the transmissibility in this phase is unclear. Based on this, we develop a generalized Susceptible-Exposed-Infected-Resistant (SEIR) model including an additional compartment of chronically infected individuals who can stay infectious for a longer duration than the reported generation time, but with infectivity reduced to varying degrees. Using the incidence and fatality data from different countries, we first show that such an assumption also yields a plausible model in explaining the data observed prior to the easing of the lockdown measures (relaxation). We then test the predictive power of this model for different durations and levels of prolonged infectiousness using the incidence data after the introduction of relaxation in Switzerland, and compare it with a model without the chronically infected population to represent the models conventionally used. We show that in case of a gradual easing on the lockdown measures, the predictions of the model including the chronically infected population vary considerably from those obtained under a model in which prolonged infectiousness is not taken into account. Although the existence of a chronically infected population still remains largely hypothetical, we believe that our results provide tentative evidence to consider a chronically infected population as an alternative modeling approach to better interpret the transmission dynamics of COVID-19.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=4fea924676c80791cc0dbb5129aef7ca)

1. **Case report: Prolonged viral shedding in six COVID-19 patients**  
   Alsaud Arwa E. American Journal of Tropical Medicine and Hygiene 2021;104:1472-1475.

COVID-19 has surfaced as a multi-organ disease predominantly affecting the respiratory system. Detection of the viral RNA through reverse transcriptase-PCR (RT-PCR) from a nasopharyngeal or throat sample is the preferred method of diagnosis. Recent evidence has suggested that COVID-19 patients can shed the SARS-CoV-2 for several weeks. Herein, we report six cases of COVID-19 who had persistently positive SARS-CoV-2 on repeat RT-PCR testing reaching up to 9 weeks. The spectrum of cases described ranges from asymptomatic infection to severe COVID-19 pneumonia. A full understanding of the virus's transmission dynamics needs further research. Prolonged viral shedding currently has unclear implications on the management and isolation decisions-the role of the cycle threshold (Ct) value in guiding therapeutic decisions is yet to be clarified. More data on the relationship between Ct values and viral cultivation are needed, especially in patients with prolonged viral shedding, to understand the virus's viability and infectivity.Copyright © 2021 by The American Society of Tropical Medicine and Hygiene.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=3b09eed64e8dae7d6165b409034c3564)

1. **COVID-19: Prolonged viral shedding in an HIV patient with literature review of risk factors for prolonged viral shedding and its implications for isolation strategies**  
   Khatib Mohamad Clinical Case Reports 2021;9:1397-1401.

Our work highlights patients at risk of prolonged viral shedding in COVID-19 and its implications for isolation strategies and explores possible solution by PCR-CT value testing (cycle threshold value). We also review the impact of HIV on COVID-19.Copyright © 2021 The Authors. Clinical Case Reports published by John Wiley & Sons Ltd.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=4d8186842fa5dbc20835247b1f1bd552)

1. **Demand for longer quarantine period among common and uncommon COVID-19 infections: a scoping review**  
   Li Zhi-Yao Infectious Diseases of Poverty 2021;10:56.

Background: As one of the non-pharmacological interventions to control the transmission of COVID-19, determining the quarantine duration is mainly based on the accurate estimates of the incubation period. However, patients with coarse information of the exposure date, as well as infections other than the symptomatic, were not taken into account in previously published studies. Thus, by using the statistical method dealing with the interval-censored data, we assessed the quarantine duration for both common and uncommon infections. The latter type includes the presymptomatic, the asymptomatic and the recurrent test positive patients. Method(s): As of 10 December 2020, information on cases have been collected from the English and Chinese databases, including Pubmed, Google scholar, CNKI (China National Knowledge Infrastructure) and Wanfang. Official websites and medias were also searched as data sources. All data were transformed into doubly interval-censored and the accelerated failure time model was applied. By estimating the incubation period and the time-to-event distribution of worldwide COVID-19 patients, we obtain the large percentiles for determining and suggesting the quarantine policies. For symptomatic and presymptomatic COVID-19 patients, the incubation time is the duration from exposure to symptom onset. For the asymptomatic, we substitute the date of first positive result of nucleic acid testing for that of symptom onset. Furthermore, the time from hospital discharge or getting negative test result to the positive recurrence has been calculated for recurrent positive patients. Result(s): A total of 1920 laboratory confirmed COVID-19 cases were included. Among all uncommon infections, 34.1% (n = 55) of them developed symptoms or were identified beyond fourteen days. Based on all collected cases, the 95th and 99th percentiles were estimated to be 16.2 days (95% CI 15.5-17.0) and 22.9 days (21.7-24.3) respectively. Besides, we got similar estimates based on merely symptomatic and presymptomatic infections as 15.1 days (14.4-15.7) and 21.1 days (20.0-22.2). Conclusion(s): There are a certain number of infected people who require longer quarantine duration. Our findings well support the current practice of the extended active monitoring. To further prevent possible transmissions induced and facilitated by such infectious outliers after the 14-days quarantine, properly prolonging the quarantine duration could be prudent for high-risk scenarios and in regions with insufficient test resources. [Figure not available: see fulltext.]Copyright © 2021, The Author(s).

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=4d85014ab84ac9dd1c407a6f54462236)

1. **Duration of SARS-CoV-2 RNA shedding and factors associated with prolonged viral shedding in patients with COVID-19**  
   Li Tong-Zeng Journal of Medical Virology 2021;93:506-512.

To investigate the factors associated with the duration of severe acute respiratory syndrome coronavirus 2 RNA shedding in patients with coronavirus disease 2019 (COVID-19). A retrospective cohort of COVID-19 patients admitted to a designated hospital in Beijing was analyzed to study the factors affecting the duration of viral shedding. The median duration of viral shedding was 11 days (IQR, 8-14.3 days) as measured from illness onset. Univariate regression analysis showed that disease severity, corticosteroid therapy, fever (temperature>38.5degreeC), and time from onset to hospitalization were associated with prolonged duration of viral shedding (P <.05). Multivariate regression analysis showed that fever (temperature>38.5degreeC) (OR, 5.1, 95%CI: 1.5-18.1), corticosteroid therapy (OR, 6.3, 95%CI: 1.5-27.8), and time from onset to hospitalization (OR, 1.8, 95%CI: 1.19-2.7) were associated with increased odds of prolonged duration of viral shedding. Corticosteroid treatment, fever (temperature>38.5degreeC), and longer time from onset to hospitalization were associated with prolonged viral shedding in COVID-19 patients.Copyright © 2020 Wiley Periodicals LLC

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1. **Dynamics of a Dual SARS-CoV-2 Lineage Co-Infection on a Prolonged Viral Shedding COVID-19 Case: Insights into Clinical Severity and Disease Duration**  
   Pedro Nicole Microorganisms 2021;9:No page numbers.

A few molecularly proven severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) cases of symptomatic reinfection are currently known worldwide, with a resolved first infection followed by a second infection after a 48 to 142-day intervening period. We report a multiple-component study of a clinically severe and prolonged viral shedding coronavirus disease 2019 (COVID-19) case in a 17-year-old Portuguese female. She had two hospitalizations, a total of 19 RT-PCR tests, mostly positive, and criteria for releasing from home isolation at the end of 97 days. The viral genome was sequenced in seven serial samples and in the diagnostic sample from her infected mother. A human genome-wide array (>900 K) was screened on the seven samples, and in vitro culture was conducted on isolates from three late samples. The patient had co-infection by two SARS-CoV-2 lineages, which were affiliated in distinct clades and diverging by six variants. The 20A lineage was absolute at the diagnosis (shared with the patient's mother), but nine days later, the 20B lineage had 3% frequency, and two months later, the 20B lineage had 100% frequency. The 900 K profiles confirmed the identity of the patient in the serial samples, and they allowed us to infer that she had polygenic risk scores for hospitalization and severe respiratory disease within the normal distributions for a Portuguese population cohort. The early-on dynamic co-infection may have contributed to the severity of COVID-19 in this otherwise healthy young patient, and to her prolonged SARS-CoV-2 shedding profile.

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1. **Exceptionally high COVID-19 viral load and very long duration of shedding in a young pauci-symptomatic child with autism resident in an Italian nursing home**  
   Grossi Enzo The Journal of infection 2021;82:e29-e30.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=73bb12b338f231ea0d53ef1522d2722d)

1. **Factors associated with delayed viral shedding in COVID-19 infected patients: A retrospective small-scale study**  
   Cao Hui-ru Respiratory Medicine 2021;178:106328.

Background: The outbreak of COVID-19 has caused ever-increasing attention and public panic all over the world. Until now, data are limited about the risk factors to virus shedding in COVID-19 infected patients. Method(s): In this retrospective study, data were collected from 87 patients hospitalized with COVID-19 infection in Suzhou. Using Cox proportional hazards regression and Kaplan-Meier survival analysis, the risk factors to COVID-19 RNA shedding was to be established according to demographic information, clinical characteristics, epidemiological history, antiviral medicine and corticosteroid administration. Result(s): The median duration of COVID-19 RNA shedding from admission was 13.11 +/- 0.76 days. There was no significant difference in viral shedding duration in terms of gender, age, history of Hubei province stay, characteristics of chest CT on admission, lymphocytopenia and clinical severity. By Cox proportional hazards model, excessive 200 mg cumulative corticosteroid (HR, 3.425 [95% CI, 1.339-7.143]), time from illness onset to hospitalization (<5 days) (HR, 2.503 [95% CI, 1.433-4.371]) and arbidol-included therapy (HR, 2.073 [95% CI, 1.185-3.626]) were the independent risk factors to delay COVID-19 RNA shedding. Besides of excessive 200 mg of cumulative corticosteroid (HR, 2.825 [95% CI, 1.201-6.649]), admission within 5 days from illness onset (HR, 2.493 [95% CI, 1.393-4.462]) and arbidol-included therapy (HR, 2.102 [95% CI, 1.073-4.120]), lymphocytopenia (HR, 2.153 [95% CI, 1.097-4.225]) was further identified as another unfavorable factor to 10-day viral shedding. Conclusion(s): The potential risk factors could help clinicians to identify patients with delayed viral shedding, thereby providing the rational strategy of treatment and optimal anti-viral interventions.Copyright © 2021

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1. **High-dose but Not Low-dose Corticosteroids Potentially Delay Viral Shedding of Patients With COVID-19**  
   Li Sijia Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2021;72:1297-1298.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=237d4757d6cf50e52794afb447fdf64f)

1. **Iatrogenic immunosuppression can lead to prolonged viral shedding and absent immune response to COVID-19**  
   Psaros Einberg Afrodite Acta paediatrica (Oslo, Norway : 1992) 2021;:No page numbers.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=5731c6aff084b651d672edbd2223dd8e)

1. **Kawasaki disease following coronavirus disease 2019 with prolonged fecal viral shedding**  
   Uda Kazuhiro Pediatrics international : official journal of the Japan Pediatric Society 2021;63:597-599.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=34d39f35b76e2cf6fc986365c401dfd2)

1. **Long-Term Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infectiousness Among Three Immunocompromised Patients: From Prolonged Viral Shedding to SARS-CoV-2 Superinfection**  
   Tarhini Hassan The Journal of infectious diseases 2021;223:1522-1527.

BACKGROUND: Guidelines for stopping coronavirus disease 2019 patient isolation are mainly symptom-based, with isolation for 10 to 20 days depending on their condition. METHOD(S): In this study, we describe 3 deeply immunocompromised patients, each with different clinical evolutions. We observed (1) the patients' epidemiological, clinical, and serological data, (2) infectiousness using viral culture, and (3) viral mutations accumulated over time. RESULT(S): Asymptomatic carriage, symptom resolution, or superinfection with a second severe acute respiratory syndrome coronavirus 2 strain were observed, all leading to prolonged infectious viral shedding for several months. CONCLUSION(S): Understanding underlying mechanisms and frequency of prolonged infectiousness is crucial to adapt current guidelines and strengthen the use of systematic polymerase chain reaction testing before stopping isolation in immunocompromised populations.Copyright © The Author(s) 2021. Published by Oxford University Press for the Infectious Diseases Society of America. All rights reserved. For permissions, e-mail: journals.permissions@oup.com.

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1. **Prevalence and Clinical Significance of Persistent Viral Shedding in Hospitalized Adult Patients with SARS-CoV-2 Infection: A Prospective Observational Study**  
   Vena Antonio Infectious Diseases and Therapy 2021;10:387-398.

Background: The goal of this study was to investigate the prevalence and factors associated with persistent viral shedding (PVS) in hospitalized patients with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection. Method(s): This was a prospective observational study including all consecutive adults hospitalized with SARS-CoV-2 infection. When the first nasopharyngeal swab was positive for SARS-CoV-2 RNA (day 0), additional samples were obtained on days + 3, + 5, + 7 and then once every 7 days until virus detection was negative. PVS was defined as the duration of shedding of at least 21 days after diagnosis. The primary endpoint of this study was the prevalence of PVS. Result(s): Data were obtained regarding 121 consecutive hospitalized patients with SARS-CoV-2 infection (median age 66 years, male sex 65.3%). Overall, the prevalence of PVS was 38% (46/121 patients). According to univariate analysis, factors associated with PVS were immunosuppression (6.7% vs 21.7%, p = 0.02), increased interleukin-6 (IL-6) levels (>= 35 ng/ml) at the time of diagnosis (43.4% vs 67.3%, p = 0.02), time from onset of symptoms to diagnosis (median days 7.0 vs 3.5, p = 0.001), intensive care unit admission (22.7% vs 43.5%, p = 0.02), and need for invasive mechanical ventilation (20.0% vs 41.3%, p = 0.01). The multivariate analysis indicated that immunosuppression, increased IL-6 levels at the time of diagnosis, time from onset of symptoms to diagnosis, and need for mechanical ventilation were independent factors associated with PVS. Conclusion(s): PVS was detected in up to 38% of hospitalized patients with SARS-CoV-2 infection and was strongly associated with immunosuppression, increased IL-6 levels, and the need for mechanical ventilation.Copyright © 2021, The Author(s).

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1. **Prolonged SARS-CoV-2 viral shedding in patients with chronic kidney disease**  
   O'Sullivan Eoin D. Nephrology 2021;26:328-332.

Recent World Health Organization guidance has aimed to provide pragmatic guidance acknowledging the role of sequential nasopharyngeal swabs taken >24 hours apart for SARS-CoV-2 in high-risk populations. Patients with chronic kidney disease (CKD) are known to have an altered immune milieu which may be associated with a delay in viral clearance. Here, a cross-sectional observational study of 138 patients admitted with SARS-CoV-2 infection at two large regional hospitals in Scotland, UK examined the median time to two consecutive negative nasopharyngeal swabs for SARS-CoV-2 in an inpatient population. The median time from admission to the first of two consecutive negative nasopharyngeal swabs was 18 days (range = 1-44) in patients with CKD, compared with 11 days (range: 1-71) in patients without CKD (P =.0007). Multivariable linear regression analysis using explanatory variables of age, sex, SARS-CoV-2 disease severity, key comorbidities and renal function showed that declining estimated glomerular filtration rate was independently associated with prolonged time to viral clearance. Our data suggest that patients with CKD who are admitted to hospital with SARS-CoV-2 take longer to achieve sequential negative nasopharyngeal swab reverse transcription-polymerase chain reaction results than those without CKD. This has implications for renal service provision, discharge planning and hospital capacity as well as a direct impact on patients due to extended hospital stay, anxiety and stigmatisation.Copyright © 2020 Asian Pacific Society of Nephrology

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1. **Prolonged SARS-CoV-2 viral shedding in patients with solid tumours and associated factors**  
   Rogado Jacobo European journal of cancer (Oxford, England : 1990) 2021;148:58-60.

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1. **Prolonged SARS-CoV2 Viral Shedding in an Elderly Patient**  
   Jariwal Roopam Cureus 2021;13:e15128.

Coronavirus disease 2019 (COVID-19) has been devastating to the elderly population, especially due to a lack of clear guidelines for treatment. Corticosteroids have been the mainstay in treating the cytokine storm caused by the virus. In the past, prolonged viral shedding of Middle East Respiratory Syndrome (MERS) was noted in patients treated with high-dose corticosteroids. It is unclear whether this also holds true for severe acute respiratory syndrome coronavirus (SARS-CoV2). To our knowledge, this case report highlights the longest reported disease course of SARS-CoV2, lasting approximately 210 days. Copyright © 2021, Jariwal et al.

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1. **Prolonged shedding of SARS-CoV-2 in an elderly liver transplant patient infected by COVID-19: a case report**  
   2021;:7003-7007.

Coronavirus disease 2019 (COVID-19) pandemic gripped the globe. SARS-CoV-2 is highly infectious and is susceptible to all populations. Immunosuppressed patients have greater risk for opportunistic infections. However, the understanding regarding the biological characteristics of SARS-CoV-2 in immunosuppressed patients remains unclear. Herein, we present a case of prolonged shedding of SARS-CoV-2 in a liver transplant patient with COVID-19. A 61-year-old male post liver transplant was confirmed COVID-19 infection on day 10 of illness onset. The patient has received immunosuppressive treatment for over 11 years and has a history of hypertension for 10 years. With antiviral treatment and temporary discontinuation of tacrolimus immunosuppression, he had complete clinical symptoms relieve on day 24. However, recurrently positive tests of SARS-CoV-2 RNA were presented on day 35 and on day 39 after two consecutive negative tests. IgG antibody test for SARS-CoV-2 was positive with IgM negative on day 41. The final shedding duration lasted 52 days. Prolonged shedding of SARS-CoV-2 should be a matter of concern and might attribute to long-term immunosuppression. Therefore, dynamic surveillance and prolonged quarantine are required for immunocompromised individuals. Further data should be collected to investigate if there is a universal prolonged shedding window of SARS-CoV-2 in immunosuppressed patients.

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1. **Prolonged viral shedding and antibody persistence in patients with COVID-19**  
   Fotouhi Fatemeh Microbes and Infection 2021;23:104810.

SARS-CoV-2 as a new global threat has affected global population for one year. Despite the great effort to eradicate this infection, there are still some challenges including different viral presentation, temporal immunity in infected individuals and variable data of viral shedding. We studied 255 COVID-19 suspected individuals to assess the viral shedding duration and also the antibody development against SARS-CoV-2 among the cases. Real Time RT-PCR assay was applied to determine the virus presence and SARS-CoV-2 antibodies were evaluated using SARS-CoV-2 IgM and IgG kits. 113 patients were confirmed for COVID-19 infection. The patients were followed until negative PCR achieved. The median viral shedding among studied population was obtained 34.16 (+/-17.65) days which was not significantly associated with age, sex and underlying diseases. Shiver and body pain were found in prolonged form of the infection and also patients who had gastrointestinal problems experienced longer viral shedding. Moreover, IgG was present in 84% of patients after 150 days. According to this data, the median viral shedding prolongation was 34.16 days which indicates that 14 days isolation might not be enough for population. In addition, IgG profiling indicated that it is persistent in a majority of patients for nearly 6 months which has brought some hopes in vaccine efficacy and application.Copyright © 2021 Institut Pasteur

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1. **Prolonged Viral Shedding in Patients with Mild to Moderate COVID-19 Disease: A Regional Perspective**  
   Hossain Mehrab E. Infectious Diseases: Research and Treatment 2021;14:No page numbers.

Background: The risk of transmission of Coronavirus Disease 2019 (COVID-19) is increasingly understood to be greatest early after symptom onset, however, factors associated with prolonged and increased risk of transmission remain unclear. In settings where COVID-19 prevalence is low, there may be a benefit of extending the period that patients are isolated to decrease the risk of transmission. This study explored the duration of viral shedding in such a location, in patients with mild-moderate COVID-19 disease in Ballarat, Australia. Method(s): Patients diagnosed with COVID-19 disease using a real-time reverse-transcriptase-polymerase-chain-reaction (RT-PCR) assay from oropharyngeal and bilateral deep nasopharyngeal sampling and managed through Ballarat Health Services between March 1 and May 1, 2020 were included. Patients were retested if they were afebrile for >72 hours, asymptomatic and >14 days since symptom onset. If positive on retesting, patients were tested every 3 to 7 days thereafter. Result(s): Patients underwent testing a median of 4 days (range 1-12) after initial symptom onset. Duration of symptoms ranged from 1 to 36 days. Positive tests were recorded up to a median of day 21 (range 6-38). Cycle thresholds were inversely correlated with time since symptom onset (P <.0001). Median time to the first negative test was 25 days (range 12-32). Two patients who had remained asymptomatic for >7 days after initial symptom onset had recrudescence of mild symptoms on day 13 and 14; both tested positive on follow-up tests at this time. Conclusion(s): This study demonstrates prolonged shedding of COVID-19 in patients with mild-moderate disease. It suggests that some patients with mild disease may have recrudescence of symptoms a week or more after their initial symptoms resolved.Copyright © The Author(s) 2021.

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1. **Prolonged viral shedding of SARS-CoV-2 in an immunocompromised patient**  
   Nakajima Yukiko Journal of infection and chemotherapy : official journal of the Japan Society of Chemotherapy 2021;27:387-389.

The duration of viral shedding of SARS-CoV-2 is usually less than 10 days. We experienced a COVID-19 case with prolonged viral shedding for 2 months. His cell mediated immunity has been depressed (CD4+T cell <100/mul) due to advanced malignant lymphoma and chemotherapy which had been completed 4 months prior to the onset of symptoms of COVID-19. We administered several treatments against COVID-19, however the results of Polymerase Chain Reaction (PCR) from nasopharyngeal specimens remained positive to SARS-CoV-2 for 2 months. Moreover, virus isolation assays performed on Day 59 also remained positive. He was finally discharged on Day 69 with two consecutive negative PCR results for SARS-CoV-2. Immunocompromised status may prolong viral shedding and it is therefore important for the clinician to take into account this when assessing such patients. Copyright © 2020 Japanese Society of Chemotherapy and The Japanese Association for Infectious Diseases. Published by Elsevier Ltd. All rights reserved.

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1. **SARS-CoV-2 Persistent Viral Shedding in the Context of Hydroxychloroquine-Azithromycin Treatment**  
   2021;:890.

SARS-CoV-2 nasopharyngeal shedding contributes to the spread of the COVID-19 epidemic. Among 3271 COVID-19 patients treated at the Hospital University Institute Méditerranée Infection, Marseille, France from 3 March to 27 April 2020, tested at least twice by qRT-PCR, the median SARS-CoV-2 nasopharyngeal shedding duration was 6 days (range 2–54 days). Compared with short shedders (qRT-PCR positivity < 10 days), 34 (1.04%) persistent shedders (qRT-PCR positivity ≥ 17 days; mean ± SD: 23.3 ± 3.8 days) were significantly older, with associated comorbidities, exhibiting lymphopenia, eosinopenia, increased D-dimer and increased troponin (p < 0.05), and were hospitalized in intensive care unit in 17.7% vs. 1.1% of cases (p < 0.0001). Viral culture was positive in six persistent shedders after day 10, including in one patient after day 17, and no viral co-pathogen was detected in 33 tested patients. Persistent shedders received azithromycin plus hydroxychloroquine ≥ 3 days in 26/34 (76.5%) patients, a figure significantly lower than in short shedders (86.6%) (p = 0.042). Accordingly, mortality was 14.7% vs. 0.5% (p < 0.0001). Persistent shedding was significantly associated with persistent dyspnea and anosmia/ageusia (p < 0.05). In the context of COVID-19 treatment, including treatment with azithromycin plus hydroxychloroquine, the persistence of SARS-CoV-2 nasopharyngeal shedding was a rare event, most frequently encountered in elderly patients with comorbidities and lacking azithromycin plus hydroxychloroquine treatment.

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1. **SARS-CoV-2 Persistent Viral Shedding in the Context of Hydroxychloroquine-Azithromycin Treatment**  
   Drancourt Michel Viruses 2021;13:No page numbers.

SARS-CoV-2 nasopharyngeal shedding contributes to the spread of the COVID-19 epidemic. Among 3271 COVID-19 patients treated at the Hospital University Institute Mediterranee Infection, Marseille, France from 3 March to 27 April 2020, tested at least twice by qRT-PCR, the median SARS-CoV-2 nasopharyngeal shedding duration was 6 days (range 2-54 days). Compared with short shedders (qRT-PCR positivity < 10 days), 34 (1.04%) persistent shedders (qRT-PCR positivity >= 17 days; mean +/- SD: 23.3 +/- 3.8 days) were significantly older, with associated comorbidities, exhibiting lymphopenia, eosinopenia, increased D-dimer and increased troponin (p < 0.05), and were hospitalized in intensive care unit in 17.7% vs. 1.1% of cases (p < 0.0001). Viral culture was positive in six persistent shedders after day 10, including in one patient after day 17, and no viral co-pathogen was detected in 33 tested patients. Persistent shedders received azithromycin plus hydroxychloroquine >= 3 days in 26/34 (76.5%) patients, a figure significantly lower than in short shedders (86.6%) (p = 0.042). Accordingly, mortality was 14.7% vs. 0.5% (p < 0.0001). Persistent shedding was significantly associated with persistent dyspnea and anosmia/ageusia (p < 0.05). In the context of COVID-19 treatment, including treatment with azithromycin plus hydroxychloroquine, the persistence of SARS-CoV-2 nasopharyngeal shedding was a rare event, most frequently encountered in elderly patients with comorbidities and lacking azithromycin plus hydroxychloroquine treatment.

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1. **Short-term inhibition of SARS-CoV-2 by hydrogen peroxide in persistent nasopharyngeal carriers**  
   Capetti Amedeo F. Journal of Medical Virology 2021;93:1766-1769.

Asymptomatic and convalescent coronavirus disease 2019 (COVID-19) subjects may carry severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) for months in their upper respiratory ways. Desiring to permanently clean the mucosal surfaces, we investigated the chemical agents that fit to rapidly degrade the virus. Among these, hydrogen peroxide, initially tested by two of us for tolerability, showed both good performance and acceptable side effects (burning sensation for 15-20 s). We contacted circles of family physicians and the ATS Milano (Territorial Assistance and Prevention Service), and we tested this procedure on eight persistent carriers of SARS-CoV-2, performing swabs before the procedure and after it until the reappearance of the virus or until 14 days (the incubation period), keeping the surfaces clean with a hypertonic solution. Our patients had a median time from exposure or symptom onset of 111 days, and three had relapsed after being declared "cured" (two consecutive negative swabs after quarantine). One patient had a baseline negative swab and was excluded, and two successfully ended the 14 days' course, four suppressed viral elimination for 72 h, and one for 48 h, all rebounding to weak positive (cycle thresholds above 24). Although temporarily effective, such measures may have some place in the control of viral shedding to protect the most fragile subjects.Copyright © 2020 The Authors. Journal of Medical Virology published by Wiley Periodicals LLC

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1. **The impact on outcomes of the ACS committee on trauma delayed trauma center verifications secondary to COVID19**  
   Baroutjian Amanda American Journal of Emergency Medicine 2021;39:219-220.

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1. **The long-quarantined case of COVID-19 with prolonged viral shedding and intermittent fever for more than 70 days**  
   Yamada Eijiro Future Virology 2021;16:79-84.

A 79-year old Japanese woman was diagnosed with coronavirus disease (COVID-19), caused by SARS coronavirus 2 (SARS-CoV-2), based on a positive reverse transcription-PCR (RT-PCR) test result. Chest computed tomography revealed mild interstitial pneumonia. She had intermittent persistent inflammatory reactions with fever. Laboratory findings and RT-PCR test results showed SARS-CoV-2 positivity for more than 70 days. To the best of our knowledge, this relatively mild case has the longest duration of viral shedding recorded, as confirmed by RT-PCR analysis. This case demonstrates that the viral shedding in COVID-19 can be prolonged, even in mild disease, and highlights the difficulties in distinguishing viral shedding from SARS-CoV-2 infectivity.Copyright © 2021 Future Medicine Ltd.

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1. **Two prolonged viremic SARS-CoV-2 infections with conserved viral genome for two months**  
   Abu-Raddad Laith J. Infection, genetics and evolution : journal of molecular epidemiology and evolutionary genetics in infectious diseases 2021;88:104684.

We document two cases of viremic and prolonged active infection with the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) where the viral genome was conserved for two months, but infection was with little or no symptoms. The first infection persisted for 80 days and the second for 62 days. Clearance of infection occurred 40 and 41 days, respectively, after development of detectable antibodies. Both cases were identified incidentally in an investigation of reinfection in a cohort of 133,266 laboratory-confirmed infected persons. Copyright © 2020 The Author(s). Published by Elsevier B.V. All rights reserved.

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1. **Characteristics of pediatric SARS-CoV-2 infection and potential evidence for persistent fecal viral shedding**  
   Xu Yi Nature Medicine 2020;26:502-505.

We report epidemiological and clinical investigations on ten pediatric SARS-CoV-2 infection cases confirmed by real-time reverse transcription PCR assay of SARS-CoV-2 RNA. Symptoms in these cases were nonspecific and no children required respiratory support or intensive care. Chest X-rays lacked definite signs of pneumonia, a defining feature of the infection in adult cases. Notably, eight children persistently tested positive on rectal swabs even after nasopharyngeal testing was negative, raising the possibility of fecal-oral transmission.Copyright © 2020, The Author(s), under exclusive licence to Springer Nature America, Inc.

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1. **Clinical characteristics associated with long-term viral shedding in patients with coronavirus disease 2019**  
   Zhou Miao American Journal of Translational Research 2020;12:6954-6964.

Background: To delineate the clinical characteristics associated with long-term viral shedding (>21 days) in patients with coronavirus disease 2019 (COVID-19). Method(s): In this retrospective study, factors associated with long-term (>21 days) severe acute respiratory coronavirus 2 (SARS-CoV-2) RNA shedding were evaluated in a conhort of 609 patients from two hospitals in Wuhan. Result(s): The median duration of SARS-CoV-2 viral shedding was 19 days (interquartile range, 10-28 days) among all patients. There were 42% of patients having prolonged viral shedding time (>21 days), in which the longest viral shedding time was 58 days. When comparing patients with early (<=21 days) and late viral RNA clearance (>21 days), prolonged viral shedding was associated with age <65 (P=0.015), female sex (P=0.028), cough (P=0.025), fatigue (P=0.035), sore throat (P=0.013), aspartate aminotransferase (P=0.038), procalcitonin (P=0.010), albumin (P=0.003), D-dimer (P=0.011), lung involvement (P=0.014), reticular shadow (P<0.001) and lung consolidation (P=0.004). Age range (<65 years) (odds ratio [OR], 1.46 [95% CI, 1.05-2.03]) and female sex (odds ratio [OR], 1.40 [95% CI, 1.00-1.94]) were independent risk factors. Conclusion(s): Long-term viral shedding (>21 days) is not a rare phenomenon among COVID-19 infectious patients. Age range (<65) and female sex are independent risk factors for long-term viral shedding. Early antiviral treatment should be considered for COVID-19 patients with such risk factors. Further study should be conducted to know the infectivity of patients with long-term viral shedding in order to develop reasonable control measures.Copyright © 2020 E-Century Publishing Corporation. All rights reserved.

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1. **Clinical Course and Molecular Viral Shedding Among Asymptomatic and Symptomatic Patients With SARS-CoV-2 Infection in a Community Treatment Center in the Republic of Korea**  
   2020;:1447-1452.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=eb4b852dc987150f65c953d2db67cf9d)

1. **Clinical Factors Associated with Progression and Prolonged Viral Shedding in COVID-19 Patients: A Multicenter Study**  
   Feng Zhichao Aging and disease 2020;11:1069-1081.

Coronavirus disease 2019 (COVID-19) is a global pandemic associated with a high mortality. Our study aimed to determine the clinical risk factors associated with disease progression and prolonged viral shedding in patients with COVID-19. Consecutive 564 hospitalized patients with confirmed COVID-19 between January 17, 2020 and February 28, 2020 were included in this multicenter, retrospective study. The effects of clinical factors on disease progression and prolonged viral shedding were analyzed using logistic regression and Cox regression analyses. 69 patients (12.2%) developed severe or critical pneumonia, with a higher incidence in the elderly and in individuals with underlying comorbidities, fever, dyspnea, and laboratory and imaging abnormalities at admission. Multivariate logistic regression analysis indicated that older age (odds ratio [OR], 1.04; 95% confidence interval [CI], 1.02-1.06), hypertension without receiving angiotensinogen converting enzyme inhibitors or angiotensin receptor blockers (ACEI/ARB) therapy (OR, 2.29; 95% CI, 1.14-4.59), and chronic obstructive pulmonary disease (OR, 7.55; 95% CI, 2.44-23.39) were independent risk factors for progression to severe or critical pneumonia. Hypertensive patients without receiving ACEI/ARB therapy showed higher lactate dehydrogenase levels and computed tomography (CT) lung scores at about 3 days after admission than those on ACEI/ARB therapy. Multivariate Cox regression analysis revealed that male gender (hazard ratio [HR], 1.22; 95% CI, 1.02-1.46), receiving lopinavir/ritonavir treatment within 7 days from illness onset (HR, 0.75; 95% CI, 0.63-0.90), and receiving systemic glucocorticoid therapy (HR, 1.79; 95% CI, 1.46-2.21) were independent factors associated with prolonged viral shedding. Our findings presented several potential clinical factors associated with developing severe or critical pneumonia and prolonged viral shedding, which may provide a rationale for clinicians in medical resource allocation and early intervention. Copyright copyright: © 2020 Feng et al.

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1. **Clinical Progression of COVID-19 Patient with Extended Incubation Period, Delayed RT-PCR Time-to-positivity, and Potential Role of Chest CT-scan**  
   Burhan Erlina Acta medica Indonesiana 2020;52:80-83.

Coronavirus Disease 2019 (COVID-19), previously called 2019-nCoV, is a novel disease caused by SARS- CoV-2 which was first identified as outbreak of unknown respiratory illness in Wuhan, China. COVID- 19 was declared as global health emergency by WHO on March 11, 2020 and quickly elevated to global pandemic on 11 March 2020. COVID-19 symptom is highly various in each patient, with fever, fatigue, shortness of breath, and cough as the main presenting symptoms. Patient with COVID-19 may shows severe symptom with severe pneumonia and ARDS, mild symptom resembling simple upper respiration tract infection, or even completely asymptomatic. Approximately 80% of cases is mild. However the number may changes as more people are getting tested. Some experts are estimating that up to 50% of all cases may be asymptomatic carrier.

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1. **Corticosteroid, oseltamivir and delayed admission are independent risk factors for prolonged viral shedding in patients with Coronavirus Disease 2019**  
   Hu Fuying The clinical respiratory journal 2020;14:1067-1075.

INTRODUCTION: Coronavirus Disease 2019 (COVID-19) has spread worldwide, and it has reached to more than 14.5 million cases. Although Hubei province is the epicenter of China, little is known about epidemiological and clinical features of COVID-19 in other areas in Hubei province around Wuhan. In addition, the virological data, particularly the factors associated with viral shedding of COVID-19 has not been well described., OBJECTIVE: To describe the epidemiological and clinical features of patients with COVID-19 in Tianmen city, and identify risk factors associated with prolonged viral shedding of COVID-19., METHODS: Inpatients with COVID-19 admitted before February 9, 2020 were included. Characteristics were compared between patients with early and late viral RNA shedding. Multivariate cox regression model was used to investigate variables associated with prolonged viral shedding., RESULTS: One hundred and eighty-three patients were included. About 8.2% patients were categorized as critical degree of severity. All patients received antiviral therapy, with arbidol and interferon being the commonest. About 38.3% and 16.9% patients were treated with corticosteroid and immunoglobulin, respectively. Time from onset to admission (HR = 0.829, P < 0.001), and administration of corticosteroid (HR = 0.496, P = 0.002), arbidol (HR = 2.605, P = 0.008) and oseltamivir (HR = 0.416, P < 0.001) were independently associated with duration of viral shedding., CONCLUSION: Symptoms of patients from Tianmen are relatively mild. Treatment should be started as early as possible, but corticosteroid and oseltamivir should be initiated with caution. In addition, clinical trials on arbidol should be conducted to demonstrate its effectiveness. Copyright © 2020 John Wiley & Sons Ltd.

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1. **COVID-19 in a patient treated for granulomatosis with polyangiitis: Persistent viral shedding with no cytokine storm**  
   Daniel Pascale European Journal of Case Reports in Internal Medicine 2020;7:No page numbers.

Introduction: The coronavirus disease COVID-19 is considered a pandemic disease that has developed rapidly all over the world. As of today, it is unclear whether immunosuppression confers an increased risk for pulmonary complications, or conversely, whether it can be a protective factor with respect to a cytokine storm. Case description: We report the case of a 55-year-old male patient with granulomatosis with polyangiitis treated with rituximab who was infected with COVID-19 pneumonia. To the best of our knowledge, only 1 case has been reported in the literature with similar characteristics. The patient had a non-classic evolution of clinical symptoms with persistent fever and viral shedding, in addition to a negative serology. Conclusion(s): This case emphasizes the management and immunity response to COVID-19 pneumonia in such patients. Data are still needed regarding patients who have prolonged B-cell depletion, which may put the patient at a higher risk for reinfection.Copyright European Journal of Case Reports in Internal Medicine © EFIM 2020

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1. **COVID-19 in a patient with long-term use of glucocorticoids: A study of a familial cluster**  
   Han Yuanyuan Clinical immunology (Orlando, Fla.) 2020;214:108413.

Clusters of patients with novel coronavirus disease 2019 (COVID-19) have been successively reported globally. Studies show clear person-to-person transmission. The average incubation period is 2-14 days, and mostly 3-7 days. However, in some patients, this period may be longer. Here, we report a familial cluster of COVID-19 where a 47-year-old woman with long-term use of glucocorticoids did not develop any symptoms within the 14-day quarantine period but was confirmed with COVID-19 by tested positive of antibody on day 40 after she left Wuhan. Almost at the same time, her father and sister were diagnosed with COVID-19. The results suggest that the long-term use of glucocorticoids might cause atypical infections, a long incubation period, and extra transmission of COVID-19. Copyright © 2020 Elsevier Inc. All rights reserved.

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1. **Diabetes mellitus is a risk factor for prolonged SARS-CoV-2 viral shedding in lower respiratory tract samples of critically ill patients**  
   Buetti Niccolo Endocrine 2020;70:454-460.

PURPOSE: The length of time a critically ill coronavirus disease 2019 (COVID-19) patient remains infectious and should therefore be isolated remains unknown. This prospective study was undertaken in critically ill patients to evaluate the reliability of single negative real-time polymerase chain reaction (RT-PCR) in lower tracheal aspirates (LTA) in predicting a second negative test and to analyze clinical factors potentially influencing the viral shedding., METHODS: From April 9, 2020 onwards, intubated COVID-19 patients treated in the intensive care unit were systematically evaluated for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by RT-PCR of nasopharyngeal swabs and LTA. The time to negativity was defined as the time between the onset of symptoms and the viral clearance in LTA. In order to identify risk factors for prolonged viral shedding, we used univariate and multivariate Cox proportional hazards models., RESULTS: Forty-eight intubated SARS-CoV-2 patients were enrolled. Overall, we observed that the association of the first negative RT-PCR with a second negative result was 96.7%. Median viral shedding was 25 (IQR: 21.5-28) days since symptoms' onset. In the univariate Cox model analysis, type 2 diabetes mellitus was associated with a prolonged viral RNA shedding (hazard ratio [HR]: 0.41, 95% CI: 0.06-3.11, p = 0.04). In the multivariate Cox model analysis, type 2 diabetes was associated with a prolonged viral RNA shedding (HR: 0.31, 95% CI: 0.11-0.89, p = 0.029)., CONCLUSION: Intubated patients with type 2 diabetes mellitus may have prolonged SARS-CoV-2 shedding. In critically ill COVID-19 patients, one negative LTA should be sufficient to assess and exclude infectivity.

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1. **Does SARS-CoV-2 has a longer incubation period than SARS and MERS?**  
   Jiang Xuan Journal of medical virology 2020;92:476-478.

The outbreak of a novel coronavirus (SARS-CoV-2) since December 2019 in Wuhan, the major transportation hub in central China, became an emergency of major international concern. While several etiological studies have begun to reveal the specific biological features of this virus, the epidemic characteristics need to be elucidated. Notably, a long incubation time was reported to be associated with SARS-CoV-2 infection, leading to adjustments in screening and control policies. To avoid the risk of virus spread, all potentially exposed subjects are required to be isolated for 14 days, which is the longest predicted incubation time. However, based on our analysis of a larger dataset available so far, we find there is no observable difference between the incubation time for SARS-CoV-2, severe acute respiratory syndrome coronavirus (SARS-CoV), and middle east respiratory syndrome coronavirus (MERS-CoV), highlighting the need for larger and well-annotated datasets. Copyright © 2020 Wiley Periodicals, Inc.

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1. **Effects of oral care on prolonged viral shedding in coronavirus disease 2019 (COVID-19)**  
   Warabi Yoko Special care in dentistry : official publication of the American Association of Hospital Dentists, the Academy of Dentistry for the Handicapped, and the American Society for Geriatric Dentistry 2020;40:470-474.

AIM: To assess the effects of oral care on prolonged viral shedding in coronavirus disease 2019 (COVID-19) patients., METHODS AND RESULTS: We evaluated the clinical course of eight COVID-19 patients, including their duration of viral shedding, by PCR testing of nasopharyngeal swabs. The average time from the onset of symptoms until the virus was no longer detectable was 31.6 +/- 11.8 days (mean +/- SD; range 17-53). Thus, it took 15.1 +/- 14.7 (1-40) days from the time of clinical recovery for the virus to become undetectable. In two patients who had mental retardation and psychiatric disorders, the viral shedding period continued for 44 days or 53 days. These two patients did not voluntarily brush their teeth. When they were instructed on the importance of oral care, including tooth brushing and gargling, their tests for the coronavirus became negative., CONCLUSION: Most of the patients with COVID-19 had a viral shedding period of 30 days or less. In cases of prolonged viral shedding (>=44 days), noninfectious viral nucleic acid may have accumulated in uncleaned oral cavities and continued to be detected. We propose that tooth brushing and gargling remove such viral nucleic acid and improve the accuracy of PCR testing. Copyright © 2020 Special Care Dentistry Association and Wiley Periodicals, Inc.

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1. **Evaluating the Effectiveness of Social Distancing Interventions to Delay or Flatten the Epidemic Curve of Coronavirus Disease**  
   Matrajt Laura Emerging infectious diseases 2020;26:1740-1748.

By April 2, 2020, >1 million persons worldwide were infected with severe acute respiratory syndrome coronavirus 2. We used a mathematical model to investigate the effectiveness of social distancing interventions in a mid-sized city. Interventions reduced contacts of adults >60 years of age, adults 20-59 years of age, and children <19 years of age for 6 weeks. Our results suggest interventions started earlier in the epidemic delay the epidemic curve and interventions started later flatten the epidemic curve. We noted that, while social distancing interventions were in place, most new cases, hospitalizations, and deaths were averted, even with modest reductions in contact among adults. However, when interventions ended, the epidemic rebounded. Our models suggest that social distancing can provide crucial time to increase healthcare capacity but must occur in conjunction with testing and contact tracing of all suspected cases to mitigate virus transmission.

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1. **Factors Associated With Prolonged Viral RNA Shedding in Patients with Coronavirus Disease 2019 (COVID-19)**  
   2020;:799-806.

Male sex, delayed admission to hospital after illness onset, and invasive mechanical ventilation were associated with prolonged SARS-CoV-2 RNA shedding. Hospital admission and general treatments should be started as soon as possible in symptomatic COVID-19 patients, especially male patients.

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1. **Factors associated with prolonged viral shedding and impact of lopinavir/ritonavir treatment in hospitalised non-critically ill patients with SARS-CoV-2 infection**  
   Yan Dan European Respiratory Journal 2020;56:2000799.

Background: The duration of viral shedding is central to the guidance of decisions about isolation precautions and antiviral treatment. However, studies regarding the risk factors associated with prolonged shedding of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the impact of lopinavir/ritonavir (LPV/r) treatment on viral shedding remain scarce. Method(s): Data were collected from all SARS-CoV-2 infected patients who were admitted to isolation wards and had reverse transcription PCR conversion at the No. 3 People's Hospital of Hubei province, China, between 31 January and 9 March 2020. We compared clinical characteristics and SARS-CoV-2 RNA shedding between patients initiated with LPV/r treatment and those without. Logistic regression analysis was employed to evaluate the risk factors associated with prolonged viral shedding. Result(s): Of 120 patients, the median age was 52 years, 54 (45%) were male and 78 (65%) received LPV/r treatment. The median duration of SARS-CoV-2 RNA detection from symptom onset was 23 days (interquartile range 18-32 days). Older age (OR 1.03, 95% CI 1.00-1.05; p=0.03) and the lack of LPV/r treatment (OR 2.42, 95% CI 1.10-5.36; p=0.029) were independent risk factors for prolonged SARS-CoV-2 RNA shedding. Patients who initiated LPV/r treatment within 10 days from symptom onset, but not initiated from day 11 onwards, had significantly shorter viral shedding duration compared with those without LPV/r treatment (median 19 days versus 28.5 days; log-rank p<0.001). Conclusion(s): Older age and the lack of LPV/r treatment were independently associated with prolonged SARS-CoV-2 RNA shedding in patients with coronavirus disease 2019 (COVID-19). Earlier administration of LPV/r treatment could shorten viral shedding duration.Copyright © ERS 2020.

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1. **Factors Associated with the Delayed Termination of Viral Shedding in COVID-19 Patients with Mild Severity in South Korea**  
   Kim Bongyoung Medicina (Kaunas, Lithuania) 2020;56:No page numbers.

Background and objectives: We aimed to analyze factors associated with the period of viral shedding in patients with confirmed COVID-19 who experienced only mild symptoms. Materials and methods: We conducted a multicenter retrospective study from three community treatment centers (CTCs) of South Korea. All patients included were admitted to the three centers before 31 March 2020. We collected data about clinical characteristics and the result of real-time reverse transcription polymerase chain reaction (RT-PCR). Results: Viral shedding was terminated within 32 days and 36 days in 75% and 90% of patients, respectively (range: 8-49 days). The mean period of viral shedding was 23.8 +/- 8.7 days. In the multivariate Cox proportional hazards regression analysis, the existence of underlying comorbidities lowered the probability of the termination of viral shedding (HR = 0.561, 95% CI 0.388-0.812). Female sex and presence of COVID-19-associated symptoms also lowered the probability, but the significance was marginal. Conclusions: The existence of underlying comorbidities was associated with delayed termination of viral shedding in COVID-19 patients with mild severity.

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1. **Host tolerance contributes to persistent viral shedding in COVID-19**  
   Chang De EClinicalMedicine 2020;26:100529.

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1. **In the time of corona - Is it safe to delay treatment for prostate cancer?**  
   Fantin Joao Paulo Pretti Revista da Associacao Medica Brasileira 2020;66:388-389.

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1. **Incidence and outcomes of healthcare-associated COVID-19 infections: significance of delayed diagnosis and correlation with staff absence**  
   Khonyongwa K. Journal of Hospital Infection 2020;106:663-672.

Background: The sudden increase in COVID-19 admissions in hospitals during the SARS-CoV-2 pandemic of 2020 led to onward transmissions among vulnerable inpatients. Aim(s): This study was performed to evaluate the prevalence and clinical outcomes of healthcare-associated COVID-19 infections (HA-COVID-19) during the 2020 epidemic and study factors which may promote or correlate with its incidence and transmission in a Teaching Hospital NHS Trust in London, UK. Method(s): Electronic laboratory, patient and staff self-reported sickness records were interrogated from 1st March to 18th April 2020. HA-COVID-19 was defined as COVID-19 with symptom onset within >14 days of admission. Test performance of a single combined throat and nose swab (CTNS) for patient placement was calculated. The effect of delayed RNA positivity (DRP, defined as >48 h delay), staff self-reported COVID-19 sickness absence, hospital bed occupancy, and community incidence of COVID-19 was compared for HA-COVID-19. The incidence of other significant hospital-acquired bacterial infections (HAB) was compared with previous years. Result(s): Fifty-eight HA-COVID-19 (7.1%) cases were identified. When compared with community-acquired admitted cases (CA-COVID-19), significant differences were observed in age (P=0.018), ethnicity (P<0.001) and comorbidity burden (P<0.001) but not in 30-day mortality. CTNS-negative predictive value was 60.3%. DRP was associated with greater mortality (P=0.034) and incidence of HA-COVID-19 correlated positively with DRP (R = 0.7108) and staff sickness absence (R = 0.7815). For the study period HAB rates were similar to the previous 2 years. Conclusion(s): Early diagnosis and isolation of COVID-19 patients would help to reduce transmission. A single CTNS has limited value in segregating patients into positive and negative pathways.Copyright © 2020 The Healthcare Infection Society

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1. **Incidence and Persistence of Viral Shedding in COVID-19 Post-acute Patients With Negativized Pharyngeal Swab: A Systematic Review**  
   Morone Giovanni Frontiers in Medicine 2020;7:562.

After the global spread of a severe acute respiratory syndrome caused by a coronavirus (SARS-CoV-2), factors that influence viral diffusion have gained great attention. Human-to-human transmission mainly occurs through droplets, but viral RNA clearance in different biological fluids in coronavirus disease 2019 (COVID-19) remains unclear. We aimed to correlate the presence and the relevant temporal patterns of SARS-CoV-2 viral RNA in biological specimens (stool, urine, blood, and tears) of the transmission with clinical/epidemiological features in patients with COVID-19. We focused on the time window between the positivity of reverse transcriptase-polymerase chain reaction (RT-PCR) tests from different specimens. We used the Mantel-Cox log rank test to verify the differences in terms of viral shedding duration, while we employed the Mann-Whitney U-test for subgroup analysis. This review protocol was registered with PROSPERO number: CRD42020183629. We identified 147 studies; we included 55 (1,348 patients) for epidemiological analysis, of which we included 37 (364 patients) for statistical analysis. The most frequently used specimens other than respiratory tract swabs were stool samples (or anal/rectal swabs), with a positivity rate of 48.8%, followed by urine samples, with a positivity rate of 16.4%; blood samples showed a positivity rate of 17.5%. We found that fecal positivity duration (median 19 days) was significantly (p < 0.001) longer than respiratory tract positivity (median 14 days). Limited data are available about the other specimens. In conclusion, medical and social communities must pay close attention to negativization criteria for COVID-19, because patients could have longer alternative viral shedding.© Copyright © 2020 Morone, Palomba, Iosa, Caporaso, De Angelis, Venturiero, Savo, Coiro, Carbone, Gimigliano, Iolascon and Paolucci.

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1. **Long-term forecasts of the covid-19 epidemic: A dangerous idea**  
   Martinez Edson Zangiacomi Revista da Sociedade Brasileira de Medicina Tropical 2020;53:1-5.

Introduction: Mathematical models have been used to obtain long-term forecasts of the COVID-19 epidemic. Method(s): The daily COVID-19 case count in two Brazilian states was used to show the potential limitations of long-term forecasting through the application of a mathematical model to the data. Result(s): The predicted number of cases at the end of the epidemic and at the moment that the peak occurs, is highly dependent on the length of the time series used in the predictive model. Conclusion(s): Predictions obtained during the course of the COVID-19 pandemic need to be viewed with caution.Copyright © 2020, Sociedade Brasileira de Medicina Tropical. All rights reserved.

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1. **Longer Duration of SARS-CoV-2 Infection in a Case of Mild COVID-19 With Weak Production of the Specific IgM and IgG Antibodies**  
   2020;:1936.

Mild COVID-19 patients could carry SARS-CoV-2 for a long time, which may be related to the weak production of the virus-specific IgG and IgM. Recurrence of positive SARS-CoV-2 RNA could occur in mild COVID-19 possibly due to intermittent virus shedding, so strict quarantine and health surveillance should be taken for all discharged COVID-19 patients to prevent a potential virus spread.

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1. **More studies showing longer COVID-19 incubation period in older adults and questioning the appropriate times for quarantine and contact tracing**  
   Kong Tak-Kwan Aging medicine (Milton (N.S.W)) 2020;:No page numbers.

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1. **New coronavirus: Long incubation period and survival time**  
   Anonymous Pharmazeutische Zeitung 2020;165:42-43.

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1. **Persistent viral shedding and antibody response to the SARS-COV-2 virus in chronic hemodialysis patients**  
   Zeldis Etti Journal of the American Society of Nephrology 2020;31:273-274.

Background: The duration of SARS-CoV-2 viral RNA shedding and antibody response of chronic HD patients to the SARS-CoV-2 virus is currently unknown Methods: This is a retrospective case series of chronic HD patients who tested positive for severe acute respiratory syndrome corona virus 2 (SARS-CoV-2 RNA) on nasal or nasopharyngeal specimen between March 20 and May 28, 2020 at the James J. Peters VA Hospital. Patients were tested at varying intervals to document clearance of virus or for surveillance purposes. SARS-CoV-2 Virus IgG Antibody (Ab) testing was performed on all HD patients with COVID-19 (using the Abbot IgG nucleocapsid antibody test and i2000SR machine, Ref. range of the Ab titer: >1.39 positive) Results: Of 84 chronic HD patients, 26% (22) were diagnosed with COVID-19. Mean age of those with COVID-19 was 72+/-9 years old, 86% were Black, 77% had diabetes and all had hypertension. Of these patients, 59% (13/22) required hospitalization and 18% (4/22) died. IgG Ab testing was performed on 19 out of 22 COVID-19 patients. All 19 patients tested positive for IgG Ab with an average Ab titer of 7+/-1.2. 20 days after the first SARS-CoV-2 RNA positive test, 68% (13/19) patients remained positive on repeat RNA testing. 3 patients tested positive for SARS-CoV-2 RNA on repeat surveillance testing, despite testing negative on 2 prior consecutive nasal or nasopharyngeal specimens (Fig. 1). None of these 3 patients were symptomatic at the time their repeat swabs were positive for SARS-CoV-2 RNA Conclusion(s): All HD patients with a confirmed diagnosis of COVID-19 developed IgG Ab to the SARS-CoV-2 virus, but the SARS-Cov-2 RNA was detectable in the swab specimen for a prolonged duration of time. In a few cases, the SARS-CoV-2 RNA became detectable after 2 consecutive negative RNA specimens. It is unknown if the IgG antibodies confer immunity against the SARS-CoV-2 virus. Additionally, the significance of persistent viral RNA shedding in patients who have recovered from COVID-19 remains to be elucidated.

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1. **Persistent viral shedding despite seroconversion in a kidney transplant recipient with severe extrapulmonary COVID-19**  
   Italiano Jack BMJ case reports 2020;13:No page numbers.

Renal transplant (RT) recipients are at increased risk for infectious complications. The clinical course of COVID-19 has been described in several RT recipients with varying clinical outcomes. Most present with pulmonary manifestations, however extrapulmonary presentations are not uncommon. Also, the timing and efficacy of seroconversion in transplant recipients is not well known. This report describes the duration of viral shedding and timing of seroconversion in a young adult RT recipient with COVID-19 who presented with severe diarrhoea and acute kidney injury requiring dialysis. She developed anti-SARS-CoV-2 IgG antibody after 5 weeks despite persistently shedding the virus in the nasopharynx until 6 weeks after symptom onset. Further studies are needed to determine if immunosuppressed patients have prolonged viral shedding and are still contagious despite seroconversion. Copyright © BMJ Publishing Group Limited 2020. No commercial re-use. See rights and permissions. Published by BMJ.

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1. **Persistent viral shedding lasting over 60 days in a mild COVID-19 patient with ongoing positive SARS-CoV-2**  
   Zhang Lan Quantitative imaging in medicine and surgery 2020;10:1141-1144.

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1. **Persistent viral shedding of SARS-CoV-2 in faeces - a rapid review**  
   Gupta S. Colorectal Disease 2020;22:611-620.

Aim: In addition to respiratory symptoms, COVID-19 can present with gastrointestinal complaints suggesting possible faeco-oral transmission. The primary aim of this review was to establish the incidence and timing of positive faecal samples for SARS-CoV-2 in patients with COVID-19. Method(s): A systematic literature review identified studies describing COVID-19 patients tested for faecal virus. Search terms for MEDLINE included 'clinical', 'faeces', 'gastrointestinal secretions', 'stool', 'COVID-19', 'SARS-CoV-2' and '2019-nCoV'. Additional searches were done in the American Journal of Gastroenterology, Gastroenterology, Gut, Lancet Gastroenterology and Hepatology, the World Health Organization Database, the Centre for Evidence-Based Medicine, New England Journal of Medicine, social media and the National Institute for Health and Care Excellence, bioRxiv and medRxiv preprints. Data were extracted concerning the type of test, number and timing of positive samples, incidence of positive faecal tests after negative nasopharyngeal swabs and evidence of viable faecal virus or faeco-oral transmission of the virus. Result(s): Twenty-six relevant articles were identified. Combining study results demonstrated that 53.9% of those tested for faecal RNA were positive. The duration of faecal viral shedding ranged from 1 to 33 days after a negative nasopharyngeal swab with one result remaining positive 47 days after onset of symptoms. There is insufficient evidence to suggest that COVID-19 is transmitted via faecally shed virus. Conclusion(s): There is a high rate of positive polymerase chain reaction tests with persistence of SARS-CoV-2 in faecal samples of patients with COVID-19. Further research is needed to confirm if this virus is viable and the degree of transmission through the faeco-oral route. This may have important implications on isolation, recommended precautions and protective equipment for interventional procedures involving the gastrointestinal tract.Copyright © 2020 The Authors. Colorectal Disease published by John Wiley & Sons Ltd on behalf of Association of Coloproctology of Great Britain and Ireland

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1. **Plasma therapy cured a COVID-19 patient with long duration of viral shedding for 49 days: The clinical features, laboratory tests, plasma therapy, and implications for public health management**  
   Tan Li MedComm 2020;:No page numbers.

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1. **Probable Longer Incubation Period for Elderly COVID-19 Cases: Analysis of 180 Contact Tracing Data in Hubei Province, China**  
   Dai Jingyi Risk management and healthcare policy 2020;13:1111-1117.

Background: Factors associated with the incubation period of COVID-19 are not fully known. The aim of this study was to estimate the incubation period of COVID-19 using epidemiological contact tracing data, and to explore whether there were different incubation periods among different age gr1oups., Methods: We collected contact tracing data in a municipality in Hubei province during the full outbreak period of COVID-19. The exposure periods were inferred from the history of travel in Wuhan and/or history of exposure to confirmed cases. The incubation periods were estimated using parametric accelerated failure time models accounting for interval censoring of exposures., Results: The incubation period of COVID-19 follows a Weibull distribution and has a median of 5.8 days with a bootstrap 95% CI: 5.4-6.7 days. Of the symptomatic cases, 95% showed symptoms by 14.3 days (95% CI: 13.0-15.7), and 99% showed symptoms by 18.7 days (95% CI: 16.7-20.9). The incubation periods were not found significantly different between male and female. Elderly cases had significant longer incubation periods than young age cases (HR 1.49 with 95% CI: 1.09-2.05). The median incubation period was estimated at 4.0 days (95% CI: 3.5-4.4) for cases aged under 30, 5.8 days (95% CI: 5.6-6.0) for cases aged between 30 and 59, and 7.7 days (95% CI: 6.9-8.4) for cases aged greater than or equal to 60., Conclusion: The current practice of a 14-day quarantine period in many regions is reasonable for any age. Older people infected with SARS-CoV2 have longer incubation period than that of younger people. Thus, more attention should be paid to asymptomatic elderly people who had a history of exposure. Copyright © 2020 Dai et al.

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1. **Prolonged Duration of Viral Shedding of SARS-CoV-2: A Case Report**  
   Fong Brandon Clinical practice and cases in emergency medicine 2020;4:509-512.

INTRODUCTION: The literature on the clinical course of severe acute respiratory syndrome coronavirus 2 (SARS-COV-2) suggests patients continue shedding viral particles typically for an average of 20 days until the body builds immunity against the infection. However, a few cases have shown prolonged duration in viral shedding and highlight the significant increased mortality in these patients. It has also been suggested that multiple strains of SARS-COV-2 exist, keying the possibility to reinfection., CASE REPORT: We present a case of a 57-year-old male who presented twice over 37 days with symptoms related to SARS-COV-2, and only on his second visit was found to be in hypoxemic respiratory failure and cardiogenic shock. He also reportedly had a period of convalescence in between presentations., DISCUSSION: This case highlights the still unclear disease course of SARS-COV-2 and the need for diligence in providing strong follow-up instructions and evaluation for sequelae of the infection.

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1. **Prolonged incubation of SARS-CoV-2 in a Patient on Rituximab Therapy**  
   Koff Alan Infection Control and Hospital Epidemiology 2020;:No page numbers.

The incubation period of SARS-CoV-2 is rarely greater than 14 days. We report a patient with hypogammaglobulinemia who developed SARS-CoV-2 infection with a confirmed incubation period of at least 21 days. These findings raise concern for a prolonged presymptomatic transmission phase, necessitating a longer quarantine duration in this patient population.Copyright © 2020 Cambridge University Press. All rights reserved.

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1. **Prolonged SARS-CoV-2 shedding and mild course of COVID-19 in a patient after recent heart transplantation**  
   2020;:-.

In conclusion, immunosuppression regimen in transplant recipients with mild COVID‐19 associated symptoms may be continued unchanged. However, it may contribute to delayed virus PCR conversion and thus possible prolonged infectivity.

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1. **Prolonged viral shedding and new mutations of COVID-19 could complicate the control of the pandemic**  
   Chen Chieh-Fan Access microbiology 2020;2:acmi000133.

The studies of coronavirus disease 2019 (COVID-19) have mainly focused on epidemiological and clinical features of patients, but transmission dynamics of SARS-CoV-2 virus after patients have recovered is still poorly understood. Here we report a case with prolonged viral shedding of COVID-19 in Kaohsiung, Taiwan. This patient started to show myalgia and malaise in Wuhan, and the onset of the fever was on days 7-14 of the illness. All clinical and radiological results returned to normal after day 26, however, viral shedding was still evident 14 days later. Sequence analysis of the genome of the Taiwanese SARS-CoV-2 isolate from this patient reveals new mutations in viral replicase and ORF3a, indicating that COVID-19 evolves very quickly. Prolonged viral shedding and new mutations in the viral genome could potentially complicate the control of the COVID-19 pandemic.

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1. **Prolonged viral shedding in a lymphoma patient with COVID-19 infection receiving convalescent plasma**  
   Karatas Ayse Transfusion and Apheresis Science 2020;59:102871.

Acute respiratory syndrome coronavirus 2 (SARS-CoV-2) first identified in Wuhan, China; and spread all over the world. Reverse-transcription polymerase chain reaction (RT-PCR) test for SARS-CoV-2 usually returns to negative in 20 days post-infection, but prolonged positivity has been reported up to 63 days. A case whose viral shedding lasted 60 days is reported from China. Herein we report a patient with a history of autologous stem cell transplantation (ASCT) for lymphoma whose RT-PCR test remained positive for SARS-CoV-2 for 74 days. The prolonged RT-PCR positivity, despite convalescent plasma infusion, may suggest that the given antibodies may be ineffective in terms of viral clearance. In patients with hematological malignancies or immunosuppression, such as ASCT, may lead to prolonged viral shedding, and strict isolation is warranted for long-term SARS-CoV-2 infection control.Copyright © 2020 Elsevier Ltd

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1. **Prolonged viral shedding in an immunocompetent patient with COVID-19**  
   McKie Anthony Michael BMJ case reports 2020;13:No page numbers.

We present a case of COVID-19 in an immunocompetent patient with risk factors for severe disease who recovered after prolonged swab positivity of 61 days postsymptom onset without significant respiratory and organ dysfunction. We discuss the reasons behind her prolonged swab positivity in the context of current SARS-CoV-2 knowledge, document the trend in her inflammatory response and swab results, and discuss the implications swab positivity had on her isolation and recovery. Copyright © BMJ Publishing Group Limited 2020. No commercial re-use. See rights and permissions. Published by BMJ.

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1. **Prolonged viral shedding in feces of pediatric patients with coronavirus disease 2019**  
   Xing Yu-Han Journal of microbiology, immunology, and infection = Wei mian yu gan ran za zhi 2020;53:473-480.

OBJECTIVE: To determine the dynamic changes of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) RNA in respiratory and fecal specimens in children with coronavirus disease 2019 (COVID-19)., METHODS: From January 17, 2020 to February 23, 2020, three paediatric cases of COVID-19 were reported in Qingdao, Shandong Province, China. Epidemiological, clinical, laboratory, and radiological characteristics and treatment data were collected. Patients were followed up to March 10, 2020, and dynamic profiles of nucleic acid testing results in throat swabs and fecal specimens were closely monitored., RESULTS: Clearance of SARS-CoV-2 in respiratory tract occurred within two weeks after abatement of fever, whereas viral RNA remained detectable in stools of pediatric patients for longer than 4 weeks. Two children had fecal SARS-CoV-2 undetectable 20 days after throat swabs showing negative, while that of another child lagged behind for 8 days., CONCLUSIONS: SARS-CoV-2 may exist in children's gastrointestinal tract for a longer time than respiratory system. Persistent shedding of SARS-CoV-2 in stools of infected children raises the possibility that the virus might be transmitted through contaminated fomites. Massive efforts should be made at all levels to prevent spreading of the infection among children after reopening of kindergartens and schools. Copyright © 2020. Published by Elsevier B.V.

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1. **Prolonged viral shedding of SARS-CoV-2 in solid organ transplant recipients**  
   Nam Hannah Open Forum Infectious Diseases 2020;7:S337.

Background: Solid organ transplant (SOT) recipients are more susceptible to viral infection and present with differing viral kinetics when compared to non-immunocompromised cohorts. The duration of viral shedding in SOT recipients with SARS-CoV-2 infection is unknown. Method(s): All SOT recipients with a diagnosed of SARS-CoV-2 by nasopharyngeal of bronchoalveolar lavage RT-qPCR from March 06, 2020 to May 31, 2020 were identified. Viral shedding duration was obtained by evaluating all subsequent SARS-CoV-2 PCR results following initial positivity over time. Severity classification was defined as mild (outpatient), moderate (hospitalized), and severe (ICU level care). Data were obtained from electronic medical record case review and analyzed with Stata 16. Result(s): 71 patients with a positive SARS-CoV-2 PCR test were identified. 50 (70.4%) were classified as mild/moderate disease, while 21 (29.5%) had severe disease. Median age was 56.5 (IQR 45 - 61.3) years, and 56.9% (n = 41) were male. Older age was significantly associated with severe disease. A disproportionate number of patients were African American/Black or Hispanic at 72.2% (n=52). Interestingly, Caucasian race was significantly associated with less severe outcomes (p=0.038). The majority of patients were kidney transplant recipients (46, 63.9%), followed by liver (13, 18.1%), heart (6, 8.3%), lung (3, 4.2%), and pancreas (9, 12.5%) with a median duration from transplantation at 5 (IQR 3 - 17) years. Overall mortality was 5.6% (n=4), with all deaths occurring only in those with severe disease (19.1%, n=4). Prolonged viral shedding was observed in few patients, with median duration of SARS-CoV-2 PCR positivity at 32 (IQR 18.5 - 41.0) days. One kidney recipient was observed with up to 64 days of positive SARS-CoV-2 RT-PCR from initial diagnosis despite not developing severe disease. Demographics and Outcomes Duration of Viral Shedding in SOT Patients with COVID-19 Conclusion(s): COVID-19 can lead to significant outcomes in SOT with increased mortality in those with severe disease, as well as prolonged viral shedding. Further studies are needed to elucidate the full duration of viral shedding in this population.

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1. **Social distancing to slow the US COVID-19 epidemic: Longitudinal pretest-posttest comparison group study**  
   Reynolds Zahra PLoS Medicine 2020;17:e1003244.

Background Social distancing measures to address the US coronavirus disease 2019 (COVID-19) epidemic may have notable health and social impacts. Methods and findings We conducted a longitudinal pretest-posttest comparison group study to estimate the change in COVID-19 case growth before versus after implementation of statewide social distancing measures in the US. The primary exposure was time before (14 days prior to, and through 3 days after) versus after (beginning 4 days after, to up to 21 days after) implementation of the first statewide social distancing measures. Statewide restrictions on internal movement were examined as a secondary exposure. The primary outcome was the COVID-19 case growth rate. The secondary outcome was the COVID-19-attributed mortality growth rate. All states initiated social distancing measures between March 10 and March 25, 2020. The mean daily COVID-19 case growth rate decreased beginning 4 days after implementation of the first statewide social distancing measures, by 0.9% per day (95% CI -1.4% to -0.4%; P < 0.001). We did not observe a statistically significant difference in the mean daily case growth rate before versus after implementation of statewide restrictions on internal movement (0.1% per day; 95% CI -0.04% to 0.3%; P = 0.14), but there is substantial difficulty in disentangling the unique associations with statewide restrictions on internal movement from the unique associations with the first social distancing measures. Beginning 7 days after social distancing, the COVID-19-attributed mortality growth rate decreased by 2.0% per day (95% CI -3.0% to -0.9%; P < 0.001). Our analysis is susceptible to potential bias resulting from the aggregate nature of the ecological data, potential confounding by contemporaneous changes (e.g., increases in testing), and potential underestimation of social distancing due to spillover effects from neighboring states. Conclusions Statewide social distancing measures were associated with a decrease in the COVID-19 case growth rate that was statistically significant. Statewide social distancing measures were also associated with a decrease in the COVID-19-attributed mortality growth rate beginning 7 days after implementation, although this decrease was no longer statistically significant by 10 days.Copyright: © 2020 Siedner et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

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1. **Symptomatic Infection is Associated with Prolonged Duration of Viral Shedding in Mild Coronavirus Disease 2019: A Retrospective Study of 110 Children in Wuhan**  
   Lu Yingying Pediatric Infectious Disease Journal 2020;:E95-E99.

Background: Information regarding viral shedding in children with coronavirus disease 2019 (COVID-19) was limited. This study aims to investigate the clinical and laboratory characteristics associated with viral shedding in children with mild COVID-19. Method(s): The clinical and laboratory information of 110 children with COVID-19 at Wuhan Children's Hospital, Wuhan, China, from January 30 to March 10, 2020, were analyzed retrospectively. Result(s): The median age was 6 years old. The median period of viral shedding of COVID-19 was 15 days (interquartile range [IQR], 11-20 days) as measured from illness onset to discharge. This period was shorter in asymptomatic patients (26.4%) compared with symptomatic patients (73.6%) (11 days vs. 17 days). Multivariable regression analysis showed increased odds of symptomatic infection was associated with age <6 years (odds ratio [OR] 8.94, 95% confidence interval [CI]: 2.55-31.35; P = 0.001), hypersensitive C-reactive protein >3.0 mg/L (OR 4.89; 95% CI: 1.10-21.75; P = 0.037) and presenting pneumonia in chest radiologic findings (OR 8.45; 95% CI: 2.69-26.61; P < 0.001). Kaplan-Meier analysis displayed symptomatic infection (P < 0.001), fever (P = 0.006), pneumonia (P = 0.003) and lymphocyte counts <2.0 x 109/L (P = 0.008) in children with COVID-19 were associated with prolonged duration of viral shedding in children with COVID-19. Conclusion(s): Prolonged duration of viral shedding in children with COVID-19 was associated with symptomatic infection, fever, pneumonia and lymphocyte count less than 2.0 x 109/L. Monitoring of symptoms could help to know the viral shedding in children with COVID-19.Copyright © 2020 Cambridge University Press. All rights reserved.

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1. **The difference in the incubation period of 2019 novel coronavirus (SARS-CoV-2) infection between travelers to Hubei and nontravelers: The need for a longer quarantine period**  
   Leung Char Infection control and hospital epidemiology 2020;41:594-596.

Data collected from the individual cases reported by the media were used to estimate the distribution of the incubation period of travelers to Hubei versus that of nontravelers. Because a longer and more volatile incubation period has been observed in travelers, the duration of quarantine should be extended to 3 weeks.

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1. **Three COVID-19 cases with a long-term viral shedding period in Tunisia**  
   Bennasrallah Cyrine The Pan African medical journal 2020;35:117.

Novel coronavirus disease (COVID-19) caused by severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) has become a public health emergency of international concern. This was first emerged in Wuhan, Hubei Province, China, and then has become widespread all over the world. We report 3 cases (2 imported cases and 1 local case) with documented viral shedding (based on reverse transcription-polymerase chain reaction (RT-PCR) testing) of SARS-CoV-2 for 55, 59 and 63 days. Viral shedding duration was defined as the date of return from the COVID-19 pandemic countries for imported cases and from the first positive RT-PCR test for local cases, up to the second negative nasopharyngeal RT-PCR swab. These cases demonstrate that viral shedding after COVID-19 diagnosis can be prolonged. Copyright ©Cyrine Bennasrallah et al.

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1. **Treatment of COVID-19 Patients with Prolonged Post-Symptomatic Viral Shedding with Leflunomide -- a Single-Center, Randomized, Controlled Clinical Trial**  
   Wang Mengmei Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2020;:No page numbers.

OBJECTIVE: To evaluate the efficacy and safety of leflunomide, an approved dihydroorotate dehydrogenase inhibitor, to treat COVID-19 patients with prolonged post-symptomatic viral shedding. METHOD(S): We conducted a prospective, randomized, controlled, open-label trial involving hospitalized adult COVID-19 patients with prolonged PCR positivity. Patients were randomly assigned to receive either leflunomide (50 mg, q12h, three consecutive times, orally; then 20 mg, once daily for 8 days), in addition to nebulized interferon alpha 2a (IFN alpha-2a, 3 million IU each time, twice daily for 10 days), or nebulized IFN alpha-2a alone for 10 days. The primary end point was the duration of viral shedding. RESULT(S): A total of 50 COVID-19 patients with prolonged PCR positivity were randomized into 2 groups; 26 were assigned to the leflunomide group, and 24 were assigned to the interferon alone group. Treatment with leflunomide was not associated with a difference from the interferon alone group in the duration of viral shedding (hazard ratio for negative RT-PCR, 0.70; 95% confidence interval, 0.391-1.256; P=0.186). In addition, the patients given leflunomide did not have a substantially shorter length of hospital stay than patients treated with interferon alone, with median (IQRs) durations of 29.0 (19.3-47.3) days and 33.0 (29.3-42.8) days, respectively, P=0.170. Two leflunomide recipients were unable to complete the full 10-day course of administration due to adverse events. CONCLUSION(S): In COVID-19 patients with prolonged PCR positivity, no benefit in terms of the duration of viral shedding was observed with the combined treatment of leflunomide and IFN alpha-2a beyond IFN alpha-2a alone.Copyright © The Author(s) 2020. Published by Oxford University Press for the Infectious Diseases Society of America. All rights reserved. For permissions, e-mail: journals.permissions@oup.com.

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1. **Viral shedding prolongation in a kidney transplant patient with COVID-19 pneumonia**  
   Man Zhang American Journal of Transplantation 2020;20:2626-2627.

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