# Evidence Search Service Results of your search request

## Reinfection with COVID-19

**ID of request:** 26849  
**Date of request:** 29th December, 2020  
**Date of completion:** 4th January, 2021

If you would like to request any articles or any further help, please contact:  Jason Curtis at [jason.curtis1@nhs.net](mailto:jason.curtis1@nhs.net)

Please acknowledge this work in any resulting paper or presentation as: Evidence search: Reinfection with COVID-19. Jason Curtis. ( 4th January, 2021). SHREWSBURY, UK: Shrewsbury and Telford Health Libraries.

**Sources searched**  
EMBASE (5)  
MEDLINE (34)  
MedRxiv (2)  
UpToDate (1)

**Date range used** (5 years, 10 years): 2020 -   
**Limits used** (gender, article/study type, etc.): English-language only   
**Search terms and notes** (full search strategy for database searches below):

Relevant natural language and controlled vocabulary terms were selected and combined. Final result sets were de-duplicated and reviewed for relevance by the searcher, irrelevant results being discarded.

Searched: Medline, EMBASE, UpToDate, CEBM Search Bank, MedRxiv

MedRxiv search strategy: (coronavirus OR "corona virus" OR covid\* OR "2019-nCoV" OR "SARS-Cov") AND (reinfect\* OR re-infect\*)

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

## Contents

[A. Synopses or Summaries](#Content2)

UpToDate

[Coronavirus disease 2019 (COVID-19): Epidemiology, virology, and prevention](#Research813117)

[B. Original Research](#Content5)

1. [Genomic evidence for reinfection with SARS-CoV-2: a case study.](#Research813078)
2. [Is novel coronavirus 2019 reinfection possible? Interpreting dynamic SARS-CoV-2 test results](#Research813079)
3. [A case of COVID-19 reinfection in the UK](#Research813095)
4. [A Case of Early Re-infection with SARS-CoV-2.](#Research813107)
5. [A case of SARS-CoV-2 reinfection in Ecuador.](#Research813102)
6. [A Patient with Asymptomatic SARS-CoV-2 Infection Who Presented 86 Days Later with COVID-19 Pneumonia Possibly Due to Reinfection with SARS-CoV-2.](#Research813087)
7. [Antibodies to SARS-CoV-2 are associated with protection against reinfection](#Research813121)
8. [Are SARS-CoV-2 reinfection and Covid-19 recurrence possible? a case report from Brazil.](#Research813082)
9. [Assessment of the risk of SARS-CoV-2 reinfection in an intense re-exposure setting.](#Research813090)
10. [Asymptomatic reinfection in two healthcare workers from India with genetically distinct SARS-CoV-2.](#Research813111)
11. [Coronavirus disease 2019 re-infection: first report from Turkey.](#Research813096)
12. [COVID-19 re-infection by a phylogenetically distinct SARS-coronavirus-2 strain confirmed by whole genome sequencing.](#Research813112)
13. [COVID-19 Reinfection and Second Episodes of Olfactory and Gustatory Dysfunctions: Report of First Cases](#Research813086)
14. [COVID-19 reinfection: prolonged shedding or true reinfection?](#Research813101)
15. [COVID-19 reinfection? A suspected case in a Peruvian patient.](#Research813094)
16. [Covid-19: Hong Kong scientists report first confirmed case of reinfection.](#Research813114)
17. [Direct Observation of Repeated Infections With Endemic Coronaviruses.](#Research813115)
18. [Efficacy of Serology Testing in Predicting Reinfection in Patients With SARS-CoV-2.](#Research813116)
19. [Evidence of SARS-CoV-2 re-infection with a different genotype.](#Research813097)
20. [Evidence of Severe Acute Respiratory Syndrome Coronavirus 2 Reinfection After Recovery from Mild Coronavirus Disease 2019.](#Research813099)
21. [First report of COVID-19 reinfection in a patient with beta thalassemia major](#Research813085)
22. [No Evidence of Re-infection or Person-to-Person Transmission in Cured COVID-19 Patients in Guangzhou, a Retrospective Observational Study.](#Research813080)
23. [Predictors of severe symptomatic laboratory-confirmed SARS-COV-2 reinfection](#Research813122)
24. [Reinfection in a healthcare worker with COVID-19 in a hospital in North India](#Research813084)
25. [Reinfection of COVID-19 after 3 months with a distinct and more aggressive clinical presentation: Case report.](#Research813106)
26. [Reinfection of COVID-19 in Pakistan: A First Case Report.](#Research813104)
27. [Reinfection of SARS-CoV-2 in an immunocompromised patient: a case report.](#Research813105)
28. [Reinfection risk of novel coronavirus (COVID-19): A systematic ‎review of current evidence.](#Research813089)
29. [Reinfection with SARS-CoV-2 and Failure of Humoral Immunity: a case report.](#Research813108)
30. [Reinfection with SARS-CoV-2: Discrete SIR (Susceptible, Infected, Recovered) Modeling Using Empirical Infection Data.](#Research813098)
31. [SARS-CoV-2 re-infection: a case report from Qatar.](#Research813103)
32. [Second Episode of COVID-19 in Health Professionals: Report of Two Cases.](#Research813083)
33. [Serologic Responses in Healthy Adult with SARS-CoV-2 Reinfection, Hong Kong, August 2020.](#Research813093)
34. [Serum antibody profile of a patient with COVID-19 reinfection.](#Research813109)
35. [Setting the criteria for SARS-CoV-2 reinfection - six possible cases.](#Research813113)
36. [Severe, Symptomatic Reinfection in a Patient with COVID-19.](#Research813100)
37. [Sustained Positivity and Reinfection With SARS-CoV-2 in Children: Does Quarantine/Isolation Period Need Reconsideration in a Pediatric Population?](#Research813088)
38. [Symptomatic SARS-CoV-2 reinfection by a phylogenetically distinct strain.](#Research813110)
39. [Symptomatic SARS-CoV-2 reinfection of a health care worker in a Belgian nosocomial outbreak despite primary neutralizing antibody response.](#Research813091)
40. [The first case of documented Covid-19 reinfection in Israel.](#Research813081)
41. [The Importance and Challenges of Identifying SARS-CoV-2 Reinfections.](#Research813092)

### [C. Search History](#SearchHistory)

## A. Synopses or Summaries

#### UpToDate

**Coronavirus disease 2019 (COVID-19): Epidemiology, virology, and prevention** (2020)

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See section on 'Risk of reinfection'. This suggests that 'Overall, the short-term risk of reinfection (eg, within the first few months after initial infection) appears low. Nevertheless, sporadic cases of probable reinfection have been documented'.

## B. Original Research

1. **Genomic evidence for reinfection with SARS-CoV-2: a case study.**  
   Tillett Richard L. The Lancet. Infectious diseases 2021;21(1):52-58.

BACKGROUNDThe degree of protective immunity conferred by infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is currently unknown. As such, the possibility of reinfection with SARS-CoV-2 is not well understood. We describe an investigation of two instances of SARS-CoV-2 infection in the same individual.METHODSA 25-year-old man who was a resident of Washoe County in the US state of Nevada presented to health authorities on two occasions with symptoms of viral infection, once at a community testing event in April, 2020, and a second time to primary care then hospital at the end of May and beginning of June, 2020. Nasopharyngeal swabs were obtained from the patient at each presentation and twice during follow-up. Nucleic acid amplification testing was done to confirm SARS-CoV-2 infection. We did next-generation sequencing of SARS-CoV-2 extracted from nasopharyngeal swabs. Sequence data were assessed by two different bioinformatic methodologies. A short tandem repeat marker was used for fragment analysis to confirm that samples from both infections came from the same individual.FINDINGSThe patient had two positive tests for SARS-CoV-2, the first on April 18, 2020, and the second on June 5, 2020, separated by two negative tests done during follow-up in May, 2020. Genomic analysis of SARS-CoV-2 showed genetically significant differences between each variant associated with each instance of infection. The second infection was symptomatically more severe than the first.INTERPRETATIONGenetic discordance of the two SARS-CoV-2 specimens was greater than could be accounted for by short-term in vivo evolution. These findings suggest that the patient was infected by SARS-CoV-2 on two separate occasions by a genetically distinct virus. Thus, previous exposure to SARS-CoV-2 might not guarantee total immunity in all cases. All individuals, whether previously diagnosed with COVID-19 or not, should take identical precautions to avoid infection with SARS-CoV-2. The implications of reinfections could be relevant for vaccine development and application.FUNDINGNevada IDEA Network of Biomedical Research, and the National Institute of General Medical Sciences (National Institutes of Health).

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1. **Is novel coronavirus 2019 reinfection possible? Interpreting dynamic SARS-CoV-2 test results**  
   Duggan N.M. American Journal of Emergency Medicine 2021;39:256.

Since December 2019, COVID-19, the clinical syndrome associated with SARS-CoV-2 infection, has infected more than 6.2 million people and brought the function of the global community to a halt. As the number of patients recovered from COVID-19 rises and the world transitions toward reopening, the question of acquired immunity versus the possibility of reinfection are critical to anticipating future viral spread. Here, we present a case of a patient previously recovered from COVID-19 who re-presents with new respiratory, radiographical, laboratory, and real-time reverse transcriptase-polymerase chain reaction (RT-PCR) findings concerning for possible re-infection. We review this case in the context of the evolving discussion and theories surrounding dynamic RT-PCR results, prolonged viral shedding, and the possibility of developed immunity. Understanding how to interpret dynamic and late-positive SARS-CoV-2 RT-PCR results after primary infection will be critical for understanding disease prevalence and spread among communities worldwide.<br/>Copyright &#xa9; 2020 Elsevier Inc.

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1. **A case of COVID-19 reinfection in the UK**  
   West J. Clinical medicine (London, England) 2020;:No page numbers.

Protective immunity following COVID-19 infection is not yet fully understood. An understanding of COVID-19 reinfection will be key in guiding government and public health policy decisions in the coming months. This report describes two distinct infective episodes of COVID-19 occurring in the same individual, at the time of writing the first published case in the UK. In April 2020 a 25-year-old UK doctor exhibited classical COVID-19 symptoms, including fevers, headaches, and fatigue. A COVID-19 nucleic acid amplification test (NAAT) at the time returned negative. However, a follow-up antibody test in May 2020 returned positive. In October 2020 the same individual exhibited coryzal symptoms and headaches. He was COVID-19 NAAT tested and found to be positive. There was exposure to high viral load prior to reinfection. Overall the second infection was symptomatically milder, with a faster recovery. This evidence for reinfection poses challenges for public health and vaccination efforts to protect against the COVID-19 pandemic.<br/>Copyright &#xa9; Royal College of Physicians 2020. All rights reserved.

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1. **A Case of Early Re-infection with SARS-CoV-2.**  
   Larson Derek Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2020;:No page numbers.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=a29fee38509f77c690f66944b6fd7f4e)

1. **A case of SARS-CoV-2 reinfection in Ecuador.**  
   Prado-Vivar Belén The Lancet. Infectious diseases 2020;:No page numbers.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=c3654d75af8609b45559961615289066)

1. **A Patient with Asymptomatic SARS-CoV-2 Infection Who Presented 86 Days Later with COVID-19 Pneumonia Possibly Due to Reinfection with SARS-CoV-2.**  
   Sharma Rohit The American journal of case reports 2020;21:e927154.

BACKGROUND Coronavirus disease 2019 (COVID-19) has radically changed the world, and promising vaccine trials are currently underway. The immune responses in asymptomatic and symptomatic individuals infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) are still under investigation, and data are evolving. While it is known that humoral and cell-mediated immune responses against SARS-CoV-2 are elicited, it is uncertain whether these responses protect against reinfection or that they provide definitive evidence of viral clearance. Very few cases have been reported in the literature regarding reinfection with SARS-CoV-2. CASE REPORT We present a case of a middle-aged man with asymptomatic SARS-CoV-2 infection who later developed mild symptomatic COVID-19 after a period of 3 months. The source of reinfection was likely from the community, which had a soaring burden of infection with the highest number of COVID-19 cases per million in the world at that time. The patient had 2 negative COVID-19 polymerase chain reaction (PCR) tests 2 weeks after the initial infection. During the second infection, a nasopharyngeal reverse-transcription PCR test and tests for the presence of COVID-19 immunoglobulin (Ig)M and IgG antibodies were all positive. CONCLUSIONS Reinfection with SARS-CoV-2 is a strong possibility. This case raises concerns that asymptomatic infections may not provide long-term protective immunity to all patients, which could make them susceptible to reinfection. Possible explanations for reinfection include an interval decrease in protective antibodies titers after SARS-CoV-2 infection that may be more prevalent in patients who had an asymptomatic infection. Other possibilities include viral reactivation after a prolonged carriage of the virus or delayed immune response.

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1. **Antibodies to SARS-CoV-2 are associated with protection against reinfection**  
   2020;:n/a.

Prior SARS-CoV-2 infection that generated antibody responses offered protection from reinfection for most people in the six months following infection. Further work is required to determine the long-term duration and correlates of post-infection immunity.

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1. **Are SARS-CoV-2 reinfection and Covid-19 recurrence possible? a case report from Brazil.**  
   Bonifácio L.ívia Pimenta Revista da Sociedade Brasileira de Medicina Tropical 2020;53:e20200619.

With the large number of individuals infected and recovered from Covid-19, there is intense discussion about the quality and duration of the immunity elicited by SARS-CoV-2 infection, including the possibility of disease recurrence. Here we report a case with strong clinical, epidemiological and laboratorial evidence of, not only reinfection by SARS-CoV-2, but also clinical recurrence of Covid-19.

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1. **Assessment of the risk of SARS-CoV-2 reinfection in an intense re-exposure setting.**  
   Abu-Raddad Laith J. Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2020;:No page numbers.

BACKGROUNDRisk of reinfection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is unknown. We assessed risk and incidence rate of documented SARS-CoV-2 reinfection in a cohort of laboratory-confirmed cases in Qatar.METHODSAll SARS-CoV-2 laboratory-confirmed cases with at least one PCR positive swab that is ≥45 days after a first-positive swab were individually investigated for evidence of reinfection, and classified as showing strong, good, some, or weak/no evidence for reinfection. Viral genome sequencing of the paired first-positive and reinfection viral specimens was conducted to confirm reinfection. Risk and incidence rate of reinfection were estimated.RESULTSOut of 133,266 laboratory-confirmed SARS-CoV-2 cases, 243 persons (0.18%) had at least one subsequent positive swab ≥45 days after the first-positive swab. Of these, 54 cases (22.2%) had strong or good evidence for reinfection. Median time between first and reinfection swab was 64.5 days (range: 45-129). Twenty-three of the 54 cases (42.6%) were diagnosed at a health facility suggesting presence of symptoms, while 31 (57.4%) were identified incidentally through random testing campaigns/surveys or contact tracing. Only one person was hospitalized at time of reinfection, but was discharged the next day. No deaths were recorded. Viral genome sequencing confirmed four reinfections out of 12 cases with available genetic evidence. Reinfection risk was estimated at 0.02% (95% CI: 0.01-0.02%) and reinfection incidence rate at 0.36 (95% CI: 0.28-0.47) per 10,000 person-weeks.CONCLUSIONSSARS-CoV-2 reinfection can occur but is a rare phenomenon suggestive of protective immunity against reinfection that lasts for at least a few months post primary infection.

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1. **Asymptomatic reinfection in two healthcare workers from India with genetically distinct SARS-CoV-2.**  
   Gupta Vivek Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2020;:No page numbers.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=2ccf0b7a2276fce22cc21bcd599ca98e)

1. **Coronavirus disease 2019 re-infection: first report from Turkey.**  
   Ozaras R. New microbes and new infections 2020;38:100774.

There are concerns about the possibility of SARS-CoV-2 reinfection and recently, a patient with SARS-CoV-2 re-infection (or COVID-19) confirmed by epidemiological, clinical, serological and genomic analyses have been published. We have noticed another patient with SARS-CoV-2 re-infection based on clinical and laboratory studies: A 23-year-old woman presented to her hospital with fever (39°C), chills, fatigue, cough, headache, sore throat, muscle and joint pain on April 9, 2020. On examination, oropharynx was mildly hyperemic, and chest auscultation was normal. SARS-CoV-2 PCR from nasopharyngeal specimen was ordered. She was given isotonic saline and acetaminophen and prescribed azithromycin and acetaminophen and sent home for isolation. SARS-CoV-2 PCR was reported positive and she was given hydroxychloroquine for five days. She improved in 10 days and PCR studies on April 22, and April 27 remained negative. On 4 August 2020, she was re-admitted with fever (38.7°C), chills, fatigue, loss of appetite, taste and smell loss, muscle and joint pain. On examination, oropharynx and chest auscultation were normal. SARS-CoV-2 PCR was reported positive and she was prescribed hydroxychloroquine, acetaminophen and sent home for isolation again. She improved in one week (taste-smell loss improved in 10 days) and on follow-up visit after 14 days, she was doing well. PCR was negative on 17 August 2020. Her anti-SARS-CoV-2 antibodies were negative on 17 August 2020 and slightly positive (2.14 signal-to-cutoff) on 29 August 2020. Previous report from To et al. [Clin Infect Dis. 2020;ciaa1275. doi:10.1093/cid/ciaa1275] showed that viral genomes from first and second episodes belonged to different clades/lineages. They described second episode of asymptomatic infection occurred 142 day after the first symptomatic one. Our patient is the first report, describing two symptomatic episodes 116 days apart. We conclude that as the patients recovered from COVID-19 increases, increased awareness may delineate the characteristics of re-infection.

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1. **COVID-19 re-infection by a phylogenetically distinct SARS-coronavirus-2 strain confirmed by whole genome sequencing.**  
   To Kelvin Kai-Wang Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2020;:No page numbers.

BACKGROUNDWaning immunity occurs in patients who have recovered from COVID-19. However, it remains unclear whether true re-infection occurs.METHODSWhole genome sequencing was performed directly on respiratory specimens collected during two episodes of COVID-19 in a patient. Comparative genome analysis was conducted to differentiate re-infection from persistent viral shedding. Laboratory results, including RT-PCR Ct values and serum SARS-CoV-2 IgG, were analyzed.RESULTSThe second episode of asymptomatic infection occurred 142 days after the first symptomatic episode in an apparently immunocompetent patient. During the second episode, there was serological evidence of elevated C-reactive protein and SARS-CoV-2 IgG seroconversion. Viral genomes from first and second episodes belong to different clades/lineages. Compared to viral genomes in GISAID, the first virus genome has a stop codon at position 64 of orf8 leading to a truncation of 58 amino acids, and was phylogenetically closely related to strains collected in March/April 2020, while the second virus genome was closely related to strains collected in July/August 2020. Another 23 nucleotide and 13 amino acid differences located in 9 different proteins, including positions of B and T cell epitopes, were found between viruses from the first and second episodes.CONCLUSIONSEpidemiological, clinical, serological and genomic analyses confirmed that the patient had re-infection instead of persistent viral shedding from first infection. Our results suggest SARS-CoV-2 may continue to circulate among the human populations despite herd immunity due to natural infection or vaccination. Further studies of patients with re-infection will shed light on protective correlates important for vaccine design.

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1. **COVID-19 Reinfection and Second Episodes of Olfactory and Gustatory Dysfunctions: Report of First Cases**  
   Lechien J.R. Ear, Nose and Throat Journal 2020;:No page numbers.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=a72343be08747529716bde37f30fbb5e)

1. **COVID-19 reinfection: prolonged shedding or true reinfection?**  
   Falahi S. New microbes and new infections 2020;38:100812.

The SARS-CoV-2 pandemic is underway and millions of people have been infected. A large number of patients with COVID-19 have recovered and been discharged. While a number of recovered patients test positive again or even have a recurrence of clinical symptoms. Some researchers believe that a positive retest is related to the long-term persistence of the virus in the body, although there is some evidence in favor of reinfection. In this study, we focus more on the possible reasons for positive retesting, antibody responses, and review of possible reinfection case reports.

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1. **COVID-19 reinfection? A suspected case in a Peruvian patient.**  
   Arteaga-Livias Kovy Travel medicine and infectious disease 2020;:101947.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=77cd646acb42d8d534e7aa52cfff738d)

1. **Covid-19: Hong Kong scientists report first confirmed case of reinfection.**  
   Parry Jane BMJ (Clinical research ed.) 2020;370:m3340.

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1. **Direct Observation of Repeated Infections With Endemic Coronaviruses.**  
   Galanti Marta The Journal of infectious diseases 2020;:No page numbers.

BACKGROUNDAlthough the mechanisms of adaptive immunity to pandemic severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) are still unknown, the immune response to the widespread endemic coronaviruses HKU1, 229E, NL63, and OC43 provide a useful reference for understanding repeat infection risk.METHODSHere we used data from proactive sampling carried out in New York City from fall 2016 to spring 2018. We combined weekly nasal swab collection with self-reports of respiratory symptoms from 191 participants to investigate the profile of recurring infections with endemic coronaviruses.RESULTSDuring the study, 12 individuals tested positive multiple times for the same coronavirus. We found no significant difference between the probability of testing positive at least once and the probability of a recurrence for the betacoronaviruses HKU1 and OC43 at 34 weeks after enrollment/first infection. We also found no significant association between repeat infections and symptom severity, but found strong association between symptom severity and belonging to the same family.CONCLUSIONSThis study provides evidence that reinfections with the same endemic coronavirus are not atypical in a time window shorter than 1 year and that the genetic basis of innate immune response may be a greater determinant of infection severity than immune memory acquired after a previous infection.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=488b82c53ef206f59b459c4c9a586947)

1. **Efficacy of Serology Testing in Predicting Reinfection in Patients With SARS-CoV-2.**  
   Chaturvedi Rahul Disaster medicine and public health preparedness 2020;:1-3.

In many parts of the United States, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) cases have reached peak infection rates, prompting administrators to create protocols to resume elective cases. As elective procedures and surgeries get scheduled, ambulatory surgery centers (ASCs) must implement some form of widespread testing in order to ensure the safety of both the ASC staff and the patients being seen. The US Centers for Disease Control and Prevention (CDC) recently announced the approval of new serological testing for SARS-CoV-2, a test that can indicate the presence of IgM and IgG antibodies in the serum against viral particles. However, the possibility for reinfection raises questions about the utility of this new serological test, as the presence of IgG may not correspond to long-term immunity. SARS-CoV-2 has been known to form escape mutations, which may correspond to a reduction in immunoglobulin binding capacity. Patients who develop more robust immune responses with formation of memory CD8+ T-cells and helper CD4+ T-cells will be the most equipped if exposed to the virus, but, unfortunately, the serology test will not help us in distinguishing those individuals. Given the inherent disadvantages of serological testing, antibody testing alone should not be used when deciding patient care and should be combined with polymerase chain reaction testing.

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1. **Evidence of SARS-CoV-2 re-infection with a different genotype.**  
   Colson Philippe The Journal of infection 2020;:No page numbers.

[Available online at this link](https://www.knowledgeshare.nhs.uk/index.php?PageID=link_resolver&link=983fdf50b6e0b3b0ffd3dcbc51155f77)

1. **Evidence of Severe Acute Respiratory Syndrome Coronavirus 2 Reinfection After Recovery from Mild Coronavirus Disease 2019.**  
   Lee Jee-Soo Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2020;:No page numbers.

BACKGROUNDPositive results from real-time reverse-transcription polymerase chain reaction (rRT-PCR) in recovered patients raise concern that patients who recover from coronavirus disease 2019 (COVID-19) may be at risk of reinfection. Currently, however, evidence that supports reinfection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has not been reported.METHODSWe conducted whole-genome sequencing of the viral RNA from clinical specimens at the initial infection and at the positive retest from 6 patients who recovered from COVID-19 and retested positive for SARS-CoV-2 via rRT-PCR after recovery. A total of 13 viral RNAs from the patients' respiratory specimens were consecutively obtained, which enabled us to characterize the difference in viral genomes between initial infection and positive retest.RESULTSAt the time of the positive retest, we were able to acquire a complete genome sequence from patient 1, a 21-year-old previously healthy woman. In this patient, through the phylogenetic analysis, we confirmed that the viral RNA of positive retest was clustered into a subgroup distinct from that of the initial infection, suggesting that there was a reinfection of SARS-CoV-2 with a subtype that was different from that of the primary strain. The spike protein D614G substitution that defines the clade "G" emerged in reinfection, while mutations that characterize the clade "V" (ie, nsp6 L37F and ORF3a G251V) were present at initial infection.CONCLUSIONSReinfection with a genetically distinct SARS-CoV-2 strain may occur in an immunocompetent patient shortly after recovery from mild COVID-19. SARS-CoV-2 infection may not confer immunity against a different SARS-CoV-2 strain.

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1. **First report of COVID-19 reinfection in a patient with beta thalassemia major**  
   Okar L. Clinical Case Reports 2020;:No page numbers.

To optimize care for patients with hemoglobinopathies, frequent screening for COVID-19 is prudent as viral kinetics in asplenic patients are unknown and differentiating prolonged viral shedding versus reinfection remains a challenge.<br/>Copyright &#xa9; 2020 The Authors. Clinical Case Reports published by John Wiley & Sons Ltd.

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1. **No Evidence of Re-infection or Person-to-Person Transmission in Cured COVID-19 Patients in Guangzhou, a Retrospective Observational Study.**  
   Xu Gang Frontiers in medicine 2020;7:593133.

Objectives: To clarify the clinical characteristics of cured patients with coronavirus disease (COVID-19), and to clarify the re-infection and person-to-person transmission in the cured. Methods: A total of 187 cured COVID-19 patients with antibody test were followed up every 2 weeks in this retrospective observational study. Assessment for general condition, symptoms, epidemiological contact history, polymerase chain reaction (PCR) assay, and antibody tests were performed and recorded. Information from Guangzhou CDC was also screened. Results: There were 33 (17.6%) patients with negative results for IgG and 35 (18.7%) patients with positive results for IgM. The average days of antibody detection from disease onset were 53.0. PCR assay was positive in 10 (5.3%) patients during the follow-up. Neither IgG nor IgM results showed a relationship with PCR test results (all P > 0.05). Neither re-infection nor person-to-person transmission was found in the cured patients. Factors associated with appearance of antibody comprised hospitalization days (OR: 1.06, 95%CI: 1.02-1.11, P = 0.006) and antibiotics treatment (OR: 3.50, 95%CI: 1.40-8.77, P = 0.007). Conclusions: In our study, no evidence of person-to-person transmission was found in cured COVID-19 patients. There seemed to be no re-infection in the cured COVID-19 patients in Guangzhou. These finding suggest that the cured do not cause the spread of disease. Additionally, neither IgG nor IgM can be used to replace the PCR test in cured patients.

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1. **Predictors of severe symptomatic laboratory-confirmed SARS-COV-2 reinfection**  
   2020;:n/a.

To the best of our knowledge this is the first study evaluating disease outcomes in a large set of laboratory-positive cases of symptomatic SARS-COV-2 reinfection and factors associated with illness severity was characterized. Our results may contribute to the current knowledge of SARS-COV-2 pathogenicity and to identify populations at increased risk of a poorer outcome after reinfection.

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1. **Reinfection in a healthcare worker with COVID-19 in a hospital in North India**  
   Nazir N. Anaesthesia, Pain and Intensive Care 2020;24(5):572-573.

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1. **Reinfection of COVID-19 after 3 months with a distinct and more aggressive clinical presentation: Case report.**  
   Torres Danielle de Araujo Journal of medical virology 2020;:No page numbers.

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1. **Reinfection of COVID-19 in Pakistan: A First Case Report.**  
   Hanif Muhammad Cureus 2020;12(10):e11176.

Since its spread across the world, coronavirus disease 2019 (COVID-19) has posed a severe public health threat, and many unanswered questions about COVID-19 remain. Antibodies have been detected a few days after the onset of infection, and in some patients, these antibodies wane quickly. To date, it is unknown whether all infected patients induce an adequate protective immune response or how long this effect remains. Here, a first case report of COVID-19 reinfection in Pakistan is reported within two months of complete recovery from the first severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) infection - confirmed with two sequential negative nasopharyngeal swabs.

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1. **Reinfection of SARS-CoV-2 in an immunocompromised patient: a case report.**  
   Mulder Marlies Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2020;:No page numbers.

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1. **Reinfection risk of novel coronavirus (COVID-19): A systematic ‎review of current evidence.**  
   SeyedAlinaghi SeyedAhmad World journal of virology 2020;9(5):79-90.

BACKGROUNDThere is recently a concern regarding the reinfection and reactivation of previously reCoVered coronavirus disease 2019 (CoVID-19) patients.AIMTo summarize the recent findings and reports of CoVID-19 reinfection in patients previously reCoVered from the disease.METHODSThis study was a systematic review of current evidence conducted in August 2020. The authors studied the probable reinfection risk of novel coronavirus (CoVID-19). We performed a systematic search using the keywords in online databases. The investigation adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist to ensure the reliability and validity of this study and results.RESULTSWe reviewed 31 studies. Eight studies described reCoVered patients with reinfection. Only one study reported reinfected patients who died. In 26 studies, there was no information about the status of the patients. Several studies indicated that reinfection is not probable and that post-infection immunity is at least temporary and short.CONCLUSIONBased on our review, we concluded that a positive polymerase chain reaction retest could be due to several reasons and should not always be considered as reinfection or reactivation of the disease. Most relevant studies in positive retest patients have shown relative and probably temporary immunity after the reCoVery of the disease.

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1. **Reinfection with SARS-CoV-2 and Failure of Humoral Immunity: a case report.**  
   Goldman Jason D. medRxiv : the preprint server for health sciences 2020;:No page numbers.

Recovery from COVID-19 is associated with production of anti-SARS-CoV-2 antibodies, but it is uncertain whether these confer immunity. We describe viral RNA shedding duration in hospitalized patients and identify patients with recurrent shedding. We sequenced viruses from two distinct episodes of symptomatic COVID-19 separated by 144 days in a single patient, to conclusively describe reinfection with a new strain harboring the spike variant D614G. With antibody and B cell analytics, we show correlates of adaptive immunity, including a differential response to D614G. Finally, we discuss implications for vaccine programs and begin to define benchmarks for protection against reinfection from SARS-CoV-2.

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1. **Reinfection with SARS-CoV-2: Discrete SIR (Susceptible, Infected, Recovered) Modeling Using Empirical Infection Data.**  
   McMahon Andrew JMIR public health and surveillance 2020;6(4):e21168.

BACKGROUNDThe novel coronavirus SARS-CoV-2, which causes the COVID-19 disease, has resulted in a global pandemic. Since its emergence in December 2019, the virus has infected millions of people, caused the deaths of hundreds of thousands, and resulted in incalculable social and economic damage. Understanding the infectivity and transmission dynamics of the virus is essential to determine how best to reduce mortality while ensuring minimal social restrictions on the lives of the general population. Anecdotal evidence is available, but detailed studies have not yet revealed whether infection with the virus results in immunity.OBJECTIVEThe objective of this study was to use mathematical modeling to investigate the reinfection frequency of COVID-19.METHODSWe have used the SIR (Susceptible, Infected, Recovered) framework and random processing based on empirical SARS-CoV-2 infection and fatality data from different regions to calculate the number of reinfections that would be expected to occur if no immunity to the disease occurred.RESULTSOur model predicts that cases of reinfection should have been observed by now if primary SARS-CoV-2 infection did not protect individuals from subsequent exposure in the short term; however, no such cases have been documented.CONCLUSIONSThis work concludes that infection with SARS-CoV-2 provides short-term immunity to reinfection and therefore offers useful insight for serological testing strategies, lockdown easing, and vaccine development.

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1. **SARS-CoV-2 re-infection: a case report from Qatar.**  
   AlFehaidi Alanoud The Journal of infection 2020;:No page numbers.

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1. **Second Episode of COVID-19 in Health Professionals: Report of Two Cases.**  
   de Brito Carlos Alexandre Antunes International medical case reports journal 2020;13:471-475.

Although primary infection has been shown to prevent reinfection of SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) in animal models, gaps in the understanding of the immune response to the virus have not been adequately addressed, and some cases of possible reinfection have been reported; however, the frequency, relevance and proof of these events have yet to be determined. We report cases of two doctors who had two episodes of COVID-19 with positive RT-PCR (reverse transcriptase polymerase chain reaction) test results, raising the probability of reinfection. Case 1 was a 40-year-old male physician who presented fever and respiratory symptoms on April 10, with a positive RT-PCR test for SARS-CoV-2, with complete improvement of symptoms in five days. After 44 days, the patient presented the same symptoms of the previous episode, associated with anosmia and dysgeusia. The results of a new RT-PCR test performed two days later were positive for SARS-CoV-2. Case 2 was a 44-year-old female physician who worked in a reference clinic for COVID-19 (coronavirus disease 2019) and had onset of symptoms indicative of the disease on April 30. The RT-PCR test was positive for SARS-CoV-2, with improvement of symptoms in six days. On May 24, the patient presented fever, cough, and sore throat accompanied by headache, asthenia, myalgia, and diarrhea, and in this new episode, anosmia and dysgeusia were also present. A new RT-PCR test from nasopharyngeal swabs was performed with a positive result. Our two patients described here and other patients with possible reinfection who are now being observed in clinical practice reinforce the need to expand the investigation. Then, if the risk of reinfection is confirmed, these findings will be relevant from a clinical-epidemiological perspective to define isolation strategies and develop vaccines.

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1. **Serologic Responses in Healthy Adult with SARS-CoV-2 Reinfection, Hong Kong, August 2020.**  
   Chan Paul K. S Emerging infectious diseases 2020;26(12):3076-3078.

In March 2020, mild signs and symptoms of coronavirus disease developed in a healthy 33-year-old man in Hong Kong. His first infection did not produce virus neutralizing antibodies. In August, he had asymptomatic reinfection, suggesting that persons without a robust neutralizing antibody response might be at risk for reinfection.

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1. **Serum antibody profile of a patient with COVID-19 reinfection.**  
   To Kelvin Kai-Wang Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2020;:No page numbers.

We recently reported a patient with COVID-19 reinfection. Here, we showed that serum neutralizing antibody could be detected during the first episode but not at presentation of the second episode. During reinfection, neutralizing antibody and high avidity IgG were found within 8 days after hospitalization, while IgM response was absent.

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1. **Setting the criteria for SARS-CoV-2 reinfection - six possible cases.**  
   Tomassini Sara The Journal of infection 2020;:No page numbers.

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1. **Severe, Symptomatic Reinfection in a Patient with COVID-19.**  
   Selvaraj Vijairam Rhode Island medical journal (2013) 2020;103(10):24-26.

To date, there have only been a few reports of reinfections in COVID-19 patients. The possibility of being reinfected with COVID-19 is poorly understood. In this case report, we describe an individual who was initially diagnosed in April 2020 with COVID-19. Seven months later, he presented again to the hospital with shortness of breath and was found to have COVID-19 reinfection. We also summarize a list of all known cases of COVID-19 reinfection at this time.

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1. **Sustained Positivity and Reinfection With SARS-CoV-2 in Children: Does Quarantine/Isolation Period Need Reconsideration in a Pediatric Population?**  
   Patwardhan Anjali Cureus 2020;12(12):e12012.

BACKGROUNDThe coronavirus disease 2019 (COVID-19) pandemic is a once in a lifetime public health catastrophe that has driven the world not only into a medical crisis but has pushed to the brink of economic collapse. Prevention of transmission of the replication-competent virus to the susceptible host is the key to the control of COVID-19. The phenomenon of "sustained-positivity," "reinfections," and their role in disease transmission are poorly understood in adults and not even recognized in the pediatric population yet. This information is crucial for ascertaining the quarantine/isolation period for test-positive patients. Most of the time, adult studies' results are extrapolated and applied to children, but severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has treated children differently than adults.MATERIAL AND METHODSThe Institutional Review Board (IRB) approval has been obtained. A retrospective electronic chart review of 989 SARS-CoV-2 polymerase chain reaction (PCR)/reverse transcription-PCR (RT-PCR) positive pediatric patients was performed. The aim was to look at the existence of sustained positivity and SARS -CoV-2 reinfection in the pediatric population, as was reported in the adults.  Results: We present our retrospective observational study on 989 SARS-CoV-2 positive pediatric patients; 172 of these had repeated multiple testings, 68 had multiple consecutive positive tests over time, and 27 qualified for sustained-positive status. We also report on four pediatric COVID-19 reinfections.CONCLUSIONThis is the first report on pediatric SARS-CoV-2 reinfection, one of very few on pediatric SARS-CoV-2 sustained positivity and reinfection. These two phenomena occur in children also as reported in adults but have several differences. The reinfection is possible within one to three weeks of becoming negative as against adults who have been reported to become positive in a minimum of 45-90 days from becoming negative. More extensive reporting is essential to ascertain the accurate quarantine/isolation recommendation in children.

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1. **Symptomatic SARS-CoV-2 reinfection by a phylogenetically distinct strain.**  
   Van Elslande Jan Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2020;:No page numbers.

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1. **Symptomatic SARS-CoV-2 reinfection of a health care worker in a Belgian nosocomial outbreak despite primary neutralizing antibody response.**  
   Selhorst Philippe Clinical infectious diseases : an official publication of the Infectious Diseases Society of America 2020;:No page numbers.

BACKGROUNDIt is currently unclear whether SARS-CoV-2 reinfection will remain a rare event, only occurring in individuals who fail to mount an effective immune response, or whether it will occur more frequently when humoral immunity wanes following primary infection.METHODSA case of reinfection was observed in a Belgian nosocomial outbreak involving 3 patients and 2 health care workers. To distinguish reinfection from persistent infection and detect potential transmission clusters, whole genome sequencing was performed on nasopharyngeal swabs of all individuals including the reinfection case's first episode. IgA, IgM, and IgG and neutralizing antibody responses were quantified in serum of all individuals, and viral infectiousness was measured in the swabs of the reinfection case.RESULTSReinfection was confirmed in a young, immunocompetent health care worker as viral genomes derived from the first and second episode belonged to different SARS-CoV-2 clades. The symptomatic reinfection occurred after an interval of 185 days, despite the development of an effective humoral immune response following symptomatic primary infection. The second episode, however, was milder and characterized by a fast rise in serum IgG and neutralizing antibodies. Although contact tracing and virus culture remained inconclusive, the health care worker formed a transmission cluster with 3 patients and showed evidence of virus replication but not of neutralizing antibodies in her nasopharyngeal swabs.CONCLUSIONIf this case is representative of most Covid-19 patients, long-lived protective immunity against SARS-CoV-2 after primary infection might not be likely.

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1. **The first case of documented Covid-19 reinfection in Israel.**  
   Nachmias Vered IDCases 2020;22:e00970.

We describe the first documented case of Covid-19 reinfection in Israel, out of only a handful such case worldwide, in a 20 year old otherwise healthy young woman. In the first occasion she was mildly symptomatic, whereas the second episode was apparently asymptomatic, except for tachycardia of 90/min, compared to 60/min in the first episode. The fact that out of 25 million infected persons worldwide only a handful of re-infected cases have been identified suggests that this is a rare phenomenon. Alternatively, it will be critical to rule out that new mutations are not introduced, which are not covered by existing immunity.

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1. **The Importance and Challenges of Identifying SARS-CoV-2 Reinfections.**  
   Babiker Ahmed Journal of clinical microbiology 2020;:No page numbers.

Reports of SARS-CoV-2 reinfection have raised important questions about the strength and durability of the immune response to primary infection, which are key factors in predicting the course of the pandemic. Identifying reinfection requires detecting the virus at two different time points and using viral genomic data to distinguish reinfection from persistent viral carriage. This process is hindered by challenges of logistics and capacity, such as banking samples from primary infection and performing viral genome sequencing. These challenges may help to explain why very few cases have been described to date. In addition, reinfection may be a rare phenomenon, but detailed prospective studies are needed to rigorously assess its frequency. To provide context for future investigations of SARS-CoV-2 reinfection, we review 16 cases that have been published to date or are available in pre-print. Reinfection occurred across demographic spectra and in patients whose initial infections were both asymptomatic/mild and moderate/severe. For cases in which severity could be compared between episodes, half of reinfections were less severe, raising the possibility of partial immune protection. Although many patients had a positive total immunoglobulin or IgG result at the time of reinfection, very little examination of their immune response was performed. Further work is needed to elucidate the frequency, determinants, and consequences of SARS-CoV-2 reinfection. Establishing the necessary frameworks for surveillance and investigation will rely heavily on clinical laboratories and clinical investigators, and we propose several considerations to guide the medical community in identifying and characterizing SARS-CoV-2 reinfections.

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| 12. | EMBASE | exp "CORONAVIRUS INFECTIONS"/ | 24291 |
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