



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

HCPs, first, second, and third infections were asymptomatic in 2 (18.2%), 4 (36.4%), and 5 (45.4%), respectively. One second infection required hospitalization; no HCPs endorsed immunosuppression. The mean time to second infection was 314 days (95% CI, 238 to 390 days), while the mean interval between the second and third infection was 110 days (95% CI, 81 to 183 days) ($P=.008$ for difference in means).

This case series is subject to limitations. Following current public health guidance, postinfection testing to document polymerase chain reaction clearance was not routinely performed. However, persistence of polymerase chain reaction positivity longer than 90 days in immunocompetent individuals is unusual. Second, most third infections occurred during the omicron surge, and other variants may not display the same immune evasion to natural immunity. Third, the number of infections is too small to draw conclusions about the protective effect of prior infection or vaccination. Finally, samples were not available for genetic sequencing to confirm the variant(s) causing infection.

This case series provides new evidence of the potential for multiple reinfections in immunocompetent individuals. We noted a shorter interval between the second and third infections compared with the interval between the first and second infections, recognizing that almost all third infections occurred while the omicron variant was the predominant circulating strain. Omicron is known to partially evade vaccine-mediated and natural immunity.⁷ Although infection and vaccination appear to impart short-term protection of a similar magnitude,⁸ vaccination may still

boost immunity or provide protection against new variants in individuals with one or more natural infections.

Acknowledgments. Author contributions: Dr Swift—conceptualization, formal analysis, investigation, data curation, writing/original draft, visualization, and supervision; Dr Hainy—investigation, data curation, and writing/reviewing and editing; Dr Sampathkumar—validation, writing/reviewing and editing; Dr Breeher—conceptualization, validation, and writing/reviewing and editing.

Melanie D. Swift, MD, MPH
Caitlin M. Hainy, APRN, CNP, DNP
Priya Sampathkumar, MD
Laura E. Breeher, MD, MPH
Mayo Clinic,
Rochester, MN

Potential Competing Interests. Dr Swift reports support from Pfizer Inc via Duke University for the HERO Together COVID-19 vaccine adverse event registry. The other authors report no competing interests.

ORCID

Melanie D. Swift:  https://orcid.org/JMCP3765_0000-0002-5900-5573

- Gargouri S, Souissi A, Abid N, et al. Evidence of SARS-CoV-2 symptomatic reinfection in four healthcare professionals from the same hospital despite the presence of antibodies. *Int J Infect Dis.* 2022;117:146-154.
- Zhang J, Ding N, Ren L, et al. COVID-19 reinfection in the presence of neutralizing antibodies. *Natl Sci Rev.* 2021;8(4):nwab006.
- León TM, Dorabawila V, Nelson L, et al. COVID-19 cases and hospitalizations by COVID-19 vaccination status and previous COVID-19 diagnosis—California and New York, May–November 2021. *MMWR Morb Mortal Wkly Rep.* 2022;71(4):125-131.
- Shrestha NK, Burke PC, Nowacki AS, Terpeluk P, Gordon SM. Necessity of COVID-19 vaccination in persons who have already had COVID-19 [published online ahead of print January 13, 2022]. *Clin Infect Dis.* <https://doi.org/10.1093/cid/ciac022>
- McGonagle DG. Health-care workers recovered from natural SARS-CoV-2 infection should be exempt from mandatory vaccination edicts. *Lancet Rheumatol.* 2022;4(3):e170.
- Breeher L, Boon A, Hainy C, Murad MH, Wittich C, Swift M. A framework for sustainable

contact tracing and exposure investigation for large health systems. *Mayo Clin Proc.* 2020;95(7):1432-1444.

- Altarawneh HN, Chemaitelly H, Hasan MR, et al. Protection against the omicron variant from previous SARS-CoV-2 infection [published online ahead of print February 9, 2022]. *N Engl J Med.* doi: 10.1056/NEJM20220133
- Kojima N, Shrestha NK, Klausner JD. A systematic review of the protective effect of prior SARS-CoV-2 infection on repeat infection. *Eval Health Prof.* 2021;44(4):327-332.

<https://doi.org/10.1016/j.mayocp.2022.03.003>

Impact of the COVID-19 Pandemic on Respiratory Infection Rates



To the Editor: A substantial change in the pattern of influenza infections was noted worldwide¹ during the COVID-19 pandemic. We sought to describe our experience with seasonal respiratory infections across 60 sites of a major health care system in the Midwest United States. Although timing varies slightly from year to year, seasonal acute respiratory infections, such as influenza A/B, respiratory syncytial virus (RSV), and group A streptococcus (GAS), have predictable months of increased activity. We collected the number of tests performed for influenza A/B, RSV, GAS, and SARS-CoV-2 from November 1, 2018, to March 31, 2020 (ie, the pre-pandemic period) and April 1, 2020, to June 24, 2021 (ie, the pandemic period). During the COVID-19 pandemic, we observed lower rates of influenza A/B than previously reported and discovered substantially decreased positivity rates for RSV and GAS as well.¹⁻⁴

A total of 1,489,293 tests were performed for influenza A/B, RSV, GAS, and SARS-CoV-2 between November 1, 2018, and June 24, 2021 (Table; Supplemental Figure, available online at <http://www.>

TABLE. Tests for Acute Respiratory Infections Performed and Results

	Pre-pandemic period ^a (n=350,334)	Pandemic period ^{b,c} (n=1,138,959)	Overall (N=1,489,293)
Test performed			
Influenza A/B	20,8438 (59.5)	139,816 (12.3)	348,254 (23.4)
Respiratory syncytial virus	37,717 (10.8)	11,436 (1.0)	49,153 (3.3)
Group A streptococcus	93,392 (26.7)	42,485 (3.7)	135,877 (9.1)
SARS-CoV-2	10,787 (3.1)	945,222 (83.0)	956,009 (64.2)
Influenza A/B test results			
Negative	185,311 (88.9)	139,788 (100.0)	325,099 (93.4)
Positive	23,127 (11.1)	28 (0.0)	23,155 (6.6)
Respiratory syncytial virus test results			
Negative	34,711 (92.0)	11,412 (99.8)	46,123 (93.8)
Positive	3006 (8.0)	24 (0.2)	3030 (6.2)
Group A streptococcus test results			
Negative	70,306 (75.3)	36,863 (86.8)	107,169 (78.9)
Positive	23,086 (24.7)	5622 (13.2)	28,708 (21.1)
SARS-CoV-2 test results			
Negative	10,739 (99.6)	865,086 (91.5)	875,825 (91.6)
Positive	48 (0.4)	80,136 (8.5)	80,184 (8.4)

^aPre-pandemic period: November 1, 2018, to March 31, 2020.

^bPandemic period: April 1, 2020, to June 24, 2021.

^cAll *P* values are <.001.

Values are reported as number (percentage).

mayoclinicproceedings.org). Our pre-pandemic interval includes 2 typical respiratory seasons with peaks from November through March, during which time 11% of all influenza tests returned positive results, 8% of RSV test results were positive, and 25% of GAS test results were positive. In comparison, during the COVID-19 pandemic, there were only 28 (0.02%) positive influenza results of 139,816 tests, 24 (0.2%) positive RSV results of 11,412 tests, and 5622 (13.2%) positive cases of GAS of 42,485 tests. Even though the overall rate of testing of influenza A/B and RSV was lower during the pandemic, the positivity rate decreased significantly ($P<.001$), more than would be predicted, and approached zero.

Patients tested for non-COVID viruses during the pandemic tended to be older (median age, 41.7 years; Q1-Q3, 19.9-66.5 years) compared with patients tested during the pre-pandemic period (median age, 28.7 years; Q1-Q3, 7.9-59.4 years; Wilcoxon, $P<.001$). However, there was no age difference in comparing positive non-COVID test results between the pandemic (median age, 14.6 years; Q1-Q3, 8.3-25.9 years) and the pre-pandemic periods (median age, 12.8 years; Q1-Q3, 6.2-35.5 years, Wilcoxon, $P=.466$).

We also investigated the possibility of viral interference by SARS-CoV-2 on the rate of respiratory viral infections. To assess this, we compared positivity rates of influenza A/B and RSV between patients who had previously tested positive

for SARS-CoV-2 and patients who had not tested positive. Only respiratory tests conducted during the pandemic period were included in this subanalysis. To serve as a baseline, we also compared positivity rates among all patients during the pre-pandemic period with patients in the pandemic period who had no previous positive SARS-CoV-2 test results. We found that viral interference did not contribute in decreasing the rates of influenza or RSV.

In conclusion, there was a significant decrease observed in the rate of positivity of 3 respiratory illnesses before and during the COVID-19 pandemic. The explanation for the decreased rates of influenza A/B, RSV, and GAS is likely to be multifactorial, and further work will be needed to determine all the elements influencing this change as we navigate future respiratory seasons.

SUPPLEMENTAL ONLINE MATERIAL

Supplemental material can be found online at <http://www.mayoclinicproceedings.org>. Supplemental material attached to journal articles has not been edited, and the authors take responsibility for the accuracy of all data.



Susan M. Cullinan, MD

Department of Emergency Medicine
Mayo Clinic Health System
Eau Claire, WI

Heather A. Heaton, MD

Aidan Mullan, MA

John O'Horo, MD, MPH

Matthew J. Binnicker, PhD

Aaron J. Tande, MD

Jason A. Post, MD

Ronna L. Campbell, MD, PhD

Neha P. Raukar, MD, MS

Mayo Clinic
Rochester, MN

Potential Competing Interests: The authors report no competing interests.

ORCID

Susan M. Cullinan:  https://orcid.org/JMCP3774_0000-0002-9144-6037

1. Yum S, Hong K, Sohn S, Kim J, Chun BC. Trends in viral respiratory infections during COVID-19

pandemic, South Korea. *Emerg Infect Dis.* 2021; 27(6):1685-1688.

2. Soo RJ, Chiew CJ, Ma S, Pung R, Lee V. Decreased influenza incidence under COVID-19 control measures, Singapore. *Emerg Infect Dis.* Aug 2020;26(8): 1933-1935.
3. Lee H, Lee H, Song KH, et al. Impact of public health interventions on seasonal influenza activity during the COVID-19

outbreak in Korea. *Clin Infect Dis.* Jul 1 2021;73(1):e132-e140. <https://doi.org/10.1093/cid/ciaa672>

4. Chan KH, Lee PW, Chan CY, Lam KB, Ho PL. Monitoring respiratory infections in covid-19 epidemics. *BMJ.* May 4 2020;369:m1628. <https://doi.org/10.1136/bmj.m1628>

<https://doi.org/10.1016/j.mayocp.2022.03.012>