

## COVID-19 Resource Desk

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### New Research

\*note, **PREPRINTS** have not undergone formal peer review

**COVID-19 related publications by Providence caregivers – see [Digital Commons](#)**

#### Basic Science / Virology / Pre-clinical

- 1. SARS-CoV-2 Omicron variant shows less efficient replication and fusion activity when compared with delta variant in TMPRSS2-expressed cells.** Zhao H et al. *Emerg Microbes Infect.* 2021 Dec 24:1-18. doi: 10.1080/22221751.2021.2023329.  
<https://www.tandfonline.com/doi/full/10.1080/22221751.2021.2023329>

In this study, we sought to investigate the virological characteristics of Omicron variant and compared it with the Delta variant which has dominated the world since mid-2021. Omicron variant replicated more slowly than the Delta variant in transmembrane serine protease 2 (TMPRSS2)-overexpressing VeroE6 (VeroE6/TMPRSS2) cells. Notably, the Delta variant replicated well in Calu-3 cells which has robust TMPRSS2 expression, while the Omicron variant replicated poorly in this cell line. To confirm the difference in entry pathway between the Omicron and Delta variants, we assessed the antiviral effect of bafilomycin A1, chloroquine (inhibiting endocytic pathway) and camostat (inhibiting TMPRSS2 pathway). Camostat potently inhibit the Delta variant but not the Omicron variant, while bafilomycin A1 and chloroquine could inhibit both Omicron and Delta variants. Moreover, Omicron variant also showed weaker cell-cell fusion activity when compared with Delta variant in VeroE6/TMPRSS2 cells. Collectively, our results suggest that Omicron variant infection is not enhanced by TMPRSS2 but is largely mediated via the endocytic pathway. The difference in entry pathway between Omicron and Delta variant may have implication on the clinical manifestations or disease severity.

#### Clinical Syndrome

- 2. Early assessment of the clinical severity of the SARS-CoV-2 Omicron variant in South Africa.** Wolter N et al. *medRxiv* 2021.12.21.21268116; <https://doi.org/10.1101/2021.12.21.21268116>  
**Preprint**

Results From 1 October through 6 December 2021, 161,328 COVID-19 cases were reported nationally; 38,282 were tested using TaqPath PCR and 29,721 SGTF infections were identified. The proportion of SGTF infections increased from 3% in early October (week 39) to 98% in early December (week 48). On multivariable analysis, after controlling for factors associated with hospitalisation, individuals with SGTF infection had lower odds of being admitted to hospital compared to non-SGTF infections (adjusted odds ratio (aOR) 0.2, 95% confidence interval (CI) 0.1-0.3). Among hospitalised individuals, after controlling for factors associated with severe disease, the odds of severe disease did not differ

between SGTF-infected individuals compared to non-SGTF individuals diagnosed during the same time period (aOR 0.7, 95% CI 0.3-1.4). Compared to earlier Delta infections, after controlling for factors associated with severe disease, SGTF-infected individuals had a lower odds of severe disease (aOR 0.3, 95% CI 0.2-0.6). Conclusion Early analyses suggest a reduced risk of hospitalisation among SGTF-infected individuals when compared to non-SGTF infected individuals in the same time period, and a reduced risk of severe disease when compared to earlier Delta-infected individuals. Some of this reduction is likely a result of high population immunity.

**3. Metabolic Syndrome and Acute Respiratory Distress Syndrome in Hospitalized Patients With COVID-19.** Denson JL et al. JAMA Netw Open. 2021 Dec 1;4(12):e2140568.

doi:10.1001/jamanetworkopen.2021.40568.

<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2787394>

CONCLUSIONS AND RELEVANCE: These findings suggest that metabolic syndrome was associated with increased risks of ARDS and death in patients hospitalized with COVID-19. The association with ARDS was cumulative for each metabolic syndrome criteria present.

**4. Severity of Illness in Persons Infected With the SARS-CoV-2 Delta Variant vs Beta Variant in Qatar.** Butt AA et al. JAMA Intern Med. 2021 Dec 22. doi: 10.1001/jamainternmed.2021.7949.

Online ahead of print.

<https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2787492>

CONCLUSIONS AND RELEVANCE: In this cohort study of persons with COVID-19 in Qatar, infection with the SARS-CoV-2 Delta variant was associated with more severe disease than was infection with the Beta variant. Being unvaccinated was associated with greater odds of severe-critical disease.

## Diagnosics & Screening

**5. Diagnostics for COVID-19: moving from pandemic response to control.** Peeling RW et al.

Lancet 2021 Dec 20. DOI:[https://doi.org/10.1016/S0140-6736\(21\)02346-1](https://doi.org/10.1016/S0140-6736(21)02346-1)

[https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(21\)02346-1/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(21)02346-1/fulltext)

Diagnostics have proven to be crucial to the COVID-19 pandemic response. There are three major methods for the detection of SARS-CoV-2 infection and their role has evolved during the course of the pandemic. Molecular tests such as PCR are highly sensitive and specific at detecting viral RNA, and are recommended by WHO for confirming diagnosis in individuals who are symptomatic and for activating public health measures. Antigen rapid detection tests detect viral proteins and, although they are less sensitive than molecular tests, have the advantages of being easier to do, giving a faster time to result, of being lower cost, and able to detect infection in those who are most likely to be at risk of transmitting the virus to others. Antigen rapid detection tests can be used as a public health tool for screening individuals at enhanced risk of infection, to protect people who are clinically vulnerable, to ensure safe travel and the resumption of schooling and social activities, and to enable economic recovery. With vaccine roll-out, antibody tests (which detect the host's response to infection or vaccination) can be useful surveillance tools to inform public policy, but should not be used to provide proof of immunity, as the correlates of protection remain unclear. All three types of COVID-19 test continue to have a crucial role in the transition from pandemic response to pandemic control.

- 6. Assessment of the analytical sensitivity of ten lateral flow devices against the SARS-CoV-2 omicron variant.** Deerrain J et al. J Clin Microbiol. 2021 Dec 22;jcm0247921. doi: 10.1128/jcm.02479-21. <https://journals.asm.org/doi/10.1128/jcm.02479-21>

Timely and accurate diagnostic testing is a critical component of the public health response to COVID-19. Antigen tests are used widely in many countries to provide rapid, economical and accessible point-of-care testing (1). The vast majority of antigen tests detect nucleocapsid (N) protein, a structural protein that displays less variation than the spike (S) protein across different SARS-CoV-2 lineages. Although antigen tests are less sensitive than RT-PCR tests, their ability to quickly detect individuals with high viral loads provides clinical and public health utility in many countries, including Australia, where antigen tests have recently been approved for self-testing (2). As new variants arise, including the recent emergence of the SARS-CoV-2 omicron variant, it is essential to rapidly assess the performance of diagnostic assays. Here, in order to assess and compare the ability of antigen tests to detect delta and omicron variants, we performed a rapid assessment of ten commercially available antigen tests.

- 7. Accuracy and ease-of-use of seven point-of-care SARS-CoV-2 antigen-detecting tests: A multi-centre clinical evaluation.** Krüger LJ et al. EBioMedicine. 2021 Dec 24;75:103774. doi: 10.1016/j.ebiom.2021.103774. Online ahead of print.

[https://www.thelancet.com/journals/ebiom/article/PIIS2352-3964\(21\)00568-5/fulltext](https://www.thelancet.com/journals/ebiom/article/PIIS2352-3964(21)00568-5/fulltext)

INTERPRETATION: Variability in test performance is partially explained by variable viral loads in population evaluated over the course of the pandemic. All Ag-RDTs reach high sensitivity early in the disease and in individuals with high viral loads, supporting their role in identifying transmission relevant infections. For easy-to-use tests, performance shown will likely be maintained in routine implementation.

- 8. Quantitative SARS-CoV-2 antigen test as a tool able to predict the stage of the infection.**

Coltella L et al. J Infect. 2021 Dec 22:S0163-4453(21)00636-8. doi: 10.1016/j.jinf.2021.12.013.

[https://www.journalofinfection.com/article/S0163-4453\(21\)00636-8/fulltext](https://www.journalofinfection.com/article/S0163-4453(21)00636-8/fulltext)

FDA approved antigen (Ag) test as a fast and convenient alternative to PCR but, as known, this approach can be effective at symptoms onset (2), when viral antigen is abundant (3), otherwise false negative results can occur; moreover, positive antigenic results need to be confirmed by molecular test (4).

These assays are mostly qualitative and, even when a numerical value is provided, no straightforward correlation with the virological and clinical parameters has ever been demonstrated.

We evaluated an Ag test based on chemiluminescence (CLEIA), Lumipulse®G SARS-CoV-2 Ag (Fujirebio INC), in an extensive population with different characteristics.

## Epidemiology & Public Health

- 9. Investigation of a SARS-CoV-2 B.1.1.529 (Omicron) Variant Cluster — Nebraska, November–December 2021.** Jansen L, Tegomoh B, Lange K, et al. MMWR Morb Mortal Wkly Rep. ePub: 28 December 2021. DOI: <http://dx.doi.org/10.15585/mmwr.mm705152e3>

The B.1.1.529 (Omicron) variant of SARS-CoV-2 (the virus that causes COVID-19) was first detected in specimens collected on November 11, 2021, in Botswana and on November 14 in South Africa;\* the

first confirmed case of Omicron in the United States was identified in California on December 1, 2021 (1). On November 29, the Nebraska Department of Health and Human Services was notified of six probable cases† of COVID-19 in one household, including one case in a man aged 48 years (the index patient) who had recently returned from Nigeria. Given the patient’s travel history, Omicron infection was suspected. Specimens from all six persons in the household tested positive for SARS-CoV-2 by reverse transcription–polymerase chain reaction (RT-PCR) testing on December 1, and the following day genomic sequencing by the Nebraska Public Health Laboratory identified an identical Omicron genotype from each specimen (Figure). Phylogenetic analysis was conducted to determine if this cluster represented an independent introduction of Omicron into the United States, and a detailed epidemiologic investigation was conducted. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.

**10. Evaluation of a Test to Stay Strategy in Transitional Kindergarten Through Grade 12 Schools — Los Angeles County, California, August 16–October 31, 2021.** Harris-McCoy K, Lee VC, Munna C, Kim AA. *MMWR Morb Mortal Wkly Rep* 2021;70:1773–1777. DOI:

<http://dx.doi.org/10.15585/mmwr.mm705152e1>

TTS does not appear to increase transmission risk in public schools and might greatly reduce loss of in-person school days. Implementation requires resources that might be currently unavailable for some schools. Vaccination remains the leading recommendation to protect against COVID-19; TTS allows students with a school exposure to remain in the classroom as an alternative to home quarantine.

**11. Evaluation of Test to Stay Strategy on Secondary and Tertiary Transmission of SARS-CoV-2 in K–12 Schools — Lake County, Illinois, August 9–October 29, 2021.** Nemoto N, Dhillon S, Fink S, et al. *MMWR Morb Mortal Wkly Rep* 2021;70:1778–1781. DOI:

<http://dx.doi.org/10.15585/mmwr.mm705152e2>

Although vaccination remains the leading recommendation to protect against COVID-19, TTS allows close contacts to remain in the classroom as an alternative to home quarantine.

### Healthcare Delivery & Healthcare Workers

**12. A Health Care System's Approach to Support Nursing Leaders in Mitigating Burnout Amid a COVID-19 World Pandemic.** Trepanier S, Henderson R, Waghay A. *Nurs Adm Q.* 2022 Jan-Mar 01;46(1):52-59. doi: 10.1097/NAQ.0000000000000507. *Providence authors*

[https://journals.lww.com/naqjournal/Fulltext/2022/01000/A\\_Health\\_Care\\_System\\_s\\_Approach\\_to\\_Support\\_Nursing.8.aspx](https://journals.lww.com/naqjournal/Fulltext/2022/01000/A_Health_Care_System_s_Approach_to_Support_Nursing.8.aspx)

Burnout has been demonstrating its presence in the nursing profession for decades. The advent of the world pandemic exacerbated the impact of burnout, and health care workers are suffering. In this article, the authors offer a review of burnout and its effect on the nursing profession. The authors describe a health care system's response to support its 48000 nurses. On the basis of critical drivers that influence the state of engagement of any nurses, we implemented a program allowing us to proactively partner with core leaders to support the emotional well-being of their caregivers. We provide focused coaching and support to leaders and their teams experiencing the highest stress levels. Finally, this article offers concrete interventions that nurse leaders should consider to support their respective nurses.

## Survivorship & Rehabilitation

- 13. A clinical case definition of post-COVID-19 condition by a Delphi consensus.** Soriano JB, Murthy S, Marshall JC, Relan P, Diaz JV; WHO Clinical Case Definition Working Group on Post-COVID-19 Condition. *Lancet Infect Dis.* 2021 Dec 21:S1473-3099(21)00703-9. doi: 10.1016/S1473-3099(21)00703-9. Online ahead of print.

[https://www.thelancet.com/journals/laninf/article/PIIS1473-3099\(21\)00703-9/fulltext](https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(21)00703-9/fulltext)

People with COVID-19 might have sustained postinfection sequelae. Known by a variety of names, including long COVID or long-haul COVID, and listed in the ICD-10 classification as post-COVID-19 condition since September, 2020, this occurrence is variable in its expression and its impact. The absence of a globally standardised and agreed-upon definition hampers progress in characterisation of its epidemiology and the development of candidate treatments. In a WHO-led Delphi process, we engaged with an international panel of 265 patients, clinicians, researchers, and WHO staff to develop a consensus definition for this condition. 14 domains and 45 items were evaluated in two rounds of the Delphi process to create a final consensus definition for adults: post-COVID-19 condition occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, usually 3 months from the onset, with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis. Common symptoms include, but are not limited to, fatigue, shortness of breath, and cognitive dysfunction, and generally have an impact on everyday functioning. Symptoms might be new onset following initial recovery from an acute COVID-19 episode or persist from the initial illness. Symptoms might also fluctuate or relapse over time. A separate definition might be applicable for children. Although the consensus definition is likely to change as knowledge increases, this common framework provides a foundation for ongoing and future studies of epidemiology, risk factors, clinical characteristics, and therapy.

## Therapeutics

- 14. Namilumab or infliximab compared with standard of care in hospitalised patients with COVID-19 (CATALYST): a randomised, multicentre, multi-arm, multistage, open-label, adaptive, phase 2, proof-of-concept trial.** Fisher BA et al. *Lancet Respir Med.* 2021 Dec 16:S2213-2600(21)00460-4. doi: 10.1016/S2213-2600(21)00460-4. Online ahead of print.

[https://www.thelancet.com/journals/lanres/article/PIIS2213-2600\(21\)00460-4/fulltext](https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(21)00460-4/fulltext)

INTERPRETATION: Namilumab, but not infliximab, showed proof-of-concept evidence for reduction in inflammation—as measured by CRP concentration—in hospitalised patients with COVID-19 pneumonia. Namilumab should be prioritised for further investigation in COVID-19.

FUNDING: Medical Research Council.

- 15. Responses to a Neutralizing Monoclonal Antibody for Hospitalized Patients With COVID-19 According to Baseline Antibody and Antigen Levels : A Randomized Controlled Trial.** ACTIV-3/TICO Bamlanivimab Study Group\*. *Ann Intern Med.* 2021 Dec 21. doi: 10.7326/M21-3507.

<https://www.acpjournals.org/doi/10.7326/M21-3507>

CONCLUSION: Efficacy and safety of bamlanivimab may differ depending on whether an endogenous nAb response has been mounted. The limited sample size of the study does not allow firm conclusions

based on these findings, and further independent trials are required that assess other types of passive immune therapies in the same patient setting.

**16. Randomized Trial of Molnupiravir or Placebo in Patients Hospitalized with Covid-19.** Arribas

JR et al. NEJM Evidence 2021 Dec 16. DOI: 10.1056/EVIDoA2100044

<https://evidence.nejm.org/pb-assets/evidence-site/content/EVIDoA2100044-1639691925290.pdf>

In this phase 2 trial of patients hospitalized with Covid-19, a 5-day course of molnupiravir up to 800 mg twice daily was not associated with dose-limiting side effects or adverse events, but did not demonstrate clinical benefit.

**17. Phase 2/3 Trial of Molnupiravir for Treatment of Covid-19 in Nonhospitalized Adults.** Caraco Y

et al. NEJM Evidence 2021 Dec 16. DOI: 10.1056/EVIDoA2100043

<https://evidence.nejm.org/pb-assets/evidence-site/content/EVIDoA2100043-1639691922133.pdf>

Results. The phase 2 component randomly assigned 302 participants to treatment; baseline characteristics were comparable across treatment groups. Molnupiravir had no apparent dose-related effect on adverse events, and no clinically meaningful abnormalities in laboratory test results were observed in relation to dose or treatment. Eleven participants were hospitalized or died through day 29. Of 225 participants in the combined molnupiravir group, 7 (3.1%) were hospitalized or died, compared with 4 of 74 participants (5.4%) in the placebo group. Subgroup analyses suggested lower incidences of hospitalization and/or death in the molnupiravir versus placebo groups in participants older than 60 years of age, those with increased risk for severe illness, those with symptom onset up to (and including) 5 days before randomization, and those with both symptom onset up to (and including) 5 days before randomization and increased risk for severe illness.

Conclusions. These interim study results support further evaluation of molnupiravir as a potential treatment to reduce hospitalizations and/or death in nonhospitalized patients with Covid-19.

**18. Early Remdesivir to Prevent Progression to Severe Covid-19 in Outpatients.** Gottlieb RL et al. N

Engl J Med. 2021 Dec 22. doi: 10.1056/NEJMoa2116846. Online ahead of print.

<https://www.nejm.org/doi/full/10.1056/NEJMoa2116846>

CONCLUSIONS: Among nonhospitalized patients who were at high risk for Covid-19 progression, a 3-day course of remdesivir had an acceptable safety profile and resulted in an 87% lower risk of hospitalization or death than placebo. (Funded by Gilead Sciences; PINETREE ClinicalTrials.gov number, NCT04501952; EudraCT number, 2020-003510-12.).

**19. Effectiveness of rosuvastatin plus colchicine, emtricitabine/tenofovir and combinations thereof in hospitalized patients with COVID-19: a pragmatic, open-label randomized trial.**

Gaitán-Duarte HG et al. EClinicalMedicine. 2022 Jan;43:101242. doi:

10.1016/j.eclinm.2021.101242. Epub 2021 Dec 20.

[https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370\(21\)00523-X/fulltext](https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370(21)00523-X/fulltext)

INTERPRETATION: The combined use of FTC/TDF+COLCH+ROSU reduces the risk of 28-day mortality and the need for invasive mechanical ventilation in hospitalized patients with pulmonary compromise from COVID-19. More randomized controlled trials are needed to compare the effectiveness and cost of treatment with this combination versus other drugs that have been shown to reduce mortality from SARS-CoV-2 infection and its usefulness in patients with chronic statin use.

**20. Efficacy and safety of two neutralising monoclonal antibody therapies, sotrovimab and BII-196 plus BII-198, for adults hospitalised with COVID-19 (TICO): a randomised controlled trial.**

ACTIV-3/Therapeutics for Inpatients with COVID-19 (TICO) Study Group. Lancet Infect Dis. 2021 Dec 23:S1473-3099(21)00751-9. doi: 10.1016/S1473-3099(21)00751-9. Online ahead of print.

[https://www.thelancet.com/journals/laninf/article/PIIS1473-3099\(21\)00751-9/fulltext](https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(21)00751-9/fulltext)

INTERPRETATION: Neither sotrovimab nor BII-196 plus BII-198 showed efficacy for improving clinical outcomes among adults hospitalised with COVID-19.

FUNDING: US National Institutes of Health and Operation Warp Speed.

**21. Effect of Colchicine vs Usual Care Alone on Intubation and 28-Day Mortality in Patients**

**Hospitalized With COVID-19: A Randomized Clinical Trial.** Diaz R et al. JAMA Netw Open. 2021 Dec 1;4(12):e2141328. doi: 10.1001/jamanetworkopen.2021.41328.

<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2787585>

CONCLUSIONS AND RELEVANCE: This randomized clinical trial found that compared with usual care, colchicine did not significantly reduce mechanical ventilation or 28-day mortality in patients hospitalized with COVID-19 pneumonia.

TRIAL REGISTRATION: ClinicalTrials.gov Identifier: NCT04328480.

**22. Ruxolitinib versus dexamethasone in hospitalized adults with COVID-19: multicenter matched cohort study.** Stanevich OV et al. BMC Infect Dis. 2021 Dec 22;21(1):1277. doi: 10.1186/s12879-021-06982-z.

<https://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-021-06982-z>

CONCLUSIONS: Ruxolitinib may be an alternative initial anti-cytokine therapy with comparable effectiveness in patients with potential risks of steroid administration. Patients with a high fever ( $\geq 38.5$  °C) at admission may potentially benefit from ruxolitinib administration.

### Transmission / Infection Control

**23. Face mask fit modifications that improve source control performance.** Blachere FM et al. Am J

Infect Control. 2021 Dec 6:S0196-6553(21)00715-X. doi: 10.1016/j.ajic.2021.10.041. Online ahead of print.

<https://www.sciencedirect.com/science/article/pii/S019665532100715X>

RESULTS: Medical masks without modification blocked  $\geq 56\%$  of cough aerosols and  $\geq 42\%$  of exhaled aerosols. Modifying fit by crossing the earloops or placing a bracket under the mask did not increase performance, while using earloop toggles, an earloop strap, and knotting and tucking the mask increased performance. The most effective modifications for improving source control performance were double masking and using a mask brace. Placing a cloth mask over a medical mask blocked  $\geq 85\%$  of cough aerosols and  $\geq 91\%$  of exhaled aerosols. Placing a brace over a medical mask blocked  $\geq 95\%$  of cough aerosols and  $\geq 99\%$  of exhaled aerosols.

CONCLUSIONS: Fit modifications can greatly improve the performance of face masks as source control devices for respiratory aerosols.

**24. Spatial and temporal effects on SARS-CoV-2 contamination of the healthcare environment.**

Ziegler MJ, Huang E, Bekele S, Reese E, Tolomeo P, Loughrey S, David MZ, Lautenbach E, Kelly BJ; CDC Prevention Epicenters Program. *Infect Control Hosp Epidemiol.* 2021 Dec 27:1-16. doi: 10.1017/ice.2021.530. Online ahead of print.

<https://www.cambridge.org/core/journals/infection-control-and-hospital-epidemiology/article/abs/spatial-and-temporal-effects-on-sarscov2-contamination-of-the-healthcare-environment/74A006DECACE142EF0BBDDODDEA49BAF>

**RESULTS:** The probability of detecting SARS-CoV-2 RNA in a patient room did not vary with distance. However, we found that surface type predicted probability of detection, with floors and high-touch surfaces having the highest probability of detection (floors odds ratio (OR) 67.8 (95% CrI 36.3 to 131); high-touch elevated OR 7.39 (95% CrI 4.31 to 13.1)). Increased surface contamination was observed in room where patients required high-flow oxygen, positive airway pressure, or mechanical ventilation (OR 1.6 (95% CrI 1.03 to 2.53)). The probability of elevated surface contamination decayed with prolonged hospitalization, but the probability of floor detection increased with duration of the local pandemic wave.

**CONCLUSIONS:** Distance from patient's bed did not predict SARS-CoV-2 RNA deposition in patient rooms, but surface type, severity of illness, and time from local pandemic wave predicted surface deposition.

### **Vaccines / Immunology**

**25. Covid-19 Rates by Time since Vaccination during Delta Variant Predominance.** Paz-Bailey G et al. *NEJM Evidence* 2021 Dec 20. doi: 10.1056/EVIDoa00057

<https://evidence.nejm.org/pb-assets/evidence-site/content/EVIDoa2100057-1639782076357.pdf>

Our study suggests that protection from SARS-CoV-2 infection among all ages or death among older adults waned with increasing time since vaccination during a period of delta predominance. These results add to the evidence base that supports U.S. booster recommendations, especially for older adults vaccinated with BNT162b2 and recipients of the Ad26.COV2.S vaccine.

**26. Incidence and Estimated Vaccine Effectiveness Against Symptomatic SARS-CoV-2 Infection Among Persons Tested in US Retail Locations, May 1 to August 7, 2021.** Tabak YP, Sun X, Brennan TA, Chaguturu SK. *JAMA Netw Open.* 2021 Dec 1;4(12):e2143346. doi:

10.1001/jamanetworkopen.2021.43346.

<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2787363>

As of August 17, 2021, the US Centers for Disease Control and Prevention (CDC) reported that 168.7 million people in the US, more than half of the US population, had received full doses of SARS-CoV-2 vaccines.<sup>1</sup> This study evaluates whether estimated vaccine effectiveness against infection changes over time to help inform public health policy and clinical practices.

**27. Interim Estimate of Vaccine Effectiveness of BNT162b2 (Pfizer-BioNTech) Vaccine in Preventing SARS-CoV-2 Infection Among Adolescents Aged 12-17 Years - Arizona, July-December 2021.** *MMWR. Morbidity and mortality weekly report*, 70(5152), 1761–1765.

<https://doi.org/10.15585/mmwr.mm705152a2>

During the study, 190 adolescents contributed fully vaccinated person-time ( $\geq 14$  days after receiving 2 doses of Pfizer-BioNTech vaccine), 30 contributed partially vaccinated person-time (receipt of 1 dose or receipt of 2 doses but with the second dose completed  $< 14$  days earlier), and 66 contributed unvaccinated person-time. Using the Cox proportional-hazards model, the estimated VE of full Pfizer-BioNTech vaccination for preventing SARS-CoV-2 infection was 92% (95% CI = 79%-97%), adjusted for sociodemographic characteristics, health information, frequency of social contact, mask use, location, and local virus circulation. These findings from a real-world setting indicate that 2 doses of Pfizer-BioNTech vaccine are highly effective in preventing SARS-CoV-2 infection among Arizona adolescents. CDC recommends COVID-19 vaccination for all eligible persons in the United States, including persons aged 12-17 years.

**28. COVID-19 Vaccine Safety in Children Aged 5-11 Years - United States, November 3-December 19, 2021.** *MMWR. Morbidity and mortality weekly report*, 70(5152), 1755–1760.

<https://doi.org/10.15585/mmwr.mm705152a1>

Approximately 8.7 million doses of Pfizer-BioNTech COVID-19 vaccine were administered to children aged 5-11 years<sup>†</sup> during this period; VAERS received 4,249 reports of adverse events after vaccination with Pfizer-BioNTech COVID-19 vaccine in this age group, 4,149 (97.6%) of which were not serious. Approximately 42,504 children aged 5-11 years were enrolled in v-safe after vaccination with Pfizer-BioNTech COVID-19 vaccine; after dose 2, a total of 17,180 (57.5%) local and 12,223 systemic (40.9%) reactions (including injection-site pain, fatigue, or headache) were reported. The preliminary safety findings are similar to those from preauthorization clinical trials.

**29. Infection with the SARS-CoV-2 Delta Variant is Associated with Higher Recovery of Infectious Virus Compared to the Alpha Variant in both Unvaccinated and Vaccinated Individuals.** Luo

CH et al. *Clin Infect Dis*. 2021 Dec 18:ciab986. doi: 10.1093/cid/ciab986. Online ahead of print.

<https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciab986/6469786>

CONCLUSIONS: Infection with the Delta variant was associated with more frequent recovery of infectious virus in vaccinated and unvaccinated individuals compared to the Alpha variant but was not associated with an increase in disease severity in fully vaccinated individuals. Infectious virus was correlated with the presence of low amounts of antiviral IgG in the nasal specimens.

**30. Antibody Response and Variant Cross-Neutralization After SARS-CoV-2 Breakthrough**

**Infection.** Bates TA et al. *JAMA*. 2021 Dec 16. doi: 10.1001/jama.2021.22898. Online ahead of print.

<https://jamanetwork.com/journals/jama/fullarticle/2787447>

Breakthrough infections after vaccination against SARS-CoV-2 are increasingly reported, possibly due to waning of vaccine-induced antibody levels.<sup>1</sup> Moreover, emerging variants of concern with diminished susceptibility to vaccine-induced antibodies are responsible for most new cases.<sup>2,3</sup> Studies have focused on determining the rate of vaccine breakthrough based on antibody levels after standard vaccination practices.<sup>4,5</sup> We assessed antibody levels and variant cross-neutralization after breakthrough infection.

**31. mRNA-based COVID-19 vaccine boosters induce neutralizing immunity against SARS-CoV-2 Omicron variant.** Wilfredo F. Garcia-Beltran WF et al. medRxiv 2021.12.14.21267755; doi: <https://doi.org/10.1101/2021.12.14.21267755>

Recent surveillance has revealed the emergence of the SARS-CoV-2 Omicron variant (BA.1/B.1.1.529) harboring up to 36 mutations in spike protein, the target of vaccine-induced neutralizing antibodies. Given its potential to escape vaccine-induced humoral immunity, we measured neutralization potency of sera from 88 mRNA-1273, 111 BNT162b, and 40 Ad26.COVS vaccine recipients against wild type, Delta, and Omicron SARS-CoV-2 pseudoviruses. We included individuals that were vaccinated recently (<3 months), distantly (6-12 months), or recently boosted, and accounted for prior SARS-CoV-2 infection. Remarkably, neutralization of Omicron was undetectable in most vaccinated individuals. However, individuals boosted with mRNA vaccines exhibited potent neutralization of Omicron only 4-6-fold lower than wild type, suggesting that boosters enhance the cross-reactivity of neutralizing antibody responses. In addition, we find Omicron pseudovirus is more infectious than any other variant tested. Overall, this study highlights the importance of boosters to broaden neutralizing antibody responses against highly divergent SARS-CoV-2 variants.

**32. Neutralizing Antibody Response to Pseudotype SARS-CoV-2 Differs between mRNA-1273 and BNT162b2 COVID-19 Vaccines and by History of SARS-CoV-2 Infection.** Tyner HL et al. Clin Infect Dis. 2021 Dec 20:ciab1038. doi: 10.1093/cid/ciab1038. Online ahead of print.

<https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciab1038/6470720>

RESULTS: Among 170 unvaccinated participants with SARS-CoV-2 infection, 158 (93%) developed neutralizing antibodies (nAb) with a GMT of 1,003 (95% CI=766-1,315). Among 139 previously uninfected participants, 138 (99%) developed nAb after mRNA vaccine dose-2 with a GMT of 3,257 (95% CI = 2,596-4,052). GMT was higher among those receiving mRNA-1273 vaccine (GMT =4,698, 95%CI= 3,186-6,926) compared to BNT162b2 vaccine (GMT=2,309, 95%CI=1,825-2,919). Among 32 participants with prior SARS-CoV-2 infection, GMT was 21,655 (95%CI=14,766-31,756) after mRNA vaccine dose-1, without further increase after dose-2.

CONCLUSIONS: A single dose of mRNA vaccine after SARS-CoV-2 infection resulted in the highest observed nAb response. Two doses of mRNA vaccine in previously uninfected participants resulted in higher nAb to SARS-CoV-2 than after one dose of vaccine or SARS-CoV-2 infection alone. Neutralizing antibody response also differed by mRNA vaccine product.

**33. Escape from recognition of SARS-CoV-2 Beta variant spike epitopes but overall preservation of T cell immunity.** Riou C et al. Sci Transl Med 2021 Dec 21. DOI: 10.1126/scitranslmed.abj6824

<https://www.science.org/doi/10.1126/scitranslmed.abj6824>

SARS-CoV-2 variants have emerged that escape neutralization and potentially impact vaccine efficacy. T cell responses play a role in protection from reinfection and severe disease, but the potential for spike mutations to affect T cell immunity is incompletely understood. We assessed neutralizing antibody and T cell responses in 44 South African COVID-19 patients infected either with the Beta variant (dominant from November 2020 to May 2021) or infected prior to its emergence (first wave, Wuhan strain), to provide an overall measure of immune evasion. We show that robust spike-specific CD4 and CD8 T cell responses were detectable in Beta-infected patients, similar to first wave patients. Using peptides spanning the Beta-mutated regions, we identified CD4 T cell responses targeting the

wild type peptides in 12/22 first wave patients, all of whom failed to recognize corresponding Beta-mutated peptides. However, responses to mutated regions formed only a small proportion (15.7%) of the overall CD4 response, and few patients (3/44) mounted CD8 responses that targeted the mutated regions. Among the spike epitopes tested, we identified three epitopes containing the D215, L18, or D80 residues that were specifically recognized by CD4 T cells, and their mutated versions were associated with a loss of response. This study shows that in spite of loss of recognition of immunogenic CD4 epitopes, CD4 and CD8 T cell responses to Beta are preserved overall. These observations may explain why several vaccines have retained the ability to protect against severe COVID-19 even with substantial loss of neutralizing antibody activity against Beta.

**34. Effectiveness of mRNA vaccines in preventing COVID-19 hospitalization by age and burden of chronic medical conditions among immunocompetent US adults, March-August 2021.** Lewis

NM et al. *J Infect Dis.* 2021 Dec 21:jiab619. doi: 10.1093/infdis/jiab619. Online ahead of print.

<https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiab619/6472998>

In a multi-state network, vaccine effectiveness (VE) against COVID-19 hospitalizations was evaluated among immunocompetent adults ( $\geq 18$ -years) during March-August 2021 using a case-control design. Among 1669 hospitalized COVID-19 cases (11% fully vaccinated) and 1950 RT-PCR-negative controls (54% fully vaccinated), VE was higher at 96% (95% CI: 93-98%) among patients with no chronic medical conditions than patients with  $\geq 3$  categories of conditions (83% [95% CI: 76-88%]). VE was similar between those aged 18-64 years vs  $\geq 65$  years ( $p > 0.05$ ). Vaccine effectiveness against severe COVID-19 was very high among adults without chronic conditions and lessened with increasing burden of comorbidities.

**35. Analysis of COVID-19 Vaccine Type and Adverse Effects Following Vaccination.** Beatty AL et al.

*JAMA Netw Open.* 2021 Dec 1;4(12):e2140364. doi: 10.1001/jamanetworkopen.2021.40364.

<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2787361>

**CONCLUSIONS AND RELEVANCE:** In this real-world cohort, serious COVID-19 vaccine adverse effects were rare and comparisons across brands could be made, revealing that full vaccination dose, vaccine brand, younger age, female sex, and having had COVID-19 before vaccination were associated with greater odds of adverse effects. Large digital cohort studies may provide a mechanism for independent postmarket surveillance of drugs and devices.

**36. Omicron variant showed lower neutralizing sensitivity than other SARS-CoV-2 variants to immune sera elicited by vaccines after boost.** Ai J et al. *Emerg Microbes Infect.* 2021 Dec 22:1-

24. doi: 10.1080/22221751.2021.2022440. Online ahead of print.

<https://www.tandfonline.com/doi/full/10.1080/22221751.2021.2022440>

In this study, we explored the immunogenicity of COVID-19 breakthrough patients, BBIBP-CorV homologous booster group and BBIBP-CorV/ZF2001 heterologous booster group against SARS-CoV-2 pseudotypes corresponding to the prototype, Beta, Delta, and the emergent Omicron variant. Notably, at 14 days post two-dose inactivated vaccines, pVNT titer increased to 67.4 GMTs against prototype, 8.85 against Beta and 35.07 against Delta, while neutralization activity against Omicron was below the lower limit of quantitation in 80% of the samples. At day 14 post BBIBP-CorV homologous booster vaccination, GMTs of pVNT significantly increased to 285.6, 215.7, 250.8, 48.73 against prototype, Beta, Delta, and Omicron, while at day 14 post ZF2001 heterologous booster vaccination, GMTs of

pVNT significantly increased to 1436.00, 789.6, 1501.00, 95.86, respectively. Post booster vaccination, 100% samples showed positive neutralization activity against Omicron, albeit illustrated a significant reduction (5.86- to 14.98-fold) of pVNT against Omicron compared to prototype at 14 days after the homologous or heterologous vaccine boosters. Overall, our study demonstrates that vaccine-induced immune protection might more likely be escaped by Omicron compared to prototypes and other VOCs. After two doses of inactivated whole-virion vaccines as the "priming" shot, a third heterologous protein subunit vaccine and a homologous inactivated vaccine booster could improve neutralization against Omicron.

**37. Outbreak of SARS-CoV-2 B.1.617.2 (Delta) variant in a nursing home 28 weeks after two doses of mRNA anti-Covid-19 vaccines: evidence of a waning immunity.** Pierobon A et al. Clin

Microbiol Infect. 2021 Dec 24:S1198-743X(21)00721-7. doi: 10.1016/j.cmi.2021.12.013. Online ahead of print.

[https://www.clinicalmicrobiologyandinfection.com/article/S1198-743X\(21\)00721-7/fulltext](https://www.clinicalmicrobiologyandinfection.com/article/S1198-743X(21)00721-7/fulltext)

RESULTS: 0/20 HWs and 14/59 (24%) residents fully vaccinated and without a previous SARS-CoV-2 infection showed anti-Spike IgG  $\leq$ 50 BAU/mL (1-sided Fisher exact  $p=0.011$ ). Among these residents, a level of anti-Spike IgG  $\leq$ 50 BAU/mL resulted in a higher risk of SARS-CoV-2 infection (RR=1.55, CI95% 1.17-2.05) and severe Covid-19 disease (RR=5.33, CI95% 1.83-15.57).

CONCLUSION: Low levels of SARS-CoV-2 neutralizing anti-Spike IgG in serum 28 weeks after the administration of the second dose parallels the waning of vaccine protection.

**38. Immunogenicity and Safety of a Three-Dose Regimen of a SARS-CoV-2 Inactivated Vaccine in Adults: A Randomized, Double-blind, Placebo-controlled Phase 2 Trial.** Liu J et al. J Infect Dis.

2021 Dec 27:jiab627. doi: 10.1093/infdis/jiab627. Online ahead of print.

<https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiab627/6484920>

RESULTS: Two doses of the vaccine elicited geometric mean titers (GMTs) of 102-119, 170-176, and 1449-1617 for the three antibodies in younger adults. Pseudovirus neutralizing and RBD-IgG GMTs were similar between older and younger adults. The third dose slightly ( $<1.5$  folds) increased GMTs. Seroconversion percentages were 94% or more after two doses, which were generally similar after three doses. The predominant AEs were injection-site pain. All the AEs were grade 1 or 2 in intensity. No serious AE was deemed related to study vaccination.

CONCLUSIONS: Two doses of this vaccine induced robust immune response and had good safety profile. A third dose given 28 days after the second dose elicited limited boosting antibody response.

**39. A New Testing Platform Using Fingertick Blood for Quantitative Antibody Response**

**Evaluation after SARS-CoV-2 Vaccination.** Du J et al. Emerg Microbes Infect. 2021 Dec 24:1-38.

doi: 10.1080/22221751.2021.2023328. Online ahead of print.

<https://www.tandfonline.com/doi/full/10.1080/22221751.2021.2023328>

In summary, the assay described here represents a sensitive, precise, accurate, and simple method for the quantitative detection and monitoring of post-vaccination anti-SARS-CoV-2 spike IgG responses.

**40. Association Between Immune Dysfunction and COVID-19 Breakthrough Infection After SARS-CoV-2 Vaccination in the US.** Sun J et al. JAMA Intern Med. 2021 Dec 28.

doi:10.1001/jamainternmed.2021.7024. Online ahead of print.

<https://jamanetwork.com/journals/jamainternalmedicine/article-abstract/2787643>

**CONCLUSIONS AND RELEVANCE:** This cohort study found that full vaccination was associated with reduced risk of COVID-19 breakthrough infection, regardless of the immune status of patients. Despite full vaccination, persons with immune dysfunction had substantially higher risk for COVID-19 breakthrough infection than those without such a condition. For persons with immune dysfunction, continued use of nonpharmaceutical interventions (eg, mask wearing) and alternative vaccine strategies (eg, additional doses or immunogenicity testing) are recommended even after full vaccination.

## Women & Children

- 41. Factors Associated With Severe Gastrointestinal Diagnoses in Children With SARS-CoV-2 Infection or Multisystem Inflammatory Syndrome.** Lo Vecchio A et al. JAMA Netw Open. 2021 Dec 1;4(12):e2139974. doi: 10.1001/jamanetworkopen.2021.39974.

<https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2787258>

**CONCLUSIONS AND RELEVANCE:** In this multicenter cohort study of Italian children with SARS-CoV-2 infection or MIS-C, 9.5% of the children had severe GI involvement, frequently associated with MIS-C. These findings suggest that prompt identification may improve the management of serious complications.

- 42. Multisystem Inflammatory Syndrome in Children by COVID-19 Vaccination Status of Adolescents in France.** Levy M et al. JAMA. 2021 Dec 20. doi: 10.1001/jama.2021.23262. Online ahead of print.

<https://jamanetwork.com/journals/jama/fullarticle/2787495>

COVID-19 mRNA vaccine immunogenicity and effectiveness are well established in adolescents.<sup>1</sup> However, the effect of vaccination on multisystem inflammatory syndrome in children (MIS-C),<sup>2</sup> a severe complication associated with SARS-CoV-2,<sup>3</sup> has not yet been described. Summer 2021 in France was marked by both a fourth wave of COVID-19 cases due to the Delta variant, with a peak in August 2021, and by the recommendation of the French Public Health Agency to vaccinate children 12 years and older. We estimated the risk of MIS-C among adolescents by COVID-19 vaccination status during September 2021 and October 2021.

- 43. Maternal and Neonatal SARS-CoV-2 Immunoglobulin G Antibody Levels at Delivery After Receipt of the BNT162b2 Messenger RNA COVID-19 Vaccine During the Second Trimester of Pregnancy.** Kugelman N et al. JAMA Pediatr. 2021 Dec 21. doi: 10.1001/jamapediatrics.2021.5683. Online ahead of print.

<https://jamanetwork.com/journals/jamapediatrics/fullarticle/2787270>

**CONCLUSIONS AND RELEVANCE:** In this cohort study, receipt of the BNT162b2 mRNA COVID-19 vaccine during the second trimester of pregnancy was associated with maternal and neonatal humoral responses, as reflected in maternal and neonatal SARS-CoV-2 IgG antibody levels measured after delivery. These findings support COVID-19 vaccination of pregnant individuals during the second trimester to achieve maternal protection and newborn safety during the pandemic.

**44. Risk factors for PICU admission and death among children and young people hospitalized with COVID-19 and PIMS-TS in England during the first pandemic year.** Ward JL et al. *Nat Med.* 2021 Dec 20. doi: 10.1038/s41591-021-01627-9. Online ahead of print.

<https://www.nature.com/articles/s41591-021-01627-9>

We identified 6,338 hospitalizations with COVID-19, of which 259 were admitted to a PICU and eight CYP died. We identified 712 hospitalizations with PIMS-TS, of which 312 were admitted to a PICU and fewer than five CYP died. Hospitalizations with COVID-19 and PIMS-TS were more common among males, older CYP, those from socioeconomically deprived neighborhoods and those who were of non-White ethnicity (Black, Asian, Mixed or Other). The odds of PICU admission were increased in CYP younger than 1 month old and decreased among 15-17 year olds compared to 1-4 year olds with COVID-19; increased in older CYP and females with PIMS-TS; and increased for Black compared to White ethnicity in patients with COVID-19 and PIMS-TS. Odds of PICU admission in COVID-19 were increased for CYP with comorbidities and highest for CYP with multiple medical problems. Increases in odds of PICU admission associated with different comorbidities in COVID-19 showed a similar pattern to other causes of hospitalization examined and, thus, likely reflect background vulnerabilities. These findings identify distinct risk factors associated with PICU admission among CYP with COVID-19 or PIMS-TS that might aid treatment and prevention strategies.

**45. Risk Factors for Severe COVID-19 in Children.** Woodruff RC et al. *Pediatrics.* 2021 Dec 22:e2021053418. doi: 10.1542/peds.2021-053418. Online ahead of print.

<https://publications.aap.org/pediatrics/article/doi/10.1542/peds.2021-053418/183463/Risk-Factors-for-Severe-COVID-19-in-Children>

**RESULTS:** Approximately 30% of hospitalized children had severe COVID-19; 0.5% died during hospitalization. Among hospitalized children aged <2 years, chronic lung disease (aRR: 2.2; 95% CI: 1.1-4.3), neurologic disorders (aRR: 2.0; 95% CI: 1.5-2.6), cardiovascular disease (aRR: 1.7; 95% CI: 1.2-2.3), prematurity (aRR: 1.6; 95% CI: 1.1-2.2), and airway abnormality (aRR: 1.6; 95% CI: 1.1-2.2) were associated with severe COVID-19. Among hospitalized children aged 2 to 17 years, feeding tube dependence (aRR: 2.0; 95% CI: 1.5-2.5), diabetes mellitus (aRR: 1.9; 95% CI: 1.6-2.3) and obesity (aRR: 1.2; 95% CI: 1.0-1.4) were associated with severe COVID-19. Severe COVID-19 occurred among 12.0 per 100 000 children overall and was highest among infants, Hispanic children, and non-Hispanic Black children.

**CONCLUSIONS:** Results identify children at potentially higher risk of severe COVID-19 who may benefit from prevention efforts, including vaccination. Rates establish a baseline for monitoring changes in pediatric illness severity after increased availability of COVID-19 vaccines and the emergence of new variants.

**46. SARS-CoV-2 infection during pregnancy and associated perinatal health outcomes: a national US cohort study.** Regan AK, Arah O, Fell DB, Sullivan SG. *J Infect Dis.* 2021 Dec 27:jiab626. doi: 10.1093/infdis/jiab626. Online ahead of print.

<https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiab626/6484616>

**RESULTS:** 2,655 (3.4%) pregnancies had a documented SARS-CoV-2 infection; 3.4% required admission to intensive care, invasive mechanical ventilation or ECMO treatment. COVID-19 during pregnancy was not associated with risk of miscarriage, antepartum hemorrhage, or stillbirth, but was associated with 2-3 fold higher risk of induced abortion (adjusted hazard ratio [aHR] 2.60, 95% CI 1.17-5.78), c-section

(aHR 1.99, 95% CI 1.71-2.31), clinician-initiated preterm birth (2.88; 95% CI 1.93, 4.30), spontaneous preterm birth (aHR 1.79, 95% CI 1.37-2.34), fetal growth restriction (aHR 2.04, 95% CI 1.72-2.43), and postpartum hemorrhage (aHR 2.03, 95% CI 1.6-2.63).

CONCLUSIONS: Prenatal SARS-CoV-2 infection was associated with increased risk of adverse pregnancy outcomes. Prevention could have fetal health benefits.

**47. Children develop robust and sustained cross-reactive spike-specific immune responses to SARS-CoV-2 infection.** Dowell AC et al. Nat Immunol. 2022 Jan;23(1):40-49. doi:

10.1038/s41590-021-01089-8. Epub 2021 Dec 22.

<https://www.nature.com/articles/s41590-021-01089-8>

SARS-CoV-2 infection is generally mild or asymptomatic in children but a biological basis for this outcome is unclear. Here we compare antibody and cellular immunity in children (aged 3-11 years) and adults. Antibody responses against spike protein were high in children and seroconversion boosted responses against seasonal Beta-coronaviruses through cross-recognition of the S2 domain. Neutralization of viral variants was comparable between children and adults. Spike-specific T cell responses were more than twice as high in children and were also detected in many seronegative children, indicating pre-existing cross-reactive responses to seasonal coronaviruses. Importantly, children retained antibody and cellular responses 6 months after infection, whereas relative waning occurred in adults. Spike-specific responses were also broadly stable beyond 12 months. Therefore, children generate robust, cross-reactive and sustained immune responses to SARS-CoV-2 with focused specificity for the spike protein. These findings provide insight into the relative clinical protection that occurs in most children and might help to guide the design of pediatric vaccination regimens.

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## FDA / CDC / NIH / WHO Updates

[CDC Updates and Shortens Recommended Isolation and Quarantine Period for General Population](#)

[CDC Releases Emergency Guidance for Healthcare Facilities to Prepare for Potential Omicron Surge](#)

[FDA Authorizes First Oral Antiviral for Treatment of COVID-19](#)

[FDA Authorizes Additional Oral Antiviral for Treatment of COVID-19 in Certain Adults](#)

[FDA: SARS-CoV-2 Viral Mutations: Impact on COVID-19 Tests](#)

[WHO recommendations on mask use by health workers, in light of the Omicron variant of concern: WHO interim guidelines, 22 December 2021](#)

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## Commentary & News

[Israel's COVID-19 team recommends 4th shot for 60+, medical workers](#)

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