

Prevention of SARS-CoV-2 Infection

Last Updated: March 24, 2022

Summary Recommendations
<ul style="list-style-type: none">• The COVID-19 Treatment Guidelines Panel (the Panel) recommends COVID-19 vaccination as soon as possible for everyone who is eligible according to the Centers for Disease Control and Prevention's Advisory Committee on Immunization Practices (AI).• The Panel recommends using tixagevimab 300 mg plus cilgavimab 300 mg (Evusheld) administered as 2 consecutive 3 mL intramuscular injections (BIII) as SARS-CoV-2 pre-exposure prophylaxis (PrEP) for adults and adolescents (aged ≥ 12 years and weighing ≥ 40 kg) who do not have SARS-CoV-2 infection, who have not been recently exposed to an individual with SARS-CoV-2 infection, AND who:<ul style="list-style-type: none">• Are moderately to severely immunocompromised and may have inadequate immune response to COVID-19 vaccination; <i>or</i>• Are not able to be fully vaccinated with any available COVID-19 vaccines due to a history of severe adverse reaction to a COVID-19 vaccine or any of its components.• For patients who have previously received a dose of tixagevimab 150 mg plus cilgavimab 150 mg, the Food and Drug Administration Emergency Use Authorization states that a second dose of tixagevimab 150 mg plus cilgavimab 150 mg should be given as soon as possible.• Tixagevimab plus cilgavimab is not a substitute for COVID-19 vaccination and should not be used in unvaccinated individuals for whom COVID-19 vaccination is recommended and who are anticipated to have an adequate response.• If supplies of tixagevimab plus cilgavimab are limited, priority for use as PrEP should be given to those who are at the highest risk for severe COVID-19.• The Panel recommends against the use of bamlanivimab plus etesevimab and casirivimab plus imdevimab for post-exposure prophylaxis (PEP), as the Omicron variant and its subvariants, which are not susceptible to these agents, are currently the predominant variants circulating in the United States (AIII).
Rating of Recommendations: A = Strong; B = Moderate; C = Optional
Rating of Evidence: I = One or more randomized trials without major limitations; IIa = Other randomized trials or subgroup analyses of randomized trials; IIb = Nonrandomized trials or observational cohort studies; III = Expert opinion

General Prevention Measures

Transmission of SARS-CoV-2 is thought to occur primarily through exposure to respiratory droplets. Exposure can occur when someone inhales droplets or particles that contain the virus (with the greatest risk of transmission occurring within 6 feet of an infectious source) or touches their mucous membranes with hands that have been contaminated with the virus. Exhaled droplets or particles can also deposit the virus onto exposed mucous membranes.¹

Less commonly, airborne transmission of small droplets and particles of SARS-CoV-2 to people farther than 6 feet away can occur; in rare cases, people passing through a room that was previously occupied by an infectious person may become infected. SARS-CoV-2 infection via airborne transmission of small particles tends to occur after prolonged exposure (i.e., >15 minutes) to an infectious person who is in an enclosed space with poor ventilation.¹

The risk of SARS-CoV-2 transmission can be reduced by covering coughs and sneezes and maintaining a distance of at least 6 feet from others. When consistent distancing is not possible, face coverings may reduce the spread of infectious droplets from individuals with SARS-CoV-2 infection to others. Frequent handwashing also effectively reduces the risk of infection.² Health care providers should follow the Centers for Disease Control and Prevention (CDC) recommendations for infection control and the appropriate use of personal protective equipment.³

Vaccines

Vaccination is the most effective way to prevent SARS-CoV-2 infection. The COVID-19 Treatment Guidelines Panel (the Panel) recommends COVID-19 vaccination as soon as possible for everyone who is eligible according to CDC's Advisory Committee on Immunization Practices (AI). Three vaccines are authorized or approved for use in the United States to prevent COVID-19. For primary and booster vaccinations, the mRNA vaccines (i.e., BNT162b2 [Pfizer-BioNTech] or mRNA-1273 [Moderna]) are preferable to the Ad26.COV2.S (Johnson & Johnson/Janssen) vaccine due to its risk of serious adverse events.⁴ A primary series of COVID-19 vaccinations is recommended for everyone aged ≥ 5 years in the United States. Everyone aged ≥ 12 years should also receive a booster dose at least 5 months after completion of the primary series of an mRNA vaccine (BNT162b2 or mRNA-1273) or at least 2 months after receipt of the primary, single-dose Ad26.COV2.S vaccine.⁵ The type and dose of vaccine and the timing of the primary and booster vaccinations depend on the recipient's age and underlying medical conditions. CDC regularly updates the clinical considerations for use of the COVID-19 vaccines currently approved by the Food and Drug Administration (FDA) or authorized for use in the United States.⁶

Adverse Events

COVID-19 vaccines are safe and effective. Local and systemic adverse events are relatively common with these vaccines. Most of the adverse events that occurred during vaccine trials were mild or moderate in severity (i.e., they did not prevent vaccinated people from engaging in daily activities) and resolved after 1 or 2 days. There have been a few reports of severe allergic reactions following COVID-19 vaccination, including rare reports of patients who experienced anaphylaxis after receiving an mRNA vaccine.^{7,8}

Reports have suggested that there is an increased risk of thrombosis with thrombocytopenia syndrome (TTS) in adults who have received the Ad26.COV2.S vaccine⁸ and, rarely, the mRNA-1273 vaccine.⁹ TTS is a rare but serious condition that causes blood clots in large blood vessels and low platelets. Women aged 30 to 49 years should be aware of the increased risk of this rare event. The American Society of Hematology and the American Heart Association/American Stroke Association Stroke Council leadership have published considerations that are relevant to the diagnosis and treatment of TTS that occurs in people who receive the Ad26.COV2.S vaccine. These considerations include information on administering a nonheparin anticoagulant and intravenous immunoglobulin to these patients.^{10,11} Given the rarity of this syndrome and the unique treatment required, consider consulting a hematologist when treating these patients.

Myocarditis and pericarditis after COVID-19 vaccination are rare, and most of the reported cases were very mild and self-limiting. These conditions have occurred most often in male adolescents, young adults, and people who have received mRNA vaccines.¹²

Guillain-Barré syndrome (GBS) in people who received the Ad26.COV2.S vaccine is rare. GBS is a neurologic disorder that causes muscle weakness and sometimes paralysis. Most people with GBS fully recover, but some have permanent nerve damage. Onset typically occurs about 2 weeks after vaccination. GBS has mostly been reported in men aged ≥ 50 years.¹²

CDC provides regular updates on selected [adverse events of COVID-19 vaccines](#) on its website.

Vaccination in Pregnant or Lactating People

Pregnant and lactating individuals were not included in the initial COVID-19 vaccine trials. However, CDC, the American College of Obstetricians and Gynecologists (ACOG), and the Society for Maternal-Fetal Medicine recommend vaccination for pregnant and lactating people based on the accumulated

safety and efficacy data on the use of these vaccines in pregnant people, as well as the increased risk of severe disease in pregnant individuals with COVID-19. These organizations also recommend vaccination for people who are trying to become pregnant now or who may become pregnant in the future.¹³⁻¹⁸ The ACOG publication includes a guide to assist clinicians during conversations about COVID-19 vaccination with pregnant patients.¹⁹

Pre-Exposure Prophylaxis

Anti-SARS-CoV-2 Monoclonal Antibodies

Vaccination remains the most effective way to prevent SARS-CoV-2 infection and should be considered the first line of prevention. However, some individuals cannot or may not mount an adequate protective response to COVID-19 vaccines. Other individuals may not have been fully vaccinated because of a history of a severe adverse reaction to a COVID-19 vaccine or its components.

Based on the results of PROVENT, a large randomized controlled trial (ClinicalTrials.gov Identifier [NCT04625725](https://clinicaltrials.gov/ct2/show/study/NCT04625725)) conducted when the major circulating SARS-CoV-2 variants were Alpha (B.1.1.7), Beta (B.1.351), Delta (B.1.617.2), and Epsilon (B.1.429), the FDA issued an Emergency Use Authorization (EUA) for the anti-SARS-CoV-2 monoclonal antibodies (mAbs) tixagevimab plus cilgavimab (Evusheld) as pre-exposure prophylaxis (PrEP) for certain individuals at high risk of progressing to severe COVID-19 if they become infected with SARS-CoV-2.²⁰ A modification in the fragment crystallizable (Fc) region gives these anti-SARS-CoV-2 mAbs prolonged half-lives, resulting in potential protection from SARS-CoV-2 infection for up to 6 months, depending on the variant.

The dose used in the PROVENT trial was tixagevimab 150 mg plus cilgavimab 150 mg, which was the dose initially authorized by the FDA. Recent in vitro data showed that the BA.1 and BA.1.1 subvariants of the Omicron variant, which are the predominant variants circulating in the United States, have decreased susceptibility to tixagevimab plus cilgavimab.²⁰⁻²³ Because of these findings, on February 24, 2022, the FDA revised the EUA to authorize tixagevimab 300 mg plus cilgavimab 300 mg as the dose for individuals receiving these anti-SARS-CoV-2 mAbs for the first time.²⁰ For those who received the dose initially authorized by the FDA, the revised FDA authorization recommends administration of an additional dose of tixagevimab 150 mg plus cilgavimab 150 mg as soon as possible. The Omicron BA.2 subvariant is now emerging and has been shown in vitro to retain near-full susceptibility to tixagevimab plus cilgavimab.^{20,23,24} If Omicron BA.2 becomes the predominant variant in select regions, dose recommendations could be further refined in the future.

When prescribing tixagevimab plus cilgavimab for SARS-CoV-2 PrEP, clinicians should be aware of some important limitations:

- Tixagevimab plus cilgavimab is authorized for use as PrEP in a population not well-represented in the PROVENT trial (i.e., a very small proportion of participants were immunocompromised).
- There are no clinical trial efficacy data on preventing symptomatic COVID-19 disease with the tixagevimab 300 mg plus cilgavimab 300 mg dose. The new dose is based on pharmacokinetic/pharmacodynamic (PK/PD) modeling that suggests this dose may have in vivo activity against the Omicron BA.1 and BA.1.1 subvariants.²⁵
- Substantial uncertainty in the PK/PD model remains. It is possible that the tixagevimab 300 mg plus cilgavimab 300 mg dose, even if active, would likely provide only a limited duration (≤ 3 months) of protection against the Omicron BA.1 and BA.1.1 subvariants. Limited data inform the timing for repeat doses after the initial dose, and repeat doses are not included in the current EUA.
- The safety of tixagevimab 300 mg plus cilgavimab 300 mg is primarily based on data obtained

from TACKLE, a Phase 3 clinical trial for the treatment of patients with mild to moderate COVID-19.²⁵

- The tixagevimab 150 mg plus cilgavimab 150 mg dose initially authorized by the FDA may not be sufficient for preventing COVID-19 caused by the Omicron BA.1 and BA.1.1 subvariants. No clinical data, and limited PK/PD data, guide the administration of repeat doses of tixagevimab 150 mg plus cilgavimab 150 mg. It is unknown whether the amount of time between the initial and repeat doses of tixagevimab 150 mg plus cilgavimab 150 mg alters the duration of protection against the Omicron BA.1 and BA.1.1 subvariants.

Factoring in the limitations outlined above:

- The Panel recommends using **tixagevimab 300 mg plus cilgavimab 300 mg** administered as 2 consecutive 3 mL intramuscular (IM) injections (**BIII**) as SARS-CoV-2 PrEP for adults and adolescents (aged ≥ 12 years and weighing ≥ 40 kg) who do not have SARS-CoV-2 infection, who have not been recently exposed to an individual with SARS-CoV-2 infection, who have not previously received this regimen, **AND** who:
 - Are moderately to severely immunocompromised and may have inadequate immune response to COVID-19 vaccination, *or*
 - Are not able to be fully vaccinated with any available COVID-19 vaccines due to a history of severe adverse reaction to a COVID-19 vaccine or any of its components.
- For patients who have previously received a dose of tixagevimab 150 mg plus cilgavimab 150 mg, the FDA EUA states that a second dose of tixagevimab 150 mg plus cilgavimab 150 mg should be given as soon as possible.
- **Tixagevimab plus cilgavimab is not a substitute for COVID-19 vaccination and should not be used in unvaccinated individuals for whom COVID-19 vaccination is recommended and who are anticipated to have an adequate response.**

Individuals who qualify as having moderate to severe immunocompromising conditions under the FDA EUA for tixagevimab plus cilgavimab are those who:

- Are receiving active treatment for solid tumors and hematologic malignancies.
- Received a solid organ transplant and are receiving immunosuppressive therapy.
- Received chimeric antigen receptor T cell therapy or a hematopoietic stem cell transplant (within 2 years of transplantation or receiving immunosuppression therapy).
- Have a moderate or severe primary immunodeficiency (e.g., DiGeorge syndrome, Wiskott-Aldrich syndrome).
- Have advanced or untreated HIV infection (defined as people with HIV and CD4 T lymphocyte counts < 200 cells/mm³, a history of an AIDS-defining illness without immune reconstitution, or clinical manifestations of symptomatic HIV).
- Are receiving active treatment with high-dose corticosteroids (i.e., ≥ 20 mg prednisone or equivalent per day when administered for ≥ 2 weeks), alkylating agents, antimetabolites, transplant-related immunosuppressive drugs, cancer chemotherapeutic agents classified as severely immunosuppressive, tumor-necrosis blockers, or other immunosuppressive or immunomodulatory biologic agents (e.g., B cell-depleting agents).

Additional Considerations

- Because there are no clinical efficacy data available for tixagevimab 300 mg plus cilgavimab 300 mg, and there are uncertainties about the extent and duration of protection against the Omicron

BA.1 and BA.1.1 subvariants, high-risk individuals who receive PrEP should continue to use other measures to protect themselves from infection, especially if these subvariants are circulating within their communities.

- The strength of the Panel's recommendation for tixagevimab 300 mg plus cilgavimab 300 mg is based partly on PK/PD modeling for the Omicron BA.1 and BA.1.1 subvariants and on the anticipation that the susceptible BA.2 subvariant will soon become dominant in the United States.
- If supplies of tixagevimab plus cilgavimab are limited, priority for use as PrEP should be given to those who are at the highest risk for severe COVID-19.
- If a person has received a COVID-19 vaccine, tixagevimab plus cilgavimab should be administered at least 2 weeks after vaccination.

Clinical Trial Data for Tixagevimab Plus Cilgavimab

PROVENT is an ongoing, Phase 3, double-blind, randomized, placebo-controlled trial that evaluated the use of tixagevimab plus cilgavimab for SARS-CoV-2 PrEP.²⁰ The study enrolled adults aged ≥ 18 years who had not received a COVID-19 vaccine and who were at increased risk of severe SARS-CoV-2 infection (e.g., those aged ≥ 60 years or those who had a prespecified comorbidity) or who had an increased risk of acquiring SARS-CoV-2 infection due to their occupation or living situation. The study excluded those with a history of confirmed SARS-CoV-2 infection or who had a positive SARS-CoV-2 antibody result at screening.

The analyzed population included participants who received a negative reverse transcription polymerase chain reaction (RT-PCR) result at baseline. Participants received either tixagevimab 150 mg plus cilgavimab 150 mg (administered as 2 consecutive IM injections; $n = 3,441$) or placebo (administered as 2 IM injections; $n = 1,731$). The primary endpoint was symptomatic SARS-CoV-2 infection and a positive RT-PCR result during the 183 days of follow-up.

During the study, once COVID-19 vaccines became available, participants could choose to be unblinded and receive the vaccine. Only the primary endpoints that occurred prior to unblinding or vaccine receipt were included in the analysis, resulting in a median follow-up of 83 days. Baseline characteristics were well-balanced between the arms. Prior to unblinding or vaccination, RT-PCR-confirmed symptomatic SARS-CoV-2 infection was reported for 8 participants (0.2%) in the tixagevimab plus cilgavimab arm and 17 participants (1.0%) in the placebo arm, representing a 77% reduction in the incidence of infection in the tixagevimab plus cilgavimab arm (95% CI, 46% to 90%; $P < 0.001$). A post hoc analysis after a median follow-up period of 6.5 months showed a similar relative risk reduction for symptomatic infection in the tixagevimab plus cilgavimab arm.

Adverse events were reported for 35% of participants in the tixagevimab plus cilgavimab arm and 34% of participants in the placebo arm. Serious adverse events were reported in 1% of participants in each arm; 1 participant in the tixagevimab plus cilgavimab arm had an anaphylactic reaction that was resolved with epinephrine therapy. The incidence of adverse events was similar in both study arms; most events were mild (73%) or moderate (24%). Rare, serious cardiac adverse events occurred in 0.6% of participants in the tixagevimab plus cilgavimab arm and in 0.2% of participants in the placebo arm. All participants who experienced a cardiac event had cardiac risk factors or a history of cardiac disease at baseline. There was no clear temporal pattern between these serious cardiac adverse events and administration of the mAbs.

TACKLE was a Phase 3 trial for the treatment of nonhospitalized patients with mild to moderate COVID-19. In this study, 452 high-risk adults aged ≥ 18 years received a single IM dose of tixagevimab 300 mg plus cilgavimab 300 mg and had a follow-up visit within 183 days (the median follow-up was 84 days). Adverse events were reported for 29% of participants in the tixagevimab plus cilgavimab arm

and for 36% of participants in the placebo arm; the majority of events were mild to moderate in severity. Serious cardiac adverse events were reported for 4 participants; 3 had received tixagevimab plus cilgavimab and 1 had received placebo. All events occurred in participants who had cardiac risk factors or a history of cardiovascular disease.²⁰

Other Drugs for Pre-Exposure Prophylaxis

- The Panel **recommends against** the use of any oral drugs for SARS-CoV-2 PrEP, except in a clinical trial (AIII).

Clinical trials are investigating several agents, including emtricitabine plus tenofovir alafenamide or tenofovir disoproxil fumarate, hydroxychloroquine, ivermectin, and supplements such as zinc, vitamin C, and vitamin D. Please check [ClinicalTrials.gov](https://clinicaltrials.gov) for the latest information.

Hydroxychloroquine, given at different doses and durations, has been studied in randomized controlled trials to assess whether it could prevent SARS-CoV-2 infection in those at risk for being exposed to infected individuals, such as health care workers. One study reported no evidence of a benefit of hydroxychloroquine, and it was ultimately halted due to futility before it reached its target enrollment.²⁶ In another hydroxychloroquine study, which also did not meet its target enrollment and was stopped early, the majority of the potential transmission events were not confirmed by virologic testing.²⁷ Neither study demonstrated any evidence of a reduction in rate of acquiring infection. Both studies reported an increased frequency of mild adverse events in the treatment group.

Post-Exposure Prophylaxis

Anti-SARS-CoV-2 Monoclonal Antibodies

- The Panel **recommends against** the use of **bamlanivimab plus etesevimab** and **casirivimab plus imdevimab** for post-exposure prophylaxis (PEP), as the Omicron variant, which is not susceptible to these agents, is currently the predominant variant circulating in the United States (AIII).

Vaccination remains a highly effective way to prevent SARS-CoV-2 infection. However, despite widespread availability of COVID-19 vaccines, some individuals are not fully vaccinated or cannot mount an adequate response to the vaccine. Some of these individuals, if infected, are at high risk of progressing to serious COVID-19. Bamlanivimab plus etesevimab and casirivimab plus imdevimab have previously received FDA EUAs for PEP; however, the predominant variant currently circulating in the United States is the Omicron variant. The Panel **recommends against** the use of these anti-SARS-CoV-2 mAbs because the Omicron variant is not susceptible to them (AIII).

Chloroquine and Hydroxychloroquine

- The Panel **recommends against** the use of **hydroxychloroquine** for SARS-CoV-2 PEP (AI).

Both chloroquine and hydroxychloroquine have in vitro activity against SARS-CoV and SARS-CoV-2.^{28,29} A small cohort study without a control group suggested that hydroxychloroquine might reduce the risk of SARS-CoV-2 transmission to close contacts.³⁰ There have been several large trials to determine whether hydroxychloroquine can reduce the risk of infection after exposure to individuals infected with SARS-CoV-2. These studies used different dose schedules and targeted different at-risk populations. In addition, some studies were unable to confirm infection using molecular or antigen tests. None of these studies demonstrated any evidence of efficacy for hydroxychloroquine, and all showed a higher risk of generally mild adverse events in those who received the drug.³¹⁻³³

Other Drugs for Post-Exposure Prophylaxis

- The Panel **recommends against** the use of other drugs for SARS-CoV-2 PEP, except in a clinical trial (AIII).

A number of other agents (e.g., ivermectin, hyperimmune gamma globulin, convalescent plasma, interferons, tenofovir with or without emtricitabine, vitamin D) are currently being investigated for SARS-CoV-2 PEP. The latest clinical trials for SARS-CoV-2 PEP can be found at [ClinicalTrials.gov](https://www.clinicaltrials.gov).

High concentrations of ivermectin have been shown to inhibit SARS-CoV-2 replication in vitro.^{34,35} Population data indicated that countrywide, mass-use of prophylactic chemotherapy for parasitic infections, including the use of ivermectin, was associated with a lower incidence of COVID-19.³⁶ At this time, few clinical trials have evaluated the safety and efficacy of using ivermectin for SARS-CoV-2 PrEP or PEP. Although several studies have reported potentially promising results, the findings are limited by the design of the studies, their small sample sizes, and the lack of details regarding the safety and efficacy of ivermectin.

In a descriptive, uncontrolled, interventional study of 33 contacts of patients with laboratory-confirmed COVID-19, no cases of SARS-CoV-2 infection were identified within 21 days of initiating ivermectin for PEP.³⁷ In a small, case-control study in SARS-CoV-2-exposed health care workers, 186 participants who became infected were matched with 186 uninfected controls. Of those who received ivermectin after exposure to SARS-CoV-2, 38 were in the infected group and 77 were in the uninfected group, which led the investigators to conclude that ivermectin reduced the incidence of SARS-CoV-2 infection.³⁸

References

1. Centers for Disease Control and Prevention. Scientific brief: SARS-CoV-2 transmission. 2021. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/sars-cov-2-transmission.html>. Accessed March 18, 2022.
2. Centers for Disease Control and Prevention. COVID-19: how to protect yourself & others. 2021. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html>. Accessed March 18, 2022.
3. Centers for Disease Control and Prevention. Infection control guidance for healthcare professionals about coronavirus (COVID-19). 2020. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control.html>. Accessed March 18, 2022.
4. Centers for Disease Control and Prevention. Johnson & Johnson's Janssen COVID-19 vaccine overview and safety. 2022. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines/janssen.html>. Accessed January 26, 2022.
5. Centers for Disease Control and Prevention. Stay up to date with your COVID-19 vaccines. 2022. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/different-vaccines.html>. Accessed March 22, 2022.
6. Centers for Disease Control and Prevention. Use of COVID-19 vaccines in the United States: interim clinical considerations. 2022. Available at: <https://www.cdc.gov/vaccines/covid-19/clinical-considerations/covid-19-vaccines-us.html>. Accessed March 21, 2022.
7. Centers for Disease Control and Prevention. Interim considerations: preparing for the potential management of anaphylaxis after COVID-19 vaccination. 2020. Available at: <https://www.cdc.gov/vaccines/covid-19/info-by-product/pfizer/anaphylaxis-management.html>. Accessed March 22, 2022.
8. Food and Drug Administration. Fact sheet for healthcare providers administering vaccine (vaccination providers): emergency use authorization (EUA) of the Janssen COVID-19 vaccine to prevent coronavirus disease 2019 (COVID-19). 2022. Available at: <https://www.fda.gov/media/146304/download>.
9. See I, Lale A, Marquez P, et al. Case series of thrombosis with thrombocytopenia syndrome after COVID-19 vaccination—United States, December 2020 to August 2021. *Ann Intern Med*. 2022. Available at:

<https://www.ncbi.nlm.nih.gov/pubmed/35038274>.

10. American Society of Hematology. Vaccine-induced immune thrombotic thrombocytopenia. 2022. Available at: <https://www.hematology.org/covid-19/vaccine-induced-immune-thrombotic-thrombocytopenia>. Accessed March 22, 2022.
11. Furie KL, Cushman M, Elkind MSV, et al. Diagnosis and management of cerebral venous sinus thrombosis with vaccine-induced immune thrombotic thrombocytopenia. *Stroke*. 2021;52(7):2478-2482. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33914590>.
12. Centers for Disease Control and Prevention. Selected adverse events reported after COVID-19 vaccination. 2022. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/safety/adverse-events.html>. Accessed March 22, 2022.
13. Centers for Disease Control and Prevention. COVID-19 vaccines while pregnant or breastfeeding. 2022. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations/pregnancy.html>. Accessed March 22, 2022.
14. Society for Maternal-Fetal Medicine. Publications and clinical guidance. 2022. Available at: <https://www.smfm.org/covidclinical>. Accessed March 22, 2022.
15. Shimabukuro TT, Kim SY, Myers TR, et al. Preliminary findings of mRNA COVID-19 vaccine safety in pregnant persons. *N Engl J Med*. 2021;384(24):2273-2282. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33882218>.
16. Zauche LH, Wallace B, Smoots AN, et al. Receipt of mRNA COVID-19 vaccines and risk of spontaneous abortion. *N Engl J Med*. 2021;385(16):1533-1535. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/34496196>.
17. Goldshtein I, Nevo D, Steinberg DM, et al. Association between BNT162b2 vaccination and incidence of SARS-CoV-2 infection in pregnant women. *JAMA*. 2021;326(8):728-735. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/34251417>.
18. Collier AY, McMahan K, Yu J, et al. Immunogenicity of COVID-19 mRNA vaccines in pregnant and lactating women. *JAMA*. 2021;325(23):2370-2380. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33983379>.
19. The American College of Obstetricians and Gynecologists. Practice advisory: COVID-19 vaccination considerations for obstetric-gynecologic care. 2020. Available at: <https://www.acog.org/clinical/clinical-guidance/practice-advisory/articles/2020/12/vaccinating-pregnant-and-lactating-patients-against-covid-19>. Accessed March 22, 2022.
20. Food and Drug Administration. Fact sheet for healthcare providers: emergency use authorization for Evusheld (tixagevimab co-packaged with cilgavimab). 2022. Available at: <https://www.fda.gov/media/154701/download>.
21. Cameroni E, Bowen JE, Rosen LE, et al. Broadly neutralizing antibodies overcome SARS-CoV-2 Omicron antigenic shift. *Nature*. 2022;602(7898):664-670. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/35016195>.
22. Takashita E, Kinoshita N, Yamayoshi S, et al. Efficacy of antibodies and antiviral drugs against Covid-19 omicron variant. *N Engl J Med*. 2022;386(10):995-998. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/35081300>.
23. Iketani S, Liu L, Guo Y, et al. Antibody evasion properties of SARS-CoV-2 omicron sublineages. *bioRxiv*. 2022;Preprint. Available at: <https://www.biorxiv.org/content/10.1101/2022.02.07.479306v1>.
24. Takashita E, Kinoshita N, Yamayoshi S, et al. Efficacy of antiviral agents against the SARS-CoV-2 omicron subvariant BA.2. *N Engl J Med*. 2022. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/35263535>.
25. Food and Drug Administration. Emergency Use Authorization (EUA) for Evusheld. 2022. Available at: <https://www.fda.gov/media/156674/download>.
26. Abella BS, Jolkovsky EL, Biney BT, et al. Efficacy and safety of hydroxychloroquine vs placebo for pre-exposure SARS-CoV-2 prophylaxis among health care workers: a randomized clinical trial. *JAMA Intern Med*.

- 2021;181(2):195-202. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33001138>.
27. Rajasingham R, Bangdiwala AS, Nicol MR, et al. Hydroxychloroquine as pre-exposure prophylaxis for coronavirus disease 2019 (COVID-19) in healthcare workers: a randomized trial. *Clin Infect Dis*. 2021;72(11):e835-e843. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33068425>.
 28. Yao X, Ye F, Zhang M, et al. In vitro antiviral activity and projection of optimized dosing design of hydroxychloroquine for the treatment of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). *Clin Infect Dis*. 2020;71(15):732-739. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/32150618>.
 29. Vincent MJ, Bergeron E, Benjannet S, et al. Chloroquine is a potent inhibitor of SARS coronavirus infection and spread. *Virology*. 2005;2:69. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/16115318>.
 30. Lee SH, Son H, Peck KR. Can post-exposure prophylaxis for COVID-19 be considered as an outbreak response strategy in long-term care hospitals? *Int J Antimicrob Agents*. 2020;55(6):105988. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/32305587>.
 31. Barnabas RV, Brown ER, Bershteyn A, et al. Hydroxychloroquine as postexposure prophylaxis to prevent severe acute respiratory syndrome coronavirus 2 infection: a randomized trial. *Ann Intern Med*. 2021;174(3):344-352. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33284679>.
 32. Boulware DR, Pullen MF, Bangdiwala AS, et al. A randomized trial of hydroxychloroquine as postexposure prophylaxis for COVID-19. *N Engl J Med*. 2020;383(6):517-525. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/32492293>.
 33. Mitja O, Corbacho-Monne M, Ubals M, et al. A cluster-randomized trial of hydroxychloroquine for prevention of COVID-19. *N Engl J Med*. 2021;384(5):417-427. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33289973>.
 34. Caly L, Druce JD, Catton MG, Jans DA, Wagstaff KM. The FDA-approved drug ivermectin inhibits the replication of SARS-CoV-2 in vitro. *Antiviral Res*. 2020;178:104787. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/32251768>.
 35. Belhadj Z, Meot M, Bajolle F, et al. Acute heart failure in multisystem inflammatory syndrome in children in the context of global SARS-CoV-2 pandemic. *Circulation*. 2020;142(5):429-436. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/32418446>.
 36. Hellwig MD, Maia A. A COVID-19 prophylaxis? Lower incidence associated with prophylactic administration of ivermectin. *Int J Antimicrob Agents*. 2021;57(1):106248. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33259913>.
 37. Aguirre Chang G FA. COVID-19: post-exposure prophylaxis with ivermectin in contacts. At homes, places of work, nursing homes, prisons, and others. *ResearchGate*. 2020;Preprint. Available at: https://www.researchgate.net/publication/344781515_COVID-19_POST-EXPOSURE_PROPHYLAXIS_WITH_IVERMECTIN_IN_CONTACTS.
 38. Behera P, Patro BK, Singh AK, et al. Role of ivermectin in the prevention of SARS-CoV-2 infection among healthcare workers in India: a matched case-control study. *PLoS One*. 2021;16(2):e0247163. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33592050>.