

Interim recommendations for use of the Moderna mRNA-1273 vaccine against COVID-19

Interim guidance

First issued 25 January 2021

Updated 15 June 2021

Updated 19 November 2021

Updated 23 February 2022

Updated 18 August 2022



Background

This interim guidance has been developed on the basis of the advice issued by the Strategic Advisory Group of Experts (SAGE) on Immunization at its extraordinary meeting on 21 January 2021 (1), consecutively updated at the extraordinary SAGE meeting on 27 May 2021 (2), updated in writing on 19 November 2021, 23 February 2022 and last updated at the extraordinary SAGE meeting on 11 August 2022 (3).

Declarations of interests were collected from all external contributors and assessed for any conflicts of interest. Summaries of the reported interests can be found on the [SAGE meeting webpage](#) and [SAGE Working Group webpage](#).

The guidance here is based on the evidence summarized in the Background document on the Moderna mRNA-1273 vaccine against COVID-19 (4).

[Annexes](#) (5) which include GRADE and evidence-to-recommendations (ETR) tables have also been updated to reflect the updated recommendations.

All referenced documents are available on the SAGE COVID-19 webpage: <https://www.who.int/groups/strategic-advisory-group-of-experts-on-immunization/covid-19-materials>.

These interim recommendations¹ refer to the mRNA-1273 vaccine, manufactured by Moderna. The vaccine is also known as COVID-19 Vaccine Moderna. In some countries, the vaccine is known under the trade name of “Spikevax”. In the subsequent text the vaccine will be referred to as mRNA-1273. On 30 April 2021, mRNA-1273 was granted WHO’s Emergency Use Listing (EUL).

¹ The recommendations contained in this publication are based on the advice of independent experts, who have considered the best available evidence, a risk–benefit analysis and other factors, as appropriate. This publication may include recommendations on the use of medicinal products for an indication, in a dosage form, dose regimen, population or other use parameters that are not included in the approved labelling. Relevant stakeholders should familiarize themselves with applicable national legal and ethical requirements. WHO does not accept any liability for the procurement, distribution and/or administration of any product for any use.

Methods

SAGE applies the principles of evidence-based medicine and has set in place a thorough methodological process for issuing and updating recommendations (6). A detailed description of the methodological processes as they apply to COVID-19 vaccines can be found in the SAGE evidence framework for COVID-19 vaccines (7). This framework contains guidance on considering data emerging from clinical trials in relation to the issuance of vaccine-specific evidence-based recommendations.

Goal and strategy for the use of the mRNA-1273 vaccine against COVID-19

The COVID-19 pandemic has caused significant morbidity and mortality throughout the world, as well as major social, educational and economic disruptions. There remains an urgent global need to make COVID-19 vaccines available and deploy them at scale and equitably across all countries. Countries are recommended to use the WHO Prioritization Roadmap (8) and the WHO Values Framework (9) as guidance for their prioritization of target groups. The WHO Prioritization Roadmap recommends that priority of vaccine use be given to the highest priority-use groups (health workers, older persons, persons with moderate to severe immunocompromising conditions), and high priority-use groups (persons with comorbidities, teachers, pregnant women etc). Within the capacity of programmes and vaccine availability, additional priority-use groups should be vaccinated as outlined in the WHO Prioritization Roadmap, taking into account national epidemiological data and other relevant considerations.

Vaccine performance

The initial results of the phase 3 trial in persons aged ≥ 18 years, conducted in 2020, showed an efficacy in preventing COVID-19 of any severity of COVID-19 of 94% (10). After a median follow-up of 5.3 months at the end of the blinded phase of the trial, vaccine efficacy in preventing COVID-19 was 93% (95% confidence interval [CI]: 91–95%); in preventing severe disease, efficacy was 98% (95% CI: 93–100%); and in preventing asymptomatic infection, 63% (95% CI: 57–69%) (11). Antibody levels declined but remained high throughout this period. The geometric mean titre was lower in those aged ≥ 56 years than in trial participants aged 18–55 years (12). Several studies have shown that the mRNA-1273 vaccine is effective in preventing symptomatic laboratory confirmed COVID-19 (pooled effectiveness = 89.2% [95% CI: 82.0–98.6%]); hospitalizations (pooled effectiveness was estimated to be 95% [95% CI: 93 to 96%]); and deaths (pooled effectiveness: 94% [95% CI: 92–95%]) (13).

Interval between dose 1 and dose 2

Vaccine effectiveness was significantly higher against both infection and hospitalization with a longer 7–8-week interval between doses versus the manufacturer-specified 3–4-week interval (14). An inter-dose interval of 8 weeks or longer was associated with a lower risk of myocarditis compared to the 4-week interval (15).

Duration of protection and first booster dose

Vaccine effectiveness against any PCR-confirmed infection in a study in the Czech Republic declined from 90% (95% CI: 89–91%) at 0–2 months, to 65% (95% CI: 63–67%) at 7–8 months after receipt of the second dose. Vaccine effectiveness against hospital admissions and deaths declined at significantly lower rates: at around 15% and 10% respectively during the first 6–8 months after dose 2. The administration of a booster dose returned protection to a rate equal to, or above, the estimates in the first 2 months after dose 2 (16).

Administration of a booster dose of 50 μg at least 6 months after the 100 μg mRNA-1273 primary series increased neutralizing antibody titres by 13-fold, 1 month after vaccination compared to pre-booster levels (17). The reactogenicity and adverse event profile observed after the booster dose was generally similar to that observed following dose 2 of the initial 2-dose regimen, which suggests no potentiation of reactogenicity or any new safety signals arising from administration of a third dose.

Variants of concern:

Delta: A large, post-licensure study conducted in southern California in the United States of America, showed that the effectiveness of a 2-dose regimen of mRNA-1273 against Delta infection was 79.8% (95% CI: 67.4–87.5%) and waned slowly over 9–12 months to 57.5% (95% CI: 50.4–63.6%), while the effectiveness following a booster dose was high (94.0% [(95% CI: 92.3–95.4%)] and durable through ~6 months (18). The effectiveness of 2 and 3 doses against hospitalization with Delta were both more than 98%. A post-introduction observational study among 3689 adults aged ≥18 years who were hospitalized in the United States during 11 March to 15 August, 2021, which included the Delta variant surge, showed vaccine effectiveness against hospitalizations of 93% (95% CI: 91–95%) (19). The effectiveness against mild infections in health workers was 91% (95% CI: 81–96%) during the months preceding the emergence of the Delta variant and declined to 66% (95% CI: 26–84%) when the Delta variant became the predominant virus strain, which could reflect waning immunity or reduced effectiveness because of Delta variant prevalence, or both (20).

Omicron: A large, post-licensure study conducted in southern California during December 2021, when Omicron surged, showed that the effectiveness of a 2-dose regimen of mRNA-1273 against Omicron infection was 42.8% (95% CI: 33.8–50.7%) and quickly declined from day 91 to the end of the observation period (>270 days). Vaccine effectiveness against infection after a booster dose rose to 67.9% (95% CI: 65.8–69.9%). The effectiveness of 2 and 3 doses against hospitalization with Omicron was 74.8% (95% CI: 2.4–93.5%) and 99.7% (95% CI: 82.2–100.0%), respectively (18). In the United Kingdom, vaccine effectiveness against *symptomatic* Omicron variant infections after 2 doses of mRNA-1273 declined from around 65% to 70%, 2–4 weeks after dose 2, to around 10% by 25 weeks after dose 2. In the period 2–4 weeks after a booster dose of mRNA-1273, effectiveness ranged from around 60% to 75%, dropping to 25% to 40%, 15 or more weeks after the booster dose (21).

Second boosters:

A relative vaccine effectiveness from a different mRNA vaccine was found to be 62% (95% CI, 50-74) against severe COVID-19, and 74% (95% CI, 50 to 90) against COVID-19 related death comparing 3 dose recipients to 4 dose recipients (22). A study from Israel, also from a different mRNA vaccine, demonstrated overall breakthrough infection rates of 368 of 5331 (7%) in the 4-dose group and of 4802 of 24280 (20%) in the 3-dose group (relative risk, 0.35; 95% CI, 0.32-0.39) (23). A further analysis of the risk of severe COVID-19 from 7 days to 30 days post fourth dose showed 42.1 events per 100,000 persons, as compared with 110.8 events per 100,000 persons in the 3-dose recipient comparison group.

Adolescents aged 12-17 years:

A phase 2/3 trial of mRNA-1273 in adolescents aged 12–17 years (2489 vaccine recipients and 1243 placebo recipients) showed that the vaccine was well tolerated, immunogenic, and efficacious (24). Vaccine efficacy against symptomatic illness was 93% (95% CI: 48–100%) in the pre-Omicron period. Immunogenicity and the reactogenicity profiles were similar to those previously shown for young adults (24).

Children aged 6 -11 years

Immunogenicity in participants 6-11 years of age was compared to immunogenicity from a subset of participants 18-25 years of age from a Phase 2/3 trial, for whom clinical efficacy has been demonstrated. The geometric mean titer ratio of neutralizing antibodies in children as compared with young adults was 1.2 (95% CI, 1.1 to 1.4), and the between-group difference in the serologic response was 0.1 percentage points (95% CI, -1.9 to 2.1), findings that met the noninferiority criterion for the coprimary immunogenicity objective. Vaccine efficacy was descriptively analysed as a secondary endpoint in the study. Estimated vaccine efficacy was 88% (95% CI, 70 to 96) against Covid-19 occurring 14 days or more after the first injection, at a time when B.1.617.2 (delta) was the dominant circulating variant (25, 26). Post-introduction data with another mRNA vaccine indicate a VE against hospitalization of 68% at median of 37 days after the second dose in children aged 5–11 years, a VE of 40% against infection during the 2 months after the second dose in children aged 5–11 years) (27). mRNA vaccine effectiveness against MIS-C remained high (78%) among children aged 5–11 years.

Children aged 6 months-5 years

A randomized, double-blind, placebo-controlled phase 2/3 trial was conducted in 6,388 participants, with a median blinded follow-up after dose 2 of 68 days for children aged 6–23 months and 71 days for children aged 2–5 years. Vaccine efficacy ≥ 14 days after dose 2 was 37% (95% CI, 13 to 54) for 2–5 year olds and 51% (95% CI, 21 to 69%) for 6–23 month olds in preventing symptomatic, laboratory-confirmed COVID-19 in childrens with or without evidence of previous SARS-CoV-2 infection (CDC case definition) (25, 28). No severe cases were reported. Vaccine efficacy against asymptomatic, laboratory-confirmed SARS-CoV-2 infection was 16% (95% CI = –19%–41%) among children aged 6 months–5 years with or without evidence of previous SARS-CoV-2 infection. After dose 2, 66% of caregivers reported any local reaction among the child vaccine recipients after vaccination, and 65.9% reported any systemic reaction; most reactions were mild to moderate with symptom onset 1–2 days after vaccination and resolving after 2–3 days. Reactogenicity was generally less frequent in children aged 6 months–5 years than in those aged 6–11 years. No cases of myocarditis were observed during the trial, but sample size is too small to draw conclusions.

Intended use according to the vaccine label

Persons aged 6 months and older.

WHO recommendation for use

For prioritization by age and other considerations, please see the WHO Prioritization Roadmap (8). Healthy children and adolescents belong to the lowest priority-use group, children and adolescents with comorbidities belong to the medium priority-use group, and children and adolescents with moderate to severe immunocompromising conditions belong to the highest priority-use group.

Administration

For persons aged 12 and above, the schedule, as per manufacturer specification, is 2 doses (100 μg , 0.5 ml each), given intramuscularly into the deltoid muscle, 4 weeks apart.

For children aged 6 to 11 years, the schedule as per manufacturer specification is 2 doses (50 μg in 0.25 ml each), 4 weeks apart.

For children aged 6 months to 5 years, the schedule, as per manufacturer specification, is 2 doses (25 μg [0.25 ml each), 4 weeks apart.

WHO recommends that the second dose should be administered 4–8 weeks after the first dose; an interval of 8 weeks between doses is preferred as this interval is associated with higher vaccine effectiveness and lower risk of myocarditis. However, these considerations should be balanced against the need to achieve quick protection, in particular for high risk groups, in settings of high transmission intensity and circulating variants of concern.

Booster doses

Booster doses are administered to a vaccinated population that has completed a *primary vaccination series* when, with time, the immunity and clinical protection has fallen below a rate deemed sufficient in that population. The objective of a booster dose is to restore vaccine effectiveness.

In accordance with the WHO Prioritization Roadmap, a first booster dose (50 μg at 0.25 ml, *i.e.* half the dose used in the *primary series*) is recommended for the highest priority-use groups (e.g. older adults, persons with moderate to severe immunocompromising conditions, and health workers), 4–6 months after the completion of the primary series. Once high booster dose coverage has been achieved in the highest priority-use group or booster dose uptake slows considerably in the highest

priority-use groups, countries should also consider a booster for lower priority-use groups.² If more than 6 months have elapsed since completion of the primary series, the booster dose should be given at the earliest opportunity.

To further reduce the risk of severe disease, deaths and disruptions of health services, WHO recommends countries should consider a second booster dose 4-6 months after the first booster dose for all older persons (age specific cut-off should be defined by countries based on local COVID-19 epidemiology), all persons with moderate and severe immunocompromising conditions, regardless of age, adults with comorbidities that put them at higher risk of severe disease, pregnant women and health workers (<https://www.who.int/publications/i/item/WHO-2019-nCoV-vaccines-SAGE-good-practice-statement-second-booster>).

For children below the age of 12, there is currently no recommendation for booster doses except for children with immunocompromising conditions. If more data become available for the need of booster doses in this age group, this recommendation will be updated.

Interchangeability with doses of other COVID-19 vaccines (heterologous schedules)

WHO supports a flexible approach to using different EUL COVID-19 vaccine products for different doses (heterologous schedule), and considers a total of 2 doses of any combination of EUL COVID-19 vaccines (e.g. 1 dose of mRNA-1273 vaccine, and 1 dose of another EUL COVID-19 vaccine) to be a complete primary series. Heterologous vaccination (including boosters) should only be implemented with careful consideration of current vaccine supply, vaccine supply projections, and other access considerations, alongside the potential benefits and risks of the specific products being used.

Heterologous booster

For persons aged 12 and above, a 50 µg dose of mRNA-1273 vaccine may be used as a booster dose following a completed primary series using any other EUL COVID-19 vaccine platform (29).

Co-administration with vaccines other vaccines

Based on several co-administration studies of COVID-19 vaccines and inferred from co-administration studies of other adult vaccines, COVID-19 vaccines may be given concomitantly, or any time before or after, other adult vaccines including live attenuated, inactivated, adjuvanted, or non-adjuvanted vaccines (30). When administered concomitantly, the vaccines should be injected in separate sites, preferably different extremities. Continued pharmacovigilance monitoring is recommended.

Contraindications

A history of anaphylaxis to any component of the vaccine is a contraindication to vaccination. If anaphylaxis occurs after the first dose, a second dose of the vaccine should not be administered.

Precautions

A history of anaphylaxis to any other vaccine or injectable therapy (i.e., intramuscular, intravenous, or subcutaneous vaccines or therapies) is considered as a precaution but not a contraindication to vaccination. For such persons, a risk assessment should be conducted by a health professional. It remains uncertain if there is an increased risk of anaphylaxis, but counselling should be

² In some circumstances, there may be a relatively close trade-off in optimizing the impact of vaccine use between offering booster doses to older adults to avert more hospitalizations and deaths versus offering primary series doses to the remaining adults, adolescents, and children, that depend on country conditions, including supply and roll-out timelines, past epidemic dynamics and infection-induced immunity, vaccine product, vaccine effectiveness, and waning of protection.

given about the potential risk of anaphylaxis and the risks should be weighed against the benefits of vaccination. Such persons should be observed for 30 minutes after vaccination in health-care settings where anaphylaxis can be immediately treated.

In general, persons with an immediate non-anaphylactic allergic reaction to the first dose (such as urticaria, angioedema or respiratory symptoms without any other symptoms (cough, wheezing, stridor), that occur within 4 hours of administration) should not receive additional doses, unless recommended after review by a health professional with specialist expertise. However, subject to individual risk–benefit assessment, mRNA-1273 could be provided under close medical supervision if it is the only available option for persons at high risk of severe COVID-19.

In the United States anaphylaxis occurred at a rate of 2.5 cases per million mRNA-1273 doses administered (31). As a small number of anaphylactic reactions have also been reported in vaccinees without a history of anaphylaxis, WHO recommends that mRNA-1273 should be administered only in settings where anaphylaxis can be treated. Until more data and insights are available with regard to anaphylaxis after mRNA-1273 vaccination, all vaccinees should be observed for at least 15 minutes after vaccination.

The vial stoppers are not made with natural rubber latex, and there is no contraindication or precaution to vaccination for persons with a latex allergy. In addition, as mRNA-1273 does not contain eggs or gelatin, there is no contraindication or precaution to vaccination for persons with allergies to any food substances.

Myocarditis is a rare adverse event that has been reported after receipt of mRNA COVID-19 vaccines. The observed risk is highest in males aged 18–39 years (with the highest risk in males aged 18–24 years), and highest within a few days after dose 2. In the United States, out of 64 million total doses (doses 1 and 2) of mRNA-1273 vaccine administered to persons aged ≥ 18 years (as of 13 January 2022), 359 cases of myocarditis were reported during 0–7 days following vaccination that met the case CDC working definition (32), with an estimated 32.2 excess cases reported per 1 million second doses. Most cases of myocarditis resolve without treatment but no long-term follow-up data are yet available.

Data from the United Kingdom and Canada of mRNA vaccines suggest that rates of myocarditis/pericarditis are lower with an extended interval between the first and second dose of mRNA vaccine primary series (33). According to Moderna's global safety database, rates of myocarditis/ myopericarditis are lower following the third dose compared to the second dose, and lower among adolescents than young adults.

In October 2021, the Global Advisory Committee on Vaccine Safety (GACVS) COVID-19 subcommittee concluded that mRNA COVID-19 vaccines have clear benefits in all age groups in reducing hospitalizations and deaths due to COVID-19. The favourable benefit–risk increases with increasing age. Countries should consider the individual and population benefits of immunization relevant to their epidemiological and social context when developing their COVID-19 immunization policies and programmes (34).

Vaccinated individuals should be instructed to seek immediate medical attention if they develop symptoms indicative of myocarditis or pericarditis, such as new onset and persisting chest pain, shortness of breath, or palpitations following vaccination. It is important to rule out other potential causes of myocarditis and pericarditis, including COVID-19 infection and other viral aetiologies.

Development of myocarditis or pericarditis after any dose of mRNA-1273 vaccine is considered a precaution to subsequent doses of COVID-19 vaccine. Until additional safety data are available, individuals who develop myocarditis or pericarditis after a dose of mRNA-1273 vaccine should generally not receive additional doses of any COVID-19 vaccine, unless recommended after review by a health professional with specialist expertise.

In persons with an acute febrile illness (body temperature over 38.5 °C) vaccination should be postponed until they are afebrile.

Vaccination of specific populations

Older persons

The risk of severe COVID-19 and death increases steeply with age. Post-introduction vaccine effectiveness studies have shown high effectiveness and good safety profiles in older persons. Vaccination is recommended for older persons without an upper age limit.

Persons with comorbidities

Vaccination is recommended for persons with such comorbidities that have been identified as increasing the risk of severe COVID-19, in line with the WHO Prioritization Roadmap (8).

Children and adolescents 6 months -17 years of age

Children aged 6 months to 17 years with comorbidities that put them at higher risk of serious COVID-19 disease should be offered vaccination.

For healthy children and adolescents, COVID-19 is rarely lethal. MIS-C and post-acute COVID sequelae are rare, but may occur even after mild or asymptomatic infection. Children can experience significant morbidity but most infections are self-limiting, with only a small proportion requiring hospitalization.

Countries contemplating vaccinating children should consider the benefit-risk, affordability, epidemiological situation, programmatic trade-offs, national childhood vaccination programmes and opportunity costs, seroprevalence rates, and community acceptance. It is of utmost importance for children to continue to receive the recommended childhood vaccines for other infectious diseases.

In accordance with the WHO Prioritization Roadmap, the priority remains to prevent deaths by achieving high vaccine coverage (primary series and boosters) in the highest and high priority-use groups.

Pregnant persons

Pregnant women with COVID-19 are at higher risk of developing severe disease, with increased risk of intensive care unit admission and invasive ventilation, compared to non-pregnant women of reproductive age. COVID-19 in pregnancy is also associated with an increased risk of preterm birth, and of neonates requiring neonatal intensive care. It may also be associated with an increased risk of maternal mortality (35-37). Pregnant women who are older (aged ≥ 35 years), or have high body mass index, or have an existing comorbidity such as diabetes or hypertension, are at particular risk of severe outcomes from COVID-19.

Developmental and reproductive toxicology (DART) studies of mRNA-1273 have not shown harmful effects in pregnant animals and their offspring. A growing body of post-introduction vaccine pharmacovigilance data have not identified any acute safety problems, with obstetric outcomes including spontaneous abortion and neonatal outcomes similar to reported background rates (38-40). COVID-19 mRNA vaccines are immunogenic in pregnant women, and initial post-introduction vaccine effectiveness studies have shown high effectiveness of mRNA-1273 in pregnant women, similar to effectiveness in non-pregnant people (41, 42). Further, emerging evidence demonstrates that vaccination with mRNA vaccines during pregnancy is associated with a reduced risk of severe COVID-19 in young infants (38, 43).

WHO recommends the use of mRNA-1273 in pregnant individuals. WHO has identified pregnant women as a priority-use group for COVID-19 vaccination, given their increased risk of severe outcomes.

WHO does not recommend pregnancy testing prior to vaccination. WHO does not recommend delaying pregnancy or terminating pregnancy because of vaccination.

Breastfeeding persons

Breastfeeding offers substantial health benefits to breastfeeding women and their breastfed children. Vaccine effectiveness is expected to be similar in breastfeeding women as in other adults. In addition, vaccine-elicited antibodies are found in breast milk following vaccination of breastfeeding women, suggesting possible neonatal as well as maternal protection(44, 45). As mRNA-1273 is not a live virus vaccine and the mRNA does not enter the nucleus of the cell and is degraded quickly, it is biologically and clinically unlikely to pose a risk to the breastfeeding child. Several small studies show that mRNA vaccine-elicited antibodies are found in breast milk, which might help protect breastfeeding infants. On the basis of these considerations, WHO recommends the use of mRNA-1273 in breastfeeding women as in non-breastfeeding individuals. WHO does not recommend discontinuing breastfeeding because of vaccination.

Moderately and severely immunocompromised persons, including persons living with HIV with CD4 cell count of <200 cells/μl

Moderately and severely immunocompromised persons (ICPs) are at higher risk of severe COVID-19, regardless of age, although increasing age remains an important co-factor. For purposes of this interim recommendation, moderately and severely immunocompromised persons include those with active cancer, transplant recipients, immunodeficiency, and active treatment with immunosuppressives. It also includes people living with HIV with a current CD4 cell count of <200 cells/μl, evidence of an opportunistic infection, not on HIV treatment, and/or with a detectable viral load (i.e. advanced HIV disease).³ For more details, see the WHO Interim recommendations for an extended primary vaccination series in immunocompromised persons (46).

Available data for WHO EUL COVID-19 vaccine products suggest that vaccine effectiveness and immunogenicity are lower in ICPs compared to persons without immunocompromising conditions (46). The emerging evidence suggests that an additional dose included in an extended primary series enhances immune responses in some ICPs (47). Reactogenicity data of an additional (third) dose given to ICPs, where reported, have generally been similar to those observed for the standard primary series of the vaccine being administered. Given the significant risk of severe COVID-19 for ICPs, if infected, WHO considers that the benefits of an additional (third) dose in an extended primary series outweigh the risks based on available data, though additional safety monitoring is required.

WHO recommends an extended primary series including an additional (third) full 100 μg dose for ICPs. A first and second booster dose (fourth and fifth doses) given 4-6 months after the previous dose is recommended.

Available evidence (46) suggests that an additional (third) dose should be given 1–3 months after the second dose in the standard primary series in order to increase protection as quickly as possible in ICPs. The most appropriate timing for the additional dose may vary depending on the epidemiological setting and the extent and timing of immune suppressive therapy and course of the disease, and should be discussed with the treating physician.

³ **Active cancer:** Active immunosuppressive treatment for solid tumour or hematologic malignancy (including leukaemia, lymphoma, and myeloma), or within 12 months of ending such treatment. **Transplant recipients:** Receipt of solid organ transplant and taking immunosuppressive therapy; receipt of stem cell transplant (within 2 years of transplantation, or taking immunosuppressive therapy). **Immunodeficiency:** Severe primary immunodeficiency; chronic dialysis. **HIV** with a current CD4 count of <200 cells/μl and/or lacking viral suppression. **Immunosuppressives:** Active treatment causing significant immunosuppression (including high-dose corticosteroids), alkylating agents, antimetabolites, transplant-related immunosuppressive drugs, cancer chemotherapeutic agents, tumor-necrosis factor (TNF) blockers, and other drugs that are significantly immunosuppressive or have received in the previous 6 months immunosuppressive chemotherapy or radiotherapy

Information and, where possible, counselling about the limitations around the data on administration of an additional dose to ICPs should be provided to inform individual benefit–risk assessment.

Given that protection may remain inadequate in a portion of immunocompromised persons even after the administration of an additional dose, WHO further recommends that close contacts (in particular caregivers) of such individuals should be vaccinated if eligible (according to the product-specific vaccines that have received EUL). Additional public health and social measures at household level to protect immunocompromised persons are also warranted depending on the local epidemic circumstances.

Persons living with HIV who are stable on Antiretroviral Therapy

Persons living with HIV may be at higher risk of severe COVID-19. Among the phase 3 clinical trial participants with well controlled HIV, there were no reported differences in safety signals. HIV-positive persons who are well controlled on highly active antiretroviral therapy and are part of a group recommended for vaccination can be vaccinated. Available data on administration of the vaccine are currently insufficient to allow assessment of vaccine efficacy or safety for persons living with HIV who are not well controlled on therapy. It is possible that the immune response to the vaccine may be reduced, which may alter its effectiveness. In the interim, given that the vaccine is not a live virus, persons living with HIV who are part of a group recommended for vaccination may be vaccinated. Information and, where possible, counselling about vaccine safety and efficacy profiles in immunocompromised persons should be provided to inform individual benefit–risk assessment. It is not necessary to test for HIV infection prior to vaccine administration.

Persons who have previously had SARS-CoV-2 infection

Vaccination should be offered regardless of a person’s history of symptomatic or asymptomatic SARS-CoV-2 infection. Viral or serological testing for prior infection is not recommended for the purpose of decision-making about vaccination. Data from the pooled analyses indicate that the vaccine is safe in people with evidence of prior SARS-CoV-2 infection. Within 6–12 months after an initial natural infection, available data show that symptomatic reinfection is uncommon. The optimal time interval between a natural infection and vaccination is not yet known. Prior SARS-CoV-2 infection was associated with a statistically significantly lower risk for breakthrough infection among individuals receiving the mRNA-1273 vaccines in Qatar between December 21, 2020, and September 19, 2021 (48). Given limited vaccine supply, persons with PCR-confirmed SARS-CoV-2 infection may choose to delay vaccination for 6 months. However, emerging data indicate that breakthrough infections occur in settings where variants of concern are circulating, in particular Omicron. In these settings earlier immunization after infection is advisable e.g., within 3 months. When more data on duration of immunity after natural infection become available, the length of this time period may be revised.

Persons with current acute COVID-19

Persons with acute PCR-confirmed COVID-19, including persons who are in-between doses, should not be vaccinated until after they have recovered from acute illness and the criteria for discontinuation of isolation have been met. The optimal minimum interval between a natural infection and vaccination is not yet known. Given that the additional benefit may be limited if vaccination is given too soon after natural infection, typically an interval of 3 months or more could be considered.

Persons who previously received passive antibody therapy for COVID-19

In people who have previously received monoclonal antibodies or convalescent plasma as part of COVID-19 treatment, vaccination does not need to be delayed. Although some reduction in vaccine-induced antibody titres was observed in people who previously received antibody products, the clinical significance of this reduction is unknown, and the balance of benefits vs. risks favours proceeding with vaccination, even when considering the possibility of diminished vaccine effectiveness in this situation.

Special settings

Persons in settings such as refugee and detention camps, prisons, slums, and other settings with high population densities, where physical distancing is not implementable, should be prioritized for vaccination as outlined in the WHO Prioritization Roadmap (8), taking into account national epidemiological data, vaccine supply and other relevant considerations.

As noted in the WHO Prioritization Roadmap, national programmes should give special consideration to groups that are disproportionately affected by COVID-19 or that face health inequities as a result of social or structural inequities. Such groups should be identified, barriers to vaccination should be addressed, and programmes should be developed to enable equitable access to vaccines.

Other considerations

SARS-CoV-2 variants

SARS-CoV-2 viruses undergo evolution. Variants of concern may have higher transmissibility, disease severity, risk of reinfection, or a change in antigenic composition resulting in lower vaccine effectiveness. Data show some reduction in neutralization activity of mRNA-1273 against the Beta variant, as well as against Delta, and more marked reduction against Omicron. These findings highlight the urgent need for a coordinated approach for surveillance and evaluation of variants and their potential impact on vaccine effectiveness. WHO will continue to monitor the situation; as new data become available, recommendations will be updated accordingly. Variant-updated vaccines, including bivalent vaccines, are currently in development (49, 50).

SARS-CoV-2 tests

Prior receipt of the vaccine will not affect the results of SARS-CoV-2 nucleic acid amplification or antigen tests for diagnosis of acute/current SARS-CoV-2 infection. However, it is important to note that currently available antibody tests for SARS-CoV-2 assess levels of IgM and/or IgG to the spike or the nucleocapsid protein. The vaccine contains mRNA that encodes the spike protein; thus, a positive test for spike protein IgM or IgG could indicate either prior infection or prior vaccination. To evaluate for evidence of prior infection in an individual who has received mRNA-1273, a test that specifically evaluates IgM or IgG to the nucleocapsid protein should be used. A positive nucleocapsid protein-based assay indicates prior infection. Antibody testing is not routinely recommended to assess immunity to COVID-19 following mRNA-1273 vaccination.

Role of vaccines among other preventive measures

As recent data suggest limited effect of the vaccine on transmission, in particular in the context of Omicron, public health and social measures to reduce SARS-CoV-2 transmission must continue, including use of face masks, physical distancing, handwashing, appropriate ventilation and other measures as appropriate in particular settings, depending on the COVID-19 epidemiology and potential risks of emerging variants. Government advice on public health and social measures should continue to be followed by vaccinated individuals, as well as those who have not yet been vaccinated.

Countries' strategies related to COVID-19 control should be designed to facilitate the participation of children in education and other aspects of social life, regardless of vaccination (51).

Other programmatic considerations

Countries should consider broader integration of COVID-19 vaccination into primary health care through national immunization programmes.

WHO recommends that countries consider co-administration of COVID-19 vaccines with seasonal influenza vaccines, whenever feasible, dependent on seasonality. The known risk of serious illness for older adults and many other priority groups infected either with influenza virus or SARS-CoV-2 is substantial. Other adult vaccines may also be co-administered with COVID-19 vaccines as WHO aims for a life course approach for the implementation of COVID-19 vaccines. Such a programmatic approach will help to reach higher uptake of vaccines, increase efficiency and protect stretched health care systems.

Community engagement, and effective communication

Community engagement and effective communication (including risk communication) are essential to the success of COVID-19 vaccination programmes. Prioritization decisions should be made through transparent processes that are based on shared values, the best available scientific evidence, and appropriate representation and input by affected parties. Furthermore, communication about the mechanism of action of mRNA vaccines, and efficacy and safety data derived from clinical trials and post-marketing studies, needs to be strengthened. Strategies should include: (i) culturally acceptable and linguistically accessible communications regarding COVID-19 vaccination made freely available; (ii) active community engagement and involvement of community opinion leaders and trusted voices to improve awareness and understanding of such communications; and (iii) inclusion of diverse and affected stakeholder opinions in decision-making. Such efforts are especially important in subpopulations who may be unfamiliar with or distrustful of health-care systems and immunization.

Vaccination logistics

The mRNA-1273 is provided as a frozen suspension at -25 °C to -15 °C in a multidose vial containing 10 doses. The vaccine must be thawed prior to administration. After thawing, 10 doses (0.5 ml each) can be withdrawn from each vial. Vials can be stored refrigerated at 2–8 °C for up to 30 days prior to withdrawal of the first dose. After the first dose has been withdrawn, the vial should be held between 2 °C and 8 °C and discarded after 6 hours.

When assessing the feasibility of deploying mRNA-1273, immunization programmes should consider the cold-chain requirements. Conditions must be met to avoid exposure of vials to sunlight and ultraviolet light.

Appropriate medical treatment to manage anaphylaxis must be immediately available for vaccinees. Hence, this vaccine should only be administered in settings with the necessary resources and trained health workers, and that allow for at least 15 minutes of post-vaccination observation.

When scheduling vaccination for occupational groups, e.g., health workers, consideration should be given to the reactogenicity profile of mRNA-1273 observed in clinical trials, occasionally leading to time off work in the 24–48 hours following vaccination.

In considering the programme implications of implementing these recommendations, particular attention should be given to equity, including the feasibility, acceptability, and effectiveness of the programme in resource-constrained settings (for example, how to ensure cold-chain storage and the need to be able to provide treatment for anaphylaxis).

Recommendations on addressing current knowledge gaps through further surveillance and research

WHO recommends the following research and post-authorization monitoring activities:

- Safety surveillance and monitoring:
- serious adverse events including myocarditis (52)
- cases of multisystem inflammatory syndrome following vaccination, cases of COVID-19 following vaccination that result in hospitalization or death;
- rates of myocarditis after booster doses
- rates of myocarditis by age and sex

- background rates of AESIs (including myocarditis), maternal and neonatal outcomes, and mortality in groups prioritized for vaccination.
- Vaccine effectiveness:
 - vaccine effectiveness in relation to time interval between doses;
 - vaccine effectiveness in relation to new virus variants of concern;
 - studies to investigate whether this vaccine reduces SARS-CoV-2 transmission and viral shedding;
 - assessment and reporting of breakthrough infections and virus sequence information;
 - head-to-head studies with other vaccines on extent and duration of immunity using standardized neutralization, T-cell and mucosal immunity assays;
 - vaccine effectiveness against post-COVID-19 conditions
 - indirect protection in unvaccinated populations
 - impact on enabling in-person schooling for children and adolescents
 - impact of third and fourth doses (first and second boosters) in the community
 - impact of additional boosters in immunocompromised persons
- Subpopulations:
 - prospective studies on the safety in pregnant and lactating women;
 - safety data on vaccination in immunocompromised persons, including persons living with HIV and persons with autoimmune disease.
- Vaccination logistics
 - immunogenicity and safety studies of co-administration with other vaccines, including pneumococcal vaccines, to adults and older persons, and routine childhood vaccinations in younger persons;
 - stability of vaccine under alternative cold-chain distribution and storage conditions.
- Virus variants
 - global surveillance of virus evolution and the impact of virus variants on vaccine effectiveness to support update of vaccines;
 - Modelling to determine the trade-offs for the use of vaccines with reduced effectiveness against emergent variants;
 - Booster studies with updated vaccine formulations.

Table of updates

Update 18 August 2022

Section	Rationale for update
Paediatric age indication	Reflects recent authorization of the age indication from age 6 months upwards.
Interchangeability between vaccine products and platforms	Both homologous and heterologous schedules are encouraged.
Booster doses	Booster doses (third dose) is recommended 4-6 months after the 2 nd dose, given increasing evidence of waning of vaccine effectiveness over time, further compounded by lower vaccine effectiveness against Omicron and Delta that can be restored with a third dose.
Second booster doses	2 nd booster doses (fourth dose) are recommended 4-6 months after the last dose in certain subpopulations at higher risk for severe disease and death
Pregnant persons	Updated section given increasing body of evidence of safety, immunogenicity and vaccine effectiveness in pregnant persons
Co-administration	In adults and adolescents, co-administration with any live or non-live vaccines is permissible

Update 23 February 2022

Section	Rationale for update
Vaccine performance	Updated to reflect new data on duration of vaccine effectiveness, and vaccine effectiveness against variants of concern.
Booster dose	To address evidence of waning effectiveness over time, in particular in the context of variants of concern.
Heterologous schedules	To reflect the increasing evidence that heterologous schedules (dependent on vaccine products) have benefits.
Interchangeability between vaccine products and platforms	Increasing evidence underpins the role of heterologous schedules and boosters.
Precautions	Updated rates for myocarditis per age group and per dose.

Update 19 November 2021

Section	Rationale for update
Additional dose	Reflects recent authorization of a third dose to immunocompromised individuals with certain underlying conditions.
Interchangeability between vaccine products and platforms	Mix-and-match studies remain limited, but recent evolving evidence led to an update in this section.

Paediatric age indication	A phase 3 trial in children aged 12–17 years indicated likely high efficacy and good safety in this age group, leading to an extension of the previous age indication from 18 years onwards down to age 12 onwards.
Children and adolescents below the age of 18 years	The following statement was added: For children and adolescents COVID-19 is rarely severe. Evidence suggests that adolescents, particularly older adolescents, are as likely to transmit SARS-CoV-2 as adults. WHO recommends that countries should consider using mRNA-1273 in children aged 12–17 years only when high vaccine coverage with 2 doses has been achieved in higher priority groups as identified in the WHO Prioritization Roadmap. Children 12–17 years of age with comorbidities that put them at significantly higher risk of serious COVID-19 disease, alongside other high-risk groups, may be offered vaccination. There are currently no efficacy or safety data for children below the age of 12 years. Until such data are available, individuals below 12 years of age should not be routinely vaccinated.
Pregnant and breastfeeding women	Text was updated to reflect more recent evidence on vaccination of pregnant women. Given the increasing evidence on safety and effectiveness of this vaccine in pregnant women, WHO now recommends the use of mRNA-1273 in pregnant women.
Immunocompromised persons	Updated regarding the need for a third dose in certain immunocompromised populations.

Update 15 June 2021

Section	Rationale for update
Considerations for deferring the second dose in settings with limited vaccine supply	Post-introduction vaccine effectiveness studies in countries that have implemented an inter-dose interval longer than per emergency use authorization (up to 12 weeks) have shown a high public health impact. This observation combined with additional immunological data support that countries facing a high incidence of COVID-19 combined with severe vaccine supply constraints could consider delaying the second dose up to 12 weeks in order to achieve a higher first dose coverage in high priority populations.
Pregnant and lactating women	Text was updated and harmonized with the Recommendations for the Pfizer mRNA vaccine.
Role of vaccines among other preventive measures	The following statement was added: “Countries’ strategies related to COVID-19 control should be designed to facilitate children’s participation in education and other aspects of social life.”.
SARS-CoV-2 variants	This section has been added to reflect the latest data with regards to the circulation of variants of concern and evidence on the impact on effectiveness of the vaccine.

Funding source

SAGE members and SAGE working group members do not receive any remuneration from the Organization for any work related to SAGE. The SAGE secretariat is funded through core contributions to WHO.

Acknowledgements

This document was developed in consultation with:

External: Current members of the Strategic Advisory Group of Experts on Immunization ([SAGE](#)) and the [SAGE Working Group on COVID-19 Vaccines](#).

WHO: Annelies Wilder-Smith, Joachim Hombach, Melanie Marti, Shalini Desai, Katherine O'Brien.

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WHO continues to monitor the situation closely for any changes that may affect this interim guidance. Should any factors change, WHO will issue a further update. Otherwise, this interim guidance document will expire 2 years after the date of publication.

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WHO reference number: WHO/2019-nCoV/vaccines/SAGE_recommendation/mRNA-1273/2022.2