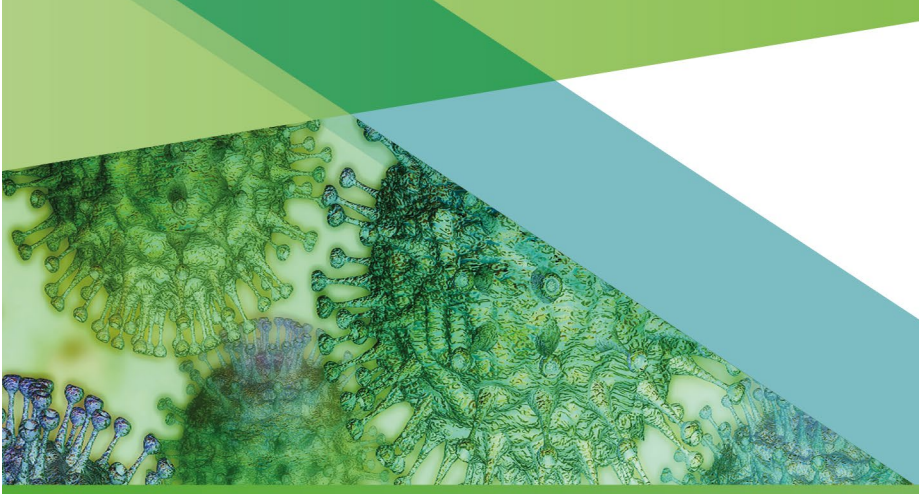

TECHNICAL REPORT

Interim guidance on the benefits of full vaccination against COVID-19 for transmission and implications for non-pharmaceutical interventions

21 April 2021

Summary

COVID-19 vaccines licensed in the EU/EEA have been shown during clinical trials to be highly effective in providing protection against symptomatic and severe COVID-19. Evidence from real-life usage of COVID-19 vaccines has confirmed these clinical trial findings and also showed high vaccine effectiveness against PCR-confirmed SARS-CoV-2 infection.

Limited evidence indicates that fully vaccinated individuals, if infected, may be less likely to transmit SARS-CoV-2 to their unvaccinated contacts. Uncertainty remains regarding the duration of protection in such cases, as well as possible protection against emerging SARS-CoV-2 variants.

Viral circulation in the EU/EEA currently remains high, and the cumulative vaccination uptake in the EU/EEA is still low in the adult population aged 18 years and older, although higher in specific groups of the population targeted in the initial phases of the COVID-19 vaccine rollout, such as people aged 80 years and older and healthcare workers.

In the current context, and given the available evidence:

- The risk of developing severe COVID-19 disease for a fully vaccinated individual is very low in younger adults and middle-aged adults with no risk factors for severe COVID-19, and low in older adults or people with underlying risk factors.
- The risk of developing severe COVID-19 disease for an unvaccinated individual who has been in contact with a fully vaccinated person exposed to SARS-CoV-2 infection is very low to low in younger adults and middle-aged adults with no risk factors for severe COVID-19, and moderate in older adults or persons with underlying risk factors (limited evidence available so far).

The overall reduction in risks of severe COVID-19 disease is dependent on vaccine uptake and vaccination coverage in the general population and is modulated by several other factors, such as age and underlying conditions, vaccine characteristics, variants of concern, setting, and the epidemiological situation.

To date, given the current risks as assessed, there are specific situations in which non-pharmaceutical interventions (NPIs) can be lifted:

- When fully vaccinated individuals meet other fully vaccinated individuals (very low/low risk), physical distancing and the wearing of face masks can be relaxed;
- When an unvaccinated individual or unvaccinated individuals from the same household or social bubble meet fully vaccinated individuals, physical distancing and the wearing of face masks can be relaxed if there are no

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risk factors for severe disease or lower vaccine effectiveness in anyone present (e.g. older age, immunosuppression, other underlying conditions);
- When contact tracing, vaccinated contacts who have been exposed to a confirmed case should continue to be managed according to existing ECDC guidance. However, health authorities may consider undertaking a risk assessment on a case-by-case basis and subsequently classify some fully vaccinated contacts as low-risk contacts. Factors that need to be taken into consideration in such assessments include, for example, the local epidemiological situation in terms of circulating variants, the type of vaccine received, and the age of the contact. The risk of onward transmission to vulnerable persons by the contact should also be considered.
- Requirements for testing and quarantine of travellers (if implemented) and regular testing at workplaces can be waived or modified for fully vaccinated individuals as long as there is no or very low level circulation of immune escape variants (in the community in the country of origin, in the case of travellers).
- In the current epidemiological context in the EU/EEA, in public spaces and in large gatherings, including during travel, NPIs should be maintained irrespective of the vaccination status of the individuals.
- Countries considering relaxing measures for fully vaccinated people should take into account the potential for uneven inequitable vaccine access across the population.

Examples from countries where vaccination coverage is higher and severe COVID-related outcomes and SARS-CoV-2 incidence have subsequently declined, such as the United Kingdom (UK) and Israel, provide an indication of how population-level transmission can be reduced with the careful application and slow release of public health prevention measures while vaccination rollout is scaled up as quickly as possible throughout the EU/EEA.

Scope of this document

This document aims to provide interim guidance on the risks for fully vaccinated individuals to develop or transmit infection that will give rise to severe COVID-19 disease in the context of the current epidemiological and vaccine coverage situation in the EU/EEA.

The document assesses the following questions:

- What is the risk of developing severe COVID-19 for a fully vaccinated individual?
- What is the risk of severe COVID-19 for an unvaccinated individual in contact with a fully vaccinated person who has recently been exposed to SARS-CoV-2 infection?

This document does not assess these risks for partially vaccinated individuals or for individuals previously infected with SARS-CoV-2.

Based on the risks assessed, the guidance discusses possible conditions under which non-pharmaceutical interventions (NPIs) could be relaxed during specific contacts between fully vaccinated and other individuals and highlights where, based on the current epidemiological situation in Europe, strict adherence to measures is still required.

This guidance will inform considerations on whether and when a set of non-pharmaceutical interventions (NPIs) and related measures could be modified in the light of the assessment:

- For fully vaccinated individuals when meeting other fully vaccinated individuals; and
- For fully vaccinated individuals when meeting unvaccinated individuals.

The guidance provided focuses on meetings between two individuals, households or social bubbles and, due to the current lack of evidence, does not address meetings between larger gatherings of groups of people.

This guidance will be revised as more evidence on COVID-19 vaccination emerges, in particular on the duration of protection of vaccines and on vaccine effectiveness against infection and protection against emerging variants of SARS-CoV-2.

Target audiences

Target audiences for this document are the European Commission, the Health Security Committee, the EU/EEA collaboration with National Immunisation Technical Advisory Groups, and national public health institutes and ministries of health in the EU/EEA, as well as public health experts and decision-makers at national and subnational level.

Background

Public health issues

In light of the deployment of COVID-19 vaccines throughout the EU, there are ongoing discussions on the exemptions or relaxations of measures for fully vaccinated individuals. Some EU/EEA Member States have already taken measures to exempt fully vaccinated individuals from some of the requirements that are usually applied to the general population. An overview of exemptions by country is presented in Table 1. Other countries outside of the EU, including Israel [1] and the United States [2], have provided recommendations for fully vaccinated individuals and exemptions that apply to them.

Table 1. Exemptions from restrictive measures through vaccination proof, EU/EEA Member States, as of 14 April 2021 [3]

ECDC-JRC Response Measure Database Exemption from restrictive measures through vaccination proof				
Country	**Geographical implementation**	**Date of implementation**	**Specification**	**Target population**
Romania	National	18-Jan-21	Exemption from quarantine upon arriving in the country	Travellers
Iceland	National	25-Jan-21	Allowed non-essential travel in the country; Exemption from quarantine upon arriving in the country (as of 6-Apr-21 open to non-Schengen)	Travellers
Estonia	National	1-Feb-21	Exemption from quarantine upon arriving in the country	Travellers
Norway	National	3-Feb-21	Exemption from quarantine	HCW
Slovakia	National	1-Mar-21	Exemption from movement restrictions	General population
Aragón (Spain)	Regional	5-Mar-21	Allowed additional activities in nursing homes	LTCF residents
Netherlands	National	8-Mar-21	Allowed additional visitors in nursing homes	LTCF residents
Lithuania	National	10-Mar-21	Exemption from quarantine and testing upon arriving in the country	Travellers
Región de Murcia (Spain)	Regional	15-Mar-21	Allowed additional visitors when full LTCF community is vaccinated	LTCF residents
Spain	National	15-Mar-21	More flexibility in nursing homes' activities and visitors	LTCF residents
Cantabria (Spain)	Regional	26-Mar-21	Allowed additional visitors (included minors) when full LTCF community is vaccinated	LTCF residents
Andalucía (Spain)	Regional	8-Apr-21	Allowed additional activities in nursing homes	LTFC residents
Comunidad Valenciana (Spain)	Regional	12-Apr-21	Allowed additional activities and visitors in nursing homes	LTCF residents
Croatia	National	12-Apr-21	Allowed non-essential travel to the country, even with single dose (if received 14 days prior to arrival)	Travellers
Ireland	National	12-Apr-21	Fully vaccinated individuals allowed to gather without PPE (two households maximum) ; Additional activities allowed in LTCF	General population; LTCF residents
Denmark	National	21-Apr-21	Social and leisure activities allowed with proof of vaccination (from 06-May-21 indoor activities allowed)	General population

On 29 March 2021, ECDC published a report on the 'Risk of SARS-CoV-2 transmission from newly infected individuals with documented previous infection or vaccination' [4]. The review of evidence on immunity and possibilities for transmission from infected, previously vaccinated individuals to susceptible contacts found that:

- There is evidence of reduction of secondary attack rates among contacts of vaccinated from a large register-based household transmission study from Scotland. This study suggested that vaccination of a household member reduced the risk of infection in household members by at least 30%.
- There is evidence that vaccination significantly reduces viral load, duration of shedding and symptomatic/asymptomatic infections in vaccinated individuals, which could translate into reduced transmission, although it can vary by vaccine product, target group, and SARS-CoV-2 variant [5]. In light of this, the total number of infections is expected to decrease significantly as vaccination coverage increases, provided that there is a match between the vaccine strains and the circulating virus strains. This will lead to decreased transmission overall.
- Follow-up periods for vaccinated persons are not yet sufficiently long enough to draw conclusions on the duration of protection against infection. Antibody titres in vaccinated individuals peak at 3–4 weeks following vaccination.
- Many of the vaccine efficacy studies were carried out before the emergence of SARS-CoV-2 variants of concern (VOCs).
- In studies that address the variants, there is limited preliminary evidence of efficacy against B.1.1.7 and of reduced vaccine efficacy, in particular for B.1.351 and possibly also for P.1 (both sharing the E484K mutation).

In the week after publication of the above-mentioned report, additional data have emerged on the effectiveness of vaccination in transmission [5-7] in adults and adolescents from both observational and clinical trial studies, largely in the context of the predominance of the B.1.1.7 variant. These are highlighted in Tables 3 and 4.

Epidemiological overview in the EU/EA

The latest available data on the number of cases and deaths globally is published on ECDC's website [8].

Detailed epidemiological information on laboratory-confirmed cases reported to The European Surveillance System (TESSy) is published in ECDC's weekly COVID-19 surveillance report and the overview of the epidemiological situation in relation to the COVID-19 pandemic by country is also published in ECDC's weekly COVID-19 country overview.

There is sustained high viral circulation, with 14-day case notification rates above 60 per 100 000, throughout the EU/EEA [9], including increasing proportions due to variants of concern. SARS-CoV-2 strains that may evade one or more of the current vaccines are highly prevalent in some parts of the world, and are already present in many parts of the EU/EEA. For the period 15 to 28 March 2021, the median (range) of the variants in all samples sequenced in the period in these 10 countries was 74.6% (12.8–85.4%) for B.1.1.7, 0.6% (0.0–20.7%) for B.1.351 and 0.0% (0.0–10.4%) for P.1 [10].

The vaccination uptake at population level in the EU/EEA and in specific groups as of week 14 (11 April 2021) was as follows:

- Low cumulative uptake of vaccination in the adult population aged 18 years and above (among 30 EU/EEA countries reporting data to ECDC):
  - median cumulative uptake of the first dose is 19% (range: 7.8%-35.9%);
  - median cumulative uptake of full vaccination is 7.4% (range 1.6%-15.5%).
- Higher uptake in specific groups targeted by vaccination as outlined in the European Commission Communication "A united front to beat COVID-19" [11]:
  - Among those aged 80 years and over:
    - Among 24 reporting EU/EEA countries, the median cumulative uptake is 70.7% for the first vaccine dose (range: 7.2%-99.8%) and 47.8% for the full vaccination (range: 0.9% to 97%);
    - Eight countries (Belgium, Denmark, Finland, Iceland, Ireland, Malta, Portugal, and Sweden) have reached 80% uptake of the first dose, while an additional four countries (Austria, Italy, Luxembourg, and Norway) are close to reaching this milestone (between 70 and 80%);
    - Iceland and Malta have reached 80% uptake of full vaccination, while Ireland and Norway are close to reaching this milestone (between 70 and 80%).
  - Among healthcare workers:
    - The median cumulative uptake among 15 reporting EU/EEA countries is 65.6% for the first vaccine dose (range: 19.3%-100%) and 50.3% for the full vaccination (range: 14.8% to 100%);
    - Five countries (Estonia, Hungary, Ireland, Romania, and Spain) have reached 80% uptake of the first dose, while Czechia is close to reaching this milestone (77.8%);
    - Only two countries (Hungary and Romania) have reached 80% uptake of full vaccination.

Methodology

The method adopted for this document follows the rapid risk assessment methodology developed by ECDC [12] and adapted for the purpose of this specific public health question.

The available scientific evidence on the risk of SARS-CoV-2 transmission to susceptible contacts from infected individuals with documented previous infection or vaccination [4] published by ECDC on 29 March 2021 and additional literature that has been published thereafter was used throughout this guidance to inform the risk qualification. The risk assessment also takes the overall epidemiological situation and vaccine update status in the EU/EEA into account; as these parameters differ across the EU/EEA, national and regional policy makers may choose to adjust the assessment of risk and advice to local populations accordingly.

This document does not address all possible situations and settings where fully vaccinated and unvaccinated individuals may meet but indicates modulating factors that may modify the assessment of the risk and thereby the corresponding preventive measures.

The risk assessment approach aims to use the best available evidence to weigh and communicate the level of risk and corresponding uncertainties, while acknowledging that compete elimination of SARS-CoV-2 transmission risk is not feasible nor practicable.

The proposed approach can then be used for individuals from selected population groups, in different settings and at different time points. This document will be updated as further evidence on the impact of COVID-19 vaccines accumulates, as vaccine uptake at population level increases and as the epidemiological situation in the EU/EEA changes.

Risks assessed

The risks referred to apply to the EU/EEA setting in general, from the perspective of a fully vaccinated individual as defined in the glossary of this document, in the current context of high viral circulation in the EU and low vaccination uptake in the general population.

Risk 1: What is the risk that a fully vaccinated individual will develop severe COVID-19 disease?

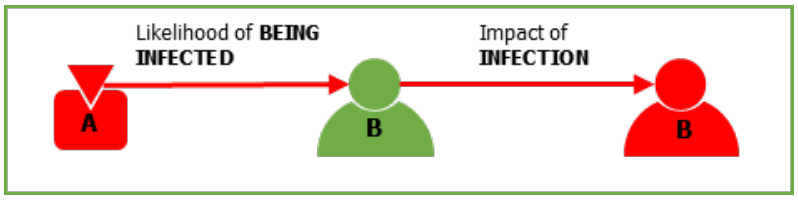
This risk question addresses the likelihood that a fully vaccinated person is exposed and infected with SARS-CoV-2 and subsequently develops severe disease.

The assessment of this risk is a combination of:

1. The likelihood of exposure to SARS-CoV-2 and the likelihood of being infected when exposed to SARS-CoV-2; and
2. the impact as a probability of developing severe disease – if infected.

The assessment of this risk can be graphically represented as Figure 1 and as depicted in Annex Figure A.

Figure 1. The risk of a fully vaccinated individual (referred to as B) becoming exposed and infected with SARS-CoV-2 (by individual A – infected) and developing severe disease



Red: infected, green: vaccinated

A detailed description of the assessed risk and the evidence used to inform the risk is summarised in Table 4.

How likely is exposure to SARS-CoV-2?

The likelihood that a fully vaccinated individual will be exposed to SARS-CoV-2 is affected by several factors:

- **The local epidemiological situation:** a setting with high circulation of SARS-CoV-2 increases the risk of exposure for those present in that setting, including fully vaccinated individuals. In week 12, 29 EU/EEA countries had high 14-day case notification rates (above 60/100 000 population), with increases observed in 17 countries. The overall rate for the EU/EEA was 489/100 000 population, and has been increasing for five weeks [9]. Although SARS-CoV-2 incidence varies between and within countries, viral circulation currently remains high in the vast majority of EU/EEA countries.
- **COVID-19 vaccine uptake at national level:** as vaccination coverage increases, virus circulation and risk of exposure should decrease accordingly. As of week 14, vaccine coverage in all EU/EEA countries remains low, with median first dose coverage at 19% and second dose coverage at 7.4% [13]. Vaccine coverage is much higher in select settings, such as long-term care facilities (LTCFs) and in some age groups (e.g. individuals over 80 years), but overall vaccine coverage is currently low in most of the EU/EEA.
- **Other factors** that affect the likelihood of a fully vaccinated individual's exposure to SARS-CoV-2 include the **nature and duration of contact** that they have with an infected individual. Indoor exposure in poorly ventilated areas, longer duration of contact, less physical distance, and the absence of face masks all increase the likelihood of SARS-CoV-2 exposure [14].
- Finally, **variants of concern**, which are circulating at increasing levels in all EU/EEA countries, are estimated to be more transmissible than non-variant of concern SARS-CoV-2 viruses, with evidence that B.1.1.7 is at least 50% more transmissible [15-17], while B.1.351 is estimated to be 1.2-2.3 times more transmissible [18] and the P.1 variant 1.4 to 2.2 times more transmissible [19] than previously circulating variants. To date, there are no estimates of transmissibility of VOCs specifically in vaccinated individuals or in populations with high coverage of COVID-19 vaccines.

Taken together, due to the high viral circulation and low vaccination coverage throughout the EU/EEA presently, the likelihood of a fully vaccinated individual being exposed to SARS-CoV-2 is currently considered to be **high**,

although this likelihood can be decreased through the application of preventative measures, including NPIs. High viral circulation and increased transmissibility may be enhanced by local circulation of variants of concern.

If exposed, how likely is it that a fully vaccinated individual will become infected with SARS-CoV-2?

All four vaccines authorised for use in the EU/EEA have been granted conditional marketing authorisation owing to high efficacy against COVID-19 disease [20]. However, with no vaccine reaching 100% efficacy or providing sterilising immunity, a certain number of fully vaccinated individuals will remain susceptible and become infected if exposed to the virus. Emerging evidence from real-world studies indicates that breakthrough infections occur to the extent expected based on results from clinical trials and subsequent observational studies. Several studies have assessed the efficacy and effectiveness of COVID-19 vaccines against SARS-CoV-2 infection and confirmed that infection is significantly reduced in fully vaccinated individuals:

- A 67.6% reduction in PCR-confirmed SARS-CoV-2 infections was observed in fully vaccinated individuals compared to unvaccinated controls in the trial studying the AstraZeneca vaccine [21].
- In a prospective cohort of healthcare personnel and other frontline workers in the United States who were tested weekly, mRNA vaccines had a 90% vaccine efficacy in preventing symptomatic and asymptomatic SARS-CoV-2 [5].
- In a non-randomised study from Israel, individuals vaccinated with two doses of Pfizer-BioNTech vaccine had a 92% reduction of PCR-confirmed SARS-CoV-2 infection compared to unvaccinated individuals [22]. More than 80% of the specimens collected in Israel during the study period were reported as B.1.1.7.
- A retrospective non-randomised study from the United States among individuals undergoing pre-procedural and presurgical screening reported an 80% reduction in risk of asymptomatic infection for patients fully vaccinated with Pfizer-BioNTech or Moderna vaccine compared to unvaccinated patients [23].
- In a retrospective cohort study among healthcare workers in Denmark, the Pfizer-BioNTech vaccine effectiveness of 90% against PCR-confirmed SARS-CoV-2 infection was reported seven days after the second dose compared to unvaccinated healthcare workers. In the same study, a reduction of 64% in PCR-confirmed SARS-CoV-2 infections was observed from seven days after the second dose among fully vaccinated residents of long-term healthcare facilities compared to unvaccinated residents [24].
- The SIREN study from the UK showed an 86% reduction in laboratory-confirmed SARS-CoV-2 infections seven days after the second dose of vaccine compared to unvaccinated healthcare workers [25]. The B.1.1.7 variant was dominant during the duration of the study.
- A retrospective case-control study in California found that vaccine effectiveness of 86% (95% CI 67-94%) against SARS-CoV-2 infection in individuals fully vaccinated with either Pfizer-BioNTech or Moderna COVID-19 vaccines [26]. In this study, 26% of cases did not report symptoms and this did not differ significantly between vaccinated and unvaccinated individuals.
- A registry-based cohort study in long-term care facility residents in Spain, found 92% (95% CI 91-93%) vaccine effectiveness against PCR-confirmed SARS-CoV-2 infection among residents and 97% (95% CI 95-98%) and 98% (95% CI 97-99%) against hospitalisation and mortality, respectively, up to two months after two doses of Pfizer-BioNTech vaccine [27].

Many of the vaccine efficacy studies were carried out before the emergence of SARS-CoV-2 VOCs. In studies that address the variants, there is limited preliminary evidence of reduced vaccine efficacy, in particular for B.1.351 and possibly also for P.1 [28-31]. Infections with variant viruses in fully vaccinated individuals have been reported [32,33], although the frequency of this and the severity of illness following infection is not yet well-understood. However, there is also emerging data indicating vaccine efficacy to be maintained for B.1.1.7 [22,30,34], and possible preliminary evidence for B.1.351 from Pfizer-BioNTech [7]. A preprint study from Israel reported that from one week after the second dose of Pfizer-BioNTech vaccine, vaccinated individuals were disproportionately infected (odds ratio 8:1) with the B.1.351 variant compared to unvaccinated individuals, although numbers were small [35]. The situation is continuously evolving and will need to be carefully monitored for any sign of further escape from vaccine-induced immunity by existing and newly emerging VOCs.

Age is an important factor that impacts vaccine efficacy and likelihood that an exposed vaccinated individual may become infected with SARS-CoV-2, given that immune responses are generally lower in older and frail adults [36]. For the purposes of this guidance, we have considered persons who are 60 years and above as older adults, but an age-risk gradient remains in persons above 60 years, with higher risk in older age groups. Additional factors that will modulate the risk of infection include the immune status of the individuals, as immunocompromised individuals may not mount an immune response post-vaccination; the type of vaccine received, where although efficacy is high for all currently licensed vaccines in the EU/EEA, it does vary between products; and the amount of time that has passed since the vaccination was received, since long-term follow-up on duration of immunity has not yet occurred given the recent nature of vaccine availability.

Overall, because vaccine efficacy is high for all the currently licensed vaccines in the EU/EEA, the likelihood of SARS-CoV-2 infection in a fully vaccinated individual following exposure is assessed to be **very low**.

If infected, is severe disease in vaccinated individuals likely?

Overall, vaccine trials were not powered enough to assess outcomes like severe COVID-19 and death [37]. Efficacy against mild COVID-19 disease was reported as high, ranging from 57% (Janssen COVID-19 vaccine in South Africa where B.1.351 was circulating widely) to 95% [38,39]. In a large observational study from Israel involving 596,618 individuals, vaccine effectiveness against hospitalisation and severe disease after two doses of Pfizer-BioNTech vaccine was 87% (95% CI 55-100%) and 92% (95% CI 75-100%), respectively [22]. A retrospective analysis from the United States reported that individuals vaccinated with a mRNA vaccine, who were then diagnosed with COVID-19, had a 14-day hospitalisation rate 60% lower than unvaccinated individuals [40]. Data from the UK showed a reduction of 35% (95% CI 4-56%) in hospitalisations from 14 days after one dose of AstraZeneca vaccine administered to individuals older than 80 years compared to unvaccinated individuals from the same age group. Similarly, COVID-19 case-fatality ratio within 21 days from disease onset was 54% (95% CI 41-64%) less in individuals older than 80 years who had received one dose of Pfizer-BioNTech vaccine at least 14 days before disease onset compared to unvaccinated individuals from the same age group [41]. Real-world data from a retrospective cohort of individuals in London found very low rates of hospitalisation among individuals who tested positive for SARS-CoV-2 following one dose of AstraZeneca or Pfizer-BioNTech COVID-19 vaccination (0.1% hospitalisation rate in vaccinated individuals from 28 days following one dose of vaccine). In the same study, of the deaths reported, 11% of individuals vaccinated with one dose had a positive SARS-CoV-2 test in the 28 days preceding the death compared to 24.3% in the unvaccinated group [42].

Although there is not yet extensive real-world data on severity of disease by age group among fully vaccinated individuals, age has been in general the strongest predictor for whether individuals infected with SARS-Cov-2 are likely to develop severe disease, with far higher odds of severe disease and death in older adults as compared to younger and middle-aged adults [9].

In addition to age, certain underlying medical conditions are associated with higher risk of severe COVID-19 disease and death [43].

Furthermore, some variants of concern are associated with more severe outcomes including hospitalisation, ICU admission and, for B.1.1.7, higher risk of death [44,45]. These estimates are, however, carried out in the context of unvaccinated individuals and may not apply directly to the risk of infected vaccinated individuals. Finally, the type of vaccine received and the amount of time that has passed since vaccination may both affect the likelihood of severe disease if infected, given that vaccine efficacy differs between products and that duration of protective immunity is not known.

Overall, the impact of developing severe disease in a fully vaccinated individual who is infected with SARS-CoV-2 is likely to be **very low in younger and middle-aged adults** specifically.

In older adults, the impact of developing severe disease **may range from very low to moderate**, depending on age but also modulated by underlying health conditions, gender, the presence of variants of concern, vaccine received and amount of time since vaccination.

Summary: What is the risk that a fully vaccinated individual will develop severe COVID-19 disease?

Overall:

- The likelihood that a fully vaccinated individual will be exposed to SARS-CoV-2 given the current epidemiological situation and vaccine coverage in the EU/EEA is considered to be **high**.
- The likelihood of infection in a fully vaccinated person if exposed is considered to be **very low**.
- If infected, the impact of developing severe disease severe disease in a fully vaccinated person is considered to be **very low for younger and middle-aged adults**, and **very low to moderate** for older adults or persons with other underlying risk factors.

Taken together, according to the ECDC risk-ranking matrix, the overall risk of COVID-19 disease in a fully vaccinated individual is **very low** in younger and middle-aged adults, and **low** in older adults or people with underlying risk factors.

Table 2. Risk ranking matrix [12]

Impact \ Probability	None	Very low	Low	Moderate	High
Very low	None	Very low risk	Low risk	Low risk	Moderate risk
Low	None	Low risk	Low risk	Moderate risk	Moderate risk
Moderate	None	Low risk	Moderate risk	Moderate risk	High risk
High	None	Moderate risk	Moderate risk	High risk	Very high risk

Risk 2: What is the risk that an unvaccinated individual in contact with a fully vaccinated person exposed to SARS-CoV-2 infection will develop severe COVID-19?

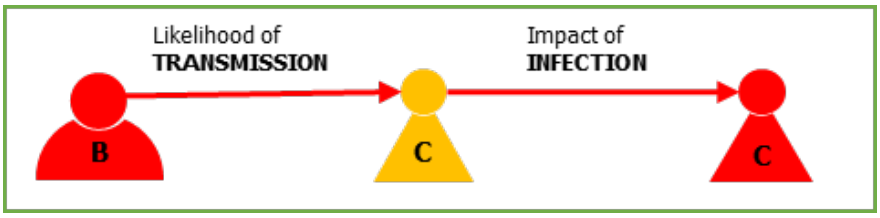
This risk question is linked to the first risk question and addresses the likelihood that a fully vaccinated person, exposed to infection, transmits SARS-COV-2 to an unvaccinated person[1] who would subsequently develop severe disease.

The assessment of this risk is **a combination of the following:**

- The **likelihood of infection** through contact with a fully vaccinated person exposed to infection; and
- the **impact** as probability of the unvaccinated individual developing severe disease – if infected.

The assessment of this risk can be graphically represented as described in Figure 2 and as depicted in Annex Figure B.

Figure 2. The risk that a fully vaccinated but nonetheless SARS-CoV-2-infected individual (B) transmits the infection to unvaccinated contacts (C) who would subsequently develop disease. Here, individual B acts as a source of infection for individual C



Red: infected, yellow: unvaccinated

A detailed description of the assessed risk and the evidence used to inform the risk is summarised in Table 5.

If infected with SARS-CoV-2, what is the likelihood that a fully vaccinated person transmits the disease?

Information on transmission of SARS-CoV-2 from fully vaccinated individuals is currently scarce although new evidence is becoming available:

- A register-based study from Scotland has shown that secondary attack rates of PCR-confirmed SARS-CoV-2 infection in households of healthcare workers vaccinated with one dose of either AstraZeneca or Pfizer-BioNTech vaccine were reduced by 30% compared to households of unvaccinated healthcare workers [46].
- A modelling study using data from the Moderna vaccine trial estimated a reduced potential for transmission of SARS-CoV-2 of at least 61% in vaccinated individuals compared to unvaccinated individuals [47].

[1] Due to a lack of evidence, this document does not assess these risks for partially vaccinated individuals or for individuals previously infected with SARS-CoV-2.

- Reductions of viral load and duration of viral shedding have been observed in the AstraZeneca vaccine trial (with no difference between B.1.1.7 and non-B.1.1.7 infections) in symptomatic and asymptomatic PCR-positive vaccinated individuals compared to PCR-positive unvaccinated controls [48].
- Data from Israel showed a four-fold reduction of viral load in infections occurring 12−28 days after the first dose of the Pfizer-BioNTech vaccine [49].
- A registry-based cohort study in long-term care facility residents in Spain estimated that indirect protection to other unvaccinated residents conferred by vaccination at ≥29 day following a first dose of mRNA vaccine was 81.4% (95% CI 73.3-90.3%) and 12.8 infections prevented per 10,000 unvaccinated per day [50].

There are many factors that modulate this risk, including the nature and duration of contact between the infected fully vaccinated individual and the unvaccinated contact. Indoor exposure in poorly ventilated areas, longer duration of contact, less physical distance, and the absence of face masks all increase the likelihood of SARS-CoV-2 exposure generally [14], although this evidence applies generally and was not generated in response to transmission risk from vaccinated individuals.

It is not clear whether viral load and duration of viral shedding will translate into a reduction of transmission from vaccinated individuals. Transmission risk may also be impacted by the type of vaccine, as the ability to reduce viral load in the vaccinated individual, if they are infected, may differ across vaccine products. Additional factors that will modulate the risk of transmission include the immune status of the unvaccinated individual; and the amount of time that has passed since the vaccination was received, given that long-term follow up on duration of immunity has not yet occurred given the recent nature of vaccine availability.

Finally, variants of concern, which are circulating at increasing levels in all EU/EEA countries, are estimated to be more transmissible than non-variant of concern SARS-CoV-2 viruses, with evidence that B.1.1.7, is at least 50% more transmissible, [15-17], while B.1.351 is estimated to be 1.2-2.3 times more transmissible [18] and P.1 1.4-2.2 times more transmissible [19] than previously circulating variants. There are not yet any estimates of transmissibility of VOCs specifically in fully vaccinated individuals or in populations with high coverage of COVID-19 vaccines. Immune escape could possibly also be associated with increased transmission risk from a fully vaccinated individual to an unvaccinated contact. There is evidence of reduced vaccine efficacy against mild and moderate COVID-19 for B.1.351 and possibly also for P.1 [28-31]. However, there is also emerging data indicating vaccine efficacy to be maintained for B.1.1.7 [22,30,34], and also preliminary evidence for B.1.351 from Pfizer-BioNTech [7].

In summary, based on the limited evidence available, the likelihood of an infected vaccinated person transmitting the disease is currently assessed to be **very low to low**.

If infection is transmitted by a fully vaccinated person to an unvaccinated individual, is severe disease likely?

There is no evidence on severity of disease following transmission from a fully vaccinated individual nor evidence that transmission of the virus from fully vaccinated individuals would lead to a different pattern of viral replication and disease progression. Evidence from SARS-CoV-2 generally indicates that age is the strongest predictor for whether individuals infected with SARS-Cov-2 are likely to develop severe disease, with far higher odds of severe disease and death in older adults as compared to younger and middle-aged adults [43]. Severe disease is also more likely in individuals with underlying comorbidities.

Younger age in the unvaccinated individual are associated with lower risk of severe outcomes if infected with SARS-CoV-2. In those under the age 60, 2.9% of individuals infected with SARS-CoV-2 since August 2020 have been hospitalised and 0.3% have had severe infection (requiring ICU admission or oxygen support). The crude case fatality rate for individuals under 60 years of age is 0.1%. Older age, male gender and the presence of underlying conditions in the unvaccinated individual are associated with higher risk of more severe outcomes if infected with SARS-CoV-2. In individuals 60 years or older, 22.5% of individuals infected with SARS-CoV-2 since August 2021 have required hospitalisation and 2.8% have had severe infection (requiring oxygen support and/or ICU admission). The crude case fatality rate for individuals over 60 is 8.3% [9].

Finally, variants of concern, may impact the severity of disease, with more severe outcomes including hospitalisation, ICU admission and, for B.1.1.7, higher risk of death [44,45]. These estimates are, however, carried out in the context of unvaccinated individuals and may not apply directly to the risk of infected fully vaccinated individuals.

Overall, the impact of developing severe disease if infection is transmitted by a fully vaccinated person to an unvaccinated contact is **low for younger and middle-aged adults and high for older adults or people with underlying comorbidities**. The probability is modulated by underlying conditions (e.g. frailty, immunocomprised state) and by the presence of variants of concern which could increase transmissibility or severity of disease.

Summary: What is the risk that an unvaccinated individual in contact with a fully vaccinated person exposed to SARS-CoV-2 infection will develop severe COVID-19?

Overall:

- The likelihood that a fully vaccinated person will transmit SARS-CoV-2 to a unvaccinated individual is very low to low;
- The impact of developing severe disease of infection if transmission has occurred is low to high, depending on the age and underlying conditions of the unvaccinated contact.

Taken together, according to the ECDC risk-ranking matrix, the risk that an unvaccinated individual in contact with a fully vaccinated person exposed to SARS-CoV-2 infection will develop severe COVID-19 is **low to moderate**, depending on modulating factors, the most important of which is age of the unvaccinated contact, but also the presence of variants of concern, the nature and duration of contact, the use of NPIs, and the type of vaccine received, and the length of time since vaccination.

Table 1. Risk ranking matrix [12]

Impact \ Probability	None	Very low	Low	Moderate	High
Very low	None	Very low risk	Low risk	Low risk	Moderate risk
Low	None	Low risk	Low risk	Moderate risk	Moderate risk
Moderate	None	Low risk	Moderate risk	Moderate risk	High risk
High	None	Moderate risk	Moderate risk	High risk	Very high risk

Table 4. Risk of severe COVID-19 disease for a fully vaccinated individual

Parameter under consideration	Question	Level of the parameter (likelihood)	Summary of the evidence	Modulating factors (and their role in assessment of the parameter)	Source of the evidence	References
Likelihood for a fully vaccinated individual to get COVID-19 disease	**How likely is exposure to SARS-CoV-2?**	**High**	The current epidemiological situation is updated weekly in the ECDC COVID-19 surveillance report. In week 12, 29 EU/EEA countries had high 14-day case notification rates (above 60/100 000 population), with increases observed in 17 countries. The overall rate for the EU/EEA was 489/100 000 population and has been increasing for five weeks.	**Factors that may impact the likelihood of exposure** **Local epidemiological situation:** Higher viral circulation in the community increases the likelihood of exposure. **Vaccination uptake:** High uptake of vaccination reduces viral circulation and thereby reduce the likelihood of exposure. **Preventive measures/NPIs:** Strict adherence to preventive measures decreases the likelihood of being exposed. **Nature and duration of contact:** Indoors and longer duration of contact, no use of face masks/physical distance increase likelihood of exposure. **VOCs:** increased transmissibility associated with the following VOCs (B.1.1.7, B.1.351 and P.1) can increase likelihood of exposure.	Data collected by ECDC from official national sources	[9,13]
	If exposed, how likely is it that a fully vaccinated individual will become infected with SARS-CoV-2?	**Very low**	**Evidence from pre-licensure trials:** The AstraZeneca vaccine trial has shown a 67% reduction of PCR-confirmed infections for fully vaccinated individuals. **Post-licensure evidence:** Data from non-randomised studies on mRNA vaccines (i.e. Pfizer and Moderna vaccines) showed around 90% reduction in PCR-confirmed infections irrespective of symptoms.	**Factors that increase the likelihood of infection** **Age, presence of immunocompromised conditions:** older age, immunocompromised can increase risk of acquisition). **Variants of Concern:** evidence of vaccine escape for B.1.351 and P.1. Infections with variant viruses in fully vaccinated individuals have been reported, although the frequency of this and the severity of illness following infection is not yet well-understood. Evidence of very low likelihood of vaccine escape with non-VOC strains; and with B.1.1.7 variant. **Other modulating factors:**	Published results from randomised and non-randomised studies	**Risk of infection**: [5,6,21,22,52] **Risk of infection residents LTCF**: [24,32,33,53] **VOC breakthrough** [32,33,35]

Parameter under consideration	Question	Level of the parameter (likelihood)	Summary of the evidence	Modulating factors (and their role in assessment of the parameter)	Source of the evidence	References
				Type of vaccine: All EU-authorised vaccines have a high vaccine effectiveness (VE) but it can differ depending on age and VOC properties [51]. **Time since vaccination:** duration of immunity following vaccination is not known. **Setting:** Risk of infection for fully vaccinated individuals may be lower in some groups (e.g. residents of healthcare facilities where residents are fully vaccinated).		
Impact if a fully vaccinated individual becomes infected	**If infected, is severe disease in fully vaccinated individuals likely?**	**For younger adults and middle-aged adults: Very low**	Vaccine trial data indicate very high efficacy against death and severe infection. **Younger age** in the unvaccinated individual is associated with lower risk of severe outcomes if infected with SARS-CoV-2, but we do not know if this hold true in fully vaccinated individuals.	**Variants of Concern** (some preliminary studies indicate that certain variants are more likely to cause severe disease). **Other modulating factors:** **Type of vaccine** All EU-authorised vaccines have a high VE but it can differ depending on age and VOC properties [51]. **Time since vaccination** (duration of immunity following vaccination is not known).	Published results from randomised and non-randomised studies	**VE references** [28,54,22,40,41] **Age and severity** [9]
		For older adults: Very low to moderate	Vaccine trial data indicate very high efficacy against death and severe infection, but often lacked substantial numbers of older adults. **Older age, male gender and presence of underlying conditions** in the unvaccinated individual are associated with higher risk of more severe outcomes if infected with SARS-CoV-2, but we do not know if these hold true in fully vaccinated individuals. Reports from media suggest that severe disease is still possible among those rare vaccinated older adults that become infected.	**Variants of Concern** (some preliminary studies indicate that certain variants are more likely to cause severe disease). **Other modulating factors:** **Type of vaccine** All EU-authorised vaccines have a high VE but it can differ depending on age and VOC properties [51]. **Time since vaccination** (duration of immunity following vaccination is not known).	Published results from randomised and non-randomised studies	**VE references** [28,54,22,40,41] **Age and severity** [9]

Table 5. Risk of severe COVID-19 for an unvaccinated individual in contact with a fully vaccinated person exposed to SARS-CoV-2 infection

Parameter under consideration	Question	Level of the parameter (likelihood)	Summary of the evidence	Modulating factors (and their role in assessment of the parameter)	Source of the evidence	References
Likelihood for an infected fully vaccinated individual to transmit the infection to an unvaccinated individual	**If exposed to infection, what is the likelihood that a fully vaccinated person transmits the disease?**	**Very Low/Low** (depending on modulating factors)	The evidence of risk of transmission from fully vaccinated individuals is currently limited. A decrease of at least 30% and up to 60% in secondary attack rates in households of fully vaccinated healthcare workers compared to households of unvaccinated healthcare workers was observed with AstraZeneca and Pfizer vaccines (in the context of high circulation of B.1.1.7 variant). A decrease in SARS-CoV-2 transmission after one dose of Moderna vaccine was estimated to be at least 61% through modelling of the vaccine trial data Reduced viral load and duration of shedding was observed in fully vaccinated individuals with AstraZeneca and Pfizer vaccines. It is not yet clear how much these reductions make a fully vaccinated person less infectious to other people.	**Preventive measures/NPIs** Strict adherence to preventive measures decreases the likelihood of transmission **Nature and duration of contact:** Indoors and longer duration of contact, close contact **VOCs:** increased transmissibility associated with all VOCs; immune escape associated with B.1.351 and P.1 can increase transmission likelihood. **Type of vaccine**: the ability of the different EU-authorised vaccines to reduce the viral load might vary. This might also differ depending on virus strain. **Time since vaccination:** duration of immunity following vaccination is not known **Immune state of unvaccinated contact:** Presence of immunocompromised states in unvaccinated individuals	Preprints and published non-randomised and modelling studies.	**Likelihood of transmission (secondary attack rates):** [46,47,55] **Viral load and duration of shedding**: [48,49,56,57]
Impact of infection in an unvaccinated individual following transmission from a fully vaccinated person	If **infection** is transmitted by a fully vaccinated person to an unvaccinated contact, is severe disease likely?	**For younger adults and middle-aged adults: Low** (depending on modulating factors, e.g. age, variant of concern)	No evidence is currently available for the severity of disease following SARS-CoV-2 transmission from a fully vaccinated individual. Younger age in the unvaccinated individual are associated with lower risk of severe outcomes if infected with SARS-CoV-2. In those under the age 60, 2.9% of individuals infected with SARS-CoV-2 since	**Immune state of unvaccinated contact:** Presence of immunocompromised states in unvaccinated individuals. Presence of immunocompromised states in unvaccinated individuals **Variants of concern:** some preliminary studies indicate that certain variants are more likely to cause severe disease.	Published results from observational studies.	**Impact of infection from fully vaccinated individuals:** Not available **Impact of infection in general:**

Parameter under consideration	Question	Level of the parameter (likelihood)	Summary of the evidence	Modulating factors (and their role in assessment of the parameter)	Source of the evidence	References
			August 2021 have been hospitalised and 0.3% have had severe infection (requiring ICU admission or oxygen support). The crude case fatality rate for individuals under 60 years of age is 0.1%.	**Underlying conditions:** some conditions are associated to increased risk of severe COVID-19 also in younger age groups.		[58]
		For older adults: High (depending on modulating factors, e.g. age, variant of concern)	No evidence is currently available for the severity of disease following SARS-CoV-2 transmission from a fully vaccinated individual. Older age, male gender and the presence of underlying conditions in the unvaccinated individual are associated with higher risk of more severe outcomes if infected with SARS-CoV-2. In individuals 60 years or older, 22.5% of individuals infected with SARS-CoV-2 since August 2021 have required hospitalisation and 2.8% have had severe infection (requiring oxygen support and/or ICU admission). The crude case fatality rate for individuals over 60 is 8.3%	**Variants of concern:** some preliminary studies indicate that certain variants are more likely to cause severe disease. **Underlying conditions:** the presence of certain comorbidities may further increase the impact of an infection in older adults.	Published results from observational studies.	**Impact of infection from fully vaccinated individuals:** Not available **Impact of infection in general:** [58]

Options for response

Considerations for risk-based adjustment of non-pharmaceutical interventions

In light of the above-assessed risks for fully vaccinated individuals to be infected and transmit the infection, the de-escalation of specific NPIs can be considered in situations of gatherings of a limited number of individuals, all or most of whom are fully vaccinated, from beyond one's own household or social bubble. Table 6 presents scenarios where physical distancing and the wearing of face masks may be relaxed in indoor and outdoor encounters, based on a risk assessment for fully vaccinated individuals as well as unvaccinated individuals to develop and transmit disease. In the current epidemiological situation in the EU/EEA, in public spaces and in large gatherings, including during travel, NPIs should be maintained irrespective of the vaccination status of the individuals. NPIs such as hand and respiratory hygiene and adequate ventilation of indoor spaces should also be maintained in all settings.

Generally, when the risk of transmission of infection that will result in the development of severe COVID-19 disease is very low to low consideration around relaxing physical distancing and face mask wearing can occur.

When the risk is moderate to very high, however, the use of face masks and physical distancing should be maintained. If any individual has symptoms of illness compatible with COVID-19, the relaxation of measures is not appropriate in any scenario.

Fully vaccinated individuals meeting other fully vaccinated individuals

For fully vaccinated younger and middle-aged adults who meet other fully vaccinated individuals, the risk associated with meeting others is assessed to be very low.

For fully vaccinated older adults who meet other fully vaccinated individuals, the risk associated with meeting others is assessed to be low.

For either of these scenarios, requirements for physical distancing and the wearing of face masks can be relaxed with an acceptable residual risk. In settings of high circulation of immune escape variants, the risk will be enhanced and the relaxation of measures may not be appropriate.

Unvaccinated individuals meeting fully vaccinated individuals

In situations where an unvaccinated individual or more than one unvaccinated individuals from the same household or social bubble meet fully vaccinated individuals, the risk is low where the unvaccinated people are young or middle-aged adults with no underlying risk factors for severe COVID-19. In such situations, the requirements for physical distancing and wearing of face masks can be relaxed. In settings of high circulation of immune escape variants or if individuals in this category have risk factors for severe disease, regardless of age, the risk will be enhanced and a relaxation of measures may not be appropriate.

The scenarios provided (Table 6) are general guidelines, where considerations around the number of individuals meeting, the nature and duration of contact may also influence the assessment of the risk of developing severe disease and decision to maintain the use of face masks and physical distancing. A larger number of individuals gathering, gatherings where it is not possible to determine the presence of underlying risk factors or circulation of VOCs, meetings in indoor environments, and those that are longer in nature in environments with poor ventilation will increase the risk of SARS-CoV-2 transmission and may influence the decision to relax or maintain face masks and physical distance.

Table 6. Scenarios where physical distancing and face mask wearing may be relaxed based on the risk assessment for fully vaccinated individuals to develop or transmit severe disease

Scenario	Risk	Relaxing requirements for physical distancing and face mask wearing	Factors that would modify the risk and require maintained NPIs
Fully vaccinated individuals meeting other fully vaccinated individuals	**Fully vaccinated younger adults and middle-aged adults:** Very low	✓	Presence of COVID-19 compatible symptoms in any individual High circulation of immune escape variants
	Fully vaccinated older adults/ individuals with underlying conditions: Low	✓	Presence of COVID-19 compatible symptoms in any individual High circulation of immune escape variants
A fully vaccinated individual meeting one or more unvaccinated individuals from the same household or social bubble	**Fully vaccinated younger adults and middle-aged adults:** Low	✓	Presence of COVID-19 compatible symptoms in any individual High circulation of immune escape variants
	Fully vaccinated older adults/ individuals with underlying conditions: Low to moderate	✗	
One or more unvaccinated individuals from the same household or social bubble meeting a fully vaccinated individual	**Unvaccinated younger adults and middle-aged adults:** Low	✓	Presence of COVID-19 compatible symptoms in any individual High circulation of immune escape variants
	Unvaccinated older adults/ individuals with underlying conditions: Low to moderate	✗	

✓: Relaxation of measures can be considered; ×: measures should be maintained

Consideration for the management of fully vaccinated individuals as contacts of a confirmed COVID-19 case

Contacts of confirmed cases are at higher risk of contracting and transmitting COVID-19 compared to others in the community. Given the current uncertainty in terms of the effectiveness of different vaccines in preventing the transmission of infection to others, particularly in the context of the circulation of VOCs, a precautionary approach is warranted. Therefore, when contact tracing fully vaccinated contacts who have been exposed to a confirmed case, these contacts should continue to be managed according to existing ECDC guidance [59].

However, health authorities may consider, if resources allow, undertaking a risk assessment on a case-by-case basis and subsequently classify some fully vaccinated contacts as low-risk contacts (please refer to existing ECDC guidance for details of management of low-risk contacts) [59]. Factors that need to be taken into consideration in such assessments include, for example, the local epidemiological situation in terms of circulating variants, the type of vaccine received (if information available), and the age of the fully vaccinated contact (as older people may

not mount as effective an immune response). The risk of onward transmission to vulnerable people by the contact should also be considered, such as whether they work or reside in an institutionalised setting (e.g. long-term care facility).

Considerations for the management of fully vaccinated individuals in occupational settings in which regular testing is required

Public health authorities may consider exempting fully vaccinated individuals of very low and low risk from repeat testing in occupational and other community settings. However, caution is warranted for HCWs and LCTF staff because of the higher risk of onward transmission to vulnerable high-risk individuals.

Considerations for the management of fully vaccinated travellers

The likelihood that a fully vaccinated traveller will pose a risk for onward transmission of COVID-19 is assessed as very low. The VOC circulation profile at the place of origin of travel (e.g. high percent of immune-escape variants or immunisation with a vaccine with lower or unknown effectiveness against disease transmission) should be factored in; if such factors are present, the risk would be increased.

Countries may consider waiving the requirement for testing before or after travel and, if required, quarantine after arrival, or shortening the duration of quarantine for fully vaccinated individuals with very low risk [60].

During travel, NPIs should be maintained regardless of the vaccination status of the traveller. Fully vaccinated travellers should also respect any NPIs for fully vaccinated people in the country of destination.

Discussion

The key role of vaccination coverage in modulating the risk

Risk of infection and onward transmission of SARS-COV-2 in fully vaccinated individuals should not be considered in isolation but should always be assessed in a broader epidemiological context.

Based on evidence from Israel and the UK, it is clear that the main focus should remain on a rapid and effective deployment of vaccines in order to reduce the number of susceptible individuals, the number of hospitalisations and deaths, the viral circulation in the community, so that a stronger relaxation of measures for fully vaccinated individuals can be permitted.

The vaccination of people in close contact with individuals at increased risk of severe COVID-19 is also a key aspect to factor in, particularly in closed settings.

Experiences from Israel and the UK clearly show that with an increasing vaccination coverage in the population, there are stronger signs of indirect protection and further relaxation of measures may eventually become possible for fully vaccinated individuals.

In Israel, larger and earlier decreases in the number of COVID-19 cases and hospitalisations were observed among age groups prioritised for vaccination starting 3-4 weeks following the initiation of the vaccination campaign [61,62]. Of note, Israel experienced high viral circulation and had a lockdown in place for a one-month period during the beginning of their vaccination campaign, with nearly 90% of people in the 60 and older age group having received one dose (80% of them fully vaccinated) and 52% of the overall population vaccinated with at least one dose (40% fully vaccinated), before the lockdown was released [63,64].

In the UK, high viral circulation was observed during the beginning of the vaccination campaign in December 2020, fuelled by the rapid expansion of the more transmissible B.1.1.7 variant. COVID-19 vaccination campaigns initially prioritised providing a first dose to the oldest age groups and health and social care workers and have now expanded to those aged 50 years and older. As of 7 April 2021 in the UK, 60% of individuals over 18 years of age had received 1 dose (including >90% of those in above age 70) and 11.6% had received two doses [65,66]. The UK has seen a sharp decline in incidence, hospitalisations, and deaths, initially in the oldest age groups, followed by reductions in the rest of the population [67]. By the end of March 2021, the UK estimated that 10 400 deaths had been averted due to the vaccination programme (9 100 in the age group of individuals $\geq$80 years, 1 200 in 70 to 79 years, 100 in 60-69 years) [66]. Strict public health measures have been in place in the UK since January 2021; these are only being released very gradually, as of 12 April 2021 [68].

In both countries, rapid expansion of the B.1.1.7 variant was associated with very high viral circulation and both countries employed strict public health measures while ensuring that a large proportion of the adult population had received at least some vaccine-conferred protection, and until >90% of those in the most vulnerable groups had been vaccinated, before gradually releasing public health measures.

While vaccination coverage is low and vaccine is not widely accessible, countries considering relaxing measures for fully vaccinated people, should take into account the uneven or inequitable vaccine access across the population.

Considerations related to specific settings as risk modulating factors

The risks assessed in this document could also vary according to the setting. For some settings like long-term healthcare facilities, detention centres (e.g. prisons), refugee camps, schools, households, rehabilitation centres, specific considerations should be made.

It is important to consider the individual risk of developing severe COVID-19 of people in these settings as the impact of infection could result in very different consequences and the following settings can be outlined:

- In **long-term healthcare facilities**, the residents comprise older adults, fragile individuals, and people with underlying conditions possibly at increased risk of severe COVID-19.
- In **refugee camps, rehabilitation centres or detention centres** (e.g. prisons), living and underlying conditions may contribute to an increased baseline risk of spread of the infection and of development of severe COVID-19.
- In **schools**, the average individual risk of developing severe COVID-19 can be considered very low for students although some of teachers, professors and other staff working in the school could be at potential increased risk.
- In **household settings**, when assessing the risk it is important to consider the household composition and whether any person at increased risk of severe COVID-19 is present in the house.
- In **open settings** like offices, public transportation, gyms, bars, cafes, restaurants, cinemas, theatres, religious buildings, universities, libraries, taxis, shops, supermarkets, etc., it will be critical to consider the epidemiological situation in the broader community, in particular in relation to the vaccination coverage at the population level by different age group, and the proportion of individuals at increased risk of severe COVID-19 attending these settings, to be able to relax some measures in the future when vaccination coverage will have reached significantly much higher levels than the current ones in the EU/EEA.

The different risk associated with the different settings will inevitably lead to different needs for non-pharmaceutical interventions. Of note, the same likelihood of infection and transmission to unvaccinated individuals may have very different consequences according to the setting.

Other factors modulating the risk

The risk is also modulated by other factors. Meeting people with underlying factors increasing the risk of severe COVID-19, such as older age and specific conditions, is not the same as meeting young and healthy people. The impact of COVID-19 varies dramatically according to age in particular [9,69]. The nature, frequency and duration of the contact with a susceptible individual is a known factor modulating the risk of transmission in general. Likewise, physical distancing and the use of face masks may reduce the risk of transmission and possibly lead to exposure to a lower viral load. Behavioural changes following vaccination may affect some of these modulating factors, and therefore adherence to recommended behaviour in different contexts following vaccination is of key importance. Additionally, variants of concern may be increasingly able to escape immune defences due to the evolutionary pressure posed by natural immunity in previously infected individuals and to vaccine-induced immunity. This may affect vaccine effectiveness against infection and mild disease, but a reduction of effectiveness also against severe disease cannot be excluded, in particular among older adults and fragile individuals. For travellers, it is important to assess whether there is community circulation of immune escape variants in the country of origin and, if data is unavailable, to refrain from relaxed measures, even in vaccinated individuals. The duration of protection following vaccination against COVID-19 has not been yet established, and can only be assessed a few months following the administration of a full course. As time passes, further information on duration of immunity will become available, but it cannot be excluded that over time vaccine-induced immunity may wane and fully vaccinated people may become susceptible again.

Partially vaccinated and previously infected individuals

People who are not fully vaccinated (e.g. recipients of a one dose of a two-dose course vaccination) were not assessed in this document and, although it is known that some protection is conferred after one dose in many individuals, the level and duration of protection is not well understood [4]. Previously infected individuals may experience some degree of protection against re-infection, but it is not clear how long it may last and whether and how much it protects against VOC. Partially vaccinated and previously infected individuals were not assessed in this guidance. For the purposes of this document and for clarity in risk communication messages on the importance of receiving a full course of vaccination, no relaxation of measures should be considered for partially vaccinated and previously infected individuals.

Conclusions

The risk of developing severe COVID-19 disease for a fully vaccinated individual is very low in younger adults and middle-aged adults with no risk factor for severe COVID-19, and low in older adults or people with underlying risk factors.

The risk of developing severe COVID-19 for an unvaccinated individual who has been in contact with a fully vaccinated person exposed to SARS-CoV-2 infection, is very low to low in younger adults and middle-aged adults with no risk factors for severe COVID-19, and moderate for older adults or people with underlying risk factors (limited evidence available so far).

The overall reduction in risks of severe COVID-19 disease in the population are dependent on the vaccine uptake and vaccination coverage in the general population and are modulated by a number of other factors such as age and underlying conditions, vaccine characteristics, variants of concern, setting and epidemiological situation.

To date, given the current risks as assessed, there are specific situations where NPIs can be lifted:

- When fully vaccinated individuals meet other fully vaccinated individuals (very low/low risk), physical distancing and the wearing of face masks can be relaxed.
- When an unvaccinated individual or unvaccinated individuals from the same household or social bubble meet fully vaccinated individuals, physical distancing and the wearing of face masks can be relaxed if there are no risk factors for severe disease or lower vaccine effectiveness (e.g. age, immunosuppression, other underlying conditions).
- When contact tracing, vaccinated contacts who have been exposed to a confirmed case should continue to be managed according to existing ECDC guidance. However, health authorities may consider undertaking a risk assessment on a case-by-case basis and subsequently classify some fully vaccinated contacts as low-risk contacts. Factors that need to be taken into consideration in such assessments include, for example, the local epidemiological situation in terms of circulating variants, the type of vaccine received, and the age of the contact. The risk of onward transmission to vulnerable people by the contact should also be considered.
- Requirements for testing and quarantine of travellers (if implemented) and regular testing at workplaces can be waived or modified for fully vaccinated individuals, as long as there is no or very low circulation of immune escape variants (in the community in the country of origin, in the case of travellers).
- In the current epidemiological context in the EU/EEA, in public spaces and in large gatherings, including during travel, NPIs should be maintained irrespective of the vaccination status of the individuals.

Examples from countries where vaccination coverage is higher and, subsequently, severe COVID-related outcomes and SARS-CoV-2 incidence have declined, such as the UK and Israel, provide an indication of how population-level transmission can be reduced by increased vaccination coverage in the EU/EEA in coming months.

Limitations

There is very limited direct evidence on the transmission risk from fully vaccinated individuals, with existing information not available by vaccine product and, due to being conducted in healthcare workers and their household members, with limited applicability to the entire population.

There is limited information on duration of immunity post-vaccination, overall and for individuals of different ages and with underlying comorbidities; also by vaccine product.

There is little or no information on the severity of disease associated with breakthrough infections, overall and for individuals of different ages and with underlying comorbidities; also by vaccine product.

There is limited information on vaccine escape associated with variants of concern and, if infection occurs, whether these variants impact severity of disease, overall and for individuals of different ages and with underlying comorbidities; also by vaccine product. The published literature on levels of immunity may not yet have assessed the impact of current or emerging variant strains that could emerge.

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Disclaimer

All data published in this report is correct to the best of our knowledge at the time of publication.

Glossary

COVID-19 vaccines

COVID-19 vaccines are pharmaceutical products administered with the aim of preventing disease caused by the novel initial coronavirus SARS-CoV-2. As and when virus variants arise through amino acid substitutions, deletions, or insertions, they may become less susceptible to the immune response evoked by vaccines developed against prior circulating types. Therefore COVID-19 vaccines are may be updated at regular intervals and include one or several SARS-CoV-2 variants, similar to influenza vaccines. The regulatory framework for updating COVID-19 vaccines is under development by European Medicines Agency [70].

Vaccine course

The first three EU-authorised COVID-19 vaccine products (Comirnaty vaccine developed by Pfizer-BioNTech, COVID-19 Vaccine Moderna and Vaxzevria (previously COVID-19 Vaccine AstraZeneca)) are recommended to be administered in a two-dose regimen to prime the immune response. A fourth vaccine, Janssen COVID-19 Vaccine, was authorised for use in the EU on 11 March 2021 and is recommended to be used in a one-dose regimen for priming the immune response [71]. This vaccine was authorised by the Food and Drug Administration (FDA) in the US in late February 2021 [72] . Additional vaccines currently under rolling review by the European Medicines Agency include vaccine candidates developed by CureVac AG (CVnCov), Novavax (NVX-CoV2373) and Gamaleya (Sputnik V (GamCOVID-Vac)). COVID-19 vaccines developed and produced in China (Sinovac) and Russia (Gamaleya) are currently being procured and used in a few EU Member States (Czechia and Hungary).

It is expected that COVID-19 vaccinees may need to receive booster doses at regular intervals, and it is possible that vaccinated individuals may have to receive repeated immunisations to provide protection against emerging variants. Therefore, it is currently difficult to define who is fully vaccinated and protected against COVID-19 in the short- and long-term. This means that the assessment of vaccine-induced immune status will always be made on a case-by-case basis, guided by the product characteristics of the vaccine that the individual has received and by circulating SARS-CoV-2 virus variants at the time of assessment.

Infection

Infection is defined as the entry and development or multiplication of an infectious agent in an organism, including the body of humans and animals. In this document, natural infection refers to previous infection, or reinfection episodes subsequent to the first infection episode. Evidence of seroconversion is often required to prove that an infection has occurred, rather than just contamination with nucleic acid. In this document, a positive result from a PCR or rapid antigen test is considered as a reasonable proxy of infection for a person, irrespective of symptoms.

Immunity

Immunity is the resistance acquired by a host as a result of previous exposure to a natural pathogen or foreign substance for the host. Immunity may develop either through infection or vaccination. Acquired immunity can be expressed as humoral immunity, measured by specific antibody responses or cellular immunity, measured by T-cell responses. Currently it is understood that most of the virus neutralising antibody activity in previously infected or vaccinated persons is mediated by antibodies targeting the SARS-CoV-2 spike protein, and more specifically, the receptor binding domain (RBD) of that protein.

Transmission of infection

The process, mechanisms, and determinants by which an infectious agent or an infectious disease are spread from a source or reservoir to another person or across communities and countries.

Likelihood of transmission

The likelihood that an infected person (pre-symptomatic, symptomatic, or asymptomatic) transmits the infectious agent to one or more other individuals

Social bubble

A group of people meeting consistently with each other while not meeting people outside the group.

Unvaccinated individual

An individual with no documented history of full-course vaccination against COVID-19 (see below "Fully vaccinated individual") is considered unvaccinated in this document.

Variants of concern

This refers to variants of the SARS-CoV-2 virus which, due to recombination or spontaneous mutation, have demonstrated the potential to:

- increase in transmissibility or detrimental change in COVID-19 epidemiology;
- increase in virulence or change in clinical disease presentation; or
- decrease the effectiveness of public health measures (including NPIs), available diagnostics, vaccines, and/or
- therapeutics [73].

Fully vaccinated individuals

For the purposes of this guidance, people are considered fully vaccinated for COVID-19 from two weeks after they have received the second dose in a two-dose series (Pfizer-BioNTech or Moderna or AstraZeneca), or from two weeks after they have received a single-dose vaccine (Johnson and Johnson (J&J)/Janssen).

Contact

A contact of a COVID-19 case is any person who has had exposure to a confirmed COVID-19 case within a timeframe ranging from two days before the onset of symptoms in the case to 10 days (or, if severe symptoms or immunocompromised 20 days) after the onset of symptoms [59].

Community transmission

Countries/areas/territories experiencing larger outbreaks of local transmission defined through an assessment of factors including, but not limited to a) large numbers of cases not linked to transmission chains, b) high proportion of SARS-CoV-2 positive cases from sentinel lab surveillance, and c) multiple unrelated clusters in several areas of the country/territory/area.

Physical distancing

Avoiding physical contact, keeping a physical distance of 1–2 m and generally limiting close physical inter-personal interactions e.g. through cancelling gatherings or limiting their size.

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Annex

Figure A. Components of risk of severe COVID-19 disease for a fully vaccinated individual

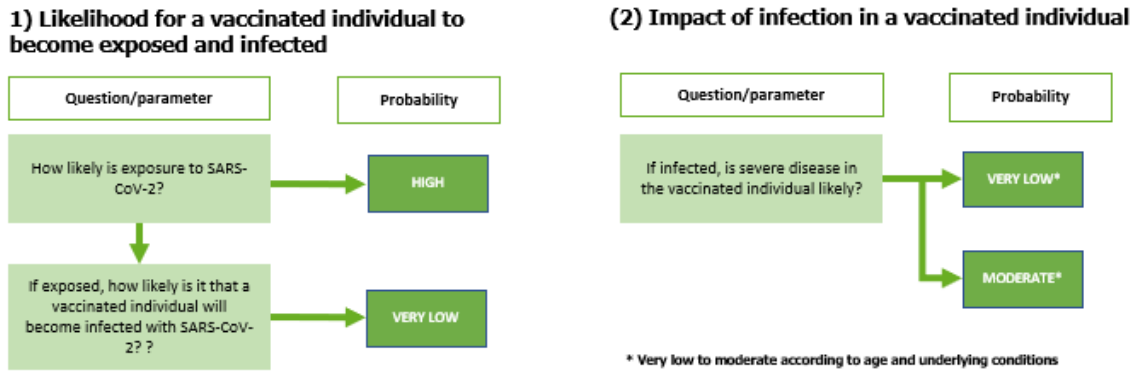

Figure B. Components of risk of severe COVID-19 for an unvaccinated individual in contact with a fully vaccinated person exposed to SARS-CoV-2 infection