

COVID-19

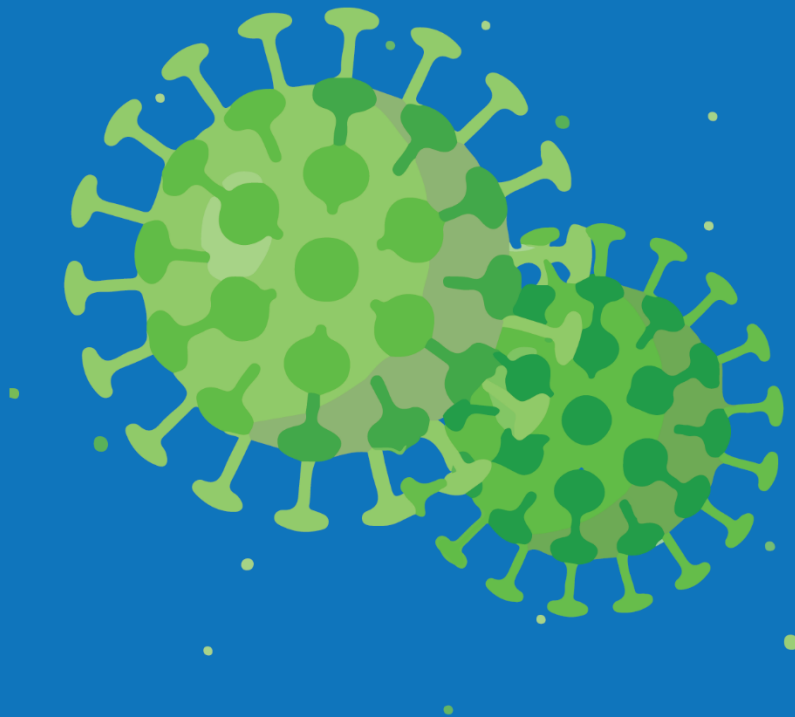
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Disease caused by the SARS-CoV-2 virus

Guidelines for COVID-19 testing and quarantine of air travellers

Addendum to the COVID-19 Aviation Health Safety Protocol



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Definitions

- Asymptomatic: refers to people who are infected but do not exhibit symptoms of COVID-19.
- Contacts of confirmed cases: refers to any person who has had exposure to a confirmed COVID-19 case within a timeframe ranging from two days before to 10 days after the onset of symptoms. If the case has had no symptoms, further assessment should be made, as outlined in 'Contact tracing: public health management of persons, including healthcare workers, who have had contact with COVID-19 cases in the European Union – third update' [1].
- COVID-19: refers to corona virus disease 2019 – a potentially severe illness caused by a SARS-CoV-2 most frequently characterised by fever, coughing, and shortness of breath. Other organs may be affected, resulting in specific symptomatology.
- Epidemiology: refers to the branch of medicine that deals with the study of the incidence, distribution and determinants of disease and the analysis of these measures in order to control the spread of diseases and improve other factors related to health.
- False negative: refers to a test result indicating that the disease is not present when the person actually does have the disease.
- False positive: refers to a test result indicating that the disease is present when the person actually does not have the disease.
- IHR: international health regulations, refers to an overarching legal framework that defines countries' rights and obligations in handling public health events and emergencies that have the potential to cross borders.
- Incidence: refers to the number of new cases of a disease over occurrence, rate or frequency of a disease - in this context the number of new cases during a specified period.
- Positive predictive value (PPV): refers to the likelihood of a positive test being true positive.
- PoE: Point of Entry
- Prevalence: the proportion of the population with a disease at a specific point or period in relation to disease burden expressed as a percentage or rate with the total population as the denominator.
- RADT: rapid antigen detection test, is a testing method for SARS-CoV-2 that can rapidly (usually in <30 minutes) detect viral components present during the infection in samples such as nasopharyngeal secretions.
- RT-PCR: reverse transcription polymerase reaction - a very sensitive testing method for detecting different pathogens based on their genetic material. It is considered to be the gold standard for the detection of SARS-CoV-2 RNA.
- Non-symptomatic: refers to persons who may or may not be infected and do not exhibit COVID-19 symptoms.
- Negative predictive value (NPV): refers to the likelihood of a negative test being true negative.
- Quarantine of contacts of cases: refers to the need for those exposed to a confirmed COVID-19 case to remain at home or in a designated safe setting for a defined period after the last exposure, with the aim of reducing virus transmission [1]. This can be voluntary, or mandatory, if implemented by local authorities.
- Quarantine of travellers: refers to travellers being required to remain at home or in a designated safe setting for a defined period after entering a region or country. This can be voluntary or mandatory, if implemented by local authorities.
- SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2, the causative agent of COVID-19.

Executive summary

This document aims to support Member States in determining a coordinated approach to reduce the risks related to the movement of people within and between the EU/EEA countries and the UK in the context of the COVID-19 pandemic. It is intended for use by decision-makers in the Member States, including public health authorities and civil aviation authorities, as well as aviation stakeholders. The recommendations outlined in this document may also be taken into account by Member States when considering temporary restrictions on non-essential travel to the EU in relation to residents of third countries¹.

The document provides information on effective and differentiated strategies to enable the health authorities to evaluate scenarios and make informed decisions on the best possible measures.

Scientific evidence and information, presented and analysed in this document, give rise to the following key considerations:

- In the current epidemiological situation, where SARS-CoV-2 is established in all EU/EEA countries and the UK, imported cases account for a very small proportion of all detected cases and are unlikely to significantly increase the rate of transmission.
- The prevalence of SARS-CoV-2 in travellers is estimated likely to be lower than the prevalence in the general population or among contacts of confirmed cases.
- Travellers should not be considered as a high-risk population, nor treated as contacts of COVID-19 cases, unless they had been in known contact with a confirmed positive case.
- Travellers should be subject to the same regulations or recommendations as applied to the local population.
- Member States should always admit their own nationals and EU citizens and their family members resident in their territory, and should facilitate swift transit through their territories.

Decision makers are invited to consider the detailed epidemiological evidence that supports the options presented in this document acknowledging that:

- In the current epidemiological situation², quarantine or systematic testing for SARS-CoV-2 of air travellers is not recommended.
- Harmonisation among Member States is recommended based on the specific measures presented in this document.

Chapter 3 outlines the main risk assessment criteria and the available evidence and information on the use of testing and quarantine for travellers. Where scientific evidence is insufficient, the document takes into consideration modelling studies and expert opinions from the relevant experts at the European Centre for Disease Prevention and Control (ECDC) and the European Union Aviation Safety Agency (EASA).

In Chapter 4, the document presents specific operational recommendations for the management of these travel-related measures by the Member States.

The document, its observations, recommendations and conclusions are based on the evidence and best knowledge available at the time of writing, as compiled and analysed by experts at ECDC and EASA. Depending on the evolution of the pandemic and future evidence and developments, in terms of risk assessment criteria, testing technologies or the introduction of vaccines, this document may require updating which may prompt further assessment by the Member States in their implementation efforts.

¹ In accordance with Council Recommendation (EU) 2020/912 of 30 June 2020 on the temporary restriction on non-essential travel into the EU and the possible lifting of such restriction; OJ L 208I 1.7.2020, p.1. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02020H0912-20201026&qid=1606575297003>

² At the time of writing, community transmission is occurring in all EU/EEA Member States and the UK.

1. Context

Within the EU/EEA and the UK, cross-border travel can refer to travel within the EU/EEA and the UK and travel from third countries outside the EU/EEA and the UK. Travellers within the EU/EEA and the UK include not only tourists, but also transport workers, commuters, students, military and diplomatic personnel, business travellers and seasonal workers. Free movement within the EU is one of the fundamental principles of the Treaty on the Functioning of the European Union [2].

In response to the first wave of COVID-19 in spring 2020, the EU/EEA countries and the UK implemented various public health measures to minimise the likelihood of COVID-19 transmission on-board various conveyances including aircraft, as well as other measures to limit the importation of COVID-19 by cross-border travel. To support the Member States, EASA and ECDC jointly developed the COVID-19 Aviation Health Safety Protocol (AHSP) [3], which provides recommendations on measures for every stage of the end-to-end traveller journey [3]. The COVID-19 AHSP also provides recommendations regarding pre- and post-flight health screening and supportive arguments for the collection and sharing of passenger locator data.

The travel-related measures adopted by the EU/EEA countries and the UK in the context of the COVID-19 pandemic have varied significantly and some of them have had an impact on citizens' rights to free movement and the functioning of the internal market. Most of the EU/EEA countries and the UK have developed national criteria to determine the potential need for testing and/or voluntary or mandatory quarantine of incoming travellers. Due to the rapidly-evolving epidemiological situation the measures have changed on average every 7–14 days. Despite initiatives such as the European Commission's Re-Open EU website [4] and the EU health preparedness recommendations for a common EU testing approach to COVID-19, agreed by the Health Security Committee (HSC) [5], the different measures have resulted in significant confusion for travellers. This is continuing to have a significant negative impact on travel and tourism.

On 13 October 2020, the Council of the European Union adopted Recommendation 2020/1475 on a coordinated approach to the restriction of free movement in response to the COVID-19 pandemic, aiming to avoid fragmentation and disruption, and to increase harmonisation, transparency and predictability for citizens and businesses [6].

On 28 October 2020, the European Commission issued a Communication on additional COVID-19 response measures [7], mandating EASA and ECDC to work on guidelines on testing in air travel which could be used by public health authorities, airlines and airports to help the safe arrival of passengers, along with a Commission Recommendation on COVID-19 testing strategies, including the use of rapid antigen tests [8].

2. Risk assessment and scientific evidence

2.1 Travel-related risks in the COVID-19 pandemic

In most countries, once the virus has been introduced into the community, imported cases are likely to contribute little to the ongoing spread of SARS-CoV-2.

Air travellers should be considered as a mostly non-symptomatic subpopulation with a low probability of being infected with COVID-19, comparable to the general population of the country of origin.

Competent authorities and the relevant stakeholders should ensure that the non-pharmaceutical interventions (NPI) outlined in the COVID-19 Aviation Health Safety Protocol are implemented and that passenger locator forms (PLF) are completed and collected in order to enable efficient contact tracing.

Air travellers should be duly informed of all the measures in place.

Entry screening, quarantine and border closures for incoming travellers are unlikely to prevent the introduction of SARS-CoV-2 into a community, although they might delay it for a short period of time. However, public health capacity must be in place to mitigate the risk of the introduction of SARS-CoV-2 and prevent further transmission.

Implementing systematic testing for SARS-CoV-2 of air travellers is not recommended, except in specific epidemiological scenarios (see below), as it may detract public health resources and laboratory capacity from essential public health activities, such as timely testing of possible cases in the community and high-risk settings, contact tracing, and cluster investigations.

Decision-makers in the Member States need to ensure that they have sufficient capacity in place for contact-tracing and all other similar measures.

Travel and population movements contribute to the spread of pathogens and/or their introduction into areas where they were not previously circulating [9]. Historically, governments intuitively turn to travel-related measures and restrictions, which potentially help build public trust, particularly for new emerging threats to health [10]. Advice against non-essential travel during an epidemic is designed to reduce the number of people who may be exposed while visiting areas or countries where community transmission is ongoing and, consequently, to reduce the risk of importation and transmission among travellers during transportation.

The first cases of COVID-19 in Europe were imported from Hubei, China. However, it is difficult to identify the first actual importation and it is postulated that the pathogen was silently circulating for weeks before its detection. Travel-related virus introduction and tourism-related spread within the EU/EEA and the UK contributed substantially to the transmission across and within countries during the early phase of the COVID-19 pandemic [11-17].

Moreover, models consistently indicate that neither temperature screening, nor surveillance of passengers at airports to identify those exhibiting COVID-19 relevant symptoms would have a major impact on the detection of imported COVID-19 cases [18,19]. A modelling study (in preprint) estimates that imported COVID-19 cases, using the May 2019 travel volumes, would have accounted for less than 1% of the total of cases in 48 countries and less than 10% in 142 countries around the world in May 2020 [20]. Therefore, in most countries, imported cases are likely to contribute little to the ongoing spread of SARS-CoV-2, once the virus has been introduced in the community.

With an effective reproduction number of COVID-19 between 2–4 (high) [21] and a long incubation period (1–14 days; median 5–7 days) [22], models estimated that a 90% reduction of the number of passengers would only delay the arrival of the outbreak in a country by approximately 10 days [23].

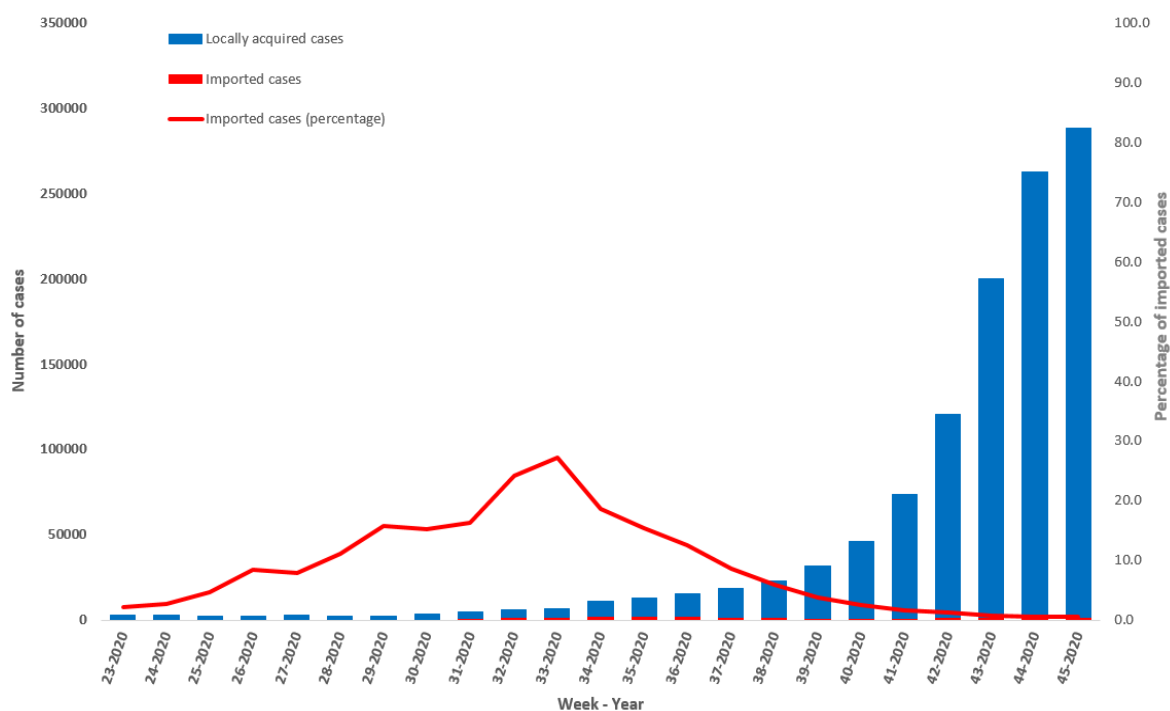
Based on evidence from past outbreaks of new emerging pathogens, as well as the above mentioned models [10,24,25], it is assessed that entry screening for COVID-19, quarantine and border closure for incoming travellers are unlikely to prevent the introduction of SARS-CoV-2 in a community but may delay it for a short period of time. However, public health capacity should be in place to promptly recognise new cases through comprehensive surveillance; undertake prompt testing and isolation of cases and carry out contact tracing for incoming travellers and quarantining of exposed contacts.

As regards air travel, documented cases of SARS-CoV-2 transmission in aircraft mainly occurred before the implementation of non-pharmaceutical interventions (NPI) [26,27]. To minimise the risk of transmission of SARS-CoV-2 during air travel, EASA and ECDC developed a dedicated COVID-19 Aviation Health Safety Protocol (AHSP) addressing all stages of travel and describing all the measures including communication, administrative controls, physical distancing measures at airports and on-board aircraft, enhanced hygiene and cleaning [3].

According to the available evidence to date, the spread of SARS-CoV-2 is mostly facilitated by human interactions in the absence of NPIs such as physical distancing, hand and respiratory hygiene and the use of face masks, with the majority of the clusters occurring in crowded indoor settings. As regards travellers, it is important to differentiate them from high-risk close contacts of a confirmed COVID-19 case. Studies have shown that the prevalence of COVID-19 in household contacts ranges from 4.6–49.5% [28], while data from contact tracing activities in Ireland show an overall positivity rate of 15% [95% Confidence Interval (CI) 11% to 20%] [29]. In contrast, prevalence in travellers is estimated by modelling studies to be much lower, closer to the estimated prevalence of COVID-19 in the general population at less than 1% [30,31]. The current average estimated point prevalence of COVID-19 in general populations in the EU/EEA countries and the UK is thought to be less than 2.5%³. As these estimates are based on reported cases and general population point prevalence studies, and as travellers with symptoms are discouraged from travelling, ECDC estimates that the current prevalence of COVID-19 among travellers in the EU/EEA is approximately 1%, although in areas of intense widespread transmission of SARS-CoV-2, the prevalence among travellers could be higher.

Based on the data on COVID-19 cases reported by EU/EEA countries and the UK to TESSy, we compared the number of imported cases as specified by the reporting Member State with that of locally-acquired cases from week 23/2020 to week 45/2020.

Figure 1. Locally acquired and imported cases of COVID-19, as reported by the destination country for eight EU/EEA countries*, weeks 23–45/2020



*Source: TESSy, ECDC.

Country reports from Czechia, Estonia, Finland, Ireland, Italy, Malta, Norway, and Slovakia. Data were included from countries that had a) $\geq 70\%$ completeness of TESSy data, when compared with data retrieved by ECDC epidemic intelligence for the same period (weeks 23 to 45), and b) maximum 35% of missing data in relation to imported cases.

Figure 1 shows that an increase of imported cases in the EU/EEA and the UK was observed during weeks 31–34, representing a relatively important proportion of imported cases during the summer holidays when the total number of cases was low. However, as testing policies focused on testing travellers during the beginning of the pandemic and the summer holidays, this proportion is likely to be biased. The proportion of imported cases decreased in subsequent weeks and in week 45 (last week with available data), imported cases only accounted for less than 1% of the total number of cases, with the vast majority of cases being locally acquired, which is consistent with the current community transmission of COVID-19 in Europe.

³ Based on the highest 14-day notification rate of 1.9% during week 47 and general population PCR point-prevalence estimates of less than 2%.

2.2 Testing and quarantine measures for air travel

Testing and quarantine of travellers are appropriate measures to delay the importation in an area where SARS-CoV-2 is not yet circulating, or once a country or a region has managed to decrease COVID-19 levels to almost zero.

Every testing and/or quarantine strategy leaves some residual risk of importation of COVID-19. Member States should assess what residual risk they are prepared to accept, then manage potential imported cases at national level through public health infrastructure (e.g. testing of suspected cases, contact tracing and isolation and provision of healthcare services.)

All available testing methods for COVID-19 have limitations and their performance depends on multiple factors, including the prevalence of the infection in the target population.

Tests will not detect individuals that are incubating the disease at the time of testing or have viral loads below the level of detection of the testing method used.

If screening of travellers is being considered, Member States should aim for the use of RT-PCR tests or other tests with performance close to RT-PCR.

RADTs perform best in cases with high viral load, in early symptomatic cases up to five days from symptom onset.

Where a country or an area has achieved consistent sustained control of SARS-CoV-2, with a 14-day incidence close to zero, RADTs are not suitable for screening incoming travellers to prevent virus introduction or re-introduction. In these situations, only RT-PCR should be used to reduce the risk of false negative results.

According to modelling studies, testing can help shorten the duration of quarantine.

Travel restrictions are regulated under the International Health Regulations (IHR) and EU law. In both cases, public safety and health threats related to infectious disease outbreaks are considered reasonable grounds for Member States to restrict free movement across borders.

Travel-related measures refer to a variety of measures at Points of Entry (PoE) in response to the COVID-19 outbreak, with the aim of controlling the spread of the disease. Providing information to travellers about the disease, the epidemiological situation in the destination country and the measures in place is very important and should be part of the risk communication strategy. In addition, Passenger Locator Forms (PLF) are recommended as an important tool to facilitate prompt contact tracing in the destination country. The effectiveness of other entry screening methods, such as temperature screening and health questionnaires, is not supported by evidence [32].

ECDC and EASA strongly recommend the advance provision of information to travellers, a simplified procedure for obtaining PLFs, preferably in digital format, and the implementation of a combination of NPIs [33] in the communities, including at airports and on-board airplanes, as set out in the COVID-19 Aviation Health Safety Protocol.

An overview of travel-related measures for air travel with their advantages and disadvantages is provided in Annex 1. This document focuses on the following travel-related measures: testing of air travellers for SARS-CoV-2 and quarantine of air travellers.

2.2.1 Testing of air travellers

Testing methods used for the diagnosis of COVID-19 include molecular (RT-PCR or RT-LAMP) and rapid antigen detection tests (RADTs). RADTs aim to detect active infections (i.e. infectious individuals at the time of testing.) RT-PCR may also detect non-infectious cases due to the prolonged existence of viral ribonucleic acid (RNA).

No diagnostic test provides 100% sensitivity and specificity; test performance depends on factors such as technical characteristics of the test, the prevalence of the infection in the target population, the timing of testing, the quality of the sample, the person's infection and immune status and the transport of specimens [34]. Proper interpretation of test results is important for accurate case management. Taking into consideration the measures already implemented (information to passengers and AHSP guidelines), air travellers are a mostly non-symptomatic subpopulation, with variable but decreased probability of COVID-19 compared to the general population (estimated prevalence of COVID-19 in travellers is approximately 1%) [35]. Test performance characteristics (sensitivity/specificity) and the prevalence of the disease in the target population play a pivotal role in determining the validity (i.e. ability to detect true positives and true negatives) of the test results. This document is, however, based on current evidence regarding the existing tests, and further technological developments may require it to be updated accordingly.

In order to ensure the expected quality of the test and for safety reasons, testing should always be conducted in accordance with manufacturer's instructions. Professional sampling is particularly important in the context of testing

with rapid antigen tests as the test lacks a control showing successful sampling. When testing at the PoE, trained healthcare or laboratory staff, or trained operators are needed to carry out sampling, testing, test analysis and reporting of test results to clinical staff and public health authorities at local, regional, national and international level. Self-testing may be an option if included in the manufacturer's instructions, provided that time and appropriate facilities are planned. When considering testing of travellers, Member States should give proper consideration to availability and prioritisation of all prerequisite resources, including appropriate human resources. The use of any diagnostic test for screening purposes, including RT-PCR and RADT, in a low prevalence population can lead to a number of false negative and false positive results, which would be higher for the RADT method. False negative cases pose a risk of importation and transmission during travel, while the false positives would require proper management until the result of the confirmation test is received. The management of the positive cases is expected to have an impact on the public health capacity as well as on aircraft and aerodrome operators, if testing is organised at airport premises.

Table 1 shows the true and false positive results expected if testing is implemented in air traveller population. As illustrated, the use of a low-performance test (with a sensitivity of 80% and specificity of 97%) would lead to more false positive (FP) and false negative (FN) results when compared to a high-performance test (with sensitivity of 95% and specificity of 98%). False positive cases are indistinguishable from true positives, unless a more specific test or repeat testing is performed for confirmation. Both false positive and false negative cases have public health implications. In the case of false positives, these individuals will have to be isolated and they will trigger contact tracing activities and further testing (i.e. requiring additional public health resources.) False negative cases, on the other hand, will give a false sense of security while triggering chains of community transmission. Therefore, the inherent risk of missing positive cases and the need to mobilise public health resources for false positive cases needs to be carefully considered when contemplating systematic testing. If systematic testing of air travellers is implemented then, as illustrated in these examples, it is critical to use clinically validated tests with high performance, which is as close as possible to RT-PCR performed in laboratories, and to ensure a rapid turnaround of test results.

Table 1. Test results when using high and low performing tests in air traveller population [35,36]

Examples of COVID-19 prevalence in the travellers	Aviation related target group tested	Test characteristics (High† / Low‡ performing test)	Test results*			
			True positive (TP)	False positive (FP)	True negative (TN)	False negative (FN)
0.5%	Average intra-EU flight: 180 travellers	H	1	4	176	0
		L	1	5	174	0
	Passenger volume per day at an EU airport: 20 000 travellers	H	95	398	19 502	5
		L	80	597	19 303	20
Passenger volume per day at an EU airport: 5 000 travellers	H	24	100	4 876	1	
	L	20	149	4 826	5	
1.5%	Average intra-EU flight: 180 travellers	H	3	4	174	0
		L	2	5	172	1
	Passenger volume per day at an EU airport: 20 000 travellers	H	285	394	19 306	15
		L	240	591	19 109	60
Passenger volume per day at an EU airport: 5 000 travellers	H	71	99	4 827	4	
	L	60	148	4 777	15	
3.0%	Average intra-EU flight: 180 travellers	H	5	3	171	0
		L	4	5	169	1
	Passenger volume per day at an EU airport: 20 000 travellers	H	570	388	19 012	30
		L	480	582	18 818	120
Passenger volume per day at an EU airport: 5 000 travellers	H	143	97	4 753	8	
	L	120	146	4 705	30	

*Results are rounded to the nearest whole number as they refer to persons, consequently the sum of the columns approximates the total number of passengers; †High- performance test: 95% sensitivity, 98% specificity; ‡Low-performance test: 80% sensitivity, 97% specificity, TP: true positive, FP: false positive, TN: true negative, FN: false negative.

Molecular tests for screening air travellers

Reverse transcription polymerase chain reaction (RT-PCR) has until now been the mainstay and the gold standard in terms of SARS-CoV-2 testing.

RT-PCR has the characteristics set out below:

- It detects the genetic material of the SARS-CoV-2 virus.
- It is a diagnostic test with high sensitivity, usually higher than 95%, and very high specificity 99–100%.
- A SARS-CoV-2 positive RT-PCR test does not necessarily mean that the tested person is infectious since recovering cases can remain RT-PCR positive for weeks.
- Although RT-PCR will very seldom miss a positive case, some false negative results can occur in cases with low viral load or improper pre-analytical conditions (e.g. sampling technique or poor swab quality).
- False positive results are rare but can occur in very low prevalence settings or in any setting in the event of contamination issues.

Reverse transcription loop-mediated isothermal amplification (RT-LAMP) technique has emerged as an alternative molecular detection method for the detection of SARS-CoV-2. RT-LAMP technique has some advantages such as fast test results and need of fewer resources, while maintaining high sensitivity and specificity [37]. Proper clinical validation studies are needed to evaluate this new technique and assess the potential role it could play in the travel setting.

Rapid Antigen Detection Tests (RADTs) for screening air travellers

RADTs have the following characteristics:

- Rapid antigen tests perform best in cases with high viral load, in pre-symptomatic and early symptomatic cases up to five days from symptom onset [38].
- The use of rapid antigen tests can be recommended for testing individuals irrespective of symptoms in settings where the proportion of test positivity is expected to be equal to or higher than 10% [38].
- Rapid Antigen Detection Tests (RADTs) can provide a result within 10–30 minutes, allowing rapid turnaround of results and shortening the time before further contact tracing and self-isolation can begin.
- Some rapid antigen tests require a laboratory instrument for the analysis, but others do not as the analysis is performed on a handheld cartridge with visual readout.
- RADTs have by nature of their technology a lower sensitivity than RT-PCR test for detecting SARS-CoV-2 and therefore a lower positive predictive value. In a low prevalence population, such as travellers, screening of asymptomatic persons by RADTs is not recommended and therefore, if such screening is to be attempted by Member States, RT-PCR tests should be used instead [38].

Validation studies for RADTs are ongoing, while a number of EU/EEA countries are piloting these tests in various settings, including at airports and PoE [38,39]. Several key principles should be taken into consideration before deploying RADTs for public health purposes [40,41].

- When using RADTs, appropriate biosafety measures must be in place, and a risk assessment performed when sampling, handling and processing specimens and tests.
- Manufacturer instructions for sample collection, specimen type, safe handling, proper waste management and intended use need to be followed precisely at all times.
- The current recommended use is for individuals with high viral loads. RADTs may miss individuals with low viral loads, for example during the pre-symptomatic phase and/or towards the end of the active infection.
- Test performance data play a significant role in test selection; ideally the test used should have undergone independent clinical evaluation (e.g. by the FIND foundation) [35].
- The sensitivities and specificities of RADTs currently range from 29% to 93.9% for test sensitivity and from 80.2% to 100% for test specificity, depending on the time of sampling [38].
- RADTs should be able to rule out most infectious cases. In a low-prevalence population, such as travellers, and if tested by RADTs, a positive test will need confirmation by RT-PCR.
- A negative result from an RADT should not be used to inform decisions on discontinuation of quarantine, which is based on the duration of the incubation period.
- RADTs may be useful for diagnosing suspected cases (e.g. travellers who suddenly develop COVID-19 compatible symptoms.)
- RADTs are not suitable for screening incoming travellers to prevent virus (re-)introduction in regions/countries that have achieved zero or very low levels of transmission. In these situations (i.e. in a low prevalence population), only RT-PCR should be used to reduce the risk of false negative results.

A number of the EU/EEA countries have implemented requirements for a recent negative COVID-19 RT-PCR test result in order to allow entry into their territory. According to modelling studies, performing a single RT-PCR test immediately upon arrival would prevent only 40% to 50% of local transmission from imported cases [30,42,43]. Furthermore, modelling studies have shown that pre-flight testing is less effective in preventing the importation of the virus than a similar test performed upon arrival. The longer the time between the sample collection from a

person without symptoms for a pre-flight test and the scheduled time of departure, the less effective the test will be. If a pre-departure negative test is requested, the sample should ideally be collected within 48 hours before departure [34]. Pre-departure testing reflects the situation of the tested individuals on the day the test is performed and cannot guarantee that they will not become positive in the immediate future. However, pre-departure testing may reduce the chances of transmission during travel, especially from areas with very high transmission levels. If a Member State is considering the introduction of pre-departure testing, it should also provide travellers with the possibility to undertake a test upon arrival [6].

Finally, implementing a testing procedure at airports may increase crowding, thus creating opportunities for SARS-CoV-2 transmission. Therefore if such testing is attempted by a Member State, it is recommended that the logistics for testing at PoE be carefully organised to ensure physical distancing and the protection of staff at all times.

2.2.2 Quarantine of air travellers

Many EU/EEA countries and the UK have adopted quarantine as a measure for incoming travellers, assuming that some of these travellers may be incubating the disease or have the disease but are asymptomatic. Some of the EU countries are making exceptions for short-term travellers (i.e. expected return within 72 hours). Quarantine for travellers will probably have an impact on their ability to work and provide for their family and it may affect their mental health. In addition, and according to the experience until now, these factors vary significantly depending on socio-economic status and age.

Travellers should be treated as local residents of the destination country and the same recommendations on how to prevent spread should apply to them, in accordance with local public health guidance.

The requirement for incoming travellers to quarantine, as a separate measure from quarantine of contacts, should be communicated to travellers by the country of destination well before their travel date, so that they have the opportunity to prepare. When implementing quarantine on entry, the country should provide adequately equipped quarantine facilities for travellers that have no possibility of home quarantine. Countries should also explore options for quarantine monitoring measures, such as daily health checks, or follow-up calls, according to their national capacities.

Data on compliance with quarantine rules are not readily available for the EU/EEA countries and the UK. Decreasing the duration of quarantine could, in theory, facilitate compliance. Moreover, there are currently no empirical data available on the effectiveness of shortened quarantine duration. At this point, only modelling studies (still in pre-print) provide information on the effectiveness of different durations of quarantine, alone or in combination with testing, to prevent the importation of COVID-19 cases [30,42,43]. An overview of these modelling studies is provided in Annex 3.

Quarantine of travellers may be an effective public health measure to delay the importation and/or limit reintroduction of SARS-CoV-2, if implemented comprehensively and very early in the evolution of the epidemic situation or when a country has reduced transmission levels to close to zero. Examples of the implementation of this approach are countries such as Taiwan and New Zealand [44,45]. In the current epidemiological situation, where SARS-CoV-2 is established in the communities of all EU/EEA countries and the UK, imported cases account for a very small proportion of all detected cases and are unlikely to contribute significantly to increased transmission (Figure 1).

2.2.3 Combination of testing and quarantine for air travellers

An approach used by several countries is to combine quarantine with the testing of incoming travellers in order to reduce quarantine duration.

According to data provided by 30 countries in the EU/EEA and the UK until 16 October 2020, 12 countries (40%) require 14-day quarantine or a combination with testing at one, five or seven days after arrival for travellers from certain countries. Five out of 30 countries require 10 days quarantine and/or testing after arrival; one Member State recommends a seven-day quarantine and testing before release and one requires two tests 48 hours apart. Lack of harmonisation and frequent, sometimes sudden, changes in national policies are causing confusion and having a deterrent effect on travel.

When assessing an appropriate quarantine duration, it is important to differentiate between contacts of a confirmed case and travellers [29,46]. Travellers, as mentioned above, represent a specific population, who are not by definition contacts of a COVID-19 confirmed case, unless they had been in contact. Risk communication is ongoing by public health authorities and aviation stakeholders to emphasise the importance of not travelling with COVID-19-compatible symptoms or, if identified as high-risk contact of a confirmed case. This remains one of the most effective ways to reduce the risk of transmission during travel and upon arrival. Available evidence does not support quarantine and testing of travellers as an effective public health measure which will substantially reduce overall transmission in the general population (other than in the exceptional situation described above, when a country has reduced transmission levels to close to zero).

Modelling studies (still in pre-print) [30,42,43] have explored different aspects of the effectiveness of various combination strategies in detecting imported cases of COVID-19, as outlined in Annex 3. Based on these studies, a 14-day quarantine period appears to be most effective in reducing the risk of transmission from travellers, although this creates logistical and financial challenges. A 10-day quarantine (without testing at day 10) seems to be the next most effective alternative, particularly if used in combination with other non-pharmaceutical interventions or where countries do not have enough testing capacity.

Alternatives involving shortened quarantine or combinations of quarantine and testing have been also explored, and it is expected that these will have less negative social impact. If a Member State implements quarantine of travellers, testing could help shorten the quarantine period. A single test upon arrival is considered to be about 40 to 50% effective in preventing the importation of the virus. Given the likely low prevalence of infection among travellers, and assuming that contact information is collected for travellers to enable follow-up if required, the combination of quarantine and a single test at around day 7 after arrival appears to offer a reasonable balance of risks and benefits as an alternative to longer quarantine without testing. However, this requires sufficient testing capacity. Testing twice (upon arrival and after a few days to release from quarantine) does not seem to significantly increase effectiveness - compared to testing only once to release from quarantine - and it is logistically challenging and more resource intensive.

Further details regarding the expected residual risk for various combinations are set out in Annex 3.

3. Operational recommendations

Importation of COVID-19 can occur from any point of origin where there is ongoing transmission, including another area in the same country. The majority of EU/EEA countries and the UK are currently experiencing widespread transmission of COVID-19 [47]. Therefore, the relative significance of the virus being introduced by cross-border travellers is minimal compared to ongoing community transmission and transmission related to national/non-cross-border travel.

Calculations from modelling studies show that all possible combinations of quarantine duration, including for 14 days, with and without testing, still involve a residual risk of cases being imported. This residual risk - which also depends on the volume of travellers and the prevalence of the disease in their place of origin - should be addressed by ensuring that public health measures are in place in the community to reduce opportunities for transmission at all times. These include NPIs, as recommended for air travel in the COVID-19 AHSP, and solid public health infrastructure, such as sufficient testing capacity for suspected cases and rapid turnaround of results, contact tracing and isolation/quarantine capacities. Given the estimated low prevalence of COVID-19 among travellers and the limited public health impact of detecting a few cases among travellers, performing systematic testing of travellers to reduce the risk of importation may not be the most effective use of public health resources.

When assessed according to the criteria set out in the Council Recommendation (EU) 2020/1475, most of the areas in the EU/EEA countries and the UK are currently classified as red⁴. At this stage, efforts should be focused on effective data collection via passenger locator forms (PLF) - where possible digitalised - to support contact tracing capacities in the community, increased testing for suspected cases and the coordination of communication between aviation stakeholders and public health authorities.

⁴ The adopted thresholds indicate that areas in EU/EEA countries and the UK are marked in the following colours:

- Green, if the 14-day notification rate is lower than 25 cases per 100 000 and the test positivity rate below 4%.
- Orange, if the 14-day notification rate is lower than 50 cases per 100 000 but the test positivity rate is 4% or higher or, if the 14-day notification rate is between 25 and 150 cases per 100 000 and the test positivity rate is below 4%.
- Red, if the 14-day notification rate is 50 cases per 100 000 or higher and the test positivity rate is 4% or higher or if the 14-day notification rate is higher than 150 cases per 100 000.
- Grey, if there is insufficient information or if the testing rate is lower than 300 cases per 100 000.

Based on existing evidence and information available, as presented in this document, ECDC and EASA offer the following recommendations

1. Available evidence does not support quarantine and testing of travellers as an effective public health measure to substantially reduce overall transmission in the general population, except when a country has reduced transmission levels to almost zero. Particularly in the current epidemiological situation⁵, systematic testing for SARS-CoV-2 and/or quarantine of air travellers is not recommended [25]. A pre-flight test could reduce the possibility of transmission during travel, especially when departure is from a country or an area with very high incidence rates. Once the epidemiological situation has improved, if countries are considering the adoption of screening or quarantine of incoming travellers, the following possible approaches – schematically summarised in Annex 2 – should be taken into account.
 - When travel is taking place from a lower-risk to a higher-risk area or between areas of similar risk, there is no public health benefit in testing for SARS-CoV-2 and/or quarantine of travellers before departure or upon arrival in the destination country.
 - Exceptionally, for travel between two high-risk areas, when travel begins from a very high-incidence area, a combination of testing and shortened quarantine could be considered, although this requires sufficient testing capacity.
 - When travel is from an area of high or unknown risk to a lower-risk area, based on modelling studies, a combination of testing and shortened quarantine could be considered, if sufficient testing capacity is available.
2. Where a country or an area has achieved consistent sustained control of the virus, having a 14-day incidence close to zero, all incoming individuals from regions with community transmission should be tested before entering the COVID-19-free areas. Given the 14-day incubation period and the possibility of asymptomatic disease, these travellers should undergo quarantine (voluntary or mandatory) and be tested rapidly if they develop COVID-19 compatible symptoms. In the absence of symptoms, they should be tested again at the end of the quarantine period [48].

When implementing the above recommendations, Member States should also give proper consideration to the principles below:

- Persons with COVID-19 compatible symptoms - or contacts of a confirmed or probable case [1] – should be discouraged from travelling by means of appropriate measures, including health safety promotion and risk communication.
- In view of the current epidemiological situation in the EU/EEA countries and the UK⁶, considering the potentially reduced opportunity for infection for people travelling for short periods (i.e. expected return within 72 hours) and where contacts with local population are limited, countries may consider exemptions from quarantine and/or SARS-CoV-2 testing for such travellers, unless they exhibit COVID-19-compatible symptoms.
- Transiting passengers should not be tested in the country of transfer, with the exception of cases developing COVID-19-compatible symptoms during travel. If countries require information on the test results for transiting passengers, they should accept that testing can be done either before departure from the country of origin or upon arrival at the final destination, in which case information on positive cases can be exchanged via the PLF system.
- Tests with high-performance characteristics should be preferred. Optimally, Member States should aim for the use of RT-PCR tests or other tests with performance close to RT-PCR, as prevalence of COVID-19 is expected to be low among air travellers, and using lower performance tests would result in a significant number of false (positive and negative) results.
- Tests used should be validated and performed by appropriately trained personnel to maintain quality and testing standards.
- Children under two years of age should be exempt from testing. For children above the age of two, Member States may consider alternative validated sample collection methods.
- Testing at Points of Entry should not be prioritised over community and healthcare needs.
- Test results should preferably be delivered in a reliable electronic format, which enables easy reading of the result and prevents fraud attempts.
- Testing requirements for travellers implemented by Member States should be notified to the European Commission and the other Member States in order to facilitate mutual recognition in accordance with the Council Recommendation (EU) 2020/1475.

If testing at airport premises is implemented, the competent national or local authorities and the relevant stakeholders should also make arrangements, as described below.

- Organise testing facilities at PoE in terms of logistics to ensure physical distancing and the protection of staff and travellers at all times.
- Develop appropriate policies for the management of positive cases describing the processes for a confirmation test, quarantine and transport to the quarantine location.
- Develop, in coordination with the aircraft and aerodrome operators, policies and procedures relating to the denial of boarding for travellers who test positive in accordance with the relevant EU requirements. Furthermore, aircraft operators should enable refund or free rebooking for those travellers who have tested positive (and their close contacts/travel companions.)

⁵ This refers to the situation at the time of publication. Depending on the evolution of the pandemic and future evidence, including risk assessment criteria, this document will be updated accordingly.

⁶ At the time of writing, community transmission is occurring in all EU/EEA MS and the UK; once countries have reduced transmission levels to close to zero this may need to be reconsidered.

In line with the guidance set out in the Council Recommendation (EU) 2020/1475 [6], any travel-related measures put in place should be proportionate and non-discriminatory, focusing on what is necessary for the protection of public health. The Member States should always admit their own nationals and Union citizens and their family members resident in their territory and facilitate swift transit through their territories. Finally, the Member States should ensure that their travel-related measures are well communicated and coordinated to facilitate compliance by the travellers.

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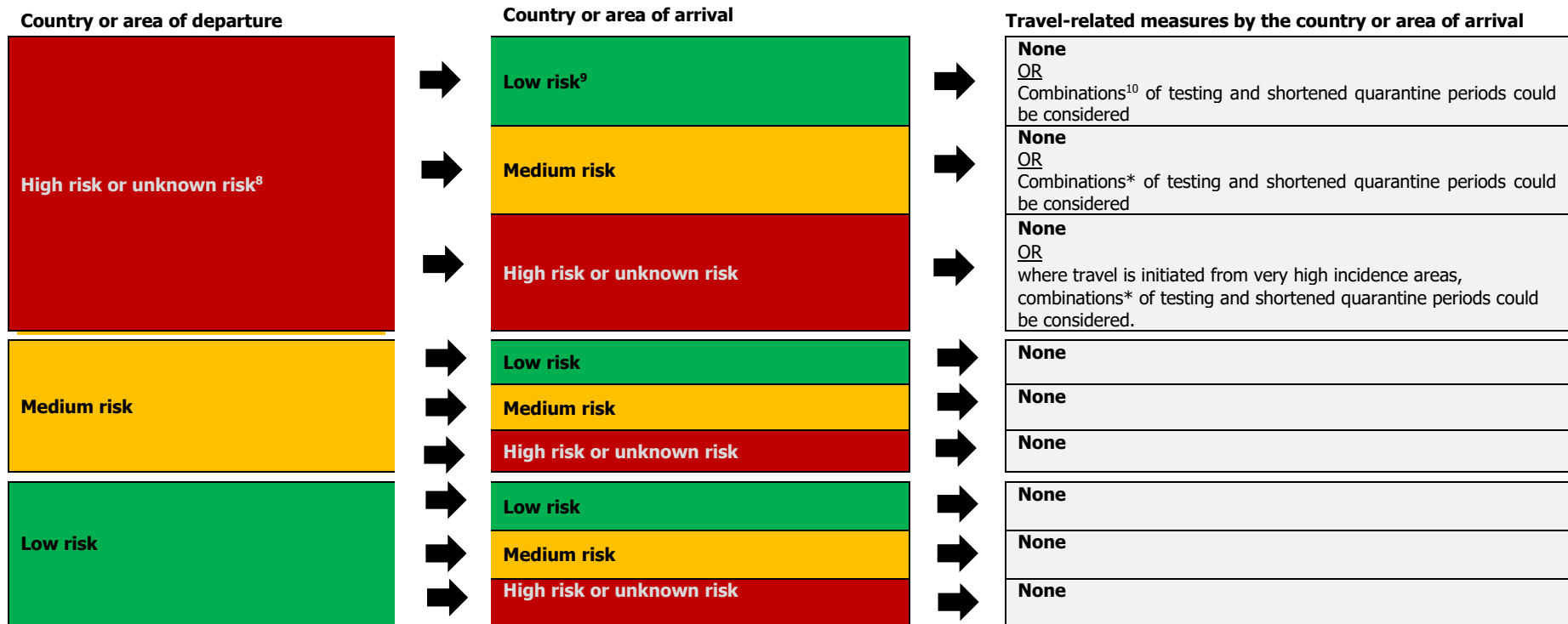
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Annex 1. Overview of travel-related measures (air travel) with advantages and disadvantages

Measure	Aim and description	Advantages and evidence	Disadvantages and evidence
RT-PCR testing before departure or after arrival at destination	<ul style="list-style-type: none"> • Aim: To detect confirmed cases among cross-border travellers. • Passenger is required to undergo an RT-PCR test within a prescribed time pre-departure and present a negative result upon arrival OR • Passenger is required to undergo an RT-PCR test upon arrival at Point of Entry (PoE) or within a prescribed time after arrival at destination. 	<ul style="list-style-type: none"> • Very accurate diagnostic test (sensitivity: 99–100%; specificity: 99–100%) • Results usually available within 12–24 hours. Shorter turnaround times are possible, but at increased cost. • Pooled testing can decrease laboratory burden. 	<ul style="list-style-type: none"> • Provides a snapshot on the day of testing; cannot exclude that the traveller becomes positive on one of day(s) following the test, or is exposed to the virus after the test was performed. • Cannot differentiate infectious from non-infectious COVID-19 cases. • Use of RT-PCR as a screening test: estimated effectiveness 39.6% (95% CI 35.2–43.7), or detection of roughly two out of five infectious passengers [43]. • Relatively high cost, which usually must be paid by the passenger. • In some EU/EEA countries, travelling may not be a valid reason for obtaining a RT-PCR test. • The use of fake negative-result certificates has been reported
Rapid Antigen Detection Test (RADT) before departure or after arrival at destination	<ul style="list-style-type: none"> • Aim: same as above with a shorter turnaround time for results. Passenger is required to undergo an antigen test, usually upon arrival at PoE (currently under study as an option). 	<ul style="list-style-type: none"> • Rapid test: results available in 10–30 minutes. • RADTs require less or no laboratory equipment. • The RADTs should be performed by trained operators. • The test can be performed on-site (at airport or other holding facility) • Lower cost than RT-PCR. 	<ul style="list-style-type: none"> • RADTs are not recommended for screening asymptomatic persons. • Currently available antigen tests generally have lower sensitivity (60–80%) but similar specificity (98–100 %) to RT-PCR. • Depending on the prevalence of the disease in the target population, RADTs may give rise to many false positives and false negatives. • Significant problems for passengers who will need to undergo RT-PCR for verification.
Quarantine of incoming travellers	<ul style="list-style-type: none"> • Aim: To prevent transmission of the virus from undetected cases among cross-border travellers. • All travellers required to quarantine for 14 days. 	<ul style="list-style-type: none"> • If implemented comprehensively at all PoEs and for all persons entering a country, it can delay introduction. • Effective if the destination area/country has achieved very low or zero transmission. 	<ul style="list-style-type: none"> • A supervisory/follow up mechanism is needed. • Logistics and financial implications for countries and travellers. • Significant barrier for cross-border travellers • The effectiveness of quarantine is estimated as: <ul style="list-style-type: none"> - 7 days: 51.3% (95% CI: 47.2–55.7) - 10 days: 68.8% (95% CI: 65.1–72.9) - 14 days: 78.0% (95% CI: 74.4–81.6) [43].

Measure	Aim and description	Advantages and evidence	Disadvantages and evidence
Combination of testing and quarantine	<ul style="list-style-type: none"> • Aim: to prevent introduction of, and transmission of the virus from, cases among cross-border travellers. • Passenger may be required to undergo testing on arrival and/or self-quarantine for 1, 5, 7 or 10 days and undergo a second RT-PCR test to be released. 	<ul style="list-style-type: none"> • Shortened quarantine period for travellers can potentially increase compliance and facilitate travelling. • Decreases cost. 	<ul style="list-style-type: none"> • Residual risk of importation with all combinations modelled in the literature: <ul style="list-style-type: none"> - Testing at airport, quarantine for four days and test on day 4 after arrival is estimated to be 68.9% effective [43]. - Quarantine for seven days and testing on day 7 is estimated to be 74% effective [43]. - Testing at the airport, quarantine for seven days and test on day 7 after arrival is estimated to be 76% effective [43]. - Quarantine of seven days with a test on day 7 and release from quarantine on day 8 after arrival is estimated to detect 94% of infected travellers [30].
Entry ban / border closure	<ul style="list-style-type: none"> • Aim: To prevent entry of cases among cross-border travellers. • All non-citizen or non-resident travellers are prevented from entering, at any PoE in the country. 	<ul style="list-style-type: none"> • If implemented comprehensively at all PoEs and for all persons entering a country, and if also including blanket quarantine for all nationals/residents entering/returning to a country. • Can have a true delay effect; proven in small island states with a limited number or well-controlled PoEs [44,45]. 	<ul style="list-style-type: none"> • Comprehensive implementation is challenging in a globalised economy as it has implications for the economic sustainability of the countries. • May have devastating financial effects on various sectors and the country as a whole. • Logistical barriers to trade and transport of merchandise including foodstuffs, medicines, PPE and equipment for the management of the public health crisis. • Questions of legality when applied to travel within the EU.

Annex 2. Guidelines for travel-related measures – air travel⁷



⁷ Based on the classification of the countries of departure and arrival, according to the criteria in Council Recommendation 2020/1475

⁸ Pre-departure testing for travellers from very high incidence regions/countries could be considered mostly to further reduce the possibility of having a positive case on board

⁹ Where a country or an area has achieved consistent sustained control of the virus having a 14-day rolling incidence close to zero, all incoming travellers should be tested and follow 14-day quarantine.

¹⁰ Based on modelling studies, the combination of quarantine and a single test once at around day 7 after arrival appears to offer a reasonable alternative, although it requires sufficient testing capacity.

* see footnote 5 above (p.12).

Annex 3. Overview of quarantine, testing combinations and effectiveness in preventing local transmission

Strategies of quarantine and testing for travellers	Estimates of residual risk of importation of COVID-19				Advantages	Disadvantages
Combinations of quarantine and testing for travellers	Estimated effectiveness of symptom and risk screening Costic et al.	Estimates of COVID-19 infectious travellers per 10.000 travellers entering the country Clifford et al. (in preprint) Using UK data from July 2020	Effectiveness (%) in preventing imported COVID-19 cases Taylor R et al. (in preprint) Using UK data from August 2020	Quantification of local transmission associated with travel prevented by quarantine (%) Ashcroft et al. (in preprint)		
NO TESTING						
Risk communication to travellers and admin measures by aviation	≈30% of symptomatic travellers are likely to fly	1-52 infectious travellers enter the community				<ul style="list-style-type: none"> - COVID-19 is estimated to have asymptomatic course in 18–30% of individuals - Pre-symptomatic transmission is well established at two days before symptom onset.
QUARANTINE ALONE						
14-day quarantine, release without any testing		0-1% residual risk (0-2 infectious travellers enter the community)	21% residual risk (assuming 80% compliance)	0-1% residual risk		<ul style="list-style-type: none"> - Difficulty in monitoring quarantine compliance for countries. - Compliance may be lower than 80%.
10-day quarantine, release without any testing			31% residual risk (assuming 80% compliance)	1% residual risk (assumes also 50% reduction of transmission due to implemented NPI measures).	Option for countries that cannot devote testing capacity to travellers, if good compliance can be monitored.	
7-day quarantine, release without any testing		Up to 20% residual risk 0-13 infectious travellers enter the community	49% residual risk (assuming 80% compliance)		It is plausible (although not supported by evidence) that a reduction in quarantine increases compliance.	
5-day quarantine, release without any testing		Up to 34% residual risk 0-22 infectious travellers enter the community				
3-day quarantine, release without any testing		Up to 50% residual risk 1-33 infectious travellers enter the community				

TESTING UPON ARRIVAL						
Single RT-PCR test upon arrival + quarantine until receiving the test result (1–2 days)		Up to 52% residual risk 1-21 infectious travellers enter the community	60% residual risk	46% residual risk (assumes also 50% reduction of transmission due to implemented NPI measures) [†]		Significant residual risk, but countries may accept that some reduction is better than nothing..
QUARANTINE AND SINGLE TEST						
Quarantine + RT-PCR test on day 7+ release on day 8 or 9		Up to 16% residual risk 0-6 infectious travellers enter the community	26% residual risk		Options for countries that wish to test travellers and can effectively monitor 7-day quarantine.	- Challenge for countries to monitor quarantine compliance.
Quarantine + RT-PCR test on day 5+ release on day 6 or 7		Up to 20% residual risk 0-8 infectious travellers enter the community		Up to 1.5% residual risk (assumes also 50% reduction of transmission due to implemented NPI measures)		
Quarantine + RT-PCR test on day 4 + release on day 6			36% residual risk			
Quarantine + RT-PCR test on day 3 + release on day 4		Up to 42% residual risk 0-15 infectious travellers enter the community				
QUARANTINE AND DOUBLE TEST						
RT-PCR Test upon arrival + quarantine + RT-PCR test on day 7 + release on day 8			24% residual risk		Options for countries, with relatively little additional estimated efficiency, if compared to single test to release.	Double testing presents logistics and resource challenges.
RT-PCR Test upon arrival + quarantine + RT-PCR test on day 6 + release on day 7		<16% residual risk 0-5 infectious travellers enter the community				
RT-PCR Test upon arrival + quarantine + RT-PCR test on day 4 + release on day 5 or 6		Up to 20% residual risk 0-9 infectious travellers enter the community	31% residual risk			

[†] NPI – non pharmaceutical interventions

- Models use different assumptions and data sets, which may not be generalisable. Please note uncertainty/confidence intervals. Please check the individual publications for the model assumptions.
- Prevalence of COVID-19 in the country of origin plays a significant role.
- Individual burden of quarantine can be psychological and financial. Quarantine has shown to be associated with symptoms of anxiety and post-traumatic stress, longer durations of quarantine were associated with poorer mental health. ([Brooks, The Lancet](#)). Quarantine impact can also be financial and can have lasting impact including on mental health ([Brooks, The Lancet](#)). People who work in less secure jobs are particularly vulnerable. Some countries provide financial aid to people in quarantine.
- Rapid tests (RDTs) are currently not recommended by ECDC for use when releasing asymptomatic people from quarantine.
- Testing used to end quarantine earlier should not compromise access/speed of testing relevant for control, such as testing of symptomatic people or testing of contacts when tracing.