Technical considerations for implementing a risk-based approach to international travel in the context of COVID-19

Interim guidance

Annex to: Policy considerations for implementing a risk-based approach to international travel in the context of COVID-19

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World Health Organization

Key points

- During the COVID-19 pandemic, international travel should always be prioritized for essential purposes, including emergency and humanitarian missions, travel of essential personnel, repatriations, and cargo transport of essential supplies.
- As countries gradually resume or readjust non-essential international travel, the introduction of risk mitigation measures aiming to reduce travel-associated exportation, importation and onward transmission of SARS-CoV-2 should be based on thorough risk assessments conducted systematically and routinely.
- The application of a precautionary approach is warranted in the presence of scientific uncertainties such as emergence of variants of concern (VOCs) or variants of interest (VOIs).
- Proof of COVID-19 vaccination should not be required as a condition of entry to or exit from a country.
- National authorities implementing testing or quarantine as a condition for entry of international travellers may consider individualized approaches to exempting them from these measures based on acquired immunity from vaccination or previous SARS-CoV-2 infection.
- Adherence to personal protective measures such as mask use and physical distancing must continue to be respected by all international travellers, both while on board conveyances and at points of entry.
- International travellers should not be considered by default as suspected COVID-19 cases or contacts or as a priority group for testing.
- The overall health and well-being of communities should be at the forefront of considerations when deciding on and implementing international travel-related measures, which should be communicated publicly and in a timely manner.

Background

As the COVID-19 pandemic continues to unfold, Member States should take appropriate measures to reduce transmission of SARS-CoV-2 associated with international travel, recognizing that even comprehensive public health measures adapted to the local epidemiologic context and capacities can mitigate the risk substantially but cannot yield "zero risk". Therefore, a risk-based approach to international travel is needed.

The World Health Organization (WHO) advises that international travel for essential purposes as defined by national authorities – which should include emergencies and humanitarian actions (such as emergency medical flights and medical evacuations); travel of essential personnel (such as emergency responders, providers of public health technical support, and critical personnel in the transport and security sectors such as seafarers); repatriations; and cargo transport for essential supplies such as food, medicines, and fuel – should not be impeded by border closures or suspensions of travel.

This updated interim guidance document provides national authorities with key considerations for establishing their policies for international travel via air, sea[1] or land between countries, territories or sub-national areas[2]. It is divided into three main sections: risk assessment, risk mitigation and risk communication. The document aims to support countries as they gradually increase the volume of international travel with the objective of reducing travel-associated exportation, importation and onward transmission of SARS-CoV-2.

The document is an update to the original interim guidance document entitled 'Considerations for implementing a risk-based approach to international travel in the context of COVID-19', which was published on 16 December 2020. The original document was the result of extensive consultations across all relevant departments and Regional Offices of WHO, as well as with the members of the Strategic and Technical Advisory Group for Infectious Hazards (STAG-IH) (1) and of an ad-hoc Technical Advisory Group for the development of a risk-based approach to the gradual increase of international travel in the context of COVID-19.

Changes from the previous version

There have been several important developments since the publication of the original version of this document, including the approval of several COVID-19 vaccines through the WHO Emergency Use Listing (EUL) (2); the start of COVID-19 vaccination in many countries; and growing evidence on protection against developing severe COVID-19 disease following vaccination and, to a lesser extent, protecting against infection and reducing transmission. In addition, several WHO-classified variants of concern (VOCs) and variants of interest (VOIs) have been identified since December 2020(3).

Consequently, this version provides key updates on:

- considerations regarding COVID-19 vaccination in the context of international travel
- guidance on how to account for SARS-CoV-2 VOCs and VOIs when assessing risk to inform mitigation measures for international travel during the COVID-19 pandemic
- updated evidence on the effectiveness and broader impact of risk mitigation measures implemented in the context of international travel during the COVID-19 pandemic.

All relevant departments and Regional Offices of WHO were consulted, as were members of the STAG-IH. Other WHO advisory groups consulted for this update include the Strategic Advisory Group of Exerts on Immunization (SAGE) (4) and the International Working Group on Ethics and COVID-19 (5). The recommendations related to testing and quarantine of international travellers and border closure or suspension of travel are informed by the deliberations of the WHO Guideline Development Group for International Travel and Health (GDG ITH) (6).

The document is an annex of the WHO document "Policy considerations for implementing a risk-based approach to international travel in the context of the COVID-19 pandemic" and it should be read in conjunction with the WHO interim guidance "Considerations for implementing and adjusting public health and social measures in the context of COVID-19" (7).

Risk-assessment approach to the implementation of risk mitigation measures for international travel

National authorities should conduct thorough, systematic and regular risk assessments as new information emerges to inform the introduction, adjustment and discontinuation of risk mitigation measures in the context of international travel.

For international inbound travel, the following factors should be considered:

- the local epidemiology (8) in departure and destination countries
- the volume of travellers between countries and existing bilateral and multilateral agreements between countries to facilitate free movement
- public health and health services performance and capacity (7) to detect and care for cases and their contacts in the destination country, including among vulnerable travellers, such as refugees, migrants and temporary or seasonal workers whose livelihoods largely depend on cross-border activities
- public health and social measures implemented to control the spread of COVID-19 in departure and destination countries and available evidence on adherence and effectiveness of such measures in reducing transmission
- contextual factors, including economic impact, human rights and feasibility of applying measures.

For a limited number of key travel routes, it may be possible for countries to make bilateral arrangements to identify additional information on the aforementioned epidemiological and operational factors. This can help to inform risk assessments associated with specific groups of travellers.

[1] For the purpose of this document, sea travel relates to international voyage via sea or an inland body of water. Nonetheless, cruise ships are out of the scope of this guidance given the many specificities of this type of conveyance.

[2] To facilitate the reading of this guidance document, the formula "countries, territories or sub-national areas" will hereinafter be referred to as "countries" or "country".

WHO encourages national authorities to publish in the public domain up-to-date data on COVID-19 incidence, public health and health services capacity and implemented public health and social measures. This includes epidemiological information on unexpected trends or signals that may indicate the emergence of VOCs or VOIs (9). Detailed information on the global impact and characteristics of each variant is provided and regularly updated in WHO's weekly epidemiological updates (3).

The impact of the circulation of new VOCs and VOIs on SARS-CoV-2 transmission will be reflected in the local epidemiology of countries of departure or destination. Nonetheless, if new variants appear to be more transmissible, cause more severe disease, and/or have the potential to partially evade natural or vaccine-acquired immunity, national authorities in countries of destination may prefer to implement stringent travel-related measures, using a precautionary approach. Such measures should not be unnecessarily biased towards countries readily sequencing and sharing findings. WHO encourages all countries to strengthen sequencing capacities for the early identification of new variants and to rapidly and transparently share that information (9).

Rapid publication and reporting to WHO of epidemiological and sequencing data allows national authorities to make informed decisions for both outbound and inbound travel. It is important to have and use sub-national epidemiological information, because this enables the application of travel-related measures at the lowest possible administrative level.

Where there is a high level of vaccine-acquired immunity among prioritized groups, epidemiology changes may start to be observed. A decoupling may occur between incidence and hospitalization and/or death rates because individuals most prone to hospitalization and death will have been immunized. In this situation, and in the absence or the limited use of public health and social measures, a greater proportion of cases may occur among younger, less vulnerable population groups. Consequently, there will be a need to recalibrate incidence thresholds, focusing on the analysis of hospitalization and ICU admission rates and incidence by age group and to assess the potential caseload of undiagnosed COVID-19 cases. For further information, see the interim guidance document "Considerations for implementing and adjusting public health and social measures in the context of COVID-19" (7).

National authorities should publish their risk assessment methodology and the list of departure countries to which restrictions apply on their government websites; and these should be updated regularly to reflect any changes.

Key questions to guide risk assessment

The following overarching questions may guide national and sub-national decision-making processes for implementing travel-related risk mitigation measures and providing advice to travellers.

- For inbound travel:
    - Will the number of cases to be imported from the country of departure likely have a significant impact on the current transmission level in the country of destination?
        - What is the probability of individuals from the country of departure being infected?
        - Are any variants classified by WHO as VOIs or VOCs that are not present in the country of destination predominant in the country of departure? Are there unexpected epidemiological trends or signals in the country of departure that may indicate the appearance of new VOCs or VOIs? Do variants that are present in the country of departure evade immunity?[3] Or, if the country of departure has limited sequencing capacities, have VOCs or VOIs been widely detected among travellers arriving from this country?
        - Is an individualized approach to public health measures based on a person's SARS-CoV-2 immunity status being implemented in the country of destination (7)?[4]
        - What is the air, land and sea route-specific volume of travellers?
        - Are the current response capacities in the country of destination sufficient to cope with the potential rise of imported cases from the country of departure? This should include risk communication capacities to inform incoming travellers, in appropriate languages, about mechanisms for seeking care and public health and social distancing measures in place. Are such public health and health care capacities accessible to all travellers, including refugees, migrants and temporary or seasonal workers?
- For outbound travel:
    - How likely are travellers to be infected in the country of destination compared to their likelihood of getting infected in the country of departure, taking into consideration the potential circulation of VOIs and/or VOCs in the country of destination?

[3] Any measures implemented to prevent or delay the importation of new variants must be continuously adjusted in light of emerging information; without bias towards countries that are sequencing and sharing findings; based on thorough assessments of risk; and continuously adapted to emerging information.

[4] Note that national authorities and conveyance operators should not require proof of vaccination as a condition of entry or exit. Further information is provided in the section "Proof of COVID-19 vaccination in the context of international travel" below.

- What travel-related measures are implemented for inbound travellers in the country of destination, including the use of individualized public health measures based on a person's SARS-CoV-2 immunity status following COVID-19 vaccination or natural infection (7)?
- Does the country of destination have sufficient response capacity to treat travellers who may need medical care while traveling?
- Does the country of departure have sufficient capacity to enforce mandatory public health and social measures on return of travellers?
- In line with the principle of shared responsibility for global health, national authorities should also consider measures to limit exportation of cases, particularly when new VOCs or VOIs emerge.

Other considerations

The overall health and well-being of communities should be at the forefront of considerations when deciding on and implementing international travel-related measures. Special attention must be paid to vulnerable groups that may be at higher risk for COVID-19 because of limited access to health care; poor living conditions; inability to adequately apply physical distancing and other public health and social measures; poor access to COVID-19 information in relevant languages; reduced income; increased discrimination and stigmatization; and increased exposure to psychological harms (10, 11). Additional relevant guidance can be found in the WHO interim guidance "Considerations for implementing and adjusting public health and social measures in the context of COVID-19" (7); and through the United Nations Development Programme (UNDP) (12), the World Tourism Organization (UNWTO) (13), the International Civil Aviation Organization (ICAO) (14), the International Labour Organization (ILO) (15), the International Maritime Organization (IMO) (16), the International Organization for Migration (11) and the World Bank (17).

Risk mitigation measures for international travel

This section describes the key considerations to be taken into account for the implementation of basic and supplementary risk mitigation measures. While basic risk mitigation measures should always be in place; the use of supplementary risk mitigation measures during the COVID-19 pandemic should be guided by a risk assessment, as outlined in the section above.

Basic risk mitigation measures

Travel advice

- Confirmed, probable and suspected cases, and contacts of confirmed or probable cases should not travel. Confirmed, probable and suspected cases should be in isolation; and contacts of confirmed or probable cases should be in quarantine.
- Persons with any signs or symptoms compatible with COVID-19 should not travel, unless SARS-CoV-2 infection has been ruled out as the cause for illness.
- Persons who are unwell should be advised to postpone travel and seek medical care.
- Persons who have not been fully vaccinated or do not have proof of previous SARS-CoV-2 infection and are at increased risk of developing severe disease and dying, including people 60 years of age or older or those with comorbidities that present increased risk of severe COVID-19 (e.g. heart disease, cancer and diabetes) should be advised to postpone travel to areas with community transmission.
- Depending on local restrictions, persons residing in areas where community-wide movement restrictions are in place may not be allowed to travel for non-essential purposes.
- All incoming travellers must follow recommendations and continue to adhere to personal protective measures such as the use of masks and physical distancing both while on board conveyances and at point of entry.

Self-monitoring for international travellers

WHO recommends that travellers self-monitor for the potential onset of symptoms for 14 days on arrival and report symptoms and travel history to local health authorities, as per instructions received by authorities in the host country, prior to departure and/or on arrival. Travellers should be provided with necessary information and instructions on how and when to contact local health authorities. Arrangements for supervision of self-monitoring should be planned and organized by national or sub-national authorities, for instance, through the use of phone messaging or digital tools. Apps for the daily reporting of health status should be in line with WHO guidance on the use of digital tools for this purpose (18).

Any traveller identified as a contact of a COVID-19 case should be supported and quarantined – as part of national response strategies (19) in accordance with WHO guidance for quarantine (20) – and tested if symptoms develop at any point during the quarantine period. All incoming travellers must adhere to those personal protective measures (such as the use of masks and physical

distancing measures) implemented in countries of destination. These measures may include movement restrictions as per national or sub-national legislation.

Multisectoral coordination and planning for disease prevention and control, surveillance and case management

Preventing cases and contacts from travelling will require establishing mechanisms to exchange information between health and immigration authorities. Countries should have a clear surveillance strategy and sufficient public health capacity to reliably identify cases and trace contacts, including among incoming travellers, in alignment with national and sub-national COVID-19 surveillance and response efforts.

National and, where needed and applicable, sub-national authorities involved in the risk assessment process should:

- inform all public and private entities responsible for the implementation of international travel measures about the requirements in place
- make operational arrangements to facilitate the compliance with such requirements, including the timely exchange of information with health authorities (for example through passenger manifests for contact tracing purposes and completion and collection of passenger locator forms)
- coordinate with conveyance operators to comply with countries' requirements for the submission of the Maritime Declaration of Health, Annex 8 of the IHR (2005) (22), and the Health Part of the Aircraft General Declaration, Annex 9 of the IHR (2005) (22).

The digitalization of passenger locator forms may facilitate the exchange of information but should be conducted in line with privacy and personal data protection as per WHO guidance (18).

International contact tracing

When a cluster or chain of SARS-CoV-2 transmission involves more than one country – including, for example, when cases are identified on conveyances, at points of entry or in persons with a history of travel while infectious – international contact tracing should be conducted rapidly in a coordinated and collaborative manner through national IHR focal points (NFPs). In line with WHO guidance for contact tracing (19), national authorities should identify contacts who were exposed to:

- a symptomatic case: 2 days before and 10 days after symptom onset, plus at least 3 additional days without symptoms (including without fever and without respiratory symptoms), for a minimum of 13 days total after symptom onset
- an asymptomatic case: 2 days before and 10 days after the date on which a sample led to confirmation of SARS-CoV-2 infection.

Bilateral exchanges between countries may facilitate case investigation aiming at identifying the source of infection and requiring retrospective tracing of cases up to two weeks before an identified case developed symptoms or was tested positive (23). Data protection must be considered throughout the contact tracing process. Whenever health information and/or personal details of an identifiable individual are exchanged between countries, these should be kept confidential in line with Article 45 of the IHR (2005) and national legislation. The use of encrypted and password-protected communication is encouraged in these circumstances.

International contact tracing is particularly important for countries with no cases, imported/sporadic cases or a small number of cluster cases. In countries where community transmission is ongoing and surveillance capacities are overwhelmed, international contact tracing may be challenging.

The NFPs are accessible at all times and can receive direct support from the WHO IHR contact points, hosted by the six WHO Regional Offices. The contact details of all NFPs and WHO IHR Contact Points are available on the secure WHO Event Information System (EIS), which is accessible to NFPs. When contact tracing involves contiguous areas in two or more bordering countries, existing bilateral and/or multi-country agreements may facilitate cross-border contact tracing.

Digital tools, such as mobile phones and apps for proximity tracing, can support and complement contact tracing efforts, but such technology cannot replace the public health contact tracing workforce required to carry out the critical functions of finding, communicating with and supporting people throughout the contact tracing process. Furthermore, the effectiveness of digital proximity tracing apps relies on their uptake and active use by the general population. For international travellers, issues of interoperability of information management systems and data sharing regulations between countries need to be considered. Legal and ethical aspects related to individual privacy and personal data protection should be considered in line with WHO guidance (18).

Environmental controls and public health and social measures at points of entry

Crowd control, physical distancing, mask use and hand hygiene measures should be put in place to minimize the risk of transmission at points of entry during check-in, passport control, in rest rooms, security areas, areas for interviews of COVID-19 suspected cases, waiting areas, boarding, disembarking, customs, baggage pick-up and any other areas where travellers congregate. Appropriate cleaning and disinfection procedures should be followed as per WHO guidance (24), with particular emphasis on surfaces that are frequently touched. Table 1 provides specific recommendations to adapt premises at points of entry.

Table 1. Considerations for adapting point of entry premises to limit the spread of COVID-19

Crowd control	Engineering modification	Enhanced compliance
Limit numbers of people and maintain physical distance of at least 1 metre between persons throughout premises at points of entry, and in particular for closed and poorly ventilated areas such as shops, restaurants, lounges, rest rooms and offices. Reduce crowding by staggering arrival and departure times of conveyances, managing flow of travellers with separate pathways, increasing the number of security and passport control booths to shorten queues, ideally taking into consideration the disease transmission in countries of departure and destination. Consider fostering cross-border collaboration for managing crowding at ground crossings. Establish a dedicated and accelerated route for transiting passengers, with special considerations for space for long transits or lay-overs.	Introduce physical barriers (cones, ropes, poles, etc.) or floor markers to ensure distance between people or limit access while in higher volume areas such as baggage or immigration. Establish spacious waiting areas to complement the crowd control strategy. Implement separating screens, shields and transparent barriers to be utilized at counters or windows where close contact is expected. Ensure proper ventilation throughout the premises at points of entry. Provide hand sanitizer stations strategically placed throughout the points of entry.	Place signs reinforcing individual protection measures and behaviour (i.e. hand hygiene, safe mask wearing where appropriate and respiratory etiquette). Use loudspeaker announcements or video loops providing instructions and information in appropriate languages. Strategically place staff throughout the points of entry to enforce compliance with public health measures and appropriate distancing/spacing.

Environmental controls and public health and social measures on conveyances

Environmental control measures and public health and social measures should be promoted and complied with on board conveyances. These are outlined in detail in the ICAO Council Aviation Recovery Task Force (CART) Take-off: Guidance for Air Travel through the COVID-19 Public Health Crisis (25), IMO COVID-19 guidance (16), and WHO guidance documents on the management of ill travellers at points of entry (26); and controlling the spread of COVID-19 at ground crossings (27), on board ships (28) and in aviation (29).

Supplementary risk mitigation measures

If the country of destination has a low risk tolerance – for example, because it has no (active) cases or is experiencing sporadic cases or a small number of clusters – supplementary risk mitigation measures can also be considered. WHO regularly evaluates the scientific evidence on the effectiveness, safety and impact of public health measures implemented to reduce travel-associated exportation and importation of SARS-CoV-2.

Point of entry authorities should have the capacities necessary to implement supplementary risk mitigation measures, as determined by national health authorities.

Exit and entry screening for signs and symptoms of COVID-19

Screening is defined as "the presumptive identification of unrecognized disease or defect by the application of tests, examinations, or other procedures which can be applied rapidly" (30).

Historically, temperature screening at points of entry has been implemented for a variety of diseases, but there is currently no high-quality evidence available to support entry screening based on temperature measurement as an effective measure for COVID-19. First, people may be travelling during the incubation period (between exposure and symptom onset). Second, they may not exhibit fever early in the course of the disease (the proportion of COVID-19 asymptomatic cases is estimated to be approximately 20% of all cases (31)). Last, they may have taken antipyretic medications to reduce fever.

WHO encourages countries that are implementing temperature measurement at exit and/or entry to share their evaluations of the use of this measure, since they are critical to build and evidence base and increase the understanding of its effectiveness and impact in the context of COVID-19.

WHO recommends visual screening of departing and arriving travellers for signs and symptoms (e.g. such as cough and difficulty breathing) and interviewing passengers (when necessary) about signs and symptoms and any exposure to confirmed or probable cases during the 14 days prior to travelling. If digital health declaration forms are used, this should be done in line with privacy and

personal data protection as per WHO guidance (18). Travellers who have symptoms or are identified contacts of COVID-19 cases should not be allowed to travel and should be referred for further medical assessment to pre-designated facilities, according to protocols in place at the point of entry and national guidance.

In addition, national authorities may ask incoming travellers to provide their contact details, so that they can be located for health monitoring during the first 14 days after arrival at destination or for international contact tracing. WHO recommends that travellers fill out a health questionnaire online before travelling or during travel to avoid crowding at arrival. Authorities may also require arriving passengers to download and utilize a national COVID-19-control app if such an app has been established in the destination country to facilitate health monitoring and contact tracing on arrival.

Summary of evidence review on effectiveness and impact of screening for signs and symptoms of COVID-19 in the context of international travel

WHO commissioned a rapid review of evidence (32) using a systematic approach to collecting studies available up to 13 November 2020 on the public health effectiveness and impact of symptom/exposure-based screening of international travellers. The review identified a limited number of studies, which had varying results. The review found one modelling study reporting that global implementation of screening measures would reduce the number of cases exported per day by 82% (33). Four modelling studies predicted delays in epidemic development, although there was wide variation between the studies in the results obtained (34, 35, 36, 37). Four additional modelling studies predicted that the proportion of cases detected would range from 1% to 53% (38, 39, 40, 41). Across nine observational studies, the proportion of cases detected by entry and/ or exit screening measures ranged from 0 to 100% (42, 43, 44, 45, 46, 47, 48, 49, 50). For symptom and temperature screening, one of these observational studies reported that the measure detected 100% of cases (46); however, all other studies reported substantially lower proportions of cases detected, ranging from 0% to 53% (42, 43, 44, 45, 47, 48, 49, 50).

SARS-CoV-2 testing for international travellers

International travellers are not considered suspected COVID-19 cases by default. Therefore, healthy travellers should not be considered as a priority group for SARS-CoV-2 testing, in particular when resources are limited, to avoid diverting resources from settings and patients where testing can have a higher public health impact and drive action. In general, high-risk settings should be prioritized for testing, as should high-risk groups including people at risk of developing severe disease and vulnerable populations and health workers, in line with WHO guidance (51).

Despite the high specificity of SARS-CoV-2 antigen-detecting rapid diagnostic tests (Ag-RDTs), false positive results will occur often in low prevalence populations like travelers. Therefore, the use of Ag-RDTs is not recommended in healthy traveller populations with low expected prevalence of disease, especially where confirmatory nucleic acid amplification testing (NAAT), such as real-time reverse-transcription polymerase chain reaction (rRT-PCR), is not readily available (52, 53).

If a country has the capacity to conduct testing in all high-risk settings and high-risks groups and decides to additionally implement testing requirements for incoming travellers, decisions on the type of assay to be used should take into account the key considerations outlined in the WHO scientific brief "COVID-19 diagnostic testing in the context of international travel" (53).

Summary of evidence review on effectiveness and impact of SARS-CoV-2 testing in the context of international travel

A WHO-commissioned rapid review of evidence (32) conducted using a systematic approach to collection of studies available up to 13 November 2020 on the public health effectiveness and impact of testing in the context of international travel found a total of 14 studies (6 observational and 8 modelling studies) that met the review inclusion criteria. An additional literature search up to 4 May 2021 identified 9 additional studies (6 observational, 2 modelling and 1 review). Several of the observational studies found that the proportion of positive cases detected through testing among arriving international travellers ranged between 58.3% and 90.24%, depending on the timing of the tests (e.g. on-arrival or two or more days afterwards) (42, 43, 48, 54, 55). rRT-PCR tests conducted two days after arrival were more effective in detecting cases. One modelling study suggested that rRT-PCR testing of all incoming travellers on arrival followed by the isolation of those testing positive and requiring a negative test at the end of isolation reduced the proportion of imported cases by 90% for a 7-day isolation period and 92% for a 14-day period (56). Other studies have shown that a single rRT-PCR test at arrival captured two-thirds of positive cases among arriving international travellers, with most of the rest detected through a second test at day 7 (57).

If molecular testing is not feasible or easily accessible, several studies have suggested that rapid antigen tests could be used to support public health strategies based on early mass screening in settings such as points of entry (57, 58, 59, 60). However, the effectiveness of using rapid tests depends on many factors, such as the disease reproductive number, the volume of travellers, test sensitivity and COVID-19 prevalence among travellers (61). One review concluded that the effectiveness of scent detection by trained dogs is comparable to or better than rRT-PCR or antigen testing procedures, suggesting that it can likely be used to screen and identify positive cases in a non-intrusive manner in settings such as points of entry (62). Some studies have evaluated the impact of testing and quarantine combined. Several modelling studies show that rRT-PCR testing combined with 14-day quarantine is the most effective strategy. Nonetheless, there is diminishing impact of quarantine beyond 10 days, when this is combined with rRT-PCR testing prior to release. Shorter quarantine of at least 5 days, combined with a negative rRT-PCR test before release, can still prevent a substantial amount of transmission, with one modelling study estimating probability of releasing an infected individual under such conditions as 23% (compared to 0% for 14-day quarantine with or without testing) (57, 59).

The available evidence shows that factors influencing the likely effectiveness of SARS-CoV-2 testing for international travellers include the cost; test type; timing of the test; whether testing is voluntary or compulsory; whether testing is monitored or used with

concomitant measures such as quarantine, isolation of symptomatic travellers and other travel-related measures; and the mitigation strategy of the receiving country. It is important to recognize that SARS-CoV-2 testing for travellers may be associated with a range of indirect psychosocial, physical and economic harms, sociodemographic inequities, infringement of human rights, disruption to travel and trade and reductions in workforce mobility.

Quarantine for international travellers

International travellers are not considered contacts of COVID-19 in principle unless a traveller meets the definition of a contact (19). Countries with no (active) cases, imported/sporadic cases, a small number of clusters of cases or that have controlled transmission and are striving to maintain this statusmay decide to implement restricted movement, and quarantine measures for incoming travellers while respecting travellers' dignity, human rights and fundamental freedoms and minimizing any discomfort or distress associated with the health measures applied to them, as outlined in the IHR (2005).

Summary of evidence review on effectiveness and impact of quarantine of international travellers in the context of COVID-19

A WHO-commissioned rapid review of evidence (32) conducted using a systematic approach to collection of studies available up to 13 November 2020 on the public health effectiveness and impact of restriction of movement (referred to as quarantine) in the context of international travel found a total of 12 modelling studies that met the review inclusion criteria. An additional literature search up to 4 May 2021 identified 5 additional studies, including 1 observational study and 2 modelling studies on the effectiveness of quarantine on air travellers and 1 qualitative study on the impact of quarantine on repatriated individuals.

A consistent, largely positive estimated effect was observed, suggesting that quarantine of travellers may reduce the incidence of and mortality from COVID-19. The results ranged from limited to substantial effects, depending on duration and compliance with quarantine, the levels of community transmission, the volume of travellers and other public health and social measures in place. Quarantine may be most applicable to countries with a low incidence of COVID-19 and/or relatively high volumes of arriving air travellers, as well as countries at the tipping point of exponential growth and/or with limited public health and health system capacities to detect and care for new cases. The positive benefits of quarantine in reducing SARS-CoV-2 transmission must be balanced against the related risks of infringement of human rights, psychosocial and economic harm, disruption to travel and trade, reductions in the movement of essential goods and workforce mobility.

One modelling study estimated that quarantining all incoming travellers reduced the proportion of imported cases by 55% for a 7-day quarantine period and by 91% for a 14-day quarantine period (63). One observational study reported that, out of all positive cases among incoming air travellers, almost 50% tested positive on arrival, and around 13% remained asymptomatic but tested positive on day 14 of quarantine, concluding that asymptomatic patients with COVID-19 represented a potential reservoir of infection.

Evidence continues to be confounded by the fact that quarantine is rarely used as a single mitigation measure. Several studies conclude that the combination of quarantine with other public health and social measures improves its effectiveness; and that combining quarantine with SARS-CoV-2 testing, particularly repeated testing, may not only improve effectiveness but also reduce the duration of quarantine. Quarantine could theoretically have indirect benefits, such as discouraging infected or exposed people from travelling, raising awareness, facilitating access to health care for other conditions detected at the point of entry and reducing the incidence or importation of other infectious diseases, such as seasonal influenza, into the receiving country.

Border closure or suspension of travel

As noted earlier, WHO recommends that essential international travel should be maintained under all circumstances. It is worth recognizing, however, that the selective or complete closure of national borders, at entry or exit, to non-essential international travel may adversely affect societies and economies – especially those population groups that are reliant on cross-border activities for a

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