Health Information and Quality Authority

An tÚdarás Um Fhaisnéis agus Cáilíocht Sláinte

Evidence summary of public health measures to limit the transmission of SARS-CoV-2 at mass gatherings

Submitted to NPHET: 25 May 2021

Published: 17 June 2021

About the Health Information and Quality Authority

The Health Information and Quality Authority (HIQA) is an independent statutory authority established to promote safety and quality in the provision of health and social care services for the benefit of the health and welfare of the public.

HIQA's mandate to date extends across a wide range of public, private and voluntary sector services. Reporting to the Minister for Health and engaging with the Minister for Children, Equality, Disability, Integration and Youth, HIQA has responsibility for the following:

- **Setting standards for health and social care services** — Developing person-centred standards and guidance, based on evidence and international best practice, for health and social care services in Ireland.
- **Regulating social care services** — The Chief Inspector within HIQA is responsible for registering and inspecting residential services for older people and people with a disability, and children's special care units.
- **Regulating health services** — Regulating medical exposure to ionising radiation.
- **Monitoring services** — Monitoring the safety and quality of health services and children's social services, and investigating as necessary serious concerns about the health and welfare of people who use these services.
- **Health technology assessment** — Evaluating the clinical and cost-effectiveness of health programmes, policies, medicines, medical equipment, diagnostic and surgical techniques, health promotion and protection activities, and providing advice to enable the best use of resources and the best outcomes for people who use our health service.
- **Health information** — Advising on the efficient and secure collection and sharing of health information, setting standards, evaluating information resources and publishing information on the delivery and performance of Ireland's health and social care services.
- **National Care Experience Programme** — Carrying out national service-user experience surveys across a range of health services, in conjunction with the Department of Health and the HSE.

Version history

Version number	Date	Details
V1.0	25 May 2021	Version sent to NPHET.
V2.0	17 June 2021	Updated to incorporate more recent information relating to public health measures, guidance and pilot events (up to 10 June 2021), and more recent evidence from primary research studies (up to 3 June 2021).

Evidence summary of public health measures to limit the transmission of SARS-CoV-2 at mass gatherings

Key points

- Mass gatherings play an important role in society, but since the onset of the COVID-19 pandemic in early 2020, due to the high risk of superspreading at these events, they have generally been restricted or prohibited in order to mitigate or prevent transmission of SARS-CoV-2.
- Superspreading events (SSEs) are defined as events that transmit infection to a larger number of individuals than is usual, and have been a feature of the COVID-19 pandemic.
- With the ongoing roll out of COVID-19 vaccination campaigns globally, mass gatherings are being permitted once again. However, a large proportion of the population remain unvaccinated and there are concerns regarding the impact of circulating variants of concern (VOCs).
- This evidence summary consisted of two research questions (RQs):
    - RQ1 was a review of websites of public health agencies and governmental departments from 22 countries and two international agencies to identify public health guidance relating to measures advised to reduce the transmission of SARS-CoV-2 at mass gatherings, as well as information relating to pilot events. The information summarised in RQ1 is correct as of 10 June 2021, but may be subject to change.
    - RQ2 was a systematic search for primary research studies published from 1 January 2020 up to 3 June 2021 to identify evidence regarding the effectiveness of public health measures to prevent the transmission of SARS-CoV-2 at mass gatherings.
- The World Health Organization (WHO) and US Centers for Disease Control and Prevention (CDC) strongly advise that a thorough risk assessment should be conducted in advance of any planned mass gathering and that there should be clear action plans for events. The US CDC further advises that the level of risk needs to be carefully considered before organising any event, with promotion of healthy behaviours (for example, mask wearing) and healthy environments (for example, ventilation) throughout. Event organisers need to be prepared in

case of someone getting sick during and after the event and there should be good communication with contact tracing services.

- As of 10 June 2021, mass gatherings are generally permitted, to varying degrees, in all 22 included countries, with generally fewer attendees permitted in indoor events than outdoor events.
- Austria, Denmark, Czech Republic, France, the Netherlands and Portugal currently require COVID-19 health certification (that is, proof of vaccination, immunity and or recent negative test, to demonstrate that an individual is at low risk of acquiring or transmitting SARS-CoV-2) in order to access mass gathering events. Six other countries (Belgium, Germany, Italy, Norway, Sweden, and Switzerland) have plans to introduce COVID-19 health certification as a requirement for accessing certain mass gathering events, over the coming months, while England is currently piloting this process.
- Considerable variability was observed in terms of pre-event testing requirements and these appear to be in flux. Twelve of the 22 included countries have stated plans to undertake (or are currently undertaking) pre-event testing:
    - polymerase chain reaction (PCR) or antigen tests are specified by six countries (Austria, Czech Republic, France, Italy, Norway and Switzerland)
    - PCR tests only are specified by three countries (Belgium, Denmark and Portugal), and antigen tests only are specified by three countries (England, Germany, the Netherlands)
    - differences were also noted in the requirements for the timing (ranging from seven days prior to on-site) and sampling (self-sampled/self-tested or provider taken) of the pre-test.
- Israel, which was one of the first countries to introduce a 'Green Pass' system, cancelled the 'Green Pass' requirements as of 1 June 2021 due to the low infection rates and the continuing downward trend of all indicators. There is now unrestricted access to all establishments and sectors in Israel, without any requirements for proof of vaccination, recent negative test or recovery from COVID-19.
- All restrictions on mass gatherings are set to be removed by June 2021 in France and Iceland, by July 2021 in Austria, England and Finland (for outdoor events), and by August 2021 in Finland (for indoor events). Denmark, the

Netherlands and Sweden have stated that all mass gathering restrictions will be lifted only when certain targets or indicators have been met.

- There are reports of completed, ongoing or planned pilot events in 15 of the 22 included countries (Austria, Belgium, England, France, Germany, Ireland, Italy, the Netherlands, Northern Ireland, Norway, Portugal, Scotland, Spain, Switzerland and Wales). The most comprehensive programmes to-date include those currently being conducted in the Netherlands and England.
- Eleven relevant studies were identified that provided evidence regarding the effectiveness of public health measures to prevent the transmission of SARS-CoV-2 at mass gatherings. Five of the 11 studies related to concerts or festivals, two related to sporting events, one to a graduation ceremony, one to the Hajj pilgrimage, one to a protest rally and one study related to a business conference and a theatre performance that occurred in the same venue on different dates.
- There is evidence from 11 studies that implementing a range of public health measures can reduce the risk of SARS-CoV-2 transmission at mass gatherings. However, there were important limitations associated with these studies. While one included study reported that extremely stringent mitigation measures substantially reduced the risk of transmission, it is unlikely that risk can be eliminated entirely.
- All studies adopted a layered mitigation approach involving multiple public health measures, therefore it was not possible to determine the effectiveness of any single measure. The most commonly implemented measures were provision of hand sanitiser, wearing of face masks, ensuring adequate ventilation, health screening, and contact tracing.
- Ten of the 11 included studies focused on events that took place outdoors or in indoor settings with specified minimum levels of ventilation. The other study did not include a specific focus on ventilation or outdoor activities. The potential effect of ventilation in limiting transmission at indoor mass gatherings was reported in two included studies.
- While some of the findings from the eight studies that trialled pre-event testing are promising, it is important to note that positive cases were detected post-event in four of these studies. It is not known if transmission occurred during the event despite various mitigation measures in place, or if these cases were already infected, but either not yet detectable or missed at the time of testing.

It is also not known whether these positive cases seeded further cases in the community as onward transmission was not measured in any included study.

- While there is a movement to reopen society and allow mass gatherings to occur once again, it is important that a suite of public health measures are implemented to mitigate the associated increased risk of transmission with these events. These public health measures may include pre- and post-event testing, capacity restrictions, excluding vulnerable populations, health screening, cohorting, requirements for adequate ventilation, face masks, hand hygiene, contact tracing and physical distancing. Although there is general consistency with regards to the implementation of most of these public health measures at mass gatherings, there is considerable variability in terms of COVID-19 health certification and pre-event testing.
- The risk of SARS-CoV-2 transmission at mass gatherings can be reduced by implementing a range of public health measures; however, it is unlikely that this risk can be eliminated entirely. Therefore, caution is strongly advised when proceeding with the relaxation of mass gathering restrictions with due consideration given to the levels of vaccination coverage, rates of community transmission and the risk posed by circulating VOCs.

Background

Since the onset of the COVID-19 pandemic in early 2020, mass gatherings have generally been restricted or prohibited in order to mitigate or prevent superspreading events (SSEs).[1] SSEs, defined as events that transmit infection to a larger number of individuals than is usual, have been a feature of the COVID-19 pandemic.[2] It has been estimated that 80% of secondary transmissions may be caused by a small fraction (approximately 10-30%) of infectious COVID-19 cases.[3-5] A study conducted in Colorado, USA, found that among a population of 1,405 positive COVID-19 cases without symptoms, at any one time 2% of the individuals carried 90% of all SARS-CoV-2 virions, pointing to the exceptionally high viral load of a minority of cases.[6]

In other words, the evidence suggests that the transmission pattern of SARS-CoV-2 is potentially highly overdispersed, which is when the minority of infected individuals are responsible for the majority of secondary transmissions.[7] Due to the potentially overdispersed nature of SARS-CoV-2 transmission, the infection appears to spread in clusters.[8] Therefore, restricting mass gatherings has been a key public health measure implemented globally to reduce the possibility of highly infectious individuals, who may have no or mild symptoms, coming into close contact with large numbers of people.[1]

Large SARS-CoV-2 outbreaks associated with mass gatherings, in both indoor and outdoor settings, that have had significant public health consequences have been reported in the literature. For example, approximately 100 COVID-19 cases directly linked to an international business conference held in Boston, USA between 26 and 27 February 2020 seeded major outbreaks in Boston among individuals experiencing homelessness, and spread extensively across the USA and globally, ultimately resulting in hundreds of thousands of cases.[5] At least 246 COVID-19 cases were linked to attendance at nightclubs in Seoul, South Korea between 30 April and 5 May 2020. The cases were found to seed infections in other settings across the country such as several companies, an Army base, a hospital, pubs, karaoke bars and a gym.[9] An indoor wedding reception in Maine, USA in August 2020, which was attended by 55 people was linked to 177 COVID-19 cases, including seven hospitalisations and seven deaths.[10] In August 2020, approximately 460,000 persons attended a 10-day motorcycle rally in South Dakota, USA; of those who attended from neighbouring Minnesota, at least 86 individuals developed COVID-19.[11]

An evidence summary on activities or settings associated with a higher risk of SARS-CoV-2 transmission was published by the Health Information and Quality Authority

(HIQA) on 18 November 2020. The report found that the main factors contributing to SARS-CoV-2 transmission risk include: indoor environments, crowds, and prolonged and intense contact with others. Other important factors may include poor ventilation, loud speaking volume, insufficient use of face coverings and a higher viral load of the index case. In particular, activities involving dining, drinking, exercising, singing or shouting, prolonged face-to-face conversation, especially in indoor crowded environments, were found to be associated with an increased risk of transmission. The report concluded that targeted public health measures are required in settings conducive to superspreading.[12]

With the ongoing roll out of COVID-19 vaccination campaigns globally, mass gatherings are being allowed to occur once again in order to restart social and economic activities.[13] While there is emerging real-world evidence of the effectiveness of COVID-19 vaccines at reducing the transmission of SARS-CoV-2,[14] large sections of the population remain unvaccinated.[15] Additionally, there is evidence that SARS-CoV-2 variants of concern (VOCs) have a significant impact on transmissibility and disease severity and may be able to evade immune responses.[16] Superspreading events linked to these VOCs may have very serious consequences for public health and may hamper efforts to control the pandemic.[17, 18] Therefore evidence is required to determine what public health measures are necessary to enable mass gatherings to occur in the context of a continuing pandemic with circulating VOCs.

HIQA has developed a series of evidence syntheses to inform advice from HIQA to the National Public Health Emergency Team (NPHET). The advice takes into account expert interpretation of the evidence by HIQA's COVID-19 Expert Advisory Group.

The following policy question was outlined by NPHET:

> "What public health measures are necessary to enable mass gatherings to occur safely in both indoor and outdoor settings?"

The following two research questions (RQs) were formulated to inform the policy question:

> RQ1: What public health measures are advised internationally to limit the transmission of SARS-CoV-2 at mass gatherings (including both indoor and outdoor settings)?
>
> RQ2: What is the evidence that public health measures aimed at limiting the transmission of SARS-CoV-2 at mass gatherings (including both indoor and outdoor settings) are effective?

For the purpose of these review questions the following is the definition of a mass gathering, which is adapted from the definition used by the World Health Organization (WHO).

> Mass gatherings are events where there is a concentration of people at a specific location for a specific purpose over a set period of time. They can include a single event or a combination of several events at different venues and constitute a diverse range of gatherings such as sports, music/entertainment, religious events, family events (such as weddings, funerals etc.), large conferences and exhibitions, as well as community, charity events and other types of events. Attendance at the place of work, education and childcare for the purposes of work, education or childcare respectively would not ordinarily constitute a mass gathering.[19]

Methods

A detailed summary of the methods used for this evidence summary is provided in the protocol, which is available here.

For RQ1, a website search of public health agencies and governmental departments (from 22 countries and two international agencies) was conducted to identify public health guidance relating to measures advised to prevent transmission of SARS-CoV-2 at mass gatherings. Information relating to the conduct of pilot events as well as plans and conditionality for further easing of mass gathering restrictions was collated. The information summarised from public health agencies and governmental departments in RQ1 is correct as of 10 June 2021, but may be subject to change.

For RQ2, a systematic search of published peer-reviewed articles and non-peer-reviewed pre-prints was undertaken from 1 January 2020 up to 3 June 2021 to identify evidence regarding the effectiveness of public health measures to prevent the transmission of SARS-CoV-2 at mass gatherings. No language restrictions were applied. Relevant governmental reports identified through RQ1 were also included. All potentially eligible papers were exported to Covidence (www.covidence.org) for single screening of titles, abstracts, and full texts for relevance based on the inclusion and exclusion criteria outlined in the protocol.

Data extraction (and quality appraisal for RQ2) of included studies was completed by a single reviewer and checked by a second reviewer. The relevant National Heart, Lung and Blood Institute (NIH) Quality Assessment Tool was used for the quality appraisal of included studies.[20] A formal quality appraisal tool does not exist for mechanistic or environmental studies, however the single identified mechanistic study was informally appraised to identify any potential methodological limitations.

For RQ2, three key epidemiological indicators were extracted for the purposes of describing the national epidemiological situation at the time the included studies took place. The epidemiological parameters of interest were the:

- 14-day notification rate of newly reported COVID-19 cases per 100,000 population
- total number of vaccination doses (counted as a single dose) administered per 100 people
- share of the population that have been fully vaccinated (as prescribed by the vaccination protocol) against COVID-19.

These data were extracted from the Oxford Martin School, University of Oxford *(Our World in Data)* on 9 June 2021.

Results

RQ1: International review of public health measures for mass gatherings and pilot events

The websites of public health agencies and governmental departments from 22 countries and two international agencies were screened for relevant information. Notably, no relevant information was obtained from the European Centre for Disease Prevention and Control (ECDC). The information in RQ1 is correct as of 10 June 2021, but is subject to change.

Guidance on the safe conduct of mass gatherings

Appendix 1 details identified guidance documents from the 22 included countries and one international public health agency regarding the safe conduct of mass gatherings. In general, the guidance documents reiterate the importance of conducting a risk assessment prior to organising an event, strict adherence to public health measures with clear communication of these measures to attendees and staff.[19, 21-52] Across identified guidance documents, the following are generally recommended: symptom screening on arrival, ensuring people stay at home if symptomatic, collecting details for contact tracing purposes, using designated seating, face mask use (in certain settings), social distancing, hand hygiene, extensive cleaning and disinfection, avoiding congestion, and increased ventilation (if indoors).[19, 21-52] There is also a clear preference for outdoor and seated events, as indoor and or standing events are considered higher risk. In addition, guidance from Austria,[26] Spain,[53] and Switzerland (unless contact details of all attendees are

recorded)[52] specifically prohibit the consumption of food and drink at mass gathering events.

The WHO developed a Risk Assessment Tool (last updated in August 2020), and a linked interim guidance document aimed at those planning mass gatherings in the context of COVID-19.[19, 22] There are three pillars to the WHO Mass Gathering Risk Assessment Tool:

1. risk evaluation (for example, community transmission, nature of event, COVID-19 risk profile of attendees)
2. risk mitigation (for example, awareness of latest guidance, availability of masks and hand sanitisers, medical response plan, monitoring epidemiological situation, contact tracing plan, surge capacity)
3. risk communication (for example, clear communication of the rationale behind modifications to the gathering, using proper channels of communication).

With regards to this risk assessment tool, for the overall risk to be determined, the following factors need to be considered by the event organisers in the planning stage:

- the current stage of the COVID-19 outbreak and known transmission rates
- geographical distribution and number of participants, and their individual risk profile
- mitigation measures that are currently in place or feasible.

It should be noted that risk assessment is a cyclical process. Recording and reporting on the findings of the risk assessment; communicating key messages to the public, participants and event staff; and monitoring and reviewing the risk assessment must continuously occur throughout the planning stages of a mass gathering. This tool should be continuously updated to account for changing information. It is important to note that while mitigation measures can reduce the risk of SARS-CoV-2 infections, they cannot completely eliminate the threat. It is the view of the WHO that all countries with community transmission should seriously consider postponing or reducing mass gatherings that bring people together and have the potential to amplify disease. If movement restrictions and further national measures have been established in a country, the WHO risk assessment tool does not apply. However, when the process of re-opening and or conducting mass gatherings is being considered after movement restrictions have been lifted, it will be critical to ensure any decisions are based on a risk assessment. The WHO have developed a generic risk assessment tool for mass gatherings,[22] as well as specific risk assessment tools for religious[21] and sporting events.[23] Of note, all of these risk assessment tools, and associated guidance documents were developed in

July/August 2020, prior to the availability of COVID-19 vaccines, and hence the full mitigation potential of vaccinations is not incorporated into these tools.

The US Centers for Disease Control and Prevention (CDC) has also developed a guidance document (updated as of 20 May 2021) for those organising large events and gatherings.[24] The key points of the guidance document are as follows:

- avoid large events and gatherings, when possible
- consider the level of risk when deciding to host an event (for example, case numbers in the community, exposure during travel, setting and duration of event, numbers and behaviours of attendees)
- promote healthy behaviours (for example, stay home if you are ill or a close contact, physical distancing, masks, hand hygiene, respiratory etiquette, signage)
- maintain healthy environments (for example, cleaning and disinfection, organise restrooms, ventilation, safety of water supplies after prolonged shutdown, modified layouts, physical barriers, communal space, food service, shared objects)
- maintain healthy operations (for example, regulatory awareness, protection for staff and attendees who are higher risk of severe disease, shifts and attendance times, travel and transit, communication systems, sick leave for staff with COVID-19 or those who are close contacts, staff training, lessons learnt)
- be prepared if someone gets sick during or after the event (for example, isolate and transport those who are sick, clean and disinfect, notify health officials and close contacts, contact tracing).

Public health restrictions on mass gatherings

Table 1 provides an overview of current public health restrictions on mass gatherings from the 22 included countries and two international agencies, with detailed information contained in Appendix 1. Mass gatherings are generally permitted, to varying degrees, in all 22 included countries, with generally fewer attendees permitted in indoor events than outdoor events.

Where limits are specified, these range from eight in Sweden (in venues without designated seating)[43] to 1,500 in Austria (cannot exceed 50% of the maximum authorised capacity, and must be seated)[54] for indoor gatherings. For outdoor gatherings specified limits ranged from 50 in the Netherlands (in the absence of testing – see below),[55] and Finland (in regions of high incidence)[34] to 10,000 in England and Wales in large outdoor, seated venues.[56, 57] Of note, there are

currently no upper limits on numbers permitted at events in Israel[58] or Finland (in regions with a very low incidence rate).[59]

Generally, permission for the mass gathering is on the condition of significantly reduced capacity and adherence to public health measures such as face masks, physical distancing and hand hygiene, with an added emphasis on ventilation for indoor events.

Austria,[54] Czech Republic,[28, 31] Denmark[32], France,[36] the Netherlands[60] and Portugal[61, 62] currently require COVID-19 health certification (that is, proof of vaccination, immunity and or recent negative test, to demonstrate that an individual is at low risk of acquiring or transmitting SARS-CoV-2)[63] in order to access mass gathering events.

Denmark currently allows spectators meeting specified criteria to attend professional football matches. Spectators must provide proof of full vaccination, immunity (previous infection between 14 and 180 days ago) or recent negative test (polymerase chain reaction (PCR) test within 72 hours of entry) to enter. Furthermore the spectators must wear face masks except when seated, provide details for contact tracing, and be kept in cohorts of 500 separated from other cohorts. Capacity at the events is also reduced; however, there does not appear to be a fixed upper limit.[32]

In Austria, a 'Green Pass' is required prior to accessing events with 17 or more people. This involves either a negative test (PCR tests are valid for three days, healthcare worker administered antigen tests are valid for two days, self-tests are valid for one day and point-of-entry tests are valid for one-time entry), full vaccination or recovery from COVID-19.[54]

In Czech Republic, various indoor and or collective events require either a negative PCR (maximum 7 days before) or antigen test (maximum 72 hours before), or proof of full vaccination or a COVID-19 diagnosis within the past 180 days.[64]

In Portugal, in order to access certain football matches, a negative PCR test within 72 hours of kick-off is required.[61, 62]

In France, a 'health pass' (that is, proof of full vaccination, recent negative test (PCR or antigen), or recovery from COVID-19) is required to access gatherings with over 1,000 attendees.[36]

In the Netherlands, a negative rapid antigen test result (provider taken) is required within 40 hours prior to accessing a venue that opts into this system. Venues that avail of this system may allow more than 50 people to attend.[60]

Israel, which was one of the first countries to introduce a 'Green Pass' system, has cancelled the 'Green Pass' requirements as of 1 June 2021 due to the low infection rates and the continuing downward trend of all indicators. There is now unrestricted access to all establishments and sectors, without any requirements for proof of vaccination, recent negative test or recovery from COVID-19.[58]

Table 1: Overview of current public health restrictions on mass gatherings, and COVID-19 health certification (information correct as of 10 June 2021)

Country/ organisation	Current restrictions on mass gatherings (as of 10 June 2021)	COVID-19 health certification requirements for access to mass gatherings (current or planned)	Proof of full vaccination	Negative test result	Proof of Immunity
International agencies					
WHO	N/A	Testing for access not recommended	-	**X**	-
ECDC	N/A	N/A	N/A	N/A	N/A
EU/EEA countries					
Austria	Max. 1,500 indoors and max. 3,000 outdoors (75% capacity, seated). Max. 50 for private gatherings (indoor and outdoor) (more than 50 possible if permit obtained from relevant authority).	Currently in place (for events with ≥ 17 people)	✓	✓ PCR, Ag	✓
Belgium	Max. 200 indoors (75%, seated), and 400 outdoors for organised events. Max. 50 for indoor parties.	Planned from 13 August 2021	✓	✓ PCR	-
Czech Republic	Max. 10 people without COVID-19 health certification. Max. 150 for outdoor and 75 for indoor private gatherings (with COVID-19 health certification). Max. 1,000 indoors and max. 2,000 outdoors (50% capacity, seated) for concerts, football matches.	Currently in place (for gatherings with > 10 people)	✓	✓ PCR, Ag	✓
Denmark	Max. 50 indoors and max. 100 outdoors. Max. 500 at indoor and outdoor seated event. Football matches; sections of 500 seated permissible	Currently in place	✓	✓ PCR	✓
Finland	Varies by regional incidence; ranges from a max of 10 indoors and 50 outdoors to no upper limit (Assuming people are kept sufficiently apart)	None at present	N/A	N/A	N/A
France	Max. 6,000 and 65% capacity for cultural and sporting events (indoor and outdoor), with COVID-19 health certification if >1,000 people.	Currently in place (for events with greater than 1,000 attendees)	✓	✓ PCR, Ag	✓

Country/ organisation	Current restrictions on mass gatherings (as of 10 June 2021)	COVID-19 health certification requirements for access to mass gatherings (current or planned)	Proof of full vaccination	Negative test result	Proof of Immunity
Germany	Generally prohibited, however European Football Championship matches are currently being held with approx. 14,500 attendees (22% capacity) at each game.	None at present. Visitors to theatres, concerts, opera houses and cinemas may be asked to demonstrate proof of negative test, as part of the fourth step of reopening.	-	✓ Ag	-
Iceland	Max. 150, but 300 permitted at seated events	None at present.	N/A	N/A	N/A
Ireland	Max. 100 at organised outdoor events, max. 200 if minimum capacity of venue is 5,000	None at present.	N/A	N/A	N/A
Italy	Max. of 1,000 outdoors or 500 indoors at a max of 50% capacity (for theatres, concerts) and 25% (for sporting events) and all seated.	Certain large events may be subject to Green Cert requirements in the future.	✓	✓ PCR, Ag	✓
The Netherlands	Max. 50 in one venue (in the absence of testing), however if venue has capacity of ≥ 1,000, then max. 250 permitted (both indoors and outdoors). Venues such as theatres that avail of COVID-19 health certification may permit >50 people, as long as social distancing is in place.	Currently in place.	-	✓ Ag	-
Norway	Max. 20 indoors and 30 outdoors for private gatherings in a public space. Max. 50 indoors (without designated seating) (or 100 if event for young people <20 years old). Max. 200 indoors (with designated seating). Max. 200 outdoors (without designated seating). Max 600 outdoors and designated seating in cohorts of 200.	Being considered a part of steps 3 and 4 of the reopening plan (no date provided).	✓	✓ PCR, Ag	-
Portugal	Large outdoor and indoor events permitted with significantly reduced capacity (specifics are unclear).	Currently in place for attendance at football matches.	-	✓ PCR	-
Spain	Varies by region.	None at present.	N/A	N/A	N/A

Country/ organisation	Current restrictions on mass gatherings (as of 10 June 2021)	COVID-19 health certification requirements for access to mass gatherings (current or planned)	Proof of full vaccination	Negative test result	Proof of Immunity
	Football matches: Max. 30% capacity or 5,000 people (in regions of low incidence only). Business conferences/cultural events: ranges from prohibition to 75% capacity.				
Sweden	Max. 8 indoors without designated seating and 50 with designated seating. Max. 100 outdoors without designated seating and 500 with designated seating.	Under consideration for future large gatherings	✓	-	-
UK countries					
England	Max. 1,000 indoors and 4,000 outdoors (50% capacity). In the largest outdoor seated venues (>16,000 capacity), where crowds can be spread out, up to 10,000 people will be able to attend (or 25% capacity).	Currently piloting nationally.	✓	✓ Ag	Planned
Northern Ireland	Max. 500 outdoors. Risk assessment required for indoor gatherings > 15 people.	None at present.	N/A	N/A	N/A
Scotland	Level 0: Max. 2,000 outdoor seated, 1,000 outdoor standing, 400 indoor seated. Level 1: Max. 1,000 outdoor seated, 500 outdoor standing, 200 indoor seated. Level 2: Max. 500 outdoor seated, 200 outdoor standing, 100 indoor seated. Level 3: prohibited.	None at present.	N/A	N/A	N/A
Wales	Max. 4,000 at outdoor standing events and 10,000 at outdoor seated events (subject to risk assessment). Max. 30 at organised indoor events.	None at present.	N/A	N/A	N/A
Other countries					
Israel	No restrictions.	No longer in place.	–	-	–
Switzerland	Max. 100 indoors and max. 300 outdoors, all seated, 50% capacity.	Planned for 1 July 2021.	✓	✓ PCR, Ag	✓
US CDC	Varies by state	Testing for access not recommended	-	**X**	-

Key: Ag – antigen; CDC – Centers for Disease Control and Prevention; ECDC – European Centre for Disease Prevention and Control; PCR –polymerase chain reaction; WHO – World Health Organization.

Along with Austria, Czech Republic, Denmark, France, the Netherlands, and Portugal, six other countries (Belgium,[65] Germany,[66] Italy,[40] Norway,[67] Sweden,[68] and Switzerland)[69] have stated plans to introduce COVID-19 health certification as a requirement for accessing certain mass gathering events, over the coming months (Table 1). Additionally, England[70] is currently running a national pilot of rapid testing and proof of full vaccination prior to entry to mass gathering events. The 13 countries differ in their COVID-19 health certification requirements:

- six countries (Austria,[26] Czech Republic,[64] Denmark,[32] France,[36] Italy,[40] and Switzerland)[69] will accept either proof of full vaccination, immunity or a recent negative test to access mass gathering events
- Belgium,[65] England[70] and Norway[67] will only accept proof of full vaccination or a recent negative test. However, future pilots in England may seek to additionally accept proof of previous infection, as a means to access mass gathering events.[70]
- Germany,[66] the Netherlands[71, 72] and Portugal,[73] will only accept recent negative tests, in order to access these events.
- Sweden is considering using proof of full vaccination in order to access these events (Table 1).[68]

Considerable variability was observed in terms of pre-event testing requirements and these appear to be in flux. Twelve of the 22 included countries have stated plans to undertake (or are currently undertaking) pre-event testing:

- PCR or antigen tests are specified by six countries (Austria,[54] Czech Republic,[64] France,[74] Italy,[40] Norway[75] and Switzerland).[76]
- PCR tests only are specified by three countries (Belgium,[65] Denmark,[32] Portugal)[73] and antigen tests only are specified by three countries (England,[70] Germany,[66] the Netherlands).[71, 72]
- differences were also noted in the requirements for the timing (ranging from seven days prior[64] to on-site)[54] and sampling (self-sampled/self-tested[54] or provider taken)[77] of the pre-test.

No explicit statement regarding a requirement for COVID-19 health certifications to access mass gathering events was identified for the remaining seven European countries (Finland, Iceland, Ireland, Spain, Northern Ireland, Scotland and Wales). However, this may change as evidence and experience from other countries accumulates.

The WHO[78] and the US CDC[79] both advise against testing for access to mass gathering events. The CDC states that:

> "testing all event attendees and staff for COVID-19 before allowing them to enter the venue has not been systematically studied. It is unknown if entry testing at event venues provides any additional reduction in person-to-person transmission of the virus beyond what would be expected with other preventive measures (such as social distancing, wearing cloth face coverings, hand washing, enhanced cleaning and disinfection)."[79]

The WHO advise that "testing should be conducted in accordance with local health providers and national guidance. Anyone unwell or symptomatic should not be allowed to participate in the event."[78]

Table 2 outlines the indicative dates for the easing of mass gathering restrictions across all 22 included countries. Israel has largely removed all restrictions on mass gatherings.[58] All restrictions on mass gatherings are set to be removed by June 2021 in France,[36] and Iceland,[80] by July 2021 in Austria,[81] England,[82] and Finland (for outdoor events),[59] and by August 2021 in Finland (for indoor events).[59] Denmark,[83] the Netherlands,[55] and Sweden[84] have stated that all mass gathering restrictions will be lifted only when certain targets or indicators have been met, and they have not put a date on these. Denmark will lift all of its restrictions when everyone 16 years and older has been offered a COVID-19 vaccine.[83] The Netherlands will lift all mass gathering restrictions including any testing requirements, when the number of infections and hospital admissions due to COVID-19 permit this.[85] Sweden will only lift all restrictions once all of the following indicators are met:[84]

- 14-day incidence is less than 50 cases per 100,000 inhabitants
- epidemic is steadily declining for at least two weeks
- total number of patients in hospital due to COVID-19 is less than 100, of which less than 25 patients are in ICU
- vaccination coverage with at least one dose in the population over 18 years is greater than 70%.

Belgium,[65] Germany,[66] Ireland,[86] Italy,[40] Norway,[67] Portugal,[73, 87] Spain,[88] Northern Ireland,[89] Scotland,[90] Wales,[57] and Switzerland[69] have all indicated plans for significant easing of restrictions on mass gatherings over the coming months in line with epidemiological, healthcare burden and or vaccination indicators. However, none of these countries appear to indicate that all restrictions on mass gatherings will be lifted over the coming months (Table 2). The situation in Czech Republic and the US is less clear. Decisions on the easing of restrictions are likely to be made at a state- rather than a national-level for the US.

Table 2: Indicative dates for easing of mass gatherings restrictions (information correct as of 10 June 2021)

Country/ organisation	Jun 2021	Jul 2021	Aug 2021	Sep 2021 and beyond	Triggers
International agencies					
WHO	N/A	N/A	N/A	N/A	N/A
ECDC	N/A	N/A	N/A	N/A	N/A
EU/EEA countries					
Austria†	**-**	*1 Jul* No upper limit for events. Both seating and standing events possible. Notification requirement for 100 or more guests, authorisation required for 500 or more guests.	-	-	▪ transferability of disease ▪ source of infection ▪ resources available ▪ testing activity.
Belgium†	**-**	*1 Jul* Indoor events: Max. 2,000 (80% capacity, seated). Outdoor events: Max. 2,500. Ceremonies, weddings and funerals: Max. 200 indoors and max. 400 outdoors. Indoor parties: Max. 100. **30 Jul** Indoor events: Max. 3,000 (100% capacity). Outdoor events: Max. 5,000. Ceremonies, weddings and funerals: Max. 200 indoors and max. 400 outdoors. Indoor parties: Max. 100.	*13 Aug* Outdoor mass events allowed (max. 75,000 with a negative test or proof of vaccination).	*1 Sep* Indoors and outdoors: maximum numbers to be decided. Mass events allowed. Ceremonies, weddings and funerals: no restrictions. Parties: no restrictions.	▪ COVID-19 ICU occupancy ▪ COVID-19 hospitalisations ▪ vaccination coverage.
Czech Republic†	-	-	-	-	▪ incidence rate of COVID-19 infection
Denmark†	*Phase 1 (underway)* ▪ major cultural and sporting events, seated: cohorts of 500 indoors and outdoors ▪ outdoor festivals: cohorts of 200 (max. 2,000). *Phase 2 (when all persons >50 years old have received at least 1 vaccine dose)*				

Country/ organisation	Jun 2021	Jul 2021	Aug 2021	Sep 2021 and beyond	Triggers
	▪ Major cultural and sporting events, seated: cohorts of 1,000 indoors and outdoors ▪ Outdoor festivals: cohorts of 200 (max. 2,000) ▪ Indoor standing: cohorts of 300 (max. 3,000) ▪ Outdoor festivals: cohorts of 500-2,000 (max 5,000-10,000) ***All restrictions lifted (when all persons >16 years old have been offered a vaccine)***				
Finland	-	Outdoors: no restrictions	Indoors: no restrictions		▪ epidemiological situation ▪ vaccination coverage.
France†	***30 June*** No restrictions (with a COVID-19 health pass).	-	-	-	▪ incidence rate of COVID-19 infection ▪ sudden changes ▪ threat of saturation of resuscitation services.
Germany†	**Opening Step 4 - outdoor catering, theatre, sports** With a stable or falling 7-day incidence of less than 100 new infections / 100,000 inhabitants, theatres, concert and opera houses and cinemas will be opened to visitors with a daily negative rapid test or self-test With a stable 7-day incidence of less than 50 new infections / 100,000 inhabitants, theatres, concert and opera houses and cinemas can open without restrictions. **Opening Step 5 - Leisure Events, Retail, Sports** With a stable 7-day incidence of less than 50 new infections / 100,000 inhabitants, leisure events with up to 50 participants outdoors can resume.				▪ incidence rate of COVID-19 infection
Iceland	***End of June (when at least 50% of population vaccinated)*** All mass gathering restrictions lifted	-	-	-	▪ vaccination coverage
Ireland	-	***From 5 Jul*** Organised indoor events: Max. 50 (or 100 in larger venues). Organised outdoor events: Max 200 (or 500 if capacity >5,000).	Further increases in the numbers permitted at both indoor and outdoor events will be considered.	-	▪ epidemiological situation ▪ available evidence in relation to vaccine deployment, uptake and effectiveness.
Italy†	***15 Jun***	***1 Jul***	-	-	Based on 21 key process and performance indicators (e.g. number of symptomatic

<table>
<tr><th>Country/ organisation</th><th>Jun 2021</th><th>Jul 2021</th><th>Aug 2021</th><th>Sep 2021 and beyond</th><th>Triggers</th></tr>
<tr><td></td><td>Yellow/white zones: Trade fairs permitted.</td><td>Yellow/white zones: Conferences, congresses and theme parks permitted.</td><td></td><td></td><td>cases, ICU admissions, hospital admissions, positivity rate, number of outbreaks, resources).</td></tr>
<tr><td>The Netherlands†</td><td colspan="2">30 Jun
Events without designated seating permitted.

Final step (no date)
All basic rules and measures will be lifted. Based on epidemiological situation.</td><td colspan="2"></td><td>Level of infection, COVID-19 hospitalisations, vaccine deliveries and vaccination rollout.</td></tr>
<tr><td>Norway†</td><td colspan="4">Under <u>Step 3 of reopening plan</u> the following restrictions on capacity at public events will apply (no date as of yet):

<table><tr><th></th><th>Indoors</th><th>Outdoors</th></tr><tr><td>Without fixed assigned seats</td><td>400 people (200 x 2 cohorts)</td><td>Up to 800 people (200 x 4 cohorts)</td></tr><tr><td>With fixed assigned seats</td><td>1,000 people (500 x 2 cohorts)</td><td>2,000 people (500 x 4 cohorts)</td></tr></table>
If there is an opportunity to use access tests and corona certificates in the reopening of society the following rules will apply:
<table><tr><th></th><th>Indoors</th><th>Outdoors</th></tr><tr><td>Without fixed assigned seats</td><td>50% capacity up to a maximum of 1,000 people (divided into cohorts of up to 500).</td><td>50% capacity up to a maximum of 2,000 people (divided into cohorts of up to 500).</td></tr><tr><td>With fixed assigned seats</td><td>50% capacity up to a maximum of 2,500 people (divided into cohorts of up to 500).</td><td>50% capacity up to a maximum of 5,000 people (divided into cohorts of up to 500).</td></tr></table>
Under <u>Step 4</u> the following rules will apply (no date as of yet):
<table><tr><th></th><th>Indoors</th><th>Outdoors</th></tr><tr><td>Without fixed assigned seats</td><td>750 people</td><td>1,500 people</td></tr><tr><td>With fixed assigned seats</td><td>2,500 people</td><td>5,000 people
75% capacity up to a maximum of 10,000 people.</td></tr></table>
If there is an opportunity to use access tests and corona certificates in the reopening of society the following rules will apply:
<table><tr><th></th><th>Indoors</th><th>Outdoors</th></tr></table></td><td>▪ rate of infection and disease burden
▪ health services capacity
▪ status of vaccination programme.</td></tr>
</table>

<table>
<tr><th>Country/ organisation</th><th>Jun 2021</th><th>Jul 2021</th><th>Aug 2021</th><th>Sep 2021 and beyond</th><th>Triggers</th></tr>
<tr><td></td><td colspan="4"><table>
<tr><td>Without fixed assigned seats</td><td>75% capacity up to a maximum of 2,500 people</td><td>75% capacity up to a maximum of 5,000 people.</td></tr>
<tr><td>With fixed assigned seats</td><td>75% capacity up to a maximum of 5,000 people</td><td>75% capacity up to a maximum of 10,000 people</td></tr>
</table></td><td></td></tr>
<tr><td>Portugal†</td><td>Jun 14
Concert halls: 50% capacity.
Outdoor concerts in accordance with local health authorities.</td><td>-</td><td>-</td><td>-</td><td>There is a weekly evaluation of the epidemiological situation to determine whether further easing (or extension of measures) can occur.</td></tr>
<tr><td>Spain</td><td colspan="4"><u>Restrictions on mass gatherings under each Alert level (traffic light system)</u><table>
<tr><th>Type of mass gathering</th><th>Alert level 0</th><th>Alert Level 1</th><th>Alert Level 2</th><th>Alert Level 3</th><th>Alert Level 4</th></tr>
<tr><td>Congresses, meetings, meetings of business, conferences, seminars and other professional events</td><td>NR</td><td>75% capacity</td><td>50% capacity</td><td>-</td><td>-</td></tr>
<tr><td>Cinemas, theatres, auditoriums, tent circuses and similar spaces, as well as premises and establishments for cultural events and show</td><td>NR</td><td>75% capacity</td><td>75% capacity</td><td>50% capacity</td><td>-</td></tr>
<tr><td>Nightlife venues and discos</td><td>*50% capacity</td><td>50% capacity</td><td>33% capacity (2am closure)</td><td>-</td><td>-</td></tr>
<tr><td>Open air events</td><td>*Max 10,000</td><td>Max 5,000</td><td>Max 2,500</td><td>-</td><td>-</td></tr>
</table>*An additional level referred to as ‘new normality’ or ‘Alert level 0’ has been added to the alert level framework (not currently in effect).</td><td>incidence rate of COVID-19 infection
COVID-19 ICU occupancy
COVID-19 hospitalisations.
The new traffic light rules will be applied until 70% of the population, and all over-50s are vaccinated against COVID-19.</td></tr>
<tr><td>Sweden†</td><td colspan="4">Level 3: 1 Jun (14-day incidence rate > 200 per 100,000)
Social gathering: Max. 8 indoors, max. 100 outdoors.
Indoor seated event: Max. 50
Outdoor seated event: Max. 500
Exercise race: Max. 150

<u>Level 2: Jun-Jul (when 14-day incidence rate <200 per 100,000, epidemic steadily declining for at least two weeks, the total number of patients in inpatient care due to COVID-19 <300,</u></td><td>spread of infection
stability of improvements
burden on healthcare (intensive care and inpatient care) due to COVID-19
vaccination coverage in the population over 18 years.</td></tr>
</table>

Country/ organisation	Jun 2021	Jul 2021	Aug 2021	Sep 2021 and beyond	Triggers
	of which <70 patients need intensive care, and when coverage of at least 1 dose, in the population over 18 years >50%) Social gathering: Max. 50 indoors, max. 600 outdoors. Indoor seated event: Max. 300 Outdoor seated event: Max. 3,000 Exercise race: Max. 900 ***Level 1: When indicators are met (14-day incidence rate <50 per 100,000, epidemic steadily declining for at least two weeks, total number of patients in inpatient care due to COVID-19 <100, of which <25 patients in need of intensive care, and vaccination coverage of at least 1 dose, in the population over 18 years >70%)*** No restrictions. These 3 levels will be delivered through 5 stages: ▪ Stage 1 (in effect as of 1 June 2021) ▪ Stage 2 (1 July): raised participant limits for public gatherings and events and private gatherings. ▪ Stage 3 (15 July): regulations limiting the number of people per square metre in indoor and outdoor environments will be lifted. ▪ Stage 4 (expected to start in September): all participant limits for public gatherings and events and private gatherings will be lifted ▪ Stage 5: all remaining restrictions will be lifted (date not determined).				
UK countries					
England‡	-	*19 Jul* No restrictions.	-	-	▪ The vaccine deployment programme continues successfully. ▪ Evidence shows vaccines are sufficiently effective in reducing hospitalisations and deaths in those vaccinated. ▪ Infection rates do not risk a surge in hospitalisations which would put unsustainable pressure on the NHS. ▪ The government's assessment of the risks is not fundamentally changed by new Variants of Concern.
Northern Ireland	*From 21 Jun* Increased numbers at outdoor events.				Health trends, community trends and economic trends will be evaluated 3 weeks after any changes before any

Country/ organisation	Jun 2021	Jul 2021	Aug 2021	Sep 2021 and beyond	Triggers
	Return of theatres, conferences, exhibitions and concerts.				further decisions are made to ease restrictions.
Scotland	Restrictions will ease in accordance with the COVID-19 protection levels (0-4). Further details will be provided in due course regarding next steps beyond Level 0.				Moving from a higher level to a lower level is informed by the 6 WHO criteria: 1. Evidence shows that COVID-19 transmission is controlled. 2. Sufficient public health and health system capacities are in place to identify, isolate, test and treat all cases, and to trace and quarantine contacts. 3. Outbreak risks are minimised in high vulnerability settings, such as long-term care facilities and congregate settings. 4. Preventive measures are established in workplaces. 5. Manage the risk of exporting and importing cases from communities with high-risks of transmission. 6. Communities have a voice, are informed, engaged and participatory in the transition. One additional criteria that must be met before returning to geographically varied levels: 7. At least all of the JCVI groups 1-9 must have been offered a vaccination.
Wales	All of Wales is currently under alert level 1 (the lowest alert level). Further easing of restrictions will be kept under constant review. The next review date is 21 June 2021.				To move to level 1, the following conditions were met: ▪ Confirmed 7-day case rate <50 per 100,000 ▪ Confirmed case rates for those >60 years remain low

Country/ organisation	Jun 2021	Jul 2021	Aug 2021	Sep 2021 and beyond	Triggers
					▪ Projection of future case incidence rates over next two weeks do not anticipate significant rises. ▪ Test positivity <3% over 7 days ▪ Forecast of Welsh population estimated to have COVID-19 is less than 0.25% ▪ Rates of change in the indicators above – an established rapid increase may merit escalation without needing any particular thresholds to be reached ▪ Hospital capacity being managed effectively and any potential pressure from increased cases is at least 5 to 6 weeks away. ▪ No unmitigated concerns from local health professionals ▪ No unmitigated concerns raised by relevant local authority leaders or local partners.
Other countries					
Israel	Israel has largely removed all restrictions on mass gatherings				Israel has moved to a local Traffic Light Model. Every local council will receive a weekly index that is calculated by considering the number of new cases, the percentage of positive test results, and infection rate.
Switzerland†	-	*1 Jul* Organised events: Max. 3,000 for indoor events. Max. 5,000 for large outdoor seated venues (66% capacity). Max. 3,000 for outdoor standing events (50% capacity).	*20 Aug* Upper limit is 10,000.	-	▪ consultation with stakeholders ▪ epidemiological situation.

Country/ organisation	Jun 2021	Jul 2021	Aug 2021	Sep 2021 and beyond	Triggers
		Admission to major events will be limited to people who have been completely vaccinated, have recovered from COVID-19 or have had a negative test result.			
US CDC	State level decision				

Key: CDC – Centers for Disease Control and Prevention; ECDC – European Centre for Disease Prevention and Control; ICU – intensive care unit; JCVI – The Joint Committee on Vaccination and Immunisation; NHS – National Health Service; WHO – World Health Organization.

†Indicates countries where proof of vaccination, immunity and or recent negative test is currently, or may soon be, required for entry to large events.

‡Indicates countries which are currently running national pilots of rapid testing prior to entry to large events.

Pilot events

The available information on pilot mass gathering events is outlined in Appendix 2. There are reports of completed, ongoing or planned pilot events in 15 of the 22 included countries: Austria,[91] Belgium,[92] France,[93] Germany,[94, 95] Ireland,[86] Italy,[96] the Netherlands,[71, 72] Northern Ireland,[97] Norway,[41, 98, 99] Portugal,[100] Spain,[101-104] England,[70, 105] Scotland,[106] Wales,[107] and Switzerland.[69] While no pilot events were identified in the US, some sporting events with a large number of spectators have occurred since April 2021; these do not appear to be pilots, but rather 'business as usual'.[108, 109]

The scale of the pilot events varies with some countries conducting pilot events at a local or regional level (for example, Austria,[91] Italy,[96] Spain,[101-104] Germany,[94, 95] and Portugal)[100] and others conducting a nationally coordinated programme of pilots (for example, Belgium,[92] England,[70, 105] France,[93] Ireland,[86] the Netherlands,[71, 72] Northern Ireland,[97] Scotland,[106] Wales,[49] Switzerland[69] and Norway).[41, 98, 99] The most comprehensive programmes to-date include those currently being conducted in the Netherlands[71, 72] and England.[105]

Throughout April, a series of over 400 pilot events involving over 200,000 participants in total were organised by the Dutch government in conjunction with the events industry and academic partners.[72] These pilots occurred across the Netherlands and aimed to test the logistical feasibility of accessing these events (specifically, issues regarding pre-event testing (rapid test administered by a qualified healthcare professional) and use of the 'CoronaCheck' app). These events required adherence to the usual public health measures (that is, face masks, social distancing and hand hygiene). There was generally no follow-up testing after the event. There were five types of activities and events included in this 'testing for access' pilot phase:

- sports and youth activities
- casinos and arcades
- zoos, adventure and amusement parks
- cultural activities (for example, monuments, museums, theatres, concerts and music venues)
- business meetings.

The number of participants at each event varied, generally with a maximum of 500 participants per day. A total of 5,000 attendees per day were allowed in zoos while pilots in stadiums were based on a significantly reduced capacity. In addition to the 'testing for access' pilots, a series of field lab events and field lab cafes are

ongoing.[71, 72, 110] These are controlled experiments where the aim is to investigate how an event can occur safely with a larger audience and generally without adherence to the usual public health measures. These events generally require testing (rapid test) before and five days after the event. Initially all of the pre-event testing was based on PCR, however later pilots have moved to rapid antigen testing. There are requirements that the tests are administered by a healthcare professional, and not self-sampled.

Phase 1 of the field lab events started in February 2021, and included the following relatively small events:

- a business seminar
- a theatre performance
- football matches
- concerts
- festivals.

Four reports relating to these types of events (that is, indoor setting with a passive audience, outdoor setting with an active audience, indoor setting with an active audience, and outdoor festivals) are available online.[71] These four reports are examined in detail in RQ2.[111-114]

Similarly, the field lab cafes, were controlled experiments undertaken in five bars and cafes in Utrecht city between 14 and 17 April 2021.[110] Reservation and negative test (rapid antigen test) (between 48 and 24 hours before) was required in advance. Participants were asked to adhere to public health measures at these venues. Guests' and staff behaviours were observed by researchers. Participants were asked to complete a questionnaire afterwards. Fresh air supply was also monitored, based on CO_2 concentrations in the cafes. Testing after the event was not required. Results from the field lab cafes are pending.

During the ongoing second phase of field lab events, a series of 11 events are planned including the Eurovision Song Contest with 3,500 participants and two football matches with 5,000 participants each. During these field labs, investigators will examine how:

- people meet
- long they meet for
- people respond to different measures,
- visitors are screened on location.[71]

The phase 2 events are substantially larger than any of the pilots of previous field lab events and have caused controversy. For example, a music festival involving 10,000 people planned for 24 April was banned by the host city, Breda, after more than 300,000 people signed a petition opposing it.[115] More recently, over 350 researchers criticised the field lab studies in an open letter that complained of a lack of peer review, a setup that was not transparent, and ethical failings. The studies reportedly did not need approval from a medical ethics committee because they did not meet the legal definition of medical research, a panel at Radboud University Medical Center ruled. However, the authors of the open letter say the field lab events should have followed ethical guidelines for research in the social and behavioural sciences, which require participants to give their informed consent and for researchers to describe the potential drawbacks of the study for individuals and society.[115]

In England, as part of a government-funded project, with industry and academic partners, the Events Research Programme is currently carrying out pilots in a series of venues to gather evidence on the transmission risks associated with different settings, and potential approaches to managing and mitigating transmission risks.[70, 105]

Early pilots are focusing on demonstrating COVID-19 status through testing alone, while later pilots will seek to incorporate data on vaccination and acquired immunity. The Events Research Programme will examine the extent to which COVID-19 health certification would help the return of mass events in closed settings, from football matches to theatre performances, and the reopening of nightclubs. Some of the pilots already conducted include 4,000 people at the FA Cup Semi-Final at Wembley Stadium in London on 18 April 2021, 1,000 people at an indoor seated business event in Liverpool on 18 April 2021, and 3,000 people at an indoor night club in Liverpool on 30 April 2021. Around 21,000 people attended the FA Cup Final at Wembley Stadium on 15 May 2021.

These events are exempt from the wider coronavirus regulations, including the rule of six (that is, people can only meet up in a maximum of a group of six). The first phase of the Events Research Programme concluded on 15 May 2021. It is unclear when the results of these pilot studies will be announced. However, it has been noted that findings will be reported to the Prime Minister to feed into wider discussions around Step 4 of the lockdown restrictions.[105] Further large pilot events are planned as part of the second phase of the Events Research Programme, including Royal Ascot, which will take place from 15 to 19 June 2021, with 12,000 people permitted to attend each day.[116]

These events are considered controlled experiments, are approved by a national ethics board and attendees must provide consent before participating. A negative lateral flow test (LFT) result (that is, an antigen test) is required prior to entry.[70, 117] These LFTs are required to be taken through community test sites, no more than 48 hours prior to entry. An LFT taken at home is currently not considered sufficient to obtain entry.[118] Attendees will also be asked to take a home PCR test before and after the event to inform research and ensure any transmission of the virus is properly monitored.[105] However, there has been criticism surrounding the ethics of conducting the indoor night club event in particular, due to the absence of masks and social distancing given its high risk nature in a largely unvaccinated younger population. Additionally, there have been concerns raised regarding the risk for close contacts and household members of those who attended, as well as the risk to the wider community, in the context of circulating VOCs.[119]

Of note, the European Football Championship (EURO 2020) is currently underway across 11 host cities in 10 European countries (Glasgow, London, Seville, Amsterdam, Copenhagen, Munich, Rome, Budapest, Bucharest, St. Petersburg and Baku). The capacity at most stadiums has been reduced significantly and protocols are in place, but these vary substantially from country to country. For example, the capacity has been reduced to 22% (of 66,000) in the Football Arena in Munich, Germany, however 100% capacity (61,000) is permitted in the Puskas Arena in Budapest, Hungary.[120] Additionally, requirements for entry differ between venues with pre-event testing currently a requirement in at least seven venues (Rome, St. Petersburg, London, Amsterdam, Bucharest, Budapest and Copenhagen). Proof of full vaccination (London, Budapest and Copenhagen) or recovery from COVID-19 (Copenhagen) is also accepted as an alternative to a negative test result in some venues. Currently, four venues (Seville, Baku, Glasgow and Munich) do not have any COVID-19 health certification requirements, however this may be subject to change.[120] For the first two matches at least, taking place in Wembley, London, proof of a negative antigen test, taken within 48 hours of the time stadium gates open or proof of full vaccination, is required for entry as part of the ongoing Events Research Programme.[121] For all four matches taking place in the Johan Cruijff Arena in Amsterdam, proof of a negative rapid antigen test result, taken the day of the match, is required for entry as part of the ongoing Fieldlab pilot events.[122] Besides the football matches taking place in London and Amsterdam, it is unclear whether any of the other countries involved are using these EURO 2020 matches as pilot events. It would also appear that the capacity limits for these EURO 2020 matches are higher than those otherwise permitted in the respective countries.

Four completed pilot events with biological/epidemiological, environmental and or behavioural outcomes were identified in RQ1 that are relevant for RQ2 as per the

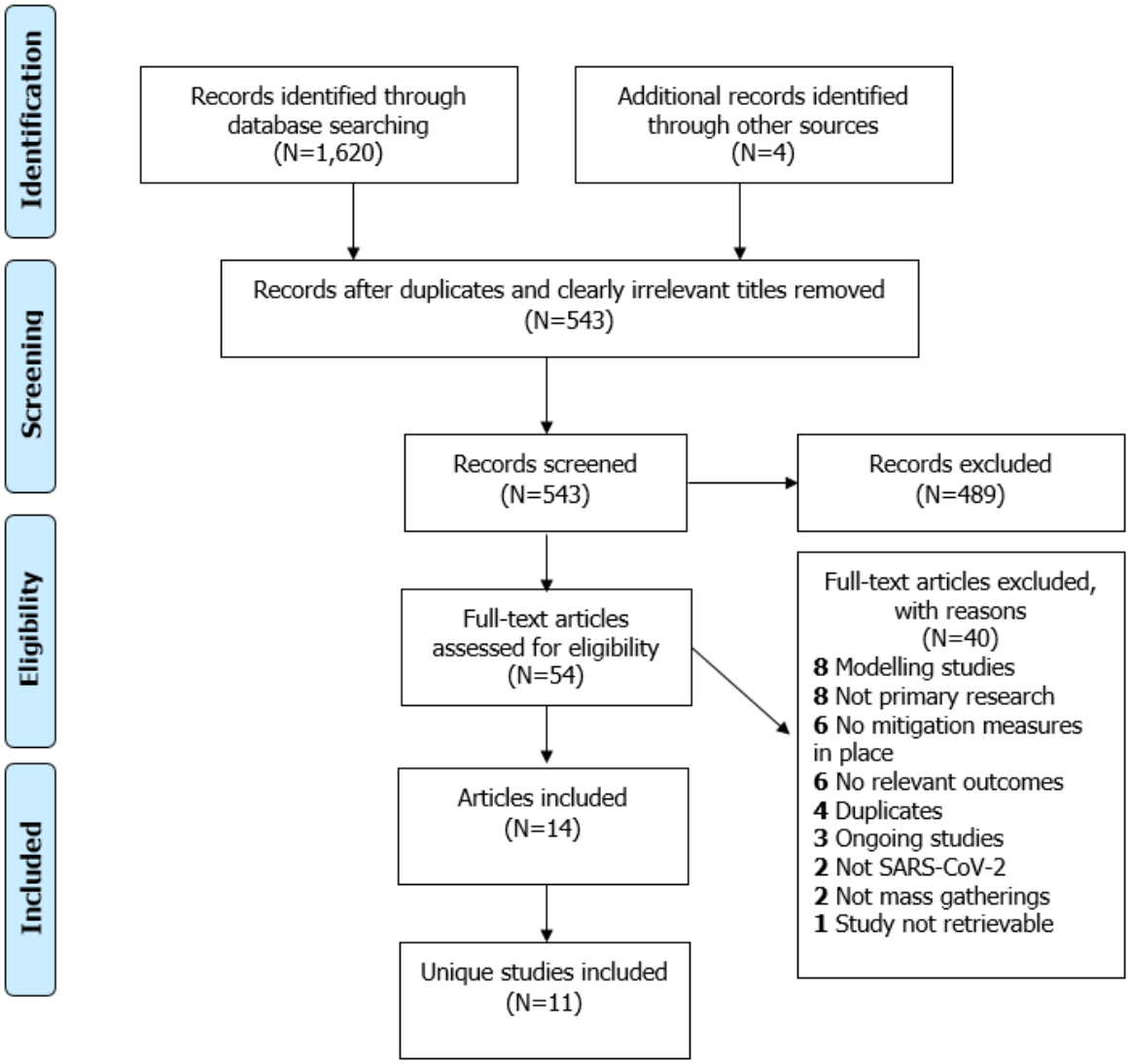
study protocol.[95, 104, 123, 124] These are examined in detail below. Two other smaller pilot events were identified, but these pilots do not report any relevant outcomes and were not included in RQ2.[91, 94] Notably, these two pilots focused on the logistical feasibility of conducting mass gathering events in the context of the COVID-19 pandemic (for example, the most efficient way of organising pre-event rapid testing, cost per test). These pilots are reported in Appendix 2.

RQ2: Evidence review of public health measures to limit SARS-CoV-2 transmission at mass gatherings

Search findings

Searches up until 3 June 2021 resulted in a total of 1,624 citations; following removal of duplicates and clearly irrelevant citations, the titles and abstracts of 543 citations were screened for relevance, with 54 full-texts assessed for eligibility and 40 subsequently excluded. At the end of this process, 14 articles were included in this evidence summary (Figure 1).[111-114, 125-134] Ten of these papers were identified through electronic database searching[125-134] and four were identified through website searching of public health agencies and governmental departments for RQ1.[111-114]

Figure 1: PRISMA flow diagram of included studies



Characteristics of included studies

Of the 14 included articles, three related to the Hajj pilgrimage of 2020 and used the same dataset,[125, 126, 128] with two other articles referring to the same mechanistic experiment.[132, 134] For the purpose of this evidence summary, the three Hajj articles will be considered as one study,[125, 126, 128] and the two articles on the mechanistic experiment will be considered as one study.[132, 134] Therefore in total, 11 unique studies that evaluated the effectiveness of public health measures to reduce SARS-CoV-2 transmission at mass gatherings were included (Table 3). Nine of these 11 studies were uncontrolled, before-after studies,[112, 114, 125-129, 131, 133] one was a randomised controlled trial (RCT),[130] and one was a mechanistic study.[132, 134] Four studies were conducted in the Netherlands,[111-114] two studies were conducted in Germany[131, 132] and one study each was conducted in India,[127] Spain,[130] Saudi Arabia,[125, 126, 128] the United Arab Emirates (UAE)[133] and South Korea.[129] The sample size of included studies ranged from 934[127] to approximately 8,800 participants.[129] In total, approximately 30,482 participants were included across all 11 studies. The mechanistic study did not involve human participants, but instead involved a dummy that simulated human breath in an indoor concert venue.[132, 134] Five of the 11 studies related to concerts or festivals,[112, 114, 130-132] two related to sporting events,[113, 133] one to a graduation ceremony,[127] one to the Hajj pilgrimage,[125, 126, 128] one to a protest rally[129] and one study related to a business conference and a theatre performance that occurred in the same venue on different dates.[111] Studies were categorised based on their setting (indoor versus outdoor) and seating arrangements ('passive' – seated event; 'active' – audience is standing or moving). Four studies included active audiences in outdoor settings (for example, football matches, festivals, pilgrimages), three studies included passive audiences in an indoor setting (for example, seated indoor concerts),[111, 131, 132] three studies included an active audience in an indoor setting (for example, indoors standing concerts, martial arts tournament),[114, 130, 133] and one study involved a passive audience in an outdoor setting (an outdoors graduation ceremony).[127]

Table 3: Characteristics of included studies

First author (year)	Country	Study design	Mass gathering type	Setting and audience type	Sample size	Overall quality rating†
Revollo (2021)[130]	Spain	Randomised controlled trial	Concert	Indoor, active	1,047	Fair
Fieldlab A (2021)[111]	The Netherlands	Uncontrolled, before-after study	Business conference and theatre performance	Indoor, passive	1,198	Fair
Fieldlab B (2021)[113]	The Netherlands	Uncontrolled, before-after study	3 football matches	Outdoor, active	7,141	Fair
Fieldlab C (2021)[114]	The Netherlands	Uncontrolled, before-after study	1 dance event and 1 music concert	Indoor, active	3,078	Fair
Fieldlab D (2021)[112]	The Netherlands	Uncontrolled, before-after study	2 festivals	Outdoor, active	3,890	Fair
Hagemann (2020)[133]	United Arab Emirates	Uncontrolled, before-after study	Mixed martial arts tournament	Indoor, active	2,182	Fair
Job (2021)[127]	India	Uncontrolled, before-after study	Graduation ceremony	Outdoor, passive	934	Poor
Jokhdar (2020),[128] Ebrahim (2021),[125] Hashim (2021)[126]	Saudi Arabia	Uncontrolled, before-after study	Hajj pilgrimage	Outdoor, active	1,000	Fair
Kim (2020)[129]	South Korea	Uncontrolled, before-after study	Protest rally	Outdoor, active	~8,800	Poor
Moritz (2020)[131]	Germany	Uncontrolled, before-after study	Concert	Indoor, passive	1,212	Poor
Schade (2021) [132, 134]	Germany	Mechanistic study	Concert	Indoor, passive (simulated audience)	N/A	N/A

†Quality can be rated as Good, Fair or Poor in accordance with the National Heart, Lung, and Blood Institute's Study Quality Assessment Tools. 'Passive' – seated event; 'active' – audience is standing or moving.

Public health measures

The range of public health measures implemented in each of the included studies is outlined in Table 4. The most commonly implemented measures were provision of hand sanitiser,[111-114, 125-131, 133] wearing of face masks,[111-114, 125-133] ensuring adequate ventilation,[111-114, 125-132] health screening (that is, temperature, symptom, travel or close contact screening)[111-114, 125-131, 133] and contact tracing.[111-114, 125-131] Pre-event quarantine was implemented in two studies.[125, 126, 128, 133]

The number and intensity of measures implemented varied across studies. Jokhdar et al., Ebrahim et al. and Hashim et al. describe the intense public health measures that were implemented in relation to the Hajj pilgrimage in Saudi Arabia, which occurred between 28 July and 2 August 2020.[125, 126, 128] This event involved PCR testing on three separate occasions (before, during and after the event), health screening and symptom checking (before, during and after the event), pre and post-event quarantine (both quarantine periods lasted 14 days each), significantly reduced numbers and exclusion of vulnerable populations, mandatory face masks, focus on outdoor activities, provision of hand sanitisers, physical distancing, congestion control, cohorting of pilgrims in defined bubbles, and contact tracing throughout. By contrast, Job et al. described a graduation ceremony in India that took place early in the pandemic (14 March 2020) where comparatively few measures were put in place, some of which were not fully implemented.[127] For example, vulnerable populations were advised not to attend, but it was noted that some did. Face masks were only provided to vulnerable people and were not universally worn by attendees. Additionally, some studies (conducted in Germany, the Netherlands and Spain) relaxed certain measures (usually physical distancing) in an attempt to see if other measures (usually pre-event testing, health screening and face masks) could mitigate the transmission risk.[111-114, 130, 131]

Table 4: Overview of public health measures implemented in each included study

Public health measure	Revollo (114)	Fieldlab A (109)	Fieldlab B (108)	Fieldlab C(114)	FieldLab D(112)	Hagemann(133)	Job (111)	Jokhdar,(112) Ebrahim,(107) Hashim(110)	Kim(113)	Moritz(115)	Schade (116)(134)
Pre-event testing	✓	✓	✓	✓	✓	✓	-	✓	-	✓	**NA**
Pre-event quarantine	-	-	-	-	-	✓	-	✓	-	-	**NA**
Health screening	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	**NA**
Face masks	✓	✓	✓	P	P	✓	✓ †	✓	✓	✓	✓
Ventilation	✓	✓	O	✓	O	-	✓	O	O	✓	✓
Excluded vulnerable populations	✓	✓	✓	✓	✓	-	✓ ‡	✓	-	✓	**NA**
Hand sanitiser	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	**NA**
Reduced numbers	✓	✓	✓	✓	✓	✓	-	✓	-	✓	**NA**
Physical distancing	-	-	-	-	-	✓	✓	✓	✓	Va	**NA**
Congestion control	✓	✓	✓	✓	✓	✓	✓	✓	-	Va	**NA**
Cohorting	-	✓	✓	✓	-	✓	-	✓	-	Va	**NA**
Contact tracing	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	**NA**
Post-event testing	✓	✓	✓	✓	✓	-	-	✓	✓	-	**NA**
Restrict movements/quarantine post event	-	✓	✓	✓	✓	-	-	✓	-	-	**NA**

†Provided to vulnerable people only. ‡Advised not to attend, but was not enforced. NA = not applicable as mechanistic study without human participants. O = Outdoors; P = poor compliance; Va = Varied; study trialled these measures to different intensities

Study findings

Randomised controlled trials

The only RCT included in this evidence summary is a study by Revollo et al. of an event in Barcelona, Spain on 12 December 2020.[130] This study was conducted when the national 14-day notification rate of newly reported COVID-19 cases in Spain was 219 per 100,000 population. COVID-19 vaccination programmes had not commenced in Spain at this time. The aim of this RCT was to assess the effectiveness of a range of public health measures at preventing SARS-CoV-2 transmission at an indoor live concert. The main measures included pre-event rapid antigen testing (and Transcription Mediated Amplification (TMA) testing), mandatory wearing of N95 face masks and 'adequate' air ventilation. Other measures implemented in this study are outlined in Table 4. Eligible participants were adults aged 18 to 59 years, without any relevant comorbidities; those with recent COVID-19 diagnosis or close contact with a positive case were excluded. All study participants with a negative antigen test (tested within nine hours prior to the event) were randomised 1:1 to the experimental arm (who attended the concert) or to the control arm (who did not attend the concert). No physical distancing was required in the concert room, however N95 mask wearing was compulsory throughout. Masks could only be removed for drinking and smoking which occurred in capacity-controlled areas. The event lasted for five hours. All study participants were followed up by PCR, antigen and TMA testing eight days post-event. The authors reported that the air concentration of CO_2 did not exceed the recommended threshold of 800 parts per million (ppm) at any measurement during the event, and the number of complete air changes per hour in the two rooms ranged from 11 to 13. Evidence suggests that recirculation of air may contribute to superspreading events, however this may be mitigated by increasing the number of air changes per hour.[135]

A total of 1,047 participants with a negative pre-event antigen test were randomised, however complete data are only available for 960 of these, and only these data were analysed. At follow-up none of the 465 people in the experimental arm became infected with SARS-CoV-2 (observed incidence 0%; Bayesian estimated incidence 0.14%; 95% credible intervals (CrI): 0% to 0.61%) versus 2 out of 495 controls (0.31%; 95% CrI: 0.04% to 0.73%). The authors concluded that there was no significant difference in incidence between the two arms. The Bayesian estimate for the difference in incidence between the experimental and control groups was reported to be -0.15% (95% CI –0.72 to 0.44). However, this study may not have been sufficiently powered to detect a statistically significant difference given that the planned number of 1,000 participants per arm was not achieved. Furthermore, the antigen tests did not detect any positive cases pre-event. It is not clear therefore

what benefit these provided above the other implemented public health measures unless knowledge of planned pre-event testing acted as a deterrent for prospective attendees who were aware that they had COVID-19 or that they had been recently exposed to SARS-CoV-2. Of note, 93 eligible individuals invited to participate did not attend for pre-event testing; their reason for non-attendance was not documented. There are also some concerns regarding how the analysis was conducted, as intention-to-treat analysis was not undertaken. Of note, a larger, follow-up study involving 5,000 participants was conducted on 27 March 2021, the results of which are pending.

Uncontrolled before-after studies

Nine of the included studies were uncontrolled, before-after studies.[111-114, 125-129, 131, 133]

Four of these nine studies were conducted in the Netherlands as part of a comprehensive national event pilot programme called Fieldlab events (as described earlier).[111-114] None of these studies have been published as peer-reviewed publications, rather all four are in the form of technical reports. The first study (Fieldlab study A) examined a business conference and a theatre performance undertaken in the same indoor venue on different dates (15 February and 20 February 2021, respectively).[111] A total of 1,198 participants were involved in this pilot, 634 of whom attended the business conference and 564 attended the theatre performance. This study was conducted when the national 14-day notification rate of newly reported COVID-19 cases in the Netherlands was 298 and 296 per 100,000 population, for the business conference and theatre performance pilots, respectively. At the time of this study the total number of vaccine doses administered in the Netherlands was 4.6 per 100 people, and 0.56% of the population was fully vaccinated (for both events).

The second study (Fieldlab study B) examined three different football matches in three different stadiums on three different dates (21 February, 28 February and 27 March 2021, respectively).[113] An increasing number of participants attended each match, 988, 1,045 and 5,108 respectively, with a total of 7,141 participants altogether. With the exception of the final Fieldlab B study on 27 March (which used same-day antigen testing), both Fieldlab A and B studies used the same pre-event testing (PCR testing a maximum of 48 hours prior to the event). This study was conducted when the national 14-day notification rate of newly reported COVID-19 cases in the Netherlands was 301, 350 and 566 per 100,000 population, for the first, second and third football matches, respectively. At the time of this study the total number of vaccine doses administered per 100 people in the Netherlands was 6.1,

8.1 and 12.7 and the proportion of the population fully vaccinated was 0.95%, 1.61% and 3.33% for the first, second and third football matches, respectively.

The third study (Fieldlab study C) examined a dance event (rave) and a music concert undertaken in the same indoor venue on different dates (6 March and 7 March 2021, respectively).[114] A total of 3,078 participants were involved in this pilot, 1,589 of whom attended the dance event and 1,489 attended the music concert. This study was conducted when the national 14-day notification rate of newly reported COVID-19 cases in the Netherlands was 375 and 374 per 100,000 population, for the dance event and music concert pilots, respectively. At the time of this study the total number of vaccine doses administered in the Netherlands was 8.1 and 9.8 per 100 people, and 1.61% and 2.1% of the population was fully vaccinated (for the dance event and music concert, respectively).

The fourth study (Fieldlab study D) examined a dance festival and a music festival undertaken in the same outdoor venue on different dates (20 and 21 March 2021, respectively).[112] A total of 3,890 participants were involved in this pilot, 1,927 of whom attended the dance festival and 1,963 attended the music festival. This study was conducted when the national 14-day notification rate of newly reported COVID-19 cases in the Netherlands was 471 and 486 per 100,000 population, for the dance and music festival pilots, respectively. At the time of this study the total number of vaccine doses administered in the Netherlands was 11.5 and 12.7 per 100 people, and 2.6% and 3.3% of the population was fully vaccinated (for the dance and music festivals, respectively).

All four Fieldlab studies involved similar public health measures, and these comprised; reduced capacity, exclusion of vulnerable groups, health screening, congestion control, 'adequate' ventilation, cohorting (that is, 'bubble' formation), face mask use, hand sanitiser, post-event testing (five days after), contact tracing, and avoiding visiting vulnerable groups for 10 days after the event. However, cohorting was not implemented in the festival pilots given the free-flowing nature of these types of events.[112] Additionally, although attendees were asked to wear masks at the indoor concert and rave, as well as at the outdoor festivals, compliance though not quantitatively measured, was noted to be poor and enforcement by officials was not possible.[112, 114]

As a result of a positive pre-event test, 11 of 1,198 (0.91%), 30 of 7,141 (0.42%), 18 of 3,078 (0.58%), and 26 of 3,890 (0.66%) were excluded from attending the event, in Fieldlab A, B, C and D, respectively. Post-event PCR testing on day five identified one positive case (from 482 out of 634 who re-tested, 0.21%) at the business conference. The research team was also alerted to three other positive cases who attended the conference from the national test and trace programme. No

positive cases were found after the theatre performance from the 444 out of 564 who undertook follow-up testing. Across the three football matches, a total of seven positive cases (0.13%) were identified at five day PCR follow-up from the 5,407 out of 7,141 who undertook retesting, with the research team notified of seven additional positive cases from the national test and trace programme. Notably, almost a quarter of those who attended any of these matches did not undertake follow-up testing. While 10 positive cases were identified outside of the studies (in both Fieldlab A and B), the authors state that most of these were infected prior to or after the event based on information from the test and trace programme. However it is unclear where most of these 10 became infected and whether they were infectious during the events.

With regards to the indoor dance event and music concert, a total of 11 positive cases (0.42%) were identified at five day PCR follow-up from the 2,603 out of 3,078 who undertook retesting, with the research team notified of three additional positive cases from the national test and trace programme. About 85% of attendees completed follow-up testing. Based on post-event testing and contact tracing investigations, the authors concluded that 4 of the 14 infections may be related to the events, and that the other infections occurred elsewhere.

In relation to the two outdoor festivals, a total of 24 positive cases (0.77%) were identified at five day PCR follow-up from the 3,106 out of 3,890 who undertook retesting, with the research team notified of two additional positive cases from the national test and trace programme. About 80% of attendees completed follow-up testing. Based on post-event testing and contact tracing investigations, the authors concluded that 16 of the 26 infections may be related to the events, and that the other infections occurred elsewhere.

In total, there were 58 positive cases associated with attendance at one of these nine Fieldlab events although whether or not transmission occurred at these events for many of these cases is uncertain. Assuming that all 15,222 individuals who tested negative pre-event subsequently attended the events, this equates to a post-event positivity rate of 0.38%, with the highest positivity rate observed at the outdoor festivals (0.67%),[112] and the lowest observed at the football matches (0.2%).[113] However, given the loss to follow-up of over 20%, along with the high community incidence of COVID-19 and low vaccination coverage at the time of these studies, it is likely that the number of positive cases identified is an underestimate.

Using the data collected, the Fieldlab researchers developed a mathematical model, and estimated that the number of infections, per 100,000 people, per hour was:

- 0.6-1.2 for the theatre performance

- 0.7-1.2 for the business conference
- 0.6-1.3 for the 1st football match
- 0.8-1.3 for the 2nd football match
- 1.2-1.7 for the 3rd football match (which involved the largest number of participants)
- 1.8-4.3 for the indoor dance event
- 1.5-3.8 for the indoor music concert
- 3.6 for the outdoor dance festival
- 1.6 for the outdoor music festival.

Participants' behaviours during the event were closely monitored using tracking devices and cameras. The majority of participants were observed to have worn their face mask for the entire event in some of the pilots (98.4% at the theatre and 94.5% at the football matches, no information was provided with regards to the business conference). However, compliance was observed to be poor at the indoor dance event and music concert, as well as at both outdoor festivals, with face masks commonly discarded once attendees were at the main stage. For each cohort, the average number of close contacts (within 1.5 metres for more than 15 minutes) per person was also measured and these ranged from three to approximately 70. The lowest average number of close contacts was observed in one of the cohorts at the first football matches, where the seating was arranged in checkerboard formation (that is, every second chair remained free). The highest number of close contacts was observed at the dance festival, where the maximum recorded number of close contacts for any individual was approximately 170.

Post-event surveys (response rate not provided) were undertaken in all four studies to assess participants' perceptions of public health measures, with consistently high positive experiences expressed for pre-event rapid or PCR testing (rated >7.7 out of 10 across all studies). Overall participants expressed a high sense of security (rated >8.8 out of 10 across all studies). However, the experience of wearing face masks for the entirety of the event was generally perceived to be negative, particularly at the festivals and indoor dance event/music concert, where only 3% and 8% rated this as positive/very positive, respectively.

The authors of these Fieldlab studies concluded that all of these types of events, that is indoor events with a passive audience (a business conference or a theatre performance), outdoor events with an active audience (a football match with spectators), indoor events with an active audience (a dance event or concert) and outdoor festivals can occur safely without physical distancing measures, even when the incidence of COVID-19 is high, as long as other public health measures are implemented. Specifically these other public health measures are pre-event rapid

testing, reduced capacity, cohorting, adequate ventilation, face mask use when moving, and active public health communication. However, the authors advise that indoor events with an active audience and outdoor festivals should not take place when the country is at the highest risk level, given the relatively high risk of transmission at these types of events. The national risk level in the Netherlands was rated as 'very serious' at the time of these events. However, it is not clear that these studies demonstrated the safety of these events, given that a number of individuals tested positive after attending, and the level of onward transmission was not measured. Of concern, a significant proportion (over 20%) of participants did not complete follow-up testing, and so the number of positive cases reported in these studies is likely underestimated.

The RESTART-19 study by Moritz et al. (currently published as a preprint) examined the SARS-CoV-2 transmission risk posed by droplets and aerosols during an experimental indoor pop concert held in Berlin, Germany on 22 August 2020.[131] This study was conducted when the national 14-day notification rate of newly reported COVID-19 cases in Germany was 20 per 100,000 population. COVID-19 vaccination programmes had not commenced in Germany at this time. The focus of the study was to observe behaviours during the event, to use this information to inform an epidemiological simulation, and also to examine the study participants' experience of the event. Participants undertook SARS-CoV-2 testing within 48 hours before the event. Testing was based on self-sampling, but the test used was not specified. No post-event SARS-CoV-2 testing was undertaken. A total of 1,212 participants attended the concert. N95 face masks and contact tracing devices were provided to all participants. Three different scenarios involving all study participants were tested in sequence:

- Scenario 1: no control measures; participants entered and exited the arena without any restrictions, no spacing between seats, and there was no physical distancing.
- Scenario 2: moderate restriction; participants were allocated to one of the quadrants within the arena, seating was arranged in checkerboard pattern (that is, every second chair remains free), and social distancing was implemented.
- Scenario 3: most stringent restrictions; there was pairwise seating of participants, social distancing was implemented, and there was an increased number of entrances and exits.

Contact tracing device data showed higher levels of close contacts (<1.5 metres for ≥15 minutes) occurred in scenario 1 compared with scenarios 2 and 3 (average ± standard deviation of 8.9 (±3.5) vs. 4.7 (±1.9) vs. 1.3 (±0.9), respectively). High

numbers of contacts were observed during entry and half time, but few lasted more than 15 minutes. In scenario 1, new contacts accumulated during the whole event, while in scenarios 2 and 3 most contacts occurred when participants were entering the arena without major further increases. Participants completed a survey after the event to assess their experience of the event. Of note, only 58% of respondents stated that they felt safe or rather safe in scenario 1 compared with 93% and 96% in scenarios 2 and 3, respectively. Participants also stated a preference for a simple facemask rather than an N95 mask for future events (90% vs. 78%).

Aerosol distribution within the arena was also simulated using a computational fluid dynamics model. The authors conducted two simulations looking at ventilation systems, and estimated that in the context of suboptimal ventilation, and in scenario 1 as described above (that is, no control measures simulation scenario), a maximum of 108 individuals may be exposed per infectious individual. This decreases to a maximum of 10 exposed individuals per infectious individual if ventilation is optimised through jet nozzles and higher airflows.

An extended susceptible-exposed-infectious-recovered (SEIR) model was developed based on data from the literature for all three scenarios described above, assuming a stable epidemic, no prior immunity, under different scenarios of COVID-19 incidence, number of mass gathering events and mask wearing. The authors estimated a best case scenario, that if 100,000 people attend mass gatherings in a month, and assuming good ventilation and mask wearing, and a seven-day incidence of 10 cases per 100,000 population, the following number of infections would be acquired from mass gatherings each month:

- Scenario 1 (no control measures): 1
- Scenario 2 (moderate scenario): 0
- Scenario 3 (most stringent scenario): 0.

Based on these data and assumptions, mass gatherings held under these contexts were estimated to contribute very little to the overall burden of disease (approximately 2% or less). However, assuming a worst case scenario, where 200,000 people attend mass gatherings in a month, and assuming sub-optimal ventilation, no mask wearing and a seven-day incidence of 100 cases per 100,000 population, the number of infections acquired from mass gathering each month are substantially greater:

- Scenario 1 (no control measures): 169
- Scenario 2 (moderate scenario): 73
- Scenario 3 (most stringent scenario): 29.

Mass gatherings held under these contexts were estimated to contribute up to 23% of subsequent COVID-19 cases in the community.

The authors concluded that the expected additional impact of indoor mass gatherings on the burden of infections is low should public health measures, including adequate ventilation, be implemented. However, it is unclear whether these data or assumptions underpinning the model are strong enough to support this conclusion.

Three studies by Jokhdar et al., Ebrahim et al. and Hashim et al. describe the public health measures implemented to support the Hajj pilgrimage in Mecca, Saudi Arabia that occurred between 28 July and 2 August 2020.[125, 126, 128] This study was conducted when the national 14-day notification rate of newly reported COVID-19 cases in Saudi Arabia was 80-95 per 100,000 population. COVID-19 vaccination programmes had not commenced in Saudi Arabia at this time. The Hajj pilgrimage usually attracts over 2.5 million Muslim pilgrims from over 180 countries worldwide, and the COVID-19 pandemic posed a serious public health threat. A risk assessment conducted by the Saudi Arabia Ministry of Health in conjunction with the WHO concluded that foreign pilgrims should be excluded from the 2020 Hajj and that the number of pilgrims should be significantly reduced. These three studies detail the comprehensive package of measures implemented by the Saudi government for the Hajj pilgrimage. A total of 1,000 pilgrims, all residents of Saudi Arabia, partook in the pilgrimage and after the third and final PCR test that occurred directly after the Hajj, no positive cases were detected.

Before the event, all eligible candidates were scheduled for an appropriate medical examination and screening visits, including a PCR test. During the initial pre-travel screening phase, 31 of 788 pilgrim candidates tested positive, and were excluded. Adults older than 65 years (with an advisory for those older than 50 years) and those with specific conditions were not allowed to participate in Hajj. Each pilgrim received clear instructions to quarantine for 14 days, including 10 days at their own home or in a hotel before travel and four days in a facility upon arrival in Mecca. A total of 757 RT-PCR- negative pilgrims along with another 379 pilgrims who had recovered from COVID-19 entered home quarantine prior to travel, with 132 subsequently dropping out. Adherence to the quarantine measures was monitored and enforced using an electronic application, called Tetamman. The application monitored daily symptoms and provided educational information for users. If someone breached their quarantine, the regional Health Command and Control Centre was alerted via an electronic bracelet. The recommended preventive measures were explicitly stated to all pilgrims for example:

- maintaining a physical distance of approximately 1.5 meters from others

- wearing face masks
- practicing safe hand hygiene
- disclosing symptoms or contact with a confirmed COVID-19 case in a timely manner.

Each pilgrim completed and signed a written consent document which detailed their comprehension and willingness to comply with all preventive measures before, during, and after Hajj. They also underwent an assessment of their living conditions to determine its suitability for home quarantine; if deemed unsuitable, they were quarantined in designated hotels.

After 10 days of quarantine, all eligible candidates travelled to Mecca under strict transit measures. They were received at another designated facility for the final four days of quarantine and underwent repeat PCR testing. Four additional positive cases were identified out of 1,004 pilgrims, and these were excluded from Hajj and transferred to quarantine facilities. The remaining 1,000 pilgrims were assigned to groups or "bubbles" of 20 pilgrims, with designated tracks by number and colour. A group of 50 trained health officers accompanied the pilgrims during each step of the Hajj rituals to provide support (for example, measuring temperatures frequently, checking symptoms, and responding to all medical complaints) and ensure full adherence to preventive measures. Measures included the provision of pre-packaged meals (no buffets), no sharing of utensils or personal instruments, no physical touching of the Holy Kaaba and other high-touch surfaces, provision of sterile pebbles for each pilgrim for the throwing ritual, and provision of prayer mats for individual use.

After all Hajj rituals were completed, all pilgrims continued using the Tetamman application and electronic tracing bracelets to enhance passive surveillance of symptoms (which were self-reported) and ensure monitoring of adherence to post-Hajj quarantine measures. In addition to the tracking application, pilgrims received daily phone calls enquiring about their symptoms and monitoring their health status. A third PCR test occurred post Hajj, through which no positive cases were detected. Then, home quarantine occurred for two further weeks. Given the comprehensive measures that were implemented in this study along with the repeated testing, the findings of this study seem credible and support the intensive nature of public health intervention to limit the spread of SARS-CoV-2 at mass gatherings. However, given the restrictive nature of the pilgrimage, it is unclear whether and how the findings can be generalisable to a normal Hajj pilgrimage, which may have a very different population, or to other settings.

Hagemann et al. described the organisation of an international mixed martial arts event that took place in Abu Dhabi, UAE, between 1 and 31 July 2020.[133] While

spectators were prohibited from attending, the sporting event involved a total of 2,182 individuals, including 1,650 local staff and 532 international delegates, of whom 102 were fighters. This study was conducted when the national 14-day notification rate of newly reported COVID-19 cases in the UAE was 40-72 per 100,000 population. COVID-19 vaccination programmes had not commenced in the UAE at this time.

According to the WHO Mass Gatherings Risk Assessment COVID-19 Tool, the risk of hosting the event during that time was considered 'Very High Risk' and so strict public health measures were implemented. A 'safe zone' was established in a region in Abu Dhabi, cordoned off from the rest of the city for two weeks before the event. All 1,650 local staff quarantined for two weeks and had at least two PCR tests prior to the event. All international delegates had to check into an airport hotel 24 hours prior to flying to Abu Dhabi and receive a negative PCR test result prior to boarding the flight. One fighter who tested positive at this stage was excluded from the tournament. A further 48 hours of quarantine and two negative PCR test results were required upon arrival in the 'safe zone' in Abu Dhabi. All cabin crew, airport staff and bus drivers were quarantined for two weeks with regular PCR testing prior to travel. In addition all individuals were PCR tested twice weekly and 24 hours before any event. Strict adherence to social distancing, hand hygiene and PPE usage was required throughout travel and the entire tournament. Individuals were subjected to daily temperature and symptom checks and movement into and out of the zone was restricted. Thermal cameras situated throughout the zone continuously monitored peoples' temperatures. Athletes were generally kept away from others. Fighters requiring medical attention were taken to 'COVID-free' hospitals, full PPE was worn and contact with anyone from outside the 'safety zone' was limited as much as possible.

Throughout the four-week tournament, a total of 18,530 samples were collected by 97 nurses and 18,706 tests were conducted (due to retesting of some borderline results). Of the 18,706 tests, a total of 17 tests were positive (0.09%), however upon resampling or retesting, all 17 were deemed to be false positives. None of these 17 individuals were symptomatic. No testing was conducted on individuals after the tournament ended. The authors of this study concluded that with the right public health measures in place, it is possible to safely host an international mass gathering sporting event in the active phase of a global pandemic.[133]

Kim et al. described two outdoor mass protest rallies involving approximately 8,800 healthcare workers that took place in Seoul, South Korea on 7 and 14 August 2020.[129] This study was conducted when the national 14-day notification rate of newly reported COVID-19 cases in South Korea was 1 per 100,000 population.

COVID-19 vaccination programmes had not commenced in South Korea at this time. Prior to the protest, guidelines were provided by the infection control office of the hospital that was planning to protest, which promoted the use of N95 masks, hand hygiene, minimum one metre distance, no physical contact, no singing or chanting, a restriction on drinking and eating, and self-reporting of symptoms after the rally. During the protest an action plan was developed and an app-based system for self-reporting of COVID-19 symptoms was used. Three to four days after both rallies, the infection control unit of the affected hospital performed universal PCR-based screening of 609 of the 646 (94%) trainee doctors who attended at least one rally. This was achieved by pooling five specimens at a time. All tests were negative. Additionally, between 7 August and 28 August, 11 participants reporting COVID-19 symptoms (including fever, cough, myalgia, sore throat, and headache) were tested; however, all PCR results were negative.

The authors concluded that the study provided important information regarding low transmission rates in mass gatherings at open spaces when appropriate personal protective practices are followed. However, given that only a small proportion of protestors were sampled and tested, and testing was limited to medical trainees, they may not be representative of the entire population of protestors. It is also not known whether the transmission rate was truly low at this event. Furthermore, given the sometimes prolonged incubation period of COVID-19 of up to 14 days,[136] it is not clear whether testing participants three to four days after the event would have detected all potential cases. Hence, the findings from this study have unclear implications.

Job et al. described the public health measures that were implemented at a graduation ceremony in Rishikesh, India on 14 March 2020, prior to widespread availability of SARS-CoV-2 diagnostics.[127] This study was conducted when the national 14-day notification rate of newly reported COVID-19 cases in India was <0.01 per 100,000 population. However, SARS-CoV-2 testing capacity was very limited during the early stages of the pandemic, and so the reported incidence is likely an underestimate of the true burden of infection at the time. COVID-19 vaccination programmes had not commenced in India at this time. A total of 934 people attended the event and had travelled from all over India. Although older adults were advised not to attend, 4.2% of all attendees were over the age of 60 years. The organisers developed a prevention protocol in advance of the event and conducted a structured risk assessment. The protocol included health screening in advance and on entry, collecting details for contact tracing, hosting the event outside, mandatory hand sanitiser, masks for vulnerable populations and repeated announcements reinforcing key public health measures (such as physical distancing and cough etiquette). Based on the pre-event health screening, two people were

excluded from attending based on symptoms (non COVID-19) and two due to international travel. After the event, all attendees were asked to contact the organisation's clinical team if any symptoms developed up until 28 days after the event. No attendees self-reported a COVID-19 symptom or diagnosis up until 28 days after the event. The authors concluded that a similar protocol may allow for other mass gatherings to safely occur during the COVID-19 pandemic. However, given the serious methodological issues with this study, such as the lack of diagnostic testing, and reliance on self-reporting of COVID-19 symptoms of diagnosis after the event finished, there is very limited confidence in the findings of this study.

Mechanistic study

One mechanistic study that did not involve human participants was included in this evidence summary. Schade et al. experimentally examined the dispersion of aerosols in four concert halls to evaluate the risk of SARS-CoV-2 spreading via aerosols, with and without a face mask, in this setting.[132, 134] A dummy was used that emits simulated human breath containing aerosols (mean diameter of 0.3mm) and CO_2, with a horizontal exhalation velocity of v_H = 2.4 m/s, measured 10 cm in front of the mouth. Aerosol and CO_2 concentration profiles were mapped using sensors placed around the dummy. No substantial concentration of aerosols and CO_2 was found at adjacent seats, provided that there were floor displacement outlets under each seat enabling a minimum local fresh air vertical velocity of v_V = 0.05 m/s, that the air change rate per hour was more than 3, and that the dummy wore a surgical face mask. The data showed that both the aerosol and CO_2 concentrations were diluted down rapidly with increasing distance from the emitter. However, without a face mask, significant concentrations of aerosols and CO_2 were measured at greater distances away from the emitting dummy (that is, two seats to the left or right and the row directly in front of these two seats). At one of the measurement points, slightly higher values than anticipated were obtained, due to the presence of a temporarily fluctuating air flow with a horizontal velocity of V_H = 0.01 m/s, thus indicating the importance of even slight air flow changes on aerosol dispersion. The authors concluded that both vertical fresh air flow ventilation and face mask usage, are important for protecting the audience from viral aerosol dispersion in a concert hall environment. The authors also concluded that knowledge of aerosol dispersion in real-world environments is important for the safe reopening of concert halls. Given that this study did not involve any human participants, did not involve aerosolised SARS-CoV-2 and was small in nature, the application of these findings to real world settings is unclear. However, the findings may inform future larger studies which may provide data useful for modelling purposes

Quality appraisal

Quality appraisal was conducted using the National Heart, Lung, and Blood Institute (NHLBI) quality assessment tools. The quality appraisal of the single RCT is described in Table 5, and the quality appraisal of the nine uncontrolled, before-after studies is described in Table 6. Overall, seven of the 10 studies were rated as fair quality,[111-114, 125, 126, 128, 130, 133] and three were rated as poor quality.[127, 129, 131] No study was rated as good quality (the highest quality rating). Across all studies, there were important methodological concerns which in turn affected the internal validity of the studies.

While the selection bias and allocation bias were minimised in the single RCT by Revollo et al. relating to a concert event in Spain, there are concerns regarding the inconsistent testing regime and outcome assessment, insufficient sample size and per-protocol analysis.[130] Hence, the quality of this RCT was rated as fair.

Table 5: Quality appraisal of randomised controlled trial

Quality appraisal criteria	Revollo
1. Was the study described as randomized, a randomized trial, a randomized clinical trial, or an RCT?	✓
2. Was the method of randomisation adequate (i.e., use of randomly generated assignment)?	✓
3. Was the treatment allocation concealed (so that assignments could not be predicted)?	✓
4. Were study participants and providers blinded to treatment group assignment?	**x**
5. Were the people assessing the outcomes blinded to the participants' group assignments?	**NR**
6. Were the groups similar at baseline on important characteristics that could affect outcomes (e.g., demographics, risk factors, co-morbid conditions)?	**NR**
7. Was the overall drop-out rate from the study at endpoint 20% or lower of the number allocated to treatment?	✓
8. Was the differential drop-out rate (between treatment groups) at endpoint 15 percentage points or lower?	✓
9. Was there high adherence to the intervention protocols for each treatment group?	**NR**
10. Were other interventions avoided or similar in the groups (e.g., similar background treatments)?	**x**
11. Were outcomes assessed using valid and reliable measures, implemented consistently across all study participants?	**x**

12. Did the authors report that the sample size was sufficiently large to be able to detect a difference in the main outcome between groups with at least 80% power?	**x**
13. Were outcomes reported or subgroups analyzed prespecified (i.e., identified before analyses were conducted)?	**NA**
14. Were all randomized participants analyzed in the group to which they were originally assigned, i.e., did they use an intention-to-treat analysis?	**x**
Quality Rating†	**Fair**

†Quality can be rated as Good, Fair or Poor. ✓Yes. **x** No. NA = not applicable. NR = none reported.

All nine uncontrolled, before-after studies, were assessed to have clearly stated the study objectives and delivered the public health measures consistently to all participants (Table 6). However, there were concerns regarding the representativeness of participants,[125, 126, 128, 129, 133] the sample size,[125, 126, 128, 129, 131] outcome assessment,[127, 129, 131] blinding of outcome assessors,[111-114, 125-131, 133] loss to follow-up[111, 113] and the statistical analysis.[111-114, 125-130, 133]

Table 6: Quality appraisal of uncontrolled, before-after studies

Quality appraisal criteria	Fieldlab A	Fieldlab B	Fieldlab C	Fieldlab D	Hagemann	Job	Jokhdar, Ebrahim, Hashim	Kim	Moritz
1. Was the study question or objective clearly stated?	✓	✓	✓	✓	✓	✓	✓	✓	✓
2. Were eligibility/selection criteria for the study population prespecified and clearly described?	✓	✓	✓	✓	x	✓	✓	✓	✓
3. Were the participants in the study representative of those who would be eligible for the test/service/intervention in the general or clinical population of interest?	✓	✓	✓	✓	x	✓	x	x	✓
4. Were all eligible participants that met the prespecified entry criteria enrolled?	NR	NR	NR	NR	NR	x	✓	x	✓
5. Was the sample size sufficiently large to provide confidence in the findings?	NR	NR	NR	NR	NR	NR	x	x	x
6. Was the test/service/intervention clearly described and delivered consistently across the study population?	✓	✓	✓	✓	✓	✓	✓	✓	✓
7. Were the outcome measures prespecified, clearly defined, valid, reliable, and assessed consistently across all study participants?	✓	✓	✓	✓	✓	x	✓	x	x
8. Were the people assessing the outcomes blinded to the participants' exposures/interventions?	x	x	x	x	x	x	x	x	x
9. Was the loss to follow-up after baseline 20% or less? Were those lost to follow-up accounted for in the analysis?	x	x	✓	✓	NR	NR	✓	NA	NA
10. Did the statistical methods examine changes in outcome measures from before to after the intervention? Were statistical tests done that provided p values for the pre-to-post changes?	x	x	x	x	x	x	x	x	NA
11. Were outcome measures of interest taken multiple times before the intervention and multiple times after the intervention (i.e., did they use an interrupted time-series design)?	NA	NA	NA	NA	NA	NA	NA	NA	NA

12. If the intervention was conducted at a group level (e.g., a whole hospital, a community, etc.) did the statistical analysis take into account the use of individual-level data to determine effects at the group level?	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Quality Rating†	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Poor**	**Fair**	**Poor**	**Poor**

†Quality can be rated as Good, Fair or Poor. ✓Yes. **x** No. NA = not applicable. NR = none reported.

No suitable formal quality appraisal tool exists for mechanistic studies and thus the experimental study by Schade et al. has not been formally appraised within the context of this evidence summary.[132, 134] It was noted that this study provided a reasonable degree of information relating to the methodology employed, including the experimental design, environmental conditions and measurement methods. However, the quality of the methodologies employed were not appraised. Based on the data provided, it was not possible to ascertain if the conditions in this study reflect real-world environments.

One of the 11 studies included in this review is published as a preprint, so it has not yet been formally peer-reviewed, raising additional concerns about overall quality and the potential for results to change prior to formal publication.[131] Additionally, a further four studies are published as technical reports. It is unclear whether these reports were subject to peer review.[111-114] Of note, seven studies were either funded or supported by the events industry, which raises some concerns regarding their impartiality.[111-114, 130, 131, 133]

Discussion

Main findings

This evidence summary collated information regarding public health measures on mass gatherings and pilot events, and synthesised the totality of the evidence on the effectiveness of such measures at reducing the risk of SARS-CoV-2 transmission at mass gatherings. While it is widely acknowledged that mass gatherings are considered high risk activities for superspreading and propagating the COVID-19 pandemic, it is evident that there is a movement across Europe to ease mass gathering restrictions in line with the increasing pace of vaccination and improving epidemiological and healthcare utilisation indicators. Large pilot events are ongoing in this area, notably the Events Research Programme in England and the FieldLab events programme in the Netherlands. Evidence from these large pilot events may help to inform decisions regarding risk mitigation strategies in these settings, and may enable social, cultural and economic activity to resume safely. The use of COVID-19 health certification (that is, proof of full vaccination, immunity and or recent negative test) in enabling mass gatherings appears to be an increasingly common practice across Europe.

The WHO and US CDC strongly advise that a thorough risk assessment should be conducted in advance of any planned mass gathering and that there should be clear action plans for events.[19, 24] The US CDC further advises that the level of risk needs to be carefully considered before organising any event, with promotion of healthy behaviours (for example, mask wearing and physical distancing) and healthy environments (for example, disinfection and ventilation) throughout. Event organisers need to be prepared in case of someone getting sick during and after the event and there should be good communication with contact tracing services.[24]

There is evidence from 11 studies of poor to fair quality, that implementing a range of public health measures can reduce the risk of SARS-CoV-2 transmission at mass gatherings. Across the 11 included studies, the most commonly implemented measures were provision of hand sanitiser,[111-114, 125-131, 133] wearing of face masks,[111-114, 125-133] ensuring adequate ventilation,[111-114, 125-132] health screening (that is, temperature, symptom, travel or close contact screening)[111-114, 125-131, 133] and contact tracing.[111-114, 125-131] All studies adopted a layered mitigation approach involving multiple public health measures, therefore it was not possible to determine the effectiveness of any single measure. Eight of the studies implemented pre-event testing.[111-114, 125, 126, 128, 130, 131, 133] While some of the findings from these studies that trialled pre-event testing are promising, it is important to note that positive cases were detected post-event in four of these studies.[111-114] It is not known if

transmission occurred during the event despite pre-event testing, or if these cases were already infected, but either not yet detectable or missed at the time of testing. It is also not known whether these positive cases seeded further cases in the community as onward transmission was not measured in any included study.

Extremely stringent mitigation measures may substantially reduce the risk of transmission, however, it is unlikely that risk can be eliminated entirely. The only available evidence in this regard relates to the experience of the 2020 Hajj pilgrimage, where very strict public health measures were implemented and enforced.[125, 126, 128] Attendance at the pilgrimage was only permitted for a significantly reduced number of people (0.004% of usual numbers); those at higher risk of complications from COVID-19 were excluded, and pilgrims were required to undergo 14 days of quarantine both before and after the pilgrimage, undertake three PCR tests at various stages, undergo health screening and daily symptom monitoring, as well as strictly adhere to face mask use, hand hygiene, social distancing and cohorting. Thirty-five COVID-19 positive cases were identified at the first and second PCR tests, and were prevented from attending the Hajj. Evidence from this study suggests that the risk of transmission at mass gatherings may be reduced to very low levels, but only after implementation of stringent public health restrictions, which may not be feasible, acceptable or sustainable for most types of mass gatherings.

Ten included studies either focused on settings with specified minimum levels of indoor ventilation or took place outdoors.[111-114, 125-132, 134] The potential effect of ventilation in limiting transmission at indoor mass gatherings was reported in two included studies.[131, 132] Based on a computational fluids dynamic model simulating an indoor concert, Monitz et al. estimated a 10-fold increase in the number of individuals exposed to an infectious person in a sub-optimal ventilation scenario compared with an adequately ventilated scenario.[131] Schade et al. demonstrated, using an aerosol and CO_2 emitting dummy, that the concentrations of aerosols and CO_2 were significantly diluted at adjacent seats when there was adequate ventilation in a concert hall environment.[132]

Behavioural evidence was reported by six included studies and provided additional insights into participants' behaviours and attitudes.[111-114, 130, 131] Very high adherence to face mask requirements was observed in three studies (involving a business conference, a theatre performance and an indoor arena concert),[111, 113, 131] but adherence was observed to be very poor in two other studies (involving an indoor dance event/music concert and outdoor festivals).[112, 114] Participants reported that they mostly felt safe at these events[111-114, 131] except in the scenario with no control measures simulated by Moritz et al. (when only 58% of respondents

stated that they felt safe or rather safe), possibly reflecting peoples' anxieties about overly relaxing measures.[131] Respondents reported high levels of willingness to avail of pre-event testing (PCR or rapid antigen testing) and wear face masks in order to attend a future event. Respondents also stated a preference for simple face masks rather than N95 masks, and for only wearing face masks when moving rather than all the time.[111-114, 131] While acknowledging this preference, the potential for airborne transmission of SARS-CoV-2, particularly in indoor environments must be acknowledged.[137] The mechanistic study by Schade et al. included in this review provided evidence that face masks can reduce the risk of aerosol transmission for those seated in a concert hall.[132, 134]

Contact tracing data were monitored in five studies.[111-114, 131] These data showed higher levels of contacts during entry and exit to the venue as well as during intermissions. Certain cohorts were also found to have a higher number of close contacts, which may have been related to the large size of the cohort or to the nature of the interactions (for example, dining during the intermission).[111, 113] Of note, the highest number of close contacts (<1.5 metres for >15 minutes) was observed at the dance festival conducted as part of the Fieldlab pilot events in the Netherlands, where the average number of close contacts per person was approximately 70 and the maximum recorded number of close contacts for any individual was approximately 170.[112]

No included study measured the impact of these mass gathering events on the wider population or on the healthcare system, and this is an important research gap. However, Moritz et al. modelled the impact of different mass gathering sizes on the overall epidemic in the community, based on different assumptions of baseline incidence, level of ventilation, face mask wearing, and the level of measures implemented at the study event.[131] The authors estimated that mass gatherings would have a limited impact on the wider epidemic if the community incidence is low, there is adequate ventilation, face masks are worn consistently, and measures are implemented at the event. However, the authors estimated that the impact on the wider epidemic may be substantial, contributing possibly up to 23% of cases, should these conditions not be met. Importantly this study suggests that the baseline incidence of COVID-19 in the community at the time of an event is an important consideration. This is contrary to the initial assessments by the authors of the Fieldlab events, who recommend the recommencement of indoor gatherings with a passive audience (for example, business conferences) and outdoor gatherings with an active audience (for example, football matches) with certain public health measures in place (except physical distancing), irrespective of the incidence of COVID-19 in the community.[111, 112] However, the more recently conducted Fieldlab pilot events (that is, the indoor dance event and music concert and the outdoor

festivals) were assessed by the research team to be associated with a higher level of risk than the previously conducted pilots, and so they have advised against organising such events when the national 'risk level' is at its highest.[112, 114]

The ethics of conducting experimental concerts involving young people who may not be vaccinated also needs to be considered. While evidence generated from such pilot events are important for developing a greater understanding of how to mitigate risks at mass gatherings, concerns have been expressed regarding the health consequences posed by attendance at events where measures have been substantially relaxed.[115] There have also been concerns raised for the wider communities, resulting in the cancellation of at least one large event in the Netherlands. It is important that any research in this area is conducted in line with best-practice ethical principles.[138]

Research into the hosting of mass gatherings in the context of the COVID-19 pandemic is ongoing. Findings from large pilot events, such as those conducted in England as part of the Events Research Programme[139] or those conducted as part of the Dutch Fieldlab programme[71] are expected imminently, which may provide additional evidence on how to mitigate transmission risk at mass gatherings. Furthermore, as the epidemiological landscape changes due to the rollout of COVID-19 vaccination programmes globally, it is likely that the risks associated with SARS-CoV-2 infection may change,[14] and this may have positive implications for how mass gatherings are organised. However, the spread of variants of concern (VOCs), in particular the delta variant (B.1.617.2), may hinder plans to relax all restrictions on mass gatherings, given the associated increased transmissibility.[140] Hence, ongoing monitoring of both the epidemiological situation and the research evidence is required to determine the best approach to organising mass gatherings in the future.

Extant literature

With regards to the eight included studies that conducted pre-event testing, five included studies used PCR tests,[111, 112, 114, 125, 126, 128, 133] one used lateral flow antigen tests,[130] and one study changed from PCR to lateral flow antigen tests during the study.[113] It is not clear what type of test was used in the other included study that conducted pre-event testing.[131] There are advantages and disadvantages to both PCR and antigen tests. PCR tests have a higher sensitivity than antigen tests, particularly in asymptomatic populations,[141] and are considered to be the gold standard for diagnosing SARS-CoV-2 infections.[142] However, PCR tests tend to be more expensive, have a longer turnaround time and require trained professionals to process.[142] Antigen tests, though less sensitive than PCR, may better correlate with

peak infectivity. Antigen testing has the added advantage of shorter turnaround times.[143, 144] However, self-testing using antigen tests, while relatively cheap and easily deployed, may not be an appropriate method for preventing infectious individuals from accessing mass gatherings, given the unsupported and unsupervised nature of the process.[145] The requirement for trained professionals to obtain or supervise samples and administer antigen tests at events, presents additional logistical and cost implications. For example, Revollo et al. required 45 nurses and one physician to collect nasopharyngeal swabs from all 1,047 eligible participants before the event.[130] Of note, this study did not detect any positive cases using antigen testing pre-event, raising questions regarding the added benefit of this particular measure, particularly if the incidence of COVID-19 is low. However, knowledge of planned pre-event testing may have acted as a deterrent for prospective attendees who were aware that they had COVID-19 or that they had been recently exposed to SARS-CoV-2.[130] More research is required to determine the optimal pre-event testing strategy, or whether testing is required, to limit SARS-CoV-2 transmission at mass gatherings.

While the infection risk associated with mass gatherings and the types of public health measures that are needed to limit transmission are reasonably well understood, it may be useful to draw on behavioural science when interpreting how best to implement these measures in real-world situations. Drury et al. published a review of the behavioural risks and mitigation strategies for reopening large venues and live events once COVID-19 restrictions have eased, from a behavioural science perspective.[13] The authors highlight that the risk of a mass gathering event may not be attendance at the event itself, but the group activities surrounding the event, for example, travelling to the event and meeting at the pub. The authors state that careful consideration, coordination and resourcing is needed to manage the risks associated with activities before and after the mass gathering event. This could include staggering travel, or making more trains and buses available shortly before and after the events. The authors also highlight the risk of events not taking place, which could lead people to congregate in bars and in private homes (which are inherently high-risk settings for transmission) in order to watch events on television.

Drury et al. discuss collective behaviour and risks at mass gatherings in order to understand and develop mitigation measures.[13] 'Group identities' are described as a particular feature of many gatherings, whereby people identify as part of a team and may be more likely to interact with strangers who support the same team at these events, for example sports fans. People may be more comfortable with being in closer proximity to others within the same 'group'. There are also 'social norms' at these events, so that high-risk group activities such as singing, chanting or dancing may be expected at certain events.

To encourage people to adhere to public health measures (for example, mask wearing, hand hygiene, physical distancing) at mass gatherings, Drury et al. recommend developing a clear communication strategy, based on knowledge of 'group identity' processes and 'social norms'.[13] The aim of such a strategy is to frame these public health behaviours as the new norm, that is internalise these behaviours as an inherent part of what it means to belong to the 'group', while conversely make risky behaviours (such as physical closeness and shouting) at odds with being a good 'group' member. The authors suggest that the communication strategy should be co-developed with members of the 'group' to attain buy-in, stress the messages about risk, involve highly respected members of the 'group', and involve extensive communications channels.

Strengths and limitations

The main strength of this evidence summary is its comprehensiveness, combining information on mass gathering measures, guidance and ongoing pilot events from 22 countries and two public health agencies, with evidence of effectiveness of such measures from 11 studies. This evidence summary therefore provides an up-to-date situational report on the state-of-play of mass gatherings and pilot events in the context of the COVID-19 pandemic.

This evidence summary is undertaken based on information and data available at the time of writing. In particular, the information summarised from public health agencies and governmental departments in RQ1 is correct as of 10 June 2021, but is subject to change. An important limitation with regards to the pilot events identified in the 22 included countries as part of RQ1, is that these were not systematically searched for, and hence these should not be viewed as an exhaustive list. Given that many of these pilot events are not coordinated at a national level, but rather conducted locally, and that this is a quickly evolving area, it is possible that some pilot events are not captured in the current report. However, a pragmatic search was undertaken for each country in an attempt to identify any pilot event reported on the websites of public health agencies and governmental departments or in the media.

A number of other limitations need to be considered when interpreting the findings of this review. Studies involving SARS-CoV-2 outbreaks and the potential effect (or otherwise) of mitigation measures may be subject to publication bias. This is where favourable outcomes of an experiment are more likely to be published in the academic literature, than those with negative findings.[146] It is likely that there are SARS-CoV-2 outbreaks that have occurred at mass gatherings despite implementation of public health measures. Findings from these studies would be

informative in that lessons may be learned with regards to potential failures in the mitigation strategy and how these might be appropriately dealt with going forward.

Important consideration with regards to the included studies is seven of them were funded and or supported by the events industry.[111-114, 130, 131, 133] While partnership with the events industry is important for the implementation of large pilot events, it is important to acknowledge that the objective of these studies may differ from those conducted from a public health perspective. As part of RQ1 several smaller pilot events were identified that focused on the logistical feasibility of conducting pre-event testing rather than measuring any health-related outcomes associated with attending the event.[91, 94] While the logistics of conducting mass gatherings in the context of a global pandemic are important from the event organiser's perspective, the impact of mass gatherings on the spread of SARS-CoV-2 needs to be carefully monitored. While not common in the studies in this review, robust surveillance and contact tracing post-event is required to identify any clusters associated with a mass gathering and to inform policy decisions regarding how to reduce the risk of transmission associated with these events.

Conclusions

Mass gatherings play a crucial role in society, but since the onset of the COVID-19 pandemic, they have generally been restricted or prohibited in order to mitigate or prevent superspreading events. Large SARS-CoV-2 outbreaks associated with mass gathering, have occurred, in both indoor and outdoor settings, with significant public health consequences. While there is a movement to reopen society and allow mass gatherings to occur once again, it is important that a suite of public health measures are implemented to mitigate the associated increased risk of transmission. These public health measures may include pre- and post-event testing, capacity restrictions, excluding vulnerable populations, health screening, cohorting, requirements for adequate ventilation, face masks, hand hygiene, contact tracing and physical distancing. Although there is general consistency with regards to the implementation of most of these public health measures at mass gatherings, there is considerable variability in terms of COVID-19 health certification and pre-event testing.

The risk of SARS-CoV-2 transmission at mass gatherings can be reduced by implementing a range of public health measures; however, it is unlikely that this risk can be eliminated entirely. Therefore, caution is strongly advised when proceeding with the relaxation of mass gathering restrictions with due consideration given to the levels of vaccination coverage, rates of community transmission and the risk posed by circulating variants of concern.

The information summarised from public health agencies and governmental departments in RQ1 is correct as of 10 June 2021, but may be subject to change.

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Appendix 1 Public health measures and guidance relating to mass gatherings

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
International agencies			
WHO[19, 22, 78] **https://www.who.int/publications/i/item/10665-333185** 5 August 2020	**Current restrictions on mass gatherings** N/A **General guidance regarding mass gatherings** The WHO has developed a Risk Assessment Tool and a linked interim guidance document aimed at those planning mass gatherings in the context of COVID-19 ***There are 3 pillars to the WHO Mass Gathering Risk Assessment Tool:*** 1. Risk Evaluation (e.g. community transmission, nature of event, COVID-19 risk profile of attendees) 2. Risk Mitigation (e.g. awareness of latest guidance, availability of masks and hand sanitisers, medical response plan, monitoring epidemiological situation, contact tracing plan, surge capacity) 3. Risk Communication (e.g. clear communication of the rationale behind modifications to the gathering, using proper channels of communication). ***Risk assessment tool:*** ▪ The Risk Assessment Tool contains an in-built algorithm that calculates an overall risk score for the planned mass gathering. The Tool outlines the importance of clearly communicating plans and findings with staff, participants and general public. ▪ This risk assessment should be used in conjunction with the WHO interim guidance document. ▪ To accurately provide answers to the risk evaluation and risk mitigation questions, organisers must be knowledgeable about the	N/A	WHO mass gathering COVID-19 risk assessment tool – Religious events Safe Ramadan practices in the context of COVID-19 WHO Mass gathering COVID-19 risk assessment tool – Sports events

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	current COVID-19 outbreak. The organisers should reference the daily global COVID-19 situation reports provided by WHO as well as national COVID-19 situation reports, if available. ▪ Risk assessments must be conducted with input from local public health authorities. Personnel with expertise in mass gatherings, risk assessment, epidemiology, infectious disease control measures and risk communication must be engaged from the initial stages of planning. ▪ For the overall risk to be determined, factors under consideration include: ○ the current stage of the COVID-19 outbreak and known transmission rates ○ the geographical distribution and number of participants, and their individual risk profile ○ the WHO risk assessment tool ○ the mitigation measures that are currently in place or feasible. ▪ It should also be noted that risk assessment is a cyclical process. Recording and reporting on the findings of the risk assessment; communicating key messages to the public, participants and event staff; and monitoring and reviewing the risk assessment must continuously occur throughout the planning stages of a mass gathering. This tool should be continuously updated to account for changing information. ▪ It is important to remember that while mitigation measures can reduce the risk of COVID-19 infections, they cannot completely eliminate the threat. It is the view of the WHO that all countries with community transmission should seriously consider postponing or reducing mass gatherings that bring people together and have the potential to amplify disease and support physical distancing. Any decisions can be supported through the use of WHO tools, in particular the Risk Assessment for Mass Gatherings during COVID-19. ▪ If movement restrictions and further national measures have been established in a country, the WHO risk assessment tool does not		

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	apply. However, when the process of re-opening/conducting mass gatherings is being considered after movement restrictions have been lifted, it will be critical to ensure any decisions are based on a risk assessment, such as the WHO Mass gatherings COVID-19 risk assessment tool. ▪ Of note, this Risk Assessment Tool, and associated guidance was developed prior to the availability of COVID-19 vaccines. **Specific information on testing and vaccination requirements** ▪ The WHO do not recommend that event organisers provide COVID-19 testing. Instead, they advise that testing should be conducted in accordance with local health providers and national guidance. Anyone unwell or symptomatic should not be allowed to participate in the event. ▪ The WHO recommend to establish close collaboration with local public health authorities well before the event, to facilitate testing for athletes, officials or spectators who meet pre-agreed suspect cases definitions. Consideration should be given to the host country's health service capacity to manage any COVID-19 activity, and other public health issues happening at the event over and above its own national pandemic response. ▪ Vaccination is not discussed in these policy documents as they were published prior to the availability of COVID-19 vaccines.		
ECDC	No relevant document identified	N/A	None identified
EU/EEA countries			
Austria[25, 26, 54, 81, 147-151] https://www.bmkoes.gv.at/Themen/Corona	**Current restrictions on mass gatherings** Max 50 people: This applies to both indoor and outdoor events. Meetings of up to 16 people are permitted without notification or approval.	**Plans for further easing of restrictions on mass gatherings** ***Planned from 1 July 2021:*** ▪ no upper limit for events	Corona crisis: Information for musicians, organizers, club

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
/Corona-Kunst-und-Kultur.html 10 June 2021	Meetings of 17 or more people require notifying the local health authority. The serving of beverages and the serving of food are not permitted. This rule applies to weddings, garden parties, and similar events. If there are more than 50 people, a permit must be obtained from the locally responsible district administrative authority and the event organiser must appoint a COVID-19 officer and develop and implement a COVID-19 prevention concept. Additionally for events involving greater than 50 people: ▪ assigned seating is required ▪ maximum limits are 1,500 people indoors and 3,000 outdoors ▪ maximum 75% capacity ▪ events must close at 10pm ▪ serving of beverages and food are not permitted. **General guidance regarding mass gatherings** The minimum distance and the FFP2 obligation must be observed at all events. Minimal physical distance is reduced from 2m to 1m. **Specific information on testing and vaccination requirements** A Green Pass (Recovered, Tested, Vaccinated) is required prior to accessing events with 17 or more people. This involves either a negative test (PCR tests will be valid for three days, healthcare worker administered antigen tests valid for two days, self-tests, which are valid for one day and point-of-entry tests for one-time entry), full vaccination or recovery from COVID-19.	▪ both seating and standing possible ▪ notification requirement for 100 or more guests, authorisation required for 500 or more guests. **Associated triggers to inform easing of restrictions on mass gatherings** The evaluation of the current epidemiological situation at federal, state and district level is carried out on the basis of four indicators: ▪ Transferability (cases): The indicators "7-day number of cases" (new cases that have occurred in the past 7 days), "7-day incidence" (new cases that have occurred over the past 7 days per 100,000 inhabitants), "Number of new clusters within a calendar week"," Number of districts with new cluster cases within a calendar week" and "Number of cluster case-free districts within a calendar week" are intended to help assess the epidemiological development of the SARS-CoV2 spread. ▪ Source search (cluster): The indicator "Cases with a clear source" shows the traceability of the transmission chain as a result of Case & Contact Tracing. ▪ The newly occurring cases are also assessed with regard to their clinical manifestation of the SARS-CoV2 infection (symptomatic/asymptomatic). ▪ Resources (in healthcare): Here indicators are used that show the existing and required supply capacities. They contain the current	operators / support measures and opportunities / useful information Questions and answers on COVID-19 measures in the context of art and culture funding Frequently asked questions and listed support measures for the arts and culture

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
		occupancy in normal and intensive care units as well as the current utilisation of the existing hospital capacities. ▪ Tests: The indicators "tests per 100,000 inhabitants", "number of tests in the past 7 days" and the "positivity rate" (proportion of positive tests in all tests per region) allow statements about the test activity and provide information about the transmission in the respective region.	
Belgium[65, 92, 152, 153] https://www.info-coronavirus.be/nl/protocollen/#evenementen Unclear when last updated.	**Current restrictions on mass gatherings** Indoor events (e.g. cultural performances, shows or sports competitions) up to 200 people or 75% of the room capacity, seated, with face masks and at a safe distance from each other are permitted. Outdoor events up to 400 people, with face masks and at a safe distance from each other are permitted. Parties and receptions up to 50 people indoors are permitted. Ceremonies, weddings and funerals up to 100 people indoors and 200 people outdoors are permitted. Protests and demonstrations up to 100 people, with a pre-arranged route are permitted. **General guidance regarding mass gatherings** *Guidance* General considerations for organisers and visitors covering masks, hand hygiene and physical distancing before, during and after events. A range of online risk assessment tools are approved by the National Security Council for organisers to identify potential COVID safety risks and by local authorities as an advisory model when issuing permits. https://www.covideventriskmodel.be/ *COVID Event Risk Model* Used by organisers to identify potential COVID safety risks and by local authorities as an advisory model when issuing permits.	**Plans for further easing of restrictions on mass gatherings** *Step 2: From 1 July 2021* ▪ Indoor events: up to 2,000 people or 80% of the room capacity, seated, with face masks and at a safe distance from each other ▪ Outdoor events: up to 2,500 people, with face masks and at a safe distance from each other. ▪ Ceremonies, weddings and funerals: up to 200 people indoors or 400 people outdoors. ▪ Parties and receptions: up to 100 people indoors. For the remainder, they must follow the rules for the catering industry. *Step 3: From 30 July 2021* ▪ Indoor events: up to 3,000 people or 100% of the room capacity, with face mask and at a safe distance from each other. ▪ Outdoor events: up to 5,000 people. As of 13 August, outdoor mass events can resume with a max of 75,000 participants. Proof of vaccination or a recent negative PCR test will be	Going out together in complete safety: agreements per sector Sector guide professional arts Event Catering Trade fairs

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	COVID Event Risk Model Protocol Used by organisers to pre-assess fulfilment of required 23 parameters. *COVID Infrastructure Risk Model* Used by permanent operators of sports, cultural and event infrastructure. Partly relies on the same set of parameters as the COVID Event Risk Model, but with additional infrastructure considerations. **Specific information on testing and vaccination requirements** No current requirement for attendees to identify their health status or submit to testing. As of 13 August, outdoor mass events are allowed upon presentation of proof of vaccination or a recent negative PCR test	required of participants. It will also be possible to provide rapid on-site antigen testing. *Step 4: From 1 September 2021* ▪ For indoor and outdoor events, the maximum permitted numbers are to be determined ▪ Mass events (indoor and outdoor) will be allowed upon presentation of proof of vaccination or a recent negative PCR test ▪ Marriages, funerals and worship services: no restrictions ▪ Parties and receptions: without restrictions indoors. **Associated triggers to inform easing of restrictions on mass gatherings** *Triggers for Step 2 (from 1 July 2021):* Step 2 will commence, provided that 6 out of 10 adults have had their first vaccine, the number of hospital admissions show a favourable trend and a target maximum threshold of 500 beds in intensive care occupied by COVID-19 patients has been met. This step will not occur before 1 July 2021. *Triggers for Step 3 (from 30 July 2021):* Step 3 will commence, provided that 7 out of 10 adults have had their first vaccine, the number of hospital admissions show a favourable trend and a target maximum threshold of 500 beds in intensive care occupied by COVID-19 patients has been met. This step will not occur before 30 July 2021.	

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
		Triggers for Step 4 (from 1 September 2021): Step 4 will commence, provided that 7 out of 10 adults have had their first vaccine, the number of hospital admissions show a favourable trend and a target maximum threshold of 500 beds in intensive care occupied by COVID-19 patients has been met. This step will not occur before 1 September 2021.	
Czech Republic[28, 30, 31, 64, 154-160] https://covid.gov.cz/en/situations/free-movement-people/gatherings 8 June 2021	**Current restrictions and general guidance on mass gatherings** The number of persons allowed to gather in public or private is now 10 people. However, with a requirement of proof of COVID-19 health status for entry, this increases to 75 (indoor gatherings) or 150 (outdoor gatherings) persons maximum. Maximum 30 for weddings and funerals. Proof of health status is required for entry to concerts and other musical, theatrical, film and other artistic performances, including circuses and variety shows, sports matches, matches, competitions, congresses, educational events and rehearsals in full-time form, with seating occupied by a maximum of 50% and restricted to 1,000 people indoors and 2,000 people outdoors. Proof of health status is also required for federal, sporting, dance, traditional and similar events and other gatherings, festivities, pilgrimages, parades, tastings and celebrations with a maximum of 200 indoors and 500 outdoors. Choirs can be organised with a maximum of 30 people with physical distancing. Peaceful assembly can occur in groups of up to 20 participants and observe a spacing between groups of participants. **Specific information on testing and vaccination requirements** Various indoor and or collective events require the following:	**Plans for further easing of restrictions on mass gatherings** No further information available at this time. **Associated triggers to inform easing of restrictions on mass gatherings** When 7-day incidence nationally falls below 100 cases per 100,000, restrictions around outdoor theatres and concerts, outdoor dining will be eased. This target has been achieved. When 7-day incidence nationally falls below 50 cases per 100,000, indoor hospitality and gyms and cinemas are expected to reopen. This target has been achieved.	None identified

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	A PCR test (max 7 days before), an antigen test (max 72 hours before), fully vaccinated (or at least 22 days from first dose on a 2 dose schedule) or have had COVID-19 in past 180 days.		
Denmark[32, 33, 83, 161, 162] www.coronasmitte.dk 1 June 2021	**Current restrictions on mass gatherings** No more than 50 people can gather indoors and no more than 100 people can gather simultaneously outdoors at the same location. Events of up to 500 people indoors and outdoors with fixed seating have resumed. Outdoor markets can be held with up to 500 participants and have a closing time in the period between 18.00 and 05.00. Amusement parks, casinos, gaming halls and other indoor facilities such as play and bathing areas can also reopen their premises with area requirements, requirements for corona passes and face masks as well as other infection prevention measures. There are some exceptions to this rule, for example: ▪ The ban on gatherings does not apply to indoor activities for socially vulnerable children and young people up to and including the age of 21, whether they are alone or with their families, when the activities are organised by public authorities, organisations, associations, businesses or cultural institutions. However, activities for which more than 50 people have gathered simultaneously at the same location are banned. ▪ The ban on gatherings does not apply to private homes and adjacent gardens. However, courtyards and the like which are at the disposal of residents from a large number of homes, and gardens adjacent to private homes where events that are open to the public are held, are excluded from this exemption. ▪ The ban on gatherings does not apply to religious services nor to baptism, marriage or similar religious ceremonies performed in the Evangelical Lutheran Church of Denmark and other religious communities at premises usually at their disposal. For such services and ceremonies, a max of 500 people can gather simultaneously, provided that the minimum floor area requirement is observed.	**Plans for further easing of restrictions on mass gatherings** **An expert group made the following recommendations on 23 April 2021** Events with >500 participants require a health plan 2 phases planned. Corona Pass central to all events going forward. **Phase 1:** implementation underway. *Major cultural and sporting events with seated audiences* ▪ Sections of 500 people indoors and outdoors ▪ Fixed seats ▪ Social distance between individuals, and additional space requirements for indoor settings ▪ Focus on ventilation indoors ▪ Masks when not seated *Outdoor festivals* ▪ sections of 200 people ▪ max 2,000 participants ▪ participants in each section can move freely, however with social distance and space requirements ▪ accommodation on campsite not allowed.	Private events, parties and celebrations during the COVID-19 pandemic Larger public gatherings in a time of COVID-19 Guidelines for conferences, meetings, trade fairs and outdoor markets

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	▪ People being present by virtue of an employment relationship are not included in the number of people gathered. People such as coaches, facilitators, trainers, tutors etc. who are present by virtue of an employment relationship under which they receive payment are not included in the max number of people who can gather simultaneously. Moreover, there is an upper limit of 500 people in total who can gather simultaneously for events exempt from the ban on 'small' gatherings. Everybody attending, including people being present by virtue of an employment relationship, are included in the 500 people. ▪ The ban on gatherings does not apply to events, activities etc. at which the audience are mainly seated at assigned seats facing a stage, cinema screen, speaker or the like. This applies only to cultural events etc., including concerts, performances, lectures etc., and to congregational activities held by the Evangelical Lutheran Church of Denmark and other religious communities. ▪ cultural activities, nor religious services, religious ceremonies and congregational activities for residents at nursing homes organised by the local council (if it is a public nursing home) or by the management team (if it is a private nursing home) together with a cultural institution, the Evangelical Lutheran Church of Denmark or another religious community. ▪ amusement rides at amusement parks and travelling fun fairs. ▪ Professional athletes and the facilities used by the athletes before, during and after the performance of the sport are exempt from the ban on 'small' gatherings. Accordingly, up to 500 professional athletes can attend simultaneously. As regards audience, it is no longer possible to organise indoor professional sports events with an audience as the facilities used by professional athletes are not open to the public, including audience. ▪ Professional football matches are allowed if played according to a special scheme under which the audience are placed in sections with no more than 500 people, with a distance of 1 metre between them and separate entrance and exit routes and separate audience service facilities. Face masks are also required except when the audience are	**Phase 2** can occur when all individuals over the age of 50 have received at least one vaccine *Major cultural and sporting events with seated audiences* ▪ sections of 1,000 people indoors and outdoors ▪ fixed seats ▪ social distance between individuals, and additional space requirements for indoor settings ▪ focus on ventilation indoors ▪ masks when not seated ▪ no requirement for being seated. *Indoor standing event* ▪ sections of 300 people ▪ max 3,0000 ▪ can move freely but space requirements ▪ focus on ventilation indoors ▪ masks if required. *Outdoor festivals* ▪ sections of 500-2,000 people ▪ max 5,000-10,000 participants ▪ participants in each section can move freely, however with social distance and space requirements ▪ accommodation on campsite not allowed.	

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	seated, as are COVID passports and the registration of all audience members to facilitate the tracking and tracing of outbreaks. ▪ The ban on gatherings does not apply to political and other opinion-shaping gatherings. Accordingly, political events with political speeches, community singing and concerts with a political or other opinion-shaping message can be held for an unlimited number of people. ▪ The ban only applies if people have gathered simultaneously, that is, if the event is staggered then more than 75 people can attend an outdoor event. However, physical distance must be maintained, and people must not be allowed to cross paths during the event. In any case, no more than 500 people can attend the entire event simultaneously. ▪ It is also possible to organise outdoor events etc. by sectioning off participants into groups of no more than 75 people, including any volunteer coach, instructor etc., in the same outdoor area. In such cases, each group activity must be held as a separate event, and it must be made sure that all groups are effectively separated. Groups can be separated by allocating a separate section to each group or by similar arrangements. The same coach, instructor etc. cannot be the leader of several of the groups present at the same time as, in that case, it will be considered to be one single event falling within the ban on gatherings. **General guidance regarding mass gatherings** *General guidance* ▪ anyone with symptoms of COVID-19 should stay home ▪ it is recommended that events, as far as possible, be held outdoors because it provides the best ability to keep distance and reduces the risk of both contact and droplet infection. ▪ The National Board of Health has published posters with the 6 general tips for prevention of infection spread. It is recommend to hang these up at events and to link them in the invitation.	When everyone over the age of 16 has been offered a vaccine all restrictions could be lifted.	

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	▪ It may also be necessary to pay special attention to who is participating in the event (children, young people, adults, older people and those at increased risk of serious illness). It may be necessary to take special care of persons at increased risk of COVID-19 adverse outcomes, e.g. by marking zones where it is ensured that a distance of at least 2 meters can be maintained, and where extra consideration is given. ▪ Ensure that there is access to hand sanitizer. Encourage participants to bring their own hand sanitizer or wet wipes and consider handing out small bottles of rubbing alcohol. When handing out flyers or other material, there should be a special focus on hand hygiene and on maintaining social distance. ▪ Make sure that equipment shared between several users, e.g. megaphones and microphones, are cleaned between users. If there are water fountains, ensure that glasses or bottles are not shared or reused and that faucets are cleaned frequently. ▪ In general, it is a good idea to keep a distance of 1 m from others to prevent infection. For activities such as singing, loud speech /shouting, movement, etc. there is an increased risk of droplet infection, and therefore the recommendation is that in these situations at least 2m distance be kept. ▪ Ensure there is sufficient space so social distance can be maintained. In areas where congestion can form, e.g. in queues for those lined up toilets, you can make line markings that help the participants keep their distance. ▪ In situations where it is difficult or impossible to comply with distance recommendations or regulate distance to others, e.g. at a joint procession or close assembly, it is important to reduce the number and duration of contacts, especially face-to-face contacts. It is also particularly important to pay extra attention to compliance with the other infection and prevention recommendations, including hand hygiene and cough etiquette. ▪ If people at increased risk want to participate in the event, they can be made aware of the possibility of wearing the National Board of Health		

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	badge that shows others that you want them to keep their distance. Other participants should be encouraged to pay special attention to those wearing this badge. ▪ In situations where frequent or prolonged face-to-face contact within 1m cannot be avoided, the use of physical barriers such as face masks or face visor provide extra protection. **Specific information on testing and vaccination requirements** Corona Pass (negative PCR test <72 hour, fully vaccinated or previous infection between 14 and 180 days ago) are required to attend professional football matches. Corona Passes will become important as larger gatherings are permitted.		
Finland[34, 35, 59, 163, 164] https://avi.fi/usein-kysyttya-koronaviruksesta#accordion-FkUhWGKAqmTQ 1 June 2021	**Current restrictions on mass gatherings** The restrictions in relation to mass gatherings vary across Finland. Restrictions on mass gatherings under each phase are outlined below: **Epidemic at a stable level** ▪ General guidelines on safe distances and good hygiene are in force. ▪ There are no restrictions on the number of participants in public events. Arrangements ensure good hygiene and guidelines for customers. Participants and parties are kept sufficiently far apart. ▪ Participants are kept sufficiently far apart in public and private customer and business premises. **Acceleration phase of the epidemic** ▪ There are no restrictions on the number of participants in public events. Participants and parties must avoid close contact with others when there are more than 10 people indoors and more than 50 people in enclosed outdoors spaces. ▪ Private events are subject to the same recommendation as public events.	**Plans for further easing of restrictions on mass gatherings** *July/August (subject to change)* In July, outdoor gatherings will be allowed without restrictions on the number of people, but restrictions will continue to be in place for indoor gatherings. The restrictions on indoor gatherings may be lifted in August at the earliest. **Triggers to inform easing of restrictions on mass gatherings** Restrictions on mass gatherings will be eased in areas that are at baseline or acceleration phase. The baseline phase corresponds to the situation in Finland in summer 2020. At this phase, the epidemic is at a stable level. In the acceleration phase, the spread of the epidemic is beginning to	More specific guidance in relation to camp activities for children and young people can be found here

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	▪ The use of public and private customer and business premises may be restricted. Participants and parties must avoid close contact with others when there are > 10 people indoors and > 50 people in enclosed outdoors spaces. ▪ There may be restrictions on the number of passengers in public transport. **Community transmission phase of the epidemic** ▪ The number of participants in public events is limited to 10 people indoors and 50 people in enclosed outdoor spaces. Participants and parties must avoid close contact with others. Outdoor events may be organised for > 50 people if those attending can be divided into separate blocks. ▪ Private events are subject to the same recommendation as public events. ▪ Public and private spaces may be temporarily closed altogether. This applies to spaces with high risk of infection, such as gyms, indoor playgrounds, swimming pools and public spaces in shopping centres. ▪ There may be restrictions on the number of passengers in public transport. **General guidance regarding mass gatherings** ▪ Ensure that there are sufficient hand sanitisers and hand washing facilities available. ▪ Take care of the toilet facilities and ensure the availability of soap and hand towels. ▪ Ensure there is adequate space to maintain social distancing and that there are routine cleaning procedures in place. ▪ It is important to communicate that individuals with COVID-19 like symptoms should not attend a public event, public gathering or public space. There should be a system in place where pre-booked tickets can be easily cancelled.	speed up, the regional incidence of cases is higher than at the baseline level and there are several local and regional transmission chains. Additionally, the June easing of restrictions is contingent on most people of working age having received their first vaccine dose. In, August restrictions are eased only if all people of working age have received their first vaccine dose. The Government will reassess the conditions for lifting the restrictions and update the set timetable every two weeks. The impact of the decisions on the COVID-19 epidemic will be monitored and new restrictions can be dismantled every two to three weeks. The government sets a target timetable for the controlled lifting of restrictions, which is completely dependent on: ▪ the development of the epidemic situation ▪ and vaccine coverage. Restrictive measures will be lifted in June if the following targets are met: June: Vaccination coverage of working-age population having received their first dose of the vaccine is more than 50%.	

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	▪ It is important for all participants to engage in good hygiene practices and ensure that other public health measures are maintained to prevent the spread of asymptomatic transmission. ▪ Event organisers should recommend the use of masks. ▪ The importance of good cough and hand washing etiquette should be well communicated. ▪ In situations where queues may arise, people should be reminded and assisted in maintaining social distance. **Specific information on testing and vaccination requirements** No testing or vaccination requirements at present.		
France[36, 74, 93, 165] https://www.gouvernement.fr/info-coronavirus/questions-reponses 9 June 2021	**Current restrictions on mass gatherings** ▪ Museums, monuments, cinemas, theatres and performance halls with a seated audience (up to 65% capacity) can reopen, on condition that they respect the gauges and protocols adapted to each place and activity. ▪ Outdoor amateur competitions (surfing, cycling, trail running, motorsport, etc.) are authorised if the activity does not involve contact, and up to a limit of 50 participants. ▪ Up to 6,000 people and 65% of official capacity in places of culture and sports establishments, indoors and outdoors (over 1,000 attendees are subject to the health pass) ▪ The reopening of exhibitions and fairs, subject to compliance with gauges and protocols adapted to each place and activity, with a max capacity of 6,000 people (over 1,000 attendees are subject to the health pass). **General guidance regarding mass gatherings** *General guidance* ▪ maintain social distancing ▪ spectators must be seated.	**Plans for further easing of restrictions on mass gatherings** On February 18, the Minister of Culture presented festival organizers with a framework for holding their events this summer. This framework provides for authorising events with a maximum audience of 5,000 spectators on the same site and for the same event. Arrangements for welcoming the public must be provided for in a seated configuration and while respecting physical distancing. This general framework should be specified in the form of specific health protocols. Regular progress updates will take place with professionals in order to adapt it to changes in the health situation. *From June 30* Possibility of participating in events bringing together more than 1,000 people outdoors and	None identified

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	Specific information on testing and vaccination requirements *Health pass* The health pass will verify a person's vaccination status, negative test (antigen or PCR) result or certificate of recovery, allowing them, for example, access to a gathering or event of more than 1,000 people, when these events are permitted. The health pass will centralise several documents relating to COVID-19: negative test results sheets, the certificate of recovery from COVID-19 or the vaccination certificate. The health pass can be used in digital format via the TousAntiCovid Carnet application. This tool allows you to store the various certificates of a person, but also those of their children or people for whom they are responsible. It will also be possible to use the health pass in paper format by presenting the various documents requested directly. The health pass will not be compulsory to access places of everyday life such as restaurants, theatres and cinemas, or to visit friends. On the other hand, it will be compulsory in places or events bringing together more than 1,000 people, such as stadiums, festivals, leisure parks, concerts, fairs, exhibitions or exhibitions. The health pass is currently used to access gatherings or events with over 1,000 attendees, as of June 9.	indoors (subject to health pass). No restrictions with a health pass. **Triggers to inform easing of restrictions on mass gatherings** The reopening of mass gatherings is subject to compliance with gauges and protocols. Also the health pass, for example, will help individuals grant access to a gathering or event of more than 1,000 people from 9 June. 'Emergency health brakes' may apply in a cities or regions according to 3 criteria: ▪ an incidence rate greater than 400 infections per 100,000 inhabitants ▪ a very sudden increase in this incidence rate ▪ a threat of saturation of resuscitation services. If necessary, the Government, in consultation with the regions and local communities, will block the planned reopening.	
Germany[37, 66, 120, 166-169] https://www.bundesregierung.de/breg-de/themen/coronavirus/corona-diese-regeln-und-einschraenkung-gelten-1734724	**Current restrictions on mass gatherings** Generally mass gatherings are prohibited in line with emergency break, restrictions vary by state. For example, Munich is hosting three group games and one quarter final of the delayed European Football Championship (EURO 2020), with a maximum attendance of 22% (approx. 14,500) of the total 66,000 stadium capacity permitted. **General guidance regarding mass gatherings** 'Emergency brake' legislation was implemented across Germany on 21 April which brought in strict measures. If, for 3 consecutive days, the	**Plans for further easing of restrictions on mass gatherings** Decision to ease measures is made by each State. However, the Federal Government has outlined a 5 step opening plan which includes mass gatherings from Step 4: **Opening step 4 - outdoor catering, theatre, sports**	

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10 June 2021	number of new infections in one county or a city exceeds 100 per 100,000 residents in the last 7 days (incidence rate over 100), stricter rules apply automatically. This includes a ban on all gatherings except one household meeting with one more person. All cultural and leisure facilities remain closed. If the incidence rate is below 100, the measures adopted by each Federal state applies and this includes the permission or otherwise of mass gatherings. Religious services in churches, mosques and synagogues continue to be allowed subject to maintaining a minimal physical distance, wearing a medical (surgical), and no singing by the congregation. The 'emergency brake' legislation will expire on 30 June 2021, at the latest. **Specific information on testing and vaccination requirements** Visitors to theatres, concerts, opera houses and cinemas may be asked to demonstrate proof of negative test, as part of Step 4 of reopening.	With a stable or falling 7-day incidence of less than 100 new infections / 100,000 inhabitants, theatres, concert and opera houses and cinemas will be opened to visitors with a daily negative quick test or self-test With a stable 7-day incidence of less than 50 new infections / 100,000 inhabitants, theatres, concert and opera houses and cinemas can open without restrictions. **Opening Step 5 - Leisure Events, Retail, Sports** With a stable 7-day incidence of less than 50 new infections / 100,000 inhabitants, leisure events with up to 50 participants outdoors can resume. **Associated triggers to inform easing of restrictions on mass gatherings** Reopening of all economic and social activity will be decided by each Federal State, and will vary depending on the incidence rate.	
Iceland[38, 80] https://www.covid.is/categories/effective-restrictions-on-gatherings	**Current restrictions on mass gatherings** Regulation on restrictions on gatherings due the pandemic shall apply as of 26 May and remain in force up to and including 16 June 2021. ▪ The maximum number of people allowed in the same location is 150 persons, with certain restrictions outlined below, both in public and private locations.	**Plans for further easing of restrictions on mass gatherings** ***There are 4 main steps for easing restrictions, with the final step due to commence in the second half of June 2021:***	None identified

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26 May 2021	**General guidance regarding mass gatherings** *Events with seated guests:* Up to 300 persons may be present during religious and life ceremonies; stage, cultural and sports events; conferences; lectures; and comparable events provided that the following conditions are met. ▪ Guests may not sit across from each other unless 2m separate them. ▪ Permitted proximity conditions between unrelated parties are, at present, 1m in seats. ▪ The participation of all guests must be registered to numbered seats and must state their name, ID No. and telephone number. The information is to be preserved for two weeks. ▪ Everyone must use a face mask and it ensured that the distance between unrelated parties is more than 1m. ▪ Intermissions and refreshments during shows are permitted. ▪ Mixing between sections is to be prevented. This includes both before and after the event. ▪ If it is not possible to fulfil the above conditions, the rules on a 150-person maximum shall apply for the event in question. Performing arts, cinema theatres and other cultural events: ▪ May have up to 150 persons on stage, i.e. during rehearsals and shows. ▪ Up to 300 seated guests may be accommodated. ▪ Such guests must wear face masks. ▪ Seats are to be numbered and labelled with the name of the guest. ▪ Selling or offering food and drink during intermissions is not permitted. ▪ Children born in 2015 and later are included in this number. At the ceremonies of religious and life events, up to 300 persons may attend. General restrictions apply to funeral receptions, confirmations and comparable events, i.e. 150 persons in the same area.	**4. Second half of June:** All restrictions lifted domestically. It is expected that all domestic restrictions can be lifted in the second half of June. **Associated triggers to inform easing of restrictions on mass gatherings** *Second half of June* At that time, it is estimated that about 75% of the population will have at least one vaccine dose.	

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	Nightclubs and bars ▪ may be open until 23:00 all days of the week with a maximum of 150 guests in each area. ▪ Alcoholic beverages are to be served to seated guests. ▪ All guests must be registered by name, ID No. and telephone number. ▪ All guests must have left the location at 24:00. Sport competitions for children and for adults are permitted and up to 300 seated guests may be accommodated. Such guests must wear face masks. Seats are to be numbered and registered with the name, ID No. and telephone number of the guest. **Specific information on testing and vaccination requirements** No testing or vaccination requirements at present.		
Ireland[39, 86, 170-172] https://www.gov.ie/en/campaigns/c36c85-covid-19-coronavirus/ 8 June 2021	**Current restrictions on mass gatherings** The numbers permitted at organised outdoor events has increased to a maximum of 100 for the majority of venues, with a maximum of 200 for outdoor venues with a minimum accredited capacity of 5,000. If you are an unvaccinated household you can have visitors from 1 other unvaccinated household inside your home. Fully vaccinated people can meet indoors in private homes if there are no more than 3 households there. This can include unvaccinated people from 1 household if they are not at risk of severe illness. Galleries, museums, libraries and other cultural attractions are open. Outdoor facilities such as golf courses, tennis courts, zoos and heritage sites have reopened. **General guidance regarding mass gatherings**	**Plans for further easing of restrictions on mass gatherings** In order to prepare for the easing of restrictions, it is intended that a selected small number of sport and cultural pilot live events will take place in June. The purpose of these pilots is to assess logistical arrangements to implement necessary protective measures. This will inform guidance for venues due to reopen in July or with growing numbers in August. See a list of pilot events here. **From 5 July 2021 (subject to the public health situation at the time)** ▪ You can have visitors from up to 3 other households inside your home. ▪ 50 people can attend a wedding celebration or reception.	GUIDELINES FOR RE-OPENING Business Conference and Business Event Venues Overview Guidelines to Re-opening Guidelines for re-opening business conference and event venues

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	Fáilte Ireland has consulted the industry to develop a set of detailed and practical guidelines to prepare business conference and event venues to operate safely. All of the principles in these guidelines are underpinned by advice made available from the HSA, HSE, FSAI, WHO and other relevant bodies. Consideration should be given to the following before reopening events: Physical distancing, cleaning products and protocols, locations for distribution of PPE, arrival and public areas etc. Delegates should be screened for COVID-19 symptoms and risk factors before they enter the venue. They should declare if they have had any symptoms of COVID-19 in the past 14 days. **Specific information on testing and vaccination requirements** No testing or vaccination requirements at present.	▪ First communions, confirmations and baptisms may take place. Related family gatherings should strictly adhere to prevailing public health advice on household mixing, including visitors to your home and indoor and outdoor dining. Any decision to schedule such ceremonies should take account of the disease situation in the local community. ▪ Organised indoor events: Maximum of 50 attendees at the majority of venues (in groups of up to 6). Maximum of 100 can attend events in larger venues with strict public health measures in place (where strict 2m seated social distancing and one-way controls for entry and exit can be implemented (includes business, training, conferences, events in theatres and other Arts events)). ▪ Organised outdoor events: Maximum of 200 attendees for the majority of venues. Maximum of 500 for outdoor venues with a minimum accredited capacity of 5,000. **Under consideration for August** Assuming continued progress, further easing of restrictions will be considered for August: ▪ further increases in the numbers permitted at both indoor and outdoor events. ▪ maximum attendance at wedding receptions and celebrations to increase to 100. **Associated triggers to inform easing of restrictions on mass gatherings** The situation will be subject to ongoing review taking account of the evolving epidemiological	Guidelines for reopening sports grounds

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		situation and available evidence in relation to vaccine deployment, uptake and effectiveness. Decisions in relation to mass gatherings will also be informed by the results from pilot studies.	
Italy[40, 173, 174] https://www.governo.it/it/articolo/domande-frequenti-sulle-misure-adottate-dal-governo/15638#zone 18 May 2021	**Current restrictions on mass gatherings** Mass gathering guidance varies by zone colour (currently all regions are in the Yellow or White Zone) **General guidance regarding mass gatherings** ▪ In Yellow Zones, it is possible to hold shows open to the public in theatrical halls, concert halls, cinemas, live-clubs (live music venues, in which the activity of dance) and in other rooms or spaces, indoors and outdoors. ○ Shows in the presence of the public must take place exclusively with pre-assigned seats and on condition that the respect of the interpersonal distance of at least 1 m is ensured both for spectators who are not habitually cohabiting, and for the staff. ○ The permitted capacity cannot exceed 50% of the maximum authorised and the maximum number of spectators cannot in any case exceed 1,000 for outdoor shows and 500 for indoor shows, for each single room. ○ The activities must be carried out in compliance with the guidelines adopted by the regions or by the Conference of Regions and autonomous provinces or, failing that, in compliance with the national ones. ○ In relation to the progress of the epidemiological situation and the characteristics of the sites and outdoor events, a different maximum number of spectators can be established, in compliance with the principles established by the Technical-Scientific Committee, with suitable guidelines to prevent or reduce the risk of contagion adopted by the Conference of Regions and Autonomous Provinces.	**Plans for further easing of restrictions on mass gatherings** In Yellow and White Zones, from 15 June 2021, trade fairs will be permitted in compliance with specific protocols and guidelines of the sector. ▪ Guidelines may provide, with reference to particular events, that access is restricted only to subjects in possession of the "COVID-19 green certifications". ▪ It will also be allowed to enter the national territory to participate in fairs, without prejudice to the obligations established in relation to the foreign territory of origin. ▪ In Yellow and White Zones, from 1 July 2021, conferences and congresses, theme parks, will be allowed, in compliance with sector protocols and guidelines. **Associated triggers to inform easing of restrictions on mass gatherings** Transition between zones is based is based on 21 key process and performance indicators (e.g. number of symptomatic cases, ICU admissions, hospital admissions, positivity rate, number of outbreaks, resources).	None identified

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	▪ In Yellow Zones, the presence of the public is allowed at competitive sport events and competitions recognised as being of pre-eminent national interest with a provision of the Italian National Olympic Committee and the Italian Paralympic Committee concerning individual and team sports, organised by the respective national sports federations, associated sports disciplines, sports promotion bodies or international sports organisations. ○ The seats must be pre-assigned and respect for the interpersonal distance of at least 1m must be ensured both for spectators who are not habitually cohabiting, and for the staff. ○ The permitted capacity cannot exceed 25% of the maximum authorised and, in any case, the maximum number of spectators cannot exceed 1,000 for outdoor events and 500 for indoor events. ○ The activities must be carried out in compliance with the guidelines adopted by the Presidency of the Council of Ministers - Department for Sport, after consulting the Italian Sports Medical Federation, on the basis of criteria defined by the Technical Scientific Committee. ○ In relation to the progress of the epidemiological situation and the characteristics of the sites and outdoor events, a different maximum number of spectators can be established, in compliance with the principles established by the Technical Scientific Committee, with suitable guidelines to prevent or reduce the risk of contagion. These guidelines may provide, with reference to particular events, that access is reserved only for subjects in possession of COVID-19 green certifications. ○ For competitions or events or sports of particular importance, which also take place indoors, the Undersecretary with responsibility for Sport can also establish, after consulting the Minister of Health, a different date from that of 1 June 2021.		

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	▪ In White Zones, the same rules apply with regards to mass gatherings. Nightclubs, discos and other dance venues have not yet been given a date for reopening. **Specific information on testing and vaccination requirements** ▪ Particular events may require that access is reserved only for subjects in possession of COVID-19 green certifications. Italian 'green pass' will certify that the holder had either been fully vaccinated, had tested negative for coronavirus within the past 48 hours, or had already contracted and recovered from COVID-19.		
The Netherlands[55, 72, 85, 175-178] https://www.rijksoverheid.nl/onderwerpen/coronavirus-covid-19/algemene-coronaregels/cijfers-en-onderzoeken-over-het-coronavirus/pilot-toegangsbewijzen 28 May 2021	**Current restrictions and general guidance on mass gatherings** Group size outdoors: 4 people The maximum group size will increase to 4 people. This means that you can be outdoors with three other people. Or you can engage in an outdoor activity with 3 other people. But you must still keep 1.5m apart from people outside your household or family. Children under the age of 13 do not count towards the limit of 4 people. Large venues The maximum number of visitors in one space is 50, at a distance of 1.5m apart. Large venues with 1,000 seats or more, however, may admit up to 250 visitors, 1.5m apart. This applies to all large indoor and outdoor venues like indoor arenas, open-air theatres and concert halls. Museums and historic buildings may reopen their indoor spaces. Museums may admit one visitor per 10 square metres. Cinemas including art house cinemas, pop music venues, and theatres can also open their doors again, subject to certain conditions including reservation, health checks and designated seating. Reservations can be made for up to 4 people. This	**Plans for further easing of restrictions on mass gatherings** ***Step 4: Planned from 30 June 2021:*** ▪ Events where guests don't have an assigned seat will be allowed, subject to 1.5m distancing or entry passes, as well as other conditions. ▪ Examples include festivals, concerts and funfairs. Discotheques and nightclubs also fall under this provision. ▪ However, these events must take account of local rules and requirements, such as permits. ▪ The government will decide on 22 June whether to implement step 4 as planned. ***Step 5 (the final step):*** lifting the basic rules and removing the entry pass system, can only be taken when the number of infections and hospital admissions allow this. No date set for this.	None identified

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	limit does not apply to children under 13 and people who are part of the same household. The maximum number of visitors in one space or room is 50, at a distance of 1.5m apart. Large venues with a capacity of 1,000 seats or more, however, may admit up to 250 people, 1.5m apart. This limit does not include staff. People of all ages can now take part in artistic and cultural activities in groups. This means that orchestras can rehearse together, for instance. People do not have to stay 1.5m from one another during rehearsals if this is not possible. However, the number of people who can be in one space cannot exceed 50, excluding teaching staff. No audiences are allowed. The other rules for singing, acting, music and dance continue to apply. Indoor spaces at amusement parks, nature parks and zoos may reopen. These include, for example, reptile houses and covered attractions. Casinos, play and recreational facilities (for example, laser gaming venues), saunas and spas may also reopen. The maximum number of visitors permitted will be either one person per 10 square metres or up to 50 people in one space, 1.5m apart, depending on the nature of the activity, i.e. whether visitors move around or are mainly seated. Reservations, registration and a health check are mandatory. Reservations can be made for up to 4 people. This limit does not apply to children and people who are part of the same household. When indoors visitors must wear a face mask. Adults may once again do sport in groups of up to 50 people without having to keep 1.5m apart, if the sport in question requires people to be closer. The requirement to keep 1.5m apart when doing sport had already been lifted for young people and children. **Specific information on testing and vaccination requirements**	Separately, the pilot events will determine how to safely allow mass gatherings to occur. There is a step-by-step plan, where in 6 phases events will go to 100% capacity, sitting/standing without measures in January 2022. Phase 1 (completed) – Limited capacity events with 1.5m social distancing. All seated. Phase 2 (completed) 50% capacity with 75% seated and 25% standing. Phase 3 – 100% capacity with 50% seated and 50% standing. Phase 4 – 100% capacity with 25% seated and 75% standing. Phase 5 – 100% capacity with all seated and/or standing with public health measures in place. Phase 6 – Fully capacity without any measures in place. **Associated triggers to inform easing of restrictions on mass gatherings** How fast the steps set out in the reopening plan can be taken depends on the number of COVID-19 patients in hospital. The fewer the patients, the more quickly restrictions can be lifted.	

<table>
<tr><th>Country/ organisation

Date of last update</th><th>Current public health measures on mass gatherings</th><th>Planned easing of restrictions for mass gatherings</th><th>Links to sector specific guidance</th></tr>
<tr><td></td><td>The government has decided to introduce coronavirus entry passes as part of step 3 (since 5 June 2021) of the reopening plan. This involves a negative rapid test result within 40 hours prior to the event. Children under the age of 13 do not need to be tested. Establishments serving food and drink, cultural venues and organisers of professional sporting competitions can choose to make use of this system. This can help them ensure that they can safely host more people. Venues such as theatres or restaurants that do not use the system can host a maximum of 50 people. If they opt to use the system, they can host as many people as they can accommodate if people are 1.5m from one another while seated. Events where guests have an assigned seat, whether indoors or outdoors, are also allowed again. However, these events must take account of local rules and requirements, such as permits. There are plans to lift the entry pass requirement under Step 5.

For the pilot test events, a negative rapid test result (Rapid tests validated by the RIVM that are administered by a qualified healthcare professional, unclear if PCR, LAMP or antigen) is required in advance of the event for everyone over 12 years of age. In case of a negative test result, participants receive a unique code which is entered into a Corona Check app. This generates a QR codes which permits the person to attend the event. Staff testing is voluntary but is advised.</td><td></td><td></td></tr>
<tr><td>Norway[41, 67, 75, 179-183]

https://www.fhi.no/en/op/novel-coronavirus-facts-advice/advice-and-information-to-other-sectors-and-occupational-</td><td>Current restrictions on mass gatherings

▪ Private gatherings (in own home)- up to 10 visiting guests indoors (not including household members), plus any number of ‘protected people’ (People who are fully vaccinated, people who have received one dose, and it has been 3 to 15 weeks since they received the dose or people who have had COVID-19 disease in the last six months). Specific public health guidance for protected people can be found here.
▪ Private gatherings in a public place or borrowed premises -Up to 20 people indoors or up to 30 people outdoors.</td><td>Plans for further easing of restrictions on mass gatherings
Norway is currently in Step 2 of its 4 step plan for easing restrictions since 27 May.

Under Step 3 the following restrictions on capacity at public events will apply:<table><tr><td></td><td>Indoors</td><td>Outdoors</td></tr><tr><td>without fixed</td><td>400 people (200 x 2 cohorts)</td><td>Up to 800 people (200 x 4 cohorts)</td></tr></table></td><td>Trainings, organized sports activities and sporting events can be carried out in line with the authorities' recommendations and</td></tr>
</table>

<table>
<tr><th>Country/ organisation

Date of last update</th><th>Current public health measures on mass gatherings</th><th>Planned easing of restrictions for mass gatherings</th><th>Links to sector specific guidance</th></tr>
<tr>
<td>groups/events-and-gatherings/

7 June 2021</td>
<td>

Indoor events without fixed designated seating – up to 50 people, or up to 100 people at an indoor sports event for athletes under the age of 20 who belong to a sports team in the same municipality.
Indoor events with fixed designated seats – Up to 200 people.
Outdoor events without fixed seats – Up to 200 people.
Outdoor events with fixed designated seats – Up to 600 people, in cohorts of up to 200 people with at least 2m distance between each cohort. For events that last for a longer time, cohorts of up to 200 participants can be replaced during the day. The cohorts must be changed in a way that meets infection control requirements and there must be no contact between the cohorts.

General guidance regarding mass gatherings

A risk assessment and checklist is available for culture and sporting events.

Guidance for all events:

Must appoint an organiser (not require to be present) who is responsible for ensuring that the event meets the requirements of the regulation and conduct a pre event risk assessment.
Comply with social distancing guidelines including physical distancing (allow 4 m^2 per person).
Organiser ensures basic hygiene requirements e.g. adequate toilet facilities and the possibility of maintaining hand hygiene.
No activity that requires body contact with others than those who are in the same household, such as dancing, team sports, etc.
Maintain a list of attendance for contact tracing and seat/area location during event if relevant.
Distinction between fixed allotted seats and whether it is indoors and outdoors.
Groups of people can be replaced if they have not had contact with others, to facilitate additional attendants.

</td>
<td>
<table>
<tr><td>assigned seats</td><td></td><td></td></tr>
<tr><td>with fixed assigned seats</td><td>1,000 people (500 x 2 cohorts)</td><td>2,000 people (500 x 4 cohorts)</td></tr>
</table>

If there is an opportunity to use access tests and corona certificates in the reopening of society the following rules will apply:
<table>
<tr><td></td><td>Indoors</td><td>Outdoors</td></tr>
<tr><td>without fixed assigned seats</td><td>50% capacity up to a maximum of 1,000 people (divided into cohorts of up to 500)</td><td>50% capacity up to a maximum of 2,000 people (divided into cohorts of up to 500)</td></tr>
<tr><td>with fixed assigned seats</td><td>50% capacity up to a maximum of 2,500 people divided into cohorts of up to 500 if everyone in the audience sits in fixed assigned seats</td><td>50% capacity up to a maximum of 5,000 people divided into cohorts of up to 500</td></tr>
</table>

Under Step 4 the following rules will apply:
<table>
<tr><td></td><td>Indoors</td><td>Outdoors</td></tr>
<tr><td>without fixed assigned seats</td><td>750 people</td><td>1,500 people</td></tr>
</table>
</td>
<td>sports guidelines</td>
</tr>
</table>

<table>
<tr><th>Country/ organisation

Date of last update</th><th>Current public health measures on mass gatherings</th><th>Planned easing of restrictions for mass gatherings</th><th>Links to sector specific guidance</th></tr>
<tr><td></td><td>

- If your event is an open invitation then the event area must be physically delimited (within a fenced area, an area surrounded by barricades etc.).
- Table service for alcohol only, and only alongside food purchases.
- Alcohol cannot be served after 12pm.
- Maintain good ventilation of venue.
- Avoid congestion.
- It is recommended to arrange for a distance of 2 m between people who will sing together indoors in areas with increased transmission
- The organiser shall implement measures to meet the requirements for distance between participants who are not in the same household at events where the audience sits on fixed, assigned seats. If necessary, security shall be used to ensure this.

Specific information on testing and vaccination requirements

As part of Steps 3 and 4 of the reopening plan (no date provided), the use of access tests and corona certificates (based on vaccination and PCR/ antigen testing in the last week) may be used to allow greater numbers to attend events.

</td><td>

<table>
<tr><td>with fixed assigned seats</td><td>2,500 people</td><td>5,000 people
75% capacity up to a maximum of 10,000 people</td></tr>
</table>

If there is an opportunity to use access tests and corona certificates in the reopening of society the following rules will apply

<table>
<tr><td></td><td>Indoors</td><td>Outdoors</td></tr>
<tr><td>without fixed assigned seats</td><td>75% capacity up to a maximum of 2,500 people</td><td>75% capacity up to a maximum of 5,000 people</td></tr>
<tr><td>with fixed assigned seats</td><td>75% capacity up to a maximum of 5,000 people</td><td>75% capacity up to a maximum of 10,000 people</td></tr>
</table>

Associated triggers to inform easing of restrictions on mass gatherings

An overall assessment will be conducted based on three checkpoints which determine when to proceed to step 3 of the reopening plan:
1. The rate of infection and the disease burden.
2. The capacity of the health services.
3. The status of the vaccination programme.
Data and not dates will determine whether to progress from one step to the next. In general, three weeks will need to elapse between each step.

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</table>

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
Portugal[61, 62, 73, 87, 184] https://www.visitportugal.com/en/content/covid-19-measures-implemented-portugal 31 May 2021	**Current restrictions on mass gatherings** In most of the country large outdoor and indoor events are allowed with reduced occupancy since 1 May, however information is limited in this regard. Funfairs, private amusements parks and water parks are open. **General guidance regarding mass gatherings** None identified **Specific information on testing and vaccination requirements** As of 19 May a negative test is required before accessing a professional football match (where these matches are permitted).	**Plans for further easing of restrictions on mass gatherings** **From 14 June** ▪ Concert halls can open with a 50% capacity ▪ Outdoor concerts can take place with seating capacity to be defined by the health authorities. Stricter rules will apply in municipalities that in two consecutive assessments record an incidence rate greater than: ▪ 120 cases per 100,000 inhabitants in the last 14 days ▪ 240 cases per 100,000 inhabitants in the last 14 days. **Associated triggers to inform easing of restrictions on mass gatherings** There is a weekly evaluation of the epidemiological situation to determine whether further easing (or extension of measures) can occur.	None identified
Spain[21, 24, 42, 53, 88, 185-190] https://www.mscbs.gob.es/en/profesionales/saludPublica/ccayes/alertasActual/nCov/documentos.htm 12 May 2021	**Current restrictions on mass gatherings** All regions in Spain are currently between Alert levels 1-3. Under level 1 of the government's de-escalation plan (areas with a stable seven-day incidence of less than 50 new infections per 100,000) can have a max capacity of 30% or 5,000 spectators at a football match. Members of the public attending these games will need to maintain a distance of 1.5m with other people at all times. Also, entry to and exit from the stadium will be staggered and in different sections of the venue. Those attending will not be allowed to eat, smoke and must wear a FFP2 mask, without exhalation valve. Their temperature will be taken on entry. Other restrictions on mass gatherings under each Alert level is presented in a table below.	**Plans for further easing of restrictions on mass gatherings** 18,000 fans will be allowed to attend the EURO 2020 football game held in Estadio La Cartuja, Seville. Spain's national government are also currently making plans to hold other events with up to 10,000 attendees. Easing of measures will be in accordance with the traffic light system.	Football league spectators

<table>
<tr><th>Country/ organisation

Date of last update</th><th>Current public health measures on mass gatherings</th><th>Planned easing of restrictions for mass gatherings</th><th>Links to sector specific guidance</th></tr>
<tr><td></td><td>

Restrictions on mass gatherings under each Alert level (traffic light system)

<table>
<tr><th>Type of mass gathering</th><th>Alert level 0</th><th>Alert Level 1</th><th>Alert Level 2</th><th>Alert Level 3</th><th>Alert Level 4</th></tr>
<tr><td>Congresses, meetings, meetings of business, conferences, seminars and other professional events</td><td>NR</td><td>75% capacity</td><td>50% capacity</td><td>-</td><td>-</td></tr>
<tr><td>Cinemas, theatres, auditoriums, circuses of tent and similar spaces, as well as premises and establishments for cultural events and show</td><td>NR</td><td>75% capacity</td><td>75% capacity</td><td>50% capa city</td><td>-</td></tr>
<tr><td>Nightlife venues and discos</td><td>*50% capacity</td><td>50% capacity</td><td>33% capacity (2am closure)</td><td>-</td><td>-</td></tr>
<tr><td>Open air events</td><td>*Max 10,000</td><td>Max 5,000</td><td>Max 2,500</td><td>-</td><td>-</td></tr>
</table>

*An additional level referred to as 'new normality' or 'Alert level 0' has been added to the alert level framework (not currently in effect).

General guidance regarding mass gatherings

The Spanish Ministry of Health have developed guidance for mass events and activities in the context of COVID-19. This guidance is broadly based on CDC and WHO guidance.

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Associated triggers to inform easing of restrictions on mass gatherings

Based on "Coordinated response actions to control the transmission of COVID-19 framework." Region must be in Alert 1 level (low risk level) in order to avail of stadium attendance. This involves 14 day incidence of less than 50 per 100,000 and 7 day incidence of less than 25 per 100,000. Additionally, ICU occupancy with COVID-19 cases should be <10% and occupancy of hospitalisations with COVID-19 should be <5%.

The new traffic light rules will be applied until 70% of the population, and all over-50s are vaccinated against Covid-19.

</td><td></td></tr>
</table>

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	The guidance provides a framework for assessing the risk of SARS-COV-2 transmission associated with mass events or activities. For the risk assessment of a planned event/activity, the following should be considered: ▪ Epidemiological situation (e.g. incidence of COVID-19). ▪ Event characteristics (e.g. number of attendees, place of origin, health conditions, nature of the venue, expected interactions, and duration of event). ▪ Ability to implement IPC measures (e.g. cleaning, contact details, ventilation, isolation protocols etc.) before, during and after the event. A global risk assessment should then be made based on the risk due to the event characteristics and the risk mitigation capacity. Any event that has a residual high or very high risk should consider cancellation or postponement. **Specific information on testing and vaccination requirements** No testing or vaccination requirements at present.		
Sweden[43, 68, 84, 191-193] https://www.krisinformation.se/detta-kan-handa/handelser-och-storningar/20192/myndigheterna-om-det-nya-coronaviruset/restriktioner-och-forbud 6 June 2021	**Current restrictions on mass gatherings** *Maximum number of participants in events:* Indoors: ▪ Indoors without designated seating: 8 participants. ▪ Indoors with designated seating: 50 participants. (Parties must be able to keep a distance of at least 1m sideways. Each group may not exceed 4 people.) Outdoors: ▪ Outdoors without designated seating: 100 participants. ▪ Outdoors with designated seating: 500 participants. Others:	**Plans for further easing of restrictions on mass gatherings** The Swedish Public Health Agency assesses that society as a whole can return to a normal situation in September 2021. The assessment is dependent on the vaccination effort progressing as planned and that compliance with other rules and recommendations remains high. Adjustments of infection control measures are proposed to take place gradually depending on the situation. The Public Health Agency of Sweden uses three levels as its basis for continued adaptations of COVID-19	None identified

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	▪ Private events in rented premises: 8 people. ▪ Exercise race: 150 participants. **Specific information on testing and vaccination** In mid-June, the Government plans to communicate its position on whether it will introduce the possibility of using a vaccination certificate or similar proof of vaccination for certain public gatherings and events for a limited period. The position will clarify how this should be regulated and which public gatherings and events it would concern. Proof of vaccination could be used to enable large-scale events that would not otherwise be possible due to the pandemic to take place.	restrictions. Level 3 came into effect as of 1 June 2021. **Level 2 (June-July when indicators are reached)** ▪ 50 can meet indoors and 600 outside ▪ 300 at an indoor seated event ▪ 3,000 can attend a seated outdoor event ▪ 900 can attend an exercise race. **Level 1** ▪ No restrictions. These levels will be delivered through 5 stages: ▪ Stage 1 (in effect as of 1 June 2021) ▪ Stage 2 (1 July): raised participant limits for public gatherings and events and private gatherings. ▪ Stage 3 (15 July): regulations limiting the number of people per square in indoor and outdoor environments will be lifted. ▪ Stage 4 (expected to start in September): all participant limits for public gatherings and events and private gatherings will be lifted ▪ Stage 5: all remaining restrictions will be lifted (date not determined). **Associated triggers to inform easing of mass gatherings** The indicators determining transition from one level to the next are: ▪ spread of infection	

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
		▪ stability of improvements ▪ burden on healthcare (intensive care and inpatient care) due to COVID-19 ▪ vaccination coverage in the adult population. **Level 3** is the default phase from 1 June 2021, even if 14-day incidence >200 cases/100,000 inhabitants. **Level 2** occurs when the following conditions are met: ▪ 14-day incidence <200 cases/100,000 inhabitants ▪ the development in the spread of infection must have been steadily declining for at least 2 weeks ▪ the total number of patients in inpatient care due to COVID-19 <300, of which <70 patients need intensive care ▪ vaccination coverage of at least 1 dose, in the population over 18 years >50%. **Level 1** occurs when the following conditions are met: ▪ 14-day incidence <50 cases/100,000 inhabitants ▪ the development in the spread of infection must have been steadily declining for at least 2 weeks ▪ total number of patients in inpatient care due to COVID-19 <100, Of which <25 patients in need of intensive care ▪ vaccination coverage of at least 1 dose, in the population over 18 years >70%.	

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
UK countries			
England[44, 56, 82, 105] https://www.gov.uk/guidance/covid-19-coronavirus-restrictions-what-you-can-and-cannot-do 28 May 21	**Current restrictions on mass gatherings** Outdoor gatherings are limited to 30 people and indoor gatherings are limited to 6 people or 2 households (each household can include a support bubble, if eligible). Indoor entertainment and attractions such as cinemas, theatres, concert halls, bowling alleys, casinos, amusement arcades, museums and children's indoor play areas are permitted to open with COVID-secure measures in place. People can attend indoor and outdoor events, including live performances, sporting events and business events. Attendance at these events is capped according to venue type, and attendees should follow the COVID-secure measures set out by those venues: ▪ In indoor venues with a capacity of 1,000 people or 50% capacity (whichever is a lower number). ▪ In outdoor venues with a capacity of 4,000 people or 50% capacity (whichever is a lower number). ▪ In the largest outdoor seated venues, where crowds can be spread out, up to 10,000 people will be able to attend (or at 25% capacity, whichever is lower). This provision can be used by venues with a seated capacity of 16,000 or above. ▪ Musical festivals and carnivals are prohibited currently. Pilot studies are currently being carried out on mass gatherings. These events are exempt from the wider coronavirus regulations, including the rule of six. The guidance in relation to these pilot studies is detailed in Appendix 2 below. **General guidance regarding mass gatherings** For all events the 3 following rules must be adhered to: 1. Event organisers must follow all relevant COVID-secure guidance depending on the type of event, and complete a related risk	**Plans for further easing of restrictions on mass gatherings** ***Step 4 - not before 19 July (Delayed due to concerns around the delta variant)*** ▪ England plan to reopen remaining premises, including nightclubs, and ease the restrictions on large events and performances. **Associated triggers to inform easing of restrictions on mass gatherings** Before moving from one step to the next, the government will review the latest available data on the impact of the previous step against four tests. The tests are: ▪ The vaccine deployment programme continues successfully. ▪ Evidence shows vaccines are sufficiently effective in reducing hospitalisations and deaths in those vaccinated. ▪ Infection rates do not risk a surge in hospitalisations which would put unsustainable pressure on the NHS. ▪ The government's assessment of the risks is not fundamentally changed by new Variants of Concern. The indicative dates for each step are contingent on the data and are subject to change if the 4 tests are not met.	Outdoor events, funfairs, performing arts, and sports events.

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	assessment. This guidance varies according to the type of event and could include outdoor events, funfairs, performing arts or sports events. 2. Organisers and attendees must adhere to all legal requirements, including maintaining group sizes permitted by social contact restrictions at the relevant step in the Roadmap and preventing mixing between groups, enforcing social distancing guidelines and mandating face coverings in indoor areas where required. 3. All reasonable action must be taken by the event organiser to mitigate risk to public health. For all indoor settings where the use of face coverings is not legally mandated, businesses should assess the use of face coverings by staff and attendees on a case by case basis. Face coverings should be worn where social distancing may be difficult and wherever interaction between people not from the same household or support bubble is likely to occur. Employers should assess the use of face coverings by staff depending on the workplace environment, other appropriate mitigations that have been put in place, and whether reasonable exemptions apply. **Specific information on testing and vaccination requirements** Pilot studies are currently being carried out across the UK. For at least the first set of pilot events, there will be no requirement for participants to show proof of vaccine. Participants in the Events Research Programme pilots published to date will have to provide a basic COVID-19 certification that they have tested negative for COVID-19. More information is provided on this in Appendix 2 below.		
Northern Ireland[45, 89, 97, 194, 195] https://www.nidirect.gov.uk/articles/coron	**Current restrictions on mass gatherings** Up to 6 people from no more than 2 households can meet in a private home and stay overnight. Children aged 12 and under are not counted in the total. Up to 15 people (including children) from no more than 3 households can meet up outdoors in a private garden.	**Plans for further easing of restrictions on mass gatherings** **Step 5** According to the Northern Irelands Pathway out of restrictions document, larger outdoor organised	A range of different sector specific guidance

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
avirus-covid-19-regulations-guidance-what-restrictions-mean-you Unclear when last updated.	Indoor gatherings (excluding private homes) ▪ To determine the maximum number of people permitted to attend an indoor gathering, in a non-domestic setting, the organiser or operator must carry out a risk assessment. Indoor gatherings of 15 people or fewer do not need a risk assessment. Outdoor gatherings (excluding homes) ▪ Up to 500 people can attend outdoor gatherings. To determine maximum number that can attend, the organiser must have carried out a risk assessment. Outdoor gatherings of 30 people or fewer do not need a risk assessment. **General guidance regarding mass gatherings** You must wear a face covering when you go to any indoor public space, unless exempt. Venues will be required to collect customer details to help with the Test, Trace, Protect contact tracing programme. Customer details will include the: ▪ name and telephone number of each visitor over the age of 16 ▪ date and time Venues must have carried out a risk assessment and take all reasonable measures to limit the risk of transmission of the coronavirus. **Specific information on testing and vaccination requirements** No testing or vaccination requirements at present.	events, concerts and festivals can take place under step 5. An indicative date of 21 June has been set for: ▪ An increase in numbers attending outdoor gatherings. ▪ The return of audiences in theatres, concert halls and other venues, as well as the return of conferences and exhibitions. Live music events must be effectively controlled and managed. If the event is taking place in a venue that is part of larger premises (such as a hotel) it must be sufficiently isolated to ensure the volume of music in the venue does not breach ambient levels in other parts of the premises. Dancing is not permitted for audience members. Entry to performances will be by ticket only, purchased in advance. Audiences for indoor events must have allocated seating and guests must remain seated, (unless using facilities). A maximum of 6 people can be seated together. Children aged 12 and under are not counted in the total. Social distancing at a minimum of 1m will be required for live music-related activity in indoor seated venues and will be advised for all outdoor events. ▪ Up to 10 people from no more than 2 households to meet in a private dwelling and stay overnight. If a single household has 10 members, the maximum is increased to 15 from no more than 2 households.	

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
		▪ Up to 15 people from any number of households to meet in a private garden. ▪ Ending household bubbles The indicative date of 21 June is subject to review on 17 June. **Associated triggers to inform easing of restrictions on mass gatherings** Decisions to progress will be guided by four overarching principles: 1. Evidence-based: proposals for change or for keeping in place a restriction or requirement should be informed by the best available evidence and analysis. 2. Necessary: a specific restriction or requirement should be kept only as long as it is considered necessary to provide the right public health response to the incidence or spread of COVID-19. 3. Proportionate: the detrimental impacts on health, education, society and the economy that can reasonably be attributed to the restriction or requirement should be tolerated only as long as the risks associated with withdrawing or modifying it are assessed to be more severe. 4. Sustainable: communities and the economy need to be built back up in a way that builds resilience, is long-term focused, and viable. Health trends, community trends and economic trends will be evaluated 3 weeks after any changes	

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
		before any further decisions are made to ease restrictions.	
Scotland[46, 47, 90, 196-199] https://www.gov.scot/publications/coronavirus-covid-19-events-sector-guidance/ 26 May 2021	**Current restrictions on mass gatherings** In Scotland there are 5 COVID-19 protection levels (0-4). All of Scotland is at either levels 0, 1 or 2. Under each level different rules are in place in relation to mass gatherings. **Level 0** You can meet socially in groups: ▪ of up to 8 people from 4 households in your home or theirs – and can stay overnight ▪ of up to 10 people from 4 households in an indoor public place like a café, pub or restaurant ▪ of up to 15 people from 15 households outdoors. Events: ▪ outdoor seated and open space events are advised to operate with a maximum capacity of 2,000 people ▪ outdoor grouped standing events are advised to operate with a maximum capacity of 1,000 people ▪ seated indoor events are advised to operate with a maximum of 400 people. **Level 1** You can meet socially in groups: ▪ of up to 6 people from 3 households in your home or theirs – and can stay overnight ▪ of up to 8 people from 3 households in an indoor public place like a café, pub or restaurant ▪ of up to 12 people from 12 households outdoors in your garden or a public place. Events: ▪ indoors events permitted with maximum capacity of 200*	**Plans for further easing of restrictions on mass gatherings** Restrictions will ease in accordance with the COVID-19 protection levels (0-4) **July/August:** Further details will be provided in due course regarding next steps beyond Level 0. **Associated triggers to inform easing of restrictions on mass gatherings** Moving from a higher level to a lower level is informed by the 6 WHO criteria: 1. Evidence shows that COVID-19 transmission is controlled. 2. Sufficient public health and health system capacities are in place to identify, isolate, test and treat all cases, and to trace and quarantine contacts. 3. Outbreak risks are minimised in high vulnerability settings, such as long-term care facilities (i.e. nursing homes, rehabilitative and mental health centres) and congregate settings. 4. Preventive measures are established in workplaces, with physical distancing, hand washing facilities and respiratory etiquette in place, and potentially thermal monitoring.	Coronavirus (COVID-19): calculating physical distancing capacity in public settings Coronavirus (COVID-19) stadia and live events guidance

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	▪ outdoor seated events permitted with a maximum capacity of 1000* ▪ outdoor free-standing events permitted with a maximum capacity of 500*. **<u>Level 2</u>** You can meet socially in groups of up to: ▪ 6 people from 3 households in your home or theirs – and can stay overnight ▪ 6 people from 3 households in an indoor public place like a café, pub or restaurant ▪ 8 people from 8 households outdoor. Events ▪ indoor events permitted with maximum capacity of 100* ▪ outdoor seated events permitted with a maximum capacity of 500* ▪ outdoor free-standing events permitted with a maximum capacity of 250*. * For venues which can accommodate larger audiences, event planners / venue operators may apply to their local authority for exceptions to the above capacities, however 2 metre physical distancing must remain in place. **General guidance regarding mass gatherings** *General Guidance* When deciding whether an event should proceed, event organisers should consider the following key risk factors: Collection of customer details, crowd density, travel, location, demographics of attendees and duration of event.	5. Manage the risk of exporting and importing cases from communities with high-risks of transmission. 6. Communities have a voice, are informed, engaged and participatory in the transition. One additional criteria that must be met before returning to geographically varied levels: 7. at least all of the JCVI groups 1-9 must have been offered a vaccination prior to the return to geographically varied levels	

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	Collection of customer contact details Event organisers should have in place a system to collect the contact details of attendees, visitors, and workforce in support of Test and Protect. This information should be stored for at least 21 days. ***Crowd density*** In order for an event to take place, event organisers should ensure that capacity of attendees has been calculated to allow 2 metres physical distancing at all times. Pinch points such as entry, exit, stairs, escalators, vomitories, toilets and refreshment areas should be considered to ensure distancing can be maintained. Consideration should be given as to the ability to stagger arrival and exit of attendees and put any other mitigations in place. ***Travel*** Organisers should communicate to attendees that separate households should not share cars to travel to/from events and that for drive-in events there should only be one household, or extended household per vehicle. Events that involve the workforce or attendees travelling internationally are likely to carry a higher risk of transmission than events where the workforce and attendees are from the local area. ***Location*** Having a large number of people travel to a rural or island location for an event may place a significant strain on local public services, including the NHS, in the event of an outbreak. Organisers should consider local community impact. Local communities should be involved where appropriate to ensure they understand safety measures that will be in place. ***Demographics of attendees*** Certain groups are at higher risk from coronavirus. Organisers should consider whether their likely audience is a group at higher risk from coronavirus and if so whether the event should take place.		

	Duration of event Longer, for example multi-day events with overnight stays are likely to be higher risk than events of a short duration. Longer events may increase requirements for luggage or other cloakroom storage which carry an additional level of risk though contact with surfaces. *Toolkits* Scotland has developed a checklist that should be used in conjunction with the events sector guidance when considering the reopening of the events sector during the coronavirus pandemic. The checklist provides examples of some of the areas you may need to consider, implement and monitor, and should be used to support your event risk assessment. **Other relevant information:** ▪ Whoever is making the application to plan an event must provide the local authority with a description of the event, an event plan and risk assessment. ▪ Approval may be granted for a single event, or for all events of a particular type in that setting. For example, a theatre may apply to regularly host stage productions and may be granted approval for all similar events. ▪ Sports events which may expect to regularly go above the limits identified in the Protection Levels table, such as professional football and rugby matches, may be able to run regular fixtures once risk assessments have been completed and agreed without recourse to the local authority each time. ▪ Where a setting is holding different types of event, for example conference centres, a risk assessment and event plan must be submitted to the local authority, seeking approval for whether that event can proceed and whether any conditions will be attached. Any approval granted would be valid for all similar events. This could include, entertainment (concerts), trade shows and corporate events. ▪ Approval needs to be applied to your local authority to organise an event above the standard capacity limits. The proposal must include a description of the event, including physical distancing capacities of the space or venue to be used, an event operating plan and a risk assessment for the event. Local Authorities must have regard to the risk of the incidence and spread of coronavirus which may arise from the event. Local authorities may take decisions based on their existing		

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	practices, but may want to consider further criteria detailed in Annex C of the Coronavirus (COVID-19) stadia and live events guidance document. **Specific information on testing and vaccination requirements** No testing or vaccination requirements at present.		
Wales[49, 50, 57, 200-202] https://gov.wales/culture-and-heritage-destinations-and-venues-guidance-phased-return-html 4 June 2021	**Current restrictions on mass gatherings** Wales moved from Alert level 2 to alert level 1 on 7 June 2021. ▪ 30 people from 30 households (not including children under 11 from the households or carers of a member of these households) are permitted to meet outdoors, including in private gardens, outdoor public spaces and outdoor areas of regulated premises. ▪ Meeting people from another household socially indoors in another person's home is not allowed under the rules, unless the household is part of your extended household. ▪ Up to 6 people from up to 6 households (not including children under 11 from the households or carers of a member of these households) are permitted to meet in most indoor areas of regulated premises, for example, cafes, restaurants, pubs and visitor attractions. Regulated gatherings: ▪ Maximum numbers who may attend regulated gatherings outdoors is up to 4,000 people of any age (standing) and 10,000 people of any age seated (subject to risk assessment). ▪ If the organised activity is taking place indoors, the maximum number of people aged 11 and over that can take part is 30. ▪ Regulated gatherings encompass a broad range of activities that can be attended by people of any age. These activities include activities that were previously referred to as organised activities and allow for larger scale events, which includes but is not limited to: o team sports	**Plans for further easing of restrictions on mass gatherings** All of Wales is currently under alert level 1. Further easing of restrictions will be kept under constant review, however there is no information provided as yet. The next review date will be 21 June 2021. **Associated triggers to inform easing of restrictions on mass gatherings** To move to level 1, the following conditions were met: ▪ Confirmed case rate less than 50 per 100,000 people rolling seven-day average ▪ Confirmed case rates for over 60s remain low ▪ Projection of future case incidence rates over next two weeks do not anticipate significant rises. ▪ Test positivity below 3% over seven days ▪ Forecast of Welsh population estimated to have COVID-19 is less than 0.25% ▪ Rates of change in the indicators above – an established rapid increase may merit	Culture and heritage destinations and venues open to the public Guidance for event organisers of regulated gatherings during the coronavirus (COVID-19) pandemic

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	○ exercise classes ○ meetings of religious groups and support groups ○ guided tours ○ parkrun ○ car boot sales ○ fetes ○ live music concerts ○ food festivals. Regulated gatherings will vary in size and the capacity for different regulated gatherings will be determined by a risk assessment which includes taking all reasonable measures to minimise the risk of exposure to and spread of coronavirus. **General guidance regarding mass gatherings** Wales have developed guidance that offers high-level advice for culture and heritage destinations and venues that are open to the public. These include museums, art galleries, libraries, archives, historic buildings, historic gardens, ancient monuments, cinemas and arts venues, including concert halls and theatres. The guidance document sets out practical considerations for managing culture and heritage destinations and venues. Some of the practical considerations are outlined below: ▪ Undertake a specific assessment of the risk of exposure to coronavirus at the premises and in doing so consult persons working on the premises or representatives of those persons; ▪ ensure that a distance of 2metres is maintained between people on the premises; ▪ ensure where people are required to wait to enter the premises, that a distance of 2 metres is maintained between them ▪ take any other reasonable measures for that purpose, to minimise the risk of exposure to coronavirus at the premises, for example,	escalation without needing any particular thresholds to be reached ▪ Hospital capacity being managed effectively and any potential pressure from increased cases is at least five to six weeks away. ▪ No unmitigated concerns from local health professionals ▪ No unmitigated concerns raised by relevant local authority leaders or local partners.	

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	measures which limit close face to face interaction and maintain hygiene such as: ○ changing the layout of premises including the location of furniture and workstations; ○ controlling use of entrances, passageways, stairs and lifts; ○ controlling use of shared facilities such as toilets and kitchens; ○ controlling the use of, or access to, any other part of the premises; ○ installing barriers or screens; ○ providing or requiring use of personal protective equipment; and ○ providing information to those entering or working at the premises about how to minimise the risk of exposure to coronavirus. Other reasonable measures may include: ▪ not carrying out certain activities ▪ closing a part of the premises ▪ allowing staff to isolate due to having symptoms of COVID-19, testing positive for the virus, or having had close contact with somebody who has tested positive ▪ collecting contact information from those on the premises (staff, visitors and members of the public), taking reasonable measures to ensure that it is correct, and retaining it for 21 days. *Guidance for visitor attractions:* ▪ customers will be encouraged to pre-book with details of all members of the group ▪ contact details will be required for contact tracing purposes ▪ entry to the premises will be controlled ▪ licenced premises, such as pubs, will be providing table service only ▪ all food and drink should be consumed at tables		

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	▪ physical distancing measures will be applied, such as tables being spaced out ▪ face coverings must be worn other than when seated to eat or drink ▪ when utilising outdoor spaces, venues are required to ensure that the use of physical coverings, awnings, gazebos, marquees and similar structures are implemented in a way that is aligned with current public health advice. Generally this means that structures with a roof or ceiling must be open-sided (at least 3 sides or more than 51% open). **Specific information on testing and vaccination requirements** No testing or vaccination requirements at present.		
Other countries			

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
Israel[51, 58, 203, 204] https://www.gov.il/en/departments/news/04052021-01 1 June 2021	**General guidance regarding mass gatherings** ▪ From 1 June 2021 the green pass and purple badge requirements have been cancelled. ▪ The cancellation of the Green Pass requirements allows for unrestricted access to all establishments and all sectors. Effective from 1 June, it will no longer be required to present the Green Pass or valid negative coronavirus test results. Access will no longer be limited to anyone, including children and non-vaccinated adults, to all establishments that up until now have been operating subject to the Green Pass requirements such as hotels, restaurants, event venues and gardens, sport stadiums and more. ▪ The cancellation of the Purple Badge means that there will no longer be any restrictions on gatherings or occupancy ratios. All establishments may resume all normal activities, without any restrictions on occupancy, serving food and other special conditions that have been set as pre-requisites for this establishment's operations. These relaxation measures shall also apply to workplaces and public transportation. ▪ The indoor masking requirement will remain in place. **Specific information on testing and vaccination requirements** There are no longer requirements for testing or vaccination**.**	**Plans for further easing of restrictions on mass gatherings** Israel has largely removed all restrictions on gatherings. **Associated triggers to inform easing of restrictions on mass gatherings** As of 12 May 2021 Israel has moved to a local Traffic Light Model. Every local council will receive a weekly index that is calculated by weighing the number of new cases, the percentage of positive test results, and infection rate. The index is updated once every 2 weeks.	None identified
Switzerland[52, 69, 76, 205] https://www.bag.admin.ch/bag/de/home/krankheiten/ausbrueche-epidemien-pandemien/aktuelle-ausbrueche-epidemien/novel-	**Current restrictions on mass gatherings** Since 31 May 2021, ▪ Events with up to 50 participants are allowed. This refers to events without an audience, such as club meetings and activities. ▪ Events in front of an audience may take place indoors with a maximum of 100 people indoors of 300 people outdoors. The following additional special provisions apply to events with an audience: ▪ A maximum of one half of the seats may be occupied	**Plans for further easing of restrictions on mass gatherings** ▪ On 26 May 2021, the Federal Council passed the regulations for major events with more than 1,000 people, which are to take place from 1 July 2021. ▪ The Federal Council will set the requirements for medium-sized events with more than 100 or 300, but fewer than 1000 people, as part of the	None identified

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
cov/massnahmen-des-bundes/empfehlungen-fuer-die-arbeitswelt.html#701366771 20 May 2021	▪ It is compulsory for visitors to sit ▪ No food or drinks may be offered unless the organizer records the contact details of all visitors, in which case consumption is permitted in the public area at the seat. Pilot events are possible from 1 June: max 600 indoors and 1,000 outdoors. **Specific information on testing and vaccination requirements** None currently, but it is planned that larger scale events later in the summer, from 1 July 2021, will require that attendees are fully vaccinated, negative tested or recovered from COVID-19. A uniform Swiss-wide Covid certificate (forgery-proof proof of vaccination, test (PCR or antigen) and recovery) should also be available by the summer, which will make it much easier to check the evidence at the entrance.	next planned opening step in June; consultation of the cantons is planned from 11 June. ▪ From 1 July, major events are possible again. The maximum number of people for indoor events will be 3,000 people. Outside large events with compulsory seating and two thirds of the capacity can now take place with a maximum of 5,000. For outdoor events with standing room, such as open airs, a maximum of 3,000 people are permitted, at half capacity and with a mask. ▪ Admission to major events is limited to people who have been completely vaccinated, have recovered from Covid-19 or have had a negative test result. The Covid certificate should be used as soon as it is available. ▪ From 20 August 2021, this upper limit is to be increased to 10,000 people. ▪ These dates and numbers of participants are not an opening plan: the Federal Council will only decide later whether such events can actually be held. The cantons must revoke the permits or issue additional restrictions if the epidemiological situation deteriorates to such an extent that the large-scale event can no longer be held or contact tracing is no longer guaranteed. In this case the protective screen takes effect. ▪ Only vaccinated, negative tested and recovered people can take part in such events. **Associated triggers to inform easing of restrictions on mass gatherings**	

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
		With regards to easing of mass gathering restrictions, the Federal Council has launched consultations with the cantons, cities and municipalities, the umbrella organisations of the social partners, the industry associations and organisations concerned in the fields of events and sport, the Council of Religions and the relevant committees. Because major events require longer preparations, the Federal Council wants to give the organisers a certain degree of planning security as early as possible. Should events be cancelled due to deteriorating epidemiological situation at the time, the federal government and the cantons will contribute to the uncovered costs for events that have to be cancelled or postponed.	
US CDC[24, 79, 108, 109, 206] https://www.cdc.gov/coronavirus/2019-ncov/community/large-events/considerations-for-events-gatherings.html 20 May 2021	**Current restrictions on mass gatherings** Varies by State. **General guidance regarding mass gatherings** The CDC has developed a guidance document for those organising large events and gatherings, along with an 'events and gatherings readiness and planning tool'. The key points of the guidance document are as follows: ▪ Avoid large events and gatherings, when possible ▪ Consider the level of risk when deciding to host an event (e.g. case numbers in the community, exposure during travel, setting and duration of event, numbers and behaviours of attendees) ▪ Promote healthy behaviours (e.g. stay home when ill or close contacts, physical distancing, masks, hand hygiene, respiratory etiquette, signage)	**Plans for further easing of restrictions on mass gatherings** Various sporting events with large crowds have occurred in the US since April 2021. The decision to allow spectators to return is made at the State-level. **Associated triggers to inform easing of restrictions on mass gatherings** State-level decision.	Considerations for Communities of Faith Considerations for Community-based organisation events Recommendations for Tribal Ceremonies and Gatherings

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	▪ Maintain healthy environments (e.g. cleaning and disinfection, organise restrooms, ventilation, safety of water supplies after prolonged shutdown, modified layouts, physical barriers, communal space, food service, shared objects) ▪ Maintain healthy operations (e.g. regulatory awareness, protection for staff and attendees who are higher risk of severe disease, shifts and attendance times, travel and transit, communication systems, sick leave for staff with covid-19 or those who are close contacts, staff training, lessons learnt) ▪ Be prepared if someone gets sick during or after the event (e.g. isolate and transport those who are sick, clean and disinfect, notify health officials and close contacts, contact tracing). The readiness and planning tool aligns with the guidance document and includes the following: ▪ General readiness assessment (that is, make initial preparations before the event to promote healthy behaviours, environments, and operations that reduce the spread of COVID-19) ▪ Preparing for if someone gets sick (that is, plan for what should happen before, during and after someone gets sick) ▪ Daily/weekly readiness assessment (that is, conduct the day of and during the event to monitor and maintain healthy behaviours, environments, and operations that reduce the spread of COVID-19) ▪ End-of-day actions and resources (that is, conduct end-of-day actions and address any additional considerations specific to the programme or community context). Event planners and administrators may review and complete the general readiness assessment while working with state and local officials as part of making initial preparations before the event to promote healthy behaviours, environments, and operations that reduce the spread of COVID-19. The daily/weekly readiness assessment may be used to monitor and maintain recommended practices. Planning tools are also included to help event planners and administrators prepare for if someone gets sick,		During the COVID-19 Outbreak

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance
	plan after-event actions, and address the specific needs and circumstances of the local community. Implementation should be guided by what is feasible, practical, acceptable, and tailored to the needs and context of each community. The risk of SARS-CoV-2 spreading at events and gatherings increases as follows: ▪ Lowest risk: Virtual-only activities, events, and gatherings. ▪ More risk: Smaller outdoor gatherings in which individuals from different households remain spaced at least 6 feet apart, wear cloth face coverings, do not share objects, and come from the same local area (e.g., a community, town, city, or county). ▪ Higher risk: Medium-sized in-person gatherings that are organised/laid out to allow individuals to remain spaced at least 6 feet apart, some wear cloth face coverings and come from outside the local area (e.g., a community, town, city, or county). ▪ Highest risk: Large in-person gatherings where it is difficult for individuals to remain spaced at least 6 feet apart, do not wear cloth face coverings and travel from outside the local area. **Specific information on testing and vaccination requirements** ▪ CDC does **not** recommend testing all attendees and staff before allowing them to enter. Testing all event attendees and staff for COVID-19 before allowing them to enter the venue has not been systematically studied. It is unknown if entry testing at event venues provides any additional reduction in person-to-person transmission of the virus beyond what would be expected with other preventive measures (such as social distancing, wearing cloth face coverings, hand washing, enhanced cleaning and disinfection). ▪ CDC does recommend conducting health checks such as temperature screening and/or symptom checking of staff and attendees safely and respectfully, and in accordance with any applicable privacy laws and regulations.		

Country/ organisation Date of last update	Current public health measures on mass gatherings	Planned easing of restrictions for mass gatherings	Links to sector specific guidance

Key: CDC – Centers for Disease Control and Prevention; ECDC – European Centre for Disease Prevention and Control; FFP – filtering facepiece; FSAI – Food Safety Authority of Ireland; HSE – Health and Safety Authority; HSE – Health Service Executive ICU – intensive care unit; JCVI – The Joint Committee on Vaccination and Immunisation; N/A – not applicable; NHS – National Health Service; PCR – polymerase chain reaction; PPE – personal protective equipment; RIVM – Dutch National Institute for Public Health and the Environment; WHO – World Health Organization.

Appendix 2 Information on pilot events

Country/ organisation	Pilot events
International Agencies	
WHO	N/A
ECDC	N/A
EU/EEA countries	
Austria[91]	**Information on pilot events** A two day pilot event was conducted in September 2020 with two groups of 1,000 students at Austria's largest conference centre, Vienna International Centre ***Dates and location*** 16-17 September 2020 at Vienna International Centre ***Guidance/protocol on conduct of pilot events***

Country/ organisation	Pilot events
	NADAL® COVID-19 Ag Rapid Tests were used at entry to the event. Any positive cases were isolated immediately, an additional PCR test was carried out before the individuals concerned were sent to quarantine at home. ***Results*** Close to 2,000 tests were conducted with five positive results, so the proportion of positive cases was around 0.25%. On the second day of the event, one of these individuals tested positive, having presented a negative result on the first day. This particular case once confirms that an antigen test only ever provides a snapshot of an individual's viral load. This suggests that rapid tests should be carried out on a daily basis at multi-day events The organisers reported that it took an average of 30 seconds per swab and a maximum of 10 minutes per result. As a rule of thumb, the organisers suggested that the number of test lanes needed and time slots for participants could be calculated on the basis of the 30 seconds it takes to complete each swab. This means that each test lane was able to process an average of 120 people each hour Each test lane required one medical expert to take the throat swab and two to three assistants to prepare the solution and support the test subjects. In addition, a team of paramedics was on hand at the end of the test lane to manage any positive cases. Conducting the test took an average of six to ten minutes from swabbing to receiving the test result. In total, 50-60% of the students invited to take part in this optional event elected to do so, in spite of the possible waiting times and the fact that they could stream it at home
Belgium[92, 207-211]	**Information on pilot events** Around 30 pilot and pilot projects are being planned for May 2021 to determine, practically and under scientific guidance, how the various economic sectors can start safely or prevent their closures in the future. Details have been identified for 6 of the pilots, all of which are part of an initiative of the Wallonia-Brussels Federation in collaboration with DNAlytics, UCLouvain, ULB, ULiège and actors in the cultural sector. The 6 studies have been evaluated by the ethics committee of the Erasme-ULB university hospital. Each pilot event will include mandatory testing, 2 saliva tests 7 days apart, on 2 groups with identical characteristics, one of which actually participated in the event, unlike a control group that did not participate. The first event involved a concert by the Ykons group, indoors according to a capacity level of 50% with a masked audience seated in bubbles 1.5 meters apart and entry by rapid tests. The second, involves an outdoor performance in front of a maximum of 500 people, with people masked and situated at shorter distances than the currently imposed standards, that is, at a distance of 1 meter. The third pilot involves a comedy show with a seated audience of 400 people indoors (out of a total number of 613 seats), i.e. a capacity of 65% which exceeds current protocols. A fourth event involves a indoor concert for 300 people standing, masked, but without distancing. Details are not yet available for the other two pilot events. ***Dates and location*** From May 2021, location(s) unclear for all but 6 events: 7 May in Spa 12 May in Namur 5 June in Arlon 12 June in Louvain-La-Neuve 21 June in Brussels 26 June in Mons

Country/ organisation	Pilot events
	Guidance/protocol on conduct of pilot events None identified *Results* Results from the first 2 pilot events are published via press release only: For the 7 May concert in Spa, 423 people registered online with 190 attending the event and 94 people assigned to the control group. The 109 people making up the technical team, artists, reception staff and protocol guests were also tested. The saliva samples were analysed by the ULiège laboratory using the PCR technique. No positive case was detected on the day of the event, neither among the participants, nor within the control group. The tests carried out 7 days after the event on participants from both groups, who represented themselves in sufficient numbers to ensure the reliability of the results, were also negative, both for the participants and for the control group. For the 12 May outdoor performance, 793 people registered online, 256 people attended the performance and 150 people showed up for the control group test. The 144 people making up the technical team, artists, reception staff and additional guests were also tested. The saliva samples were analysed by the ULiège laboratory. Only one positive case was detected: it was a member of the technical staff present on the day of the event. No positive cases were reported among the participants and none in the control group. The tests carried out 7 days after the event on the participants of the two groups, who represented themselves in sufficient number to guarantee the reliability of the results, were also all negative, both for the participants and for the control group.
Czech Republic	None identified
Denmark	None identified
Finland	None identified
France[212-215]	**Information on pilot events** Two pilot studies are planned. Details for the pilot study in Paris are below. Detail about the Montpellier study are not available. However, the test concert project has been authorised by the Minister of Culture which will be conducted in partnership with the Montpellier University Hospital, at the "Secret Place" - a famous rock venue located in Saint-Jean-de-Védas. **Paris: Study on Prevention of SARS-CoV-2 Transmission During a Large Indoor Gathering Event (SPRING)** The Assistance Publique - Hôpitaux de Paris (University of Paris public hospital system) and PRODISS (National union of producers, broadcasters, festivals and musical and variety performance venues) will conduct a RCT comparing an indoor concert with masks and hand hygiene to no concert using antigen testing. According to the clinical trial registration details NCT04872075, the stated objective of the study is to demonstrate if there is no increase in the risk of SARS-CoV-2 salivary carriage 7 days after a concert in the group participating in the event compared to a non-participating group who stayed at home. The hypothesis is that a systematic screening of SARS-CoV-2 within the 3 days before the event allows to control the risk of transmission and prevent cluster of transmission during the concert. *Dates and location* 29 May 2021, Accor Arena, Paris Bercy.

Country/ organisation	Pilot events
	Guidance/protocol on conduct of pilot events Before inclusion, participants will pre-register to the event via a website. 7,000 participants will be enrolled and will get an appointment for an inclusion visit at the Accor Arena (Paris Bercy, France). During 3 days (from D-3 to D-1) pre event, participants with a registration will come to the Accor Arena to have a rapid Sars-Cov-2 antigen test (results in 15 min). If the test is positive, the participant will be contacted and managed by the medical team in charge of the national strategy for positives cases. People with a negative test will be included and randomised: ▪ Two kits with tube for collecting saliva samples (for D0 and D7) will be given to each participant at this visit ▪ People randomised in the experimental group will receive their concert ticket at a later date. ▪ At Day 0, people randomised in the experimental group, will come to the Accor Arena with their ticket to participate in the concert. At the entrance, they should give their D0 saliva sampling kit. The people randomised in the control group will stay at home and will send their D0 saliva sample by post mail. ▪ At Day 7 (±1 day) all the participants must return their D7 saliva sampling kit via post mail. Primary Outcome Measures: ▪ Number of participants with a positive salivary RT-PCR at day 7 after the date of the concert [Time Frame: 7 days after the concert (±1day)] Secondary Outcome Measures: ▪ Number of participants in each group with a positive salivary RT-PCR the day of the concert [Time Frame: The day of the concert] to evaluation of the salivary carriage on day 0 (the concert day) despite a negative test within 3 days before the event and the conversion rate of salivary carriage between D0 and D7. ▪ Molecular analysis of transmission clusters [Time Frame: 7 days after the concert (±1day)] for comparison of the sequence of complete viral genome in participant with a positive test at day 7. ▪ Average percentage of participants wearing their mask adequately for the duration of event [Time Frame: The day of the concert] ▪ Percentage of adequate mask wearing among participants according to location and time [Time Frame: The day of the concert] to identify the circumstances (place, time) of failure of accurate mask wearing by the participants. ▪ Percentage of participants who downloaded and / or used the TousAntiCovid application at the time of inclusion [Time Frame: The day of the concert] to estimate the feasibility and acceptability of using the Tousanticovid application. Inclusion Criteria: ▪ aged between 18 and 45 years old ▪ lack of symptoms or no contact with people with Covid-19 in the last 2 weeks ▪ negative antigenic test to Covid-19 in the 3 days before the experiment ▪ people who declared to have no risk factor to severe form of Covid-19 ▪ people who declared not to live in the same place as someone with these risk factors ▪ people residing in Ile-de-France area. Exclusion Criteria: ▪ positive test to SARS-CoV-2 within 3 days before the concert

Country/ organisation	Pilot events
	▪ people with clinical signs suggesting infectious respiratory disease ▪ people with severe Covid-19 risk factor ▪ people living with someone having severe covid-19 risk factor ▪ not affiliated to social security ▪ people who cannot remain standing for the time of the experimentation (about 5 hours) ▪ person under tutorship or curatorship ▪ pregnant women or not having effective contraception method. Trial registration: NCT04872075 ***Results*** Estimated Primary Completion Date: 5 June 2021 Estimated Study Completion Date: 5 October 2021 ***Additional information*** A third event was proposed. However, it did not receive authorisation by the Minister of Culture as the proposal was noted to be "scientifically interesting but was not selected due to risks associated with the proposed health protocols".
Germany[94, 216-218]	**Information on pilot events** Several pilot events have been conducted in Germany. The first of which involved over 1,000 participants occurred in Berlin in August 2020 at an experimental pop concert with three different intensities of public health measures. Another pilot event (part of a series of 9 linked pilots in Berlin - Perspektive Kultur: Berliner Pilotprojekt Testing) involved approximately 1,000 attendees at a symphony concert in Berlin in March 2021. ***Dates and location*** Berlin, 22 August 2020 Berlin, 20 March 2021 ***Guidance/protocol on conduct of pilot events*** Berlin, August 2020, pop concert. All attendees wore N95 masks during the event and provided negative tests (type of test unclear) beforehand. Three different scenarios of public health measures were tested among three distinct groups 1) no restrictions (no control measures scenario) 2) moderate restrictions (checkerboard pattern seating, twice as many entrances) and 3) strong restrictions ((pairwise seating with 1.5 m interspace to the next pair, four times as many entrances). Berlin, March 2021, symphony concert. Attendees required a negative antigen test in order to enter the venue. Half of the audience was tested in decentralised test centres coordinated by the State in advance of the concert, the other half were able to use a test centre set up especially for the event in the foyer immediately prior to the event. DiaLab SARS-CoV-2 rapid antigen test was used centrally. Four test stations were set up in the foyer, with a team of 6 at each station. A medical team of doctors and scientists supervised the process. Face masks (except for the orchestra who

<table>
<tr><th>Country/ organisation</th><th>Pilot events</th></tr>
<tr><td></td><td>were behind glass), social distancing, one way systems, contactless admission, hand hygiene, increased cleaning were implemented. No drinks or food were supplied and there was no interval. The study tested the logistical feasibility of such an event.

Results
Results of August 2020 pilot are published: The authors concluded that the expected additional effect of indoor mass gathering events on burden of infections is low if hygiene concepts are applied and adequate ventilation exists. A total of 960 participants completed the questionnaire (79% of all participants). Of those, 88% could picture attending an event or concert under the conditions of scenario 2 and 82% under the conditions of scenario 3. The majority of respondents (89%) felt that wearing N95-masks was unproblematic, sometimes a little restrictive, but they could get used to it quickly. This study is discussed as part of RQ2.

March 2021, the pilot event was found to be logistically feasible by the study organisers. All 486 tests performed on site were negative, no acute SARS-CoV-2 infection could be detected, however 35 (7.4%) were inconclusive and required re-testing in 33 cases and re-sampling in 2 cases. All returned negative tests on second test. Each station processed 2.36 people per minute. The average duration from check-in to swabbing was 12 minutes and 20 seconds. The majority of the audience (73%) had a preference for being centrally tested at the location, instead of at a decentralised centre beforehand, however this does mean that large numbers of untested people may use public transport. On average, each test cost €34.56. Good air extraction and air dilution was measured on the day of the event (no measurements provided). It was observed that almost all of the guests wore the correct mask and wore them throughout the event (no measurements provided).

Additional information
While other pilot events were planned in Berlin during March and April as part of a series of events, it would appear that some of these were postponed given the deteriorating epidemiological situation.</td></tr>
<tr><td>Iceland</td><td>None identified</td></tr>
<tr><td>Ireland[86, 219, 220]</td><td>Information on pilot events
A number pilot events will be held across Ireland from 10 June to the end of June. These pilots will help to evaluate and review progress to advance additional events and increasing capacity in July and August. Of the identified pilots, 4 relate to cultural events and 16 relate to sport. These include outdoor music concerts, indoor music performances, GAA, Camogie and Ladies Gaelic Football Association games, League of Ireland games, rugby games and other sports like golf and athletics.

Dates and location
<table>
<tr><th>Date</th><th>Venue</th><th>Event</th><th>Capacity</th></tr>
<tr><td>10 June</td><td>Iveagh Gardens</td><td>Outdoor music event curated by NCH</td><td>500</td></tr>
<tr><td>11 June</td><td>RDS</td><td>Leinster v Dragons</td><td>1,200</td></tr>
<tr><td>11 June</td><td>Tallaght Stadium</td><td>Shamrock Rovers v Finn Harps</td><td>1,000</td></tr>
<tr><td>11 June</td><td>Turners Cross</td><td>Cork City v Cabinteely</td><td>600</td></tr>
<tr><td>20 June</td><td>Croke Park</td><td>Camogie National League Finals</td><td>3,000</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Country/ organisation</th><th>Pilot events</th></tr>
<tr><td></td><td>
<table>
<tr><td>18-20 June</td><td>TBC</td><td>Possible pilot of a GAA Men's National Football League Final if scheduled</td><td>unclear</td></tr>
<tr><td>23 June</td><td>University Limerick Concert Hall</td><td>Indoor - Irish Chamber Orchestra</td><td>519</td></tr>
<tr><td>25 June</td><td>Tallaght Stadium</td><td>Shamrock Rovers v Drogheda</td><td>1,000</td></tr>
<tr><td>26 June</td><td>Croke Park*</td><td>Division 1 and 2 LGFA League Finals</td><td></td></tr>
<tr><td>26 June</td><td>Morton Stadium, Santry</td><td>Athletics Ireland National Championships</td><td>Up to 400</td></tr>
<tr><td>26 June</td><td>Tolka Park</td><td>WNL Shelbourne vs Cork</td><td>unclear</td></tr>
<tr><td>26 June</td><td>Phoenix Park</td><td>Outdoor music festival type event - fully seated</td><td>3,500</td></tr>
<tr><td>26 June</td><td>INEC Club, Killarney, Co Kerry</td><td>Music performance indoors (hotel setting) – fully seated</td><td>200</td></tr>
<tr><td>End of June</td><td>The Curragh</td><td>Race Meeting</td><td>1,000 for one day of the three day event</td></tr>
<tr><td>01 July</td><td>Mount Juliet, Kilkenny</td><td>Irish Open Golf (European Tour)</td><td>unclear</td></tr>
<tr><td>02 July</td><td>Tallaght Stadium</td><td>LoI Shamrock Rovers v Dundalk</td><td>unclear</td></tr>
<tr><td>03 July</td><td>Aviva Stadium</td><td>Ireland v Japan</td><td>unclear</td></tr>
<tr><td>03 July</td><td>Semple Stadium – Thurles</td><td>Munster GAA Hurling Semi Final Cork v Limerick</td><td>unclear</td></tr>
<tr><td>04 July</td><td>Dr. Hyde Park</td><td>Connacht GAA Football Championships – Roscommon v Galway</td><td>unclear</td></tr>
<tr><td>10 July</td><td>Aviva Stadium</td><td>Ireland v USA</td><td>unclear</td></tr>
</table>

Guidance/protocol on conduct of pilot events
▪ The measures recommended in the guidelines offer multiple layers of protection and pre-event testing will not be required.
▪ Fans will need to wear masks throughout the events, will be seated and socially distanced from other fans.
▪ All spectators will need a ticket which will record their name in case contact tracing is needed after the event.
▪ For the trial events no food and beverages will be available.
▪ A code of conduct for fans will be devised for each event and health declarations will be expected from all attendees.
▪ Entry times will be staggered to allow for efficient and safe throughput of fans.
▪ All Spectators should be encouraged to download the HSE COVID Tracker App.
▪ Organisers may also request/require Spectator's to complete health declarations as part of their ticketing process.
▪ There will be contact tracing tied to each ticket which will be held for 28 days, to support the HSE if there is a case linked to the event.
▪ Full details of guidelines for Reopening Sports grounds can be found here.

Results
Unclear when results will be available</td></tr>
<tr><td>Italy[96, 221]</td><td>Information on pilot events</td></tr>
</table>

Country/ organisation	Pilot events
	No national pilot events identified. There is evidence of local and regional pilots ongoing, though information is limited. Two such pilot events planned for June which will require pre event testing (<12 hours) or proof of vaccination status via the mobile Vax Pass app. Two precautionary measures will be implemented: masks must be worn at entrance and no congregating around the bar counter and serving areas. *Dates and location* 12 June at Rodolfo Rotundo's Atmosphere, Calabria. 26 June at Domenico Iofalo's Dalì Beach Club, Calabria. *Guidance/protocol on conduct of pilot events* None available. *Results* Unclear when results will be available. However, the results will be used to inform local safety protocols developed for the safe reopening of the discos immediately for outdoor events and, in September for indoor events. *Additional information* None
Netherlands[71, 72, 115, 122, 222, 223]	**Information on pilot events** Throughout April a series of over 400 pilot events involving over 200,000 participants in total were organised by the Dutch government in conjunction with the events industry, and academic partners. These events occurred across the Netherlands, with varying numbers of participants at each event. There were 6 types of activities in the pilot phase which include 5 testing for access pilots, and field labs/café events: ▪ Sports and youth activities ▪ Casinos and arcades ▪ Zoos, adventure and amusement parks ▪ Cultural activities (e.g. monuments, museums, theatres, concerts and music venues) ▪ Business meetings ▪ Field labs events and field lab cafes. The testing for access pilots investigate: ▪ whether visitors are confident that it is safe enough ▪ what the visitors think beforehand to test for access ▪ what the organisations think of the check on a valid negative test certificate at the gate ▪ whether the supporting ICT and apps work properly, for example the CoronaCheck app ▪ whether the specially built test lanes are working properly.

Country/ organisation	Pilot events

Guidance/protocol on conduct of pilot events including, dates and locations

1. Test for access pilots

Registration in advance and a negative test (Rapid tests validated by the RIVM that are administered by a qualified healthcare professional unclear if PCR, LAMP or antigen) are required in advance (within 40 hours of event). The negative test result can be displayed via an app. Children under the age of 12 may enter without a test certificate.
Public health measures must be adhered to (e.g. social distancing, hand hygiene, face masks (where required)) at pilot 'test for access' events.

Number of visitors allowed per pilot event is partly dependant on the epidemiological situation

- small-scale activities with a maximum of 500 participants per day
- large transfer locations (e.g. zoos) with a maximum of 5,000 people per day
- for stadiums, a maximum of 50% of what was possible in September.

2. Field lab/field café

The field lab/café events are controlled experiments. These studies investigate how an event can occur safely with a larger audience and generally without adherence to the usual public health measures. Generally required testing before and after (5 days) the event. Fieldlab has a step-by-step plan, where in 6 phases events will go to 100% capacity, sitting/standing without measures in Jan 2022

The Fieldlab events started in February 2021 with small events (Phase 1), and used PCR testing (48 hours in advance of event and 5 days after).

- a business seminar with 500 visitors
- a theatre performance with 500 visitors
- football matches (1,500 visitors)
- concerts (1,500 visitors).

During the ongoing 2nd phase of field lab events, the following practical tests are permitted under strict conditions:

Field lab events				
Date	**Type of event**	**Event name**	**Place**	**Number of participants**
27 March	Outdoor active	Football match: World Cup Interland	Amsterdam	5,000
15 April	Indoor pop concert	3FM Awards	Utrecht	1,500
7 May	Concert	BackToLive	Den Bosch	3,500
8 May	Outdoor sports competition	Mudmasters	Haarlemmermeer	9,000
14 May	Indoor concert	Residentie Orchestra in Zuiderstrandtheater	the Hague	1,000

Country/ organisation	Pilot events

15 May	Nightclub	Clubs Amsterdam	Amsterdam	1,000
16 May	Sports game	Marathon	Enschede, Twente Airport	5,000
20 May	Scholarship	Summit	Utrecht	3,000
17-22 May	TV / music recording	Eurovision song contest	Rotterdam	3,500
May (date not yet known)	Concert	Starting shot Gala	East Gelre	10,000
May (date not yet known)	Festival with overnight stay	BackToLive Walibi	Biddinghuizen	9,000

Specifically, during phase 2, the mandatory PCR tests have been replaced by rapid tests. If the rapid test is positive a PCR test is undertaken. These rapid tests must be undertaken 24 hours prior to the end of the event. For each pilot, a sample of approximately 10% of visitors are taken with the rapid antigen test (Panbio, COVID-19 Antigen Rapid Test from Abbott) in addition to the pre-event test (rapid antigen or PCR test administered at a designated test centre in advance of the event). Another rapid test is required 5 days after the event.
During these field labs, investigators will examine:

- how people meet
- how long they meet for
- how people respond to different measures
- the way in which visitors are checked for temperature and rapid tests on location.

Similarly, the Fieldlab Cafes, were controlled experiments undertaken in 5 bars and cafes in Utrecht city between 14 and 17 April 2021. Reservation and negative test (rapid test) (between 48 and 24 hours before) was required in advance. Participants were asked to adhere to public health measures at these venues. Guests' and staff behaviours were observed by researchers. Participants were asked to complete a questionnaire afterwards Fresh air supply was also monitored. Testing after the event was not required.

Results

Reports are available for some of the Phase 1 field lab studies conducted. These include a business conference and a theatre performance with 500 visitors (type 1 study), and also football matches, with up to 1,500 visitors (type 3 study). Results are now available for type 2 (indoor concert) and type 4 studies (festivals) (see Appendix 1). The results are only available as reports conducted by the researchers and are not peer-reviewed or in pre-print format. Phase 2 trials with large numbers of participants in a range of different settings are ongoing.

Based on Phase 1 findings, FieldLab researchers concluded that indoor events with passive audiences (e.g. business conference, theatre performance) can take place safely, even at high SARS-CoV-2 incidence. The researchers recommended relaxing social distancing measures and putting in place pre-event or access testing and other measures.

- rapid test at a decentralised location, close to home, a maximum of 24 hours before the end of the event, using an App for proof of negative test result

Country/ organisation	Pilot events
	▪ 50% capacity and no need for social distancing ▪ groups separated from each other ▪ face masks ▪ high quality ventilation ▪ active communication regarding measures in place. Based on another phase 1 pilot, FieldLab researchers also concluded that outdoor events with an active audience (e.g. football matches) can take place safely, even at high SARS-CoV-2 incidence. The researchers recommended relaxing social distancing measures and putting in place pre-event or access testing and other measures. ▪ rapid test at a decentralised location, close to home, a maximum of 24 hours before the end of the event, using an App for proof of negative test result ▪ 50-75% capacity and no need for social distancing ▪ Business Seats can be filled on the same basis as regular grandstand sections, the BusinessClub (the indoor area where business visitors stay) can be done with a maximum capacity of 20%. Because of the natural separation, so-called sky boxes can be used on 50-75% capacity ▪ groups separated from each other ▪ face masks only when moving when capacity is up to 50%, but must be continuous between 50%-75% ▪ active communication regarding measures in place. On 28 May, following the results of all 4 Phase 1 pilot events, the Fieldlab Events group submitted a proposal to government, which has yet to be commented upon. The proposal includes a 4-level framework of precautionary measures based on local transmission levels aimed at facilitating events: *Risk level very serious* It is not advisable to organise music, film or other festivals. It is also not advisable to organise events without fixed places or seating, such as pop concerts or indoor dance events, only for a seated audience and with a maximum occupancy of 50%. *Risk level serious* Festivals are possible, albeit under strict conditions. In addition, cultural institutions and events with a permanent place for each visitor can welcome 75% of the total number of possible visitors. All visitors must be tested beforehand. *Risk level worrisome* Theatre performances, concerts with seated audiences, business conferences and seminars can take place without prior testing, provided the ventilation is in order. At events, 100% of the available capacity can be used. Visitors are required to wear a mask when in motion and that the public flows in and out regulated, remotely and with time locks. For (professional) sports events, events without fixed places and festivals and transfer locations, a test in advance is recommended. *Risk level vigilant*

Country/ organisation	Pilot events
	Only for indoor concerts and outdoor festivals rapid tests are still necessary before the event. Everywhere 100% of the capacity can be used, while theatres and other indoor locations must comply with the so-called Building Decree in terms of ventilation. *Additional information* Fieldlab has come under fire as events have grown bigger and COVID-19 cases in the Netherlands surged. A music festival for 10,000 people on 24 April was banned by the host city, Breda, after more than 300,000 people signed a petition opposing it. Additionally, more than 350 researchers criticised the studies in an open letter that complained of a lack of peer review, an in transparent setup, and ethical failings. The studies didn't need approval from a medical ethics committee because they didn't meet the legal definition of medical research, a panel at Radboud University Medical Center ruled. But the authors of an open letter say Fieldlab should have followed ethical guidelines for research in the social and behavioral sciences, which stipulate that participants give their informed consent and researchers assess the potential drawbacks for individuals and society. Ongoing Fieldlab events include the delayed European Football Championship (EURO 2020). For all four matches taking place in the Johan Cruijff Arena in Amsterdam, a negative rapid antigen test result, taken the day of the match, is required for entry as part of the ongoing Fieldlab pilot events.
Norway[98, 224, 225]	**Information on pilot events** A series of pilot concert events (each with a capacity of around 5,000 people) will be trialled in June. The aim is to recruit a total of 30,000 participants for the various events. *Dates and location* June, location(s) unclear *Guidance/protocol on conduct of pilot events* A protocol for a randomised controlled trial using antigen testing and contact tracing to assess the effectiveness of a range of measures for mass events. The test events will only include unvaccinated participants aged 18 and 45 with no underlying risk factors and have not tested positive for COVID-19 in the previous six months. Half of the test group will be randomised to attend concerts and shows under various conditions (with/without face masks and social distancing), while the other half will be randomised to a control group and will not attend any concert or event. Those who are allocated to the concert group may be randomised a second time, to different forms of infection control measures, e.g. to wearing a face mask, or not (to be decided). The concert group will then be tested before and after the event has taken place. The control group will be tested afterwards only using PCR tests. All concert goers receive antigen test 72 hours or less before the event either by self-testing or at testing facilities (to be decided) and PCR test 6-8 days after the event. Those who test positive will be excluded from attending the concert and will immediately be offered a PCR-test. Main outcome is PCR test results with secondary outcomes including clinical COVID-19 disease in participants and close contacts, hospital admissions, rapid test false positives and number of quarantined persons. The relationship between the number of close contacts (based on data from contact tracing app) and COVID-19 risk will also be assessed.

Country/ organisation	Pilot events
	A minimum of 23,000 participants are required in order to achieve statistical power. Trials registration: NCT04898127 ***Results*** Estimated Primary Completion Date: June 2021 Estimated Study Completion Date: December 2021
Portugal[61, 62, 100, 223, 226, 227]	**Information on pilot events** A series of 4 pilot events took place in Portugal in early May. The largest of which was a comedy pilot test event undertaken in Lisbon on 9 May 2021 involving 1,000 attendees, that is two-thirds of capacity. The event was indoors. Portugal's football league scrapped plans to welcome fans back into stadiums for the final round of fixtures on 17 May as it was decided that conditions could not be met for test-pilot events to take place and thus the return of fans for this event was not authorised. A pilot event that was set to take place on 19 May was cancelled for spectators. The Champions League final was held in Porto, Portugal on 29 May 2021, involving over 12,000 spectators from the 2 participating UK clubs, which was organised by UEFA, the Portuguese Football Federation and had input from the Ministry of Health and the General Directorate of Health. Testing was conducted prior to the match. There does not appear to have been any analysis published relating to this event, however newspaper reports suggest that a large number of passengers on the flights home to the UK were notified of being close contacts. ***Dates and location*** May 2021, Lisbon, Porto and other locations ***Guidance/protocol on conduct of pilot events*** Pilots: Attendees had to undergo testing prior to the event and had to wear face masks for the duration of the event. Only people living in Portugal, between 18 and 65 years old could attend. Attendees must not have belonged to a risk group, could not have been infected in the previous 90 days and must have had a negative antigen test prior to the event. Champions League Final: A negative PCR test was required for entry to the stadium (as well as prior to both flights for those flying to/from the UK). ***Results*** Unclear when results will be available
Spain[101-103, 130, 228]	**Information on pilot events** Various pilot events are underway or have been completed across Spain. On 12 December 2020, a randomised controlled trial involving over 1,000 individuals was undertaken in Barcelona, with over 500 participants randomised to attend the concert. On 27 March 2021, a 5,000 people pilot concert was held at Palau Sant Jordi in Barcelona, with the objective of establishing a new protocol for organising events. Various events were held in Girona, including a clubbing night on 2 May 2021. Additionally, a series of pilot events consisting of 10 events and 4,000 people is also planned for Barcelona with the first event to start on 21 May. However, details are sparse but according to a news article facemasks were mandatory

Country/ organisation	Pilot events
	throughout the event, QR codes are to be used to identify participants for contact tracing, ventilation would be enhanced and hand hygiene stations would be placed throughout the venues. No further details or results are available. ***Guidance/protocol on conduct of pilot events*** ***1. Pilot concert in Sala Apolo, in Barcelona, 12 December 2020*** All participants signed an informed consent, were 18-59 years, had no comorbidities, were not living with old household contacts, and had not been diagnosed of COVID during the last 14 days. All of them had a same-day entry screening with a negative SARS-CoV-2 antigen test and a transcription-mediated amplification test (TMA) performed in nasopharyngeal swabs by health-care personnel. All TMA-positive samples were re-tested by RT-PCR. Study participants with a negative result on Ag-RDT were randomly assigned 1:1 to either enter the indoor live event (experimental arm) or not entering the event (control arm). All study participants were visited 8 days after the event for nasopharyngeal swab collection and TMA test (follow-up day 8 test). A series of safety measures were implemented inside the venue as well. There was a delimited outdoor place for smoking inside the building with a strict control of the number of people in the place. The bar zone (with a capacity of 1600 attendees) was located in a supplementary room and drinks were served only in that zone. Alcoholic beverages were allowed. Participants were asked to remove the face mask only when drinking. A certified N95 cloth mask was given to every participant at the venue entrance. Mask wearing was mandatory during the entire event, but no physical distancing was required in the concert room (with a capacity of 900 persons), where singing and dancing was permitted as well. All air flows and room ventilation were optimized in the two indoor rooms and air exchange was monitored along the entire event. ***2. Pilot concert held at Palau Sant Jordi in Barcelona, 27 March 2021*** The event took place without physical distancing requirements, but to access the concert, a negative antigen test result was required. Tests were carried out the same day of the concert by specialised medical teams resulting in six people tested positive that could not enter to the concert. Attendants were from 18 to 65 years old and had to wear FFP2 masks, provided by the organisation. Additionally, their body temperature was checked at the entrance, hand sanitiser was available throughout the premises and access to the premises, bar service and toilets was divided by sectors in groups of 1,800 people. In addition, attendants could also take part, on a voluntary basis, in an observational study aimed to assess SARS-CoV-2 infection rate over 14 days after the event. ***3. Various events including indoor clubbing at Girona, 2 May 2021.*** Entry was allowed to people who had undergone an antigen COVID-19 test, showed a negative PCR test or had proof of previous infection ***Results*** ***1. Pilot concert in Sala Apolo, in Barcelona, 12 December 2020*** In the final intention-to-treat analysis (ITT-exposed), none of the 463 participants in the experimental group were infected with SARS-CoV-2 (incidence 0%; 95% credibility intervals: 0% -0.7%) whilst in the control branch (without access to the concert) 2 of 496 participants were infected

Country/ organisation	Pilot events
	(incidence 0.4%; credibility intervals 95%: 0.1% -0.8%). The authors concluded that attending a live music concert staged with a series of security measures that included a negative antigen test for SARS-CoV-2 done on the same day, was not associated with an increase in COVID-19 infections. These results are discussed in RQ2. *2. Pilot concert held at Palau Sant Jordi in Barcelona, 27 March 2021* A press release on 27 April stated that six out of the 4,592 attendants, who agreed on taking part of the study, were COVID positive within the 14 days after the concert. This meant a cumulative incidence of 131 cases per 100,000 inhabitants, which was lower of the cumulative incidence in Barcelona in the same age group and during the same period of time (259 cases per 100,000 inhabitants). The researchers stated that 4 out of the 6 cases were suspected to have not occurred in the concert. Researchers concluded that the concert did not have an impact on SARS-CoV-2 transmission among the concert attendants and this pilot has shown that live concert with 5,000 attendants screened the same day, wearing masks and in a well-ventilated place could be a safe activity. A full report of the study findings are yet to be released. *3. Various events including indoor clubbing at Girona, 2 May 2021.* No results are available as of yet.
Sweden	None identified
UK countries	
England[105, 116, 119, 121, 139, 229-233]	**Information on pilot events** The Events Research Programme are carrying out pilots in a series of venues to gather evidence on the transmission risks associated with different settings, and potential approaches to managing and mitigating transmission risks. Early pilots focussed on demonstrating COVID-status through testing alone, while later pilots will seek to incorporate data on vaccination and acquired immunity. The Events Research Programme will examine the extent to which COVID-status certification would help towards the return of crowds to mass events and closed settings, from football matches to theatre performances, and the reopening of nightclubs. The programme will be run across a range of venue and activity types, including the World Snooker Championship at the Crucible in Sheffield and the Circus nightclub in Liverpool, and a crowd of up to 20,000 at Wembley for the FA Cup final on 15 May. A second phase of pilots started at the end of May. These implementation pilots will provide additional evidence for organisers and consumers on the logistical and practical considerations of reopening events safely. To ensure safety each event will only go ahead on the basis of robust national and local approvals. *Dates and locations* The Events Research Programme's first phase of pilots includes: ▪ FA Cup Semi Final, Wembley Stadium (18 April) ▪ World Snooker Championship, Crucible Theatre, Sheffield (17 April - 3 May)

Country/ organisation	Pilot events
	▪ Luna Cinema, Liverpool (23-25 April) ▪ Mass participation run, Hatfield House, Hatfield (24-25 April) ▪ Carabao Cup Final, Wembley Stadium (25 April) ▪ ACC Business Event, Liverpool (28 April) ▪ Circus Nightclub, Liverpool (30 April - 1 May) ▪ FA Cup Final, Wembley Stadium (15 May) The second phase of pilot events planned for June, include but are not limited to: ▪ UEFA EURO 2020 matches, Wembley Stadium (13 June and 18 June). Maximum of 22,000 per match. ▪ Three-day festival pilot event, Donington Park 18-20 of June. The capacity at the festival will be 10,000 people. The three 10k runs - set to take place at Hatfield Park with 3,000 people and up to 3,000 spectators at each event (outdoor, mass participation run) over the course of 24-25 April have been postponed, with organisers seeking an alternative venue. The Government has selected events based on settings that cover a range of criteria, including different audience capacities, outdoor and indoor venues and different layouts. In order that the results are widely applicable, they will test some settings and layouts more than once thereby increasing the evidence base. The pilot findings will be transferable across different sectors, maximising the output from a small number of studies. Further events may be announced in due course. *Guidance/protocol on conduct of pilot events* ▪ Hand sanitiser will be available at all events. Attendees should bring their own face masks as they may still be required to wear them around the venue. ▪ Attendees will be subject to scientifically and ethically designed pre- and post-event monitoring to gather evidence associated with different settings and approaches to managing and mitigating transmission risk. ▪ Attendees must produce a negative Lateral Flow Test (LFT) result from that day of, or the day before to enter the scientific pilot event. Testing will largely be delivered through the existing community testing network, with results validated by the event organisers before ticket-holders are admitted to the venue. ▪ Attendees will be asked to take pre- and post-event home PCRs tests, carried out to inform the research. Further information on booking these tests will be sent to attendees prior to the event. ▪ Walk or cycle to the event where possible. ▪ If using public transport, you should regularly sanitise your hands, wear a face covering unless you are exempt, and social distance where possible. ▪ It is a legal requirement that, unless exempt, you must wear a face covering on public transport and inside transport hubs, e.g. train stations. You could be fined £200 minimum if you do not comply.

Country/ organisation	Pilot events
	▪ If travelling by car, you should avoid sharing a car with anyone outside of your household or support bubble. If this isn't possible, you should open the windows, wear a face covering, unless exempt, and leave seats free to social distance. Guidance specific to the UEFA EURO 2020 matches, Wembley Stadium (13 June and 18 June) Ticket holders based in the UK will need: ▪ Proof of a negative LFT, reported and demonstrated via a text message or email from NHS Test and Trace. This can be on your device (including a screenshot) or a printout. The test needs to be taken within 48 hours of the time stadium gates open (meaning 3 hours before match kick-off). ▪ Or proof of full vaccination - both doses received at least 14 days prior to the match (demonstrated via the NHS App or via the Scottish or Welsh vaccination record services). Ticket holders based elsewhere will need: ▪ Proof of a negative LFT, reported and demonstrated via a text message or email. The test needs to be taken within 48 hours of the time stadium gates open (meaning 3 hours before match kick-off). ▪ Any other test results, e.g. a PCR test result from a private company, will not be accepted and entry will be denied. Other requirements: ▪ Spectators must retain at least 1m distance from others. ▪ Ticket holders must ensure that face coverings are worn at all times, including when seated in the stadium bowl. Guidance specific to the Three-day festival pilot event, Donington Park 18-20 of June ▪ You'll need to take a LFT at home and it has to be negative for you to enter the event. ▪ A PCR test will also be required before you get to the event, it is recommended to drop it in a Priority Post Box before you get to the event ▪ Five days after the event, you'll be asked to take a second PCR test and send it back to the Events Research Programme (ERP). ▪ There will not be a requirement to wear a mask or social distance. ▪ You will still need to follow current COVID guidelines in regards to masks and social distancing in the car parks and drop off/pick up points. ***Results*** It is unclear when the results of these pilot studies will be announced. However, it has been noted that findings will be reported to the Prime Minister to feed into wider discussions around Step 4 of the lockdown restrictions. Three-day festival pilot event at Donington Park: Researchers from Public Health England will be overseeing the study. They will be gathering data on transmission risk, the suspension of social distancing and face coverings over several consecutive days. It is unclear when the results will be published. ***Other relevant information***

Country/ organisation	Pilot events
	The Government has established programmes of work to consider different aspects of how they should handle reopening of mass gathering events. One of the programmes of work includes a review of COVID-Status Certification. COVID-status certification acquired through vaccinations, testing or natural immunity is being taken into consideration when considering the reopening of mass gathering events. COVID-status certification aims to provide reassurance that an individual is at reduced risk of transmission. This could allow some freedoms to be restored more safely, for example by allowing mass events to admit more participants and social distancing rules to be relaxed. COVID-status certification could potentially play a role in settings such as theatres, nightclubs, and mass events such as festivals or sports events to help manage risks where large numbers of people are brought together in close proximity. The Government will begin to trial COVID-status certification in certain settings, including large events, through the Events Research Programme. There have been some criticisms of the Events Research Programme, particularly with regards to the Liverpool 'rave'. The criticisms surround the ethics of conducting such high risk activities in the absence of masks and social distancing, and the risk that attendance may present for contacts or household members who did not attend, as well as the risk to the wider community. Additionally there are concerns regarding the optional nature of follow-up PCR testing and the fact that even clinically extremely vulnerable people could attend. Further large pilot events are planned as part of the second phase of Events Research Programme, including Royal Ascot, which will take place from 15 to 19 June 2021, with 12,000 people permitted to attend each day.
Northern Ireland[97, 234, 235]	**Information on pilot events** The Northern Ireland Executive agreed to use the Irish Cup final as part of a study to inform the future safe return of spectators to large scale venues. Up to 1,000 fans will be able to sign up to attend. The Culture Minister announced on 24 May that further pilot live events are due to take place in June and July. *Dates and locations* 21 May 2021, Mourneview Park Football Stadium in Lurgan. *Guidance/protocol on conduct of pilot events* ▪ Access to the match will be strictly controlled and on a ticket-only basis to enable contact tracing systems to work effectively. ▪ All attendees will be asked to carry out a rapid COVID LFT no more than 48 hours before the event. ▪ Guests who test positive using the rapid COVID test should seek a confirmatory PCR (laboratory processed) test. ▪ Guests attending the event may be chosen at random to undergo rapid COVID testing prior to being admitted to the ground as an additional safeguarding measure. ▪ Attendees will be asked to perform follow up rapid COVID tests on days 2 and day 8 after the event. ▪ No-one with symptoms of Covid-19 will be permitted entry to the event. ▪ Reduced social distancing measures will be in place for the purposes of this event only. ▪ No food or beverages will be served at the game. ▪ Behaviours of spectators will be monitored. ▪ Fans will be invited to provide feedback after the event. ▪ Participants will be asked to ensure that face coverings are worn at all times, even when seated.

Country/ organisation	Pilot events
	Results Unclear when results will be available
Scotland[106]	The 'Restarting the Events Sector Pilot Events at Scottish Rugby' document provides a summary of mitigation strategies that can be implemented to reduce the risk of SARS-CoV-2 transmission at an event. The document provides an overview of a pilot rugby event that occurred, however it is unclear when exactly this event occurred and what the results were.
Wales[107]	**Information on pilot events** Under the guidance of Welsh Government, the pilot business event at Celtic Manor on 20 May tested the risk mitigation measures proposed for the industry with a range of stringent health and safety measures in place. The Pilot Event at the Celtic Manor Resort was one of nine indoor and outdoor pilot events throughout South Wales, in partnership with Welsh Government. Public Health Wales officials were present to observe the event and provide feedback to Welsh Government. Survey responses will also be gathered from attendees to shape the business events reopening strategy in Wales. ***Date(s) and location*** 20 May 2021, Celtic Manor. Dates and locations of other pilot studies are unclear ***Guidance/ protocol on conduct of pilots*** Attendees were asked to carry out a COVID-19 LFT on arrival, having already secured a negative PCR test in the days prior, 3 separate colour groups were assigned to manage delegate flow, and mask wearing was required when not seated for sessions. Capacity at the event was 100 people, ordinarily the location can hold more than 1,000 people. 2 meter physical distancing had to be maintained at all times. ***Results*** None identified to date.
Other countries	
Israel	None identified
Switzerland[69, 236]	**Information on pilot events** **Step 1: Pilot events from 1 June 2021**

Country/ organisation	Pilot events
	Pilot events are possible from 1 June. The maximum number of people for indoor events is 600 people, as suggested in the consultation. Up to 1,000 people can take part in outdoor pilot events instead of the 600 as originally planned. Five instead of three pilot events can be carried out per canton. For outdoor events, the mask requirement is waived at the seat. **Step 2: Major events from 1 July, 2021** From 1 July, major events are possible again. The maximum number of people for indoor events remains, as suggested, at 3,000 people. Outside, on the other hand, large events with compulsory seating and two thirds of the capacity, contrary to the preliminary draft, can now take place with a maximum of 5,000 instead of 3,000 people. For outdoor events with standing room, such as open airs, a maximum of 3,000 people are permitted, at half capacity and with a mask. Admission to major events is limited to people who have been completely vaccinated, have recovered from Covid-19 or have had a negative test result. The Covid certificate should be used as soon as it is available. **Step 3: Major events from 20 August 2021 with 10,000 people** From August 20, major events with a maximum of 10,000 people can take place. The consultation was originally scheduled for 1 September. There are no longer any capacity restrictions indoors. For outdoor events with compulsory seating, there should also be no audience restriction. The third step is closely linked to the start of the stabilisation phase, when all persons willing to vaccinate have been vaccinated. ***Protective shield: deductible and deductible reduced*** In order to support the implementation of events of greater importance than the cantons, Parliament introduced a "protective shield" for the event industry in the spring session of 2021 with the new Art. 11a of the Covid-19 Act. This means that public events can be planned before it is clear whether the epidemiological situation allows them to be held. The federal government and the cantons contribute to the uncovered costs for events that have to be cancelled or postponed due to the epidemiological situation. The condition for compensation is that the canton has approved the public event concerned and has also placed it under the protective umbrella. Other conditions include a group of visitors that goes beyond the canton in which the event takes place and the participation of at least 1,000 people per event day. ***Dates and locations*** June 2021, locations unknown. ***Guidance/protocol on conduct of pilot events*** None identified. ***Results***

Country/ organisation	Pilot events
	Unclear when results will be available
US CDC[108, 109]	No pilot events identified. However, various sporting events with large crowds have occurred in the US since April 2021. The decision to allow spectators to return is made at the State-level.

Key: Ag – antigen; CDC – Centers for Disease Control and Prevention; ECDC – European Centre for Disease Prevention and Control; ERP – Events Research Programme; FFP – filtering facepiece; HMG - Her Majesty's Government; LAMP - Loop-mediated Isothermal Amplification; N/A – not applicable; NHS – National Health Service; PCR – polymerase chain reaction; PPE – personal protective equipment; RIVM – Dutch National Institute for Public Health and the Environment; WHO – World Health Organization.

Appendix 3 Characteristics and outcomes of included studies

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
Randomised controlled trial					
Revollo 2021 Spain DOI: 10.1016/S1473-3099(21)00268-1 RCT (peer reviewed)	**Type:** Indoor Concert **Sample size:** Total number randomly assigned = 1,047 With full follow-up data = 960: 465 in experimental arm, 495 in control arm Staff members = 58 **Demographics:** Eligible participants were adults aged 18 to 59 years with a negative result in an Ag-RDT performed on a nasopharyngeal swab collected immediately before entering the event. Participants with known COVID-19 diagnosis within the 14 days before the event, relevant	**Public health measures in place:** Pre-event ▪ Exclusion of vulnerable groups. ▪ Installation of two Apps (contact tracing app and an app for transferring results/completing questionnaires). ▪ Limited numbers Day of the event ▪ Health screening ▪ Antigen testing ▪ Face masks (N95) – mandatory ▪ Adequate ventilation ▪ Congestion control ▪ Specific area for drinking and smoking ▪ Hand sanitiser ▪ Temperature and CO_2 control ▪ Adequate ventilation ▪ All staff tested After the event	**14 day incidence of COVID-19 per 100,000 population:** 219 **Total number of COVID-19 vaccine doses administered per 100 population:** 0 **Proportion of population fully vaccinated (%):** 0	**Biological/epidemiological:** Pre-event ▪ Of 960 randomised participants, 0 had a positive Ag RDT at baseline screen, but 28 (2.9%) had a positive TMA result (13 in experimental and 15 in control arms), of them 2 had a positive RT-PCR (1 in experimental and 1 in control arms). Ct value of both was 37. ▪ All 28 TMA positive participants had previously been diagnosed with COVID-19 within a median of 50 days prior to the event. 0 of the 28 samples showed a cytopathic effect on cell culture. ▪ All staff tested negative for Ag-RDT and RT-PCR at baseline. After the event: ▪ 0 of the 465 people in the experimental arm became infected with SARS-CoV-2 (observed incidence 0%; Bayesian estimated incidence 0.14%; 95%CI: 0% to 0.61%) versus 2 out of 495 controls (0.31%; 95%CI: 0.04% to 0.73%). ▪ No significant difference in incidence between the two arms. ▪ The Bayesian estimate for the incidence between the experimental and control groups was –0.15% (95% CI –0.72 to 0.44). ▪ All staff tested negative for RT-PCR at follow up.	▪ This study provides evidence on the safety of indoor mass gathering events conducted during a COVID-19 outbreak under a comprehensive preventive intervention based on same-day screening with Ag-RDT, compulsory facial mask-wearing, and adequate ventilation. ▪ The results regarding virological assessment

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
	comorbidities, or living with older people were excluded. mean age, 33.6 years (SD 8.6); male, 783 (81.6%) **Setting:** Indoor, live event, with an active crowd Salo Apolo, Barcelona, Spain. 12 December 2020. Duration of 5 hours. Night time. **Pre/post event activities:** NR	▪ Health screening (10 days after event) ▪ Follow-up testing – day 8 **Testing strategy:** ▪ Ag-RDT from 9 hours before the event alongside sampling for TMA and RT-PCR. ▪ Participants with negative Ag-RDT were randomly assigned to experimental arm or control arm. ▪ TMA result reported 24-48 hours after the event. ▪ All TMA positive samples were re-tested for RT-PCR, assessed for viral isolation on cell culture, and affected patients were contacted via phone for a structured interview. ▪ All study participants were visited 8 days after the event for follow up RT-PCR, Ag-RDT and TMA test		**Environmental:** ▪ The air concentration of CO_2 did not exceed the recommended threshold of 800 ppm at any measurement during the event. ▪ The number of complete air exchanges per hour in the two rooms ranged from 11 to 13. **Behavioural:** Participants spent an average of 2 hours 40 mins in the concert. In the post-event questionnaire, participants expressed their willingness to attend another activity with the same safety protocol (median score 9.29 out of 10, IQR 9–10). **Healthcare utilisation:** NR	suggest that a baseline screening might allow easing some of the additional preventive measures, particularly in indoor events with pre-assigned seats (i.e., theatres), associated with lower transmission risk.
Uncontrolled, before-after studies					
Fieldlab A, 2021 The Netherlands	**Type:** A business conference and a theatre performance **Sample size:**	**Public health measures in place** <u>Pre-event</u>	**14 day incidence of COVID-19 per 100,000 population:**	**Biological/epidemiological:** <u>Pre-event tests (PCR)</u> Business conference (n=634 tested): + 6 (0.95%)	▪ The authors conclude that the risk per hour at these types of

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
Uncontrolled, B/A study. https://fieldlabevenementen.nl/wp-content/uploads/2021/04/Fieldlab-Evenementen-Adviesaanvraag-Type-I-versie-1.1.pdf (technical report)	Total = 1,198 Business conference, 634 Theatre performance, 564 **Demographics/ Excluded:** Vulnerable groups excluded (people over 70 years and those with specific underlying conditions as determined by RIVM) **Setting:** Indoor setting, with a passive audience. 15 February 2021 – business conference. Utrecht, the Netherlands. 20 February 2021 – theatre performance. Utrecht, the Netherlands. **Pre/post event activities:** ▪ 63% of attendees at the	▪ Pre-test PCR, maximum 48 hours prior to the event ▪ Group size limitation ▪ Exclusion of vulnerable groups ▪ Request installation CoronaMelder app for contact tracing ▪ Limited numbers Day of event ▪ Triage questions ▪ Temperature measurement ▪ Event logistics ▪ Rapid antigen test (Panbio™ COVID-19 Ag Rapid Test from Abbott) on location in 1:10 ratio ▪ Ventilation according to building regulations ▪ Cohorting ▪ Face mask ▪ Hand sanitiser After the event ▪ PCR post test on day 5 after the event visit ▪ Refrain from visiting vulnerable groups up to 10 days after the event, or until receipt of a negative test result	▪ Business conference: 298 ▪ Theatre performance: 296 **Total number of COVID-19 vaccine doses administered per 100 population:** ▪ Business conference: 4.62 ▪ Theatre performance: 4.62 **Proportion of population fully vaccinated (%):** ▪ Business conference: 0.56 ▪ Theatre performance: 0.56	- 628 ? 0 Theatre (n=564 tested): + 3 (0.89%) - 559 ? 2 *Dropout of 11 of 1,198 due to positive pre-event tests (0.91%) = 910 per 100,00* On-site rapid testing Business conference (n=103 tested): + 0 - 103 ? 0 Theatre (n=89 tested): + 0 - 89 ? 0 After the event tests (PCR) Business conference (n=482 tested, 76% of pretests): + 1 (0.21%) - 481 ? 0 (3 other attendees tested positive post-event via the national test and trace programme. Authors do not believe these 3 were infected at the event) Theatre (n=444 tested, 79% of pretests): + 0	events with measures and pre-testing is equal to the risk in social situations at home or with a visit to home (without testing). The authors conclude that these types of events can occur, even at a high prevalence, provided that the conditions of the following set of measures: ▪ Rapid test at a decentralized location, close to home ▪ Rapid test at maximum 24 hours from the end of the event

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
	theatre performance used a car ▪ 18% used public transport ▪ 13% used a moped ▪ 6% walked.	**Testing strategy:** ▪ PCR 48 hours before, rapid antigen test in random sample during, and PCR 5 days after.		- 444 ? 0 <u>Risk model:</u> The greatest impact is achieved through a validated rapid test, with additional impact of intelligent design and logistics of the event, enabling good inflow and outflow, and adequate ventilation or outside air. Estimated the number of infections per 100,000 people per hour. ▪ Theatre performance from 0.6 to 1.2 ▪ Congress from 0.7 to 1.2 **Environmental:** *<u>Ventilation:</u>* Measurement shows that the limit value of 'too little' ventilation was not achieved during the theatrical performance **Behavioural:** <u>Observation*:*</u> Theatre setting: 98.4% of visitors wore a face mask for entire performance. <u>Survey:</u> Perception of measures by theatre attendees (out of 10, higher scores = more positive) ▪ Face masks while seated 5.7 ▪ Face masks while moving, 6.6 ▪ Spacing of seats, 7.4 ▪ Temperature screening, 6.5 ▪ Staggered arrival, 6.4 ▪ Rapid test, 8.9 ▪ PCR test, 8.9.	▪ Using an app or otherwise access control for a negative test result ▪ Occupation of the location with 50% of the capacity and thus the release of the 1.5 meters measure from the regular RIVM framework within the event location ▪ Use of group separation options based on capacity and site design ▪ Use of a facemask during the on-site movement phase ▪ Ventilation in accordance

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
				Overall experience = 9.1. Sense of security =8.8. Another post-event survey asked attendees to rate their experience of mask wearing: *Entire stay:* 15% positive/very positive, 46% neutral, 39% negative/very negative. *Moving-only:* 20% positive/very positive, 62% neutral, 18% negative/very negative. The use of eye guards was tested in one of the bubbles. 41 (58%) visitors experienced this as neutral, 11 (15%) as positive to very positive, 14 (21%) as negative to very negative. <u>Testing for access preferences (at future events) by theatre attendees</u> ▪ Rapid test, 62% ▪ PCR, 25% ▪ No test, 13% <u>Data monitoring</u> ▪ 92% of the conference visitors and 95% of the theatre visitors installed the app. ▪ 100% of the visitors individually registered ▪ 0% failed health triage questions at entrance ▪ 0% had high temperature <u>Business conference:</u> Similar number of close contacts (>15 mins, <1.5m distance) per person for each bubble (even though some were larger than others) ▪ On average around 7-8 close contacts per bubble. ▪ Most contacts are made in the foyer.	with building regulation ▪ Active communication with visitors, for sharing relevant information and pointing out compliance with the measures. ▪ The authors conclude that with these measures, Type I events have no additional risk of increasing the spread of the virus or increasing hospitalisations.

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
				Theatre*:* Lower number of average contacts at theatre than business conference, between 5 and 7. ▪ Bubbles 2 and 3 (that were smaller and or did not eat during the break) had fewer contacts than the larger bubble that could eat at the break (~5 vs 7). ▪ video analysis: observed that people stayed in their own company in the foyer and therefore kept social distance. **Healthcare utilisation:** NR	
Fieldlab B, 2021 The Netherlands Uncontrolled, B/A study. https://fieldlabevenementen.nl/wp-content/uploads/2021/04/Fieldlab-Evenementen-Adviesaanvraag-Type-III-versie-1.0.pdf	**Type:** Three football matches **Sample size:** *Total = 7,141* Match 1 – 988 Match 2 – 1,045 Match 3 – 5,108 **Demographics/ Excluded:** Vulnerable groups excluded (people over 70 years and those with specific underlying conditions as determined by RIVM) **Setting:**	**Public health measures in place:** Pre-event ▪ Pre-test PCR, maximum 48 hours prior to the event (for match 1 and 2) ▪ Exclusion of vulnerable groups ▪ Request installation CoronaMelder app for contact tracing ▪ Limited numbers Day of event ▪ Rapid test on match day for 3rd match ▪ Triage questions ▪ Temperature measurement ▪ Group size limitation	**14 day incidence of COVID-19 per 100,000 population:** ▪ Match 1: 301 ▪ Match 2: 350 ▪ Match 3: 566 **Total number of COVID-19 vaccine doses administered per 100 population:** ▪ Match 1: 6.1 ▪ Match 2: 8.1 ▪ Match 3: 12.7 **Proportion of population fully vaccinated (%):**	**Biological/epidemiological:** Pre-event tests (PCR) Match 1 (n=988 tested): + 10 (1.01%) - 977 ? 1 Match 2 (n=1,045 tested): + 2 (0.19%) - 1,043 ? 0 Match 2 (rapid test) (n=5,108 tested): + 18 (0.35%) - 5,090 ? 0 *Dropout of 30 of 7,141 due to positive pre-event tests (0.42%) = 420 per 100,000*	The authors conclude that: ▪ the risk per hour at events of these type (with measures and pre-testing) is equal to the risk in social situations at home or with a visit to home (without testing). ▪ social distance measures

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
(technical report)	Outdoor setting, with an active audience. 21 February 2021, Goffert stadium, Nijmegen, the Netherlands. 28 February 2021, Yanmar stadium, Almere, the Netherlands 27 March 2021, Johan Crujiff Area, Amsterdam, the Netherlands **Pre/post event activities:** ▪ 49% of attendees used a car ▪ 36% used a moped ▪ 9% walked ▪ 6% used public transport	▪ Event logistics ▪ Rapid test on location in 1:10 ratio ▪ Cohorting ▪ Face mask ▪ Hand sanitiser <u>After the event</u> ▪ PCR post test on day 5 after the event visit (replaced by rapid test for the 3rd match) ▪ Refrain from visiting vulnerable groups up to 10 days after the event, or until receipt of a negative test result **Testing strategy:** ▪ PCR (or rapid test for 3rd game) 48 hours before, rapid antigen test (Panbio™ COVID-19 Ag Rapid Test from Abbott) in random sample during, and PCR (or rapid test for 3rd game) 5 days after.	▪ Match 1: 0.95 ▪ Match 2: 1.61 ▪ Match 3: 3.33	<u>On-site rapid testing</u> Match 1 (n=90 tested): + 0 - 90 ? 0 Match 2 (n=75 tested): + 0 - 875 ? 0 Match 3 N/A as rapid test on match day for entry. <u>Post-event tests (PCR)</u> Match 1 (n=831 tested, 84% of pre-tests): + 3 (0.36%) - 827 ? 0 (3 other positive cases were notified to the researchers from the test and trace programme. authors believe at least 1 was infected elsewhere) Match 2 (n=858 tested, 82% of pre-tests): + 1 (0.11%) - 857 ? 0 (1 other positive case detected via national test and trace system was notified to the research team. Authors believe case was infected at home the day after the event)	within the venue can be relaxed by using pre-event or access testing and other recommended measures. The authors also concluded that these types of events can, with the right set of measures, take place safely, even at high prevalence of SARS-CoV-2. These measures include: ▪ Rapid test at a decentralized location, close to home ▪ Rapid test at maximum 24 hours from the end of the event ▪ Using an app or otherwise

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
				Match 3 (rapid test) (n=3,718 tested, 73% of pre-tests) + 3 (0.08%) - 3,715 ?0 (Authors notified of 3 other positive cases via national contact tracing service. Not known where cases became infected). About 75% of the visitors had the test carried out afterwards <u>Risk model:</u> The business club bubbles had a significantly higher modelled risk of infection and hospitalisation than the other bubbles. This remains the case even though capacity was at 20% in the Business Club. Estimated the number of infections per 100,000 people per hour. ▪ Match 1 from 0.6 to 1.3 ▪ Match 2 from 0.8 to 1.3 ▪ Match 3 from 1.2 to 1.7 Modelled risk was higher in the 3rd match (that is, the match with the largest crowd). **Environmental:** NR **Behavioural:**	access control for a negative test result ▪ Occupation of the location with 50-75% of the capacity and thus the abandonment of the 1.5 meter measure from the regular RIVM framework within the event location <u>Specific for football stadiums</u>: ▪ Business Seats can be filled on the same basis as regular grandstand sections, the Business Club (the indoor area where business visitors stay)

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
				<u>Observation</u> 1. 94.5% of visitors wore a face mask for entire game. <u>Survey</u> Perception of measures by attendees (out of 10, higher scores = more positive) ▪ Face masks while seated, 6.2 ▪ Face masks while moving, 6.5 ▪ Spacing of seats, 6.6 ▪ Temperature screening, 6.8 ▪ Staggered arrival, 6.9 ▪ Rapid test, 8.0 ▪ PCR test, 8.8. Overall experience = 8.7 Sense of security =8.9 Another post-event survey asked attendees to rate their experience of mask wearing: *Entire stay:* 15% positive/very positive, 50% neutral, 35% negative/very negative. *Moving-only:* 21% positive/very positive, 64% neutral, 15% negative/very negative. <u>Testing for access preferences (at future events) by attendees</u> ▪ Rapid test, 54% ▪ PCR, 33% ▪ No test, 13% <u>Data monitoring</u>	can be done with a maximum capacity of 20%, or in a specific setting ▪ Because of the natural separation, so-called sky boxes can be used on 50-75% of the occupation (in accordance with the regular grandstand). ▪ Use of group separation options based on capacity and site design ▪ Use of a facemask during the movement phase on location when occupied up

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
				▪ 95.1% of visitors installed the app. ▪ 100% of the visitors individually registered ▪ 0% failed health triage questions at entrance ▪ 0% had high temperature ▪ *Match 1:* Similar number of close contacts (>15 mins, <1.5m distance) per bubble (even though some were larger than others), except for one bubble ○ On average around 5-7 close contacts per person, except in one bubble which had an average of 3 contacts per person (people were seated in checkerboard arrangement) ○ Most contacts are made in the foyer. ▪ *Match 2:* Similar number of average contacts per bubble (~4-5), except for one bubble which had a much higher average number of close contacts (~10), and this bubble had a larger number of people in it. ▪ *Match 3:* Two of the nine bubbles were equipped with tags to simulate 50% and 75% capacity, with an average of ~6 and 7 close contacts respectively. Number of close contacts peaked at half time. **Healthcare utilisation:** NR	to 50%, continuous use of face mask when occupied >50 and< 75% ▪ Active communication with visitors, for sharing relevant information and pointing out compliance with the measures.
Fieldlab C, 2021 The Netherlands Uncontrolled, B/A study.	**Type:** Dance event and a music concert **Sample size:** *Total = 3,078* Dance event – 1,589 Music concert – 1,489 **Demographics/**	**Public health measures in place:** Pre-event ▪ Pre-test PCR, maximum 48 hours prior to the event ▪ Exclusion of vulnerable groups	**14 day incidence of COVID-19 per 100,000 population:** ▪ Dance event: 375 ▪ Music concert: 374	**Biological/epidemiological:** Pre-event tests (PCR) Dance event (n=1,589 tested): + 11 (0.69%) - 1,578 ? 0 Music concert (n=1,489 tested):	The authors concluded that these type of indoor, active events can take place, even in high prevalence, provided the following

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
https://fieldlabevenementen.nl/wp-content/uploads/2021/05/Fieldlab-Evenementen-Adviesaanvraag-Type-II-versie-1.0.pdf (technical report)	**Excluded:** Vulnerable groups excluded (people over 70 years and those with specific underlying conditions as determined by RIVM) **Setting:** Indoor setting, with an active audience. Dance event - 6 March 2021, Ziggo Dome, Amsterdam, the Netherlands. Music concert - 7 March 2021, Ziggo Dome, Amsterdam, the Netherlands. **Pre/post event activities:** ▪ 44% of attendees used a car ▪ 42% used public transport ▪ 10% used a moped	▪ Request installation CoronaMelder app for contact tracing ▪ Limited numbers Day of event ▪ Triage questions ▪ Temperature measurement ▪ Group size limitation (in 6 bubbles) ▪ Event logistics ▪ Rapid test on location in 1:10 ratio ▪ Cohorting ▪ Face mask (usage varied by bubble) ▪ Hand sanitiser After the event ▪ PCR post test on day 5 after the event visit ▪ Refrain from visiting vulnerable groups up to 10 days after the event, or until receipt of a negative test result on day 5 **Testing strategy:** ▪ PCR 48 hours before, rapid test (Panbio™ COVID-19 Ag Rapid Test from Abbott) in	**Total number of COVID-19 vaccine doses administered per 100 population:** ▪ Dance event: 8.1 ▪ Music concert: 9.8 **Proportion of population fully vaccinated (%):** ▪ Dance event: 1.6 ▪ Music concert: 2.1	+ 7 (0.47%) - 1,482 ? 0 *Dropout of 18 of 3,078 due to positive pre-event tests (0.58%) = 580 per 100,000* On-site rapid testing Dance event (n=143 tested): + 0 - 143 ? 0 Music concert (n=169 tested): + 0 - 169 ? 0 Post-event tests (PCR) Dance event (n=1,328 tested, 84% of pre-tests): + 8 (0.6%) [inclusive of 1 contact tracing reports] - 1,320 ? 0 Music concert (n=1,275 tested, 86% of pre-tests): + 6 (0.47%) [inclusive of 5 contact tracing reports] - 1,269 ? 0 About 85% of the visitors had the test carried out afterwards	measures are in place: ▪ Rapid test at a decentralised location, close to home ▪ Rapid test up to 24 hours from the end of the event ▪ Using an app or otherwise access control on a negative test result ▪ Occupancy rate depending on the risk level: ▪ In the risk level very serious we would recommend no standing audience ▪ In the risk level serious standing public at 50% of the capacity possible, with

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	▪ 4% walked	random sample during, and PCR 5 days after.		Three of the 14 cases were reported from the national contact tracing service. The authors deduced based on post-event testing and contact tracing investigations that 4 of the 14 infections may be related to the events. Eight of the 14 cases were believed to be old infection. <u>Risk model:</u> The greatest risk reduction was estimated to be achieved by a validated rapid test, with additional impact of intelligent design and logistics of the event, enabling good inflow and outflow, and adequate ventilation of outside air. Estimated the number of infections per 100,000 people per hour: ▪ Dance event from 1.8 to 4.3 ▪ Music concert from 1.5 to 3.8 Estimated average number of close contacts per hour: ▪ Dance event from 5.3 to 15.9 ▪ Music concert from 4.4 to 13.2 Estimated contamination rate by large droplets: ▪ Dance event from 55% to 70% ▪ Music concert from 51% to 68%. Modelled risk was higher in the dance event. Neither event was estimated to be of equivalent infection risk as remaining at home. The estimated risk was highest in both events in the bubble with 100% capacity (standing).	clear divisions in zones for standing audience ▪ From worrisome, 100% occupancy is possible, with measures in place. ▪ Use group segregation options based on capacity and site design ▪ Use of a face mask during the movement phase on location ▪ Active communicatio n with visitors, for sharing relevant information and pointing out compliance

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				The authors acknowledge that the risk is considerably higher in active, indoor events than in previously studied events. **Environmental:** The total fresh air supply to the room prior to the events was set to: 305,000 m^3/h. This corresponds to a ventilation rate of approx. 2.2 (volume of the room is approximately 140,000 m^3). The ventilation system was adjusted to 100% outdoor air. There was 200 m^3/ hour per person of ventilation available during the pilot events in the Ziggo Dome. This is well above the minimum value of 24 m ^{3}/hour/per person as stated in the draft guideline *Dance event:* The authors believe that 2 of the 10 sensors were giving artificially high readings due to the use of CO_2 cannons at the venue (with maximum CO_2 concentrations exceeding 2,000ppm and 4,000ppm respectively). Across the remaining 8 sensors, the average P50 and P95 values for CO_2 concentrations were 689ppm and 767ppm respectively, which are slightly higher than the theoretical pre-calculated CO_2 equilibrium concentration of 600ppm, but still lower than the maximum acceptable limit of 1,700 ppm. CO_2 equilibrium concentration is the concentration at which those present generate as much CO_2 as is removed via ventilation. *Music event:* Across all 10 sensors, the average P50 and P95 values for CO_2 concentrations were 630ppm and 704ppm respectively, which the authors believe fit	with the measures.

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				reasonably well with the theoretical pre-calculated CO_2 equilibrium concentration of 600ppm, and are well lower than the maximum acceptable of 1,700 ppm. No individual sensor recorded a concentration exceeding the maximum limit. **Behavioural:** <u>Observation</u> Poor compliance (not quantified) with face mask usage when in the venue, but better compliance when accessing facilities (e.g. food, toilets) A short observatinal study conducted on a separate group of individuals at the same venue (but not during either event) examined the impact of facemasks on droplet dispersion, The findings of this study were: • most drops fall to the ground within 1m • no drops found on the upper body of persons at 0.5-1m distance • drops present on 'touch' surfaces • masks are effective in preventing droplet spread • 'drinking' activities make masks less effective. <u>Survey</u> Perception of measures by attendees (out of 10, higher scores = more positive) ▪ Face masks while seated, 3.2 ▪ Face masks while moving, 4.6 ▪ Easing of 1.5m physical distance, 9.2 ▪ Temperature screening, 6.2 ▪ Staggered arrival, 6.5 ▪ Rapid test, 7.7	

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				▪ PCR test, 9.4. Overall experience = 8.9 Sense of security = 9.2 Another post-event survey asked attendees to rate their experience of mask wearing: *Entire stay:* 8% positive/very positive, 48% neutral, and 43% negative/very negative. *Moving-only:* 17% positive/very positive, 69% neutral, 14% negative/very negative. <u>Testing for access preferences (at future events) by attendees</u> ▪ Rapid test, 51% ▪ PCR, 42% ▪ No test, 17% <u>Data monitoring</u> ▪ 99% of visitors installed the app. ▪ 100% of the visitors individually registered ▪ 0% failed health triage questions at entrance ▪ 0% had high temperature ▪ *<u>Dance event:</u>* Substantially more close contacts (>15 mins, <1.5m distance) in the 2 bubbles with the highest concentration of people (100% and 75% capacity) compared with the 4 other bubbles with more restricted capacity, or seated, or where people could decide for themselves whether to sit or stand (45-60 vs. 10-20). ▪ *<u>Music concert:</u>* Similar pattern to the dance event, except the overall number of close contacts in each bubble was lower by a factor of 1.5 (~35 vs. 5-10). A	

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				much more erratic pattern of close contact encounters observed at the music concert given the build up to the climax in the music concert, which is not necessarily the case in the dance event. **Healthcare utilisation:** NR	
Fieldlab D, 2021 The Netherlands Uncontrolled, B/A study. https://fieldlabevenementen.nl/wp-content/uploads/2021/05/Fieldlab-Evenementen-Adviesaanvraag-Type-IV-versie-1.0-1.pdf (technical report)	**Type:** Dance festival and a music festival. **Sample size:** *Total = 3,890* Dance festival – 1,927 music festival – 1,963 **Demographics/ Excluded:** Vulnerable groups excluded (people over 70 years and those with specific underlying conditions as determined by RIVM) **Setting:** Outdoor festival setting, with an active audience. Dance festival - 20 March 2021,	**Public health measures in place:** Pre-event ▪ Pre-test PCR, maximum 48 hours prior to the event ▪ Exclusion of vulnerable groups ▪ Request installation CoronaMelder app for contact tracing ▪ Limited numbers Day of event ▪ Triage questions ▪ Temperature measurement ▪ Event logistics ▪ Rapid test on location in 1:10 ratio ▪ Face mask ▪ Hand sanitiser After the event ▪ PCR post test on day 5 after the event visit	**14 day incidence of COVID-19 per 100,000 population:** ▪ Dance festival: 471 ▪ Music festival: 486 **Total number of COVID-19 vaccine doses administered per 100 population:** ▪ Dance festival: 11.5 ▪ Music festival: 12.7 **Proportion of population fully vaccinated (%):** ▪ Dance festival: 2.6 ▪ Music festival: 3.3	**Biological/epidemiological:** Pre-event tests (PCR) Dance festival (n=1,927 tested): + 17 (0.88%) - 1,910 ? 0 Music festival (n=1,963 tested): + 9 (0.46%) - 1,954 ? 0 *Dropout of 26 of 3,890 due to positive pre-event tests (0.66%) = 660 per 100,000* On-site rapid testing Dance festival (n=159 tested): + 0 - 159 ? 0 Music festival (n=158 tested): + 0 - 158 ? 0	The authors concluded that these type of outdoor festivals can take place, even in high prevalence, provided the following measures are in place: ▪ Rapid test at a decentralised location, close to home ▪ Rapid test up to 24 hours from the end of the event ▪ Using an app or otherwise access control on a negative test result ▪ Occupancy rate

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	Biddinghuizen, the Netherlands. Music festival - 21 March 2021, Biddinghuizen, the Netherlands. **Pre/post event activities:** ▪ 56% of attendees used a car ▪ 34% used public transport ▪ 7% used a moped ▪ 3% walked	▪ Refrain from visiting vulnerable groups up to 10 days after the event, or until receipt of a negative test result on day 5 **Testing strategy:** ▪ PCR 48 hours before, rapid test (Panbio™ COVID-19 Ag Rapid Test from Abbott) in random sample during, and PCR 5 days after.		<u>Post-event tests (PCR)</u> Dance festival (n=1,533 tested, 80% of pre-tests): + 12 (0.78%) - 1,521 ? 0 Music festival (n=1,635 tested, 83% of pre-tests): + 14 (0.86%) [inclusive of 2 cases notified by the national contact tracing system) - 1,621 ? 0 About 81% of the visitors had the test carried out afterwards Two of the 26 cases were reported from the national contact tracing service. The authors deduced based on post-event testing and contact tracing investigations that 16 of the 26 infections may be related to the events. The remaining cases are believed to be old infections, caught elsewhere or else unclear source of infection. <u>Risk model:</u> The greatest risk reduction was estimated to be achieved by a validated rapid test, with additional impact of intelligent design and logistics of the event, enabling good inflow and outflow, and adequate ventilation of outside air. Estimated the number of infections per 100,000 people per hour:	depending on the risk level: ▪ In the risk level very serious we would recommend not to have festivals ▪ In the risk level serious standing audience is based on a capacity of 1 m^2 per person, possibly, seated based on 75% of normal occupancy. ▪ From worrisome, 100% occupancy is possible, with measures in place. ▪ Use of a face mask during the movement

First author, Country, Design, DOI	Characteristics of Mass gathering	Public health measures in place	National epidemiological situation at time of event	Outcomes (*biological/ epidemiological, environmental, behavioural, healthcare utilisation*)	Author conclusions
				▪ Dance festival, 3.6 ▪ Music festival, 1.6 Estimated average number of close contacts per hour: ▪ Dance festival, 14.1 ▪ Music festival, 6.2 Estimated contamination rate by large droplets: ▪ Dance festival, 96% ▪ Music festival, 96% Modelled risk was higher in the dance festival. Neither event was estimated to be of equivalent infection risk as remaining at home. **Environmental:** The events were 100% naturally ventilated. It was estimated that the tent's total fresh air supply would be approx. 622,000m^3/h, as long as there was a wind speed of at least 2m/s. This corresponded to a ventilation rate of about 55 given that the volume of the tent is about 11,400m^3. For the approx. 1,500 attendees this means that there would be 414m^3/hour/person, well above the minimum recommended levels of 24m^3/hour/person. If the wind speed fell to only 1m/s. this would equate to a fresh air supply of 311,000 m^3/h, and a ventilation rate of approx. 26, still much higher than the minimum recommended levels.	phase on location ▪ Keep a distance of 1.5m when not at a stage ▪ Active communication with visitors, for sharing relevant information and pointing out compliance with the measures.

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				The theoretical CO_2 equilibrium concentration was estimated to be 510ppm. That is the concentration at which those present generate as much CO_2 as is removed via natural ventilation. *Dance festival:* The actual fresh air supply on the day of the event was 574,000 m^3/h, which was comparable to that estimated in advance. Across all 10 sensors, the average P50 and P95 values for CO_2 concentrations were 534ppm and 757ppm respectively, which are slightly higher than the theoretical pre-calculated CO_2 equilibrium concentration of 510ppm, but still lower than the maximum acceptable limit of 1,700 ppm. The authors believed that the CO_2 cannons affected readings. No individual sensor recorded a concentration exceeding the maximum limit. *Music festival:* The actual fresh air supply on the day of the event was 718,000 m^3/h, which was even higher than that estimated in advance. Across all 10 sensors, the average P50 and P95 values for CO_2 concentrations were 495ppm and 693ppm respectively, which the authors believe fit reasonably well with the theoretical pre-calculated CO_2 equilibrium concentration of 510ppm, and are well lower than the maximum acceptable of 1,700 ppm. No individual sensor recorded a concentration exceeding the maximum limit. **Behavioural:** Observation	

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				Poor compliance (not quantified) with face mask usage throughout entire event. <u>Survey</u> Perception of measures by attendees (out of 10, higher scores = more positive) ▪ Face masks while seated, 2.9 ▪ Face masks while moving, 3.1 ▪ Easing of 1.5m physical distance, 9.6 ▪ Temperature screening, 6.4 ▪ Staggered arrival, 5.1 ▪ Rapid test, 8.5 ▪ PCR test, 9.5. Overall experience = 9.3 Sense of security = 9.6 Another post-event survey asked attendees to rate their experience of mask wearing: *Entire stay:* 3% positive/very positive, 56% neutral, and 40% negative/very negative. *Moving-only:* 5% positive/very positive, 63% neutral, 33% negative/very negative. <u>Testing for access preferences (at future events) by attendees</u> ▪ Rapid test, 62% ▪ PCR, 32% ▪ No test, 6%	

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				Data monitoring ▪ 99% of visitors installed the app ▪ 100% of the visitors individually registered ▪ 0% failed health triage questions at entrance ▪ 0% had high temperature. ▪ *Dance festival:* The number of close contacts was fairly gradual throughout the event, with a peak at the time of exiting. ▪ The average number of close contacts per person (>15 mins, <1.5m distance) was approximately 70, with a maximum number of approx. 170 close contacts reported. Substantially more close contacts were observed with attendees at the dance festival than at the indoor dance event. ▪ *Music festival:* A much more erratic pattern of close contact encounters observed at the music festival possibly due to the manner of the festival programming. A much lower average number of close contacts observed at the music festival in comparison with the dance festival by a factor of 3 (~20 vs. ~70). However, the number of close contacts observed was still relatively high when compared with previous events. **Healthcare utilisation:** NR	
Hagemann et al. 2020	**Type:** sporting event – Ultimate Fighting Championship (UFC)	Pre-event: An area of 11.8 km^2 on Yas Island was identified to be turned into a virus free 'safe zone'. Within this area there were 7 hotels, 29 food	**14 day incidence of COVID-19 per 100,000 population:**	**Biological/epidemiological:** ▪ Prior to departing for Abu Dhabi, 1 fighter tested positive and was symptomatic. Fighter was excluded from the tournament.	This exercise demonstrates that with the correct processes and resources in place,

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United Arab Emirates DOI: 10.1136/bjsports-2020-103511 (peer reviewed)	**Sample Size:** 2,182 people (1,650 local staff and 532 international delegates, including 102 fighters) **Demographics:** NR **Setting:** indoor setting, with active attendees. 1-31 July 2020. An area of 11.8km^2 on Yas island, Abu Dhabi, United Arab Emirates was zoned off with people entering requiring negative PCR tests. **Pre and post event activities:** Pre-event Athlete arrives at airport 24 hours prior to flight to Abu Dhabi, complete PCR test. Can board with negative result. Fighters arrived from	and beverage outlets, 8 swimming pools, a golf course, 4 spas and 5 gyms. Two weeks before the launch of UFC 'Fight Island', the zone was secured; 1,650 local staff went into lockdown and had at least 2 PCR tests prior to the start of the event. Any staff testing positive were immediately removed from the safe zone. During travel, a strict virus transmission risk mitigation strategy was employed: All passengers were required to wear PPE and follow normal hygiene measures with social distancing, while all Etihad crew and airport staff were quarantined and tested regularly for 2 weeks prior to the flights (as were all bus drivers). One of the Abu Dhabi Airport terminals was made available for the exclusive use of the international delegates. All international delegates had to check into an airport hotel 24 hour hours prior to flying to Abu Dhabi and had to receive a negative PCR	▪ Between 1 and 31 July 2020, ranged from 40-72 **Total number of COVID-19 vaccine doses administered per 100 population:** ▪ N/A **Proportion of population fully vaccinated (%):** ▪ N/A At the time of the event, the risk of hosting the event was "Very High Risk" according to the WHO Mass Gathering Risk Assessment COVID-19 Tool due to being in the active phase of the pandemic. The fighters and support teams came from different countries, with	▪ A total of 18,530 samples were collected by 97 nurses and 18,706 tests were conducted (due to retesting of borderline results). ▪ The average turnaround time for reporting was 11 hours and 43 min with an expedited service for fighters and management (sometimes returning results in less than two hours). ▪ During the 4 weeks, 17 tests (0.09% of all tests) returned positive results, but on resampling and retesting two times, all of these were found to be false-positive results, based on cycle threshold (Ct) values. None of these individuals were symptomatic. **Environmental:** NR **Behavioural:** NR **Healthcare utilisation:** NR	it is possible to safely host a mass gathering sporting event of this nature (without spectators) in the active phase of the COVID-19 pandemic.

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	59 different cities across the world. <u>Post-event</u> No information	test before being allowed to board the flight. All international delegates within the safe zone were subjected to 48 hours quarantine on arrival (with another 2 PCR tests conducted 24 hours apart during this time). Delegates could leave their room after 48 hours quarantine and 2 negative PCR test results. <u>During the event:</u> Other risk mitigation measures - ongoing education on hygiene was provided and strict sanitisation measures, social distancing and PPE/mask wearing - were enforced. Participants were subjected to daily temperature and symptom checks and movement into and out of the zone was stringently restricted. Thermal cameras situated throughout the zone continuously monitored peoples' temperatures. Athletes were generally kept away from other participants where possible and had their own private gym and training area adjacent to each of their hotel rooms. There was additional focus on sanitising	different epidemiological situations (no information on country of origin for fighters/delegates given).		

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		the arena before, during and after fights. Everyone within the safe zone was tested two times per week, including 24 hours before an event. Separate isolation rooms were established and anyone testing positive or leaving and re-entering the zone was placed in these areas. 48 hours quarantine and two negative PCR results allowed re-entry into the zone. Fighters requiring medical attention outside of the zone were taken to 'COVID-free' hospitals, full PPE was worn and contact with anyone outside limited as much as possible. No spectators were permitted at any of the events. <u>After the event</u> At the end of the event, the athletes are escorted back to the airport for their flights home. No more information is provided.			
Job et al. 2021 India DOI: 10.7860/JCDR	**Type**: Graduation ceremony. **Sample size**: 934 people	**Public health measures:** <u>Pre-event</u> ▪ Prevention protocol was developed in advance of the	**14 day incidence of COVID-19 per 100,000 population:** <0.01 (prior to widespread	**Biological/epidemiological:** ▪ Biological outcomes only reported. ▪ 0/934 COVID-19 attendees diagnosed up to 28 days after the event.	A well-planned and controlled gathering using the preventive protocol is a

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/2021/47856.14713 (peer reviewed)	**Demographics**: 60.2% in 21-40 years age group, 35.5% in 41-60 years age group, and 4.2% in 10-20 years and >60 years age groups. **Excluded**: Children were not allowed inside of tents. High-risk individuals were advised not to attend event. **Setting:** 14 March 2020, daytime seated event for a duration of 4 hours held in four temporary marques outside, at the All India Institute of Medical Sciences, Rishikesh, Uttarakhand, India. **Pre/post event activities:** <u>Pre-event</u> ▪ Travelled from different states	event which included logistics and equipment required. ▪ Designation of roles including COVID-19 officer. ▪ Structured risk assessment including the level of audience involvement, the level of knowledge about the disease, the likely immunity of the age group of the attendees to potential infections, the ventilation at the venue, and the accommodation sites were ascertained. ▪ Screening questionnaire (online and print versions). ▪ List of all attendees created (presumably for contact tracing). <u>Day of event</u> ▪ Event was held outside with good ventilation ▪ Thermal scanning for temperature at entrance, ▪ Followed by clinical screening for affirmative responses to the pre-screening questionnaire and for those who failed thermal scanning	availability of SARS-CoV-2 testing) **Total number of COVID-19 vaccine doses administered per 100 population:** 0 **Proportion of population fully vaccinated (%):** 0	▪ 2 people were excluded from attending based on symptoms (non COVID-19) and 2 due to international travel. **Environmental:** NR **Behavioural:** NR **Healthcare utilisation:** NR	feasible and workable option. This prevention protocol can be used widely in organised gatherings.

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	of India and beyond (2 from abroad) to event location. <u>Day of event</u> ▪ Included sit down dining. <u>After the event</u> ▪ Traveling.	▪ Mandatory hand sanitizer at entry and exit sites and available throughout. ▪ Masks were provided (mostly to the elderly and all 55 high-risk attendees). ▪ Repeated public health announcements were made regarding physical distancing, cough etiquette, and hand hygiene, along with the placement of multiple eye-catching banners regarding preventive steps. <u>After the event</u> ▪ All attendees were informed to contact the clinical team if any symptoms developed after the event until 28 days **Testing strategy:** No pre or post testing conducted.			
Jokhdar et al. 2021 Saudi Arabia DOI: 10.1089/hs.2020.0144	**Type:** Hajj pilgrimage. **Sample size:** 1,000 pilgrims of 160 different countries, but all from Saudi Arabia.	**Public health measures:** <u>Pre-event</u> ▪ All eligible candidates were scheduled for appropriate medical examination and screening visits. ▪ Each candidate received clear instructions to quarantine for 14 days, including 10 days at	**14 day incidence of COVID-19 per 100,000 population:** 80-95 **Total number of COVID-19 vaccine doses administered per 100 population:** 0	**Biological/epidemiological:** ▪ During the initial pre-travel screening phase, 31 pilgrim candidates tested positive. ▪ During the second PCR testing 10 to 14 days later, upon arrival in the Hajj area, 4 additional positive cases were identified. ▪ No confirmed cases of COVID-19 were recorded among all pilgrims during or after the end of the holy rituals.	This paper highlights the success of the risk mitigation plan in place during the Hajj pilgrimage in 2020 during the COVID-19 pandemic and the efforts of the

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(peer reviewed) Ebrahim 2021 Saudi Arabia DOI: 10.1093/jtm/taaa194 (peer reviewed) Hashim et al. 2021 Saudi Arabia DOI: 10.4269/ajtmh.20-1563 (peer reviewed)	**Demographics**: Not reported. **Inclusion criteria:** Eligibility criteria for all candidates who applied to participate in Hajj included: 1. participant must be between the ages of 20 and 65 years (with an advisory for candidates older than 50 years), 2. not have certain high risk chronic diseases, 3. not be obese, 4. not be pregnant, and 5. have a negative PCR COVID-19 test. **Setting:** Outdoor Hajj pilgrimage in Saudi Arabia between 28 July and 2 August. **Pre/post event activities:**	home or in a hotel before travel and 4 days in a facility upon arrival in Makkah. ▪ Adherence to the quarantine measures was monitored and enforced using a national electronic application known as Tetamman. ▪ The application monitored daily symptoms and provided educational information for users. ▪ Also linked to a smart wearable electronic tracing bracelet, which generated alerts at the regional Health Command and Control Center if candidates violated quarantine measures. ▪ Recommended preventive measures were explicitly stated for all pilgrims for example ○ maintaining a physical distance of approximately 5 feet (1.5 meters) from others, ○ wearing face masks, ○ practicing safe hand hygiene, and	**Proportion of population fully vaccinated (%):** 0	**Environmental:** NR **Behavioural:** NR **Healthcare utilisation:** NR	Saudi government to prevent associated outbreaks.

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	All eligible candidates from every region of the Kingdom travelled to Makkah under strict transit measures. Pilgrims were assigned to groups or "bubbles" of 20 pilgrims. Waiting posts, housing, and bus seats were assigned to each bubble of 20.	○ disclosing symptoms or contact with a confirmed COVID-19 case in a timely manner. ▪ Each candidate completed and signed a written consent document which detailed their comprehension and willingness to comply with all preventive measures before, during, and after Hajj. ▪ They also underwent an assessment of their living conditions to determine its suitability for home quarantine; if deemed unsuitable, they were quarantined in designated hotels. <u>During event</u> ▪ After 10 days of quarantine, all eligible candidates from every region travelled to Makkah under strict transit measures and were received at another designated facility for the final 4 days of quarantine and repeat PCR testing for COVID-19.			

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		▪ Any candidate with a positive PCR test was immediately excluded. ▪ All confirmed COVID-19 cases were transferred to quarantine facilities and received proper medical care. ▪ Safe "bubbles" and tracks – Pilgrims were assigned to groups or "bubbles" of 20 pilgrims, with designated tracks by number and colour ▪ A group of 50 trained health officers accompanied the pilgrims during each step of the Hajj rituals to provide the maximum level of care (e.g. measuring temperatures frequently, checking symptoms, responding to all medical complaints) and ensure full adherence to preventive measures. ▪ Measures included the provision of pre-packaged meals (no buffets), no sharing of utensils or personal instruments, no physical touching of the Holy Kaaba and other high-touch surfaces, provision of sterile pebbles for each pilgrim for			

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		the throwing ritual, and provision of prayer mats for individual use. <u>After the event</u> ▪ After finalizing Hajj rituals, all pilgrims continued using the Tetamman application and electronic tracing bracelets to enhance passive surveillance of symptoms (self-reporting) and ensure monitoring of adherence to post-Hajj quarantine measures. ▪ In addition to the tracking application, pilgrims received daily phone calls enquiring about their symptoms and monitoring their health status. ▪ Home quarantine occurred for two weeks after Hajj. **Testing strategy:** <u>Pre-event</u> 1) Pilgrims had to have a negative PCR COVID-19 tests prior to the event. Each candidate received clear instructions to quarantine for 14 days (including 10 days at			

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		home or in a hotel before travel and 4 days in a facility upon arrival in Makkah. <u>During event</u> 2) After 10 days of quarantine, all eligible candidates travelled to Makkah designated facility for the final 4 days of quarantine and received repeat PCR testing for COVID-19. Any candidate with a positive PCR test was immediately excluded. <u>After event</u> **3)** A third PCR test was conducted post-Hajj. All pilgrims continued using the Tetamman application and electronic tracing bracelets to enhance passive surveillance of symptoms (self-reporting). Pilgrims received daily phone calls enquiring about their symptoms and monitoring their health status. No cases of COVID-19 were detected.			

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Kim et al 2020 Seoul, South Korea DOI: 10.3346/jkms.2020.35.e380 (peer reviewed)	**Type**: Protest **Sample size**: Approximately 8,800 healthcare workers, including 646 trainee doctors and medical students. **Demographics**: 646 trainee doctors participated in the rally at least once. Of these 318 (49%) were men with a median age of 29 (IQR, 27–32) years There was no demographic information provided on others who participated in the protest. **Setting:** Outdoor protests in Yeouido Park, Southwestern Seoul on August 7 and 14, 2020 among medical students, interns, and residents across Korea.	**Public health measures:** Pre-event Guidelines provided by the infection control office were handed out, which promoted the use of: ○ filtering face piece 2 equivalent respirator masks, ○ hand hygiene, ○ minimum 1 meter distancing, ○ no physical contact, ○ no singing or chanting, restriction on drinking or eating food, and self-monitoring of symptoms after the rally Day of event An action plan and an app-based system for notification of COVID-19 symptoms was developed for trainee doctors After the event Testing was carried out on trainee doctors. **Testing strategy:** PCR-based universal screening pooling 5 specimens 3–4 days after the rally. ▪ Universal screening was carried out on 609 (94%) of	**14 day incidence of COVID-19 per 100,000 population:** 1 **Total number of COVID-19 vaccine doses administered per 100 population:** 0 **Proportion of population fully vaccinated (%):** 0	**Biological/epidemiological:** ▪ Of the 646 trainee doctors that attended the protest, 609 (94%) were tested, of which none tested positive. ▪ From August 7 to August 28, 11 participants had COVID-19 symptoms including fever, cough, myalgia, sore throat, and headache. However, PCR results were negative for all of them. **Environmental:** NR **Behavioural:** NR **Healthcare utilisation:** NR	The data suggested low transmission rates in open air mass gatherings when appropriate personal protective practices were followed. As this was a single-center study and Korea has a low prevalence of COVID-19, further studies in other settings are warranted.

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	Approximate duration of the protest was 3 hours. Participants with coronavirus disease 2019 (COVID-19) symptoms were restricted from joining the rally. **Pre/post event activities:** The participants that were tested work together in a tertiary care hospital.	646 trainee doctors who attended at least one rally. ▪ There were 387 participants in the first rally. Among them, 360 (93%) participants underwent PCR tests on August 10 (3 days after the rally). ▪ The number of participants in the second rally was 555. Among them, 525 (95%) participants underwent PCR tests (4 days after the rally) August 18.			
Moritz 2020 Germany Uncontrolled B/A study https://www.medrxiv.org/content/10.1101/2020.10.28.20221580v3 (preprint)	**Type:** Indoor concert **Sample size:** 2,023 participants underwent baseline screening, 1,212 ultimately took part in the experiment. **Demographics:** **Age** ▪ ***18-25*** n=355, (29.3%) ▪ ***26-30,*** n=169 (13.9%)	**Public health measures in place:** Three different scenarios simulated, all participants experienced each scenario in turn: Scenario 1 no control measures – participants entered and exited the arena without any restrictions, no spacing between seats. no social distancing. Scenario 2: moderate scenario – participants were allocated to 1 of 4 quadrants	**14 day incidence of COVID-19 per 100,000 population:** 20 **Total number of COVID-19 vaccine doses administered per 100 population:** 0 **Proportion of population fully vaccinated (%):** 0	**Biological/epidemiological:** **Testing** Pre-event: All participants (n=1,212) and staff (unknown number) tested negative within 48 hours before event. Post-event: No testing. Study authors were not made aware of any infections after the study. *Epidemiological simulation:* An extended susceptible-exposed-infectious-recovered (SEIR) model was developed based on data from the literature for all 3 scenarios, with the assumption of a stable epidemic, and no protective immunity, with differing	The authors concluded that under hygiene protocols and good ventilation, even substantial number of indoor mass gatherings would only have minimal effects on the overall number of infections in the population. However, poor ventilation systems can lead

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	▪ ***31-35,*** n=248 (20.5%) ▪ ***36-40,*** n=186 (15.3%) ▪ **41-45**, n=143 (11.85%) ▪ **46-50,** n=111 (9.2%) **Sex** Male, n=43 (36.6%) Female, n=767 (63.3%) Other, n=2 (0.2%) **Excluded:** the following participants were excluded from this study ▪ older than 50 or younger than 18, ▪ had self-reported obesity (Body-Mass-Index >30), ▪ individuals with chronic diseases, and conditions affecting lungs, liver or kidneys, cardiovascular	within the arena, seating arranged in checkerboard pattern (i.e. every second chair remains free), social distancing. Scenario 3: most stringent scenario – pairwise seating of participants, social distancing, increased number of entrances and exits. Pre-event ▪ Exclusion of high risk groups ▪ Pre-event testing ▪ Temperature screening ▪ Symptom screening ▪ Close contact or travel exposure screening Day of event ▪ Face masks provided (N95) – worn at all times except when seated or eating/drinking ▪ Hand sanitiser provided ▪ Contact tracing device provided ▪ Information provided to participants on measures. After the event ▪ Contact tracing		baseline incidence assumptions, considering the impact of masks. Model findings: For incidence of 50/100,000 per week of positive tested cases, between 10 and 40 infectious persons on average will attend any event, assuming the total number of persons taking part in mass gatherings is 100,000 to 200,000 per month. When 7-day incidence increases to 100 per 100,000, between 40 and 90 are estimated to attend. If the incidence falls to 10 per 100,000, then between 4 and 7 are estimated to attend. If 100,000 people attend mass gatherings in a month, and assuming good ventilation and mask wearing, and a 7-day incidence of 10/100,000, the following number of infections acquired from mass gathering each month are estimated: ▪ Scenario 1 (no control measures): 1 ▪ Scenario 2 (moderate scenario): 0 ▪ Scenario 3: (most stringent scenario) 0. If 100,000 people attend mass gatherings in a month, and assuming good ventilation and mask wearing, and a 7-day incidence of 50/100,000, the following number of infections acquired from mass gathering each month are estimated: ▪ Scenario 1 (no control measures): 7 ▪ Scenario 2 (moderate scenario): 3.5 ▪ Scenario 3 (most stringent scenario): 1.	to a considerably higher rate of aerosol expositions and can thereby result in a high number of infections.

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	diseases, cancer, immune suppression, the intake of immunosuppressants, or pregnant. **Setting**: 22 August 2020. Indoor Arena, Leipzig, Germany. Day time. The total room volume of the Arena is 135,000 m3. The ventilation system has a total capacity of 198 000 m3/h and uses 100% fresh air. The outlets under the grandstands have a capacity of 114,000 m3/h. In addition, there are jet nozzles above the heads of the spectators on the grandstand at the long sides, which blow air downstream to the inner space.	**Testing strategy** All participants and staff members underwent self-sampling for SARS-CoV-2 within 48 hours before the event. No information is provided on the type of test undertaken. No follow-up testing was conducted.		If 200,000 people attend mass gatherings in a month, and assuming sub-optimal ventilation, no mask wearing and a 7-day incidence of 50/100,000 the following number of infections acquired from mass gatherings each month are estimated: ▪ Scenario 1 (no control measures): 27 ▪ Scenario 2 (moderate scenario): 14.5 ▪ Scenario 3 (most stringent scenario): 4 If 200,000 people attend mass gatherings in a month, and assuming sub-optimal ventilation, no mask wearing and a 7-day incidence of 100/100,000 the following number of infections acquired from mass gatherings each month are estimated: ▪ Scenario 1 (no control measures): 169 ▪ Scenario 2 (moderate scenario): 73 ▪ Scenario 3 (most stringent scenario): 29 For scenarios 2 and 3, particularly with the use of masks, the expected number of infections occurring in the events are below 10 per month. Consequently, the effect of the events on the total number of positive tested cases or quarantined persons when compared to the situation when no events take place is low. Overall, 2.3%, 1.1%, and 0.4% of the observed incidence would be attributed to mass gatherings for scenarios 1, 2 and 3 with the use of masks for the incidence of 100/100 000 per week and 100 000 persons in events per month. However, when incidence is high (100/1000 7-day incidence~), there is no mask wearing and suboptimal ventilation, and 200,000 people attend	

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	Pre/post event activities: NR			mass gatherings in a month, the impact on wider epidemic of an event compared to no event is substantial. The estimated number of excess positive cases attributed to mass gathering (relative to no event) per month is as follows: ▪ Scenario 1 (no control measures): 392 ▪ Scenario 2 (moderate scenario): 175 ▪ Scenario 3 (most stringent scenario): 70. **Environmental:** Aerosol distribution within the arena was simulated using a computational fluid dynamics model. In the simulated current ventilation version (simulation #1) of the arena, particle tracking revealed that jet nozzles placed in the arena produce large air rollers on the laterals grandstands. The ejected air streams down from the corner of the roof just above the highest rows, runs parallel to the lateral grandstand to the inner floor of the arena where it rises up to the roof top and the air flow cycle is renewed. Additionally, jet nozzles substantially increase the airflow and thus reduce density of aerosols. In another simulation #2 the authors compared the current airflow with a second variant of the ventilation system in which the air was suctioned at the roof top and the jet nozzles were shut down to reduce air rollers in the arena. Here, the intended increased vertical airflow from the bottom to the roof (layer ventilation) was not achieved. This resulted in a lower air exchange rate. In scenario 1 (no control measures scenario) the authors estimated that	

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				the maximum number of exposed people, per infectious person was ▪ 10 with jet nozzles and higher airflows (simulation #1) ▪ 108 with no jet nozzles and lower airflows (simulation #2). **Behavioural:** *Post event questionnaire (n=960 responses, 79.2% response rate):* Participants were asked if they would attend a future concert under the different scenarios if they had to pay for it: ▪ Scenario 1 (no control measures), 66% yes/rather yes ▪ Scenario 2 (moderate scenario), 88% yes/rather yes ▪ Scenario 3 (most stringent scenario), 82% yes/rather yes Participants were asked about willingness to wearing different types of masks at future concerts ▪ Simple facemask, 90% yes/rather yes ▪ FFP-2, 78% yes/rather yes Participants were asked how safe they felt in the various scenarios: ▪ Scenario 1 (no control measures): 58% felt safe/rather safe and 42% felt unsafe/rather unsafe ▪ Scenario 2 (moderate scenario): 93% felt safe/rather safe and 6% felt unsafe/rather unsafe ▪ Scenario 3: 96% felt safe/rather safe and 4% felt unsafe/rather unsafe.	

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				Data monitoring: Based on contact tracing device data the average (±SD) number of close contacts (<1.5m) per person in the 3 different scenarios are as follows: *For ≥ 10 seconds* ▪ Scenario 1 (no control measures): 63.9 (±17.1) ▪ Scenario 2 (moderate scenario): 36.4 (±12.0) ▪ Scenario 3 (most stringent scenario): 18.0 (±7.2) *For ≥ 5 minutes* ▪ Scenario 1 (no control measures): 14.1 (±5.2) ▪ Scenario 2 (moderate scenario): 6.1 (±2.4) ▪ Scenario 3 (most stringent scenario): 2.2 (±1.5) For ≥15 minutes ▪ Scenario 1 (no control measures): 8.9 (±3.5) ▪ Scenario 2 (moderate scenario): 4.7 (±1.9) ▪ Scenario 3 (most stringent scenario): 1.3 (±0.9) High numbers of contacts were observed during entry and half time, but only few lasted more than 15 minutes. In scenario 1, new contacts accumulated during the whole event, while in scenarios 2 and 3 most contacts occurred during the entry phase without major further increases. **Healthcare utilisation:** NR	
Mechanistic study					
Schade et al. 2021	**Type:** Simulated concert.	**Public health measures:** ▪ Surgical mask.	N/A	**Biological/epidemiological:** N/A	The aerosol and CO_2

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Germany DOI: /10.1016/j.ijid.2021.04.028 https://www.mdpi.com/1660-4601/18/6/3037 (linked paper) (peer reviewed)	**Sample size:** Did not include human attendees. Involved 1 test dummy. **Demographics**: NA **Setting**: 4 different indoor concert halls with similar low-level displacement ventilation systems (air change rate per hour = 3) with capacity ranging from 400 to 1650 seats.	▪ Ventilation was 3 air changes per hour.		**Environmental:** Initial horizontal flow was diverted upwards when wearing a mask compared to unmask. A t-test confirmed the hypothesis that for concert halls with low-level displacement ventilation, the initial aerosol concentration is diluted down to less than 0.85% when the distance to the source is more than 1 m. Unmasked: At a distance of 0.5 m from the CO_2 and aerosol emitting dummy (emitting 35,000p/cm^3 of aerosols), the density of aerosol particles is diluted down to 11,300 p/cm^3 (32%), and at a distance of 1.5m it is measured to be 260 p/cm^3 which is 0.7% of the particle number density emitted from the dummy. The seat located directly on the right of the dummy shows an aerosol concentration of 214 p/cm^3 (0.6%) while at the seat directly to the left a concentration of 7500 p/cm^3 was obtained (21%) and the seat directly in front and one to the left the concentration was 2300 p/cm3 (6.6%). A similar pattern was observed when CO_2 was measured. Masked: All measured aerosol concentrations are diluted to less than 0.9% with respect to the concentration emitted by the dummy and the CO_2 concentration is in the range of the background level. A strong temporal fluctuation of the aerosol concentration was measured when the dummy was not masked. However, when the dummy was masked, the aerosol	concentrations were diluted down more rapidly with increasing distance from the emitter when wearing a mask compared to unmask. This experimental study demonstrates the importance of a vertical fresh air flow ventilation for protecting the audience from viral aerosol dispersion in a concert hall.

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				concentration was consistently around the background concentration of <5mcg/m^3. A similar pattern was observed when CO_2 was measured. The correlation between CO_2 and aerosol dispersion in the concert hall was found to be 0.77 for the given conditions (Pearson's correlation). **Behavioural:** N/A **Healthcare utilisation:** N/A	

Key: Ag-RDT – Antigen Rapid Diagnostic Tests; N/A –not applicable; NR –not reported; PCR- Polymerase Chain Reaction; ppm – parts per million; RT-PCR – Reverse Transcription Polymerase Chain Reaction.
+ Indicates that test results are positive
- Indicates that test results are negative
? Indicates that test results are inconclusive

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For further information please contact:
Health Information and Quality Authority
George's Court
George's Lane
Smithfield
Dublin 7
D07 E98Y

+353 (0)1 8147400
info@hiqa.ie
www.hiqa.ie