

# COVID-19 Evidence Update

COVID-19 Update from SAHMRI, Health Translation SA  
and the Commission on Excellence and Innovation in Health

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## **COVID-19 transmission risk in entertainment settings**

### **Executive Summary**

This review covers available evidence on the risk of COVID-19 transmission in entertainment settings such as **nightclubs, bars, pubs, strip clubs, festivals, live performances and concerts**, as well as **weddings and dance classes**. The review aims to examine risk mitigation strategies for these settings, including but not limited to **dancing and alcohol** consumption.

**State of the evidence:** There is a significant number of reports of clusters of COVID-19 emerging from the above settings published in the peer-reviewed literature and by credible sources including government agencies and the World Health Organization. While there is considerable academic and industry commentary, there is very little quality evidence evaluating COVID-19 risk management strategies in these settings. While it is well-established that alcohol is a disinhibitor, there is an absence of quality evidence regarding alcohol consumption and reduced COVID-19 protective behaviours in these settings. There are several reports (including media reports) of failures of controls in nightclubs e.g. inadequate provision of details for contact tracing and absence of social distancing.

#### **Evidence of clusters arising from entertainment settings:**

- There are numerous examples of clusters of cases linked to indoor entertainment settings, reported in the peer-reviewed literature, by official government sources and in the media.
- Bars, pubs and nightclubs have been identified as high-risk settings for the spread of COVID-19, as well as other respiratory illnesses.
- The WHO reports that there are consistent observations of nightclubs being “amplifying environments”

#### **Evidence on contributing factors and risk mitigation strategies:**

- There is an **absence of high-quality evidence** on factors which have contributed most to the risk of transmission in these settings.
- Potential risk factors that have been proposed include:
  - large crowds in confined spaces with inadequate ventilation
  - widespread mixing between groups
  - respiratory factors: volume of speech, singing, physical exertion from dancing, coughing or sneezing
  - alcohol consumption/intoxication undermining social distancing and personal hygiene.
- Strategies proposed to minimise risk are similar to those known to be effective in other indoor settings:
  - not attending when unwell
  - booking systems and record keeping to assist with contact tracing
  - limits on density, physical distancing
  - having sufficient ventilation
  - physical barriers
  - hygiene, enhanced cleaning
- ‘Novel’ strategies reported in the international media include:
  - concerts in drive-ins with patrons in cars
  - performers and/or patrons in plastic bubbles, behind perspex or fencing

- One pre-print modelling study [1] aimed to determine the impact of different intervention strategies by setting (including parties and nightclubs) and to produce an “event R” (expected number of new infections due to the presence of a single infected individual at an event). They present a fundamental relationship between “event R” and four parameters: transmission intensity, duration of exposure, the proximity of individuals, and the degree of mixing. They argue the importance of tailoring prevention strategies (distancing, mask wearing, physical barriers, ‘social bubbles’ or small groupings) to the activity and setting, adjusting for factors such as: event duration, mixing, speaking, singing and eating. In all scenarios, interventions that increase physical distancing are effective.

## Context

### Local Policy

- [Government of South Australia 24 Aug 2020](#): A COVID Management Plan is required for high-risk public activities:
  - gatherings and activities of more than 1,000 people
  - licenced premises under the Liquor Licencing Act 1997 where both dancing and the consumption of liquor occurs
  - the operation of a nightclub, where the principle purpose of the premise is for the consumption of liquor, the playing of loud, amplified music and dancing.

- [COVID Management Plan FAQs](#)

#### [What is a high-risk activity?](#)

High-risk activities are activities that present a higher risk of COVID-19 transmission. These risk factors include, but are not limited to:

- Large numbers of people gathering in a single location.
- Events or activities held indoors.
- Higher levels of movement and interaction.
- Interaction between non-familiar social groups.
- Confined spaces or small room size.
- Activities that involve forced exhalation (i.e. dancing or physical activity).
- Consumption of alcohol.
- The type of ventilation.
- Likelihood of prolonged contact with strangers.
- How people travel to and from the event, assemble, enter and exit, and behave at the event in relation to social distancing and hygiene.

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Other risks may also be present in how people travel to and from the event, assemble, enter and exit, and behave at the event. Certain high-risk activities can also make contact tracing more difficult and time consuming, which can slow down SA Health’s ability to trace and contact people who may have been exposed to COVID-19 and to quickly contain outbreaks.

### Evidence Statements

- [World Health Organization 9 July 2020 \[2\] \(Scientific brief\)](#): *Transmission of SARS-CoV-2: implications for infection prevention precautions*.
  - Transmission of SARS-CoV-2 can occur through direct, indirect, or close contact with infected people through infected secretions such as saliva and respiratory secretions or their respiratory droplets, which are expelled when an infected person coughs, sneezes, talks or sings.
  - **Respiratory droplet transmission** can occur when a person is in close contact (within 1 metre) with an infected person who has respiratory symptoms (e.g. coughing or sneezing) or who is talking or singing.
  - Indirect contact transmission involving contact of a susceptible host with a contaminated object or surface (**fomite transmission**) may also be possible.
  - There is active debate about whether SARS-CoV-2 may spread through **aerosols** in indoor settings with poor ventilation. It is theoretical possible, however, the extent that exhalation generates aerosols, and the infectious dose of viable SARS-CoV-2 required to cause infection to another person, are not currently known.
    - “Some outbreak reports related to indoor crowded spaces (40) have suggested the possibility of aerosol transmission, combined with droplet transmission, for example, during choir practice

(7), in restaurants (41) or in fitness classes.(42) In these events, short-range aerosol transmission, particularly in specific indoor locations, such as crowded and inadequately ventilated spaces over a prolonged period of time with infected persons cannot be ruled out. However, the detailed investigations of these clusters suggest that droplet and fomite transmission could also explain human-to-human transmission within these clusters. Further, the close contact environments of these clusters may have facilitated transmission from a small number of cases to many other people (e.g., superspreading event), especially if hand hygiene was not performed and masks were not used when physical distancing was not maintained.(43)”

- “Outside of the household setting, those who had close physical contact, shared meals, or were in enclosed spaces for approximately one hour or more with symptomatic cases, such as in places of worship, gyms, or the workplace, were also at increased risk of infection.(7, 42, 71, 72)”
- WHO has a comprehensive set of recommendations to prevent transmission, including “At all times, practice frequent hand hygiene, physical distancing from others when possible, and respiratory etiquette; avoid crowded places, close-contact settings and confined and enclosed spaces with poor ventilation; wear fabric masks when in closed, overcrowded spaces to protect others; and ensure good environmental ventilation in all closed settings and appropriate environmental cleaning and disinfection.”
- Qureshi 22 June 2020 [3] (CEBM, University of Oxford): Evidence to support the 2m social distancing rule.
  - Social distancing rules have been implemented based on the conceptual framework of large droplets only travelling a small distance; they do not account for the potential for airborne droplets to travel further and that droplet sizes are on a continuum rather than a large/small dichotomy.
  - Factors that influence the distance respiratory droplets spread include: “violent respiratory events” (e.g. coughing, sneezing, **volume of speech, singing, physical exertion**); ventilation and indoor airflow (one preprint study found that there was an 18.7 fold increase in odds of transmission in indoor vs outdoor settings, but limited details on the settings were reported (Nishiura; doi: 10.1101/2020.02.28.20029272)).

## SUMMARY OF KEY EVIDENCE

### Case study reviews – Multiple settings

- Leclerc 2020 [4] (Wellcome Open Research; peer-reviewed):
  - Aimed to gather information on reported clusters of COVID-19 cases to determine types of settings in which SARS-CoV-2 transmission occurred.
  - **Key findings:** Found many examples of SARS-CoV-2 clusters linked to a wide range of mostly indoor settings. Few reports came from schools, many from households, and an increasing number were reported in hospitals and elderly care settings across Europe.
    - **Details:** Searched scientific literature and media articles (data available online: <https://bit.ly/3ar39ky>). Definition of cluster was “first-generation cases that acquired the infection due to transmission in a single specific setting at a specific time. Aimed to estimate final (proportion of people in that setting who became infected) and secondary (proportion of contacts of one case who became infected) attack rates in each setting, but unable to do so due to missing data.
    - Found evidence for 201 events, which were classified into 22 settings - see table below.
    - Most clusters involved fewer than 100 cases, with the exceptions being in healthcare (hospitals and elderly care), large religious gatherings, food processing plants, schools, shopping, and large co-habiting settings (worker dormitories, prisons and ships). Other settings with examples of clusters between 50–100 cases in size were **weddings**, sport, **bar**, shopping and work. The majority of our reports are from China and Singapore.
    - **Limitations:** not representative; bias due to media coverage (e.g. more likely to be reported if controversial or interesting social narrative, recall bias (special, one-off events more likely to be remembered); multiple opportunities for transmission; absence of rigorous surveillance systems and widespread testing, especially early in the pandemic; mildly symptomatic or asymptomatic symptoms not reported.
    - **Religious venues** were associated with a large number of cases: common features include: large number of attendees, confined spaces and physical contact.
    - Worker dormitories in Singapore was another setting with many cases, as were elderly care homes, hospitals and ships, which are all known to be at risk of clusters of infectious disease.

Setting type	Number of reported events	Secondary cases			Total cluster size			Total number of cases across all clusters	Countries	Indoor / outdoor
		Min	Median	Max	Min	Median	Max			
Bar	12	2	9	16	3	13	80	319	Germany, Austria, Italy, Singapore, Japan, USA, Australia, New Zealand, Brazil	Indoor / outdoor
Building site	4	/	/	/	5	20.5	49	95	Singapore	Outdoor
Conference	5	/	/	/	3	10	89	148	Canada, Singapore, Japan, USA, New Zealand	Indoor / outdoor
Elderly care	17	/	/	/	5	19	167	638	UK, Canada, Scotland, France, Germany, Italy, USA, Japan, New Zealand, Luxembourg	Indoor
Food processing plant	9	2	2	2	3	84	518	1207	USA, Germany, Canada, Netherlands	Indoor
Funeral	1	3	3	3	4	4	4	4	USA	Indoor / outdoor
Hospital	9	1	3	14	2	10	118	224	China, Singapore, Italy, Taiwan, South Korea, Japan	Indoor
Hotel	2	/	/	/	3	5	7	10	Singapore	Indoor
Household	36	1	3	11	2	4	12	168	China, Italy, Vietnam, Taiwan, South Korea, Hong Kong, France	Indoor
Meal	17	1	3	10	2	5	47	134	Singapore, USA, Vietnam, China, South Korea, Japan	Indoor
Prison	4	351	351	351	66	226	353	871	USA, Ethiopia	Indoor
Public	4	/	/	/	10	10	27	57	China, Japan	Indoor / outdoor
Religious	15	1	18	52	2	23	130	570	USA, Singapore, South Korea, US, China, India, Netherlands, Germany	Indoor / outdoor
School	8	1	1	131	2	22	133	349	Singapore, France, USA, New Zealand, Australia, Sweden	Indoor / outdoor
Ship	5	619	619	619	78	662	1156	3597	Grand Princess, Diamond Princess, Ruby Princess, USS Theodore Roosevelt, Charles de Gaulle aircraft carrier	Indoor
Shipyards	1	/	/	/	22	22	22	22	Singapore	Indoor / outdoor
Shopping	9	5	10	19	7	20	163	361	China, Singapore, Peru, Mexico	Indoor / outdoor
Sport	6	1	1	1	2	7.5	65	95	South Korea, Singapore, Italy, Japan	Indoor / outdoor
Transport	1	1	1	1	3	3	3	3	China	Indoor
Wedding	3	/	/	/	13	43	98	154	Australia, New Zealand	Indoor / outdoor
Work	12	6	7	11	4	8.5	97	198	China, Singapore, South Korea, Germany	Indoor
Worker dormitories	21	/	/	/	3	24	797	1702	Singapore	Indoor

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NOTES: the following table includes data available from the same resource as above (available online), which was last updated on 6 July 2020. Bar was reclassified as "Party".

Setting	Further setting information	Indoor / outdoor	Country	Date	# of clusters	Primary cases	Secondary cases	Total cases per cluster
Party	Harper's Brew Pub	indoor	USA	29/06/2020	1			85
Party	Party	Indoor / outdoor	Australia	9/04/2020	1			30
Party	Bar	Indoor	Austria	24/03/2020		1	15	16
Party	Country Club	Indoor / outdoor	Brazil	4/04/2020				60
Party	Nightclub	Indoor	Germany	10/03/2020		1	16	17
Party	Indoor carnival	Indoor	Germany	9/04/2020	1			7
Party	Private event - restaurant	Indoor	Germany	26/05/2020	1			18
Party	Local pub	Indoor	Italy	26/02/2020	1	1	3	4
Party	Live music bar	Indoor	Japan	15/03/2020	1			10
Party	River boat party	Indoor	Japan	15/03/2020	1			10
Party	Four live music venues	Indoor	Japan	15/03/2020	4			80
Party	Bar	Indoor	New Zealand	9/05/2020	1			77
Party	Hero's bar	Indoor	Singapore	30/03/2020	1			5
Party	Backstage contact	Indoor	USA	21/03/2020		1	2	3
Wedding	Wedding	Indoor / outdoor	Australia	30/04/2020	1			43
Wedding	Wedding	Indoor / outdoor	New Zealand	18/05/2020	1			98
Wedding	Wedding	Indoor / outdoor	New Zealand	18/05/2020	1			13
Wedding	Wedding	Indoor	Jordan	20/05/2020	1	1	76	77

- Prakash 2020 [5] (medRxiv, preprint):
  - Aimed to establish risk of transmission during everyday activities, based on identifying point-exposure to an infected person, on a specific occasion, for a well-defined duration.
  - **Key findings:** Attack rates were much higher in family dinner situations compared to sit-down dinners with lesser mixing among people eating at different tables, suggesting that the number of personal interactions in a group and their proximity are important for transmission.
    - **Details:** Curated data from a range of sources to arrive at 44 case studies across 20 situations.
    - Only 1 situation at a **nightclub** was identified (Itaewon night club area in South Korea). Average attack rate was estimated to be 6.27% (CI: 5.15-7.61%).
    - The situations with the highest average attack rates were work meetings (72.7%; CI: 43.6-98.0%), open work space with everyone talking and no physical separation (78.7%; CI: 70.3-85.3%), **singing** in a group with mixing together (86.9%; CI: 76.2-93.2%); and family dinners (66.7%; CI: 48.8-80.8%).
    - Authors did not report limitations.

## Case studies – Night clubs and bars

- Maechler 2020 [6] (Clin Microbiol Infect):
  - Analysis of cases identified at the first public testing site in Berlin, **Germany**.
  - **Key findings:** A **nightclub** was a transmission hotspot; 27.7% (26/94) of one night's visitors were found positive.
    - **Details:** On March 6, local health authorities informed the public of a COVID-19 case who had visited a nightclub on February 29. Between March 6 and March 16, 94 persons who had visited the club the same evening presented at the test site.
- Choi 2020 [7] (Int J Environ Res Public Health):
  - Case study describing the major SARS-CoV-2 cluster transmission hotspots in **South Korea**.
  - **Key findings:** Religious sects and **nightclubs** were associated with large outbreaks
    - **Details:** A 29-year-old man visited multiple nightclubs in a leisure district in Seoul on 1 May 2020 and tested positive for SARS-CoV-2 on 7 May 2020. These venues accounted for more than 160 cases and community transmissions. South Korea was under modified social distancing restrictions at the time. Clubs and shops were allowed to be open and receive customers, but people were still urged to avoid unnecessary contact with others and stay home. **Contact tracing** was very tricky in this instance. Although clubs were supposed to verify all visitors' names and contact details before allowing them to enter the venue, public health authorities found **patron information insufficient for tracking**. Almost 2000 club patrons in the cluster left false or incomplete contact information or avoided follow-up calls. Many of these nightclubs were popular among LGBT (lesbian, gay, bisexual, and transgender) communities in Seoul; fears of being involuntarily outed may have made some visitors hesitant to identify themselves.
    - The public health authorities and local governments employed a more technology-based approach to comb through the nightclub-goers. They requested that all mobile network operators (LG, SK, and KT) submit signal tower records, and found that 10,905 people were in the proximity of the nightlife suburb of Seoul from 24 April to 6 May 2020. Text messages were sent to these people, asking them to get tested and to self-quarantine.
    - The public health authorities and police forces investigated all security camera footage, both in nightclubs and on the street, tracking the movements from the bars to the subway stations. The public health authorities traced credit card transactions of more than 500 people to complement the mobile data.
- Kang 2020 [8] (Emerg Infect Dis J):
  - Case study of SARS-CoV-2 exposure and spread through nightclubs in **South Korea**.
  - **Key findings:** At least 246 cases of coronavirus disease (COVID-19) have been linked to nightclubs in Seoul, South Korea. During the April 30–May 5 holiday, young adults from across the country who visited nightclubs in Seoul contracted COVID-19 and spread it nationally. Nightclubs were temporarily closed to limit COVID-19 spread.
    - **Details:** Nightclubs that had been closed as part of the social distancing policy reopened on April 30, ahead of the April 30–May 5 Golden Week holiday. People from around the country visited the Itaewon area (Itaewon-dong) in downtown Seoul during the holiday period.
    - Starting on May 6, several COVID-19 cases were confirmed among persons who had visited nightclubs in Itaewon during the holiday. Secondary transmission by case-patients linked to the Itaewon nightclubs led to local transmission of COVID-19 in other parts of the country. On May 9,



the Seoul Metropolitan Government announced indefinite closure of all nightclubs in Seoul to control the source of the outbreak.

- Contact tracing of persons who had visited any of the 5 major nightclubs in Itaewon during April 30–May 6 led to the identification of 5,517 persons for screening; of those, 1,257 were actively monitored. An additional 57,536 persons who had spent >30 minutes in the vicinity of the nightclubs, as determined by their cell phone location data, were sent a series of text messages encouraging them to undergo testing.
  - The prevalence of positive results for COVID-19 in nightclub visitors was 0.19% (67/35,827); in their contacts, 0.88% (51/5,785); and in anonymously tested persons, 0.06% (1/1,627).
  - As of May 25, a total of 246 confirmed nightclub-associated cases had been reported; 96 (39%) of those were primary cases and 150 (61%) were secondary cases.
  - The estimated attack rate among nightclub visitors was 1.74% (96/5,517).
- [Linde 20 Jul 2020 \(NEWS; El Pais\)](#): Reports on an outbreak at a **nightclub** in Spain with 73 confirmed cases. 400 people attended the nightclub and 670 contacts were under medical surveillance. Another outbreak was detected following an **end-of-year party**. In a bid to prevent further outbreaks, regional authorities introduced new restrictions on nightclubs and night time bars, either through closures or reducing capacity.
  - [NPR 18 Aug 2020 \(NEWS\)](#): **Bars** were considered the most risky setting for COVID-19 spread, according to the Texas Medical Association committee: "You can't drink through the mask, so you're taking off your mask. There are lots of people, tight spaces and **alcohol is a dis-inhibitor — people change their behaviors**,"
    - There are now many examples across the U.S. of bars and nightclubs that have seeded outbreaks. In July, Louisiana rolled back its limited opening of bars, [reporting](#) that more than 400 people had caught the coronavirus just from interactions at those businesses. Texas and [Arizona](#) ordered bars to close down when [infections skyrocketed](#) and scenes of packed bars persisted. In Michigan, public health authorities have [traced close to 200 cases](#) back to a now-infamous East Lansing pub. An outbreak linked to a bar and grill in southwest Washington state is instructive. For **karaoke night**, the staff **spaced the tables, checked temperatures** at the door, even put up **plexiglass barriers** near the singers. Nonetheless, a few weeks later, close to 20 customers and employees had been infected.

## Case studies – Dance classes

- [Jang 2020 \[9\] \(Emerg Infect Dis\)](#):
  - Case study on cluster of COVID-19 cases associated with **fitness dance classes** in **South Korea**.
  - **Key findings**: During 24 days in Cheonan, South Korea, 112 persons were infected with SARS-CoV-2 associated with fitness dance classes at 12 sports facilities. Intense physical exercise in densely populated sports facilities could increase risk for infection. Vigorous exercise in confined spaces should be minimized during outbreaks.
    - **Details**: Contacts were traced back to a nationwide fitness dance instructor workshop that was held on February 15 in Cheonan. Fitness dance classes were set to Latin rhythms and have high aerobic intensity. Among 27 instructors who participated in the workshop, 8 had positive real-time reverse transcription PCR (RT-PCR) results. By March 9, we identified 112 COVID-19 cases associated with fitness dance classes in 12 different sports facilities in Cheonan. Instructors with very mild symptoms, such as coughs, taught classes for ≈1 week after attending the workshop. The instructors and students met only during classes, which lasted for 50 minutes 2 times per week, and did not have contact outside of class. Most (50.9%) cases were the result of transmission from instructors to fitness class participants; 38 cases (33.9%) were in-family transmission from instructors and students; and 17 cases (15.2%) were from transmission during meetings with co-workers or acquaintances.
    - Before sports facilities were closed, a total of 217 students were exposed in 12 facilities, an attack rate of 26.3% (95% CI 20.9%–32.5%).
    - Characteristics that might have led to transmission from the instructors in Cheonan include **large class sizes, small spaces, and intensity of the workouts**.
    - Classes from which secondary COVID-19 cases were identified included 5–22 students in a room ≈60 m<sup>2</sup> during 50 minutes of intense exercise. We did not identify cases among classes with <5 participants in the same space. Of note, instructor C taught Pilates and yoga for classes of 7–8 students in the same facility at the same time as instructor B, but none of her students tested positive for the virus. We **hypothesize that the lower intensity of Pilates and yoga did not cause the same transmission effects as those of the more intense fitness dance classes**.
    - It is possible that some cases were missed due to the unavailability of a complete roster of visitors.

## Case studies – Festivals, concerts, mass gathering events

- Streek 2020 [10] (medRxiv, preprint):
  - Aim was to calculate Infection Fatality Rate in an almost closed community setting (i.e. very limited travel in and out of the area) in Gengelt, **Germany**, noteworthy because of a super-spreading event. However, also documented the association between COVID-19 and attending a **festival (carnival events)**.
  - **Key findings:** Based on a random population sample, there was a significant positive association between celebrating carnival and infection (OR = 2.56 [1.67; 3.93],  $p < 0.001$ ). Furthermore, there was a significant positive association between celebrating carnival and the number of symptoms in infected study participants (estimated relative mean increase: 1.63 [1.15; 2.33],  $p=0.007$ ).
- Koizumi 2020 [11] (J Travel Med):
  - Used contact tracing registry data to investigate a COVID-19 outbreak linked to attendance at a series of “Live House (LH)” concert events in Osaka, **Japan**.
  - **Key findings:** LH concerts were held between 15<sup>th</sup>-25<sup>th</sup> Feb in small (~50) to medium (~100) **live music venues, often filled to capacity with standing room only**. As it was still early in the pandemic, neither social distancing nor the ban on mass gatherings was being enforced at these events. Investigation of the registries for SARS-CoV-2 cases from 15<sup>th</sup> Feb to 15<sup>th</sup> Apr resulted in the identification of 74 individuals who participated in one or more of the 8 LH events (primary cases). All infections in this cluster were connected to a 30-year old woman whose symptoms at the February 15 concert were cough, fever, rhinitis, and sore throat. Including secondary and tertiary cases, the 8 LH events resulted in a total of 103 COVID-19 cases.
  - The data demonstrate that **densely populated venues such as live concerts can “seed” infections** that can spread to other, distant areas. This observation is consistent with prior reports that document transmission of various communicable diseases, including influenza A (H1N1), through mass gatherings and “music tourism”. (doi:10.2807/ese.18.11.20426-en; doi:10.1093/jtm/tay106)
- Sekizuka 2020 [12] (PNAS): Genetic analysis of cases on the **Diamond Princess** cruise ship led the authors to conclude that most SARS-CoV-2 infections began at mass-gathering events in the recreational areas, where all passengers enjoyed **dancing, singing**, shopping, and **watching performances**.

## Case studies – Weddings

- Yusef 2020 [13] (Emerg Infect Disl): Case study of an outbreak of COVID-19 at a **wedding in Jordan**.
  - **Key findings:** There were ~360 wedding attendees (350 identified), 76 of whom developed COVID-19. On March 13, a 2-hour wedding ceremony and party were held in an indoor venue designed to accommodate <400 guests. The index case was believed to be the bride's father. He developed fever, cough, and a runny nose 2 days before the wedding and had contact with his immediate family, other relatives, and the groom during the 4 days before the wedding.
  - In Jordan, close physical contact, such as same-sex hugging, cheek-kissing, and hand shaking, are traditional wedding practices. Immediate family members, especially parents of the bride and the groom, usually stand at the entrance of the wedding hall to receive congratulations from all guests. These factors, in addition to crowded dancing and close face-to-face communication, likely contributed to the large number of infections from this wedding.
- Shen 2020 [14] (Open Forum Infectious Diseases): Investigated a cluster of infections associated COVID-19 reported from Jiaying, Zhejiang (**China**) in January of 2020.
  - **Key findings:** The cluster under investigation involves 4 confirmed cases from a family (Cases 1–4) and 3 other confirmed cases (Cases 5–7) and 1 suspected case (Case 8) thought to be linked to the familial cluster through social events. A total of 539 people who had contact with the 2 cases presumed to be the sources of the outbreak and the index patient were screened. Among the 539 screened individuals who had close contact with the index patient and his parents-in-law during the wedding party and in other public arenas, 3 tested positive and were diagnosed with COVID-19, whereas 1 was a suspected case but did not test positive.
  - During the wedding, Case 6 ate at the same table as Case 3, chatted at close distance, and they picked up guests together. Case 7 ate at a table next to Case 3 on the first day of the wedding, and they stayed in the same room during the ceremony on the second day.

**Table 2. Secondary Attack Rates for Reported Social Events**

Event	Date	Maximum Number of Potential Infectious Present <sup>a</sup>	Susceptible Present	Upper Bound of Possible New Infections	Upper Bound for Secondary Attack Rate (%)
Lunch	January 18	2	7	2	2/7 = 29%
Birthday party	January 19	4 <sup>b</sup>	30	0 <sup>c</sup>	0/30 = 0%
Wedding party day 1	January 21	4 <sup>b</sup>	186	3 <sup>c</sup>	3/186 = 2%
Wedding party day 2	January 22	4 <sup>b</sup>	257	3 <sup>c</sup>	3/257 = 1%
Lunch	January 24	4 <sup>b</sup>	4	0	0/4 = 0%

<sup>a</sup>Assumes that both Cases 2 and 3 were infected and potentially infectious throughout this period, and Cases 1 and 4 were infected and potentially infectious by January 21.

<sup>b</sup>Includes the 4-month-old.

<sup>c</sup>Assumes that Cases 1 and 4 did not get infected during those events.

## Case studies – Strip clubs

- [Seidel 18 Aug 2020 \(NEWS; CQ news\)](#): A Toronto, **Canada strip club** had been reopened just a few days before one of its staff tested positive. Under pandemic conditions, all staff were required to wear face masks, maintain safe distances - and use **plexiglass shields** where this was not possible. Patrons had been required to fill out the club's **contact tracing log** as required. Those **few that proved valid** were immediately contacted and told to self-isolate and get tested. Health authorities visit revealed that the club's records lacked transparency and laid-bare the establishment's **lack of physical distancing compliance**. 550 patrons were linked to the club. NOTE: the article does not report on how many people subsequently tested positive.

## Modelling - Multiple settings

- [Tupper 2020 \[1\] \(MedRxiv, preprint\)](#):
- Aims to provide a quantitative framework to determine the impact of various intervention strategies (reducing transmission [masks, hand hygiene], physical distancing, strict social bubbles) for a given activity by introducing the concept of “event R” (expected number of new infections due to the presence of a single infected individual at an event)
- **Key findings**: We obtain a fundamental relationship between event R and four parameters: transmission intensity, duration of exposure, the proximity of individuals, and the degree of mixing. Intervention strategies need to be tailored to the activity and setting.
  - **Details**: Inputs were derived from data from a set of reported events where transmission occurred and were well characterised. We obtained reports of outbreaks at a range of events including **parties**, meals, **nightclubs** and restaurants. For each, there was sufficient information to estimate eR and the duration T.
    - Transmission reduction strategies (e.g. face masks, barriers) reduces the transmission rate
    - Physical distancing reduces the number of contacts
    - Strict social bubbles reduces mixing among groups of people
  - The figure [overleaf] shows how eR changes with respect to time for some different settings and with different interventions.
  - The top panel shows the impact on eR for events without mixing. When the event’s duration is short, reducing transmission (for example with masks and barriers) and ensuring distancing have similar impacts, but when the duration is long, reducing transmission has much less impact than distancing. As the middle panel shows, at events where individuals mix, strict bubbles can be much more effective than either distancing or reducing the transmission rate, and distancing out-performs reducing transmission. However, when the baseline transmission rate is very low (bottom panel), distancing and reducing transmission are better than strict bubbles.
  - The bottom panel is a “linear” event: the expected number of new infections depends linearly on the number of contacts and the duration. However, saturating events also exist, where the transmission rate is high enough that a substantial number of people quickly become infected. Avoiding mixing is preferable in high saturation events.
  - Transmission rates range from 0.02-0.05 transmissions per hour (from household studies, a funeral) to 0.5-0.6 transmissions per hour (choir, party, lunch), with events involving speaking,



singing and eating (parties, meals) generally higher than those without. We also estimate the turnover and saturation; broadly, saturating events with high turnover have the highest eR and therefore are the highest risk.

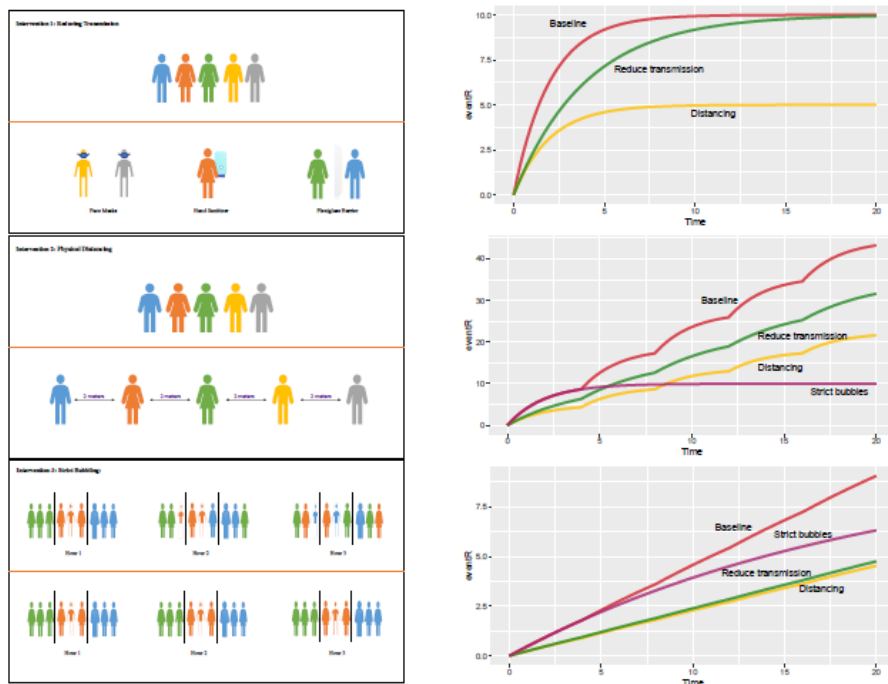


Figure 1: **Left.** The three types of intervention for reducing  $eR$  in a setting. *Top:* reducing transmission  $\beta$ , *Middle:* reducing the number of contacts at a given time  $k$ , *Bottom:* reducing mixing by increasing  $\tau$ . **Right.** The effects of these interventions on  $eR$ . At baseline,  $k = 10, \beta = 0.5, T = 20$  and  $\tau = 4$ . In each panel, reducing transmission means reducing  $\beta$  by half, distancing means reducing  $k$  (the number of people in proximity) by half, and “strict bubbles” means ensuring that attendees contact only  $k$  individuals over the whole event rather than mixing with others outside their bubble. *Top:* no mixing ( $\tau = T$ ); the horizontal axis is the total event duration in hours. *Middle:* Mixing occurs every 4 hours. *Bottom:* A setting with a 10x lower propensity for transmission ( $\beta = 0.05$ ). Here, transmission never “saturates” because  $1 - e^{-\beta\tau}$  remains small enough that it is approximately  $\beta\tau$ , which is small.

- **Application:** consider a crowded indoor event, where contacts would be about 15, and the duration approximately three hours. We would expect some mixing and an indoor transmission rate in the range of 0.2 - 0.4 per hour. This gives eR in the range 4 – 14. If transmission is 0.4, the event is 70% saturated, eR=14. Reducing contacts by half reduces eR to 7, halving the transmission rate reduces eR to 8 and strict bubbles of 15 reduce eR to 10. Reducing both transmission rate and density reduced eR to 4.
- Important to determine if the setting is likely to be linear or saturating, and whether people mix strongly or remain in small groups (or “bubbles”)
- In all events, interventions that increase physical distancing are effective. In events that are already static, the relative importance of reducing transmission is much greater in the linear setting. For events where there is mixing, bubbling is an extremely powerful intervention in the saturating case, but is less significant in the linear case.
- Saturating situations may not only make reducing transmission challenging, they may also make it difficult to estimate the effectiveness of masks and other physical barriers to transmission. This is because in saturating settings, even an intervention that halves the transmission rate may not have much impact on the number of infections. In contrast, the evidence that transmission is impacted by physical distance is quite strong.
- **Authors do not report limitations.**

- Saidan 2020 [15] (Int J of Infect Dis):
  - Estimated the probable outbreak size of COVID-19 clusters mathematically using a simple model that can predict the number of COVID-19 cases as a function of time.
  - **Key findings:** The highest R0 values were found in **wedding party events** (5), followed by religious gathering events (2.5), while the lowest value was found in the industrial cluster (2).
    - **Details:** The two wedding events held in Jordan and Uruguay were selected to evaluate the transmissibility of COVID-19 in such types of clusters. There was insufficient information about these two cluster cases, so we relied on the limited daily data published in official reports and daily news websites. It is noteworthy that it is quite difficult to precisely calculate the R0 since it is difficult to determine actual daily cases during any cluster event due to the delay in epidemiological tasks, cases sampling, and PCR testing, as well as other parameters that might delay case-reporting, such as demographic variations, etc.
    - Other data came from two religious gathering events held in Malaysia and South Korea, and an outbreak in a meat processing factory in Australia.

## Risk management – Multiple settings

- McElvenny 29 July 2020 [16] (Commissioned Report; Institute of Occupational Medicine; UK):
  - Aim was to provide an independent review of the scientific evidence concerning the transmission of COVID-19 and its implications for risk management for the entertainment industry (particularly performers, nightclubs, festivals)
  - **Key findings:** Reviewed 825 pieces of scientific evidence. Found no conclusive scientific evidence that relates specifically to the entertainment industry. Transmission is more prevalent indoors and where people are in close proximity, but the use of control measures reduces exposure and transmission.
  - **Risk management** [Diagram Overleaf]
  - Current government guidance for pubs and bars in the UK: “At this time, venues should not permit live performances, including drama, comedy and music, to take place in front of a live audience. This is important to mitigate the risks of droplet and aerosol transmission....All venues should ensure that steps are taken to avoid people needing to unduly raise their voices to each other...You should take similar steps to prevent other close contact activities, such as communal dancing.”
  - The overriding concern is the lack of evidence in relation to the relevant scenarios and so a precautionary approach is advocated.
  - The UK is moving, with the easing of restrictions, from a risk avoidance model to one of controlled risk management. Implications for particular sectors are:
    - **Pubs and bars** have been able to re-open having applied the ‘hierarchy of control’ model to manage the risk of transmission. Where social distancing of 2m is not possible, other control measures are used, such as protective screens, control of people movement, cleaning regime changes, improve ventilation and use of capacity restrictions.
    - **Performance venues**, from 25 July have been piloting a number of performance types to determine how they can re-open at scale, using same principles used for pubs and bars.
    - **Nightclubs and dance venues:** Different regulations apply across the UK. In England, they can reopen but cannot provide music together with dancing. The explanation given was “venues where individuals are expected to be at close proximity such as, nightclubs, gyms, bowling alleys, dance studios and sports courts are required to remain closed due to the increased risk of aerosol transmission and the likelihood of prolonged exposure.”
      - As part of the relaxation, from 25 July, dance studios could reopen because they are a relatively easily managed space compared with a nightclub dance floor where there is likely to be a high degree of contact between members of the public, who have not entered together, and the risk of transmission is higher.
    - **Sexual entertainment venues** – dancing on stage similar risk management to performance venues. Individual performances require separate risk assessment due to reduced distance between performer and audience.
    - **Commissioning Group for the report:** The Music Venue Trust; The Night Time Industries Association; Festival Republic; Tokyo Industries; The Deltic Group; Proud Leisure
- Proposed Risk Management Strategies [overleaf]:

	Staff	Public	Performers
<b>Elimination</b>	No persons to attend event either as employee or member of the public if they knowingly have or suspect that they may symptoms of Covid-19		
	Minimise the number of staff working.	Review occupancy levels to ensure social distancing is possible.	Consider virtual performances in the first instance.
	Open with reduced level of service.	Do not use secluded seating and non-ventilated areas.	Consider pre-recorded entertainment rather than live acts.
<b>Substitution</b>	Carry out the events in the external environment.		
	Use electronic ordering apps rather than waiters		Consider tailoring act accordingly
	Employ working methods to distance staff from public.	Provide a booking system with strict time slots. Public to adhere to time slots.	No highly physical performances Limit the amount of acts and number of persons required.
<b>Engineering Controls</b>	Employ screens and barriers to increase and maintain distancing		
	Review building layout and arrange to minimise contact with surfaces and doors.		
	Review workstations to permit social distancing	Minimise standing unless transiting. Arrange seating to maintain social distancing.	Keep performers in one location, do not allow performers to interact with the public
	Provide sufficient general ventilation to all areas to prevent stagnant areas and dead spots. Ventilation to be arranged to provide airflow paths to support a hierarchy of cleanliness (i.e. from clean areas such as dining, to less clean areas such as dance floors). Avoid high velocity supply air blowing over people and surfaces. Extract air at low level.		
	No recirculated ventilation to be allowed, only fresh air to be supplied within internal spaces.		
	Arrange internal layout and furniture to assist with airflow paths and air mixing		
	Localised ventilation and screening together to provide fresh air environment for the staff	General ventilation to provide dilution of airborne contamination	Local Exhaust ventilation (LEV) and screening. Consider design of LEV to control at source, e.g. extraction at microphone
<b>Admin Controls</b>	Enhanced cleaning between services and booking, continual cleaning of areas regularly touched e.g. door handles, toilets and sinks		
	Deep cleaning to be conducted out of normal working hours frequency to be determined on a local level		
	Regular hand washing to be carried out by all		
	Employ strict one way systems around venues		
	Pre – booking : Collect relevant data for “test and trace”		
	Training of Staff with respect to current guidance and implementation	Encourage regular hand sanitising	Training of Performers with respect to current guidance and implementation
	Staff to leave the premises immediately after the shift. Encourage cohort working groups	Limit time public can spend at events	Performers to leave the premises immediately after the shift
<b>PPE</b>	Face coverings when in contact with the public. Consider using higher levels of protection, such as respirators or facemasks.	Face coverings when not seated and transiting around the venue	Face coverings when distancing is not an option.

## Reporting of COVID-19 Risk-mitigation Strategies

- Night Time Industries Association (NITA; NSW) 7 Sep 2020 [17] (Media Release):
  - Launched a new social media campaign “Check. Check. Check.” (based on “Slip, Slop, Slap”) to encourage patrons to stay COVID-19 safe. The campaign will encourage the creation of a new ‘going out’ routine and puts the power of keeping COVID safe with patrons who will be asked to:
  - CHECK in with your **correct details at the door**
  - CHECK their **hands** by regularly **washing** and **sanitising**
  - Keep themselves and their friends safe by keeping their **physical distancing** ‘in CHECK’

### Live performances

- Environmental and Modelling Group (EMG) for the Scientific Advisory Group for Emergencies (SAGE) 12 July 2020 [18] (UK Report): transmission of COVID-19 in theatres, concert halls and other performance spaces.
  - **Key findings:** Good ventilation is a primary mitigation for reducing the risk of transmission of COVID-19 by aerosols. Performance venues should seek to maximise the fresh air ventilation rate while being mindful of thermal comfort. If the theatre operator is unsure of the level of ventilation being provided, it is recommended that NCID type CO2 sensors are installed in the occupied space and that the theatre operator checks that levels do not exceed 1000ppm for extended periods. Performance venues should take steps to reduce overcrowding including restricting numbers of people in foyer and bar/café areas as well as in back stage areas. Alongside ventilation, performance venues should implement a regular cleaning routine and ensure that surfaces which are touched by performers and audience members are cleaned before the next performance.
- Colburn 11 Jun 2020 (NEWS; AV Club): A band performed a concert to a live audience on TV; all were enclosed in **plastic bubbles**.
- Delbert 12 Aug 2020 (NEWS; Popular Mechanics): A public concert was held in Newcastle, England with clusters of up to 5 people from the same family/household seated on **raised platforms** with **small fences** around them, responsibly spaced. Around 2,500 people attended spread out over 500 platforms.
- Reuters 21 May 2020 (NEWS): A concert in Sydney was held at a **Drive-in** – patrons were required to **stay in their car**.
- Raphelson 24 Aug 2020 (NEWS; NPR): Reports on a study conducted in Germany to test different social distancing strategies at concerts, but results are not yet available.

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### Strip clubs

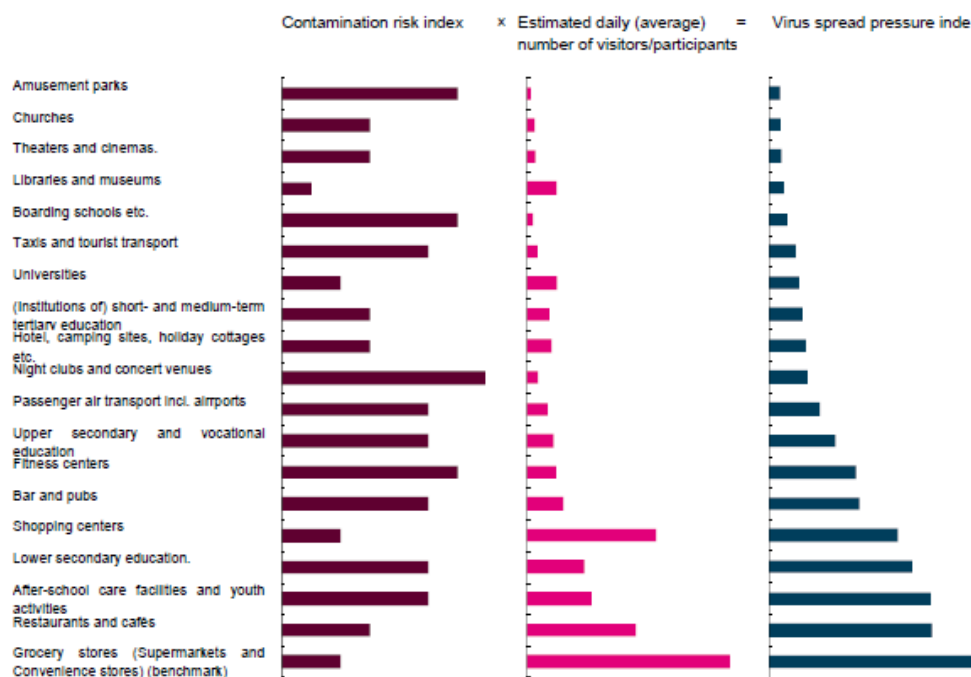
- Eagland 26 Jun 2020 (NEWS, Vancouver Sun, Canada):
  - Dancers are protected by a four-foot-tall barrier of **Plexiglas** surrounding the stage.
  - Staff **scan IDs at the front door** for contact tracing. There are half the usual number of tables inside and a bottle of hand sanitizer rests on each one.
  - After dancers pick up their tips off the stage, they put them into Ziploc bags to rinse them with rubbing alcohol.
  - Between dances, a staff member **sanitizes the stage** and other **high-touch surfaces**, including the pole.
  - **Lap dances are cancelled**.
- Castrodale 23 Jun 2020 (NEWS, Vice, US):
  - All outdoor seating would be eight feet apart or separated by a sheet of plexiglass or "other appropriate, non-porous physical barrier"
  - Performers and patrons would be required to wear **masks** at all times
  - The stage itself would be surrounded by **plexiglass**
  - **No physical contact between performers and patrons** would be allowed at any time
  - **Clean the stage** between performances



## Commentaries and other reports

- Dalton 2020 [19] (SSRN, pre-print):
  - Uses five high-risk settings as case studies to explore factors associated with transmission risk. The settings were **nightclub** and **karaoke** rooms, gyms, ski resorts, cruise ships and religious gatherings.
  - **Night clubs and Karaoke rooms.** Clusters in nightclubs identified in South Korea and Hong Kong. Pre-COVID-19, **meningococcal disease transmission** in nightclubs marked them as settings conducive to the transmission of respiratory tract pathogens. Reasons cited by the authors [not backed up by citation of evidence]: crowding, poorly ventilated with **loud music**, requiring attendees to place their faces very close together as they **yell to communicate**. Alcohol enhances risk by removing barriers to approaching strangers and encroaching within their personal space. Additionally, attendees may **sing with the music, kiss, hug and share drinks**.
  - **Gyms – fitness dance classes:** 54 of 217 (25%) students exposed to infectious gym instructors were infected across 12 gymnasiums in South Korea. Transmission did not appear to occur when there was less than 5 participants in a class or 10 square metres or more per participant. The difference in attack rates based on exercise level suggest an **elevated respiratory rate** rather than transmission via contaminated surfaces alone.
  - Estimating relative risk based on comparing a restaurant patron reference case (1m distance from another patron, eating and drinking) with a **nightclub patron**, including the authors citations.
    - Increased risk calculated as the multiplication of the following factors:
      - 3-10 fold increase due to **louder vocalisation (yelling or singing) due to loud music** (<https://doi.org/10.1038/s41598-019-38808-z>)
      - 8 fold increase due to **communicating at a shorter distance** (30cm vs 1m) (doi: 10.1111/ina.12314)
      - 3 fold increase due to **light exercise (dancing)** (doi: 10.1016/j.envint.2020.105794)
      - 3 fold increase due to **mixing in a nightclub** compared to a restaurant
    - The authors suggest that the combined effects is an approximate 200 fold increase in risk (3x8x3x3).
- Andersen 2020 [20] (Institute of Labor Economics Report):
  - Analysed reopening strategies in **Denmark** based on economic principles and risk assessment. The authors produced a figure that showed the risk of contamination across multiple sectors. Nightclubs and concert venues were identified as having a high contamination risk, but due to having few daily visitors, did not rank highly in 'virus spread pressure' on the country as a whole.

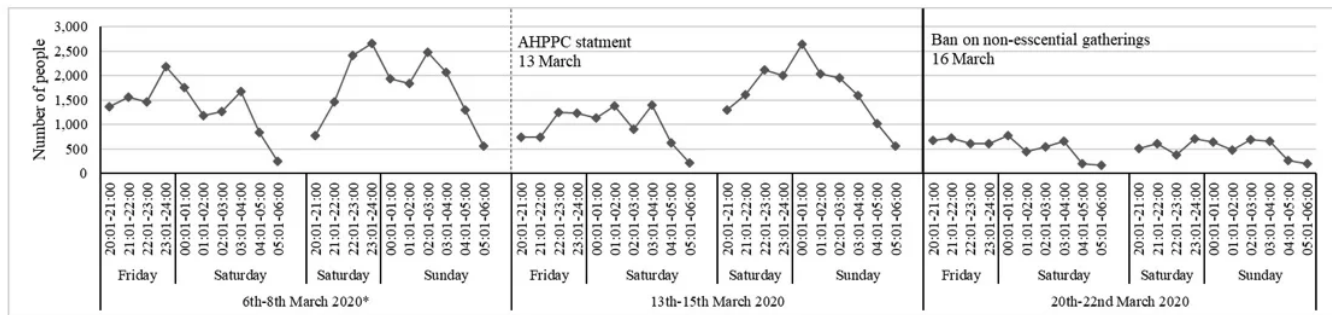
**Figure 1: Assessment of contamination risks across sectors**



- Miller, P. 11 Sep 2020 ([Croakey](#)):
  - Discussion on the risks of opening pubs, bars and nightclubs
  - The alcohol industry is putting pressure on the Victorian Premier Daniel Andrews to reopen licensed venues; public health experts disagree.
    - High-risk locations include those that **attract crowds in close proximity**, and where alcohol consumption undermines social distancing and personal hygiene.
    - Trusting **intoxicated people** to maintain social distancing might be good for business in the short term, but experience from around the world, and importantly, a concern for the Victorian and Australian community, would suggest these narratives are deeply unhelpful.
    - Texas Governor Abbott: "If I could go back and redo anything, it probably would have been to slow down the opening of bars, now seeing in the aftermath of how quickly the coronavirus spread in the bar setting."
    - The Texas Medical Association has produced the table below, which identifies 'going to a bar' as the most risky behaviour for COVID transmission [See Overleaf]
    - [In Seoul](#), over 100 cases linked to a single person attending a nightclub. [An outbreak](#) linked to a Prague nightclub accounted for 98 cases. In the US, [a bar in Orlando](#), Florida had its liquor license suspended after more than 40 people who went there upon its reopening caught coronavirus.
    - [Nightclubs](#) in British Columbia, Canada, have been ordered to shut, and over 300 people [were quarantined](#) after a nightclub outbreak in Zurich, Switzerland.
    - The [first major outbreak](#) in NSW post-lockdown was an outbreak from a pub that welcomed 1,000 people over a day that a single truck driver with COVID visited.
    - There are also examples of breaches to COVID safety measures:
      - the [Unity Hall Hotel in Balmain](#) was ordered to close after multiple breaches
      - In South Australia, [photos and video](#) of crammed dance floors and packed line-ups into venues in various locations have emerged on social media
      - photos of up to 250 people queuing outside [the Golden Sheaf Hotel in Sydney](#), shortly after the end of the first lockdown.
    - Importantly, such large scale exposures place a huge demand on the community's contact tracing resources.



- Using smartphone sensors validated to count pedestrians moving through night-time entertainment precincts (NEPs) in Brisbane's Fortitude Valley, the authors calculated change in the number of people in NEPs before and after the restrictions (13 March- ban on non-essential mass gatherings, then on 23 March non-essential business were closed due to lack of compliance with social distancing guidelines).
- Foot traffic declined by 15% after first set of restrictions and 66% after the second set.



- The high numbers of people who attended the Fortitude Valley after the AHPHC announcement demonstrates that asking people to practise social distancing when drinking and socialising is just not going to control COVID-19 transmission in the high-risk context of entertainment precincts.

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**Expert input:** Prof Steve Wesselingh (SAHMRI)

**Suggested citation:** Miller C, Dono J, May N, Wesselingh S. (2020) COVID-19 transmission risk in entertainment settings. SAHMRI, Adelaide, South Australia.

<https://www.sahmri.org/covid19/>

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