Managing COVID-19 Risk in the UK Entertainment Industry

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Report for: Commissioning Group of:

The Music Venue Trust
The Night Time Industries Association
Festival Republic
Tokyo Industries
The Deltic Group
Proud Leisure

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1. Executive Summary

The Institute of Occupational Medicine (IOM) is an independent not for profit research and consultancy organisation, based in Edinburgh, which works in the area of occupational and environmental health risks and their mitigation. IOM was engaged by a commissioning group consisting of the Night Time Industries Association, the Music Venues Trust, Festival Republic, Tokyo Industries, The Deltic Group and Proud Leisure. The Commissioning Group's instructions were to provide an independent review of the scientific evidence concerning the transmission of COVID-19 and its implications for the entertainment industry, including in particular performers, nightclubs and festivals.

Scale of Study: The study has reviewed 825 pieces of scientific evidence, which, in turn, had used several thousand other studies in order to give an insight as to how Coronavirus is transmitted and how the entertainment industry might respond and manage the risk of transmission as it resumes its work.

Science relating to the Entertainment Industries: We have found no conclusive scientific evidence that relates specifically to the entertainment industry. The virus is agnostic as to whom it affects and where. Transmission is more prevalent indoors and where people are in close proximity, but the use of control measures reduces exposure to the virus and hence its transmission. We have found no evidence that precludes the opening of any indoor or outdoor venue, provided a risk assessment is undertaken and control measures are in place. The lack of data relating to specific entertainment venues is an area of potential future study.

Impact on Health: Evidence suggests that as you get older you are more at risk of more serious illness should you contract the virus. There is a growing group of vulnerable and extremely vulnerable people including those over 70 or those with underlying health conditions. Smoking and obesity may also increase the seriousness of illness caused by COVID-19. Ethnicity appears to have some bearing on severity. Key symptoms are regularly updated as data is gathered. Everyone can get COVID-19.

Virus transmission methods: The virus is highly contagious and is transmitted quickly in three key ways; direct contact with someone who has the virus, indirect contact via surfaces that have the virus on them and contact from the virus suspended in the air. These three transmission routes have driven the guidance as to how to reduce the risk of transmission.

Entry to the body: It enters the body via eyes, nose or mouth. Preventing entry is the key driver behind the initial guidance provided to the public. Good personal hygiene and not touching your face are essential.

Close contact: Initially transmission was deemed to be, primarily, by the virus being in large droplets of saliva and mucus. These are relatively large and do not travel more than two metres. Keeping two metres apart reduces the risk of transmission from between two (2) and ten (10) times compared with one metre. The correct use of face coverings enables much closer distances to be used as it catches the saliva or mucus droplets which contain the virus at source.

Surfaces: Once on a surface the virus, dependent upon surface type, is capable of surviving for up to 72 hours. It can be killed on surfaces through normal, thorough cleaning using most common cleaning materials.

Airborne: Evidence has emerged that the virus is also capable of being in aerosol form and can travel quickly if projected (such as sneezing or coughing) over much greater distances. In its aerosol form it is more easily dispersed in well ventilated spaces. There is some guidance (often from product manufacturers) on Air Change Rates per hour (ACH) for various places, but it is generally not referenced. The healthcare sector has the most guidance, with operating theatres have 20 – 30 ACH. Some guidance was found relating to entertainment venues. The range is between 5 – 20 ACH. The control of aerosol is much harder once in the air. As a result it needs to be caught much closer to its source. The wearing of a face covering (non-powered) can reduce transmission from between 45% - 85%.

Prolonged Exposure: There is some evidence that prolonged exposure to higher concentrations of the virus worsen the effect. There is no guidance on how long prolonged exposure is nor have we found research in this area.

Emerging Insight: The scientific community are producing large amounts of research on transmission prevention, immunisation and treatment. There are a number of significant knowledge gaps which are being filled, almost daily, that means any solutions devised to control transmission will need to be constantly evaluated as to their effectiveness. As new insight is provided regulations will change.

UK Government Approach: The UK Government's lock down approach was focused on seeking to avoid risk of exposure for the public. As the science evolves, different controls and barriers are seeking to be used to enable lockdown to be eased. The move in approach is to one of risk management and control at a local level.

Hierarchy of Control: SAGE has provided a 'bow tie' model, akin to the 'Swiss Cheese' Model to risk management, that provides a series of barriers and controls that can be used together to manage transmission rates.

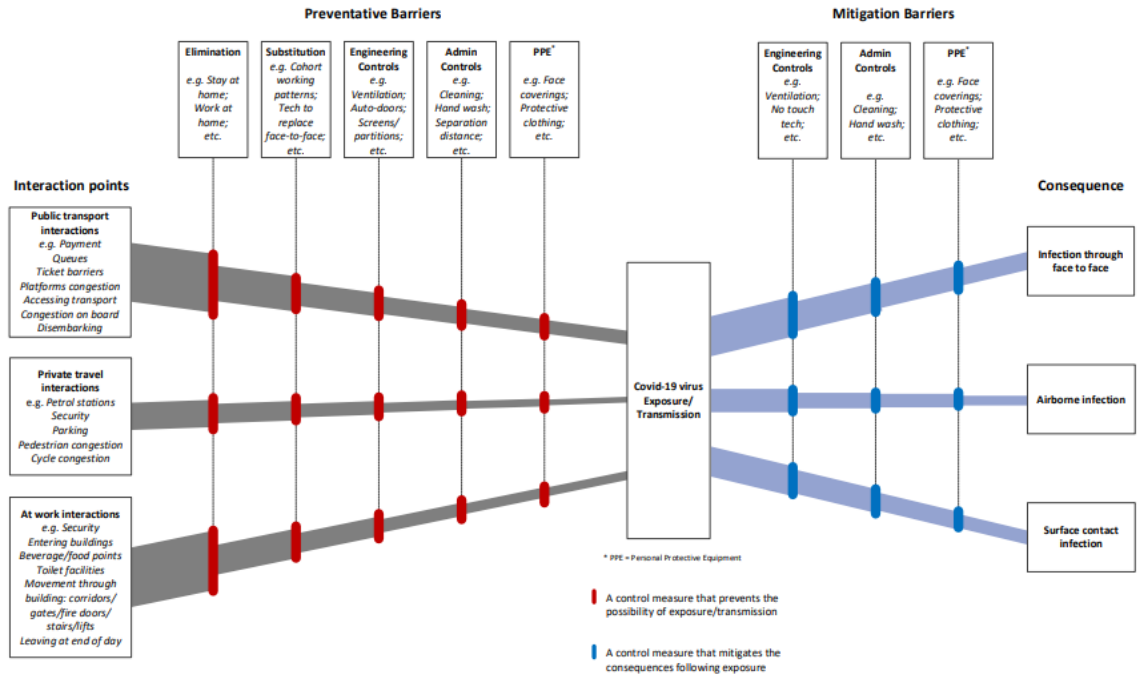


Figure 2: Bowtie diagram that can be used to graphically determine appropriate prevention and mitigation measures

The details in this model are constantly evolving and have focused, initially on the elimination risk.

Layering of Controls: The cumulative impact of layered barriers is difficult to prove due to lack of data. Theoretically if using no barrier or control is 100% risk, using one reduces the risk by 50%, using two by a further 50% (75% cumulative risk reduction) and so on. The principle is an effective model but the lack of data at this time means we are unable to show how much more effective one particular barrier or control is over another. This is an area of research that needs to be done. SAGE does acknowledge that there is a cumulative benefit of using multiple controls *(pp 20: EMG-SAGE report 04 June 2020).*

Using the 'Bow Tie' to identify new mitigations: Whilst a number of the mitigations are already known and being used, such as personal hygiene, venue cleaning and distancing, others, such as engineering solutions around ventilation or the layering of personal protection equipment (face mask use) are not as well understood and are opportunities for refining the initial guidance that Government has provided, thereby enabling a return to operations faster.

Mitigations mapped to the SAGE 'Bow Tie': The study has identified a number of mitigation options that map against the barriers identified by SAGE in their 'bow tie' above.

	Staff	Public	Performers
Elimination	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 that live acts.
Substitution	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.
Engineering Controls	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
Admin Controls	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
PPE	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.

The list above is not exhaustive.

Current Guidance: UK Government guidance is based upon SAGE reviewed evidence. There is currently a lag between the data being applied in the use of guidance and publication for use by the wider community. As such, we have assumed that the science behind the guidance will have followed scientific peer review protocols and is valid. The guidance is evolving as new knowledge is created. Details of where the most pertinent, at this time, are included within this document. At present the UK Government has produced sectoral guidance including for pubs, bars and takeaway services, and also for the performing arts, based on the risk assessment approach. There is no guidance for nightclubs. From 01 August 2020 performances will be allowed indoors and outdoors, subject to social-distancing measures.

Purpose of paper: This paper is provided to inform the commissioning group about the current Government and other guidance that is available and the scientific evidence that underpins the guidance as well as any recent additional scientific evidence that is available. A number of options have been identified that can be used to demonstrate a considered approach when assessing and managing risk. As the situation is constantly evolving it is recommended that the commissioning group refer the any Government guidance prior to any activity.

Acknowledgements IOM is grateful for the contributions of the commissioning group in understanding how various types of entertainment venue operate and are currently interpreting the legislative, regulatory and operating guidance. In particular we are grateful to Philip Kolvin QC for his insight and interpretation of the legal and regulatory environment currently operating in the UK (primarily England) in relation to the management of entertainment venues.

2. Introduction

Currently, the Government's guidance for pubs and bars states: "At this time, venues should not permit live performances, including drama, comedy and music, to take place in front of a live audience". The Government's website explains that live performances carry "an increased risk of transmission", as might "patrons needing to raise their voices to be heard above background music". Further, it adds: "There may be an additional risk of infection in environments where you or others are singing, chanting, shouting or conversing loudly". The overriding concern is that the lack of evidence in relation to the relevant scenarios and so a precautionary approach is advocated.

We have been asked by a commissioning group of entertainment venue and event providers (contract via Music Venue Trust) to examine the high-level scientific advice given to Government and the underlying science concerning the risk factors associated with Covid-19 infection, including how the virus is spread (e.g. aerosol presence, droplet propulsion, surface contamination), and the likely effectiveness of mitigation measures of relevance to the UK entertainment industry (e.g. air quality/filtration, hand hygiene, Perspex screens).

We were also asked to identify the evidence-base behind other relevant existing guidance.
This report therefore examines the current Government and other guidance that is available, as well as other recent scientific evidence that might be relevant, for UK entertainment industry. In particular, it considers whether venues that have (live) entertainment may be able to do so whilst adequately controlling COVID-19-related risks and, if so, what risk mitigation measures need to be in place to ensure that risks of infection are adequately controlled (to meet the concerns of Local Authority Licensing Officers and Environmental Health Officers).

3. The disease and its transmission

This section has reproduced the summary of the situation as expressed by SAGE (Scientific Advisory Group for Emergencies). Some discrepancies, contradictions or inaccuracies have been identified in the SAGE guidance at the time of writing. These have been indicated in the footnotes within the sections below.

Coronavirus disease (COVID-19) is an infectious disease caused by a coronavirus (SARS-CoV-2) discovered in Wuhan, China at the end of 2019. The virus has subsequently caused a global pandemic, which by Friday 24th July had caused 297,914 laboratory-confirmed cases in the UK and 45.677 deaths[1].

Most people infected with the COVID-19 virus experience mild to moderate respiratory illness and recover without special treatment. However, older people, and those with underlying medical conditions such as cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness. There is also evidence that the rate of COVID-19 infection was over twice as high in those with Black or Bangladeshi ethnicity than White British ethnicity and for people of Chinese, Indian, Pakistani, Other Asian, Caribbean and Other Black Ethnicity the rate of infection was 10-50% higher than White British[2].

The best way to prevent or slow down transmission is for people to be well informed about the COVID-19 virus, the disease it causes, how it spreads, and take appropriate precautions to minimise the risk of infection. The general advice is to protect yourself and others from infection by washing your hands or using an alcohol-based rub frequently and avoid touching your face.

The original advice from the World Health Organisation (WHO) was that the COVID-19 virus spreads primarily through large droplets of saliva or discharge from the nose or mouth when an infected person coughs or sneezes. However, evidence has emerged to suggest that the virus may be present as very small (respirable) particles and droplets suspended in the air, and such aerosols may form an important route of exposure, especially in indoor environments.

Treatments for COVID-19 are in the early stages of development and scientists globally are working hard to develop a vaccine, with some trials testing a proposed vaccine already underway.

[1] https://coronavirus.data.gov.uk/

[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892376/COVID_stakeholder_engagement_synthesis_beyond_the_data.pdf

4. Government Response and Guidance

4.1. SAGE

SAGE was set up to provide scientific and technical advice to support government decision makers during emergencies. Its membership is listed on the gov.uk website[3]. During the COVID-19 pandemic, SAGE has additionally relied on expert scientific advice from expert groups, including:

- New and Emerging Respiratory Virus Threats Advisory Group (NERVTAG)
- Scientific Pandemic Influenza Group on Modelling (SPI-M)
- Independent Scientific Pandemic Influenza Group of Behaviours (SPI-B)
- COVID-19 Genomics UK (COG-UK)
- Health Data Research UK (HDR UK)

According to SAGE, the national and global response to the spread of COVID-19 continues to develop quickly and our knowledge of the virus is growing.

Unfortunately, at the time of writing this section of the report, the latest minutes of the SAGE meetings that are publicly available are those from the 39th meeting held on 28 May 2020, and so there is no public record of the science behind any recommendations in relation to live entertainment at various venues.

4.2. Scientific Evidence from Government[4]

The SAGE report dated 4th June 2020 (which is the latest publically available), covered transmission of SARS-CoV-2 and mitigating measures. Much of the section below is drawn directly from the SAGE reports. Key sections been identified in italics.

4.2.1. Executive Summary

- *Transmission of SARS-CoV-2 is most strongly associated with close and prolonged contact in indoor environments. The highest risks of transmission are in crowded spaces over extended periods (high confidence).*

[3] https://www.gov.uk/government/publications/scientific-advisory-group-for-emergencies-sage-coronavirus-covid-19-response-membership/list-of-participants-of-sage-and-related-sub-groups

[4] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892043/S0484_Transmission_of_SARS-CoV-2_and_Mitigating_Measures.pdf

- *Physical distancing is an important mitigation measure (high confidence). Where a situation means that 2m face-to-face distancing cannot be achieved it is strongly recommended that additional mitigation measures including (but not limited to) face coverings and minimising duration of exposure are adopted (medium confidence).*
- *Selection of prevention and mitigation measures should consider all the potential transmission routes and need to be bespoke to a setting and the activities carried out (high confidence).*

4.3. Understanding Transmission

- *Transmission of SARS-CoV-2 is most strongly associated with close and prolonged contact, suggesting that close-range direct person-to-person transmission (droplets) and indirect contact transmission (via surfaces and objects) are the most important routes of transmission.*
- *There is weak evidence that aerosol transmission may play a role under some conditions such as in poorly ventilated crowded environments. This evidence is predominately from one outbreak investigation. Laboratory bio-aerosol experiments show that SARS-CoV-2 can survive in the aerosol state for over 1 hour.*
- *There is evidence for asymptomatic transmission and weak but evolving evidence for super-spreading events where a small number of people infect large numbers of others. Given that these people may be asymptomatic (and thus not coughing or sneezing) it is possible that they are able to disperse large amounts of virus aerosol through normal respiratory activities.*

4.4. Physical distancing

- *There is a non-linear relation between the risk of transmission and distance of separation for face-to-face contact. Duration of this contact is also important with risk proportional to time. Given the uncertainties about transmission and dose-response it is not possible to say with certainty what a safe distance of separation is, but best current evidence suggests that 1m carries between 2 and 10 times the risk of 2 m of separation.*
- *Where it is necessary for people to be closer than 2m face-to-face for a prolonged period or where someone has multiple frequent interactions with others at shorter distance, additional measures will be required to disrupt close-range transmission. In most cases, this is likely to be based on limiting duration of contact, using face coverings and orientation of people (with the highest risk being for people who are face-to-face and in close proximity to one another).*
- *Countries that specify a separation distance below 2m generally mandate other mitigation measures, usually face masks or face coverings as a minimum. The exception is Australia, which recommends 1.5m and does not mandate face coverings but, this is in the context of very low disease prevalence.*
- *Outdoor transmission remains low risk through aerosol and indirect contact routes, but face-to-face exposure (e.g. ⩽2m for a prolonged period) should still be considered a potential risk for transmission via respiratory droplets.*

4.5. Prevention and mitigation measures

- *Selecting prevention and mitigation measures should use a "hierarchy of control" approach. It is important to ensure that measures are in place to cover all the transmission routes, and groups of measures are likely to be needed to ensure this is achieved. Graphical methods may be beneficial to help organisations visualise the impacts and interactions of different measures.*

- *Evidence relating to hand-hygiene and face coverings includes a number of randomised trials and meta-analyses. A recent meta-analysis study has also considered the role of distance in transmission and is consistent with our analysis around this measure.*
- *Given the very recent origin of this novel virus, very few engineering or environmental mitigation measures have strong evidence to support their effectiveness. A number have data from idealised studies to show theoretical efficacy, but there are very few real-world studies. Decisions on selection of engineering controls will inevitably need to be based on incomplete evidence as "do nothing" is not an option. Appropriate controls should be identified through collaborative risk assessments carried out between employers and employees.*
- *While some measures may be predicted to only have a small effect if applied in isolation, applying multiple measures in combination will lead to much greater, and in some cases synergistic, effects (pp 20: EMG-SAGE report: 04 June 2020)*

4.5.1. Overview of Modes of Transmission

Transmission is still thought to occur through three main mechanisms as illustrated in Figure 1 [1, 2]:

- *Close-range direct person-to-person transmission happens when someone is directly exposed to the respiratory droplets emitted by another person. These virus carrying droplets and aerosols can lead to virus entering the body through eyes, nasal membranes, oral mucosa, or the respiratory system. Close range transmission can also be through direct physical contact with the infectious person.*
- *Indirect surface contact transmission happens when someone touches a surface that has been contaminated with the virus. They may then become infected when they touch their nose, eyes or mouth with a contaminated hand or object (fomite). Surfaces can be contaminated through the deposition of respiratory droplets and by people who are infectious touching surfaces with their hands.*
- *Aerosol transmission occurs when small virus containing respiratory droplets evaporate to less than 5 micron diameter particles (droplet nuclei) and are carried by the air, where they are subsequently inhaled. These droplets may be released from respiratory actions (breathing, talking, coughing etc.) as well as through aerosol generating procedures in a hospital or dental environment. These particles principally transit infection over short distances but potentially could transmit over longer distances (<2m[5]) too (and for indoor environments, to fill a room).*

[5] We believe this was meant to be greater than rather than less than

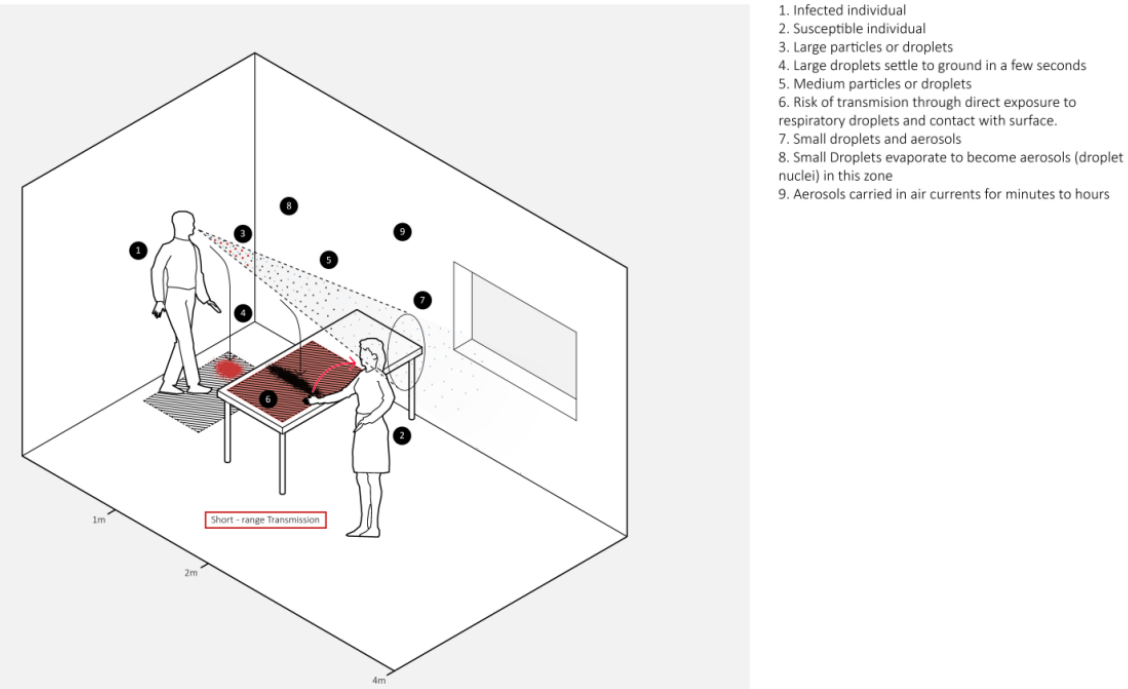


Figure 1: Illustration of the transmission routes for COVID-19

Infection required inoculation[6] by sufficient number of viral particles to cause infection – the number of particles required to cause infection is not yet known. However, the infectious dose received depends on the quantity of infectious virus multiplied by the duration of exposure, and hence both must be considered when evaluating risk.

4.6. Risk Assessment factors

Risk of transmission depends on a number of factors. These are:

- The **highest risk for close-range transmission is when someone is face-to-face** with an infectious person at a distance of 2m or less for a prolonged period. The risk increases with the amount of time spent in close proximity to the infectious person and with the reduction of distance and data suggest risk at 2m face-to-face is around 10 times lower than the risk at 1m [3]. A new meta-analysis [7]paper of reported transmission, slightly contradicts this suggesting that the risk of transmission at 2m separation is approximately half that at 1m, although this does not consider the orientation or the mode of transmission [4]. When people are side-to-side or behind one another, risk is likely to arise by aerosol transmission and so is determined by the influence of ventilation; at 1m the exposure risks would be similar to those at 2m when face-to-face in indoor environments.

- **Risk of contact transmission increases with the proximity to the infectious person** (surfaces close by are more likely to be contaminated), the number of surfaces touched, the composition

[6] We interpret this to mean infiltration

[7] A meta-analysis is a quantitative synthesis of the results of several studies to provide an overall estimate of effect.

of the surfaces, virus survival on hands and surfaces, and higher frequency face touching behaviour. Frequent cleaning of hand touch surfaces and good hand hygiene reduce risk. The virus is not likely to survive for long periods of time on outdoor surfaces in sunlight, but may survive for more than 24 hours in indoor environments.

- The risk of **aerosol transmission is highest when people share poorly ventilated spaces where the viral aerosols can build up rather than being diluted and removed by ventilation**. Risk increases with time spent in the same shared enclosed environment. Risk is generally higher closer to the infectious person, but beyond this close proximity the concentration of aerosols that a susceptible person will be exposed to depends on the ventilation in the room.

- **Transmission by aerosol can happen at distances beyond 2m** in the same enclosed space especially if ventilation is poor and duration of exposure is relatively long. It is possible, but generally unlikely, that aerosol transmission can happen between people in different rooms (via ventilation systems). Aerosol transmission risk is considered to be very low outdoors due to high dilution of virus carrying aerosols and UV inactivation of the virus.

- The amount of virus released by an infected person and its dispersion characteristics facilitates the transmission. Aerosol dispersion is governed by complex physics defining the airflow. Key factors include the type of respiratory activity (a sneeze generates the most particles, breathing and talking produce less), the velocity of the air released (a cough or a sneeze is more violent than breathing or talking and hence the aerosol and droplets can travel further). The virus could also be introduced via nasal discharge through contamination on hands. The point at which the exposure occurs in the disease progression of the infected individual is also important; there is evidence that viral shedding may be highest the day prior to symptom onset [5]. No viable virus has been recovered from air samples taken in hospitals from patients who generally are at a more advanced stage of infection. Viral RNA has only been recovered from these samples occasionally at low levels, although one study suggests it is higher for patients in the first week of illness [6]. There is limited quantitative data yet to indicate how this varies between people.

- Transmission may also be influenced by environmental conditions. The virus is stable on surfaces and in air under laboratory conditions that simulate indoor environments, but only for limited time periods. **The virus survives better under colder, drier conditions** with survival times of hours to days. Experiments under simulated sunlight suggests that high exposure to UV in outdoor environments will reduce the survival time to the order of minutes, however this will depend on the time of year and the cloud cover.

All of the issues identified above are important to consider when developing a risk assessment. Given each job comprises a mix of individual work activities, it will be important to identify the factors that influence risk and the appropriate mix of prevention and mitigation at the level of the work activity to reduce these risks to levels which are as low as reasonably practicable. This underlines the need for front line employees as well as managers to be involved in risk assessment preparation.

4.7. Latest evidence for importance of different modes of transmission and key factors

Evidence that transmission is predominantly occurring in indoor spaces where people are in close proximity continues to grow [7]. Care homes and hospitals have been recognised as high-risk environments. Household transmission also remains one of the most significant infection settings and hence it is important to continue to provide guidance to households and public health messaging on mitigating transmission [8]. An increase in workplace contacts will increase risk of infection and is thus likely to lead to further household transmission.

Recent animal studies [9-11] have shown that transmission can occur without direct contact between animals housed in separate but closely located cages, confirming that close range droplet and/or aerosol routes are important (it is not possible to determine from these experiments whether transmission was through droplets, aerosols or both). CDC in the USA have recently clarified their information on transmission to indicate that direct person-to-person exposure is likely to be the predominant form of transmission.

4.8. Outbreak Clusters

There are growing numbers of anecdotal reports of outbreak clusters, where one person is responsible for localised clusters (super-spreading events involving infection of large numbers of people), sometimes over a relatively short time period (typically hours). Very few of these outbreaks have yet been formally reported in the academic literature, and those which have, contain very limited information on the environment and possible routes of transmission. However, the types of environment and circumstances of transmission are concerning as they involve commonly practised communal activities. At least two outbreaks with a high attack rate have been associated with choir rehearsals and several clusters have been associated with religious settings, parties, bars, restaurants, and nightclubs. The Skagit Choir outbreak [12] resulted in 33 confirmed and 20 probable cases among 61 people from one infector in a 2.5 hour period. Transmission could include contact and close-range as well as possible aerosol transmission, which may be exacerbated through singing.

4.9. Pre-symptomatic and Asymptomatic transmission

There is good evidence that pre-symptomatic and asymptomatic transmission occurs, and may underpin some of these clusters. The infectious individuals are not necessarily coughing or sneezing, but they are shedding sufficient virus to cause multiple secondary cases through normal respiratory activities and/or through contamination of surfaces. A case in a church in Singapore [13] identified transmission to one person who sat in the same seat as an infector at a subsequent event suggesting transmission through contaminated surfaces. A cluster in a shopping mall in China indicated some close contact, but several cases occurred with no direct contact and hence transmission through "virus contamination of common objects, virus aerosolization in a confined space, or spread from asymptomatic infected person" was implicated. The areas proposed for this transmission were restrooms or elevators [14].

4.10. Distance and other measures on the reduction of infection

A new meta-analysis study [4] considered influence of distance and the application of face masks and eye protection (face shields) on the transmission of SARS, MERS and SARS-CoV-2. This does not provide detail on the mechanisms for transmission but shows how these factors influence the risk of exposure. The paper reports that a physical distance of more than 1 m probably results in a large reduction in virus infection (adjusted relative risk 0.18 (95% CI 0.09-0.38)); for every 1 m further away in distancing, the relative effect might decrease 2.02 times (95% CI 1.08 to 3.76; p = 0.041). The paper considers masks and eye protection as exposure controls only and shows both reduce risk but with low certainty in the evidence. It should be noted that many of the papers within this meta-analysis were from healthcare settings and all were based on indoor environments.

4.11. Transmission via human waste

In a recent single study infectious virus has been isolated (but not enumerated) from faeces [15]. While there is not yet any evidence of transmission, this may raise the possibility of transmission through contact with faecal matter and potentially during toilet flushing or faulty building drainage systems. Transmission through direct exposure to droplets, inhalation of aerosol in bathroom environments or contamination of surfaces including hand washing facilities in bathroom environments could be possible, although there is no evidence currently to suggest that it is a significant route.

4.12. Outdoor transmission

Two recent computational studies [16, 17] have modelled dispersion of respiratory droplets in outdoor conditions and shown that the wind can carry droplets further than 2 m. Neither of these studies has been validated in a real-world context and neither take account of the infectious dose needed to initiate infection, but one showed that the fraction of respiratory droplets that deposited on a person at a distance of a 1.83 m (6ft) doubled at a wind speed of 4 m/s compared to 0 m/s. There is no further evidence for transmission outdoors, and the risk outdoors remains very low. However, face-to-face transmission could be possible we recommend that people continue to observe a distance of 2 m when face-to-face and avoid prolonged exposure to other people.

Many gaps in knowledge remain about the importance of different transmission modes and factors that influence them. We recommend that the investigation of outbreaks to a standardised protocol that includes environmental factors should be a priority in order to understand how transmission is happening across different settings.

4.13. Choosing prevention and mitigation measures

This section largely reproduces the evidence from the 4th June 2020 SAGE report. Creating an environment that minimises the possibility of transmission requires appropriate actions to prevent and mitigate risk. This should consider all of the known transmission routes together with the time that someone is exposed. It should also consider the chance of coming into contact with an infected person, which will depend on the nature of the job, the prevalence of the virus in the population and the level of vulnerability of susceptible people. A greater level of mitigation will be needed where:

- The environment includes people who are particularly vulnerable to COVID;
- People are at high risk of exposure to someone with COVID;
- People are exposed to individuals where there is little record of who they came into contact with, thus reducing the opportunities for contact tracing (e.g. public transport and other public spaces);
- The nature of a job means it is likely that people will be in close proximity other people;
- The nature of a job means it is likely that people will be highly networked and therefore may act as transmission amplifiers.

The efficacy, effectiveness and confidence in the evidence for 39 identified prevention and mitigation approaches is set out in Table 1 in Appendix 5. This considers the hierarchy of risk and the route(s) that the measure can prevent or mitigate. The efficacy is considered to be the theoretical performance under ideal conditions, while the effectiveness considers the real-world performance which takes into account likely impacts of technical limitations and behavioural aspects. Scores for efficacy, effectiveness and confidence are based on expert views, who scored independently using a 5-point Likert scale. This was carried out rapidly to provide an initial assessment. Factors such as practicality and cost are not considered in this assessment, but are discussed in Table 2 which summarises the rationale for each option.

This is a novel disease with a small but rapidly developing evidence base. There are very few randomised controlled studies, and very few systematic reviews or meta-analyses. In assessing our confidence in the evidence we have taken account of this limited nature and volume of evidence, the quality of the studies, and the risks of different forms of bias, including publication bias.

4.14. Types of measures

In selecting appropriate measures, it is important to identify combinations of approaches that address all the potential routes of infection (direct person-person, indirect surface contact, and aerosol) and that are bespoke to the environment and the activities that are carried out.

- Some measures act as **preventative barriers** that limit exposure to a source of infection, while others act as **mitigation barriers** that limit the consequences when exposure does happen. **Several measures act as both prevention and mitigation**.
- Some measures act against only one transmission route, while others are able to prevent or mitigate more than one route. In some cases, it is possible that the introduction of a measure could raise the risk of transmission through another route or have other negative consequences. Care should be taken, to consider both the intended and unintended consequences any particular approach.
- The potential for interactions between different measures is not yet well understood. While some measures may be predicted to only have a small effect if applied in isolation, applying multiple measures in combination will lead to much greater, and in some cases synergistic, effects.

4.15. Application of measures

All measures should be considered in the context of the disease prevalence in the environment and the risk of exposure to an infectious person. When there is a high prevalence of disease stringent measures and good adherence are important for both personal protection and to stem the transmission of the disease in the community. When prevalence drops to a sufficiently low level it is likely that measures can be relaxed considerably in most environments. Taking these decisions will need to weigh up the likelihood of exposure, the vulnerability of the people concerned and the wider consequences to society.

It is important to have good confidence in the prevalence of the disease in order to make these judgements effectively. It may be appropriate to link measures to Joint Biosecurity Centre alert levels provided these are robust.

4.16. Quantification of risk and mitigations

There is currently insufficient evidence on transmission to be able to confidently quantify absolute risk of infection and the impact of mitigation measures. For some modes of transmission, it may be possible to use surrogate approaches, computational models or data from other diseases to estimate the relative effects of prevention and mitigation measures. However, as many of these are environment specific it can be difficult to quantify with a high degree of confidence. There is a well-established concept of "tolerable risk" which is defined by HSE as "…'tolerable' does not mean 'acceptable'. It refers instead to a willingness by society as a whole to live with a risk so as to secure certain benefits in the confidence that the risk is one that is worth taking and that it is being properly controlled".

4.17. Layers of control – SAGE's 'bow tie' model

Visual approaches can be a useful tool to consider the application of different control measures. A Bowtie diagram (Figure 2) can be used to show how different preventative and mitigation barriers can be applied to consider their impact on interaction points and different transmission routes. A coloured block can be used to show where a particular prevention approach applies to a particular interaction or how a mitigation measure impacts on a transmission route. It is important to have at least one coloured block on each strand. A higher number of coloured blocks would provide greater confidence of more effective reduction in transmission. It can also enable easy identification of those measures that are both preventative and mitigating, or those that only act in one way.

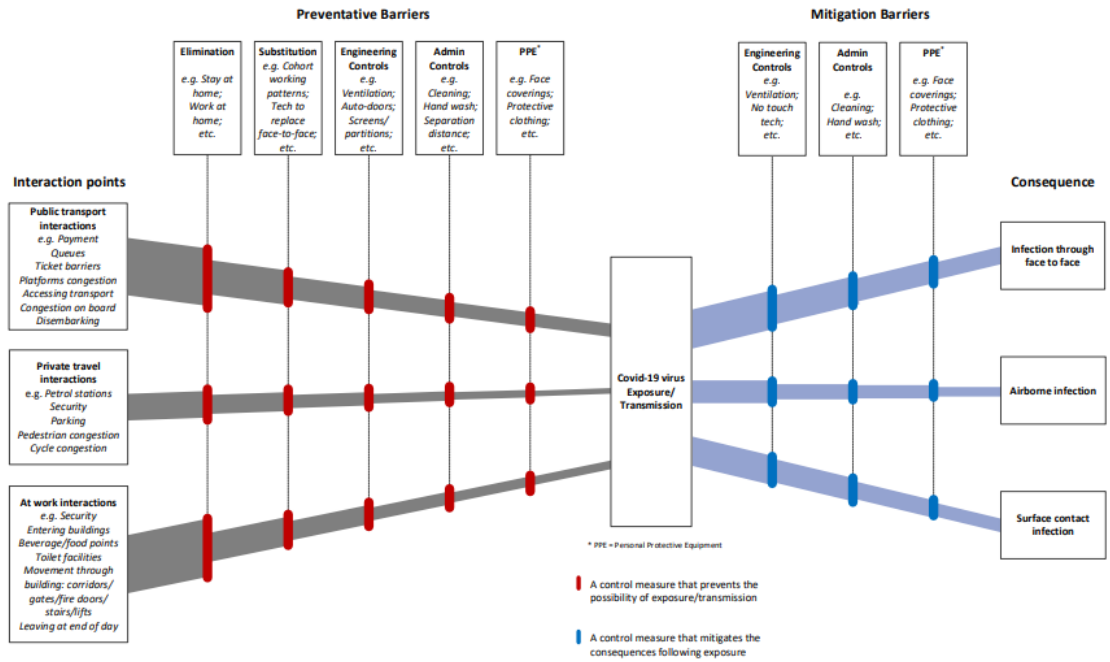


Figure 2: Bowtie diagram that can be used to graphically determine appropriate prevention and mitigation measures

5. Scientific Evidence – Broader Epidemiological Studies

Our study has looked at 825 pieces of evidence into how the virus spreads, how it can be controlled and risk of transmission managed. From the scientific data available to date it is clear that the virus is highly contagious, can be spread quickly by humans through direct contact with someone with the virus or with a surface that has virus laden contaminants upon it. There is growing evidence that aerosol transmission is also a key transmission route. The evidence we have found broadly supports the approach SAGE and the UK Government has taken. If anything, the lack of evidence publically available on COVID-19 suggests the approach taken by the UK Government has not been as cautionary as we might have expected. It is clear that, as data is analysed the approach from risk avoidance to active risk management, is being adopted.

The SAGE guidance uses the data already gathered to make decisions on how the UK should manage transmission risk whilst seeking to balance a return to 'normal' life. They have, rightly, adopted a sensible, cautionary approach to managing transmission risk in order to protect vulnerable people. Whilst there are some inaccuracies in the SAGE guidance we believe they are more to do with drafting rather than the science. This said, new studies are being published regularly which may result in changes to SAGE thinking and UK Government guidance. There are also some significant gaps in research which should be filled. One of those relates to the scale of impact of indoor, high density venues and events in how the virus is transmitted and spread. This could be an area of work the commissioning group would seek to undertake. The key findings of our study which relate to entertainment venues is below, with more detail at appendix 3.

5.1. Cleaning

Regular cleaning of surfaces is strongly recommended, as is the regulation of humidity within buildings. A study in relation to cleaning stated that cleaning with 62-71% ethanol is effective, a concentration that is typically in most sanitizers. Items should be removed from sink areas to ensure aerosolized water droplets do not carry viral particles onto commonly used items. Countertops and sinks should be cleaned with a 10% bleach solution or an alcohol-based cleaner on a regular basis. [20]

Similarly, a review of the persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents suggests that coronaviruses can persist on inanimate surfaces like metal, glass or plastic for up to 9 days, but can be efficiently inactivated by surface disinfection procedures with 62–71%

ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite within 1 minute. Other biocidal agents such as 0.05–0.2% benzalkonium chloride or 0.02% chlorhexidine digluconate are less effective [36]. There is a lack of clarity on survival rates of the virus on different surfaces. Another review suggests human coronaviruses are able to survive on steel, metal, wood, aluminium, paper, glass, plastic, ceramic, disposable gowns, and surgical gloves for 2–9 days and high temperature (⩾30 °C) can reduce the persistence period, while low temperature (4 °C) increases the persistence time up to 28 days [35].

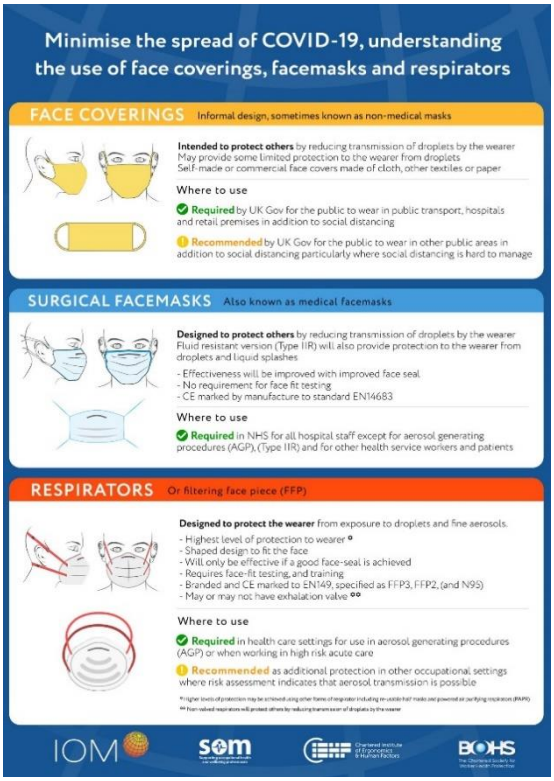
In any event, whether the survival rate is short or long, it is of key importance to implement a regular and effective cleaning regime. Staff should be reminded of the cleaning standards required and provided with the appropriate cleaning materials. There may also be good reason to have toilet attendants to ensure that WCs, surfaces and door handles etc. are kept clean and that handwashing is properly observed.

5.2. Face coverings

A study in relation to face coverings stated that the SARS-CoV-2 virus which causes COVID-19 replicates in the upper respiratory tracts, which means it is likely to be transmitted mainly by droplets (which is why there is so much emphasis on hand-washing, since droplets contaminate surfaces). Droplets emitted from the human respiratory tract, which are relatively large and are emitted by speaking as well as coughing and sneezing, quickly turn into aerosols (smaller droplets) and so unless controlled at source, they are much harder to block.

Most research on face masks and face coverings, which in the context of COVID-19 has been in health care workers, considers the extent to which they protect the wearer. However, it is also important for source control that we consider whether covering the face protects other people from droplets emitted by the wearer. Large droplets and a proportion of aerosols are blocked, not perfectly, but significantly, by cotton home-made face coverings. Thus, especially in crowded public places where social distancing is impossible, the wearing of face coverings is recommended. Mathematical modelling suggests that a face covering that is 60% effective at blocking viral transmission and is worn by 60% of the population will reduce R0 to below 1.0 [31].

The IOM guidance on which face covering to use is detailed below:



5.3. Ventilation

The beneficial effects of ventilation emerge from a number of studies but have perhaps received insufficient attention in the UK. There is scope for ventilation experts assessing the potential for airflow within building and for the capacity and nature of indoor activities to be controlled so as to minimise exposure.

On this topic, a study has concluded that the operation and maintenance of ventilation and filtration systems can help reduce the risk of airborne transmission. Higher outside air fractions and higher exchange rates in buildings may help to dilute indoor contaminants, including viral particles, from air that is breathed within buildings. This can be achieved, at the simplest level, by opening windows, through to a full mechanical ventilation system. Understanding the Air Change Rate per hour (ACH) is critical to determining the most appropriate solution. The higher the ACH the more diluted the air. There is academic debate as to whether increasing indoor air circulation rate could increase exposure by potentially re-suspending ultrafine particles. This is not proven.

In addition, there is evidence that increasing relative humidity can be detrimental to virus survival but the level of humidity is not clear, ranging between 40 – 70%, so targeted in-room humidification may be an option to consider. Further research is needed to understand the impact of natural light on SARS-CoV-2 indoors, although consideration might be given to UV light in the shorter wavelengths, as this is germicidal, although should be implemented with appropriate precaution [20]. The use of UV light is not as simple as shining a light in a room.

5.4. Food

A study specifically in relation to food concluded that there is no evidence that food is a coronavirus transmission route. However, during food preparation improper sanitization and disinfection of key touchpoints, food contact, non-food contact, equipment and cleaning tools surfaces and close contact of food handlers with staff and customers not only can put themselves on risk but can also be a risk for customers.

Food services and the retail sector should make sure proper hand hygiene, approved sanitizers and disinfectants are in use, and follow social distances at workstations and while interacting with the customers. Businesses should be vigilant to monitor the temperature of staff and incoming guests to identify if there may be any sick person to prevent further spread of coronavirus and should report to health authorities if anyone presents symptoms matching with COVID-19 [30].

6. Interpretation of the science – the guidance available

Current guidance within the UK to businesses, the public and policy makers is based, primarily, upon the SAGE documentation.
UK Government has taken a prudent, risk avoidance, approach in the early stages of the pandemic in order to reduce the spread of the virus in order to enable the NHS to operate within capacity and protect the vulnerable whilst little was known of the virus and what impact in could have on health.
The guidance is now moving into a 'risk management' approach with the easing of lockdown measures being based on the growing, and ever changing, evidence of how the virus is transmitted and the impact it has on health. The guidance documentation is updated, for Government and its agencies, frequently and it is recommended that, before any mitigations or actions are taken, reference is made to the most relevant Government guidance material. The latest guidance on how to operate in the UK is provided at the links below.

6.1. Transmission Mechanisms and Control

As indicated in the scientific review transmission occurs in three key ways: direct contact with someone who has the virus, indirect contact via surfaces that have the virus on them and contact from the virus suspended in the air. These three transmission routes have driven the guidance as to how to reduce the risk of transmission.

To reduce the risk of direct transmission the initial, solution was to keep people apart and if you showed symptom to self-isolate. The 'social distancing' guidance gave a distance, initially of 2m. This was based upon the distance the virus could travel in droplets. In addition, guidance on proximity has been provided that, where social distancing is not possible, people should not face each other to reduce direct transmission risk. The guidance has been revised to '1m plus' as new evidence emerged of the beneficial use of face covering to reduce the transmission distance.

Indirect transmission, via surfaces, is being managed by effective personal hygiene (washing of hands and not touching the face) and the use of cleaning on a regular basis. Cleaning regimes are not generally prescribed but guidance for specific industries is published on the UK Government website as it emerges. Aerosol transmission is an emerging risk and the guidance has focused, to date, upon reducing the risk of transmission of the virus at source; namely wearing face masks to catch the virus before it enters the air.

There are a number of engineering controls that, for indoor air, can be deployed to change the air and / or clean it but these have not been explored in any formal guidance at the time of writing.

6.2. Transmission Compounding Issues

A precautionary approach is being taken in relation to issues which appear to compound the likelihood of transmission; proximity to carriers, duration of time spent with carriers or in a high risk environment and the dispersion rate and speed of aerosols.
Proximity has been dealt with by the social distancing measures. With regard to duration, we have found no guidance on how long it is recommended to stay in an area. Most guidance states 'avoid prolonged periods' but there is no indication of what prolonged means.

There is growing research on dispersal patterns but the guidance, at present, is seeking to avoid any form of activity that projects air from a person faster than talking. Sneezing, coughing and shouting are ways that bodily fluids can be projected, faster into the air and much of the guidance is about managing (sneezing into your arm or tissue) or avoiding (remove noise so you do not need to raise your voice).
There is little guidance on the impact of mitigation measures, such as ventilation or screens. This is an area where the commissioning group could take a lead and set clear standards for ventilation in all types of entertainment venue.

6.3. Transmission Risk Management

A 'Swiss Cheese' or layered protection model has been adopted by SAGE using the 'Bow Tie' model. There is some evidence, but it does not provide ratios or percentage improvements, of the cumulative effect of using several different mitigations to reduce the risk of transmission. As such, the guidance has adopted an approach that several mitigations are better than one, particularly as transmission can occur through several methods. A component of this has been educating the public on how they can control transmission through advertising and media engagement. For organisations, the HSE risk assessment model prompts consideration of the various transmission risks and to consider all of the different barriers and controls that could be used to bring the risk to an acceptable level. Determining what is acceptable is not clear in the guidance. This is being left to sectors and individual businesses to decide and make the case for the risk management strategy they have selected and why.

6.4. Non-government guidance and communication

Non-Government agency guidance is a distillation of government advice, applied using existing business frameworks, templates and standards. BSI standards cover most business situations and they have collated the most relevant standard on their COVID pages. Many industry bodies have collated the guidance that is relevant to them and published it on their website. They are seeking to communicate with their industry with relevant information using a number of means and are following the current UK Government guidance. A recommendation for the group would be to use a communal website, such as the NTIA, to provide more updates to its COVID 19 pages to point to the guidance on operations.

6.5. Sectoral Guidance: Restaurants, pubs and bars

So far as food and beverage establishments are concerned, the relevant guidance is *Keeping Workers and Customers Safe during COVID-19 in restaurants, pubs, bars and takeaway services* last updated on 9th

July 2020. The guidance states that it is intended to offer guidance on how to open workplaces safely while minimising the risk of spreading COVID-19. It indicates that each business would then need to translate that into specific actions, depending on the individual circumstances. It makes it clear that the foundation of those steps must be a COVID-19 risk assessment. This is consistent with the Government approach of moving from risk avoidance to risk management.

The guidance sets out its objective: "to reduce the risk to the lowest reasonably practicable level by taking preventative measures, in order of priority."
Consistent with a hierarchical approach, the guidance states that operators should work through the following steps in order:

- Ensuring those who are unwell do not attend.
- Increasing the frequency of handwashing and surface cleaning.
- Enable working from home if possible.
- Maintain 2 metres social distance unless this is not viable, in which case a 1 metre principle should be adopted.
- Adopting mitigating measures such as increasing handwashing and surface cleaning, keeping activity times brief, using screens or barriers, avoiding workers working face to face.

The guidance sets out a list of steps that will usually be needed. These include:

General

- Setting the appropriate social distance and then implementing it, e.g. by increasing distance between tables.
- Reducing the need to queue.
- Providing guidance to customers on social distancing and hygiene, including before they arrive.
- Managing entry to prevent congestion.
- Managing WC queues.
- Encouraging customers to use hand sanitisers or handwashing facilities on their way in.
- Consider movement through the venue and mitigate risk, for example, through queue management and one-way flow.

Food and drink service

- Using social distance markings.
- Minimising self-service.
- Providing disposable condiments or regularly cleaning containers.
- Reducing the number of surfaces touched by both staff and customers, e.g. by asking customers to remain at table.
- Encouraging the use of contactless payments.
- Minimising contact between workers and customers at points of service, including by the use of screens.
- Ensuring adequate ventilation to outdoor areas.
- Encouraging contactless ordering.
- Adjusting service approaches to minimise staff contact with customers, e.g. by assigning a single staff member per table.
- Prevent customers congregating at points of service, e.g. by having only staff collect and return empty glasses.

- Increase use of outdoor areas where possible.

Toilets

- Promote good personal sanitation.
- Use social distancing marking.
- Provide sufficient sanitiser and handwashing facilities.
- Increase frequency and scope of toilet cleaning.
- Keep facilities well-ventilated.
- Use a visible cleaning schedule.
- Provide more waste facilities and frequent rubbish collection.

Communicating with customers

- Providing guidance on expectations of customers.
- Encouraging workers to remind customers of expectations.

The Guidance also provides thorough guidance in respect of worker safety.

6.6. Providing Entertainment

In respect of entertainment, the Guidance states that venues should not permit live performances. It states:

> "At this time, venues should not permit any live performances, including drama, comedy and music, to take place in front of a live audience. Venues should not permit indoor performances, including drama, comedy and music, to take place in front of a live audience. This is important to mitigate the risks of droplets and aerosol transmission - from either the performer(s) or their audience. Venues should take account of the Performing Arts guidance in organising outdoor performances. Singing and wind and brass playing should be limited to professional contexts only.
>
> All venues should ensure that steps are taken to avoid people needing to unduly raise their voices to each other. This includes, but is not limited to, refraining from playing music or broadcasts that may encourage shouting, including if played at a volume that makes normal conversation difficult. This is because of the potential for increased risk of transmission, particularly from aerosol transmission. We will develop further guidance, based on scientific evidence, to enable these activities as soon as possible. You should take similar steps to prevent other close contact activities, such as communal dancing."

This wording seems to make allowance for the playing of recorded music, or broadcasts, provided that they do not make normal conversation difficult.

The guidance suggests that it will usually be necessary to reconfigure indoor entertainment spaces to ensure customers are seated, to encourage online ticketing and contactless payments and communicate with and supervise customers to ensure that they are compliant with the venue policies.

In addition, the guidance sets out a pre-opening checklist for operators to make premises ready to operate in accordance with the regime described above and sets out further advice which it is not necessary to rehearse here.

There is no current public record of the science behind any recommendations in relation to live entertainment at various venues.

6.7. Sectoral Guidance: Performance venues

The Government has published guidance entitled "Performing Arts", last updated on 17 July 2020, which is directed at venue operators amongst others.
The guidance sets out a five-stage roadmap towards re-opening.

Stage 1 Rehearsals and training with no audience
Stage 2 Performances for recording and broadcast purposes
Stage 3 which is the current stage, is for performances outdoors with an audience and pilots for indoor performances with a limited socially-distanced audience.
Stage 4 which is expected to commence on 1st August, is for performances allowed indoors and outdoors but with a limited socially-distanced audience indoors.
Stage 5 which does not have a current date for implementation, is a return to fuller audiences indoors.

The guidance sets as its objective that all employers and organisations carry out a COVID-19 risk assessment, which echoes the risk management approach set out earlier in this paper.

It also makes special provision for singing and playing wind and brass instruments, which is not to be engaged in by non-professionals while professionals should keep the numbers of participants as low as possible in one space, with enhanced social distancing.

A hierarchy of measures, which echoes but does not precisely reflect those for pubs and bars, is also set out:

- Social distancing of 2 metres or 1 metre with robust risk mitigation where 2 metres is not viable;
- Working from home where possible;
- Increasing hand washing and surface cleaning;
- Keeping activity where social distancing cannot be maintained as short as possible;
- Using screens and barriers;
- Avoiding face to face working;
- Reducing the number of people each person has contact with;
- Additional risk mitigation for singing and playing wind and brass instruments.

Protect worker measures in performance venues are also set out. For example, only professional singers should be used, extend social distancing between singers, reduce the number of singers at one time as far as possible, using screens between singers and the audience and so forth.

The guidance deals specifically with managing audiences and reiterates the law and guidance regarding meeting in groups, as set out above. It also sets out a series of measures which will normally be needed, including:

- Limiting ticket sales to ensure adequate social-distancing.
- Provide for seated rather than standing audiences.
- Demarcate spaces.

- Discourage performances that encourage crowding, clustering or physical contact outside of household groups or support bubbles.
- Consider pinch points such as ingress and egress, WCs, waiting areas, bars and areas close to the performance area.

These themes are then developed in succeeding sections dealing with: ticketing and payments; cloakrooms; food management; entrances, exits and managing people flow; seating arrangements; WCs. The guidance represents a thorough approach to risk assessment and management in performance venues.

6.8. Websites Offering Guidance

Detailed below are some of the websites which, for the UK, provide guidance on how to operate.

6.9. UK Government
https://www.gov.uk/guidance/working-safely-during-coronavirus-covid-19

6.10. SAGE
https://www.gov.uk/government/news/coronavirus-covid-19-scientific-evidence-supporting-the-uk-government-response

6.11. Wales specific
https://gov.wales/workplace-guidance-employers-and-employees-covid19

6.12. Scotland specific
https://www.gov.scot/collections/coronavirus-covid-19-guidance/

6.13. Northern Ireland specific
https://www.nidirect.gov.uk/articles/coronavirus-covid-19-regulations-guidance-and-what-they-mean-you

6.14. HSE
https://www.hse.gov.uk/coronavirus/working-safely/index.htm

6.15. HSE guidance – 'Performing Arts'
https://www.gov.uk/guidance/working-safely-during-coronavirus-covid-19/performing-arts

6.16. HSE - Visitor events – larger events
https://www.gov.uk/guidance/working-safely-during-coronavirus-covid-19/the-visitor-economy

6.17. UK Government – Pubs, bars
https://assets.publishing.service.gov.uk/media/5eb96e8e86650c278b077616/working-safely-during-covid-19-restaurants-pubs-bars-takeaway-090720.pdf

6.18. Health Protection Scotland (HPS) – non healthcare
https://www.hps.scot.nhs.uk/web-resources-container/covid-19-guidance-for-non-healthcare-settings/

6.19. HSE – Northern Ireland
https://www.hseni.gov.uk/topic/covid-19-advice-and-guidance-places-work

6.20. Food Standards Agency
https://www.food.gov.uk/business-guidance/reopening-and-adapting-your-food-business-during-covid-19

6.21. Offices and call centres
https://assets.publishing.service.gov.uk/media/5eb97e7686650c278d4496ea/working-safely-during-covid-19-offices-contact-centres-030720.pdf

6.22. Existing Standards – BSI
https://www.bsigroup.com/en-GB/topics/novel-coronavirus-covid-19/covid-19-guidelines/

6.23. Ventilation
https://www.rehva.eu/activities/covid-19-guidance
https://www.evia.eu/indoor-air-quality/
https://www.vent-axia.com/sites/default/files/Ventilation%20Design%20Guidelines%202.pdf

6.24. WHO (health guidance)
https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance

6.25. Staff management
https://www.acas.org.uk/coronavirus
https://www.cipd.co.uk/knowledge/fundamentals/emp-law/health-safety/coronavirus-factsheet

7. Hierarchy of Control – managing the Bow Tie

7.1. Introduction – the layers of control

The starting point when evaluating any risk or hazard is the hierarchy of control, this has been used in the Bowtie diagram in figure 2 of this document (page 17). By applying this hierarchy and evaluating the suitability and efficacy of potential control measures normally leads to the implementation of inherently safer systems, with a substantively reduced risk of exposure and therefore lower illness or injury.

In this case the hazard is Covid-19 and the risk is the infection of persons through direct transmission through inhalation or via indirect transmission from contact with contaminated surfaces and entry into the body by secondary deposition into mucus membranes (eyes, nose and mouth).

Applying the hierarchy in its entirety using the bowtie approach elimination and substitution are not currently options, as removing these removes the paying clients out of the businesses. It does however allow other stages to be considered such as, engineering, administration and the use of PPE.

7.2. Administrative and PPE controls

The administrative controls are well set out in Government guidance; effective cleaning, social distancing, 'track and trace' as well as good personal hygiene. These are some of the easiest and least costly to implement and represent a quick and effective start to risk management.

Access and egress from internal spaces will also need to form part of risk assessing future use, this should include transition routes, staircases, elevators, pinch points and the use of welfare facilities.

With respect to PPE options are limited for the general public, mainly to face coverings, masks and shielding. Sectors, such as healthcare, have more detailed PPE requirements which have been adapted to respond to COVID-19. The use of PPE should be factored into any risk assessment.

7.3. Engineering Controls

Engineering controls when used correctly provide the best means for protection in this scenario because they are designed to remove the hazard at the source, before it comes in contact with the worker. Good design of engineering controls in the live entertainment industry backed up by administrative measures and the use of PPE are key to reducing risk. Whilst many of the engineering controls are factored in at the design phase of a venue build, there are a number that can be 'retro-fitted' or managed differently to

provide another barrier in the bow tie. A key is to understanding how the building currently performs in terms of engineering controls.

Well-designed engineering controls have the potential to be highly effective in protection, although there is not a one standard fits all solution and each event would need to be assessed on a case by case basis through risk assessment. In essence the provision of local exhaust ventilation in the right location used as designed may provide sufficient control to prevent the spread of contamination especially if used along sides other engineering controls such as Perspex screens and enclosures.

7.4. Protective Screens

Enclosing performers by the use of screens may not be as effective as providing extraction at source e.g. built into a microphone. Further guidance on the design of localised ventilation systems can be found in HSE guidance document HSG258, Controlling airborne contaminants at work: A guide to local exhaust ventilation (LEV). Poorly designed extract ventilation around performers may inadvertently expose the performers to aerosol transmission from the paying public and as such if considered a viable control measure would need assessing on a case by case basis.

7.5. Ventilation

General ventilation of internal spaces along with social distancing is key to reducing transmission with the general public, ideally external spaces should be used as this greatly reduces the chances of infection being spread. Where this is not possible and dependent upon the activities taking place a hierarchy of cleanliness should be considered. Ideally airflow direction within the internal environment should be controlled, providing air movement to avoid dead spots and dilution of any airborne transmission. Optimising ventilation design will significantly reduce the spread of airborne contamination out from these areas.

7.6. Learning from Healthcare - Air Change Rates

Guidance for general ventilation rates vary and many appear to be out of date, although providing an air change rate greater than twenty is the basis of providing a clean environment within operating theatres in the UK.

The Department of Health guidance further states for operating rooms, supplying enough fresh clean air to the location dilutes any airborne burden from the theatre staff to a “reasonable level”. This approach ensures that “all reasonable steps are taken to prevent or control exposure to the hazardous substance” as required by the COSHH Regulations.

A cautionary approach when designing ventilation systems is high velocity supply ventilation should be avoided, not just for the comfort of those present but to prevent airflow paths blowing over people and potentially contaminated increasing the chances of spread. Ideally high volume – low velocity supply ventilation positioned at ceiling level with terminal devices equally spread throughout floors should be provided with extraction at low level at locations to encourage a hierarchy of cleanliness.

Preventing / limiting occupation of inadequately ventilated spaces such as booths and secluded areas must be controlled. Improving ventilation in these areas as previously outlined may potentially allow such areas to be utilised.

7.7. Risk Assessment

In order to determine the most approach series of measures a thorough risk assessment will be required. The venue, type of activity, people attending, their behaviours and the existing business operations will need to be reviewed. No two venues or events are the same but there are key lessons that can be applied to all types of performance venue.

7.8. Barriers and Controls - the Layered Approach

From the study several possible mitigation options have been identified and have been mapped against the SAGE 'bow tie'. The table below gives suggestions as to how to manage risk for the different groups who will be in attendance at an event. These are not prescriptive and not suitable for all events however they form a part of the hierarchy of control and can be used to create a tailored approach to individual premises and events:

<table>
<tr><th></th><th>Staff</th><th>Public</th><th>Performers</th></tr>
<tr><td rowspan="3">Elimination</td><td colspan="3">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</td></tr>
<tr><td>Minimise the number of staff working.</td><td>Review occupancy levels to ensure social distancing is possible.</td><td>Consider virtual performances in the first instance.</td></tr>
<tr><td>Open with reduced level of service.</td><td>Do not use secluded seating and non-ventilated areas.</td><td>Consider pre-recorded entertainment rather that live acts.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="3">Substitution</td><td colspan="3">Carry out the events in the external environment.</td></tr>
<tr><td colspan="2">Use electronic ordering apps rather than waiters</td><td>Consider tailoring act accordingly</td></tr>
<tr><td>Employ working methods to distance staff from public.</td><td>Provide a booking system with strict time slots. Public to adhere to time slots.</td><td>No highly physical performances Limit the amount of acts and number of persons required.</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="4">Engineering Controls</td><td colspan="3">Employ screens and barriers to increase and maintain distancing</td></tr>
<tr><td colspan="3">Review building layout and arrange to minimise contact with surfaces and doors.</td></tr>
<tr><td>Review workstations to permit social distancing</td><td>Minimise standing unless transiting. Arrange seating to maintain social distancing.</td><td>Keep performers in one location, do not allow performers to interact with the public</td></tr>
<tr><td colspan="3">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</td></tr>
</table>

	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
Admin Controls	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
PPE	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.

8. Legal and Regulatory Environment

As evidence of the virus mounted in the UK, the Government's first legal intervention was one of risk avoidance. On 26th March 2020 it published the Health Protection (Coronavirus, Restrictions) (England) Regulations 2020, with similar regulation coming into force for Scotland and Wales. These Regulations required the closure of entertainment venues, including nightclubs, concert halls, cinemas and theatres. Pubs, bars and restaurants were permitted to continue with off-sales. The general public was prevented from leaving their homes without a reasonable excuse, which included reasonable exercise and work where this could not be done at home.

Clearly, the risk avoidance approach was effective in slowing the rate of progression of the virus through the population, but was not sustainable in the long term, economically or socially, and did not need to be maintained as the number of cases fell significantly from their peak.

Therefore, on 3rd July, the Government published the Health Protection (Coronavirus, Restrictions) (No. 2) (England) Regulations 2020 which repealed the previous Regulations, which were of national application save for Leicester, which was subject to special measures. The new Regulations required a list of premises to remain closed. The list, which has since been amended by amending regulations, currently includes: nightclubs; dance halls, discotheques and any other venue open at night with a dance floor or similar space and provides music, whether live or recorded, for dancing, unless the business ceases to provide music and dancing; sexual entertainment venues; hostess bars; casinos and bowling alleys.

The Regulations also prevent gatherings of more than 30 persons except in particular circumstances. These are supplemented by Guidance to the effect that in venues such as restaurants and pubs, people should only meet in groups of up to 2 households (with anyone in a support bubble counting as one household).

The Government has supplemented the above legal rules and guidance with sectoral guidance as detailed above.

9. Legal Framework: Health and safety in business premises

The Health and Safety at Work Act is the overarching legislation providing for the health and safety of workers and visitors, including to business premises.

Section 2 of the Act creates a duty on every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees. These duties include the provision and maintenance of a working environment that is, so far as is reasonably practicable, safe, without risks to health, and adequate as regards facilities and arrangements for their welfare at work.
Section 3 of the Act imposes similar duties in relation to persons other than employees. It says that it is the duty of every employer to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that persons not in his employment who may be affected thereby are not thereby exposed to risks to their health or safety.

Section 4 of the Act creates duties towards visitors to premises, which would include the kind of licensed premises under consideration here. It requires those who control premises to take such measures as it is reasonable for a person in his position to take to ensure, so far as is reasonably practicable, that the premises, all means of access thereto or egress therefrom available for use by persons using the premises, and any plant or substance in the premises or, as the case may be, provided for use there, is or are safe and without risks to health.

The legislation is supported by Regulations which impose more particular duties.
It is pertinent to refer to the Management of Health and Safety at Work Regulations 1999. Regulation 3 says that every employer shall make a suitable and sufficient assessment of the risks to the health and safety of his employees and others (such as visitors) arising from the conduct of the business, for the purpose of identifying the measures he needs to take to comply with the requirements of the relevant statutory provisions, including the 1974 Act.

Therefore, the Government's exhortation to operators to conduct COVID-19 risk assessments of their operation is fully in accordance with the legislative framework governing health and safety. It is therefore necessary for employer to understand the risks in relation to COVID-19 and what kind of measures are available to mitigate them.

10. Implications for particular sectors

10.1. Pubs and bars

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 has been determined as not possible other control measures such as protective screens, control of people movement, cleaning regime changes, improve ventilation and the use of capacity restrictions have been used to control the spread of the virus.

10.2. Performance venues

Performance venues are, from the 25 July, piloting a number of performance types to determine how they can re-open at scale. The principles identified and applied to pubs and bars are being used as the basis for those pilots. The guidance provided by the Government is based on the same scientific evidence being applied to all other activity in the UK.

We have found no published scientific evidence that suggests that live background instrumental music is any different to recorded background music. Musicians should be socially distanced from each other and set at an adequate distance from the audience. The risk presented specifically by singers has not been scientifically assessed as yet, although a study in relation to this is in process, funded by the Department of Digital, Culture, Media and Sport. However, risk from singers may be reduced by adequate ventilation of their performance space, including extraction at their microphone if possible.

10.3. Nightclubs and Dance venues

The Health Protection (Coronavirus, Restrictions) (No. 2) (England) Regulations 2020 do not prevent buildings which were nightclubs from opening. It prevents them from providing music together with dancing. Other regulations apply in Scotland, Wales and Northern Ireland.

In England, in so far as they are operated as bars or restaurants, they may re-open, but will need to risk assess their operation having the guidance for pubs, bars and restaurants in mind. To that end, the conclusion set out above in relation to pubs and bars applies equally here.

We have also considered the stricture on dancing, which is contained in secondary legislation. The Explanatory Memorandum says:

> *However, venues where individuals are expected to be at close proximity such as, nightclubs, gyms and bowling alleys, as well as dance studios and sports courts, are required to remain*

closed due to the increased risk of aerosol transmission and the likelihood of prolonged exposure

The explanatory notes to those Regulations state that these relaxations are part of a process of relaxation "due to the continuing falling of the transmission rate and decreasing rates of hospitalisation and fatalities. This was in line with the downgrading of the UK's COVID Alert Level from four to three by the Chief Medical Officers, meaning that we no longer face a virus spreading exponentially although it remains in general circulation."

As part of the relaxation, from 25 July 2020, dance studios are able to re-open. A dance studio is 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. However, the control measures being applied to pubs, performance venues and dance studios could be applied to a nightclub. The lessons from other performance venue pilots should be learnt and applied.

10.4. Sexual entertainment venues

Sexual entertainment venues are governed by Schedule 3 of the Local Government (Miscellaneous Provisions) Act 1982, which requires venues to hold a sex establishment licence, in addition to their premises licence held under the Licensing Act 2003.

Dancing on stage as live entertainment can be managed like any other form of performance, as being trialled by performance venues. Individual performances will require a separate risk assessment due to the reduced distance between performer and audience.

As part of any risk assessment and risk management plan the occupancy rate of the building will be a key influence on how all venue types can operate.

11. Conclusions and Recommendations

The study has provided a review of the current Government and other guidance and the scientific evidence that underpins it, as well as a review of the recent published scientific evidence. The UK is moving, with the easing of restrictions, from a risk avoidance model to one of controlled risk management. Before a vaccine is developed, the UK Government guidance is focused upon transmission reduction and control. It is clear that the situation, science, mitigations and guidance / regulations are constantly evolving as the virus and its impact become well understood.

Using the 'bow tie' model there are a series of controls and barriers that can be implemented to protect the public. These barriers and controls are not an exhaustive list and are being added to. Following a structured, layered approach to public health protection that prepares venues, staff and clients will provide clarity and confidence to all involved that reasonable mitigations to risk are being taken to prevent transmission of the virus.

There is no single solution to reducing the risk of transmission, nor to provide confidence to policy makers, staff or customers. This is a complicated time and a prudent, considered approach, using the hierarchy of control, should be taken. The science is evolving but so are the mitigations that deal with the known and unknown risks.

In order to control the transmission of the virus a layered approach to the hierarchy of control has been, and in our view, will continue to be adopted. The impact of each mitigation cannot, yet, be empirically defined. There is no COVID-19 cumulative impact algorithm that shows how effective each mitigation is in relation to others or how they work together. A disciplined approach to risk assessment and the implementation of a hierarchy of control can be applied to all types of venue, but there is no 'one size, fits all' solution, with each venue needing to demonstrate a considered approach to protecting public health.

For the commissioning group the opportunity is about showing a clear, sector-wide approach to understanding and managing the risk. This study is stage one of that approach, understanding. Stage two is focused on applying the understanding gained to their industry to determine a route map for re-opening.

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13. Appendix 1 – Government Guidance for the Restaurants, Pubs, Bars and Takeaway Services Sector[8]

This appendix reproduces the guidance and support for business in this sector.

This guidance can help you carry out your risk assessment to make sure you keep employees and other people on site safe when opening during coronavirus (COVID-19).

You should also consider the security implications of any decisions and control measures you intend to put in place, as any revisions could present new or altered security risks that may require mitigation.

13.1. A1.1 -Record your risk assessment

You need to write down the findings of your risk assessment. The Health and Safety Executive (HSE) has a risk assessment template and information on how to do a risk assessment.
You should involve your employees when completing the risk assessment.
You should consider the protected characteristics of your employees, visitors and customers when conducting your risk assessment.
You should share the results of your risk assessment with your workforce by displaying it prominently in your workplace, as well as on your website.
Where spaces have been repurposed, you should carry out a fire risk assessment.

[8] https://www.gov.uk/coronavirus-business-reopening/y/none/over_4/yes/yes/no/yes

13.2. A1.2 - Decide who should be on site

Only essential employees and people who cannot work from home should be on site.
You should not go to work if your business is closed under current government regulations.
Clinically extremely vulnerable people or vulnerable people should always work from home.
If you are concerned about returning to work, check if you should go back to work.
To keep employees safe you should:

- minimise the number of people on site
- make sure on-site employees can spot symptoms
- tell workers with symptoms to quarantine immediately
- explain new procedure and provide training where necessary
- consider the protected characteristics of your employees when making decisions, and to prevent discrimination

To support employees working remotely you should:

- provide the right equipment for people to work from home
- keep remote and on-site employees connected
- send updates to employees when the situation changes
- make sure disabled workers and new and expectant mothers can do their work from home (you have a responsibility to prevent discrimination at work)
- look after people's mental health

13.3. A1.3 - NHS Test and Trace

There is a higher risk of transmitting COVID-19 in premises where customers and visitors spend more time together in one place and potentially come into close contact with other people outside their household.

To manage this risk, establishments in the following sectors should collect details and maintain records of staff, customers and visitors:

- hospitality, including pubs, bars, restaurants and cafés
- tourism and leisure, including hotels, museums, cinemas, zoos and theme parks
- close contact services, including hairdressers, barbershops and tailors
- facilities provided by local authorities, including town halls and civic centres for events, community centres, libraries and children's centres
- places of worship, including use for events and other community activities

This guidance applies to any establishment that provides an on-site service and to any events that take place on its premises.

It does not apply where services are taken off-site immediately. (For example, a food or drink outlet which only provides takeaways, or someone collecting a pre-reserved book from the library. If a business offers a mixture of a sit-in and takeaway service, contact information only needs to be collected for customers who are staying in.)

This guidance does not apply to drop-off deliveries made by suppliers or contractors.

You should assist the test and trace service by keeping a temporary record of your staff shift patterns for 21 days and assist NHS Test and Trace with requests for that data if needed. This could help contain clusters or outbreaks.

Check the detailed guidance for what data you need to collect and how it should be managed.

13.4. A1.4 - How to ensure social distancing on site

You should always:

- stay 2 metres apart from other employees and customers (or 1 metre with risk mitigation where 2 metres is not viable)
- wash hands and clean surfaces more regularly
- put up signs and use floor tape to remind people to keep social distance
- keep the number of employees on site to a minimum
- wash your hands and clothes after helping someone in an emergency
- make sure you have enough appropriately trained staff to keep people safe (for example, having dedicated staff to encourage social distancing or to manage security)
- limit access to the kitchen
- limit contact between the kitchen workers and other employees (also when on breaks)
- have screens between equipment in larger kitchens
- have one person at a time getting things from the pantry, fridge and freezer
- minimise contact with other employees when handing over food
- ask employees to change into work uniforms on site (providing changing areas where social distancing is possible)
- wash staff uniforms on site where possible and not let employees take them home
- keep the activity time as short as possible
- space out client chairs and workstations, and place screens or barriers to separate customers
- advise workers to wear visors when working within 2 metres of clients
- move seating in waiting areas to encourage social distancing
- work side by side or back-to-back rather than face-to-face
- have fixed teams to minimise exposure
- provide training for workers on new ways of working

Where you cannot stay 2 metres apart (or 1 metre with risk mitigation where 2 metres is not viable) you should:

- only work together up to 15 minutes at a time
- use screens and barriers to separate people where possible
- work side by side or back-to-back rather than face-to-face
- have fixed teams to minimise exposure

13.5. A1.5 - Entrances and exits

You should:

- stagger arrival and departure times

- open more entrances and exits to the site
- use screens in reception areas
- mark a one-way flow where possible
- provide hand washing facilities or hand sanitiser
- provide more parking
- provide facilities to help people cycle, run or walk to work, for example bike racks
- make sure it's safe to queue and not in the way of traffic (for example, you can route the queues behind permanent physical structures such as street furniture, bike racks or bollards, or put up barriers)

13.6. A1.6 - Moving around the site

You should:

- close off areas that are not essential
- put up signs to use stairs instead of lifts whenever possible, while keeping access to lifts for disabled people
- review layouts and processes to allow employees to work further apart from each other, for example by assigning employees to specific areas of the restaurant or sections of the bar or counter
- ask people to store personal items in lockers if possible
- control the use of corridors, lifts and similar areas, for example with markings on the floor
- have floor markings where people queue, for example toilets
- stagger break times and, if possible, have breaks outdoors
- arrange seating in break areas 2 metres apart (or 1 metre with risk mitigation)
- keep the number of people to a minimum for construction site inductions and have them outdoors where possible
- have separate entrances and exits for people working in high-risk areas (for example, mechanical test sites and wet labs)
- ask employees to change into lab clothing and equipment on site and not take it home (provide changing areas where social distancing is possible)
- wash lab clothing and equipment like goggles instead of employees doing this at home
- make sure the smallest possible number of people share equipment and workstations
- put up screens where you cannot put workstations 2 metres apart
- reduce the number of people using a lab at one time (for example, by booking it)
- limit the number of people handling equipment
- make sure air filters in high-risk areas are installed and maintained to reduce the risk from airborne particles
- avoid hot-desking as much as possible
- sanitise workstations between occupants where people share
- rearrange desks to avoid face-to-face working
- use 2 metre floor markings outside the shop to organise queues
- have a one-way flow through the shop where possible
- minimise contact when customers are paying (for example, by using contactless)

- think about how to display promotional materials to allow employees and customers to stay 2 metres apart
- encourage employees to stay on site during the day - if they go out, for example for lunch, they should social distance

13.7. A1.7 - Cleaning

If someone has symptoms follow the specific instructions for cleaning after a case of COVID-19.
To minimise the risk of the virus spreading you should:

- clean the site before you reopen
- clean work areas, surfaces and equipment frequently between use with your usual cleaning products
- clean busy areas more often and more thoroughly
- restrict the use of items that are touched often
- provide more bins and empty them more often
- clear workspaces and remove waste and belongings from the area at the end of a shift
- use different gowns and towels for each client
- make sure that housekeeping staff follow government handwashing guidelines, and make a checklist of all surfaces to be cleaned when each guest vacates
- clean keys between guests
- carefully consider whether the cleaning and disinfecting products you plan to use are appropriate (such as when working on historic surfaces and heritage sites), and if not, consider alternative approaches such as using temporary non-damaging covers over the sensitive surfaces and cleaning those, or not allowing visitors in the sensitive areas

13.8. A1.8 - Handwashing, toilets, changing rooms and showers

You should:

- use signs and posters with instructions for employees to wash their hands for 20 seconds as often as possible, to avoid touching their faces and to catch coughs and sneezes in tissues
- remind employees regularly to wash their hands, especially if they handle goods and merchandise
- provide hand sanitiser throughout the site and in washrooms
- provide handwashing facilities or hand sanitiser where people handle goods and merchandise
- make sure toilets are kept clean at all times
- provide paper towels or electric dryers
- close changing rooms and showers, if you can
- make sure all water systems, for example showers and sinks, are safe to use after a prolonged facility shutdown to minimise the risk of legionella and other diseases
- set clear use and cleaning guidance for showers, lockers and changing rooms if they have to be kept open (for example, in a gym)
- encourage participants and staff to change and shower at home rather than in changing rooms where possible (for example, when going to the gym)

If you cannot close changing rooms and showers, keep them free of all personal items (such as clothes, towels and toiletries). Clean everything, including lockers, more often and thoroughly during and at the end of the day.

13.9. A1.9- Handling goods, equipment, merchandise and vehicles

There may be a risk of the virus coming into the workplace through goods, merchandise or vehicles. To avoid this you should:

- make sure workers handling goods and merchandise know to wash their hands more often
- provide more handwashing facility if possible and hand sanitiser, if not
- have a process for cleaning goods and merchandise coming into the workplace or onsite
- regularly clean any vehicles that workers take home
- clean things like reusable delivery boxes regularly
- minimising client contact with testers
- sanitise all hand tools, controls, machinery and equipment after use
- frequently clean anything that's touched regularly (such as buckets, site equipment, door handles, pump handles and printers)
- clean the parts of shared equipment you touch after each use, for example tools and vehicles such as pallet trucks and forklift trucks
- make sure you have adequate disposal arrangements
- regularly clean vehicles, for example pallet trucks and forklift trucks as well as cars or vans that workers take home
- take special care when cleaning portable toilets
- restart and test specialist equipment that's been unused for longer than usual
- work out how to clean expensive equipment that cannot be washed down and design protection around machines and equipment
- make sure you have adequate disposal arrangements
- reduce or avoid use of any non-personal kit

13.10. A1.10 – Ventilation

Before you reopen you should:

- check if you need to service or adjust ventilation systems, for example they shouldn't automatically reduce ventilation when there are fewer people on site
- get advice from your heating ventilation and air conditioning (HVAC) engineer if your systems serve several buildings and you're not sure if they need adjusting

Positive pressure systems and extractors can operate as normal.

13.11. A1.11 - Protecting customers and visitors on site

You should:

- work out the maximum number of customers that can reasonably follow social distancing guidelines (where they can stay 2 metres apart from other customers or 1 metre with risk mitigation where 2 metres is not viable)

- inform customers and visitors of guidance about visiting the premises before they arrive (for example, by providing information on your website, booking forms, or over the phone)
- use signs and provide clear information to your customers and visitors when they arrive
- encourage customers to use hand sanitiser or handwashing facilities when they enter the premises
- remind customers accompanied by children that they are responsible for supervising them at all times
- adjust indoor and outdoor seating and tables to maintain social distancing guidelines
- ensure that customers of the same household or support bubble can be seated together indoors
- ensure that customers of up to two households or support bubbles can be seated together indoors with social distancing
- ensure that customers of the same households or support bubble can be seated or stood together outdoors
- ensure that customers of up to two households or support bubbles or a group of six people from any number of households can be seated or stood together outside with social distancing
- work with your local authority or landlord to take into account the impact of your processes, including queues, on public spaces such as high streets and public car parks
- work with neighbouring businesses and local authorities to provide additional parking or facilities such as bike-racks, where possible, to help customers avoid using public transport
- reduce the need for customers to queue, but where this is unavoidable, discourage customers from queueing indoors and use outside spaces for queueing where available and safe (for example, using car parks and existing outdoor services areas)
- manage queues to ensure they do not cause a risk to individuals, other businesses or additional security risks
- consider the needs of people's protected characteristics, (such as age or disability when modifying the premise)
- when booking an appointment for a close contact service, ask the client if they can attend on their own where possible
- encourage clients to arrive at their appointment time and not too early or late to avoid congestion
- ask clients screening questions before their appointment for close contact services (if they have a new continuous cough, a high temperature, or loss of smell or taste they should reschedule their appointment)
- encourage customers in hotel and other guests accommodation to wear face coverings in communal areas
- close indoor shared facilities including communal kitchens where guests prepare their own food, and other indoor communal areas where social distancing cannot be managed
- increase the existing ventilation rate by fully opening dampers and running fans on full speed
- operate the ventilation system 24 hours a day
- increase the frequency of filter changes
- remind customers that face coverings are mandatory in shops and supermarkets, indoor shopping centres, banks, building societies, post offices and where food or drink is purchased at a take-away outlet (Some people don't have to wear a face covering including for health, age or equality reasons)

13.12. A1.12 - Restaurants, pubs, bars and takeaway services

You should follow government guidance on cleaning food preparation and service areas at all times.
Before you reopen:

- check if you need to service or adjust ventilation systems, for example they shouldn't automatically reduce ventilation when there are fewer people on site
- get advice from your heating ventilation and air conditioning (HVAC) engineer if your systems serve several buildings and you're not sure if they need adjusting
- open windows and doors to get as much ventilation as possible

Once you're open you should:

- wedge doors open, where appropriate, to reduce touchpoints (not fire doors)
- clean laminated menus or dispose of paper menus after each use
- provide only disposable condiments or clean non-disposable condiment containers after each use
- take special care when cleaning any portable toilets

When cleaning kitchens or cafes you should:

- ask workers to wash their hands before handling plates and takeaway boxes and regularly throughout the day
- keep your kitchen area as clean as possible – follow government guidance on cleaning food preparation and service areas
- have bins for collecting used towels and employees overalls
- clean the parts of shared equipment you touch after each use
- handle laundry in a way that prevents contaminating surrounding surfaces, raising dust or dispersing the virus

13.13. A1.13 - Protecting customers and visitors on site

You should:

- work out the maximum number of customers that can reasonably follow social distancing guidelines (where they can stay 2 metres apart from other customers or 1 metre with risk mitigation where 2 metres is not viable)
- inform customers and visitors of guidance about visiting the premises before they arrive (for example, by providing information on your website, booking forms, or over the phone)
- use signs and provide clear information to your customers and visitors when they arrive
- encourage customers to use hand sanitiser or handwashing facilities when they enter the premises
- remind customers accompanied by children that they are responsible for supervising them at all times
- adjust indoor and outdoor seating and tables to maintain social distancing guidelines
- ensure that customers of the same household or support bubble can be seated together indoors
- ensure that customers of up to two households or support bubbles can be seated together indoors with social distancing

- ensure that customers of the same households or support bubble can be seated or stood together outdoors
- ensure that customers of up to two households or support bubbles or a group of six people from any number of households can be seated or stood together outside with social distancing
- work with your local authority or landlord to take into account the impact of your processes, including queues, on public spaces such as high streets and public car parks
- work with neighbouring businesses and local authorities to provide additional parking or facilities such as bike-racks, where possible, to help customers avoid using public transport
- reduce the need for customers to queue, but where this is unavoidable, discourage customers from queueing indoors and use outside spaces for queueing where available and safe (for example, using car parks and existing outdoor services areas)
- manage queues to ensure they do not cause a risk to individuals, other businesses or additional security risks
- consider the needs of people's protected characteristics, (such as age or disability when modifying the premise)
- when booking an appointment for a close contact service, ask the client if they can attend on their own where possible
- encourage clients to arrive at their appointment time and not too early or late to avoid congestion
- ask clients screening questions before their appointment for close contact services (if they have a new continuous cough, a high temperature, or loss of smell or taste they should reschedule their appointment)

13.14. A1.14 - Keeping safe in meetings

You should:

- only have meetings in person if you cannot meet remotely
- stay 2 metres apart (or 1 metre with risk mitigation where 2 metres is not viable)
- use signs on the floor to help people maintain social distancing
- have meetings outdoors or in ventilated rooms
- not share objects like pens
- have hand sanitiser in meeting rooms

13.15. A1.15 - Receiving and sending goods safely

You should:

- minimise contact at drop-off and collection
- minimise contact when people pay for or exchange things, for example by using contactless and electronically signed documents
- minimise contact at security, yard and warehouse
- minimise the frequency of deliveries, for example by ordering larger amounts at a time
- have single workers load or unload vehicles if it's safe to do so
- have fixed pairs or teams where you need more than 1 person for loading
- encourage drivers to stay in the vehicle where it's safe

13.16. A1.16 - More help with your risk assessment

Read the detailed guidance for your sector. This guidance can help you carry out your risk assessment to make sure you keep employees and other people on site safe when opening during coronavirus (COVID-19).

14. Appendix 2 – Epidemiological Evidence

The scientific literature identified 825 review articles. Screening of the titles and abstracts excluded 730 articles, leaving 95 for full-text review. A further 77 review articles were excluded, because they did not add further to the evidence base (n = 76) or they were not published in English (n = 2) leaving 18 for inclusion in this report, with the addition of one relevant paper already to hand.

14.1. A2.1 - Number of virions needed to make infections likely

A mathematical model has been produced that suggests that around 1,000 virions are required to make infections in the lungs likely for aerosol infection {Evans, 2020 #853}. (Note that this paper also provided a useful basis for make risk assessment under various exposure scenarios.)
Further studies are required to confirm this estimate of 1,000 virions.

14.2. A2.2 - Vitamin D Supplementation

A review examined the role of vitamin D in reducing the risk of respiratory tract infections, utilising knowledge about the epidemiology of influenza and COVID-19. There are several mechanisms through which vitamin D supplementation might reduce the risk of infections. However, the evidence in practice is mixed, with several observational studies and clinical trials reporting that vitamin D supplementation reduced the risk of influenza, whereas others did not. Evidence supporting the role of vitamin D in reducing risk of COVID-19 includes that the outbreak occurred in winter and that the number of cases in the Southern hemisphere near the end of summer are low. The authors recommended that people at risk of influenza and/or COVID-19 should take vitamin D3, but suggested that clinical trials and large population studies should be conducted to evaluate this recommendation [18].
Overall, there is very weak evidence that vitamin D supplementation reduces the risk of COVID-19.

14.3. A2.3 - Risk factors for transmission

A mini-review considered the role of environmental factors and conditions such as temperature, humidity, wind speed as well as food, water and sewage, air, insects, inanimate surfaces, and hands in COVID-19 transmission. The authors concluded that studies on the stability of SARS-CoV-2 showed that the virus was able to survive longer on smooth surfaces that other surface types. They also concluded that sunlight and temperature increase can facilitate the destruction of SARS-CoV-2 and the stability of it on surfaces. When the ambient air temperature increases by 1oC, the cumulative number of cases decreased by 0.86%. According to the latest evidence, the coronavirus has been found in sewers, but there is no evidence that it has been transmitted via sewage or drinking water. Also, transmission though food, food packages, and food handlers has not been identified as a risk factor for the disease. According to the latest studies, the possibility of transmitting the virus through the air has been reported

in ophthalmology departments, with the results showing that SARS-CoV-2 infectious bio-aerosols can move up to 6 feet. There have been no reports of transmission by blood-feeding arthropods such as mosquitoes [19].

The Built Environment (BE) is defined as a collection of environments that humans have constructed: buildings, cars, roads, public transport, and other human-built spaces. It is important to understand the potential transmission dynamics within the BE and the human behaviour, spatial dynamics and building operational factors that potentially promote and mitigate the spread and transmission of the virus.

Buildings serve as potential transmission vectors by inducing close interaction between individuals, by containing fomites (objects or materials that are likely to carry infectious organisms). They can also facilitate aerosol transmission. Higher occupant density and increased indoor activity typically increase the potential for exposure. As individuals move through the BE, there is direct and indirect contact with the surfaces around them. Viral particles can be directly deposited and re-suspended due to natural airflow patterns, mechanical airflow, or other sources of turbulence in the indoor environment such as footfall, walking, and thermal plumes from warm human bodies. These re-suspended viral particles can then resettle back onto fomites. When an individual makes contact with a surface, there is an exchange of microbial life, including a transfer of viruses from the individual to the surface and vice versa. Once infected, individuals with COVID-19 may shed viral particles before, during, and after developing symptoms. These viral particles can then settle onto abiotic objects in the BE and potentially serve as reservoirs for onward viral transmission. Based upon preliminary studies of SARS-CoV-2 survival, the virus survives longest at a relative humidity of 40% on plastic surfaces (half-life median 15.9 h) and at relative humidity of 65% in aerosol forms (half-life median 2.7 h, and probably longer at lower relative humidity levels). Survival at 40% relative humidity on copper (half-life median 3.4h), cardboard (half-life median 8.5h) and steel (half-life median 13.1h) collectively fall between survival in the air and on plastic [20].

Thus, there is scope for ventilation experts assessing the potential for airflow within building and for capacity and nature of indoor activities to be controlled so as to minimise exposure. Regular cleaning of surfaces is also to be strongly considered, as it the regulation of humidity within buildings.

Current knowledge on whether faecal transmissibility (either orally, through fomites, or by aspiration of faecally contaminated droplets) is likely to be an important mode of COVID-19 spread is still limited [21]. The main route of SARS-CoV-2 transmission is through respiratory droplets and close contact. In a relatively closed environment, there is a possibility of aerosol transmission when exposed to high concentrations of aerosol for a long period of time. Other routes, such as faecal-oral, mother-to-child, urine, and blood borne transmission need to be confirmed by further research [22].

There may be good reason to have toilet attendants to ensure handwashing is properly observed. There is a suggestion that smokers are at increased risk of COVID-19 [23]. Concerns remain about the risk of COVID-19 for black, Asian and minority ethnic (BAME) communities [24]. Further work is required to understand innate immunity in order to enhance therapeutic strategies for COVID-19 [25].

14.4. A2.4 - Mitigation Measures

General (interim) workplace guidance has been developed:

- Any employee with symptoms of acute respiratory illness like fever (temperature more than (100.4°F [37.8°C]), with mild respiratory symptoms, should be encouraged to stay at home. Those who are having severe respiratory symptoms such as difficulty in breathing should seek health care at the earliest, and if possible, with prior appointment.
- Separate sick employees—any employee who reports sick to the workplace or becomes sick at the workplace should be separated from other employees. These employees should be educated about respiratory hygiene and should be provided a medical mask and sent home or to a hospital immediately depending on the severity of symptoms.
- To prevent transmission of the disease the employers should be flexible with policies regarding sick leave.
- The importance of respiratory hygiene and hand hygiene by all employees should be emphasized. Make sure adequate tissue paper and soap/hand sanitizers are available in the workplace.
- Studies suggest that the COVID-19 virus may persist on surfaces for a few hours or up to several days and, therefore, regular environmental cleaning is recommended with a disinfectant. Make sure the workplace, workstations, and commonly used surfaces like doorknobs, washrooms, keyboards, telephone, remote controls are frequently wiped using disinfectant or cleaning agents.
- Travel advice to employees—specific travel advice should be provided to employees traveling to and from China and countries with active infection. Employees returning from affected countries should stay at home for 14 days irrespective of the presence or absence of symptoms.
- Informational/educational materials about "Do's and Don'ts", personal hygiene, and other relevant health messages should be displayed at prominent places [26].

Consideration should be given to employing extra cleaning staff to cleaning frequently surfaces where human contact is frequent.

14.5. A2.5 - Mitigation Measures used in other Sectors

Detailed guidance using a full hierarchy of control has also been produced for dental health care [27, 28]. Specific measures developed for ophthalmological services to reduce droplet generation and infection transmission have been produced:

- The waiting rooms are kept as empty as possible by increasing the interval time between appointments, and as much as prudent, the visits of the most vulnerable patients are reduced.
- We identified a separate, well-ventilated space that allows the waiting patients to be separated by 6 or more feet, with easy access to respiratory hygiene supplies.
- Cough etiquette is promoted.
- Hand hygiene by hand sanitizing with alcoholic solutions is performed. Soap and water are used if hands are visibly soiled. Meticulous hand hygiene is strongly recommended during the following steps: before and after all patient contact; before and after using a surgical mask and after removing gloves; after having contact with respiratory and lacrimal secretions and objects/materials in the environment surrounding the patient.
- We designed and installed disposable slit-lamp plastic barriers as they may provide a measure of added protection against droplet transmission.
- Patients and physicians are strongly recommended to avoid speaking during slit-lamp examination [29].
- Consider use of plastic barriers where appropriate.

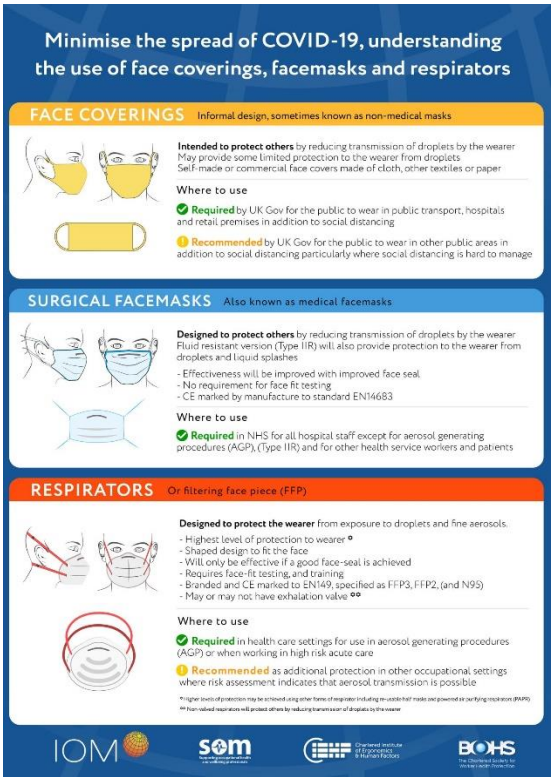
14.6. A2.6 - Food is not a transmission route

There is no evidence that food is a coronavirus transmission route. However, during the food operations, improper sanitization and disinfection of key touchpoints, food contact, non-food contact, equipment and cleaning tools surfaces and close contact of food handlers with staff and customers not only can put themselves on risk but can also be a risk for customers. Food services and the retail sector should make sure proper hand hygiene, approved sanitizers and disinfectants in use, follow social distances at workstations and while interacting with the customers. Businesses should be vigilant to monitor the temperature of staff and incoming guests to identify if there may any sick person to avoid from further spread of coronavirus and shall report to concerned health authorities if anyone symptoms matching with COVID-19 [30].
Staff should be reminded of the cleaning standards required and provided with the appropriate cleaning materials.

14.7. A2.7 - Face coverings

The SARS-CoV-2 virus which causes COVID-19 replicates in the upper respiratory tracts, which means it is likely to be transmitted mainly by droplets (which is why there is so much emphasis on hand-washing, since droplets contaminate surfaces). Droplets emitted from the human respiratory tract, which are relatively large and are emitted by speaking as well as coughing and sneezing, quickly turn into aerosols (smaller droplets) and so unless controlled at source, they are much harder to block. Most research on face masks and face coverings, which in the context of COVID-19 has been in health care workers, considers the extent to which they protect the wearer. However, it is also important for source control that we consider whether covering the face protects other people from droplets emitted by the wearer. Large droplets and a proportion of aerosols are blocked, not perfectly, but significantly, by cotton home-made face coverings. Thus face coverings, especially in crowded public places where social distancing is impossible the wearing of face coverings is recommended. However, to block inhalation of aerosols, medical-grade masks that meet stringent filtration standards are required [31]. The IOM would challenge this particular statement in this reference as medical grade masks are not designed to protect against aerosols, they are intended to protect against droplets. We also would challenge the statement that they meet stringent filtration standards (they do not).

The IOM guidance on which face covering to use is detailed below:



In the UK / Europe FFP3 (in the US N95) respirators are respiratory protective devices designed to achieve a very close facial fit and very efficient filtration of airborne particles. They are tested, in the UK and Europe to EN149 standard. The edges of the respirator are designed to form a seal around the nose and mouth. A review of the effectiveness of FFP3/N95 respirators, suggests that they are better than surgical masks for protection again infections by SARS-CoV-2, but the overall quality of the epidemiological evidence for this is low [34].

There appears to be come evidence that certain types of BCG vaccine may confer an element of protections against COVID-19 infection [32].

14.8. A2.8 - Ventilation

Proper filter installation and ventilation and maintenance of these, can help reduce – but not eliminate - the risk of airborne transmission. Higher outside air fractions and higher exchange rates in buildings may help to dilute indoor contaminants, including viral particles, from air that is breathed within the BE. This can be achieved, at the simplest level, by opening windows through to a full mechanical ventilation system. Understanding the Air Change Rate per hour (ACH) is critical to determining the most appropriate solution. The higher the ACH the more diluted the air. There is academic debate increasing indoor air circulation rate could increase exposure by potentially re-suspending ultrafine particles. This is not proven. In addition there is evidence that increasing relative humidity can be detrimental to virus survival but the level of humidity is not clear, ranging between 40 – 70%, so targeted in-room humidification may be an option to consider. Further research is needed to understand the impact of natural light on SARS-CoV-2 indoors, although consideration might be given to UV light in the shorter wavelengths, as this is germicidal, although should be implemented with appropriate precaution [20]. The use of UV light is not as simple as shining a light in a room.

14.9. A2.9 - Virus survival rates

There is a lack of clarity on survival rates of the virus on different surfaces. Another review suggests human coronaviruses are able to survive on steel, metal, wood, aluminium, paper, glass, plastic, ceramic, disposable gowns, and surgical gloves for 2–9 days and high temperature (⩾30 °C) can reduce the persistence period, while low temperature (4 °C) increases the persistence time up to 28 days [35].

14.10. A2.10 - Cleaning

Within the BE, environmental precautions can be taken to potentially prevent the spread of the virus, including chemical deactivation of viral particle on surfaces. It has been demonstrated that 62-71% ethanol is effective, a concentration that is typically in most sanitizers. Items should be removed from sink areas to ensure aerosolized water droplets do not carry viral particles onto commonly used items. Countertops and sinks should be cleaned with a 1% bleach solution or an alcohol-based cleaner on a regular basis.

A review of the persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents suggests that coronaviruses can persist on inanimate surfaces like metal, glass or plastic for up to 9 days, but can be efficiently inactivated by surface disinfection procedures with 62–71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite within 1 minute. Other biocidal agents such as 0.05–0.2% benzalkonium chloride or 0.02% chlorhexidine digluconate are less effective [36].

15. Appendix 3 – Methods used for the study

We have carried out a search for relevant scientific evidence in Web of Science on 3 July 2002. The aim was to identify relevant new evidence, possibly not considered by SAGE. Given the sheer volume of the literature we have focussed our efforts on review articles, rather than individual primary studies. However, if there are studies identified that are specifically related to live entertainment, then they will be included in the review.

The scientific search terms used (to accompany SARS-CoV2, coronavirus and COVID-19) were as follows:

- Immunity
- Half-life
- Surface
- Transmission
- Ventilation
- Symptomatic
- Asymptomatic
- Hand sanitisation
- Hand-washing
- PPE
- Personal protective equipment
- Spread
- Contagion
- Infectious period
- Age
- Sex
- Ethnicity
- Underlying conditions
- Chronic diseases
- Genetic predisposition
- Self-isolation
- Quarantining

The papers identified as a result of this search were supplemented by relevant papers that had already been identified. All the scientific references were stored in the Covidence software package.

In addition, we carried out a search of the internet on 13 July 2020 for guidance and its evidence based using the Google search engine.

- The search terms used were:
- COVID 19 Half-life / Surfaces persistence
- Effectiveness of PPE
- COVID Government Policy
- COVID 19 infectious period
- COVID Transmission
- COVID Ventilation / mitigation
- Risk Factors
- SARS / H1N1 / Spanish flu Guidance
- Air building Flow
- Use of Face masks and other interventions
- Swiss Cheese Model – Cumulative risk reduction ratios

As for the scientific references, these were supplemented by guidance already to hand or found subsequent to the search and which were deemed relevant.

The evidence was synthesised, using answers to the following questions as a guide:

1. What relevant guidance is available?
2. Who is it intended to protect?
3. What are its guiding principles?
4. What is the scientific evidence available that can inform these principles and the associated guidance?

16. Appendix 4 - SAGE guidance on reopen your business safely during coronavirus (COVD-19)

This section covers advice from SAGE that is for the sector that is most relevant for the Entertainment Industry, i.e. Restaurants, pubs, bars and takeaway services.

The advice is separated into a number of industrial sectors. Selecting the one for "Restaurants, pubs, bars and takeaway services", prompts a question about whether there have 4 or more employees. Selecting over 4 as being most relevant leads to a question about whether customers or visitors are on site. Selecting "yes" prompts a question about staff meetings. Selecting "yes" prompts a question about whether employees need to travel for work (besides their normal commute from home to work). Assuming the answer is "no" (as this will usually be the case) prompts a question about whether food are sent or received on site. An answer of "yes" finally leads to provision of the advice. The guidance for preparing businesses to open on 4 July 2020 is contained in Appendix 1.

Those aspects covered by the guidance are as follows:

- Record your risk assessment
- Decide who should be on site
- NHS Test and Trace
- How to ensure social distancing on site
- Entrances and exits
- Moving around the site
- Cleaning
- Handwashing, toilets, changing rooms and showers
- Handling goods, equipment, merchandise and vehicles
- Ventilation
- Protecting customers and visitors on site
- Keeping safe in meetings
- Receiving and sending goods safely
- More help with your risk assessment

It is notable that at the end of the guidance, there is a link to more detailed information of which business and venues can reopen from 25 July and 1 August.

16.1. Staged re-opening schedule

16.2. Business to open from 25 July

The following businesses and venues are due to reopen from 25 July, as outlined in the table below with links to guidance to ensure their safe opening:

- Indoor fitness and dance studios
- Indoor gyms
- Indoor sports courts and facilities
- Indoor swimming pools and indoor water parks

Business or venue	**Guidance for reopening safely**
Recreation and leisure	
Indoor fitness and dance studios Indoor gyms Indoor sports courts and facilities Indoor swimming pools and indoor water parks	See guidance for providers of sports and gym/leisure facilities. It is strongly advised that close-contact activity only occurs within a household group/bubble or with one other household/bubble. See guidance on forming support bubbles. All recreation and leisure businesses and facilities are strongly advised to follow guidance on operating within the visitor economy

The following businesses and venues are due to reopen from 1 August, if COVID-19 prevalence remains around or below current levels, as outlined in the table below:

- Bowling alleys
- Indoor skating rinks
- Casinos
- Exhibition halls and conference centres

Business or venue	**Guidance for reopening safely**
Recreation and leisure	
Bowling alleys Indoor skating rinks Casinos	Guidance to be published shortly. See guidance for providers of sports and gym/leisure facilities.

Business or venue	Guidance for reopening safely
	Guidance to be published shortly.
Non-residential institutions	
Exhibition halls and conference centres	These will be allowed to open for government-endorsed pilots but should not generally be open to wider business meetings or events until 1 October, subject to prevalence of Covid-19 remaining low. See guidance for exhibition halls and conference centres.

16.3. Businesses and venues already permitted to reopen

The following businesses were permitted in law to reopen in June and July following amendments to the law.
Links to guidance to ensure their safe reopening is provided.

Business or venue	Guidance for re-opening safely
Retail	
All retail is permitted to be open. Non-essential retail was permitted to reopen from 15 June.	See guidance for people who work in or run shops, branches, stores or similar environments. As of 24 July, face coverings must be worn in shops and supermarkets.
Food and Drink	
All indoor and outdoor hospitality including, cafes, bars, pubs, and restaurants, can open unless: They are a part of the premises of a business or venue which must be or remain closed from 4 July; or are a part of the premises of a business or venue which must be or remain closed from 4 July, and are not in self- contained units	People are strongly advised to only visit a restaurant in their household groups or support bubbles (where an adult who lives alone or with dependent children, can spend time with one other household indoors), or with one other household, or with up to five other people outdoors. Venues should not allow standing drinking and eating. Tables and remote or server ordering are strongly advised. At this time, venues should not permit live performances, including drama, comedy and music, to take place in front of a live audience. All food and drink establishments are strongly advised to follow guidance on how to open and operate safely.

Business or venue	Guidance for re-opening safely
that can be accessed from the outside. Please see Section 3 for businesses and venues that must remain closed.	Guidance on weddings should also be followed. From 1 August, sit down wedding receptions for up to no more than 30 people will be allowed to take place. Large wedding receptions or parties should not currently be taking place and any celebration after the ceremony should follow the broader social distancing guidance of involving no more than two households in any location or, if outdoors, up to six people from different households.
Accommodation	
Hotels, hostels, bed and breakfast accommodation, holiday apartments or homes, cottages or bungalows, campsites, caravan parks or boarding houses	Shared sleeping spaces (e.g. dormitory rooms) should not open to any groups, except those travelling in accordance with the current government guidance on social mixing outside of household groups/outside of the home. Other shared facilities (including shared showers and kitchens, but not toilets) should not open, except on campsites (and only in accordance with government guidelines for cleaning and usage) All accommodation providers are strongly advised to follow guidance on opening accommodation safely. Guidance can also be found on safely operating services in the visitor economy
Personal care	
Hair salons and barbers, including mobile hair businesses Spas Nail bars and salons and beauty salons Tanning booths and salons Massage parlours Tattoo parlours Body and skin piercing services	All close-contact service providers are strongly advised to follow guidance on how to work safely.

Business or venue	Guidance for re-opening safely
Recreation and leisure	
Cinemas Theatres and concert halls Funfairs, theme parks, adventure parks and activities Outdoor swimming pools and outdoor water parks Outdoor gyms Playgrounds Museums and galleries Bingo halls Outdoor skating rinks Amusement arcades and other entertainment centres Model villages Social clubs Indoor and outdoor attractions at aquariums, zoos, safari parks, farms, wildlife centres and any place where animals are exhibited to the public as an attraction Indoor and outdoor areas of visitor attractions including, gardens, heritage sites, film studios and landmarks	See guidance for providers of sports and leisure facilities. It is strongly advised that close-contact activity only occurs within a household group/bubble or with one other household/bubble. See guidance on forming support bubbles. All recreation and leisure businesses and facilities are strongly advised to follow guidance on operating within the visitor economy. All operators of heritage locations are strongly advised to follow guidance on operating heritage locations. See guidance for managing playgrounds and outdoor gyms. At this time, venues should not permit indoor performances, including drama, comedy and music, to take place in front of a live audience. This is important to mitigate the risks of droplets and aerosol transmission - from either the performer(s) or their audience. Venues should take account of the Performing Arts guidance in organising outdoor performances. Singing and wind and brass playing should be limited to professional contexts only. From 1 August, indoor performances to a live audience are expected to resume (subject to the successful completion of pilots, and provided prevalence remains around or below current levels). Close contact activity such as visiting an entertainment centre is strongly advised to only be conducted within a household group/bubble or with one other household/bubble.

Business or venue	Guidance for re-opening safely
Non-residential institutions	
Places of worship Crematoria, including any buildings and grounds	All places of worship are strongly advised to follow guidance on their safe use. Guidance on weddings should also be followed. See funerals guidance.
Community Centres Libraries	The government strongly advises community centres against opening for indoor fitness and sport activity until 25 July when indoor gyms and sports facilities are permitted to reopen. Those managing community centres, village halls and other community facilities are strongly advised to follow guidance on re-opening safely

16.4. Businesses and venues which will remain closed

All businesses and venues can remain open, or reopen as stated under Sections 1 and 2 above, except for those in the list below, which remain closed in law:

- Nightclubs, dance halls, discotheques
- Sexual entertainment venues and hostess bars
- Indoor play areas, including soft-play areas

If your business or venue is permitted to reopen or remain open, it must close off or cease to provide any of the above services if they are part of the business. For example, an indoor play area as part of a restaurant must remain closed.
All indoor and outdoor hospitality including, cafes, bars, pubs, and restaurants, can open unless they are a part of the premises of a business or venue which must remain closed as set out in section two above, unless they are in self-contained units that can be accessed from the outside.

17. Appendix 5 – Tables (Extracted from SAGE document)

Table 1 – Impact of mitigation on the three transmission routes, ranked in term of Efficacy (theoretical performance), Effectiveness (real-world performance) and the Confidence in the quantity and quality of evidence (from SAGE advice document[9])

Very low | Low | Medium | High | Very high | No response

[9] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892043/S0484_Transmission_of_SARS-CoV-2_and_Mitigating_Measures.pdf

Hierarchy	Mitigation	Short range	Air	Contact	Efficacy	Effectiveness	Confidence
Elimination	Prevent the presence of an infector in the environment*	***	***	***			
	Remove the use of a particular environment	***	***	***			
Substitution	Reduction of time spent in an environment*	***	***	***			
	Change work patterns to work in a cohort*	***	***	***			
	Move to outdoor working	**	***	**			
	Changes to restrict "loud" activities (e.g. reduce talking time, no singing)	***	***	*			
	Technology to replace face-to-face interactions	***		***			
Engineering	Anti-microbial surfaces			***			
	No-touch technologies			***			
	Provision of new hand wash stations			***			
	Screens/partitions	***	*	**			
	Increased fresh air ventilation rate	*	***	**			
	Change to room air distribution patterns	**	***	*			
	Application of room scale air cleaning/UV devices	*	***	*			
	Installation of local exhaust systems or local air cleaning devices	***	***	*			
	Propping open internal doors to enhance airflow		***				
	Personalised ventilation systems	**	***				
	Use of UV/HPV decontamination		***	***			
	Good maintenance of sanitation/drainage systems		**	***			
	Enhanced daylighting in buildings		*	**			
Administration	Frequency of high touch surface cleaning			***			
	Frequency of general room surface cleaning			***			
	Training on quality and effectiveness of cleaning			***			
	Provision of hand sanitiser			***			
	Replacement of jet dryers with paper towels		**	***			
	Avoid sharing equipment (e.g. IT, hotdesking)			***			
	Management of waste			***			
	Hygiene behaviours in bathrooms (e.g put the toilet seat down)		***	***			
	Changes to touch behaviours (e.g. education programmes)			***			
	Lower density of occupants	***	***	***			
	Maintain 2m distancing	***	*	**			
	One-way systems for moving through spaces	***					
	Orientation of people	***		*			
PPE	Respirator (N95/FFP3) face masks	***	***				
	Surgical face masks	***	**				
	Face coverings	***	*				
	Gloves			***			
	Protective clothing	*		***			
	Face shields/goggles	***	*				

Table 2 - Summary of rationale for each measure including the evidence available and practical considerations (from SAGE advice document)[10]

Hierarchy	Mitigation	Rationale and considerations
Elimination	Prevent the presence of an infectious person in the environment	Rationale: Removal of infectors eliminates the source of the hazard – in this case the virus - and thus reduces the risk of others becoming exposed and infected. The need for other controls is therefore negated. Evidence: Strong evidence from clinical and societal practice that a disease cannot be passed on if an infectious person is effectively isolated. Practical considerations: This would be through actions such as effective test, trace, and isolate approaches at both national level and through effective application within organisations. Environments that can track people on their premises will likely have greater success than those that are public with no records. Feasibility relies on the being able to detect and quickly react. This will be more effective with lower prevalence of virus. Asymptomatic carriers reduce the real-world effectiveness as they are much harder to detect. Social factors (e.g. financial issues if staff don't work, people ignoring rules) reduce the effectiveness.
	Remove the use of a particular environment	Rationale: Closure of some high contact or high risk environments can remove the potential for infection. This could be a whole organisation or just selected environments within an organisation. Evidence: Evidence from modelling and experience in the current pandemic that environments which enable a high degree of social contact (bars, restaurants, religious settings) are associated with clusters of cases. Evidence to show that closure of spaces within an organisation (e.g. cafeterias) is effective is weaker. Practical considerations: Closure can be very effective but needs full cooperation of the organisation and may require financial incentives to support the action. Closure of some

10 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892043/S0484_Transmission_of_SARS-CoV-2_and_Mitigating_Measures.pdf

Hierarchy	Mitigation	Rationale and considerations
		environments has knock on impacts on other factors (e.g. dentistry/health services, impacts on mental health).
Substitution	Reduction of time spent in an environment	Rationale: Shorter times in roles where face-to-face contact could happen can reduce duration of exposure to infectious people and reduce likelihood of transmission. Evidence: Good evidence from analysis of other respiratory infections and modelling studies that risk is related to duration of exposure. There is insufficient data on the infectious dose of SARS-CoV-2 virus required for infection to be able to specify a safe duration of contact. In addition this is likely to be subject to uncertainties such as environmental conditions (light levels, temp, RH), any level of viral shedding by an infected individual and mechanical ventilation influences. Practical considerations: Feasibility will depend on the flexibility of a work environment and ability to manage roles differently.
	Change work patterns to work in a cohort	Rationale: Cohorting workers/groups limits the size of the network where the virus can spread. If there is a case of infection, it is less likely that it will be spread widely within a workforce. Evidence: Modelling papers from SPI-M support this. Practical Considerations: Feasibility will depend on the flexibility of a work environment and ability to manage roles differently. This is detailed in the SPI-B paper on social networks (SAGE 04062020).
	Move to outdoor working	Rationale: Likely to reduce the amount of surface contamination as decay rate on surfaces is likely to be higher outdoors. Aerosol is more effectively dispersed than in an indoor space. Face-to-face exposure is still possible. Evidence: Very few reports of transmission of SARS-CoV-2 in outdoor environments. Some modelling studies suggest the wind can carry particles further, but no consideration of dose. Laboratory evidence to show shorter survival times for virus in bright sunlight. Practical considerations: Weather and role dependent.

Hierarchy	Mitigation	Rationale and considerations
		Enclosing outdoor spaces may increase risks. In many environments it is easier to enable physical distance between people when outside. May be issues with accessibility for some people.
	Changes to restrict "loud" activities (e.g. reduce talking time, no singing)	Rationale: Louder activities produce higher numbers of aerosols and droplets which could lead to higher viral emission rates. Activities increase breathing rate which could increase exposure. Evidence: Small amount of mechanistic evidence from studies measuring droplet production, high rates of transmission reported in several choirs and religious groups. No conclusive evidence of higher viral loads through different respiratory activities or that it is the singing activities that are responsible. EMG have noted this is a research gap which would be important to address for opening up musical activities, including the importance of wind and brass instruments. Practical considerations: Impact is likely to be low for most environments; however there is sufficient concern around singing and musical activities that activities have been restricted. There is a significant lack of evidence in this area.
	Technology to replace face-to- face interactions	Rationale: Application of mobile phone based readily-available systems such as remote ordering, "click and collect" in hospitality, retail and food sectors which can substantially reduce face-to-face exposure and in some cases can eliminate this. Evidence: Evidence that lower levels of contact at a greater distance reduce transmission, but weak evidence that technology interventions specifically achieve this. Some technologies can introduce risks as touch screen surfaces have been shown to harbour microorganisms that can be transferred between users. Practical considerations: May require technology investment (although paper based is feasible) so cost/time are factors. Potential social impacts through impact on jobs in some sectors. Digital technologies should be used with care where their introduction results in a new surface that has lots of contacts – need to be careful that these don't

Hierarchy	Mitigation	Rationale and considerations
		become a "hot spot". May add new challenges in cleaning of technology interfaces (touch screens) as harsh cleaning agents can often not be used. Touch screens in high risk settings such as healthcare or pharmacies should be treated with a high degree of caution
	Anti-microbial surfaces	Rationale: Use of surfaces with an anti-microbial finish could enhance the decay rate of virus Evidence: Effectiveness is shown for bacteria. Limited evidence yet for viruses in laboratory studies although there are studies emerging to show inactivation of coronaviruses. Limited evidence to show impact on transmission in real-world settings. Practical considerations: It is important to consider the time component of viral decay relative to frequency and duration of contamination. To be effective on high-touch sites it would rely on rapid inactivation of virus on surfaces to prevent onward transmission within a short period of time. Many surfaces are unlikely to have sufficiently rapid action to achieve this. Would need to consider which surfaces are most important.
Engineering	No-touch technologies	Rationale: Contactless technology can prevent cross-contamination and improve infection control as it removes the fomite transmission pathway. Alongside digital approaches, there are also a range of low-touch methods such as elbow operated taps, foot operated door openers etc. Evidence: Evidence that contact transmission plays an important role. No specific evidence to support the reduction of infection through contactless technology. Practical considerations: Requires behaviour change and in many cases use of smart phone apps or installation of sensor technology which can be expensive. Some digital and mechanical approaches can have accessibility issues, however other technologies (e.g. remote door opening) can improve accessibility.
	Provision of new hand wash stations	Rationale: Good hand hygiene is critical to limit fomite transmission, frequent hand washing with soap removes viruses to stop them spreading, visible provision of wash hand basins.

Hierarchy	Mitigation	Rationale and considerations
		Evidence: Lack of hand washing facilities are major deterrents for implementation of hand hygiene and the visibility of sinks is thought to have a direct impact on the handwashing frequency and duration Practical considerations: plumbing a water supply, potential crowding around sink facilities, and possible transmission from contact with the tap, need to keep the facility clean.
	Screens/partitions	Rationale: Physical partitions are expected to be effective at blocking larger droplets but unless they are designed to be completely enclosed will enable passage of smaller aerosols. Evidence: There is no available evidence yet on the efficacy of physical partitions on SARS-CoV-2 transmission. However, there is some evidence that screens and enclosures can be effective in reducing exposure to airborne material in occupational settings, although the details of the enclosure are important. Evidence on influenza exposure reduction is available for smaller barriers such as face shields. Practical considerations: Effectiveness will depend on design – many screens will require gaps to enable items to be passed between people and this should be considered carefully to minimise gaps at head height that could allow direct passage of the aerosol and droplets. Should also consider whether the screen blocks ventilation and hence raises the aerosol risk.
	Increased fresh air ventilation rate for poorly ventilated spaces	Rationale: Increasing the ventilation rate dilutes the concentration of fine aerosols and removes them from a room. This benefit is for the general population in a room, not just those in close proximity to an infected person. A lower concentration means that someone is less likely to inhale an infectious dose during their time in the room. Evidence: A systematic review suggests that less than 2 air changes per hour increases TB transmission risk. Several outbreak analysis and modelling papers correlate degree of risk with the number of particles inhaled and hence the ventilation.

Hierarchy	Mitigation	Rationale and considerations
		Practical considerations: Focus should be on poorly ventilated environments as this will have the greatest benefit; improving an already well-ventilated space will likely have a limited effect. Feasibility will depend on the design of the ventilation system and could be achieved through utilisation of natural ventilation (such as opening windows and vents) and increasing mechanical flow rates where possible and tolerable. Measurement of air change rates in use can be difficult, but approaches such as using CO2 sensors could be used to indicate ventilation efficacy. Unintended negative consequences (such as noise, security, thermal comfort) should be considered, particularly in high risk environments such as healthcare. Guidance is given by engineering professional bodies (CIBSE).
	Change to room air distribution patterns	Rationale: Airflow patterns can result in zones of relatively stagnant air in a room where someone may be subject to air with a higher concentration of virus. It is therefore preferable to set the air distribution so that fresh air being provided to the room reaches all areas of the space. Pressure differences between zones can move air from one room to another. Evidence: Some evidence from a restaurant outbreak in China where the air conditioning units created poor distribution and led to viral transmission in a poorly ventilated space. Evidence of incorrect pressurisation in hospital isolation facilities leading to transmission of other airborne viral infections. Evidence from modelling/chamber studies shows influence of in-room distribution, but very little real-world evidence. Practical considerations: Encourage mixing of air in the space when accompanied by fresh air supply. Air circulation devices such as fans can help with avoiding stagnant zones.
	Application of room scale air cleaning/UV devices	Rationale: There is reported evidence to show that room scale UV systems and air filtration devices can reduce the levels of surface and airborne microorganisms in a treated space. Evidence: Evidence for upper-room UV efficacy against

Hierarchy	Mitigation	Rationale and considerations
		TB in real-world settings. Most studies are smaller scale hospital evaluation studies or laboratory based investigations conducted under well controlled conditions. Some related, independent literature reviews have also been undertaken but these are limited in number. Practical considerations: Potential benefits in rooms with poor ventilation which can't be improved otherwise. Devices need to be sized appropriately for the environment. UV systems and some air cleaning technologies have safety considerations. UV treatment is subject to shadowing effects or for ceiling mounted devices the passage of bio aerosols past the fixed UV lamps. This is linked to the energy dose delivery of the system, so devices must be validated against appropriate target microorganisms. Air filtration system efficiency is dependent on air flow rate, achieved air mixing effects and filtration efficiency. Further to this, UV lamps deteriorate over time and must be well maintained to be effective over long periods of use. More detail in EMG paper [F].
	Installation of local exhaust systems or local air cleaning devices	Rationale: It is theoretically feasible to disrupt close range aerosol and droplet transmission using technology such as a local ventilation exhaust or air cleaning devices. Evidence: There is some limited evidence for this in healthcare, such as specialised ventilation systems in operating theatres, however there is not good evidence for application in close range infection control. Practical considerations: Devices are not readily available and their effectiveness will depend significantly on design and positioning. Such approaches may be appropriate to develop for certain high risk locations (e.g. dentistry) but are unlikely to currently be a viable approach for most environments. Research to explore approaches for dentistry should be a priority
	Propping open internal doors to enhance airflow	Rationale: Wind driven ventilation can sometimes be enhanced when opposite sides of a building are linked for airflow purposes, and propping doors open can lead to larger ventilation flow rates. Propping such doors open can also reduce contact risks through touching door handles.

Hierarchy	Mitigation	Rationale and considerations
		Evidence: Evidence is very weak Practical considerations: There may be significant barriers in many environments, including fire safety, security thermal comfort and privacy which may undermine the mitigation in practice. The impact is likely to be small. There could be risks from this strategy in high risk environments such as healthcare.
	Personalised ventilation systems	Rationale: Systems provide a clean air stream directly to individuals and hence this reduces exposure to aerosols in the general room air. Evidence: There are several studies that show provision of personalised ventilation (PV) can provide a clean air stream and could mitigate exposure, however these are all modelling/chamber based studies rather than real- world. One study shows that without careful design these systems can facilitate transport of exhaled pathogens and increase indirect exposure. Practical considerations: This is a technology area with future potential for certain environments such as offices, however there is not sufficient development yet for it to likely be a feasible solution. Approach is only effective when people are located by the PV system.
	Use of UV/HPV Decontamination	Rationale: Mobile UV and hydrogen peroxide vapour (HPV) systems can reduce surface contamination levels in room spaces of various sizes and have been applied to vehicle use in some cases. Evidence: Most studies are smaller scale hospital evaluation studies or laboratory based investigations conducted under well controlled conditions. Some independent literature reviews have been undertaken but these are limited in number. There is little evidence of recent large scale side by side comparison studies of these devices. Practical considerations: Both UV and HPV treatments are subject to shadowing effects and neither can remove physical soil on surfaces. For UV this is linked to the energy dose that can be delivered to a surface and related line of sight effects. For HPV this is related to mixing and

Hierarchy	Mitigation	Rationale and considerations
		settling of the vapour or mist which may limit treatment of surfaces that are partially hidden or facing away from the delivery system. For these reasons all such devices must be validated against appropriate target microorganisms. There are additional cost, environmental and toxicity issues. More detail is given in EMG paper [F].
	Good maintenance of sanitation/drainage systems	Rationale: Good maintenance and cleaning practices limit aerosolization from toilet flushing and ingress of aerosols from drainage system via defective water trap seals. Cleaning and hygiene practices with inspection and monitoring of water trap seals will limit spread. Evidence: Mechanistic and real-world studies showing aerosolization from toilet flushing and from defective water trap seals. Weak evidence of viral loads in air samples. Some evidence to suggest that higher ventilation rates in bathrooms can encourage aerosols from defects to enter the room and fall on surfaces. Some evidence of surface contamination mainly in hospitals. Probability of transmission low, however increased under defect conditions. Evidence for reducing aerosols from toilet flushing by closing lid before flushing and evidence for reducing spread by contact from enhanced cleaning and disinfection of bathrooms and toilet facilities. Whole system monitoring has been trialled successfully in real-world settings. Practical considerations: Any possibility of virus transmission will be decreased by enhanced cleaning regime. Maintenance of water trap seals (particularly in less visible places such as plant rooms) should be ongoing. Waterless traps in use but not widespread – easy to install. Whole system condition monitoring effective. Particular attention should be paid to this in buildings which have been unused during lockdown.
	Enhanced sunlight in buildings	Rationale: UV in sunlight may help to destroy COVID-19 viruses Evidence: There is evidence that sunlight can be effective against pathogens, and some evidence that it may be effective against COVID-19 viruses, but the studies are based in laboratory test environments.

Hierarchy	Mitigation	Rationale and considerations
		Practical considerations: Double glazing will provide a barrier to UV light, and in most buildings there would be limited sunlight opportunity to enable comprehensive exposure. Simple actions such as keeping blinds open is a low-cost measure that could have a very small benefit but may have negative impacts such as overheating and glare.
Administration	Frequency of high touch surface cleaning	Rationale: Contact transmission from contaminated surfaces could be ameliorated by cleaning of hand touch sites, provided the frequency is sufficient to mitigate the rate of recontamination. Evidence: Good evidence that a range of cleaning agents are effective against the virus. Some evidence to suggest that frequently touched sites in the patient zone should be cleaned once a day in hospital wards; and more often (twice/day; hourly) in critical care. There is evidence to show that sites which are handled most yield higher amounts of microbial soil; the more microbial soil there is at a site, the more likely that there will also be a pathogen. Microbial soil is not necessarily visible. No clear evidence for frequency of cleaning for COVID. Practical considerations: Cleaning supervisors can adjust SOPs to increase the frequency of cleaning the highest risk sites in both COVID and non-COVID areas. Provided the 'one site; one wipe; one direction' strategy is employed, surfaces can be effectively cleaned with detergent wipes in healthcare. Bleach may also be used at the appropriate dilution if there is potential heavy contamination of surfaces. Alcohol wipes may be used for some equipment in accordance with manufacturers' guidance.
	Frequency of general room surface cleaning	Rationale: Increased frequency of cleaning general room surfaces may reduce the presence of virus and reduce the risk of contact transmission to staff and visitors. Evidence: Good evidence that a range of cleaning agents are effective against the virus. There is limited evidence for transmission risks via general surfaces – there is more evidence for high touch sites. Practical considerations: Most infection control staff are likely to support increased frequency of room cleaning where there is a high COVID risk. There is a case for ensuring good cleaning generally, with a focus on high

Hierarchy	Mitigation	Rationale and considerations
		touch sites likely to increase effectiveness. The frequency selected may be dependent upon resources.
	Training on quality and effectiveness of cleaning	Rationale: Training the commercial cleaning workforce should result in more effective cleaning. Evidence: Good evidence to support the impact of targeted training for housekeeping staff in hospital environments. There is also evidence to show that this impact quickly wears off and requires repeated educational reinforcement. Practical considerations: Needs appropriate training materials to be developed and effectively disseminated in an organisation. Will need monitoring and may need incentives.
	Provision of hand sanitiser	Rationale: Increasing provision of hand sanitiser may encourage more people to clean their hands and thus reduce the risk of contact spread Evidence: Evidence that sanitiser has an antimicrobial effect, but less effective at removing physical soil. Practical considerations: Generally an easy solution in most settings. Efficacy is dependent on societal and behavioural conditioning on hand hygiene which may change with perceived level of risk. Guidance on hand hygiene is already provided by WHO and others.
	Replacement of jet dryers with paper towels	Rationale: Jet air dryers can aerosolise microorganisms from poorly washed hands. Incomplete drying of hands means that contamination can persist on hands. Evidence: Mechanistic studies to show microbial dispersion and studies using surrogate microorganisms show persistence of contamination. No direct evidence for transmission. Practical considerations: Relatively easy action to temporarily take dryers out of action and provide paper towels. Need to consider the management of paper towel waste. Longer term there are cost and energy implications.
	Avoid sharing equipment (e.g. IT, hot-desking)	Rationale: Shared surfaces create a route for indirect contact transmission via touch. Evidence: Several studies in healthcare environments have shown presence of SARS-CoV-2 virus on shared

Hierarchy	Mitigation	Rationale and considerations
		equipment such as computer mice and keyboards. For other diseases there is evidence that sharing a desk was a factor in transmission. No clear evidence of transmission for COVID, although there are office outbreaks. Practical considerations: Relatively straightforward action but there may be significant resource and space implications in some environments. Where it is not possible to avoid shared equipment, a cleaning regime between users should be implemented.
	Management of waste	Rationale: To limit transmission of SARS-CoV-2 from handling contaminated waste. This is particularly relevant to bathroom waste (paper towels used for drying hands). Evidence: Evidence for the survival of SARS-CoV-2 on different materials for considerable time. No evidence found in the literature for the safe handling of contaminated waste in buildings outside of healthcare settings and chemical contamination settings. BS5906:2005 sets out procedures for handling most types of waste in buildings. Practical considerations: Pragmatic approach required. Areas of concern: Bathroom areas, removal of potentially contaminated paper towels and other items. No evidence in literature around this area. Risk is very low but manual handling of all waste and packaging and use of compactors are possible areas of concern. Warning signage and training for staff required.
	Hygiene behaviours in bathrooms (e.g. put the toilet lid down before flushing)	Rationale: Virus could be dispersed in faecal aerosol, bathrooms have multiple high touch surfaces. Both can be modified by behaviour change. Evidence: It is well known that people do not necessarily wash their hands after using the bathroom. There is evidence for reduction in aerosol plumes by closing toilet lid before flushing, although no direct evidence of transmission. Some evidence of contamination of touch surfaces such as door handles and flush activation devices (handles, buttons, no touch controls) - see no touch section for evidence on these. Practical considerations: Place the flush behind the toilet

Hierarchy	Mitigation	Rationale and considerations
		seat so that users need to put the seat down to use the flush. Make sure that there are ample quantities of liquid (not bar) soap and disposable paper towels. Notice on the door asking whether the user has washed their hands. While closing the toilet lid will help, it may leave the toilet seat contaminated after a flush. A regime of cleaning the toilet lid before use or at regular intervals throughout the day.
	Changes to touch behaviours (e.g. education programmes)	Rationale: Reducing facial touching is likely to lead to reductions in passing contamination from hand to viral entry points on the face – mouth, nasal passages and eyes. Evidence: The evidence for changing habitual behaviours such as face touching through education programmes shows at best weak effects. More effective approaches include shaping behaviours incompatible with face touching such as keeping hands below shoulder level. Currently there is no evidence on the potential effectiveness of this approach. Practical considerations: It is difficult to change these and other habitual behaviours that often occur without awareness. Simple messaging may have a small effect, but it is unlikely to persist, and adding additional messages of this kind may distract from other messages that have a larger and more reliable effect on reducing infection and transmission.
	Lower density of occupants	Rationale: Reduces probability of an infectious person being present, reduces duration of exposure, enables easier compliance with distancing Evidence: Evidence that transmission is occurring in highly occupied settings where people are in close proximity. Models for transmission show this is an effective measure. Practical considerations: Feasibility will depend on the design and configuration of the environment and the activities that need to be carried out. Settings such as transport are difficult to operate with a lower density. Alternative strategies for work/activities such as remote meeting software, enabling active travel (cycling), limiting time people can spend in a particular location could all assist in enabling this approach.

Hierarchy	Mitigation	Rationale and considerations
	Maintain 2m distancing	Rationale: Increased distance reduces the likelihood of exposure to a high viral load through droplets/air and on surfaces close to infectious person. Evidence: Meta-analysis suggests that risk is substantially reduced at 1m and 2m provides a further 2x reduction. Chamber and modelling studies show cough aerosols and droplets are greatly reduced by a distance around 2m from the source. Epidemiological evidence from outbreaks on aircraft show highest risk within 2-3 seat rows. Practical considerations: Distancing needs to recognise that people are not static and hence allow leeway for real-world. Challenging to maintain in some environments, in which case additional measures will be needed
	One-way systems for moving through spaces	Rationale: Enable more effective physical distancing and preventing crowding, particularly in corridor type spaces Evidence: No clear evidence to support that this approach can influence disease risk. There is evidence relating to managing people flow in spaces. Practical considerations: Likely to be most appropriate for settings where there is a risk of crowding such as transport hubs, shops and corridors in schools/busy office environments. Will depend on the physical space available. Needs clear signage and reminders to follow. System needs to be carefully thought through otherwise people are likely to ignore it. May have some impacts on accessibility.
	Orientation of people	Rationale: Locating people to the side or back-to-back reduces close range exposure as people are no longer facing the direct plume or exposed to the high surface concentrations Evidence: There is evidence from modelling and chamber studies that suggests this is beneficial, but there seems to be limited real-world evidence. Practical considerations: Application will depend on the ability to rearrange a particular space and whether this will be effective for the particular circumstances. This approach

Hierarchy	Mitigation	Rationale and considerations
		should also take into account human behaviour and whether people will remain in a position where they don't face each other.
Personal protection	Respirator (FFP3/N95/FFP3) face masks	Rationale: Significantly reduces exposure to droplets and aerosols where the respirator is fit tested for the wearer and worn properly. Widely used in exposure prone occupations prior to the Sars-CoV-2 pandemic. Evidence: There are many publications over several decades to confirm the effectiveness of well-fitting FFP3/N95 (FFP2 equivalent) and FFP3 masks at protecting the wearer. This includes a number of comparison studies between different mask types. Practical considerations: Need to be fitted correctly to be effective. Only suitable for aerosol generating procedures in healthcare and other very high risk environments. The effectiveness of these masks must not be confused with surgeon style masks, which are not classed as respiratory protective equipment and are designed to protect others from droplets generated from the mouth and nose of the wearer; these are inefficient at protecting the wearer from inhalation of bio aerosols. There are concerns that valved masks could enhance exposure if the wearer is infected.
	Surgical face masks	Rationale: Reduces potential for droplet exposure through reducing amount that reaches nasal membranes/large droplet inspiration. Potentially effective as a source to block the emission of droplets and some aerosols. Reduces the force of respiratory emissions so they will travel shorter distance. Evidence: Several studies show that they are reasonably effective as a source and exposure control. More effective against droplets than aerosols. Evidence is covered in earlier NERVTAG paper, DELVE review and EMG paper (04062020) Practical considerations: Effectiveness depends on material and fit. Biggest impact on effectiveness is likely to be user compliance and wearing properly. Most appropriate for healthcare settings and high exposure risk workplaces.
	Face coverings	Rationale: Potentially effective to block the emission of droplets and some aerosols from a source of infection.

Hierarchy	Mitigation	Rationale and considerations
		Reduces the force of respiratory emissions so they will travel shorter distance. May have a small impact on exposure. Effectiveness will depend on the material and construction. Evidence: Some evidence from measurements with people, mechanistic data from laboratory/modelling shows materials can block a proportion of droplets and aerosols. Face coverings are detailed in earlier NERVTAG paper and a DELVE review. Practical considerations: Mechanistic effectiveness depends on material and fit. Important to consider user compliance, wearing properly, and hygiene aspects of face coverings.
	Gloves	Rationale: Wearing gloves can reduce the likelihood of contamination on hands Evidence: Standard PPE in healthcare, to prevent transmission from healthcare worker to patient and vice versa, however only effective where gloves are discarded afterwards. No evidence from community settings. Laboratory studies show that gloves can become contaminated and could therefore present a transmission risk to others. Practical considerations: People who wear gloves feel themselves to be protected and may miss opportunities for hand hygiene. Gloves can pose a transmission risk where they are worn in multiple environments. They should only be recommended for high risk settings with a proper protocol for use.
	Protective clothing (personal protective equipment [PPE])	Rationale: There is evidence that protective gowns, overalls and gloves will offer the wearer physical barrier protection from droplet splash and other contaminated bodily fluids and waste. Evidence: The performance quality and safety standards required for these items are underpinned internationally by a series of BS EN and ISO standard tests and within the UK only approved test houses can provide such test reassurances. Such tests provide evidence of fitness for purpose.

Hierarchy	Mitigation	Rationale and considerations
		Practical considerations: Fit, wearer comfort, including thermal comfort, requirements for manual dexterity may prevent the use of some types of PPE, acceptability to others who interact with the wearer. Donning and doffing of protective clothing is important and wearer contamination may occur during doffing if not done with care. Usage is only likely to be appropriate in a high risk environment.
	Face shields/goggles	Rationale: Reduces potential for droplet exposure through eyes for goggles and nasal membranes and large droplet inspiration for shields. Very limited effect on aerosol exposure. Evidence: No evidence as source control, some evidence from mechanistic studies and one small study with human challenge that suggests they are quite effective to prevent exposure. This is reflected in a recent meta-analysis. The performance quality and safety standards required for these items are underpinned internationally by a series of BS EN and ISO standard tests and within the UK only approved test houses can provide such test reassurances. Such tests provide evidence of fitness for purpose, including face, side of face protection and visual distortion effects Practical considerations: Relatively straightforward approach, but only likely to be appropriate for people who are at high risk of exposure and/or will struggle to maintain physical distancing. Fit, wearer comfort, including thermal comfort, requirements for good visibility may prevent the use of some visors/goggles, acceptability to others who interact with the wearer. As with protective clothing, visor/face shield removal technique is important where significant contamination is encountered and wearer contamination may occur during doffing if not done with care.

18. Appendix 6 – Short bio's: Principal scientists and contributors

Professor Damien McElvenny

Damien McElvenny is a biostatistician and epidemiologist with over 30 years of experience in occupational epidemiology and occupational health surveys. His research interests are mainly in the interaction between people's work and their health.

In particular, he is interested in occupational cancers, occupational neurodegenerative diseases, the ageing worker, work and mental ill-health, migrant workers, meta-analysis methodology, and return to work. He has experience of working with a wide range of stakeholders in scientific projects (management, workforce, trades unions, politicians), has had media training and has extensive experience of governance and data protection issues surrounding research. Damien has led/co-led a number of projects for the Institute of Occupational Medicine, including epidemiological studies of lead, rubber, hard-metal, shift work and cancer and trauma and cancer, as well as neurodegenerative diseases in former elite rugby players and football players.

Damien has also been an invited expert on International Agency for Research on Cancer working groups and at European Chemicals Agency and European Chemicals Bureau meetings, and an invited scientist and speaker and many national and international meetings. In addition, he has experience of supervising PhD and MSc students, examining PhDs and teaching undergraduate and post-graduate courses in epidemiology and risk assessment. Damien has organised national and international meetings on epidemiology in occupational health, including 26th international symposium on epidemiology in occupational health.

Professor John Cherrie

John Cherrie is a Principal Scientist at IOM, as well as Professor of Human Health at Heriot Watt University. John has a BSc (Hons) in Physics and a PhD in Occupational Hygiene. He also holds the

Diploma of Operational Competence in Occupational Hygiene (Dip Occ Hyg) from the Faculty of Occupational Hygienists within the British Occupational Hygiene Society and is an Honorary Professor at the University of Aberdeen. He has worked as an occupational hygienist for more than 30 years.

When a lecturer at Aberdeen University John organised and taught a Master of Science degree course in Occupational Hygiene (from 1991 to 2001).

John has undertaken a wide range of occupational hygiene and epidemiological studies including:

- Workers exposed to tetrafluoroethylene.
- Collaborations with the International Agency for Research on Cancer (IARC) on various epidemiological studies.
- The development of regulatory risk assessments for industrial chemicals by adapting deterministic models for inhalation exposure (ART).
- A research programme funded by the Health and Safety Executive to provide estimates of the number of people in Britain that annually die from occupational cancer.
- A study of risk factors for dermatitis amongst engineering workers exposed to soluble cutting oils.
- Environmental exposure to asbestos and determination of future cancer risks for local communities living near to asbestos contamination and workers who may have encountered asbestos.

Among his many professional achievements John was President of the British Occupational Hygiene Society 2007/08 and is currently a member of the Editorial Board for the Annals of Occupational Hygiene. John continues to be a member of several Governmental Advisory Committees.

John has to date published 116 peer-reviewed scientific articles and over 120 book chapters, letters, reviews and other scientific publications.

(EPICOH) in 2017 in Edinburgh, which is the premier world conference on occupational epidemiology.

Dr Rob Aitken

Rob Aitken is Chief Executive at IOM and he leads IOM's work programme on nanotechnology risk which currently encompasses SAFENANO (of which he is the Founder and Director), major European Commission H2020 framework projects and numerous pieces of consultancy work for public and private sector clients. His main scientific interests are in exposure/risk assessment of fine particles, effectiveness of PPE and emerging technology risk. In Gov4nano he leads the Council work package and also leads the 3 project task force on developing the NRGC.

He has been lead or co-lead on a series of major public reviews for Government Agencies in the UK and elsewhere including RIP-oN 2 and RIP-oN 3 for the ECHA, and has written several national and international standards. He is IOM lead in the H2020 project Gov4nano, starting in January 2019. In addition, he has been Principal UK Expert on Environment, Health and Safety (EHS) issues to ISO 299

Nanotechnologies and a member of OECD Working Party on Nanomaterials. Throughout FP7, he was a member of the European Commission, Nanotechnologies, Materials and new Production Technologies Program Expert Advisory Group. He holds an honorary position at Edinburgh Napier University.

Hilary Cowie

Hilary Cowie is IOM's Research Director. She has a BSc in statistics, is a Fellow of the Royal Statistical Society and Chartered Statistician. Hilary has extensive experience in the design and analysis of epidemiological morbidity and mortality studies. She has been project leader of a number of studies including a detailed statistical analysis of the relationship between exposure to inspirable dust and the presence of respiratory symptoms among UK wool textile workers, and a study of the inter-relationships of dust exposure, lung function and respiratory symptoms among workers in a variety of industries (including underground coal miners and opencast workers).

Much of her work has been concerned with the investigation of exposure-response relationships, primarily among occupational populations.

David Flower

David Flower is a qualified Occupational Hygienist, a Licentiate Member of the Faculty of Occupational Medicine and a member of The Institute of Healthcare Engineering and Estate Management (IHEEM). He has over 15 years' experience of occupational hygiene management with IOM Consulting. He leads a field team of Occupational Hygienists and ventilation specialists who enable organisation to understand the occupational health risks of their business and how best to manage those risks. David is a lead trainer in Asbestos Awareness and has also written and presented a number of bespoke training courses for ventilation maintenance including a 3 day Competent Persons course that has been endorsed by The British Occupational Hygiene Society (BOHS). He also provides support to the IOM Authorising Engineer team with technical guidance on the application of engineering controls to control health risks within a variety of industries including rail, utilities and healthcare.

Ross Clark

Ross Clark is a qualified Occupational Hygienist, a member of BOHS and the Institution of Occupational Hygiene, an accredited BSIF trainer and is the Head of Workplace Protection at IOM Consulting, running the Occupational Hygiene, Healthcare Ventilation and PPE teams. He has over 20 years' experience of conducting occupational hygiene, exposure and ventilation risk assessments across a number of sectors, including leisure, healthcare, utilities and heavy industry. Ross is an experienced practitioner in asbestos and occupational hygiene and a trainer in Asbestos Awareness and Face Fit Testing. He is a 'fit2fit' qualified trainer and assessor for respirator and face mask fitting and has been instrumental in the IOM's contribution to the sector guidance in the use of face masks in the dental industry as it emerged from the COVID-19 restrictions.

Nathan Baker

Nathan Baker is the Managing Director of IOM Consulting Ltd and Board Member of the Institute of Occupational Medicine. He has over 20 years of experience in assessing and managing risk in both the public and private sectors. Following a short career in insurance he served as an officer in the Army, deploying to several operational theatres including Iraq and Afghanistan. On leaving the Services he moved in the commercial environment, into a series of programme management roles including the implementation of a 30 year, £3Bn Public Private Partnership with the Ministry of Defence and the development of business and risk management strategies across several sectors.

He has a background in innovation and engineering, having been a strategic adviser to the Nathu Puri Institute at London Southbank University. He has represented the Institution of Civil Engineers (ICE) in industry forum discussing risk management and the pragmatic application of science and engineering in the workplace. As the Director of Engineering Knowledge at the ICE he led the Global Engineering Congress in 2018; an international forum focusing on the impact of engineering on the UN's sustainable development goals. Currently he is an independent advisor to the Association of Accounting Technicians (AAT), a member of the Royal Society of Chemistry's Chartership Review Panel and an Honorary Professor with DeMontfort University.

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