Assessment of transmission of COVID-19 in singing and music events

Question for NERVTAG:

2. Does NERVTAG consider that there is sufficient evidence for singing events to be a risk factor for transmission from a laboratory confirmed index case of COVID-19 to others to justify specific public health recommendations for controls on this activity during the pandemic?

Across the UK, 2 million people regularly sing and there are 70,000 choirs. This is an important question affecting the lives and livelihoods of many people. Singing groups come in all shapes and sizes, participants young and old and singing takes place in many settings, e.g. churches, schools, not just choirs. Participants range from professional singers where the activity is their livelihood through to amateur groups.

Beyond singing, concerns have also been raised about projected speech in theatres and playing of woodwind and brass instruments. Restriction of these activities again affects a very large number of people including almost all professional theatre and orchestral groups.

Routes of transmission:

Virus laden respiratory secretions expelled by infectious individuals are responsible for the person to person transmission of COVID. These secretions can transmit infection in a variety of ways, largely dependent on the size of the droplets that make up these secretions.

Large droplets can impact directly on mucus membranes or they can settle on surfaces and then can be picked up by hands and transported to mucus membranes.

Smaller droplets (aerosols) can be inhaled and deposit somewhere in the respiratory tract; the smaller the particle the further it can advance. It's also possible that smaller droplets can deposit on surfaces too.

It remains uncertain what the relative contributions from large droplet contact, aerosol inhalation and surface contamination are in the transmission of COVID. It's likely that all play a role with the circumstances acting at any given moment defining what may happen. Despite all we know about influenza, it has proven very difficult to tease out what the most common mechanism(s) is and the same currently holds true for COVID. Nevertheless, most authorities currently state that large droplet and surface contamination are dominant routes for COVID.

In support of a role for aerosols, evidence is accumulating that virus laden aerosols can be detected around patients with COVID (1-3) and a case report describes the likely involvement of aerosols in an outbreak scenario (4).

Respiratory secretion production during singing:

A comprehensive evidence review has been undertaken by Alberta Health Services in Canada https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-sag-singing-risk-transmission-rapid-review.pdf. A summary can be found in the supplementary information section at the end of this paper.

There is no research that investigates singing specifically in relation to transmission risk of COVID. There is also a paucity of scientific evidence on singing as an activity that poses risk of transmission of other infectious diseases such as influenza and tuberculosis.

It is known that aerosols are produced during normal breathing and talking. There is evidence that a loud voice creates more aerosols than a quiet one (5, 6); more pressure is applied to fluid lined air passages, the process that creates aerosols. Furthermore, certain types of speech (phones and words) are associated with higher levels of aerosol production (7). This may stem from the pressures involved in articulating certain sounds and the area of the throat/mouth where the sounds are produced. A new pre-print paper (8) has carried out measurements of aerosols generated while singing and compared this to breathing and speaking. The study considered only 8 participants. Results show that emissions when singing are 4-99 times higher than speaking, and 15-330 times higher than breathing. Emission rates increase with loudness. No studies have been found that look at the distances that expelled secretions travel during singing.

The result of these findings may be that singing presents a particular transmission risk for COVID (and indeed other respiratory pathogens). Several outbreak reports amongst church goers and choirs seem to back this up (9-12), though it is very difficult to confirm the route of transmission that took place in these settings as all 3 main routes of transmission will have been in play. Outbreak reports suggesting singing as a risk for TB infection are indirectly relevant as TB can only be transmitted via the aerosol route (13).

Instruments/Orchestras:

There are very little, if any, data at all concerning transmission risk and the playing of wind instruments. Some tentative investigations have been conducted, mostly German in origin. The studies mentioned below refer to aerosols but the methods used cannot reliably exclude droplets.

One study claims that aerosol emission from musician's mouths was not seen beyond 50cm and that no aerosols were seen to emerge from wind instruments themselves apart from the flute; here an aerosol was seen up to 75cm. The detection of aerosols was done by in a darkened room by shining bright light to show a 'mist'. The methodological detail and validity of this approach are unclear (14).

Another study looked at flow visualisation and air velocities from singers and wind instruments and concluded there was low risk of transmission. The methodological detail of this study has not been yet been published, but it did not study transmission per se (15).

A study measured particle generation when blowing a vuvuzela, a plastic horn popularised in the 2010 world cup in South Africa. Particle counts were almost 200 times higher with the vuvuzela compared to shouting for an equivalent duration. The authors suggest the horn increases the capacity to expel large numbers of aerosols (16)

The Lung Flute (Medical Acoustics, Buffalo, New York) is an FDA approved and WHO recognised acoustic device invented in 2002 for sputum induction. It comprises a plastic tube with a mouthpiece and an internal reed. When a patient exhales, acoustic waves are generated that travel downward along the tracheobronchial tree and vibrate secretions and sputum, increasing expectoration (17). Whether the playing of wind instruments produces similar effects is not clear.

Possible mitigations (link to EMG mitigation paper 4/6/20)

- Testing: rapid testing of 'participants' before rehearsals or performances? (**Not currently available**). Demonstration of immunity?
- Assessment: Exclusion of participants based in symptoms, fever, lower than usual oxygen saturations
- Face masks: Not really compatible with singing or playing of wind instruments
- Use of screens between musicians: This will only manage large droplets not aerosols. It may also impact on acoustics.
- Orientation of performers to limit face-to-face positioning
- Ventilation: Measures to improve indoor ventilation have the potential to reduce the risk of aerosol transmission, however this will not impact droplet transmission to the same degree. This is considered for performance venues in the companion EMG paper (16th July)
- Vaccination : Currently unavailable

For the time being social distancing is the most effective way to reduce transmission. Even in outdoor settings, the wind can keep droplets airborne for longer and in a closely clustered arrangement where people are singing for a long period of time, this could still pose a risk. Therefore, at the present time the safest way for groups to sing together is to i) sing outside, ii) use the 2m rule to socially distance and iii) avoid face-to-face positioning.

Conclusion:

There exists some evidence to suggest that singing can produce more aerosols than normal talking or breathing; it may be more akin to a cough. Singing for any appreciable amount of time therefore may present a risk for the creation of infectious aerosols and allow for infection transmission. There is no evidence describing the distance that droplets or aerosols travel after being 'released' during singing. However, it is conceivable that specific conditions and circumstances could exist to extend the range of travel of respiratory secretions. Aerosols in particular can be carried by the air in a venue.

It is not clear if the playing of wind instruments presents the same risk as singing.

At the present time this risk in mitigated by generic public health advice to practice social distancing, i.e. groups of people should not gather indoors for any purpose. Consideration of singing in schools is important, especially as schools have re-opened to some degree already.

As social distancing is relaxed, singing (especially the convening of larger groups of people for prolonged singing) should be viewed as a more risky practice and special measures may need to be considered to reduce the risk.

Further research of the risk of transmission from singing and playing wind instruments is needed.

Research needs:

PHE with DCMS are coordinating a Working Group to explore how to enable safer resumption of activities involving singing and playing of wind instruments. This will i) bring together data from rapid research activities on singing and wind instruments, ii) consider what mitigation factors might be possible, and iii) consider what further research is needed and should be prioritised by research funding bodies.

Several studies are currently underway including:

- Generation and dispersion of oral bacteria in singers compared to talking/breathing
- Measurement of aerosol production from singers and a range of musical instruments (PERFORM study)
- Visualisation of air flows around musical instruments

We are also aware of research study in the US which plans to study aerosol production from singing and wind instruments.

Evidence sources

References

1. Aerodynamic analysis of SARS-CoV-2 in two Wuhan hospitals
   https://www.nature.com/articles/s41586-020-2271-3

2. Detection of Air and Surface Contamination by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) in Hospital Rooms of Infected Patients
   https://www.medrxiv.org/content/10.1101/2020.03.29.20046557v2

3. Transmission Potential of SARS-CoV-2 in Viral Shedding Observed at the University of Nebraska Medical Center
   https://www.medrxiv.org/content/medrxiv/early/2020/03/26/2020.03.23.20039446.1.full.pdf

4. Evidence for probable aerosol transmission of SARS-CoV-2 in a poorly ventilated restaurant
   https://www.medrxiv.org/content/10.1101/2020.04.16.20067728v1

5. Aerosol Emission and Superemission During Human Speech Increase With Voice Loudness
   https://pubmed.ncbi.nlm.nih.gov/30787335/?dopt=Abstract

6. Visualizing Speech-Generated Oral Fluid Droplets with Laser Light Scattering
   https://www.nejm.org/doi/full/10.1056/NEJMc2007800

7. Effect of voicing and articulation manner on aerosol particle emission during human speech
   https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0227699

8. Aerosol emission is increased in professional singing
   https://www.depositonce.tu-berlin.de/handle/11303/11491

9. Coronavirus doctor's diary: The strange case of the choir that coughed in January
   https://www.bbc.co.uk/news/health-52589449

10. High COVID-19 Attack Rate Among Attendees at Events at a Church — Arkansas, March 2020 https://www.cdc.gov/mmwr/volumes/69/wr/mm6920e2.htm?s_cid=mm6920e2_w

11. Scientists to choirs: Group singing can spread the coronavirus, despite what CDC may say https://www.latimes.com/world-nation/story/2020-06-01/coronavirus-choir-singing-cdc-warning

12. Kasulis K. (2020). 'Patient 31' and South Korea's sudden spike in coronavirus cases. Aljazeera. https://www.aljazeera.com/news/2020/03/31-south-korea-sudden-spike-coronavirus-cases-200303065953841.html
13. Outbreak of Tuberculosis in a Church https://journal.chestnet.org/article/S0012-3692(16)34977-7/fulltext

14. Aerosol emission test: Low risk of infection due to the spread of breathing air from musicians https://www.wienerphilharmoniker.at/orchester/philharmonisches-tagebuch/year/2020/blogitemid/1423/cid/1/page/1/pagesize/20

15. Risk assessment of a coronavirus infection in the field of music https://www.mh-freiburg.de/fileadmin/Downloads/Allgemeines/engl._Risk_AssessmentCoronaMusicSpahnRichter19.5.2020.pdf

16. Propagation of Respiratory Aerosols by the Vuvuzela https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3100331/

17. Efficiency of the Lung Flute for sputum induction in patients with presumed pulmonary tuberculosis https://onlinelibrary.wiley.com/doi/full/10.1111/crj.12697

Supplementary Information:

- A comprehensive evidence review has been undertaken by Alberta Health Services in Canada https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-sag-singing-risk-transmission-rapid-review.pdf

  Summary Recommendations
  - *Given the potential risk associated with singing and SARS-CoV-2 transmission, albeit paucity of evidence, a precautionary approach is recommended:*
  - *Since singing may pose a risk of transmission due to multiple contributing factors, restrictions on singing in a group setting (e.g. choir, religious service) should be maintained, particularly in indoor or enclosed environments.*
  - *Since the action of singing in group settings (e.g. choir, religious service) occurs in close proximity to others, prolonged contact and direct contact via actions such as handholding and sharing materials such as books, appropriate social distancing, hand hygiene before and after the activity, considerations of masking (when social distancing is not possible), and any*

other relevant public health recommendations should be strictly followed and reinforced. Individuals with any respiratory symptoms should not take part and should be under isolation as per public health guidance.

- *When reductions of current COVID-19 public health measures are introduced, restrictions regarding singing as discussed in this context should be maintained and not included in the initial round(s) of measures reduced unless new evidence emerges suggesting there is no significant potential additive risk.*

- A short paper from PHE was circulated to NERVTAG
  3 main references were used; 2 published (included in Canadian review) and 1 unpublished (PHE outbreak report involving a choir)

- Viral Shedding and COVID-19 Superspreading Events
  https://www.medscape.com/viewarticle/931898

- Webinar concerning singing and infection transmission, including presentation from Don Milton (infection aerobiologist)
  https://www.barbershop.org/covid-webinar-summary