COVID-19 Risks and Precautions for Choirs

NCCEH Evidence scan

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Choral Canada
August 19, 2020
Outline

1. About NCCEH
2. Notable COVID-19 outbreaks related to choirs
3. Understanding transmission risks
4. Precautionary measures
5. Emerging research
6. Q&A
Evidence-based knowledge synthesis and translation

Identify knowledge gaps

Foster networks, build capacity for Canada’s public health system

The National Collaborating Centres
Emerging Public Health Issues

e.g. COVID-19

Contaminants and hazards
COVID-19 resources for EH

Full report available at NCCEH.CA

...and many other COVID-19 resources
Notable outbreaks

**Skagit Valley Washington,**
- 53 cases of 61 person choir, three hospitalizations, 2 deaths
- Low community spread, avoided physical contact, used hand sanitizer
- Long duration, minimal spacing (15-25 cm), limited ventilation

**Amsterdam Mixed Choir, Netherlands**
- 102 cases of 130 person choir, four deaths (1 member, 3 associated persons)
- Multiple rehearsals Feb 25-Mar 7
- Symptomatic persons reported on Mar 3, 7 rehearsals and March 8 performance

**Berlin Cathedral Choir, Germany**
- 60 cases of 80 persons who attended a March 9 practice
- One member reported a positive COVID-19 test March 14
- Within two weeks, 30 positive and 30 additional symptomatic

**French choirs**
- Feb 28 - Whir au Val (Haut-Rhin) 20 choristers and 69 secondary cases; 9 deaths
- Mar 12 - Men’s choir practice, 19 cases of 27 participants, 7 hospitalizations, no deaths;
- Connected to another choir where several members reported symptoms
But outbreaks have occurred in other group settings where there was no singing – why are choirs special?

Settings of published outbreaks to Apr 2020

Leclerc et al. 2020
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Common factors in many outbreaks

- Indoors
- Crowded spaces
- Close contacts
- Lots of interaction (greeting, talking, laughing, cheering, shouting, singing, sharing of food/objects)
- Long duration of interaction
- Poor ventilation
- Prevalence of community spread of the virus (symptomatic and asymptomatic)
Large respiratory droplets – direct exposure when in close contact with an infected person who is sneezing, coughing (droplets > 5 µm)

Smaller respiratory droplets/aerosols – direct exposure from close contact or indirect exposure from accumulated aerosols (droplets of < 5 µm)

Contact with contaminated surfaces/fomites followed by contact with nose, mouth, or eyes
**Particle size**

- **Large droplets (≥ 5~10 µm)**
  - More likely to fall to the ground at short distance
  - Intense but less frequently release in coughs/sneezes
  - More likely expelled by symptomatic persons
  - Upper airway

- **Smaller droplets/aerosols (< 5 µm)**
  - Less likely to fall to ground at short distance
  - May persist in the air for longer/accumulate
  - Less intense release but could be generated continuously
  - Generated by symptomatic **AND** asymptomatic/pre-symptomatic persons
  - Potential to reach lower respiratory tract
Singing in groups: Risks associated with large gatherings

- **Close contact** while greeting, talking, laughing, sharing of sheet music, stands, microphones
  - Increases risk of exposure to respiratory droplets and short-range aerosols
- **Gathering in large numbers for prolonged duration indoors**
  - Increases risk of exposure to accumulated aerosols
  - Limited ventilation reduces the dilution and dispersion of aerosols
- **Sharing of surfaces or objects** such as musical stands, chairs, books, microphones, instruments, food, dishes, drink dispensers
  - Increased risk of exposure via fomites
Singing in groups:
Risks associated with increased emission of droplets

- A combination of processes can affect **Quantity** and the **Size** of particles released during vocalization
- Main mechanisms for production of droplets during vocalization are fluid-film burst in the bronchioles
- Droplets release may also originate in the larynx and oral cavity
Singing in groups: Risks associated with increased emission of droplets

Quantity

- Vocalization of any type releases a higher concentration of particles than breathing
- Singing releases more particles than speaking
- Particle release is affected by:
  - Volume (Louder = more aerosols)
  - Vocalization style/enunciation
  - Deep exhalation and rapid inhalation
  - Super-emitters
Singing in groups:
Risks associated with increased emission of droplets

**Particle size**

- Studies have found that vocalization can produce a range of particle sizes:
  - Smaller droplets dominate (≤ 5-10 µm)
  - Up to 80% are ≤ 1 µm
  - Smaller droplets can remain suspended and travel further than large droplets
  - Smaller droplets are much more likely to penetrate the lower respiratory tract
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Minimizing the Risks: Distancing

• Maintaining 2 m between participants helps reduce spread due to LARGE respiratory droplets

• Distancing can also help to reduce some of the short-range transmission of smaller droplets

• Maintaining distance is easier in larger venues/rooms

• Ensure distancing is maintained for ALL activities, not just while singing (e.g. entry/exit, warm up spaces, bathrooms)

• Additional barriers or partitions could be considered where practical to do so and distancing is difficult to maintain
Minimizing the Risks: Reduce density and duration

• Larger spaces with fewer faces
  • Reduced loading of infectious particles; increased dilution and dispersion of accumulated aerosols

• Shorter duration (e.g. 30 minutes) and breaks between rehearsal or performance
  • Reduces accumulation of potentially infectious particles
  • Breaks should be in a different location, and not compromise distancing principles
Minimizing the Risks: Ventilation

- Outdoors and uncrowded
- Large indoor space with mechanical/natural ventilation (high ACH)
- Smaller indoor space with mechanical or natural ventilation (high ACH)
- Avoid confined indoor space & no ventilation

Increasing risk
Minimizing the Risks: Personal measures

• Symptomatic or potentially exposed persons should stay home

• High risk/susceptible persons should stay home

• Face coverings – if possible wear at all times, particularly where closer encounters are more likely (More on masks in the Q&A)

• Hand hygiene

• Avoid close contact, handshakes, sharing of objects/equipment
Risk Assessment

• Various approaches (WHO, Spahn and Richter 2020, PHAC, etc.)

• Consider the specific circumstance
  • Risk level of participants
  • Risk level of the venue
  • Risk level of the activity
  • Level of community transmission

• Consider mitigation potential
  • Hierarchy of controls/mitigation measures, local PH advice

• Does mitigation eliminate or reduce risks sufficiently?
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Emerging research (USA)

- International Coalition for the Performing Arts – preliminary results
  - Studies indicate that a higher concentration of respiratory particles are released during singing compared to breathing
  - Measurements indicate the effectiveness of masks and screens for reducing release of respiratory particles
  - Models of infection risk indicate risk increases over time; masks reduce risk overall

Indoor Case Study: Mask Impact on Infection Risk

Infection risk $r$ by Wells-Riley equation at the height of mouth opening, with breathing rate of 8 L/min.

- $t = 10$ min
- $t = 30$ min
- $t = 60$ min
Emerging research (Germany)

- Mürbe et al. 2020
  - Laser particle counter study, 8 subjects during breathing, speaking and singing.
  - Significantly higher emission rates for singing compared to mouth breathing and speaking; Emissions increased with volume
  - Variation between singers; Higher emission rates for phonation by females vs. males

- Hartmann and Kriegel 2020
  - Relationship between CO₂ and aerosol concentration

- Hartmann et al. 2020
  - Risk assessment of rehearsal rooms for choirs with regard to virus-laden aerosols; Compared rehearsal rooms, concert Halls and office space

- Kriegel and Hartmann 2020
  - Indoor risk assessment of virus laden aerosols..

Emerging research

Risk Calculators

- COVID-19 Airborne Transmission Estimator (Jimenez 2020)
- Airborne Infection Risk Calculator (AIRC) (Mikszewski et al. 2020)
- Risk Analysis of the transmission of CARS-CoV-2 by aerosols (in German, Trukenmüller 2020)

Essential inputs
- Room dimensions
- Air exchange
- Number of persons
- Duration of exposure
Emerging research
Aerosols transmission

• Further understanding of transmission via aerosols

• Additional evidence of viral RNA detected in the room air of COVID-19 patients. Improved understanding of how virus moves around the room – particles found deposited on window sills, under the bed (Santarpia et al. 2020);

• Isolation of culturable virus from air sample of patient rooms > 2 m distance (Lednicky et al. 2020, pre-print)

Viral particles can be dispersed due to ambient air currents

These particles may be infectious
What remains unknown?

Many questions remain...

• Movement and accumulation of aerosols in different indoor environments?
• How long do viral particles remain infectious and what is the infectious dose?
• Transmission by children, severity of disease, longer term effects
• Effectiveness of emerging technologies
  • Disinfection technologies
  • New types of coatings/surfaces
• Results of further outbreak investigations
  • Improve understanding of transmission for different settings, activities, groups etc.
• And more...
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thank you!

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Production of this presentation has been made possible through a financial contribution from the Public Health Agency of Canada.
Selected Key References


