National Collaborating Centre for Methods and Tools

Centre de collaboration nationale des méthodes et outils

School of Nursing | McMaster University

Revue rapide : Que sait-on au sujet du risque de transmission de la COVID-19 lors d'activités musicales comme chanter ou jouer d'un instrument à vent, et comment ces risques peuvent-ils être atténués?

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Veuillez noter : Cette revue a peut-être été mise à jour. Consultez la version la plus récente de cette revue en visitant le Service rapide de données probantes sur la COVID-19 du Centre de collaboration nationale des méthodes et outils, au lien ci-dessus.

Les auteures déclarent n'avoir aucun conflit d'intérêts à divulguer.

Résumé

Contexte

Chanter et jouer d'un instrument à vent sont des activités qui produisent des gouttelettes respiratoires et des aérosols et qui peuvent également générer des matières contaminées. Des lignes directrices en matière de santé publique concernant le degré auquel ces activités contribuent à la transmission de la COVID-19 pourraient aider les organisations communautaires et artistiques à répondre efficacement aux risques associés à la pandémie.

Cette revue rapide a été produite pour soutenir la réponse de l'Agence de la santé publique du Canada à la pandémie de coronavirus 2019 (COVID-19). Cette revue vise à recenser, évaluer et résumer les nouvelles données de recherche à l'appui de la prise de décision fondée sur des données probantes.

Cette revue rapide inclut les données probantes disponibles au 4 janvier 2021 pour répondre à la question suivante : **Que sait-on au sujet du risque de transmission de la COVID-19 lors d'activités musicales comme chanter ou jouer d'un instrument à vent, et comment ces risques peuvent-ils être atténués?**

Points clés

- Les données probantes dont on dispose font ressortir que le chant est associé à un possible risque de transmission de la COVID-19. On a rapporté des cas d'éclosions et d'« événements supercontaminateurs » associés à du chant collectif (répétitions de chorale, lieux de culte), bien que les rapports de cas inclus décrivent des événements survenus tôt dans la pandémie, lorsque des mesures de contrôle des infections n'étaient pas régulièrement mises en œuvre. Il n'est pas clair si le risque de transmission de la COVID-19 lié au chant est dû à l'aérosolisation de particules respiratoires, à l'expulsion de grosses gouttelettes, ou aux comportements sociaux en groupes rapprochés. Des études de modélisation démontrent que la quantité d'aérosols et la vélocité des gouttelettes produits lorsque l'on chante sont plus élevées que lorsque l'on respire ou que l'on parle. Le degré de certitude global des données probantes est très faible, et il est très probable que les conclusions changeront à mesure que de nouvelles données probantes apparaîtront.
- Il n'existe pas de données probantes claires démontrant une transmission associée au fait de jouer d'un instrument à vent, bien que des études de modélisation démontrent que le virus pourrait en théorie être transmis de cette manière. Des études de modélisation montrent une variation dans la quantité d'aérosols générés par différents instruments. Dans la plupart des études, la quantité d'aérosols et la vélocité des gouttelettes associées aux bois et aux cuivres ne sont pas significativement plus élevées que lorsque l'on respire, que l'on parle ou que l'on tousse. Le degré de certitude global des données probantes est très faible, et il est très probable que les conclusions changeront à mesure que de nouvelles données probantes apparaîtront.

- Les revues de faible qualité dont on dispose indiquent que le risque de transmission par le chant et les instruments pourrait être atténué par l'application des mesures de santé publique standard, comme le dépistage, la distanciation, le nettoyage des surfaces, l'étiquette respiratoire, l'hygiène des mains et le port du masque lorsque possible, ainsi que par des interventions spécifiques à ces contextes, comme une ventilation accrue, des horaires plus restreints et des scènes extérieures. L'efficacité de ces stratégies à réduire la transmission n'a pas été démontrée. Des études de modélisation et de simulation démontrent le potentiel d'efficacité d'une ventilation à haut volume, de l'emploi de purificateurs d'air placés au-dessus du musicien ou de la musicienne, et d'enveloppes ou de protections d'instruments (bien que ces mesures ne soient pas toujours pratiques pour jouer). L'efficacité de ces stratégies à réduire la transmission réelle n'a pas été démontrée. Le degré de certitude global des données probantes est très faible, et il est très probable que les conclusions changeront à mesure que de nouvelles données probantes apparaîtront.

Aperçu des données probantes et lacunes dans les connaissances

- Les données probantes n'ont pas clairement distingué le risque de transmission associé au chant des autres risques présents lors d'activités de chant ayant entraîné des éclosions, comme les attroupements, les contacts rapprochés, les rassemblements en grands groupes, les espaces clos, la mauvaise ventilation, la longue durée de contact, les interactions sociales, les rassemblements en coulisses, ou encore le partage de nourriture, de boissons, d'équipement et de moyens de transport. Plus d'études sont nécessaires pour déterminer le risque additionnel associé au chant.
- Bien que des études de modélisation aient démontré le potentiel du chant et du fait de jouer des bois ou des cuivres à produire des particules aérosolisées, des gouttelettes et des matières contaminées, la transmission réelle de l'infection à la COVID-19 n'a pas été démontrée de manière concluante.
- Plus d'études sont nécessaires pour déterminer si le risque de transmission de la COVID-19 associé au chant est dû à l'aérosolisation de particules respiratoires, à l'expulsion de grosses gouttelettes, ou aux comportements sociaux en groupes rapprochés.
- Plus d'études sont nécessaires au sujet de l'efficacité des mesures générales de contrôle des infections (p. ex. le lavage des mains, la distanciation ou le port du masque, lorsqu'approprié) et des stratégies d'atténuation spécifiques à réduire la transmission de l'infection associée au fait de chanter ou de jouer d'un instrument à vent.
- On observe un certain degré de chevauchement entre les études incluses dans les revues, ce qui entraîne un risque de surestimer les associations décrites lorsque l'on s'appuie sur toutes les revues disponibles. Cependant, les tendances décrites dans chaque revue sont cohérentes, et celles-ci ont été décrites dans la présente revue.

Méthodologie

Question de recherche :

Que sait-on au sujet du risque de transmission de la COVID-19 lors d'activités musicales comme chanter ou jouer d'un instrument à vent, et comment ces risques peuvent-ils être atténués? (La transmission aux membres du public a été exclue de la présente revue.)

Recherche

Les bases de données suivantes ont été fouillées le 4 janvier 2021, en utilisant les termes clés singing, sing, singer, vocal, vocalize, vocalise, vocalization, vocalist, "wind instrument", "wind player", "wind musician", "brass instrument", "brass player", "brass musician", musician, musical, "woodwind", trumpet, trombone, euphonium, tuba, flugelhorn, clarinet, saxophone, bassoon, piccolo, vuvuzela, philharmonic, orchestra, symphony, "school band", choir, choral, rehearsal, rehearse, "music group", accompanist, opera, operetta, "bell cover", "instrument cover", "musical theatre", flute, oboe, "french horn" :

- Pubmed's curated COVID-19 literature hub: LitCovid
- World Health Organization's Global literature on coronavirus disease
- COVID-19 Evidence Alerts from McMaster PLUS™
- COVID-19 Living Overview of the Evidence (L·OVE)
- McMaster Health Forum
- Prospero Registry of Systematic Reviews
- MedRxiv preprint server
- NCCMT COVID-19 Rapid Evidence Reviews
- NCCEH Environmental Health Resources for the COVID-19 Pandemic
- NCCID Disease Debrief
- Uncover (USHER Network for COVID-19 Evidence Reviews)
- Centers for Disease Control and Prevention's Morbidity and Mortality Weekly Report (MMWR)
- Alberta Health Services
- Public Health Ontario
- Public Health England
- Institut national de santé publique du Québec (INSPQ)
- ERIC via ProQuest

Une copie de la stratégie de recherche complète peut être consultée à lien.

Un appel à nous transmettre des articles pertinents a aussi été lancé par courriel à des organisations musicales nationales et provinciales canadiennes. Plusieurs articles ont été suggérés, et deux d'entre eux satisfaisaient aux critères d'inclusion de cette revue.

Critères de sélection des études

Les résultats de la recherche ont d'abord été examinés pour recenser les directives et les synthèses récentes. Les études uniques ont été incluses si aucune synthèse n'était disponible ou si des études uniques ont été publiées après que la recherche ait été effectuée à partir de la synthèse. Les sources de langue anglaise évaluées par les pairs et les sources publiées avant l'impression et avant l'évaluation par les pairs ont également été incluses. Les sources de surveillance ont été exclues. Lorsqu'ils sont disponibles, les conclusions des synthèses et les guides de pratique clinique sont présentés en premier, car ils tiennent compte de l'ensemble des preuves disponibles et peuvent donc être appliqués largement aux populations et aux milieux.

Question 1 : Que sait-on au sujet du risque de transmission de la COVID-19 lors d'activités musicales comme chanter ou jouer d'un instrument à vent?

	Critères d'inclusion	Critères d'exclusion
Population	Musiciens/interprètes (vents, cuivres, chanteurs et chanteuses)	Instruments que l'on peut jouer en portant un masque (instruments à cordes, percussions, piano, etc.) Études exclusives aux instruments que l'on peut jouer en portant un masque (p. ex., un quatuor à cordes)
Intervention	Chanter/jouer d'un instrument Être exposé à des personnes qui chantent ou qui jouent d'un instrument (p. ex., chef d'orchestre ou de chœur)	Publics Arts de la scène qui ne comportent pas de chant ou d'instruments à vent, comme la danse ou le théâtre
Résultats	Infection à la COVID-19 et/ou infection secondaire et/ou éclosion Détection du virus dans des environnements simulés	
Contexte	Orchestres, chœurs, groupes de musique, peu importe le contexte, y compris les contextes professionnels, religieux et scolaires Milieux intérieurs et extérieurs	Bars, pubs

Question 2 : Quelles stratégies atténuent le risque de transmission lors d'activités musicales?

	Critères d'inclusion	Critères d'exclusion
Population	Musiciens/interprètes (vents, cuivres, chanteurs et chanteuses) Transmission des musiciens au public	Instruments que l'on peut jouer en portant un masque (instruments à cordes, percussions, piano, etc.) Études exclusives aux instruments que l'on peut jouer en portant un masque (p. ex., un quatuor à cordes) Transmission entre les membres du public
Intervention	Stratégies de prévention et contrôle des infections Être exposé à des personnes qui chantent ou qui jouent d'un instrument (p. ex., chef d'orchestre ou de chœur)	Arts de la scène qui ne comportent pas de chant ou d'instruments à vent, comme la danse ou le théâtre
Résultats	Infection à la COVID-19 et/ou infection secondaire et/ou éclosion Détection du virus dans des environnements simulés	
Contexte	Orchestres, chœurs, groupes de musique, peu importe le contexte, y compris les contextes professionnels, religieux et scolaires Milieux intérieurs et extérieurs	Bars, pubs

Extraction et synthèse des données

Pour les synthèses, les données relatives à la conception de l'étude, au cadre, à l'emplacement, aux caractéristiques de la population, aux interventions ou à l'exposition et aux résultats ont été extraites lorsqu'elles étaient déclarées.

Évaluation de la qualité des données probantes

Nous avons évalué la qualité des données probantes incluses en utilisant des outils d'évaluation critique, comme nous le décrivons ci-dessous. L'évaluation de la qualité a été réalisée par un examinateur et vérifiée par un deuxième examinateur. Les conflits ont été résolus par la discussion. Pour certaines des données probantes incluses, aucun outil approprié n'a été trouvé, ou l'équipe de revue n'avait pas l'expertise nécessaire pour évaluer leur qualité méthodologique. Les études pour lesquelles aucune évaluation de la qualité n'a été effectuée sont indiquées dans les tableaux de données.

Méthodologie de l'étude	**Outils d'évaluation critique**
Synthèse	Assessing the Methodological Quality of Systematic Reviews (AMSTAR) AMSTAR 1 Tool
Rapport de cas	Joanna Briggs Institute (JBI) Checklist for Case Reports

Les évaluations de la qualité effectuées pour chaque étude incluse sont disponibles sur demande.

L'approche GRADE (Grading of Recommendations, Assessment, Development and Evaluations) a été utilisée pour évaluer la certitude des résultats sur la base de huit domaines clés.

Selon l'approche GRADE en matière de qualité des données probantes, les **études observationnelles**, telles que celles incluses dans cette revue, fournissent des données probantes de **faible qualité**. Cette évaluation peut être réduite encore davantage en fonction d'autres domaines :

- un risque de biais élevé;
- l'incohérence des effets;
- le caractère indirect des interventions/résultats;
- des imprécisions dans l'estimation de l'effet;
- un biais de publication.

À l'inverse, elle peut être rehaussée sur la base des domaines suivants :

- un effet important;
- une relation dose-effet;
- une prise en compte des variables confusionnelles.

Pour chaque résultat, la certitude globale des données probantes a été déterminée en tenant compte des caractéristiques des données probantes dont on dispose (des études observationnelles, dont certaines n'ont pas été évaluées par les pairs, des variables confusionnelles potentielles qui n'ont pas été prises en compte, des essais et des protocoles d'essais différents, et une absence de groupes de comparaison valides). Un jugement selon lequel « la certitude globale est très faible » signifie que les résultats risquent fort de changer à mesure que de nouvelles données probantes apparaissent.

Résultats

Synthèse de la qualité des données probantes

Ce document comprend cinq synthèses terminées, 22 études individuelles, and trois études individuelles en cours pour un total de 30 publications. La qualité des données probantes incluses dans cette revue se décrit comme suit :

Questions de recherche	Données probantes incluses		Certitude globale des données probantes
Que sait-on au sujet du risque de transmission de la COVID-19 lors d'activités musicales comme chanter ou jouer d'un instrument à vent?	Synthèses terminées	5	Faible
	Études individuelles	18	2 Élevée; 1 modérée; autres not appraised
	Études individuelles en cours	2	Non évaluée
Quelles stratégies atténuent le risque de transmission lors d'activités musicales?	Synthèses terminées Études individuelles Études individuelles en cours	5 8 2	Faible Non évaluée Non évaluée

Attention

Comme il faut rendre rapidement disponibles les nouvelles données probantes sur la COVID-19, plusieurs études émergentes n'ont pas été révisées par des pairs. Pour cette raison, nous vous conseillons la prudence quand vous utilisez et interprétez les données probantes incluses dans cette revue rapide. Nous avons fourni une synthèse de la certitude globale des données probantes afin de soutenir le processus de prise de décision. Lorsque c'est possible, nous vous recommandons de fonder vos décisions sur les données probantes de la plus haute qualité possible.

Il est important de noter que nous n'avons pas évalué la qualité méthodologique des études de modélisation mathématique. En raison de la nature hautement technique de ces études, nous recommandons vivement de consulter un expert en matière de contenu pour éclairer la prise de decision.

Question 1 : Que sait-on au sujet du risque de transmission de la COVID-19 lors d'activités musicales comme chanter ou jouer d'un instrument à vent?

Tableau 1 : Synthèses

Reference	Date Released	Description of Included Studies	Summary of Findings	Quality Rating: Synthesis	Quality Rating: Included Studies
Public Health Ontario. (2020, Nov 18). COVID-19 Transmission from Singing and Playing Wind Instruments: What We Know So Far.	Nov 18, 2020 (Search completed Oct 26, 2020)	This updated rapid review added 22 new studies to an unspecified total: • 10 experimental • 4 observational • 2 review • 6 grey literature reports	Limited evidence suggests transmission has occurred during singing (e.g., high secondary attack rates among choir members). No studies confirm transmission from playing instruments.	Low	Not reported ***NOT PEER REVIEWED***

National Collaborating Centre for Environmental Health. (2020, Sep 23). COVID-19 Risks and precautions for the performing arts.	Sep 23, 2020 (Search date not provided)	This rapid review included 21 media and literature reports of COVID-19 clusters and outbreaks associated with singing, dance, theatre, and bands.	The majority of COVID-19 clusters and outbreaks associated with music-related events are linked to large, indoor group gatherings, with close interactions over long durations. Evidence suggests that the transmission pathway is via respiratory droplets and short-range aerosols, the concentration, quantity, and size of which are increased during vocalization – especially when loud and exaggerated – compared to less intense respiratory activities. Vocalization produces fewer aerosols per event than coughing or sneezing but the total produced over time, particularly by a group, could be greater. Playing wind instruments may release more particles, at a higher velocity, than shouting, but the number is significantly lower than coughing. Drainage of breath condensate from brass instruments may pose a risk of droplet, aerosol, or fomite transmission. More research is needed to confirm and quantify these risks.	Low	Not reported ***NOT PEER REVIEWED***
Public Health Agency of Canada (2020, Jul 5). Emerging Evidence on COVID-19: COVID-19 Summary of SARS-CoV-2 Transmission and Singing/Wind Instruments.	Jul 5, 2020 (Search completed Jun 26, 2020)	This evidence brief included: • 5 experimental and simulation studies • 4 mathematical models • 5 published epidemiological investigations • 7 reports from the grey literature	Singing in indoor settings may increase the risk of COVID-19 transmission if an infected person is participating. The transmission route may be via aerosols, droplets, droplet nuclei or other small particles containing viral RNA. More research is needed to determine risk of transmission from instrument use.	Low	Range from high risk of bias and low quality (empirical evidence) to moderate/ high quality (simulation and modelling studies) ***NOT PEER REVIEWED***

National Collaborating Centre for Environmental Health. (2020, Jul 1). COVID-19 Risks and Precautions for Choirs.	Jul 1, 2020 (Search date not provided)	This rapid review included media reports and limited published evidence (study design not described).	The risks associated with singing in groups are the same as those associated with large gatherings; it is unclear to what degree loud vocalization also contributes to transmission in these settings. In one outbreak described, given the precautions followed (social distancing, hand hygiene), inhalation of respiratory aerosols in shared air over a prolonged duration is thought to have been the route of transmission. Potential routes described in other outbreaks include large respiratory droplets or surface transmission (e.g., fomites). Risk factors associated with the reported singing outbreaks included: • Crowding, close contacts • Gathering in large groups • Enclosed spaces, poor ventilation • Long duration of contact • Social interactions, greetings, backstage gatherings • Sharing food, drinks, equipment, transportation	Low	Not reported ***NOT PEER REVIEWED***
Alberta Health Services. (2020, May 22). Topic: Singing as a risk for transmission of SARS-CoV-2 virus.	May 22, 2020 (Search date not provided)	This rapid review included: • 2 epidemiological reports • 5 epidemiological studies* • 1 primary study* *3 epidemiological studies and 1 primary study analyzed other infectious diseases, not COVID-19, specifically	There is a potential risk associated with singing and COVID-19 transmission, although the evidence is limited. There have been some reports of outbreaks and "super-spreading" events associated with group singing (choir practice, places of worship). It is unclear whether the risk of transmission of COVID-19 via singing is from aerosolizing of respiratory particles, expulsion of large droplets, and/or close group social behaviours.	Low	Low (for one study; quality of other included studies not reported) ***NOT PEER REVIEWED***

Tableau 2 : Études individuelles

Reference	Date Released	Study Design	Instruments	Setting	Summary of findings	Quality Rating:
Case reports						
Charlotte, N. (2020). High rate of SARS-CoV-2 transmission due to choir practice in France at the beginning of the COVID-19 pandemic. *Journal of Voice*. Epub ahead of print.	Dec 23, 2020	Case study	Voice	Choir rehearsal n=25 adult male singers, 1 conductor, 1 accompanist	This study describes a cluster of COVID-19 infections linked to a choir rehearsal held on Mar 12, 2020 in France. There were 19 cases of COVID-19 identified among those who attended the rehearsal, with a secondary attack rate of 70%. No choristers had detectable symptoms of COVID-19 between Mar 2 and 12, Chairs were separated less than 6ft for the duration of the rehearsal, and face-to-face discussion or socialization were minimized. Choristers were not masked. The room was not ventilated. Some attendees had previously attended a separate choir's rehearsals on Mar 9 and 11. No distancing was observed at these rehearsals.	High

Miller, S. L., Nazaroff, W. W., Jimenez, J. L., Boerstra, A., Buonanno, G., Dancer, S. J., … Noakes, C. (2020). Transmission of SARS-CoV-2 by inhalation of respiratory aerosol in the Skagit Valley chorale superspreading event. *Indoor Air*. Epub ahead of print. Hamner, L., Dubbel, P., Capron, I., Ross, A., Jordan, A., Lee, J., … Leibrand, H. (2020). High SARS-CoV-2 attack rate following exposure at a choir practice - Skagit County, Washington, March 2020. *MMWR Morbidity and Mortality Weekly Report*, *69*(19), 606-610.	Sep 26, 2020 May 15, 2020	Case study	Voice	Choir rehearsal n=61 (amateur chorists; adult men and women)	This study describes a COVID-19 outbreak following a choir rehearsal held on Mar 10, 2020, in Washington, USA. (This event was described by Miller et al. and Hamner et al.) 53 attendees became ill with COVID-19 symptoms, of which 33 were confirmed cases of COVID-19 and 20 were probable cases. Three of the symptomatic people were hospitalized, and two died. The attack rate was 53.3-86.7%. One person in attendance had cold-like symptoms that began three days prior to the rehearsal. Precautions used during the rehearsal included using hand sanitizer and refraining from hugging and handshakes. Chairs were separated less than 6ft for the duration of the rehearsal. Physical distancing was not maintained. Snacks were served. The rehearsal lasted 2.5 hours. Ventilation during that time is unknown. A previous choir rehearsal was held on Mar 3; however, the odds of becoming ill after the Mar 3 rehearsal were 17.0 greater (95% CI = 5.5-52.8) for those who attended the rehearsal than those who did not, compared to the Mar 10 rehearsal, where the odds were 125.7 times greater (95% CI = 31.7-498.9) for those who attended the rehearsal.	Moderate High

Aerosol emission studies						
Abraham, A., He, R., Shao, S., Kumar, S. S., Wang, C., Guo, B., … Hong, J. (2020). Risk assessment and mitigation of airborne disease transmission in orchestral wind instrument performance. *Preprint.*	Dec 24, 2020	Aerosol emission test	Wind instruments: trumpet, trombone, bass trombone, French horn, tuba, flute, bassoon, oboe, clarinet, and bass clarinet	Concert hall	Aerosol emissions from musicians playing brass and woodwind instruments playing at three distinct volumes were measured. Correlations between aerosol emission in relation to pitch and note duration were calculated. For brass instruments, there is an inverse correlation between note duration and aerosol concentration, i.e., more aerosols are generated when notes are shorter and/or change quicker. This relationship is strongest for trumpet and weakens for larger instruments. For woodwinds, there is a possible correlation between playing notes in the upper range of the instrument and aerosol emissions for clarinet, oboe, and bass clarinet. Flute and bassoon were not tested. Overall, it was found that the radius of airflow from all instruments tested did not exceed 6ft, but the concentration of aerosols within this radius varied by instrument and music type. Limitations of this study include: • Musical phrasing and articulation not taken into account • Study is limited to 11 instruments, and emissions from other wind instruments may differ	Not appraised ***PREPRINT***

Spahn, C., Hipp, A., Schubert, B., Axt, M. R., Stratmann, M., Schmölder, C., & Richter, B. (2020). Airflow and air velocity measurements while playing wind instruments, with respect to risk assessment of a SARS-CoV-2 infection. *Preprint*.	Dec 23, 2020	Aerosol emission	Wind instruments: Trumpet, trombone, horn, tuba, alto flute, piccolo, oboe, English horn, clarinet, bass clarinet, bassoon, contrabassoon, tenor saxophone, and recorder	Concert hall	Airflow patterns released from instrument from 1m, 1.5m, and 2m were measured during different pitches and dynamics and articulations and flow was visualized. Airflow for most instruments was <0.1m/s at all distances, with measurements greater than this only recorded for tuba (0.13m/s at 1m), oboe (0.15m/s at 1m and 0.12m/s at 1.5m), and contrabassoon (0.1m/s at 1m). Pitch and volume were not observed to affect air movements. Limitations of this study: • This study measured airflow, but the potential dispersion of SARS-CoV-2 droplets remains unknown • Study was conducted with professional classical musicians, and these results may not be transferable to amateurs or other musical genres • Analysis was only measured once for each instrument; reproducibility was not explored • No analysis was done on group playing	Not appraised ***PREPRINT***
Colorado State University. (2020, Dec 2). Reducing Bioaerosol Emissions and Exposures in the Performing Arts: A Scientific Roadmap for a Safe Return from COVID19.	Dec 2, 2020	Aerosol emission	Wind instruments, voice	Laboratory	Preliminary results of dispersion of aerosols in singers while singing with and without masks and while playing instruments with and without a cover are presented. Some instruments produce more aerosols than others (trumpet and tuba produce the highest), but there is variation by performer. Masks and bell covers reduce droplet dispersion. More details will be forthcoming in this ongoing study.	Not appraised ***NOT PEER REVIEWED***

Echternach, M., Gantner, S., Peters, G., Westphalen, C., Benthaus, T., Jakubass, B., ... Kniesburges, S. (2020). Impulse dispersion of aerosols during singing and speaking: A potential COVID-19 transmission pathway. *American Journal of Respiratory and Critical Care Medicine, 202*(11), 1584-1587.	Dec 1, 2020	Aerosol emission	Professional singers	Broadcast studio	Dispersion of aerosols in professional singers while singing and speaking at two distinct levels of loudness were compared. While singing, median dispersion of aerosols was 0.86m for "loud" volumes and 0.78m for "soft" volumes. While speaking, median dispersion of aerosols was 0.82 for "loud" volumes and 0.74 for "soft" volumes. The differences were not statistically significant. Very little aerosol dispersion to either side of the study subject was noted. Limitations of this study include that only professional singers were analyzed. Furthermore, this study only explored aerosol dispersion and not risk of COVID-19 transmission.	Not appraised
Lelieveld, J., Helleis, F., Borrmann, S., Cheng, Y., Drewnick, F., Haug, G., ... Pöschl, U. (2020). Model calculations of aerosol transmission and infection risk of COVID-19 in indoor environments. *International Journal of Environmental Research and Public Health, 17*(21), 8114.	Nov 3, 2020	Modeling	Voice	Simulated office, classroom, choir practice, party	This modelling study estimates aerosol transmission of COVID-19 in several settings, including a choir practice, with various ventilation rates. Compared to other settings, choir practice was associated with highest likelihood of transmission.	Not appraised

Nusseck, M., Richter, B., Holtmeier, L., Skala, D., & Spahn, C. (2020). CO2 measurements in instrumental and vocal closed room settings as a risk reducing measure for a coronavirus infection. *Preprint*.	Oct 27, 2020	Aerosol emission	Voice, wind instruments: flute, recorder, clarinet, saxophone, oboe, brass instruments	Classroom	CO_2 concentration was used as a measure of indoor air quality. Contaminated indoor air is considered to be a factor in the transmission of COVID-19. CO_2 emissions during singing and wind instrument music lessons and associated duration of ventilation breaks were measured to determine possible duration of lessons before a critical level of 800ppm was reached, and a ventilation break would be required. Voice and wind instrument lessons were compared to a control group where participants spoke without playing an instrument. Ventilation was assessed using a CO_2 sensor. Wind instruments yielded significantly higher CO_2 emissions than the control group. Singing yielded lower CO_2 emission rates than the control group. Higher CO_2 emission rates were found in larger rooms. The duration of the lesson until the CO_2 concentration reaches the critical level of 800ppm in a $75m^3$ ranges between 25 minutes for the brass group and 36 minutes for the vocal and the control group. In a room of $100m^3$ the range of duration increases up to 35 minutes for the brass group and 53 minutes for the vocal and the control group. Ventilation (opening doors and windows) of 10 minutes was effective a reducing the CO_2 level in the room to outdoor levels, and is recommended between indoor lesson periods.	Not appraised ***PREPRINT***

Timmons Sund, L., Bhatt, N. K., Ference, E. H., Kim, W., & Johns, M. M., 3rd. (2020). Respiratory particle emission during voice assessment and therapy tasks in a single subject. *Journal of Voice*. Epub ahead of print.	Oct 22, 2020	Aerosol emission	Voice	Clinical (voice therapy room)	Respiratory particle emissions of 0.3-10µm were measured during singing and speaking exercises while wearing or not wearing a surgical mask. At short range (15cm), an unmasked person emits an average of 5.1 additional particles above baseline ambient levels. At a 1m range, there were no additional particles above baseline for a masked or unmasked person. In all conditions, there was no significant accumulation of particles. Limitations of this study include limited generalizability due to only one study subject being observed. Furthermore, this study only measured particles from 0.3-10µm, whereas human respiratory particles may range from 0.3-1000µm.	Not appraised
Moore, T. R., & Cannaday, A. E. (2020). Do "brassy" sounding musical instruments need increased safe distancing requirements to minimize the spread of COVID-19? *Journal of the Acoustical Society of America*, *148*(4), 2096.	Oct 15, 2020	Aerosol emission	Wind instruments: trumpets, trombones	Laboratory	Dispersion of particles of 15-50µm from the bells of trumpets and trombones were measured. Very little dispersion of particles was noted, with a maximum dispersion of 10cm from the bells of both instruments. Experiments were conducted in a controlled environment. It is unknown whether these results hold true in a performance setting.	Not appraised

Bahl, P., de Silva, C., Bhattacharjee, S., Stone, H., Doolan, C., Chughtai, A. A., & MacIntyre, C. R. (2020). Droplets and aerosols generated by singing and the risk of COVID-19 for choirs. *Clinical Infectious Diseases*. Epub ahead of print.	Sep 18, 2020	Aerosol emission	Voice	Not specified	Aerosol and droplet dispersion velocities during singing, speaking, and coughing was visually observed and measured. Maximum velocity of droplets expelled during singing was similar to those reported for speaking: 90% of droplets moved at velocities less than 1 m/s, and 75% of droplets moved at less than 0.5 m/s. This study did not investigate loudness, pitch, rhythm, or diction, which could impact results.	Not appraised
Mürbe, D., Kriegel, M., Lange, J., Schumann, L., Hartmann, A., & Fleischer, M. (2020). Aerosol emission of child voices during speaking, singing and shouting. *Preprint*.	Sep 18, 2020	Aerosol emission	Voice: 4 semi-professional child singers	Laboratory	Respiratory particle emissions by children of 0.3-25µm during singing, speaking, and shouting was measured. Four girls and four boys aged 13-15 years who had not undergone puberty vocal changes were tested. Emission rates for shouting were highest (683-4332 particles per second), followed by singing (141-1240 particles per second) and speaking (16-267 particles per second).	Not appraised ***PREPRINT***

He, R., Gao, L., Trifonov, M., & Hong, J. (2020). Aerosol generation from different wind instruments. *Journal of Aerosol Science, 151*, 105669.	Sep 16, 2020	Aerosol emission	Wind instruments: trumpet, bass trombone, French horn, tuba, flute, piccolo, bassoon, oboe, clarinet, and bass clarinet	n=15 professional musicians Controlled environment	Generation of aerosols of 0.5-20µm from brass and woodwind instruments being played at varying volumes and with different articulations was measured and compared to aerosol generation while breathing and speaking. Inferences on the risk of aerosol concentration for each instrument were drawn. Aerosol generation varied across instruments: tuba produced fewer aerosols than normal breathing; piccolo, flute, bass clarinet, french horn, and clarinet produced the same range of aerosols as normal breathing and speaking; and trumpet, oboe, and bass trombone generated more aerosols than speaking. Breathing produced fewer aerosols than speaking. Risk of aerosol production is found to be related to instrument size and mouthpiece design: • Brass instruments: aerosol concentration is found to be inversely correlated to tube length of the instrument. Aerosol concentration can be ranked as: trumpet > bass trombone > French horn > tuba • Woodwinds: aerosol production is inversely correlated to instrument size and is affected by mouthpiece design (i.e., air jet, single reed, and double reed instruments). Aerosol concentration can be ranked as: oboe > clarinet > bass clarinet > flute = piccolo > bassoon Aerosol generation relative to volume varied across instruments, with some exhibiting positive correlations between	Not appraised

					volume and aerosol generation (e.g., oboe, bassoon, clarinet), some exhibiting inverse correlations (e.g., flute, piccolo), and some not exhibiting a clear correlation (e.g., clarinet, trumpet, bass trombone, French horn). This study investigated instruments typically found in an orchestra. It is unknown whether these results are transferable to other wind instruments.	
Alsved, M., Matamis, A., Bohlin, R., Richter, M., Bengtsson, P. E., Fraenkel, C. J., ... Löndahl, J. (2020). Exhaled respiratory particles during singing and talking. *Aerosol Science and Technology*, *54*(11), 1245-1248.	Aug 24, 2020	Aerosol emission	Voice: 7 professional singers and five amateurs	Laboratory	Aerosol and particle emissions of 0.5-10µm during singing and talking at loud and normal volumes were measured. Singing at a normal volume produced significantly more particles than speaking at a normal volume. A trend towards more particles produced at higher pitches was noted. Professional singers produced two times more particles than amateur singers. The results are not significant. Results were measured for singing at set pitches. It is unknown how these results translate to singing songs in different musical styles.	Not appraised

Gregson, F.K.A., Watson, N. A., Orton, C. M., Haddrell, A. E., McCarthy, L. P., Finnie, T. J. R., … Reid, J. P. (2020). Comparing the respirable aerosol concentrations and particle size distributions generated by singing, speaking and breathing. *Preprint*.	Aug 20, 2020	Aerosol emission	Voice: 25 professional singers	Laboratory (operating theatre)	Aerosol and droplet concentration during breathing, coughing, speaking, singing a single note and singing a song were measured at close range (10cm). Comparisons between genders and across different singing genres (e.g., opera, theatre) were drawn. On average, singing generated a significantly higher concentration of aerosols than speaking. Singing and speaking at low volumes did not yield statistically significantly different aerosol concentrations than breathing. No significant difference in aerosol production between genders or across singing genres was found.	Not appraised ***PREPRINT***
Parker, A. S., & Crookston, K. (2020). Investigation into the release of respiratory aerosols by brass instruments and mitigation measures with respect to COVID-19. *Preprint.*	Aug 4, 2020	Aerosol emission	Brass instruments: cornet, tenor horn, baritone horn, euphonium, trombone, Eb tuba, Bb tuba Professional musicians	Laboratory	Aerosol (<5µm) and droplet (>5µm) emissions from seven brass instruments compared to normal breathing were measured. On average, fewer aerosol particles were produced while playing than while breathing. Conversely, more droplets were produced while playing than while breathing.	Not appraised ***PREPRINT***

Becher, L., Gena, A. W., & Bauhaus, C. V. (2020, Jul 23). Risk assessment of the spread of breathing air from wind instruments and singers during the COVID-19 pandemic.	Jul 23, 2020	Aerosol emission	Wind instrument: oboe, bassoon, Bb clarinet, bass clarinet, flute, piccolo, soprano recorder, Bb trumpet, tenor trombone, French horn, tuba. Voice: baritone (adult male), soprano (adult female)	Laboratory	The maximum distance of aerosol emissions from singing and playing a wind instrument was measured. Maximum distance for each instrument and singer was measured for wind instruments ranging from 20-100+cm, and singing ranging from 60-90cm. How these results differ between players or playing styles was not explored.	Not appraised ***NOT PEER REVIEWED***
Hartmann, A., Mürbe, D., Kriegel, M., Lange, J., & Fleischer, M. (2020, Jul 22). Risk assessment of rehearsal rooms for choir singing regarding aerosols loaded with virus. *Preprint.*	Jul 22, 2020	Modeling	Voice	Rehearsal room, concert hall	This modelling study estimates aerosol transmission of COVID-19 in choir practice and concert settings (with assumptions of a populated concert space) over time. Compared to an office setting, • The estimated concentration of aerosols in concert halls was lower • The estimated concentration of aerosols in a rehearsal room was higher Overall, the risk of aerosol transmission was estimated to be lower in larger, concert hall settings.	Not appraised ***PREPRINT***

Eiche, T. (2020). Studies on aerosol emissions by speaking, singing as a choir or solo, and playing wind instruments. *Preprint*.	Jun 26, 2020	Aerosol emission	Wind instruments: Bb clarinet, Eb clarinet, bass clarinet, oboe, oboe d'amore, flute, piccolo, bassoon, contrabassoon, trombone, Horn, trumpet, tuba Voice Professional musicians	Rehearsal room, theatre stage	Respiratory particle concentrations during breathing, singing, speaking, screaming, and playing wood and brass instruments were measured. Variation between people varied significantly; however, certain patterns emerged: • Less aerosols were produced while playing wind instruments than while speaking • There was very little difference in particle emissions when singing loudly compared to singing quietly • There is a positive correlation between particle concentrations and the loudness/expressiveness of speech The results of this study are limited in that the smallest particle measured was 0.25µm, whereas the SARS-CoV-2 virus is 0.1µm. Therefore, risk of COVID-19 transmission cannot be inferred from the results of this study.	Not appraised ***PREPRINT***
Brandt, L. (2020). Measurement of aerosol from brass and woodwind instruments playing 5 minutes in distances from 0.5 to 4 meter.	2020	Aerosol emission	Wind instruments: tuba, clarinet, trombone, bassoon, oboe, trumpet, horn, flute	Rehearsal room	Concentration of airborne particles of 1, 2.5 and 10µm emitted from brass and woodwind instruments at 0.5, 1, 2, 3 and 4m was measured and compared to background levels and coughing. At all distances, particle concentrations for tuba, clarinet, and trombone were similar to background concentration measures. Particle concentrations for bassoon, oboe, trumpet, horn and flute were slightly higher than background levels. In contrast, coughing yielded particle levels 70,000 times higher than background levels.	Not appraised ***NOT PEER REVIEWED***

Tableau 3 : Études individuelles en cours

Title	Anticipated Release Date	Instruments	Description of Document
Berghöfer, A. (2020). Prospective cohort study on the incidence of SARS-CoV-2-infections (COVID-19) in professional orchestra musicians and choir singers.	Not stated	Wind instruments, voice	This prospective cohort study will determine the incidence of SARS-CoV-2 infections in orchestra musicians, choir members, and non-musician controls employed in concert and opera houses.
Veeraraghavan, A., Yekovich, R., Mangum, J., Farrell, S., Raghuram, A., & Boominathan, V. (2020). Tunesflow: Studying aerosol flow spread for wind instruments and singing.	Not stated	Wind instruments, voice	This study will visualize the aerosol propagation from orchestra musicians (via woodwind and brass instruments) and opera singers using high-speed contrast imaging.

Question 2 : Quelles stratégies atténuent le risque de transmission lors d'activités musicales?

Tableau 4 : Synthèses

Reference	Date Released	Description of Included Studies	Summary of Findings	Quality Rating: Synthesis	Quality Rating: Included Studies
Public Health Ontario. (2020, Nov 18). COVID-19 Transmission from Singing and Playing Wind Instruments: What We Know So Far.	Nov 18, 2020 (Search completed Oct 26, 2020)	This updated rapid review added 22 new studies to an unspecified total: • 10 experimental • 4 observational • 2 review • 6 grey literature reports	Transmission risk may be minimized by: • Physical distancing • Mask use (when possible) • Proper hand hygiene • Avoiding sharing equipment or materials • Larger venues • Routine surface cleaning • Shortened performances • Optimal ventilation or outdoor venue It is not clear whether these strategies were proven effective in the included studies or only examples of what has been attempted.	Low	Not reported ***NOT PEER REVIEWED***

National Collaborating Centre for Environmental Health. (2020, Sep 23). COVID-19 Risks and precautions for the performing arts.	Sep 23, 2020 (Search date not provided)	This rapid review included 21 media and literature reports of COVID-19 clusters and outbreaks associated with singing, dance, theatre, and bands.	Transmission risk may be minimized by: • Screening • Forming performance or rehearsal cohorts (i.e., to limit interaction within larger companies) • Physical distancing (particularly during rehearsals, instruction, socialization, backstage preparation) • Larger venues, with multiple entrances • Reduced audience density • Shortened performances (e.g., 30-minute limits) • Mask use (however, the effectiveness of specialized "singers' masks" and face shields has not been assessed) • Optimal ventilation or outdoor venues • Proper hand hygiene • Routine cleaning and disinfection of surfaces • Avoid sharing equipment • Offsite preparation (hair, makeup) A limitation is the lack of epidemiological evidence to confirm these observations.	Low	Not reported ***NOT PEER REVIEWED***
Public Health Agency of Canada (2020, Jul 5). Emerging Evidence on COVID-19: COVID-19 Summary of SARS-CoV-2 Transmission and Singing/Wind Instruments.	Jul 5, 2020 (Search completed Jun 26, 2020)	This evidence brief included: • 5 experimental and simulation studies • 4 mathematical models • 5 published epidemiological investigations • 7 reports from the grey literature	There is no conclusive evidence of effective mitigation strategies for musicians.	Low	Range from high risk of bias and low quality (empirical evidence) to moderate/high quality (simulation and model studies) ***NOT PEER REVIEWED***

National Collaborating Centre for Environmental Health. (2020, Jul 1). COVID-19 Risks and Precautions for Choirs.	Jul 1, 2020 (Search date not provided)	This rapid review included media reports and limited published evidence (study design not described).	Transmission risk via large respiratory droplets may be minimized by: • Mask wearing • Respiratory etiquette (e.g. covering mouth when coughing or sneezing) • Physical distancing, including backstage and staggered arrangement on stage Transmission risk via respiratory aerosols may be minimized by: • Reducing crowding • Reducing duration of indoor interactions • Ensuring proper ventilation • Avoiding face-to-face singing Transmission risk via contact transmission and fomites may be minimized by: • Proper hand hygiene • Routine surface cleaning and disinfection • Avoiding sharing equipment, food, and drink Transmission risk from pre-symptomatic and asymptomatic persons may be minimized by: • Self-isolating persons who have tested positive for COVID-19 or have been exposed to known cases • Limiting number of social contacts, restricting group sizes • Physical distancing • Mask wearing	Low	Not reported ***NOT PEER REVIEWED***

Alberta Health Services. (2020, May 22). Topic: Singing as a risk for transmission of SARS-CoV-2 virus.	May 22, 2020 (Search date not provided)	This rapid review included: • 2 epidemiological reports • 5 epidemiological studies* • 1 primary study* *3 epidemiological studies and 1 primary study analyzed other infectious diseases, not COVID-19, specifically	Transmission risk may be minimized by: • Restricting singing in group settings, especially indoors • Social distancing • Proper hand hygiene before and after • Masking, when distancing not possible • Individuals with respiratory symptoms refrain from joining The authors recommend that, if public health restrictions begin to be reduced, restrictions on singing should not be lifted in the first round(s), until new evidence emerges.	Low	Low (for one study; quality of other included studies not reported) ***NOT PEER REVIEWED***

Tableau 5 : Études individuelles

Reference	Date Released	Study Design	Instruments	Setting	Summary of findings	Quality Rating:
Narayanan, S. R., & Yang, S. (2021). Airborne transmission of virus-laden aerosols inside a music classroom: Effects of portable purifiers and aerosol injection rates. *Preprint*.	Jan 3, 2021	Modeling	Brass instruments (trombone, trumpet); voice	Classroom	This modelling study estimates aerosol transmission of COVID-19 in a music class with various air purifiers, with and without mask-wearing. Singing with or without a mask produced more aerosols than playing a brass instrument. Using an air purifier reduced aerosols, with removal of 97% after a 25-minute break period.	Not appraised ***PREPRINT***
Abraham, A., He, R., Shao, S., Kumar, S. S., Wang, C., Guo, B., … Hong, J. (2020). Risk assessment and mitigation of airborne disease transmission in orchestral wind instrument performance. *Preprint.*	Dec 24, 2020	Aerosol emission	Wind instruments	Concert Hall	Researchers tested aerosol emissions from brass and woodwind instruments while using a bell cover and while using air filters to mitigate spread. For trumpet, a 3-layer cover is sufficient to reduce particle concentration to 10% of initial value. However, the 3-layer cover was “close to unplayable,” suggesting that while this type of cover is efficacious, it may not be a feasible solution. For trumpet, an air filter placed above the musician removed 90% of aerosols; comparably, an air filter placed on the floor in front of the musician only removed 3% of aerosols. Other brass and woodwind instruments not explored.	Not appraised ***PREPRINT***

Colorado State University. (2020, Dec 2). *Reducing Bioaerosol Emissions and Exposures in the Performing Arts: A Scientific Roadmap for a Safe Return from COVID19*.	Dec 2, 2020	Aerosol emission	Wind instruments, voice	Laboratory	Preliminary results of dispersion of aerosols in singers while singing with and without masks and while playing instruments with and without a cover are presented. Authors note that masks and instrument covers reduce aerosol dispersion but do not provide levels or context.	Not appraised ***NOT PEER REVIEWED***
Lelieveld, J., Helleis, F., Borrmann, S., Cheng, Y., Drewnick, F., Haug, G., ... Pöschl, U. (2020). Model calculations of aerosol transmission and infection risk of COVID-19 in indoor environments. *International Journal of Environmental Research and Public Health, 17(*21), 8114.	Nov 3, 2020	Modeling	Voice	Simulated office, classroom, choir practice, party	This modelling study estimates aerosol transmission of COVID-19 in several settings, including a choir practice, with various ventilation rates. Risk was most reduced when high-volume ventilation with a HEPA filter was used. This model did not explore the effect of mask-wearing during choir practice.	Not appraised
Nusseck, M., Richter, B., Holtmeier, L., Skala, D., & Spahn, C. (2020). CO2 measurements in instrumental and vocal closed room settings as a risk reducing measure for a coronavirus infection. *Preprint*.	Oct 27, 2020	Aerosol emission	Voice, wind instruments: flute, recorder, clarinet, saxophone, oboe, brass instruments	Classroom	CO_2 concentration was used as a measure of indoor air quality. Contaminated indoor air is considered to be a factor in the transmission of COVID-19. The duration of the lesson until the CO_2 concentration reaches the critical level of 800ppm in a 75m^3 ranges between 25 minutes for the brass group and 36 minutes for the vocal and the control group. In a room of 100m^3 the range of duration increases up to 35 minutes for the brass group and 53 minutes for the vocal and the control group. Ventilation (opening doors and windows) of 10 minutes was effective a reducing the CO_2 level in the room to outdoor levels and is recommended between indoor lesson periods.	Not appraised ***PREPRINT***

Alsved, M., Matamis, A., Bohlin, R., Richter, M., Bengtsson, P. E., Fraenkel, C. J., ... Löndahl, J. (2020). Exhaled respiratory particles during singing and talking. *Aerosol Science and Technology*, *54*(11), 1245-1248.	Aug 24, 2020	Aerosol emission	Voice: 7 professional singers and five amateurs	Laboratory	Aerosol and particle emissions of 0.5-10µm during loud singing with and without a surgical mask was measured. Singing loudly with a surgical mask reduced aerosol particles to a level similar to speaking at a normal volume.	Not appraised
Parker, A. S., & Crookston, K. (2020). Investigation into the release of respiratory aerosols by brass instruments and mitigation measures with respect to COVID-19. *Preprint.*	Aug 4, 2020	Aerosol emission	Brass instruments: cornet, tenor horn, baritone horn, euphonium, trombone, Eb tuba, Bb tuba Professional musicians	Laboratory	Aerosol (<5µm) and droplet (>5µm) emissions from seven brass instruments with and without cotton barriers over the bell were compared. Playing with a barrier reduced particle emissions compared to playing without. Aerosol production was reduced by 78.5% and droplet production was reduced by 63.8%.	Not appraised ***PREPRINT***
Eiche, T. (2020). Studies on aerosol emissions by speaking, singing as a choir or solo, and playing wind instruments. *Preprint*.	Jun 26, 2020	Aerosol emission	Wind instruments: Bb clarinet, Eb clarinet, bass clarinet, oboe, oboe d'amore, flute, piccolo, bassoon, contrabassoon, trombone, Horn, trumpet, tuba Voice Professional musicians	Rehearsal room, theatre stage	Physical distancing and room ventilation as protective measures against respiratory particle concentrations during breathing, singing, speaking, screaming, and playing wood and brass instruments were explored. Aerosols were detected at up to 4m for wind instruments and 7m for opera. However, no accumulation of particles was noted. The authors speculate that the lack of accumulation was attributed to the large size of the rooms and the continuous ventilation. The results of this study are limited in that the smallest particle measured was 0.25µm, whereas the SARS-CoV-2 virus is 0.1µm. Therefore, risk of COVID-19 transmission cannot be inferred from the results of this study.	Not appraised ***PREPRINT***

Tableau 6 : Études individuelles en cours

Title	Anticipated Release Date	Instruments	Description of Document
Sala, B. C., Codina, J. M. L., Barriga, B. R., Tabuenca, L. R., Guillermo, I. B., Ortiz, A. A., & Deiros, R. P. (2020). Risk of infection of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), COVID-19, in a massive musical show with transmission prevention measures.	Dec 22, 2020	Music event	This randomized study will test the ability of rapid screening to identify asymptomatic infection in people attending a large music event.
Veeraraghavan, A., Yekovich, R., Mangum, J., Farrell, S., Raghuram, A., & Boominathan, V. (2020). Tunesflow: Studying aerosol flow spread for wind instruments and singing.	Not stated	Wind instruments, voice	This study will visualize aerosol production from orchestra musicians (via woodwind and brass instruments) and opera singers using high-speed contrast imaging. It will make recommendations for designing safe performance spaces, based on study outcomes.

Références

Abraham, A., He, R., Shao, S., Kumar, S. S., Wang, C., Guo, B., … Hong, J. (2020). Risk assessment and mitigation of airborne disease transmission in orchestral wind instrument performance. *Preprint.*

Alberta Health Services. (2020, May 22). Topic: Singing as a risk for transmission of SARS-CoV-2 virus.

Alsved, M., Matamis, A., Bohlin, R., Richter, M., Bengtsson, P. E., Fraenkel, C. J., … Löndahl, J. (2020). Exhaled respiratory particles during singing and talking. *Aerosol Science and Technology*, *54*(11), 1245-1248.

Bahl, P., de Silva, C., Bhattacharjee, S., Stone, H., Doolan, C., Chughtai, A. A., & MacIntyre, C. R. (2020). Droplets and aerosols generated by singing and the risk of COVID-19 for choirs. *Clinical Infectious Diseases*. Epub ahead of print.

Becher, L., Gena, A. W., & Bauhaus, C. V. (2020, July 23). Risk assessment of the spread of breathing air from wind instruments and singers during the COVID-19 pandemic.

Berghöfer, A. (2020). Prospective cohort study on the incidence of SARS-CoV-2-infections (COVID-19) in professional orchestra musicians and choir singers.

Brandt, L. (2020). Measurement of aerosol from brass and woodwind instruments playing 5 minutes in distances from 0.5 to 4 meter.

Charlotte, N. (2020). High rate of SARS-CoV-2 transmission due to choir practice in France at the beginning of the COVID-19 pandemic. *Journal of Voice*. Epub ahead of print.

Colorado State University. (2020, December 2). Reducing Bioaerosol Emissions and Exposures in the Performing Arts: A Scientific Roadmap for a Safe Return from COVID19.

Echternach, M., Gantner, S., Peters, G., Westphalen, C., Benthaus, T., Jakubass, B., … Kniesburges, S. (2020). Impulse dispersion of aerosols during singing and speaking: A potential COVID-19 transmission pathway. *American Journal of Respiratory and Critical Care Medicine, 202*(11), 1584-1587.

Eiche, T. (2020). Studies on aerosol emissions by speaking, singing as a choir or solo, and playing wind instruments. *Preprint*.

Gregson, F.K.A., Watson, N. A., Orton, C. M., Haddrell, A. E., McCarthy, L. P., Finnie, T. J. R., … Reid, J. P. (2020). Comparing the respirable aerosol concentrations and particle size distributions generated by singing, speaking and breathing. *Preprint*.

Hamner, L., Dubbel, P., Capron, I., Ross, A., Jordan, A., Lee, J., … Leibrand, H. (2020). High SARS-CoV-2 attack rate following exposure at a choir practice - Skagit County, Washington, March 2020. *MMWR Morbidity and Mortality Weekly Report*, *69*(19), 606-610.

Hartmann, A., Mürbe, D., Kriegel, M., Lange, J., & Fleischer, M. (2020, July 22). Risk assessment of rehearsal rooms for choir singing regarding aerosols loaded with virus. *Preprint.*

He, R., Gao, L., Trifonov, M., & Hong, J. (2020). Aerosol generation from different wind instruments. *Journal of Aerosol Science, 151*, 105669.

Lelieveld, J., Helleis, F., Borrmann, S., Cheng, Y., Drewnick, F., Haug, G., … Pöschl, U. (2020). Model calculations of aerosol transmission and infection risk of COVID-19 in indoor environments. *International Journal of Environmental Research and Public Health, 17*(21), 8114.

Miller, S. L., Nazaroff, W. W., Jimenez, J. L., Boerstra, A., Buonanno, G., Dancer, S. J., … Noakes, C. (2020). Transmission of SARS-CoV-2 by inhalation of respiratory aerosol in the Skagit Valley chorale superspreading event. *Indoor Air*. Epub ahead of print.

Moore, T. R., & Cannaday, A. E. (2020). Do "brassy" sounding musical instruments need increased safe distancing requirements to minimize the spread of COVID-19? *Journal of the Acoustical Society of America*, *148*(4), 2096.

Mürbe, D., Kriegel, M., Lange, J., Schumann, L., Hartmann, A., & Fleischer, M. (2020). Aerosol emission of child voices during speaking, singing and shouting. *Preprint*.

Narayanan, S. R., & Yang, S. (2021). Airborne transmission of virus-laden aerosols inside a music classroom: Effects of portable purifiers and aerosol injection rates. *Preprint*.

National Collaborating Centre for Environmental Health. (2020, July 1). COVID-19 Risks and Precautions for Choirs.

National Collaborating Centre for Environmental Health. (2020, September 23). COVID-19 Risks and precautions for the performing arts.

Nusseck, M., Richter, B., Holtmeier, L., Skala, D., & Spahn, C. (2020). CO2 measurements in instrumental and vocal closed room settings as a risk reducing measure for a coronavirus infection. *Preprint*.

Parker, A. S., & Crookston, K. (2020). Investigation into the release of respiratory aerosols by brass instruments and mitigation measures with respect to COVID-19. *Preprint.*

Public Health Agency of Canada (2020, July 5). Emerging Evidence on COVID-19: COVID-19 Summary of SARS-CoV-2 Transmission and Singing/Wind Instruments.

Public Health Ontario. (2020, November 18). COVID-19 Transmission from Singing and Playing Wind Instruments: What We Know So Far.

Sala, B. C., Codina, J. M. L., Barriga, B. R., Tabuenca, L. R., Guillermo, I. B., Ortiz, A. A., & Deiros, R. P. (2020). Risk of infection of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), COVID-19, in a massive musical show with transmission prevention measures.

Schünemann, H., Brożek, J., Guyatt, G., & Oxman, A. (2013). Handbook for grading the quality of evidence and the strength of recommendations using the GRADE approach.

Spahn, C., Hipp, A., Schubert, B., Axt, M. R., Stratmann, M., Schmölder, C., & Richter, B. (2020). Airflow and air velocity measurements while playing wind instruments, with respect to risk assessment of a SARS-CoV-2 infection. *Preprint*.

Timmons Sund, L., Bhatt, N. K., Ference, E. H., Kim, W., & Johns, M. M., 3rd. (2020). Respiratory particle emission during voice assessment and therapy tasks in a single subject. *Journal of Voice*. Epub ahead of print.

Veeraraghavan, A., Yekovich, R., Mangum, J., Farrell, S., Raghuram, A., & Boominathan, V. (2020). Tunesflow: Studying aerosol flow spread for wind instruments and singing.