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High Rate of SARS-CoV-2 Transmission Due to Choir Practice in France at the Beginning of the COVID-19 Pandemic

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Summary: Objective. To document the case of a high transmission rate of SARS-CoV-2 generating a cluster linked to an indoor choir rehearsal held at the beginning of the COVID-19 pandemic in France.

Method. Case study. Data were obtained via a questionnaire.

Results. Twenty-seven participants, including 25 singers, 1 conductor and 1 accompanist attended a choir practice on March 12, 2020. The practice was indoor and took place in a non ventilated space of 45 m². No choir member reported having been symptomatic for COVID-19 between March 2 and March 12. The mean age of the participants was 66.9 (range 35–86) years. The secondary attack rate was 70%; 19/27 participants were diagnosed with COVID-19 from 1 to 12 days after the rehearsal with a median of 5.1 days. Thirty-six percent of the cases needed a hospitalization (7/19), and 21% (4/19) were admitted to an ICU. The index cases were asymptomatic and possibly multiple.

Conclusion. In the absence of valid barrier measures to prevent COVID-19 transmission, indoor choir practice should be suspended during the SARS-CoV-2 surging phases. Transmission of the virus among gatherings from asymptomatic cases is a crucial issue and a main challenge to COVID-19 control.

Key Words: COVID-19—Infectious disease transmission—Cluster—Indoor choir practice—Act of singing—Asymptomatic infection carrier.

INTRODUCTION

World Health Organization declared the COVID-19 outbreak a pandemic on March 11, 2020.¹ In response, all countries have implemented large scale public health and social measures at variable levels in an attempt to reduce the transmission of SARS-CoV-2 and minimize the impact of the epidemic. Some social activities as fitness practice,² night-clubbing,³ Zumba practice,² or working in open space offices⁴ have been described as super spreader events for COVID-19. Approximately 4.5% of the European population actively participated in collective singing activities.⁵ Few scientific publications have dealt with the individual risk of acquiring COVID-19 related to choral practice. We here report the case of a high transmission rate of SARS-CoV-2 linked to an indoor choir rehearsal in France at the beginning of the 2020 pandemic.

MATERIALS AND METHODS – CASE STUDY

The data were obtained from the participants via the collection of anonymous responses to a questionnaire. The participants were the persons who attended the choir practice, ie, the choristers the conductor and the accompanist. The rehearsal took place on March 12, 2020. It was a male choir practice. The content of the questionnaire is presented in [Table 1](#) and the analysis of the data is detailed in paragraph 3. The response rate to the questionnaire was 100%. The COVID-19 diagnoses were established by the general practitioners of the attendees or by hospital physicians for those who were hospitalized for life-threatening COVID-19.

Patient and public involvement: the president of the choir collected the questionnaires filled by the participants. The president and the conductor of the choir were interviewed by telephone. The president of a second choir designated by choir number 2 was also interviewed by telephone. The interviews were conducted by the author.

Description of the interview with the president of the choir

The main interview was conducted on May 9, 2020 and 3 telephone conversations were held between that date and June 20, 2020 to finalize the analysis of the results. The president agreed to the publication of this study and confirmed that the data and information presented in the “Results” paragraph were accurate. He drew up the diagram representing the arrangement of the choristers in the rehearsal hall on March 12. He confirmed that none of the choristers had any detectable infectious symptoms and that all seemed to be in good health. No choristers reported to him the presence of respiratory symptoms before or during the rehearsal. Some choristers who were wary of the possibility of contracting COVID-19 during the March 12 practice cancelled their participation in the rehearsal, and one chorister deliberately separated as much as possible from the other singers as a precautionary measure. Chairs were arranged further apart than usual. The president reported that the rehearsal was done in one go and the participants left the room quickly at the end of the session. The president did not witness any indoor side-by-side or prolonged face-to-face discussions and reported that socialization was minimal during the practice.

Description of the interview with the choir conductor

The interview was performed on May 9, 2020. The conductor has given his agreement to the publication of this study. He stated that he himself had presented COVID-19 in the

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TABLE 1.
Content of the questionnaire

Questions	Values
Category: Tenor, Bass, Conductor, Accompanist	T, B, C, A
Birth year	Number
Diagnosis of COVID after March 12, 2020	Yes/No
Date of the beginning of the COVID symptoms	Date d/m/y
Prescription of a RT-PCR SARS CoV-2 test by a physician	Yes/No
RT-PCR SARS CoV-2 test performed	Yes/No
Severe presentation of COVID-19 requiring hospitalization	Yes/No
Date of healing (approximate)	Date d/m/y or unhealed
Date of death	Date d/m/y
Number of secondary COVID-19 cases between March 12 and March 26	Number
Close contact with a person with COVID symptoms between March 5 and March 12	Yes/No/Unknown

period following the rehearsal held on March 12. He reported the appearance of sore throat, headache, and 37.8° C temperature on March 15. Loss of smell happened on March 20, with a marked fatigue persisting for at least 10 days. The conductor provided the dimensions of the rehearsal hall which he had measured himself. He confirmed the statements of the president quoted in the previous paragraph as well as the general data presented in the “Results” paragraph of the article. The conductor mentioned that he has been told of secondary cases of COVID-19 among the wives of the male ill choristers. During the same period, no cases have been reported in the female choir desks the last rehearsal of which had been held without the male desks on March 4. The conductor indicated that one of the choristers present at the rehearsal on March 12 had also participated in 2 rehearsals on March 9 and March 11 with the members of choir number 2.

Description of the interview with the president of choir number 2

This interview was conducted on May 9, 2020. Choir number 2 is a mixed choir. The president reported that a 2-hour rehearsal in a 40 m² room was held on March 9 (with 28 participants) and March 11 (with 30–35 participants including those who attended the session on March 9). No distancing measures were observed. On March 9, 2 male choristers were presenting a cough and one had a particularly altered face. The latter chorister did not attend the following rehearsal on March 11 due to a state of fever that was diagnosed on March 10. From March 14 onwards, several

choristers declared themselves ill one after the other. The president mentioned that COVID-19 was diagnosed by a general practitioner in about two thirds of the choristers at the end of March. Four attendees were hospitalized for severe COVID-19. No death occurred. Secondary cases were reported in household members of ill choristers (notably the sister and mother of one chorister). The president of choir number 2 agreed for a publication of these data.

RESULTS

There were 27 participants at the March 12 rehearsal: 25 singers, the accompanist and the conductor. The mean age of the attendees was 66.9 (range 35–86) years. The singers were split into 2 groups of 11 tenors and 14 basses. The mean age of the tenors was 66.9 (range 35–86) years. The mean age of the basses was 69.1 (range 48–84) years. The duration of the choir practice was 2 hours. The practice took place inside a 45 m² and 3 m high room (mean surface available per person of 1.6 m²). The room was not ventilated. The participants were not masked. The choir members were sitting less close to one another than usual, but at a distance of less than 6 feet. Socialization acts were avoided during the practice (no shaking hands, no food sharing and no pauses). The male choir has had a previous rehearsal on March 2. No choir member reported having been symptomatic for COVID-19 (ie, respiratory symptoms or fever) between March 2 and 12. The conductor was standing in front of the choir, the accompanist was near the tenors. [Figure 1](#) shows the position of the attendees in the practice room.

Nineteen COVID-19 cases were identified among the members of the ensemble. [Figure 2](#) provides the incidence of secondary COVID cases among the choir attendees from March 13 to 24, 2020. A confirmed case was defined as an individual who has tested positive for SARS-CoV-2 by RT-PCR test performed on a nasopharyngeal sample and/or a case presenting a severe COVID-19 requiring hospitalization. A probable case was defined as a person presenting an acute respiratory illness relating to COVID-19 by a general practitioner 1–14 days following the rehearsal without having been evaluated with an RT-PCR test. Seven confirmed cases and 12 probable cases were identified. The dates of onset of symptoms among the cases ranged from March 13 to March 22 ie, 1–10 days after the practice (median = 5 days, range 1–13 days). The secondary attack rate (SAR) was 33% among the confirmed cases and the overall attack rate was 70%. The SAR was 72% (8/11) among the tenors, of 64% (9/14) among the basses, and of 100% (2/2) among the nonchoristers (conductor and accompanist) who were standing in front of the singers.

The mean age of the individuals who developed a severe COVID-19 defined by the need for a hospitalization, was 70.5 years (range 53–78). Seven of the 19 persons who became ill were hospitalized (36%), whose 57% (4/7) were treated in an intensive care unit, which represents 21% (4/19) of all patients. The mean age of those who developed

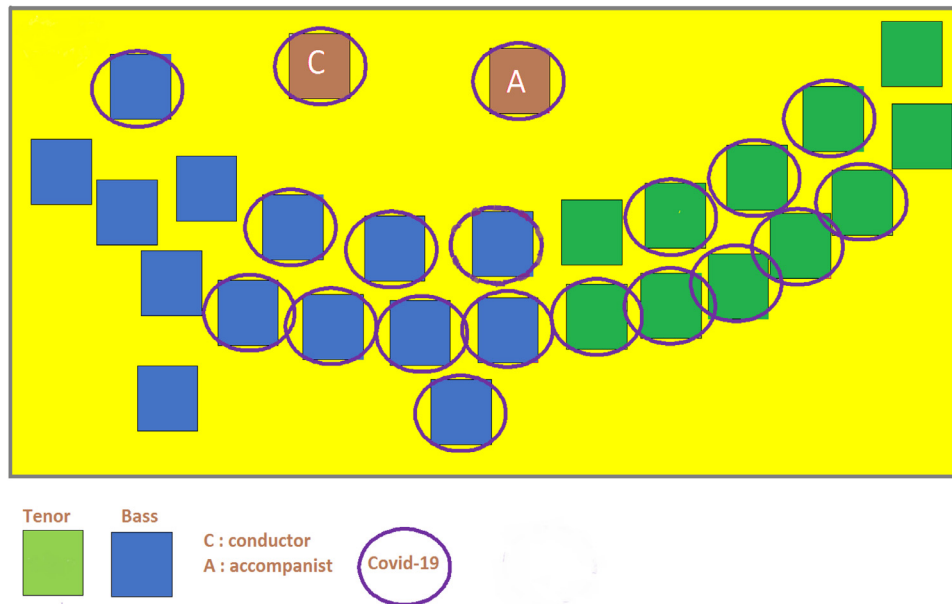


FIGURE 1. Sketch showing the position of the attendees in the practice room on March 12, 2020.

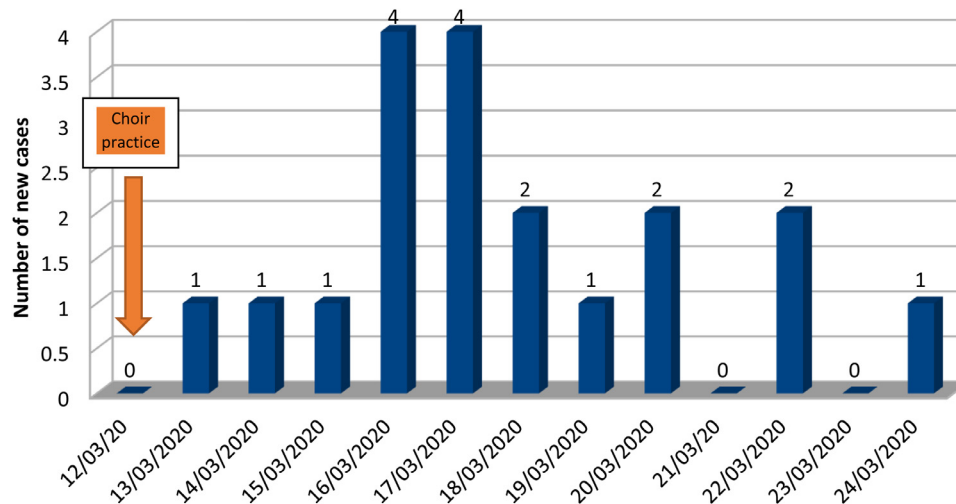


FIGURE 2. Incidence of secondary COVID-19 cases among the choir attendees.

a mild COVID-19 (64%) was 60.9 years, (range 35–77). The fatality rate was 0%. Thirteen tertiary cases were later reported, mostly household contacts.

The index cases were possibly multiple. Of 2 attendees who had a close contact with a COVID-19 case within 7 days before the practice, 1 developed COVID-19 symptoms 4 days after the rehearsal on March 16. The other attendee was the chorister who has had close contacts with the members of choir number 2 during 2 practices on March 9 and March 11 as mentioned in paragraph 2. He tested positive for COVID-19 on March 19.

DISCUSSION

From end February to end March 2020, SARS-CoV-2 was actively circulating in Europe. Several clusters of COVID-19 cases linked to choir practice were reported by the general

media. In Whir au Val (Haut-Rhin, France), following a rehearsal of the Chorale de Saint Martin on February 28 with 20 choristers, 69 secondary cases were later identified and 9 persons died.⁶ The Amsterdam Gemengd Koor (130 choristers) gave a 3-hour concert on March 8 at the Concertgebouw of Amsterdam (The Netherlands). The occurrence of 102 secondary COVID-19 cases was reported, including 4 fatal cases.⁷ In Germany, within 2 weeks after gathering for a rehearsal on March 9, 30 members of the Berlin Cathedral Choir's 80 singers tested positive for COVID-19, and a further 30 reported COVID-19 symptoms.⁸

In the USA, the Skagit County Public Health Department (Washington) investigated a cluster of 53 persons among 61 choristers who had attended a choir practice on March 10. Two of them died of COVID-19.⁹

In France, the number of new cases of COVID-19 began to grow exponentially in March. In the absence of effective

treatment for the disease, efforts to control COVID-19 pandemic have relied on personal preventive actions, physical distancing, stay-at-home orders, school closures, and workplace restrictions adopted at the national level. On March 9, the gathering of more than 1000 people was forbidden. On March 12, the closure of all schools and universities was ordered. On March 13, those restrictions were extended to the gathering of more than 100 people. The stay-at-home order was effective on March 17 after more than a thousand new confirmed cases were reported within 24 hours.¹⁰ On the date the rehearsal took place, people in France were not yet familiar with the barrier measures.

The incubation period of SARS-CoV-2 is known to be 1–14 days with a median of 5.1 days.¹¹ The March 12 practice is the likely point-source exposure event because the surge of COVID-19 cases occurred 5 days later. The individual whose onset of symptoms was March 13 (within 24 hours after the practice), might have been a pre-symptomatic carrier of SARS-CoV-2 at the time of the rehearsal, which could explain the shortness of the delay between the date of the event and the onset of the illness.¹² All the choristers were asymptomatic at the time of the practice. A recent publication about a cohort that included 303 patients with SARS-CoV-2 infection in South Korea, showed that the cycle threshold values of SARS-CoV-2 RT-PCR of asymptomatic patients (36%) and symptomatic patients are similar.¹³ The hypothesis that the transmission of SARS-CoV-2 by asymptomatic or presymptomatic carriers is significantly increasing the spread of the virus has been supported by several authors,^{12,14,15} and justifies for that matter the development of mass COVID-19 screening by PCR testing. We presume that the 3 attendees who declared having had close contact with a COVID-19 case within 7 days before the event may have been the index cases jointly exposing their fellow attendees to a probable high cumulative viral load by vocalizing during the 2-hour practice.

The basic reproduction number of SARS-CoV-2 is approximately of 2.2–2.5.¹⁶ The estimated SAR within households is 10%–37%, with a much smaller SAR among close contacts made outside households (0%–5%).^{17,18} In comparison, we found a much higher SAR which shows that SARS-CoV-2 has had the potential to spread widely during the choir rehearsal under its peculiar environmental and circumstances: indoor setting, narrow and non ventilated space, shortened interindividual distances. A study published in March shows that the transmission of SARS-CoV-2 is likely at much higher risk in enclosed spaces than outside.¹⁹ In addition, some other high human density environments like workplaces have been reported as important risk sites for the spread of SARS-CoV-2 and potential sources of further transmission.⁴ For that reason, at the ongoing reopening phase of the pandemic, for people working in the same room, a minimum surface area of 4 m² available per person was recommended by the French Work Ministry.²⁰

SARS-CoV-2 is transmitted between people by infectious droplets emitted in close proximity to the nose, mouth or eyes of a susceptible person.²¹ A study published in June

emphasizes the role of airborne transmission for the spread of the virus. Inhaled droplets and fine aerosol particles are conventionally delineated at a size of 5 μm to characterize their distinct dispersion efficiencies and residence times in air as well as the deposition patterns along the human respiratory tract. Droplets are deposited in the upper regions of the respiratory tract, from which they may be removed in nasal secretions or carried upward by the muco-ciliary escalator, to be expelled or swallowed. In contrast, inhaled aerosolized particles can penetrate to the depths of the lungs, where they may be deposited in the alveoli.²² Smaller droplets are able to be propelled further than 3–6 feet and to remain airborne longer after certain respiratory emissions,^{23,24} particularly in poorly ventilated spaces.²⁵ Singing might have contributed to enhance SARS-CoV-2 person-to-person transmission through emission of droplets and aerosolization in a closed space with a relative high number of individuals. World Health Organization acknowledged in July that transmission of the virus by aerosols may have been responsible for reported outbreaks of COVID-19 in some closed settings, such as places of worship or places of work where people may be shouting, talking, or singing.²⁶ Furthermore, despite avoiding social relations during the practice, it might have been occasions of facilitating the transmission of the virus like speaking face to face with one another shortly but recurrently.

This investigation has a number of limitations. The choristers (except the president) were not interviewed by the author. The clinical features of the COVID-19 presentation of the cases except for the conductor were not available, prohibiting a detailed description of the symptoms. The index case-patients were not identified. A majority of cases were not tested for SARS-CoV-2, which might have led to underascertainment of infections, particularly for those who were pre-symptomatic or asymptomatic. At mid-March 2020, France was at the third stage of the epidemic because the SARS-CoV-2 was aggressively circulating countrywide. Testing patients reporting mild symptoms wasn't recommended in this context by the French High Council for Public Health (Haut Conseil de la Santé Publique, HCSP) that prioritized the access to diagnostic tests for patients at risk of severe forms of Covid-19 and for healthcare workers.²⁷

CONCLUSION

At the end of winter 2020 in Europe, when the barrier measures were not yet well-defined and applied, indoor choir practices could potentially create super-spreading COVID-19 events. The characteristics of the viral transmission via close human contacts was probably enhanced by the act of singing, at a phase of intense circulation of SARS-CoV-2 in the population at this period. We report in our study the role of asymptomatic infection carriers initiating a silent chain of transmission of the coronavirus, leading to a cluster under the circumstances of the rehearsal. This study confirms that the transmission of the virus from asymptomatic cases is very efficient. This type of transmission is a crucial

issue and a main challenge to infection control. For safety purposes, indoor choir practice should be suspended during SARS-CoV-2 surging phases. As the benefits of barrier measures and social distancing are known to be effective in several countries in terms of reduction in the incidence of COVID-19, the question of the resuming of choir practice in safe conditions is being raised. Experts' recommendations²⁸ that have been recently set out to provide operational guidelines to choir singers will need to evolve over time depending on the evolution of the COVID-19 pandemic.

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COMPETING INTERESTS

The author has declared no competing interest.

ETHICAL INFORMATION

The author confirms all relevant ethical guidelines have been followed. The frame of the study was discussed with an Institutional Review Board (DRCI) which is ISO 9001:2015 certified for promotion, vigilance, financial and legal management of Hospices Civils de Lyon (France) studies. The DRCI confirmed that this study as a Category 3 Human Research Project (HRPIN 3), does not require under current French law the advice of an ethics committee.

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