

## COVID-19: what churches should know about transmission during singing

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**Purpose:** Bishop Bonnie Perry tasked me with summarizing the latest scientific information about how COVID-19 is spread, how well it spreads during singing, and if masks or social distancing could mitigate the spread.

**Core message:** Asymptomatic spread of COVID-19 occurs, and it is possible (although heavily debated) that the virus can be transmitted through aerosols – small particles that can penetrate masks and remain in the air for a period of time. Singing probably increases the chance that aerosolization occurs. Churches/singing have been the source of outbreaks in Asia and in the US, but there is limited specific data on how far infectious particles could spread and if masks would limit this.

**Recommendation:** Limit singing in public gatherings, even with the use of masks and social distancing, until more robust data shows that singing does not result in airborne transmission of disease.

### **Details:**

Note that the CDC has already released interim guidance for faith-based organizations.<sup>1</sup>

Testing: Testing still remains limited. Several tests are available on the market,<sup>2</sup> but fall into two categories. One looks at the presence of viral RNA (genetic material) within a patient (these are called “PCR tests” (polymerase chain reactions). Patients have to have their nose (nasopharyngeal cavity) swabbed, and then laboratory technicians run the PCR to discover if the sample contains any viral genetic material. The second type of test looks at antibodies. For this test, patients have their blood collected, so it is sometimes referred to as a “serology” test. The PCR test requires more specialized equipment than the antibody test, and so there are more delays getting results because it has to be shipped to a more central laboratory. The antibody test may not be very accurate, however, and there could be a lot of false positives. However, even for the PCR test there can be false positives – particularly for patients who are recovering. The PCR test can detect partial RNA fragments from virus, which is basically \*dead\* and does not signify an active case of disease, but just a previous viral infection. For both tests, there may be delays in getting a positive result, even after an individual is infected. This is because it takes a while (several days) for the virus to replicate enough within an individual body before it can be detected, and it takes even longer (~1 week) for the body to mount an immune response (which is what the antibody test measures).

There is a third type of test (which looks for antigens, that is chemicals on the virus surface), but none are currently available.

Note that a positive antibody test does *not* mean that an individual is protected against future infection. At this point, we do not know how long immunity lasts for COVID-19, and we do not

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<sup>1</sup> CDC. 2020. <https://www.cdc.gov/coronavirus/2019-ncov/community/organizations/guidance-community-faith-organizations.html>

<sup>2</sup> Stephanie Pappas. LiveScience. March 31, 2020. <https://www.livescience.com/coronavirus-tests-available.html>

know if every infection results in a strong enough immune response to prevent future infection. A study of another strain of coronavirus ~30 years ago found that immunity for most individuals did not last longer than 1 year.<sup>3</sup>

Current epidemiological situation: Worldwide, there have been over 3.2 million confirmed cases, one-third of which (over 1 million) have occurred in the US.<sup>4</sup> Within the US, Michigan has been particularly hard hit, with over 40,000 confirmed cases and 3,670 deaths.<sup>5</sup> Wayne county, home to Detroit, has had 1,727 deaths, the fourth highest of any county in the US.<sup>6</sup> The current situation in Michigan shows a plateauing of cases and deaths. Tracking the number of deaths gives a clearer picture of trends than confirmed cases, because the number of cases confirmed depends on the availability of testing, whereas we assume most people who have died from COVID-19 have been caught by surveillance systems and vital records. The number of deaths in Michigan has fluctuated between 70 and 240 for the last three weeks.<sup>7</sup>

It is important to note that the true number of infected individuals is probably much larger than the number of reported cases. New York state, for instance, has reported ~300,000 cases,<sup>8</sup> however a survey of the general population found that 13.9% had antibodies to COVID-19 (~2.7 million people).<sup>9</sup> If the mortality rate and transmission patterns are similar between New York and Michigan (not necessarily true), then that could mean that Michigan has actually had over 400,000 individuals infected (around 4.2% of the population).

Future scenarios: The current political goals have been to somewhat limit interactions (but not completely) and to slow the spread until a vaccine is developed. For COVID-19 to be stopped we either need to snuff it out by limiting all interactions among people, or we need to make enough of the population immune that the disease cannot sufficiently spread. Immunity can be gained through a natural infection or a vaccine. Given the infectiousness of COVID-19,<sup>10</sup> we will need somewhere between 50% and 85% of the population immune to stop the spread of disease.<sup>11</sup> This means 50%-85% of the population needs to be infected (a number we are not even remotely close to) or vaccinated (although the proportion who need to be vaccinated will

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<sup>3</sup> Note this was a very small study (only 10 people tested). Callow et al. 1990. Epidemiol Infect. <https://pubmed.ncbi.nlm.nih.gov/2170159/>

<sup>4</sup> Johns Hopkins Coronavirus Resource Center. April 30, 2020. <https://coronavirus.jhu.edu/map.html>

<sup>5</sup> NPR. Tracking the Pandemic. April 30, 2020. <https://www.npr.org/sections/health-shots/2020/03/16/816707182/map-tracking-the-spread-of-the-coronavirus-in-the-u-s>

<sup>6</sup> Johns Hopkins Coronavirus Resource Center. April 30, 2020. <https://coronavirus.jhu.edu/us-map>

<sup>7</sup> Institute for Health Metrics and Evaluation. April 30, 2020. <https://covid19.healthdata.org/united-states-of-america/michigan>

<sup>8</sup> NPR. Tracking the Pandemic. April 30, 2020. <https://www.npr.org/sections/health-shots/2020/03/16/816707182/map-tracking-the-spread-of-the-coronavirus-in-the-u-s>

<sup>9</sup> LaVit, Brown, Clukey. Bloomberg. April 23, 2020. <https://www.bloomberg.com/news/articles/2020-04-23/new-york-finds-virus-marker-in-13-9-suggesting-wide-spread>

Slightly different numbers (14.9%) reported later by governor's office.

<https://www.governor.ny.gov/news/amid-ongoing-covid-19-pandemic-governor-cuomo-announces-phase-ii-results-antibody-testing-study>

<sup>10</sup> The basic reproductive number has had wide estimates: 2.2 to 5.7 across different scenarios according to Sanche et al. Emerging Infectious Diseases. 2020. [https://wwwnc.cdc.gov/eid/article/26/7/20-0282\\_article](https://wwwnc.cdc.gov/eid/article/26/7/20-0282_article)

<sup>11</sup> Equation for herd immunity threshold from Fine et al. Clinical Infectious Diseases. 2011. <https://www.ncbi.nlm.nih.gov/pubmed/21427399>

likely need to be even greater than these percentages because the vaccine won't be 100% effective).

How is COVID-19 spread: There is a huge debate in scientific circles on whether COVID-19 has airborne or just droplet spread.<sup>12</sup> Droplet spread means the virus is spread in close contacts as large-ish droplets from an individual are exhaled, coughed, sneezed within a <6 foot radius. Individuals in that area can either directly be exposed to the droplets, or can touch surfaces ("fomites" in epidemiological lingo) and then later touch their face and become infected. It may be possible to spread virus just through talking, which can release droplets.<sup>13</sup>

Airborne spread would mean that the virus could be aerosolized (able to be suspended in air for a long period of time). In this way, it could be propelled further than 6 feet from someone who is infected (sneezed particles can be propelled 8 meters), and it could stay in the air for a period of time, such that someone walking into that area could breathe in viral particles and become infected.

A commentary in the journal *Science* suggests that the virus can be transmitted through an airborne method.<sup>14</sup> They reached this conclusion after reviewing experimental evidence from physicists, and testing surfaces within health care facilities. Moreover, we know that the virus can be transmitted from individuals who are asymptomatic or who are presymptomatic (meaning that they can transmit before having any symptoms).<sup>15</sup> For the large numbers of individuals who have been infected (shown in the antibody study from New York), it is likely that many were infected from individuals who hadn't shown any symptoms at the time of exposure. However, others have disagreed and said that an airborne virus would have resulted in more cases in China.<sup>16</sup>

Singing: Choirs and churches have been sources of COVID-19 outbreaks. In Washington state, one choir practice of 60 individuals, resulted in 45 becoming infected and 2 dying.<sup>17</sup> In South Korea, one church-goer infected at least 37 other parishioners.<sup>18</sup> At a funeral (for someone who did not die of COVID-19), one person was infected and had only mild symptoms, but infected 4 others, one of whom died.<sup>19</sup> There is a particular concern that churches can be a source of "superspreading" – in that a large number of individuals would be infected by one person, more than would be expected given averages.<sup>20</sup> It is unknown what factors can potentiate the

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<sup>12</sup> Lewis. 2020. [https://www.seme.org/site/docs/covid-19/Lewis\\_090420\\_Coronav\\_airborne\\_No\\_experts\\_agree.pdf](https://www.seme.org/site/docs/covid-19/Lewis_090420_Coronav_airborne_No_experts_agree.pdf)

<sup>13</sup> preprint (not yet peer reviewed): Anfinrud et al. 2020. <https://www.medrxiv.org/content/10.1101/2020.04.02.20051177v1.full.pdf>

<sup>14</sup> Service. 2020. *Science*. <https://doi.org/10.1126/science.368.6487.119>

<sup>15</sup> Gandhi et al. 2020. *NEJM*. <https://www.nejm.org/doi/full/10.1056/NEJMe2009758>

Wei et al. 2020. *MMWR*. [https://www.cdc.gov/mmwr/volumes/69/wr/mm6914e1.htm?s\\_cid=mm6914e1\\_w](https://www.cdc.gov/mmwr/volumes/69/wr/mm6914e1.htm?s_cid=mm6914e1_w)

<sup>16</sup> quote from Dr. Rutherford in MacBride. 2020. *DailyBeast*. <https://www.thedailybeast.com/your-mask-may-not-be-enough-if-covid-19-is-in-the-air>

<sup>17</sup> Read. 2020. *LA Times*. <https://www.latimes.com/world-nation/story/2020-03-29/coronavirus-choir-outbreak>

<sup>18</sup> Lanese. 2020. *LiveScience*. <https://www.livescience.com/coronavirus-superspreader-south-korea-church.html>

<sup>19</sup> Ghinai et al. 2020. *MMWR*. <https://www.cdc.gov/mmwr/volumes/69/wr/mm6915e1.htm>

<sup>20</sup> Frieden, Lee. 2020. *Emerging Infectious Diseases*. [https://wwwnc.cdc.gov/eid/article/26/6/20-0495\\_article](https://wwwnc.cdc.gov/eid/article/26/6/20-0495_article)

superspreading of COVID-19, it's possible that asymptomatic (or presymptomatic) individuals could be superspreaders.

I have not identified singing as a risk factor in many studies. One study from China showed a cluster of cases, in which the index case was singing.<sup>21</sup> A study in Hong Kong found cases related to individuals who had been singing, but they also were not wearing masks.<sup>22</sup>

A larger question is how *far* could an individual propel coronavirus while singing. An experimental study of aerosols showed that aerosolized particles could travel 7-8 meters (23-27 feet)<sup>23</sup>; the researcher doesn't mention what the infected individual would be doing to propel the virus this far – likely this is more of a distance related to sneezing than singing. Yet, a recent article in *Lancet Infectious Diseases* writes this<sup>24</sup>:

*Churches host prolonged repeated activities, during which close contact occurs, thus providing the opportunity for disease spread through droplets or fomites. Singing (a common practice in churches) can generate droplets in a similar quantity to coughing. Repeated social interactions of church groups has also facilitated discovery of transmission, compared with other settings in which people might not know each other.*

**Masks:** Currently there is an advisory for citizens to wear cloth masks in public places. Although these masks could be relatively efficient in preventing an infected individual from expelling droplets, they are less effective for aerosolized particles. One study found that 40%-90% of aerosolized particles are able to penetrate cloth masks.<sup>25</sup>

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<sup>21</sup> preprint (not yet peer reviewed): Liu et al. 2020. <https://europepmc.org/article/ppr/ppr122544>

<sup>22</sup> Cheng et al. 2020. Journal of Infection. <https://doi.org/10.1016/j.jinf.2020.04.024>

<sup>23</sup> Bourouiba. 2020. JAMA Insights.

<https://jamanetwork.com/journals/jama/fullarticle/2763852?applied=scweb>

<sup>24</sup> Yong et al. 2020. Lancet Infectious Diseases. [https://doi.org/10.1016/S1473-3099\(20\)30273-5](https://doi.org/10.1016/S1473-3099(20)30273-5)

<sup>25</sup> Rengasamy et al. 2010. Annals of Occupational Hygiene. <https://academic.oup.com/annweh/article/54/7/789/202744>