AGENDA ITEM R7K

Supplemental materials in support of City's Amended Phase 3 Opening Order and Emergency Measures, dated January 6, 2021 (as may be extended), at Section A.1.c

The Impact of Vocalization Loudness on COVID-19 Transmission in Indoor Spaces

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Abstract

There have been several documented outbreaks of COVID-19 associated with vocalization, either by speech or by singing, in indoor confined spaces. Here, we model the risk of in-room airborne disease transmission via expiratory particle emission versus the average loudness of vocalization and for variable room ventilation rates. The model indicates that a 6-decibel reduction in average vocalization intensity yields a reduction in aerosol transmission probability equivalent to doubling the room ventilation rate. The results suggest that public health authorities should consider implementing "quiet zones" in high-risk indoor environments, such as hospital waiting rooms or dining facilities, to mitigate transmission of COVID-19 and other airborne respiratory diseases.

Main Text

There is an emerging consensus that COVID-19 is transmissible via airborne aerosol particles that are emitted when infected individuals breathe, speak, sneeze, or cough [1 -8]. The relative contributions of these expiratory activities to airborne transmission remains unclear, but multiple outbreaks have been documented in which asymptomatic carriers were speaking or singing in confined indoor spaces with susceptible individuals [9,10]. Vocalization causes micron-scale droplets of respiratory mucosa to form via a "fluid-film-burst" mechanism, either in the lungs during inhalation due to expansion of the alveoli, or in the vocal cords due to rapid opening and closing of the glottis during phonation [11-13]. Upon exhalation into the ambient air these droplets rapidly evaporate to leave behind dried aerosol particles large enough to carry viable virus that, although too small to see by eye, are lightweight enough to remain suspended for long times; particles smaller than approximately 5 μm will typically be removed from rooms by air exchange rather than gravitational settling [14-16]. Expiratory particles in this size range from exhaled breath are known to carry infectious influenza virus [17]; likewise, viable SARS-CoV-2, the virus responsible for COVID-19, has been observed in micron-scale aerosol particles sampled from hospital air several meters away from infected patients [18].

We recently demonstrated that the emission rate of micron-scale respiratory aerosol particles strongly correlates with the loudness of speech [19,20]. An increase in vocalization intensity of about 35 decibels, roughly the difference between whispering and shouting, yields a factor of 50 increase in the particle emission rate. We also reported that the size distribution of the dried particles is independent of vocalization loudness, and that certain individuals, for unclear reasons, act as superemitters during vocalization, releasing an order of magnitude more particles than average. We hypothesized that airborne disease transmission might occur more readily in noisy environments where infected individuals must speak loudly, thus causing enhanced emission of infectious expiratory particles into the air [19]. Epidemiologists have speculated that recent COVID-19 outbreaks in churches [9], bars [21], or meat processing facilities [22,23] might be due in part to the loudness of these environments. In response, various public health authorities have provided official recommendations that discourage [24-27] or even explicitly prohibit [28] singing and other loud vocalizations, or prohibit conditions like playing loud music that necessitate raising of voices [29].

Much remains unknown, however, about the possible link between vocalization loudness and airborne disease transmission. If virus-laden particles are emitted via vocalization, and if louder vocalization yields more particles, then a key question is: how does the loudness of vocalization affect the transmission probability?

As a starting point to addressing this question, we use the simplest quantitative theoretical model for airborne disease transmission, named the Wells-Riley model after the early investigators who performed this pioneering work [30,31]. Detailed derivations and assessments of the accuracy of the Wells-Riley model are provided elsewhere [32,33]; here we simply use the model framework, which is that the transmission probability follows the complement of a Poisson distribution,

$$P = 1 - e^{-\mu}, \tag{1}$$

where μ is the expected number of infectious pathogens that a susceptible individual inhales. This probability distribution assumes that only one pathogen is necessary to initiate infection, but more complicated expressions are available to account for larger minimum infectious doses [14]. In the classic Wells-Riley formulation, μ is calculated with the assumption that pathogens are emitted at a rate q pathogens per second from one or more infected individuals in a room with instantaneously well-mixed air, so that the relative positions of the infected and susceptible individuals are irrelevant. As such, the model does not account for potential enhanced transmission by direct inhalation of the respiratory plume emitted by an infected individual, but the assumption of well-mixed air serves in part as the basis for minimum ventilation standards promulgated by CDC [34] and ASHRAE [35] because it yields a lower bound for transmission risk to all room occupants regardless of position. The Wells-Riley model further assumes that the room has a ventilation rate of Q liters per minute delivering fresh (pathogen-free) air, and that susceptible individuals are moving B liters of air in and out of their lungs per minute of breathing (i.e., the minute ventilation). In the case where there is just one infected individual, the expected value is

$$\mu = \frac{\eta q B}{Q} t, \tag{2}$$

where t is the total exposure time. The parameter η here represents an infection efficiency ($0 < \eta < 1$) that includes physical effects, like the deposition efficiency within the respiratory tract of the susceptible individual, and immunological effects, like the ability of the immune system to repress the infection. For a minimum infectious dose of 1 pathogen, the quantity ηq is equivalent to the "quanta" of infectivity initially used by Wells and Riley in their models [30,31].

It is already well known from equations (1) and (2) that increasing the exposure time or decreasing the room ventilation rate will increase the expected number of inhaled pathogens and the corresponding transmission probability [36]. What is new here is consideration of the impact of vocalization intensity on the virus aerosolization rate q. The particle emission rates that we previously reported were measured in a laboratory environment while using a microphone and decibel meter placed near the mouth [19,20]. Importantly, the particle emission rate varied linearly with the root-mean-square amplitude as measured by the microphone; the amplitude varies nonlinearly with the corresponding sound pressure level in decibels (Fig. S1). Using these measurements, we can relate expected particle emission rates to different sound pressure levels, measured in C-weighted decibels (dBC). Full details are presented in the Supplementary material; the final result is that the average particle emission rate is estimated to depend on the vocalization intensity L_{p1}, measured in dBC at 1 m from a non-masked speaker, as

$$N_{avg} = (1-\phi)\,\widehat{N}_{br} + \phi\,\widehat{N}_{voc}\left(\frac{L_{p1}+25}{105}\right)^{10.6}, \tag{3}$$

where $\widehat{N}_{br}$ and $\widehat{N}_{voc}$ are scaled expiratory particle emission rates for breathing and vocalization, respectively, that depend on the expiratory flowrates. The parameter ϕ represents the fraction of time the infected individual is vocalizing during the exposure time; ϕ is close to zero for individuals who vocalize rarely such that breathing-related emission dominates, and approaches one for those who vocalize continuously, such as in singing or chanting. The average virus aerosolization rate then is

$$q = C_v V_d \left[\xi(1-\phi)\,\widehat{N}_{br} + \phi\,\widehat{N}_{voc}\left(\frac{L_{p1}+25}{105}\right)^{10.6}\right], \tag{4}$$

where C_v is the viral concentration in the respiratory fluid of the infected individual, and V_d is the pre-evaporation volume of droplets emitted during vocalization. The parameter $\xi = V_b/V_d \approx 0.5$ is the volume ratio of droplets emitted via breathing versus vocalization; several researchers have found that vocalization yields significantly larger droplets than breathing [11,13,19]. Combination of equations (2) – (4) into (1), and noting that the ventilation rate in a room with volume V_{room} is related to the air changes per hour as $Q = V_{room}ACH$, yields the desired probability,

$$P = 1 - \exp\left(-k \frac{\left[\xi (1-\phi)\, \hat{N}_{br} + \phi\, \hat{N}_{voc} \left(\frac{L_{p1}+25}{105} \right)^{10.6} \right]}{ACH} t \right). \tag{5}$$

Here $k = \frac{\eta B C_v V_d}{V_{room}}$ is an effective rate constant composed of parameters that, for a given room and specific virus, are not readily alterable by human interventions.

The striking feature of equation (5) is the large power-law dependence on the vocalization intensity. A contour plot of the transmission probability versus vocalization intensity and duration illustrates this pronounced impact for a 1-hour exposure time in a room with three ACH (Figure 1). The transmission probability is lowest in the bottom left corner, corresponding to infectors who vocalize rarely and quietly, as might be observed in a library or quiet office space. In contrast, the transmission probability increases gradually with duration and rapidly with intensity. It reaches maximal values in the top right corner, corresponding to infectors who vocalize loudly and close to continuously, as might be observed in a noisy bar environment or at a choir practice.

The model also gives insight on the cost-benefit analysis of increasing the room ventilation rate. Fig. 2A shows the transmission probability versus vocalization intensity for different ACH values. As expected, doubling the ventilation rate of fresh (pathogen-free) air decreases the transmission probability. A notable feature, however, is that a similar reduction in transmission probability can be gained, without changing the ventilation rate, simply by decreasing the vocalization intensity by approximately 6 dBC. This reduction can be quantified via a risk reduction factor,

$$f = \frac{P_{original} - P_{intervention}}{P_{original}}, \tag{6}$$

where $P_{original}$ is the probability at some initial condition and $P_{intervention}$ is the adjusted probability via an intervention either with an increased ventilation rate or decreased vocalization.

For simplicity, we can focus on small values of μ such that asymptotically $P \approx \mu$, in which case the risk reduction factor for doubling the room ventilation rate is $f = \frac{1}{2}$. If the infected individual simply vocalizes half as often (i.e., φ is halved), then to good approximation $f \approx \frac{1}{2}$ as well. Furthermore, keeping the room ventilation rate and the vocalization duration fixed, the risk reduction factor for decreasing the vocalization intensity by δ decibels is

$$f = 1 - \left(\frac{L_{p1}+25-\delta}{L_{p1}+25}\right)^{10.6}. \quad (7)$$

To achieve a 50% reduction in risk for vocalization that ordinarily would occur at 60 dBC would require a decrease of only $\delta = 5.4$ dBC. More precise calculations of the risk reduction factor (Fig. 2B) show that in general, a 10 dBC decrease in average vocalization intensity is always more effective at reducing risk of aerosol transmission than doubling the ventilation rate.

The risk reduction achieved either by increasing room ventilation or by decreasing the loudness of vocalization is insensitive to the pathogen concentration in respiratory emissions or their infection efficiency, though those quantities do affect the actual probability of transmission. In other words, the numerical values of the probabilities shown in Figs 1 and 2A will vary with the viral load of the infector, but the overall shape of the curves will remain the same. Similarly, wearing of masks will reduce the particle emission rate of the infector and decrease the effective deposition efficiency in susceptible individuals and thus decrease the overall probability, but the relative risk reduction as characterized here will remain unchanged. We also emphasize that the Wells-Riley model explicitly assumes the air is well mixed, and that more sophisticated plume or puff models [37,38] or computational fluid dynamics models [39,40] are required to account for the directionality and turbulent diffusivity of the airflow and proximity of individuals. Whatever transport model is used, however, the vocalization source terms in equations (3) and (4) suggest that reductions in vocalization intensity will strongly decrease the amount of virus available to be transported, and thus decrease the overall transmission probability.

To relate these proposed decibel decreases to real-world situations, we consider typical noise levels in different indoor environments, often measured in A-weighted decibels (dBA), which are thought to better reflect subjective perceptions of loudness. Ambient noise in restaurants is typically between 65–80 dBA, with an average of 73 dBA [41], and background noise levels of 75 dBA have been observed at day-care facilities [42]. Music plus crowd noise in bars and nightclubs can average as high as 90-100 dBA [43]. The relationship between ambient noise levels and the speech loudness necessary for comprehension is complex, but in general speech must be nearly the level of the background noise to be understood, and speakers adjust their vocalization intensity to maintain a positive signal-to noise ratio when possible [44-46]. As a result, all other things being equal, a reduction in background noise on the order of 5-10 decibels will facilitate, if not directly result in, a corresponding reduction in average speaking levels. Further, the relatively high amount of background noise in many public spaces suggests that there is considerable room to reduce noise levels behaviorally (e.g., turning music down, encouraging silence), since noise is not inherent to the operation of many of these spaces (as opposed to industrial facilities). When wearing facemasks, the reduction in the background noise necessary to achieve a similar magnitude reduction in transmission risk may be larger owing to the need to speak more loudly through the mask [47]. A more detailed analysis of mask filtration efficacy and vocalization through masks is necessary to characterize the impact of this effect on transmission probability.

There are tremendous installation, maintenance, and energy costs associated with increased ventilation rates, especially in air conditioned or heated indoor spaces [48]. In practice many ventilation systems recycle a substantial fraction of the room air, so increasing the flow rate of fresh (pathogen-free) air requires even more ACH. In comparison, there is little cost for signage and dissemination campaigns aimed at discouraging use of loud voices in shared indoor environments. Libraries, for example, are traditionally quiet in part because librarians promulgate social conventions against loud conversations. The results presented here suggest that public health authorities should consider fostering comparable social conventions in hospital waiting rooms or other high-risk environments where people must congregate and social distancing is difficult to maintain. The results also suggest that epidemiologists should consider the acoustic conditions of indoor environments as a potential contributing factor in situations where outbreaks of COVID-19 or other viral respiratory diseases might occur.

Acknowledgments

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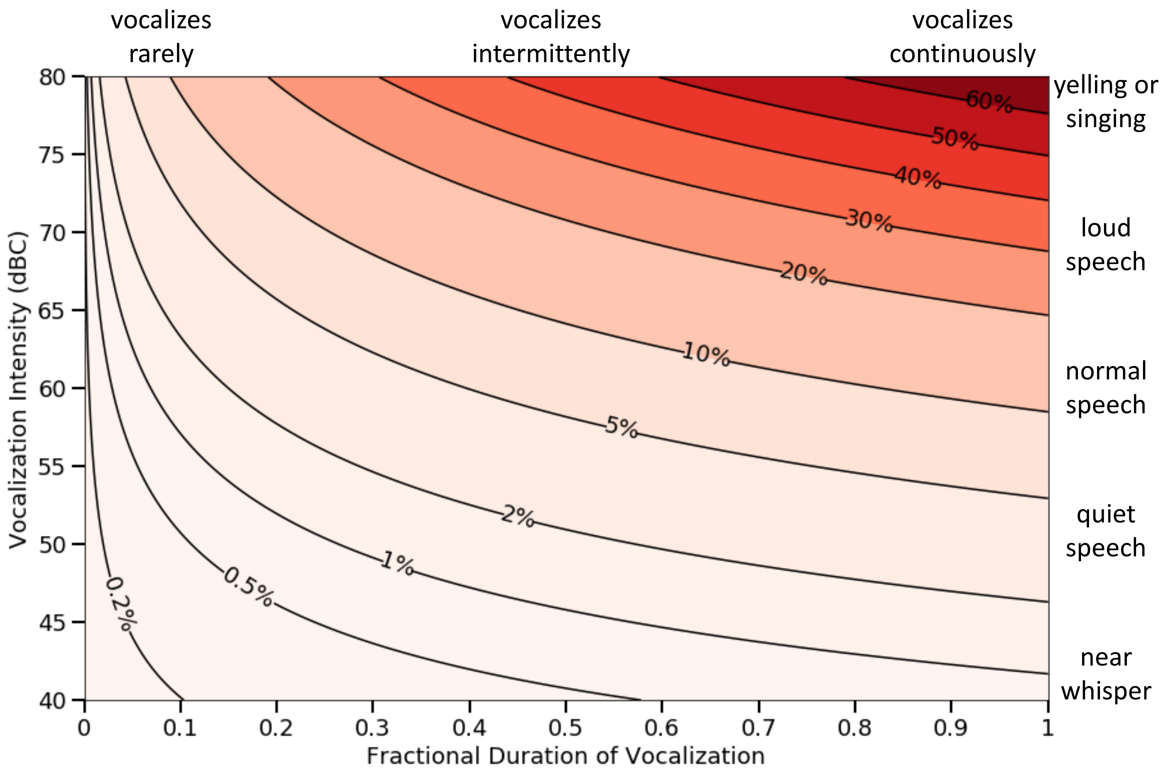
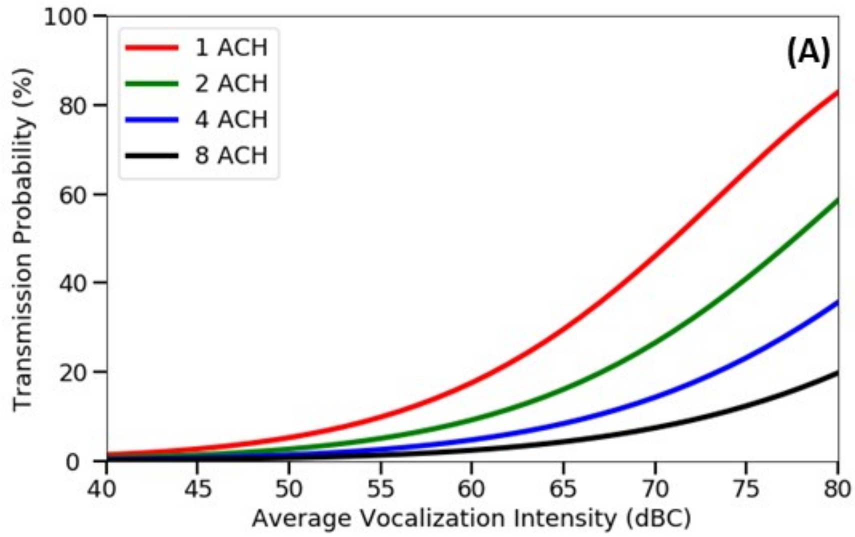


Figure 1 – Contour plot of transmission probability for 1 hour of exposure to a vocalizing individual infected with SARS-CoV-2, in a room with 3 ACH, versus the vocalization loudness (measured at 1 meter) and the fractional duration of vocalization (ϕ) by the infector during the hour-long exposure. Model parameters are listed in Table S1.



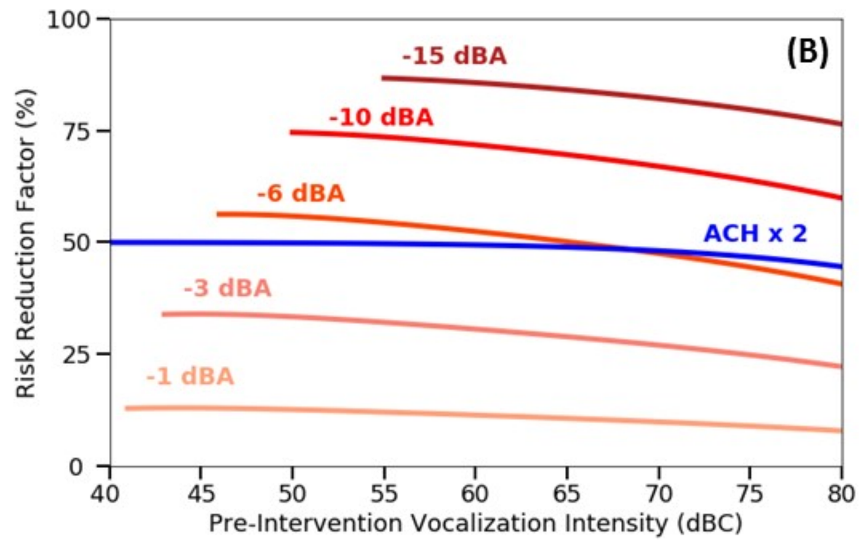


Figure 2 – **(A)** Probability of susceptible individuals becoming infected with SARS-CoV-2 after 1-hour of exposure, during which infector vocalized half of the time ($\phi = 0.5$) at the specified sound pressure level (measured 1 meter from the speaker). **(B)** The risk reduction factor versus original vocalization intensity for different decreases in vocalization intensity (red curves) or increasing the ventilation by a factor of two (blue curve). Model parameters listed in Table S1.

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Supplementary Information:

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Here we derive equation (3) in the main text, which describes the relationship between the measured vocalization intensity, as measured in decibels, and the average emission rate of expiratory aerosol particles. The empirical data and experimental methods are described in detail by Asadi et al., *Scientific Reports* 2019; for reference similar results were reported by Asadi et al., *PLoS One* 2020. In brief, participants either breathed or vocalized into a funnel connected to an aerodynamic particle sizer (APS) placed in a HEPA-filtered laminar flow (Fig. S1a). The APS

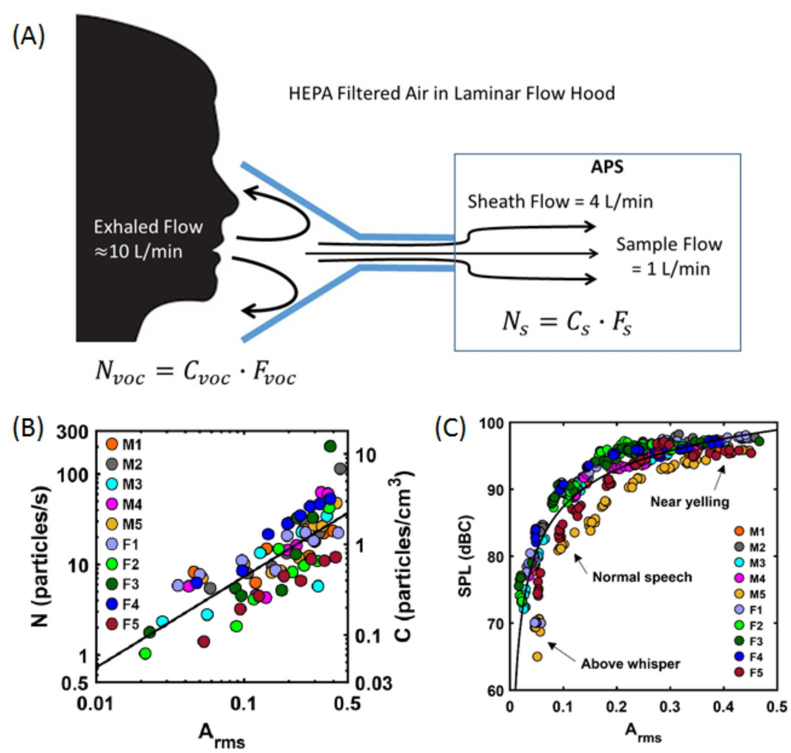

Figure S1 – **(A)** Schematic of the experimental apparatus (not to scale) and approximate airflow streamlines. Microphone and decibel meter next to the funnel are not shown. See also Asadi *et al*. 2019 supplementary Fig 1 and Fig S12. **(B)** Scatter plot of the particle emission rate detected in the APS versus the vocalization amplitude. Solid line has a slope of 1.004. Reproduced from Fig. 2c of Asadi *et al*. 2019. **(C)** Calibration curve relating the amplitude to the sound pressure level, measured at 5 cm from the mouth, in C-weighted decibels. Solid line is the power-law fit given by equation S5. Reproduced from Fig. S1 of Asadi *et al*. 2019.

draws in 5 liters/min of air from the funnel, of which 80% comprised a sheath flow and 20% a sample flow (F_s) measured in the detector. A microphone and a decibel meter placed near the funnel entrance simultaneously measured the root-mean-square amplitude, A_{rms}, of the vocalization and the corresponding sound pressure level (SPL) in C-weighted decibels.

The key finding, shown in Fig. S1b, is that the rate of particles moving through the detector in the sample flow, in particles per second (p/s), varied linearly with the vocalization amplitude,

$$N_s = \kappa\, A_{rms}\,. \tag{S1}$$

The amplitude varied from 0 to 0.5 (arbitrary units), and the slope κ was approximately 30 to 40 particles per second for speaking or 'singing' respectively (cf. Figs 2c and 3b of Asadi et al. 2019). Importantly, however, not all of the exhaled air was fed into the detector. Typical exhalation flow rates during breathing and vocalization (F_{voc}) range from 8 to 12 L/min (Loudon 1988, Gupta et al. 2010), while the APS only detected particles in the sample flow at 1 L/min. As the breathing and vocalization flow rates exceed the total APS flow rate (5 L/min) there is no dilution of the sampled air. Thus, to estimate the total particle emission rate, we equate the concentration in the detector to the exhaled concentration in the funnel ($C_s = C_{voc}$), yielding the relationship

$$N_{voc} = \frac{F_{voc}}{F_s} N_{s,voc}, \tag{S2}$$

where N_{voc} is the total particle emission rate from vocalization (p/s). A similar statement pertains to the (non-vocalization) particle emission rate during breathing, N_{br}. Over sufficiently long time periods, the average total particle emission rate will reflect the relative amounts of time spent breathing versus vocalizing, viz.,

$$N_{avg} = (1-\phi)N_{br} + \phi\, N_{voc}, \tag{S3}$$

where $0 \le \phi < 1$ is the fraction of time the individual spends vocalizing. Inserting the relationships defined in (1) and (2) into (3) yields

$$N_{avg} = (1-\phi)\frac{F_{br}}{F_s} N_{s,br} + \phi\kappa \frac{F_{voc}}{F_s} A_{rms}. \tag{S4}$$

Next, we note that the microphone amplitude A_{rms} is related to the sound pressure level in decibels via a power-law relationship of the form

$$L_{p0} = cA_{rms}^b, \tag{S5}$$

as shown in Fig. S1C. Nonlinear regression yields best fit values of $b = 0.094$ and $c = 105$ dBC. The decibel readings were recorded 6.5 cm from the mouth, but it is standard to report sound pressure levels at a distance of 1 m from the noise source. Accordingly, we adjust the sound pressure level as

$$L_{p1} = L_{p0} + 20\log_{10}\frac{r_0}{r_1} = L_{p0} - \Delta, \tag{S6}$$

where Δ= 25 dBC for $r_1 = 1$ m. Combination of (1), (2), (5) and (6) yields the particle emission rate versus sound pressure level,

$$N_{voc} = \kappa \frac{F_{voc}}{F_s} \left(\frac{L_{p1}+\Delta}{a}\right)^{1/b}. \tag{S7}$$

Finally, combining everything into equation S4 yields the desired expression,

$$N_{avg} = (1-\phi) \frac{F_{br}}{F_s} N_{s,br} + \phi\kappa \frac{F_{voc}}{F_s} \left(\frac{L_{p1}+\Delta}{a}\right)^{1/b}. \tag{S7}$$

For convenience we define $\widehat{N}_{br} = N_{s,br} \frac{F_{br}}{F_s}$ and $\widehat{N}_{voc} = \kappa \frac{F_{voc}}{F_s}$, and substitution of the empirical coefficients a , b, and Δ yields equation (3) in the main text.

The independent variables of interest in equation S7 for modeling the transmission probability are ϕ and L_{p1}. All other parameters are known from the empirical measurements reported by Asadi et al., except for the expiratory flowrates F_{br} and F_{voc}. As noted by several authors, the relationship between measured sound pressure level and the expiratory flow rate is quite complicated, and depends on the pitch (fundamental frequency), the "open quotient" of the vocal cords, the lung pressure and vocalization pressure threshold, and the glottal and epiglottal resistances (Schneider and Baken 1984, Titze 1992, Jiang et al. 2016). As first summarized succinctly by Rubin et al., there is a "lack of any consistent relationship between sound pressure levels and air flow" (Rubin et al. 1967). Accordingly, as a first approximation here we simply treat the average flow rate during vocalization as a fixed constant independent of the sound pressure level, which in general will yield a conservative underestimate of the total particle emission rate as sound pressure level increases. Model parameters and sources are listed in Table S1.

Parameter	Value	Reference
$\boldsymbol{V_{room}}$	300 m^3	–
$\boldsymbol{t}$	1 hour	–
$\boldsymbol{B}$	1.3×10^{-4} m^3/s	Chen et al.
$\boldsymbol{C_v}$	10^8 virions/mL	To et al.
$\boldsymbol{\eta}$	0.4	Rissler et al.
$\boldsymbol{F_{br}}$	8 L/min	Gupta et al.
$\boldsymbol{F_{voc}}$	10 L/min	Gupta et al.
$\boldsymbol{F_s}$	1 L/min	Asadi et al.
$\boldsymbol{N_{br}}$	0.05 particles/s	Asadi et al.
$\boldsymbol{\kappa}$	40 particles/s	Asadi et al.
$\boldsymbol{\theta}$	0.32	Liu et al.
$\boldsymbol{\xi}$	0.51	Asadi et al.
$\boldsymbol{V_d}$	0.18 pL	Asadi et al.

Table S1 – Parameter models used in Figs 1 and 2 in the main text.

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HEALTH CARE

A New Strategy To Contain the Coronavirus

Lessons From the U.S. Northeast and Japan

By Emily Gee, Aly Shakoor, Maura Calsyn, Nicole Rapfogel, and Topher Spiro | August 6, 2020, 5:00 am

Getty/Rob Kim

People lay out on the grass while maintaining social-distancing guidelines in Williamsburg, Brooklyn, on August 3, 2020.

After states rushed to reopen their economies in late spring, coronavirus cases began to surge across most of the United States. At the same time, states in the Northeast have experienced declines in COVID-19 cases, deaths, and hospitalizations. Despite having been the epicenter of the U.S. cases throughout the early spring, this region now has a relatively low degree of new case incidence, even as transmission of the virus accelerates in other parts of the country—particularly in the South and West. (see Figure 1)

Public health experts agree that the rush to end stay-at-home orders without meeting public health benchmarks and the politicization of mask-wearing have created this surge. This report analyses the timing and scope of reopening measures to determine which specific actions were more likely to be the reason for the latest spikes. In particular, the following factors appear to be why the Northeast has had more recent success than the rest of the country in slowing the spread of COVID-19:

- The timing and duration of initial stay-at-home orders
- The timing and scope of reopening economic activity
- Individual behavior and local culture, which may have been influenced by local COVID-19 risks early in the pandemic and reinforced by local policy choices

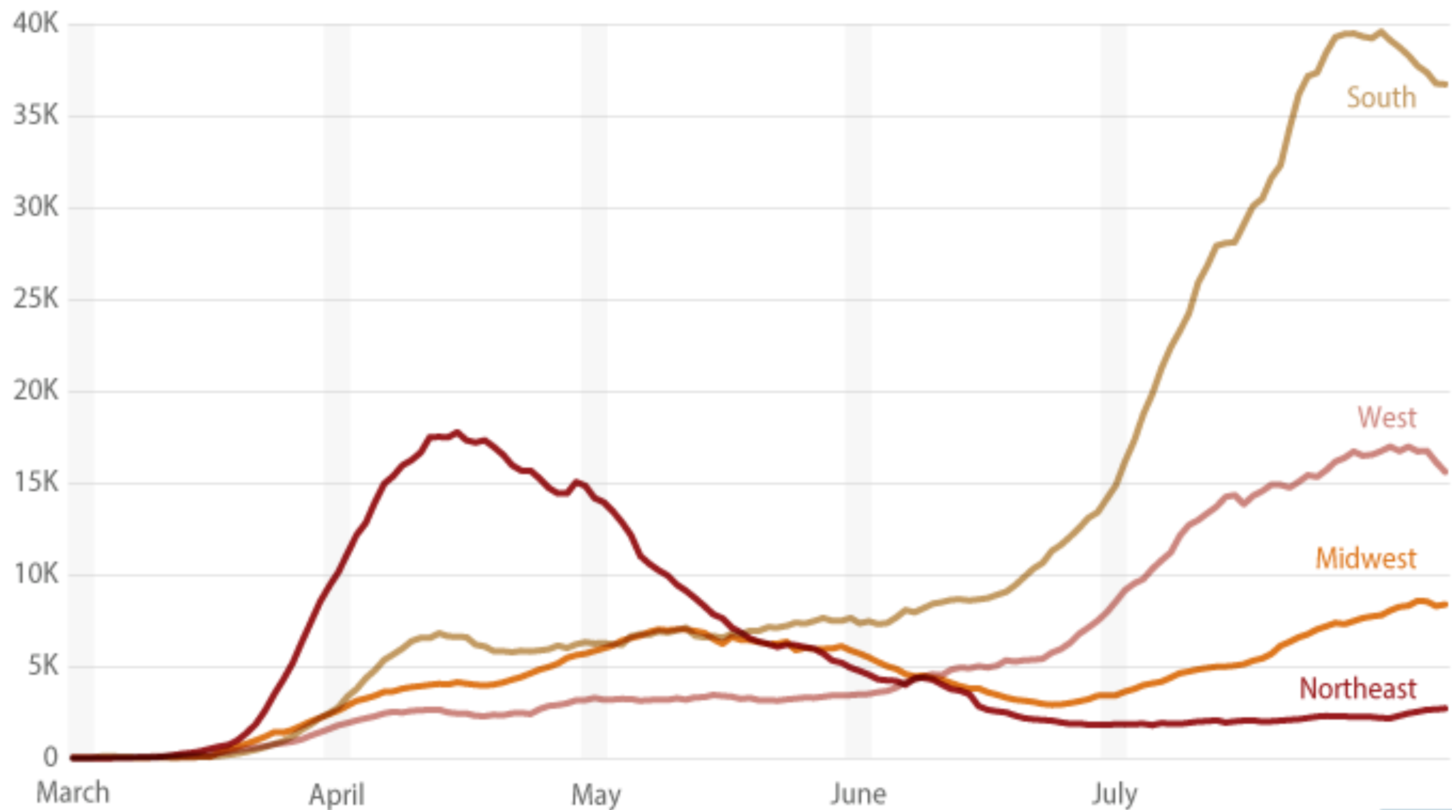
In particular, this analysis finds that a key policy difference between the Northeast and other states is the timing of reopening bars and indoor dining, combined with the adoption of mask mandates before the lifting of stay-at-home orders. In addition, this report briefly compares these findings with the experiences of other countries, focusing on Japan's successful approach to cluster-based contact tracing and public education.

Given this evidence, other states and the federal government must at a minimum work to quickly replicate these conditions throughout the rest of the United States. In addition to mask mandates, federal economic support directed to high-risk businesses and their workers can keep those companies financially viable, protect workers' health and pocketbooks, and slow the spread of the virus.

FIGURE 1

COVID-19 positive cases by region

7-day moving average of new cases reported per day, March 1–July 29, 2020



Source: The COVID Tracking Project, "Regional Cases," available at https://covidtracking.com/data/charts/regional-cases (last accessed July 2020).

The need for both the first and second wave of business closures was never inevitable. Like other countries around the world, the United States could have prevented high levels of community spread through swift and aggressive measures such as testing and tracing or promoted the adoption of personal hygiene habits such as social distancing and mask-wearing. Unfortunately, the federal government's failure to act early on in the pandemic and states' decisions to reopen too rapidly mean that targeted closures are again critical to controlling the spread of COVID-19 in the United States. This approach of targeted closures and attacking clusters is what is needed at a minimum in areas with substantial spread—but ultimately, local stay-at-home orders may also be needed to create the conditions under which this strategy could work.

Policy differences between the Northeast and other

states

In the absence of clear federal guidance, states started implementing in March various social-distancing policies—starting with targeted recommendations for at-risk individuals and bans on large gatherings and culminating with stay-at-home orders. Over the next two months, more than 42 states and the District of Columbia had stay-at-home orders in place for at least some period of time; by June 9, all of these orders had been lifted to some extent. There remains enormous variation across states, as described below.

Differences in the timing and duration of stay-at-home orders

Generally, states in the Northeast implemented stay-at-home orders one to two weeks sooner than other regions, particularly Southern states. (see Figure 2) New York and Massachusetts had implemented orders by March 22 and March 24, respectively, whereas Arizona and Texas did not implement orders until March 31 and April 2, respectively. Rhode Island was the last of the Northeastern states with major spread to adopt a stay-at-home order.

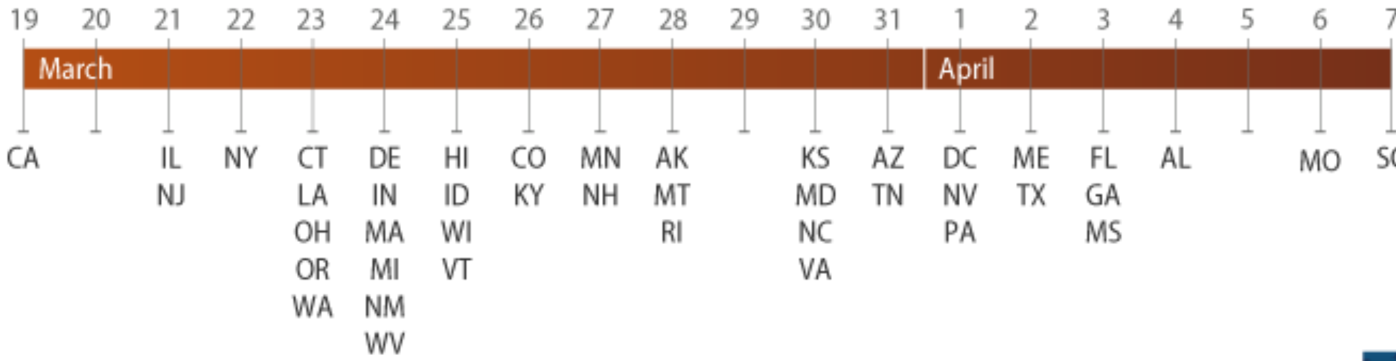
The Northeast was also unique in that it was the only region in which all states implemented a stay-at-home order. (For the purposes of this analysis, the authors define the Northeast region according to the U.S. Census Bureau definition.) In the other regions, eight states—Arkansas, Iowa, Nebraska, North Dakota, Oklahoma, South Dakota, Utah, and Wyoming—never issued stay-at-home orders.

Washington state and California—which were early U.S. epicenters—were among the first several states with stay-at-home orders, and both states are again facing surges in COVID-19 cases. As discussed below, their subsequent decisions to allow the reopening of bars, restaurants, and other retail activity on a county-level basis canceled out the benefit of their early, decisive actions.

FIGURE 2

State stay-at-home orders for COVID-19

Date of implementation, by state



Source: Kaiser Family Foundation, "When State Stay-at-Home Orders Due to Coronavirus Went into Effect," April 9, 2020, available at https://www.kff.org/other/slide/when-state-stay-at-home-orders-due-to-coronavirus-went-into-effect/.

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Given the impact that even a week of social distancing can have in reducing the spread of COVID-19, it is likely that these delays exacerbated eventual spread across the United States. In addition, state policymakers who delayed the adoption of stay-at-home orders until April may have reinforced differences in residents' attitudes toward social distancing, as discussed below.

There are also differences between the Northeast states and other states in how long their stay-at-home orders remained in place. Not only were the Northeast states some of the earliest to adopt strict stay-at-home policies, but they also kept them in place until May or June and generally conditioned their termination upon a sustained decline in cases. Of the Northeast states, Rhode Island's order was in place for the shortest period of time—for six weeks from March 28 to May 9. By contrast, Florida's order lasted 30 days, and Texas's was in place for less than a month. Colorado's full stay-at-home order was similarly short in duration, but the state had imposed other social-distancing requirements for a longer period of time. In addition, Denver did not relax its stay-at-home mandate until two weeks after the statewide measure was lifted, and it and surrounding counties encouraged residents to remain at home.

The timing and scope of reopening economic activity

While both the start date and duration of the initial stay-at-home order differ between regions, simply looking at the day on when states announced the start of their reopenings does not fully explain the following divergent trends in transmission. Nor has the number of cases at the time of reopening correlated to a state's ability to avoid future outbreaks. In fact, Northeastern states with high incidence upon their initial reopening—including the original epicenter of New York—have fared better than other states that reopened with lower incidence such as Arizona.

A comparison of states in the Northeast with a handful of other states—including some with early major outbreaks (California, Michigan, and Washington); some with recent outbreaks (Arizona, Florida, and Texas); and others adjacent to the region (Delaware and Maryland)—strongly indicates that the actions taken by states after their initial reopening date are most determinative of future outbreaks. Clearly, the speed and breadth of reopening matter greatly.

The Northeast states that have been most successful in keeping transmission under control as they have reopened have several key features in common. They were later to reopen in-person dining, and a few have yet to reopen bars. They also typically had a mask mandate in place a full month prior to the first phase of reopening. Combined with other factors, this strategy appears to be working: The Northeast states that were hardest hit in the spring—Connecticut, New Jersey, New York, and Massachusetts—now have lower new case incidence and positive rates than other states as well as compared with the nonrural states within the region. As discussed below, these findings are consistent with the growing scientific consensus about how the virus spreads.

Key reopening features in Northeast states linked with lower transmission

There is growing consensus that the virus that causes COVID-19 is spread not only through larger respiratory droplets but also via tiny droplets called aerosols. These aerosols can remain in the air longer and accumulate over time, increasing the risk of transmission in closed, indoor spaces. Masks limit the spread of both droplets and aerosols when worn by infected individuals. In addition, there is now some evidence that masks can reduce the amount of virus inhaled by the person wearing the covering. Table 1 features a summary of state policies on reopenings and masks.

TABLE 1

State policies to limit the spread of COVID-19

Dates for stay-at-home orders, mask mandates, and restrictions on indoor dining and bars

State	Stay-at-home order	Masks mandated	Indoor dining reopened (restricted capacity)	Bars reopened (restricted capacity)
Northeast				

Connecticut	March 23–May 20	April 20	June 17 (50%)	Not open
Maine	April 2–May 31	April 30	May 18	Not open
Massachusetts	March 24–May 18	May 6	June 22	Not open
New Hampshire	March 27–June 15	No mandate	June 15	June 15
New Jersey	March 21–June 9	April 8	Not open	Not open
New York	March 22–May 28	April 15	June 12	June 12
Pennsylvania	April 1–June 4	April 15	May 29 July 16 (25%)	May 29 July 16 (25%)
Rhode Island	March 28–May 8	May 8	June 1 (50%) June 30 (66%)	June 1 (50%) June 30 (66%)
Vermont	March 25–May 15	August 1	June 8 (25%) June 26 (50%)	June 8 (25%) June 26 (50%)
Other states				
Arizona	March 31–May 15	No mandate	May 11	May 11 Re-closed June 29
California	March 19; lifted by county starting May 8	June 18	May 18 Re-closed July 13	June 12 Re-closed July 13
Colorado	March 26–April 26	July 17	May 25 (50%)	June 21 (25%) Re-closed June 30
Delaware	March 24–May 31	April 28	June 1 (30%) June 15 (60%)	June 15 (60%)
Florida	April 3–April 30 (to June 12 for medically vulnerable people)	No mandate	May 4 (25%) May 18 (50%)	June 5 (50%) Re-closed June 26
Maryland	March 30–May 15	April 15	June 12 (50%)	Not open
Michigan	March 24–May 28 (lifted May 18 for Upper Peninsula)	June 17	May 22 (50%)	May 22 (50%) Re-closed July 31
Texas	April 2–April 30	July 2	May 1 (25%) May 22 (50%) June 12 (75%) June 26 (50%)	May 22 (25%) June 3 (50%) Re-closed June 26
Washington	March 23–May 31	June 26	May 8	June 5 Re-closed July 30

Note: Maine, New York, Pennsylvania, California, Michigan, and Washington reopened bars and indoor dining on a regional basis within the state. The date listed is for the earliest opening within the state. The boxes by the state names represent the incidence of new cases per day per 100,000 population over the seven days ending July 29. Green indicates two or fewer cases, which was the peak level in South Korea; yellow indicates 10 or fewer cases; red indicates more than 10 cases.

Source: CAP authors' analysis; The COVID Tracking Project, "Historic values for all states," available at https://covidtracking.com/data (last accessed

Source: CAP authors analysis, The COVID Tracking Project, "Historic values for all states," available at https://covidtracking.com/data (last accessed July 2020); Kaiser Family Foundation, "When State Stay-at-Home Orders Due to Coronavirus Went into Effect," April 9, 2020, available at https://www.kff.org/other/slide/when-state-stay-at-home-orders-due-to-coronavirus-went-into-effect/; National Academy for State Health Policy, "Chart: Each State's COVID-19 Reopening and Reclosing Plans and Mask Requirements," available at https://www.nashp.org/governors-prioritize-health-for-all/ (last accessed July 2020).

Bar and indoor dining reopenings

Based on this evidence, bars and indoor dining pose unique risks of virus transmission; their very purpose ensures that people will be gathered—without face masks—while indoors. As Dr. Anthony Fauci said during a Senate testimony in June, such "congregation" inside bars is "really not good, really not good." More than 150 COVID-19 cases, for example, have been linked to a single bar in East Lansing, Michigan. An unpublished study of Google location data found that the single policy associated with the greatest increase of social distancing was bar and restaurant closures. Conversely, according to a JPMorgan Chase analysis of credit card spending, in-restaurant purchases are the strongest predictor of increases in COVID-19 cases. Inside noisy bars and restaurants, patrons may speak loudly or yell in order to be heard, leading infected individuals to emit more aerosols and transmit the virus. Authorities in the District of Columbia issued warnings to about a dozen bars for having music louder than "a conversational level." Inebriation presents another risk, as it potentially limits patrons' judgment of COVID-19 risks and makes it challenging for bar staff to enforce social distancing.

For these reasons, it's not surprising that states that have been slower to reopen bars and indoor dining locations have experienced lower rates of transmission than states that rushed to reopen these establishments. The earliest that bars were reopened in the Northeast was June, and Massachusetts has said that bars and nightclubs won't reopen until therapeutics or a vaccine become available.

States in the Northeast also kept indoor dining closed through the end of May, with the exception of Maine, which allowed some indoor dining in mid-May. Indoor dining has yet to resume in New Jersey or in New York City. Rhode Island was the first state in the region to relax its stay-at-home order and among the earlier states to reopen indoor dining. The state's cases have been rising in the weeks after indoor dining resumed, and its rate of new cases is more than double that of Massachusetts and New York.

TABLE 2

COVID-19 new case incidence and testing by state

Averages over the week ending July 29

State	Daily new case incidence	Positive test rate	Daily tests per 100,000 population
Northeast			
Connecticut	5.3	1.4%	366
Maine	1.5	0.8%	181
Massachusetts	3.9	2.6%	147
New Hampshire	2.5	2.3%	111
New Jersey	5.0	1.5%	324
New York	3.5	1.1%	329
Pennsylvania	7.6	6.1%	126
Rhode Island	10.0	4.7%	210
Vermont	0.9	0.6%	154
Other states			
Arizona	34.7	20.2%	172
California	22.3	7.2%	308
Colorado	10.6	7.8%	136
Delaware	11.9	4.6%	258
Florida	47.8	19.3%	247
Maryland	14.4	6.4%	227
Michigan	7.5	2.2%	334
Texas	25.5	11.9%	214
Washington	10.6	5.4%	195

Note: Incidence is new cases reported per day per 100,000 population.
Source: Authors' analysis; The COVID Tracking Project, "Historic values for all states," available at https://covidtracking.com/data (last accessed July 2020).

Except for Delaware and Maryland, the non-Northeast states examined here allowed indoor dining starting in May. Texas was the first, with a May 1 reopening. Washington and California phased in reopening by county starting in May. Indoor dining resumed on June 5 for Washington's three most populous counties, which are part of the greater Seattle area. Los Angeles-area restaurants were allowed to reopen for indoor dining by the end of May, and by mid-June nearly all counties in California had received state approval for in-restaurant dining. Gov. Gavin Newsom (D) later re-closed indoor dining in 19 counties and then statewide.

Among the nine non-Northeast comparison states, all except Maryland had reopened bars by June, with Arizona, Michigan, and Texas reopening bars in May. California, Colorado, Texas, Arizona, and Florida re-closed bars within the past several weeks. The danger of reopening bars and restaurants too soon is apparent in Michigan: After successful containment of a March outbreak concentrated in the Detroit metro area, cases rose again beginning in mid-June—just a few weeks after the state reopened bars and indoor dining. Due to “outbreaks tied to bars,” Gov. Gretchen Whitmer (D) re-closed bars and indoor dining in most of the state just one month after reopening them “to slow the spread of the virus and keep people safe.”

Adoption and timing of mask mandates

Both laboratory studies and real-world experiences overwhelmingly affirm that masks are effective at preventing the transmission of the virus. More specifically, a recent *Health Affairs* study found that mask mandates in 15 states and the District of Columbia were associated with declining COVID-19 growth rates and had a greater impact over time. In addition, some experts believe that masks may reduce the dosage of virus exposure for the wearer, resulting in less severe cases of COVID-19 for those who do become infected. As evidence mounted that masks can reduce the spread of the coronavirus, most states in the Northeast enacted mask requirements by early May. With Vermont’s mask mandate effective as of August 1, New Hampshire is the only remaining state in the region without a mask mandate; both states continue to have a low level of cases, likely in part because they are among the more rural states in the region.

In contrast, California and Washington, despite also being early U.S. epicenters, did not mandate masks until the second half of June. Texas adopted a mask mandate in July, and Arizona and Florida still do not require masks. All of these states experienced surges in cases in July.

The contribution of testing and tracing to the Northeast’s success

In contrast to nations such as South Korea, the United States has struggled to expand testing and implement contact tracing. After initial roadblocks in test supply and access nationally, and despite recent concerns about delays in test results, states—particularly those in the Northeast—have made substantial progress in scaling up their testing and contact-tracing programs.

Testing and tracing do not seem to be the primary driver of Northeast’s success. Public officials and health care workers in the region struggled to obtain sufficient supplies for testing to combat the severe outbreaks in the spring. As the Northeast worked to establish control over the spread of the virus, the volume of testing rose and then leveled off in the region. The positive test rate in the Northeast has remained low over the past several weeks, indicating that states in the region are conducting sufficient testing. The positive test rate in most other states is well above the World Health Organization's recommended level of 5 percent for reopening. With positive rates near 20 percent, Arizona and Florida need to conduct far more tests to adequately monitor outbreaks.

Overall, the level of contact-tracing activity appears higher in the Northeast than in the South. According to the CovidActNow database, states in the South are contacting fewer new cases than those in the Northeast. The percentage of cases who provide information about their contacts is lower, and the percentage of contacts who are reached—a superior measure of effectiveness—is unknown.

Nevertheless, states in the Northeast have not had uniformly successful experiences with contact tracing. Rhode Island was among the first to have a program in place. Gov. Gina Raimondo (D) established public-private initiatives "very early on" in the pandemic to develop "aggressive testing, very aggressive contact tracing." The state also developed an app that keeps a digital "location diary" and helps public health personnel maintain contact with people in isolation. Despite these efforts, COVID-19 cases have risen in the state after it eased up on social-distancing measures.

Massachusetts and New York have maintained relatively low incidence plateaus despite challenges with contact tracing. Massachusetts launched its program in April and announced last month that it was scaling back the program. Transmission is dwindling in the state, but the program was also criticized for being unreliable. New York City's contact-tracing program hired around 3,000 people in late May, yet only around 35 percent of positive cases provided information to the program in its first two weeks.

The contribution of nonpolicy factors on community spread

Decisions by individual people, businesses, and the local culture also appear to play a role in mitigating the transmission of the virus. Many of these factors may reinforce local COVID-19 mitigation policies, and residents' tolerance for mandated business closures and social-distancing rules can also support or constrain local policy choices.

Politicization: The politicization of mask-wearing and other mitigation measures appears to be influencing both policy decisions and individual behavior. For example, respondents who identified as Democratic-leaning were more likely to wear a mask, according to surveys by Pew Research Center. This may be in part due to the fact that Democratic-voting counties were also harder hit by the virus early on and were more likely to impose stay-at-home orders.

The overall politicization of the COVID-19 crisis appears to be deepening preexisting distrust of public health officials and undermining contact-tracing efforts. Further exacerbating this issue, the racist history of public health experiments on Black people may cause distrust toward contact tracers.

Salience: This may also play a role in whether people adopt hygiene and social-distancing habits as well as support stricter policies. Because the Northeast was hit hard by the virus early on, residents of that region may be more receptive to policy and behavioral changes. One expert in Massachusetts noted that residents "were scared and understood the need for precautions." As of April, people in the Northeast were twice as likely to personally know someone who had COVID-19 (42 percent) than people in the West (21 percent), according to polling by Pew Research Center. Similarly, people in the Northeast and Midwest were more likely to know someone who had been hospitalized than residents of the South or West.

Throughout the United States, people are more likely to wear a mask and more likely to report that they see others wearing masks in counties that have experienced greater health impacts related to COVID-19. For example, a March outbreak in the Denver area may have spurred Coloradans to wear masks and social distance.

Climate: Some experts have pointed to a link between COVID-19 hotspots and regions that are using higher levels of air conditioning. Hotter temperatures drive people indoors to cooler but more poorly ventilated spaces. In fact, the Centers for Disease Control and Prevention (CDC) has recommended that homes and businesses open windows for increased circulation of outdoor air in order to reduce transmission of the virus. The rash of new cases that emerged in the Sunbelt in July contradict President Donald Trump's unfounded speculation in April that heat and light would diminish the virus.

Seroprevalence: Some observers suggest that herd immunity will play a major role in slowing transmission, particularly in areas of the country already hard-hit by the virus. Evidence from seroprevalence studies, however, suggest that the vast majority of the population has not yet developed COVID-19 antibodies, even in the Northeast. The CDC said in late June that it believes that approximately 24 million Americans had been infected with COVID-19—equivalent to about 10 percent of the U.S. population. Among the large-scale seroprevalence surveys maintained by the CDC using commercial lab-based samples, the places with the highest antibody levels documented to date are New York City (23 percent as of late April and early May) and Louisiana (5.8 percent as of early April). Herd immunity for COVID-19 may not occur until 70 percent of the population has become infected, assuming that a COVID-19 infection confers long-lasting immunity—a feature that has not yet been proven.

What other countries have in common with the U.S. Northeast

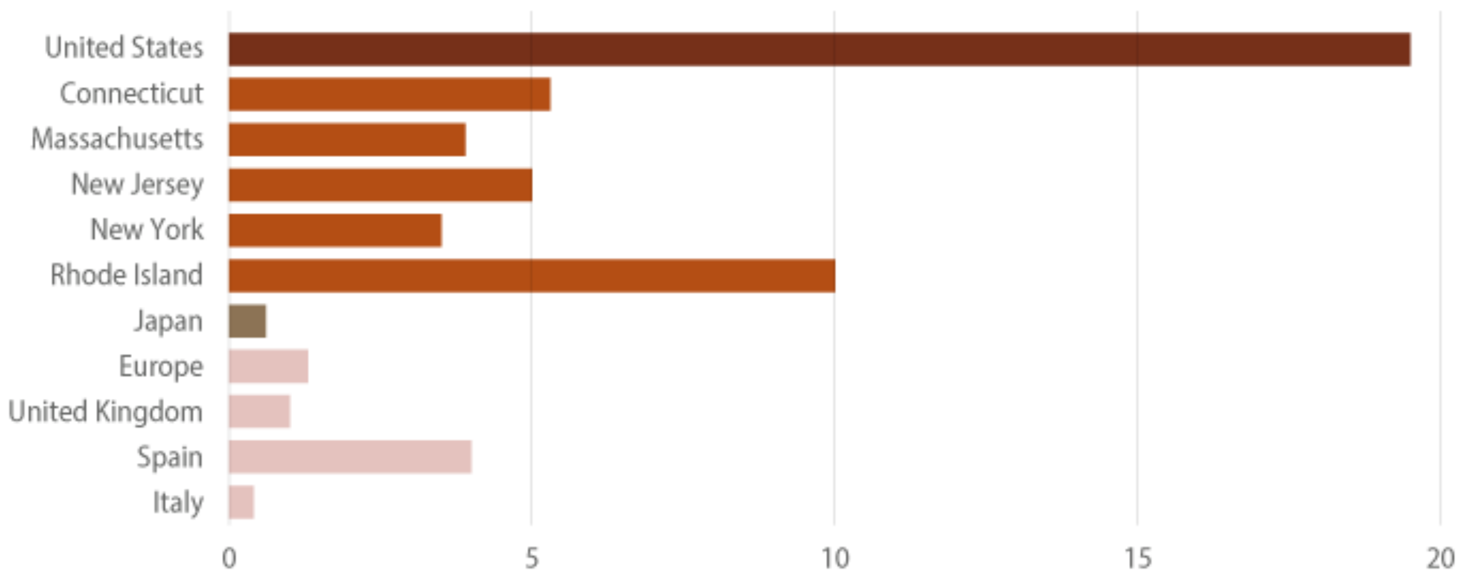
New case incidence generally remains higher in the U.S. Northeast compared with that in countries in Western Europe. Public health experts have pointed to America's "piecemeal, politicized approach" to the virus as the reason why it has lagged behind its Western European peers. Most Western European nations acted quickly to lock down and to test and trace. Even Spain and the United Kingdom—which were slower than other European countries in their initial responses and which faced uncontrolled spread—nevertheless achieved lower incidence after locking down. (Cases have risen again in Spain, which has the highest rate of new cases in Europe.)

Combining data across 17 major countries in Western Europe, the authors find that there were fewer than two new positive cases reported per day per 100,000 population in the seven-day period ending July 29 (1.4 cases). Of the 17 countries, only Belgium (2.3 cases), Portugal (2.1 cases), and Spain (4.6 cases) had rates above two cases per day per 100,000 population. The incidence in the United States over the same period was 19.5 new cases per day per 100,000 population nationally but far lower in states in the Northeast, according to the authors' analysis of COVID Tracking Project data. (see Figure 3) While incidence numbers are partly dependent upon the level of testing—more testing can lead to detection of more cases—the United States still has a higher all-time positive rate than most European nations despite conducting more tests per capita than any other country.

FIGURE 3

Incidence of new COVID-19 cases

Daily new case incidence for selected countries and states in the U.S. Northeast



Notes: European average is among 17 major western European nations. Incidence is new cases reported per day per 100,000 population during the week ending July 29.

Source: Authors' analysis; The COVID Tracking Project, "Historic values for all states," available at https://covidtracking.com/data (last accessed July 2020); European Centre for Disease Prevention and Control, "Download today's data on the geographic distribution of COVID-19 cases worldwide," available at https://www.ecdc.europa.eu/en/publications-data/download-todays-data-geographic-distribution-covid-19-cases-worldwide (last accessed July 2020).

Japan's successful coronavirus response

While Japan has successfully limited COVID-19 cases and deaths, unlike the United States, its policy environment bears some resemblance to U.S. conditions early in the pandemic. Japan did not impose a lockdown and lacked the authority to order one. Like the United States, Japan does not have a digital contact-tracing program and conducted relatively few tests per capita. It instead relied upon manual contact tracing carried out by the country's 450 local public health centers to identify clusters of infections. Japan's success can be attributed in part to voluntary changes: Many businesses shut down by choice, and mask-wearing became universal without a mandate. Japan's public health response emphasized individual behavior, instructing individuals to avoid the "Three Cs": closed spaces, crowded places, and close-contact settings. In July, Japan experienced a new series of outbreaks, some linked to hostess clubs where people gather and drink. While the spike in cases in Japan is nowhere near U.S.

levels, it illustrates the hazards of reopening high-risk venues even when transmission is relatively low.

While the U.S. government missed its opportunity to elicit a wave of voluntary closures or mask-wearing in the early stages of the pandemic, it is not too late for federal, state, and local leaders to generate conditions similar to those in Japan through policy by mandating masks and ordering targeted closures until transmission is lower. In addition, Japan's experience highlights that contact tracing need not be implemented as a national program to be successful. Given their resource constraints, U.S. public health officials should consider adapting a similar approach to contact tracing, focusing on identifying and tracing infections related to clusters and urging temporary closures of venues and gatherings that are likely to lead to super-spreading events.

Recommendations

The Northeast's relative success in bringing COVID-19 under control, as well as the runaway spread of the virus in other regions of the country, serves as a lesson that policymakers need to take swift and decisive action in order to reduce community transmission and prevent future waves over the coming year.

Close indoor dining and bars

Given the risks that bars pose and the fact that they have been pinpointed as the sites of major outbreaks, states should consider following Massachusetts' example by keeping bars closed until an effective COVID-19 vaccine or therapy is widely available. Similarly, because reopening indoor dining, even at limited capacities, is linked to increasing incidence, states should also reevaluate their decisions to allow restaurant patrons to dine indoors, especially in hotspots.

Federal lawmakers should continue to provide robust unemployment insurance for workers and offer financial support for bars and restaurants that is better targeted to meet their needs than the current Paycheck Protection Program. Support for those businesses should help cover their fixed costs during mandated closures or capacity restrictions for public health reasons. Doing so would reduce pressure on business owners to reopen prematurely and allow employees in the industry to avoid high-risk work environments. States and cities that reopen too soon risk resurgences of the virus and the need for another round of closures. A separate CAP analysis of states' initial responses to the pandemic found that states with longer stay-at-home orders not only better managed the spread of COVID-19 but also did not have worse economic outcomes.

Monitor other potentially high-risk venues

Officials should closely monitor indoor venues—such as gyms and places of worship—where people generate high emissions of droplets and aerosols while exercising or singing. Current science and local incidence could justify additional closures or other public health measures such as capacity limits, mandating that activities move outdoors, and requiring masks.

States have also allowed businesses that inherently require people to be in close proximity, such as hair and nail salons, to reopen. There have not been any reports of major COVID-19 outbreaks traced to hair or nail salons in the United States, although these settings are likely to pose a greater risk than other nonessential businesses where social-distancing measures can be more consistently maintained. This success to date offers further evidence that compliance with hygiene and social-distancing protocols, including continuously worn masks, can minimize risk relative to venues such as bars and restaurants. A CDC-published case study of two COVID-19 positive hairdressers who did not infect their clients suggests that face-coverings can help prevent transmission. Given the potential for lax compliance and enforcement of such measures, however, officials should continue to pay close attention to these businesses.

States must also monitor whether their restrictions on indoor gatherings are sufficient. For instance, a recent cluster of new cases in New Jersey linked to indoor parties near the Jersey Shore further demonstrates the importance of ongoing vigilance in tracking the virus, enforcing existing rules, and educating the public about the significant risk posed by groups gathering indoors, especially without masks.

Mandate masks

Given the growing pool of evidence that face masks are among the most effective ways to contain the spread of the virus, mask mandates are an essential tool to reduce transmission in public places. Governors and mayors who have not already done so must implement state and local mask mandates, publicize these rules, and ensure that all residents, especially lower-income individuals, have access to masks at no cost to them. Congress should make financial relief for businesses during the pandemic conditional upon mandating masks for both employees and customers.

Adopt cluster-based contract tracing

With reports of long turnaround times for COVID-19 test results, prospective contact tracing—which seeks to identify people who were in contact with an individual who tests positive—is losing its value. In addition, staffing and funding shortages have hampered contact-tracing efforts. State and local governments should put resources behind the Japanese cluster-based contact-tracing model.

Recent evidence has shown that a small number of people are responsible for the majority of cases due to the ways their bodies multiply and emit the virus as well as the risk of activities in which they engage. Such individuals carry and emit higher viral loads than others, becoming what *The New York Times* describes as "virus chimneys, blasting out clouds of pathogens with each breath." Perhaps more importantly from a contact-tracing perspective, many clusters of cases are traceable to high-risk events or activities that occur in an enclosed space, with conditions worsened by poor ventilation, longer duration, large crowds, or forceful exhalation due to yelling, singing, or exercising.

Japan's cluster-based contact-tracing model combines testing and interviews to link cases and look retrospectively for chains of transmission. It then uses patterns in that information to identify "sources that have a potential to become a major outbreak." Some U.S. cities and states are already implementing similar procedures, although they may not be aware of this particular model. For example, Allegheny County, Pennsylvania, has improved its ability to hone in on high-risk venues thanks to the knowledge gleaned from its contact-tracing program. State and local governments must make a more concerted effort to focus on preventing super-spreading events.

Conclusion

Not only did the federal government fail to act quickly enough to prevent infections from spiraling out of control, but many states also reopened high-risk venues and businesses too soon. Those areas currently facing uncontrolled spread of the virus must take swift action to slow transmission, using the approaches that were most successful in the Northeast as well as in other countries. These actions must include, at a minimum, near-term targeted closures of super-spreading venues such as bars and mandating masks as well as longer-term investments in cluster-based contact tracing.

Keeping businesses shuttered for weeks or months should be the last resort for containing COVID-19, as other countries have demonstrated that strategies based on testing, tracing, and isolating are effective. The insufficient public health infrastructure and the recent degree of community spread in much of the United States, however, means that the United States cannot currently manage the virus through testing and tracing alone. Many state and local officials have no choice but to close and monitor high-risk venues, including indoor dining and bars, if they want to contain infections. Indeed, even more aggressive measures may need to be taken to drive transmission down to a level where this strategy would work. The goal of business closures is not to suppress economic activity. On the contrary, it is the only way to solve the public health crisis that is blocking the U.S. economy's path to recovery.

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Center for American Progress

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DRIVE INNOVATION INFOGRAPHICS JULY 09, 2020

How Will COVID-19 Unfold in 2020's Second Half?

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Editor's Note: The following article is part of an ongoing series offering our strategic advice and expertise on what healthcare industry stakeholders should do immediately in response to the rapidly evolving novel coronavirus (COVID-19) pandemic.

KEY TAKEAWAY

Some countries (like Germany and Norway) have seen their population's mobility increase without significant increases in the spread of COVID-19. #OWHealth

The first half of 2020 was marked by the emergence of COVID-19 and its rapid global spread. Countries navigated their way through initial suppression and in recent weeks, tentative reopening. Early questions revolved around potential scenarios – three months, six months, and beyond. As we described in May (*The Long Haul*), we have now entered the long haul of suppression, with the virus becoming endemic, flaring periodically in various geographies. The virus could be eradicated with the invention and global distribution of an effective vaccine, a cure, or a therapeutic that drastically reduces the burden of the disease; eradication of the virus may also be aided by rising herd immunity if natural infection confers protection for significant enough periods.

Questions now revolve around a longer time frame – what does the rest of the year look like? How do we return to work and school and manage economic activity while co-existing with the virus? How much of our previous, normal lives and economy can we reclaim without new waves of infection that threaten to overwhelm our health system? Below, we lay out our perspective on these key questions.

Many countries across the world and all US states have made steps towards reopening; many have well over a month of reopening behind them while others are just now entering their first and second phases of reopening. As per Exhibit 1 below, the United States in particular is seeing increasing new case counts and hospitalizations by at least 10 percent in 39 states, largely clustered in the South and West of the country.

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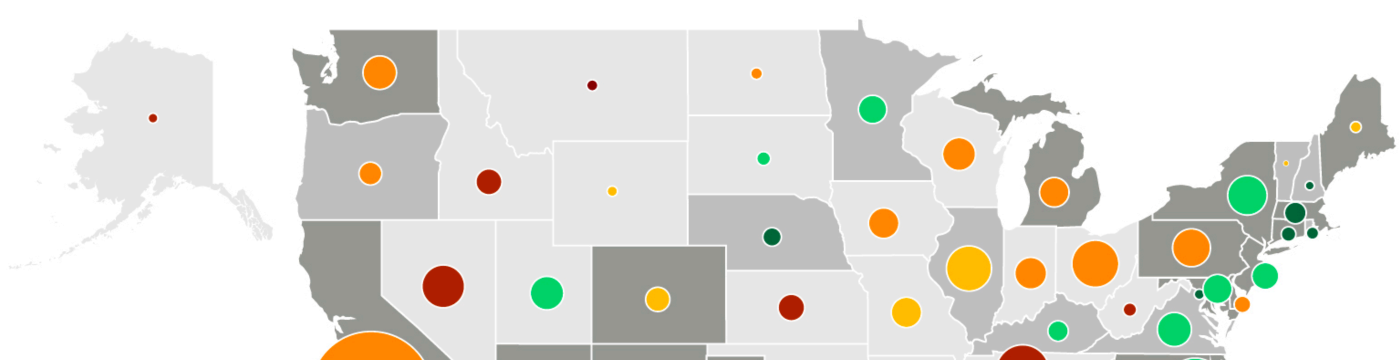
DESPITE STRONG RECOVERY IN THE NORTHEAST, THE US IS EXPERIENCING ALARMING RESURGENCE, ESPECIALLY IN THE SOUTH AND WEST



South/West
High risk

- 9 of 10 states with highest active cases are in South (CA is 2nd)
- Several states (AZ, FL, TX) have positive rates of 15–25%
- Health system capacity is already or soon to be strained, resulting in elective procedure suspension, business reclosures, and mandates for masks in public in some states

Rural States
Moderate–high risk

- All fully reopened and fared well for multiple weeks
- Though some case counts are still low, others (ID, NM) are comparable to other western hotspots

Midwest
Moderate–high risk

- Cases rising across most of the region after a number of weeks of flat to declining growth
- Many states (IA, IN, KS, NE) have concerning rise in positive test rates >5%

Northeast/mid-atlantic
Low–moderate risk

- Generally hit hard by initial outbreak
- Cautiously reopening after case decline, though many (NY, NJ, DE) have paused reopening plans

Legend:

% Change in new daily cases — 2 weeks (bubble size represents number of active cases): 0% or less · 1–25% · 26–50% · 51–100% · 101%+

Fully reopened[1] more than 4 weeks · Fully reopened[1] less than 4 weeks · Partially reopened

1. "Fully reopened" defined as when a majority of high risk businesses, including bars, movie theaters, or gyms, have been reopened with indoor service. This chart does not account for regulatory restrictions that may or may not be in place in those businesses, including mask wearing or capacity constraints.

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Of concern are states with high levels of total active infections (including estimated undetected cases) per million (such as Arizona, South Carolina, Arkansas, Texas, Florida, Mississippi, and Alabama) and an instantaneous reproduction rate R(t) significantly greater than 1, leading to exponential growth of active cases and new cases.

As we have mentioned repeatedly, some resurgence of the virus is expected, but why have these states seen such alarming growth? There are multiple reasons, but here are the main ones:

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WHY ARE SOME STATES EXPERIENCING SHARP COVID-19 SPIKES?

1. Reopening without a significant enough decline in total active cases, i.e., the total new cases in the previous 14 days was too high, leaving too much active infection circulating in the community.
2. Reopening strategies, overall guidance, and individual behaviors are laxer than in places that experienced a significant initial infection wave.
3. Moving rapidly from one reopening phase to the next, without being sure the geography doesn't experience a subsequent and significant uptick in cases with each stage of reopening, allowed active infections to continue to circulate in the community.
4. Mask wearing has become a political statement, and many individuals have considered not wearing a mask as a matter of personal freedom, rather than of public health and safety.
5. States seeing significant new growth have all reopened venues that represent some of the riskiest settings (such as bars and indoor restaurant dining).
6. Rising temperatures are now driving individuals back into air-conditioned spaces where transmission is much more likely.

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First, reopening without a significant enough decline in total active infections, simply put, meant the total of new cases from the past 14 days left too many active cases circulating in the community. To use an analogy with forest fires, the number of active cases represents the current size of the forest fire. Achieving R(t) below 1 gives us an indication that the fire is beginning to shrink but it is clearly also important to understand how big the fire is before deciding whether it is an appropriate time to reduce measures to contain it. A large but shrinking fire is as much of a concern as a small but growing fire.

Second, states (and individuals therein) spared early may not have had a full appreciation for the impact that nearly exponential spread of the virus could have in their geography (for example, overwhelmed hospital systems and the worsening of outcomes for unrelated diseases and conditions). As a result, reopening strategy, overall guidance, and individual behavior are more lax than in places that experienced a significant wave of infections initially.

Third, reopening too rapidly between phases without time to measure the impact of each phase was detrimental. While the number of undetected cases (for example, asymptomatic cases) is not directly observable, it should be factored into any decision. Otherwise, we would underestimate the total size of the problem. Our best estimate for total cases is currently six times, and could be as high as 10 times, the number of confirmed cases in the US. This translates to between five and eight percent of the total population. For Mexico, where testing per population is very low, our best estimate is undetected cases are 38 times confirmed cases.

Fourth, consider lax guidance on/lack of compliance with behaviors that prevent transmission. Driven by a combination of political stances, personal beliefs, and quarantine fatigue, perhaps exacerbated by weeks of mass public protests, we have seen significant variation between states concerning mask wearing and social distancing. We know from multiple research studies these behaviors work to reduce transmission. (For example, a *Lancet* study suggested just one meter of physical distance could reduce the chance of infection by up to ten percentage points). We see a strong correlation between behavior and case growth. Sixteen states recommend, but do not require, their residents wear masks in public. In those states, new coronavirus cases have risen by 92 percent over the last two weeks. In the 15 states that have mandated wearing masks in public for at least a month, new cases have risen by only 17 percent over the last two weeks. Mask wearing has (unfortunately) become a political statement and many individuals have considered not wearing a mask a matter of personal freedom, rather than of public health and safety. In addition to the actual protection they provide, masks serve as a reinforcement of on-going vigilance – they signal, "we know this isn't over and we are continuing to keep each other safe."

Fifth, rapid re-opening of some of the riskiest settings (such as bars and indoor restaurant dining) exacerbated transmission. States seeing significant new growth have all reopened these venues to some degree. Not only are these venues riskier due to sustained, proximal interaction between individuals in a setting with recirculating air, but the atmosphere could contribute to increasingly risky behavior (for example, noisy environments drive individuals to shout and sit or stand in close proximity to each other, and consuming alcohol lowers inhibitions around maintaining distance). While there is substantial variation in hygiene, distancing, and capacity requirements by region, in the 13 states (including DC) that had not reopened indoor bars by mid-June, new cases have fallen by three percent over the past two weeks. In the 38 states that had reopened indoor bars, cases had risen by 98 percent over the past two weeks.

Lastly, rising temperatures are driving individuals back into air-conditioned spaces such as gyms, restaurants, and bars where transmission is much more likely, since rapidly recirculating air gives momentum for the virus to travel distances within closed spaces.

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WHAT HAVE WE LEARNED FROM THE FIRST SIX MONTHS OF THE COVID-19 ERA?

1. **Some homes pose greater risks.** Certain living situations (like the tight confines of a nursing home, homeless shelter, or a ship) mean certain people have a greater risk of becoming infected.
2. **Infection isn't one-size-fits-all.** Some specific populations of people are more likely to develop severe infections that may result in hospitalization, respirator usage, or death.
3. **Washing your hands may save a life.** The infection of others can be prevented or controlled by measures like hygiene, selective quarantines, wearing masks in public, and social distancing (which all require enforcing).
4. **We've learned we're still learning.** Although those who get infected develop antibodies, we don't know for how long or to what extent antibodies protect people from future novel coronavirus infections.
5. **We're still determining the long-term impacts on COVID-19 survivors' health, but residual damage is possible.** Certain COVID-19 positive patients suffer long-lasting ill effects even after they "recover" and have tested negative.
6. **Mental health must be a key focus.** Fear of the virus, lockdowns, financial worries, and disruptions from further shutdowns have brought on and/or exacerbated anxiety and depression, spurring concerns about a "secondary pandemic."

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This coronavirus is novel, meaning it's new in humans and as of yet we have no 'herd immunity' to it. Without mitigation efforts, it is very contagious. We know the virus spreads efficiently through the air and is transmitted through speaking (especially by coughs and sneezes within three to six feet), and actions like singing and shouting at greater distances. Further complicating matters, a large number of infected people may show no symptoms but can still transmit the virus to others. Therefore, this is not just about asking the obviously symptomatic to self-isolate. It's about asking **everyone** to take measures to protect one another. Here are several considerations:

First, certain situations place people at a greater infection risk. These include tight living quarters (such as group homes, nursing homes, homeless shelters, and crew quarters on ships), places where people are in enclosed spaces for long periods (such as bars, restaurants, churches, and movie theaters), retail settings where staff have continuous and close contact with the public, and any air-conditioned crowded spaces with rapidly recirculating air.

Second, certain groups are at higher risk of developing severe infections resulting in hospitalization, and death. For a variety of reasons, these include people over 60 years old, people with underlying lung, heart, cancer, or diabetes diagnoses, as well as people of lower socioeconomic status.

Third, infecting others can be reduced by (all) people wearing masks in public, practicing social distancing, frequent handwashing, and asking those who are infected (and their close contacts) to quarantine.

Fourth, individuals with infections respond by developing antibodies thought to protect them from reinfection periods, though we currently don't know for how long. Individuals with asymptomatic infections appear to develop lower levels (and in some, no levels) of antibodies. Whether these people are protected is unknown.

Fifth, certain COVID-19 positive patients suffer long-lasting damages and illnesses even after they test negative and have "recovered" from the virus.

Lastly, fear of the virus, the isolation and loneliness of shutdowns, the financial worries, and disruption from potential subsequent lockdowns to suppress a rapid resurgence lead to anxiety and mental health concerns.

From a public health perspective, the main goals of suppression measures have always been to protect the highest-risk people and to manage the number of infections below hospital system capacity to allow clinicians to care for COVID-19 patients AND the patients with everyday illnesses in their communities (such as heart attacks, strokes, appendicitis, and cancer). Doing this can protect economic health by giving employees and consumers confidence in the geography's ability to contain the virus.

So What Do We Do Now?

In short, get R(t) of total cases under control in places where it has increased to the extent that hospital capacity is threatened or has been exceeded. Elsewhere, keep as much of the economy open as possible – particularly in temperate months where outdoor activity is easily managed (in the US, for example, this includes Summer and early Fall in the Northeast and Midwest regions, or Fall and Winter in the South).

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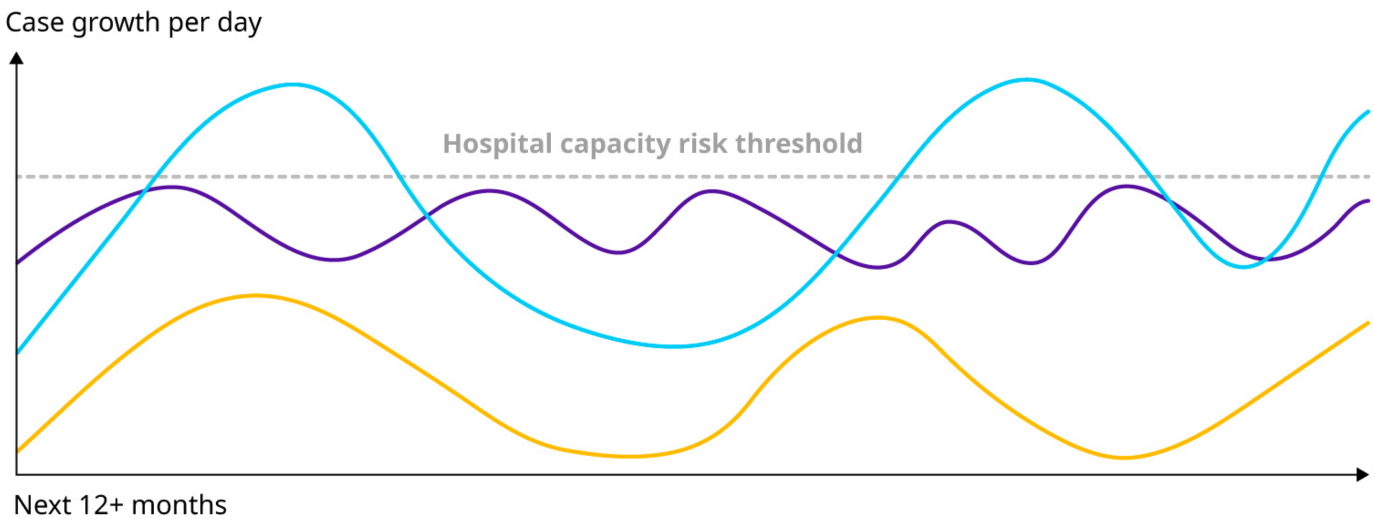
FINDING THE OPTIMAL R(t) BALANCE

States should strive to keep as much of the economy open as possible without overwhelming the health system

Case growth — the long haul of suppression



1. Managing R(t) —

Proactively tighten and ease suppression to maintain balance and keep R(t) just <1; proper testing important to accurately calculate R(t)

+ Economy is as open as possible without threatening health infrastructure
+ Maximal herd immunity without overwhelming health system[1]
+ Limited need for reactive, destabilizing suppression measures

2. Rapid Case Growth —

Limited suppression measures until health system strain is too high, followed by broad, reactive suppression measures in response

+ Rapid progress towards herd immunity during "open" periods[1]
– Economic instability driven by need to reclose broadly when case counts rise too high
– Population less willing to "reclose", leading to lower compliance and less effective suppression

3. Cautious suppression —

Targeted suppression measures levied well before growth approaches risk threshold

+ Limited public health risk
+ Lower case count enables targeted suppression
– Higher likelihood of extended unemployment/ economic disruption
– Longer road to herd immunity[1]

1. Assumes protective immunity is conferred and lasts long enough for herd immunity to be impactful

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As per the above exhibit, aside from revitalizing the economy, a potential benefit of this approach is the accelerated progress towards achieving herd immunity, if infection confers protective immunity for a significant enough time (ideally, at least a year). Here are five suggestions on how to do this:

1. Understand hospital capacity thresholds – particularly intensive care unit (ICU) capacity in each geography – and closely monitor them to understand how R(t) is changing, for how many days you can afford to run at that R(t) before breaching hospital capacity, and what options will slow down R(t).

The better we understand this and the more time we have to act, the better we can make smaller, timely adjustments and prevent the need for blunt lockdown measures. For example, regions across New York must have at least 30 percent of ICU and hospital beds open to move forward with reopening, and the local government has indicated it will reverse course in regions with substandard figures.

In states with significant new growth, we are already facing new disruption risks. On June 25, Texas Governor, Greg Abbott, issued an executive order suspending elective procedures in four Texas counties given the rapid rise of cases in Dallas. Despite "abundant" capacity on June 22nd, now current projections show Dallas Fort-Worth (DFW) reaching full capacity as soon as mid-July, though surge capacity is ready to be deployed. As cases rise, we expect more pauses on elective procedures to follow – leading to significant financial ramifications to health systems already damaged by revenue loss in the last few months. In early July, Abbott mandated that Texans living in counties with more than 20 coronavirus cases wear a face covering in public.

2. Decouple mobility from transmission through the right behaviors.

During the pandemic's early stages when we were sheltering in mass scale, mobility rates and the transmission rate of the virus were tightly correlated. As we reopen, however, we are learning about the impact of allowing certain activities to resume, and that mobility and the transmission rates are not always tightly correlated. We've also learned from the examples set by other countries who experienced outbreaks before the US. Some countries (like Germany and Norway) have seen their population's mobility increase **without** significant increases in the spread of the virus. We believe this is driven in part by learned behavior – wearing masks, washing hands, keeping socially distant, and conducting continuous screenings with selective quarantines for those who test positive. Countries and states that have made this a part of their culture (often in response to experiencing a "tsunami" first wave, or experience with a prior pandemic), are seeing greater reopening success. In the US, this culture must be made more consistent across states and reinforced by the government and private sector. Employers are well-positioned to educate and influence their employees to drive the right kind of behavior (such as mask wearing, social distancing, and self-reporting symptoms without fear of repercussions). This will require consistent and repeated messaging, the right forms of support (including mental health and wellbeing), and appropriate policies (such as no loss of pay if an individual has symptoms and needs to stay home).

3. Shift towards safe(r) interactions.

The past six months have helped clarify which activities and venues pose the greatest risks and which ones are relatively safer. We have also learned there is tremendous heterogeneity in transmission – many interactions lead to no transmission at all, while others turn into "super spreading" events. Shifting as much activity outdoors as is feasible is a clear first step, but what about the highest risk settings – bars, restaurants, gyms, and churches? Can we re-imagine operations sufficiently through spacing, reduced capacity, physical barriers, and improved ventilation, or are some of these simply too risky to be opened?

As per the below exhibit, evidence from reopened countries suggests the answer may be yes, but only after active caseload has diminished significantly and with a strong revision of current operations:

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REOPENED ACTIVITIES AND VENUES FALL ON A BROAD SPECTRUM OF RISK

We can reopen the riskiest, but it will require reimagining operations

Less risky

Can easily accommodate and enforce distancing, PPE, hygiene protocols, and capacity limits; largely outdoors

- Car dealerships
- Takeout
- Medical appointments
- Outdoor recreation (e.g. golf, fishing, tennis)

More risky

Can reasonably implement safety protocols, but contact above recommended levels is likely; indoor activities that facilitate transmission

- In-store retail
- Dine-in restaurants
- Office space (e.g. corporate buildings)
- Public transit
- Appointment-based personal services (e.g. nail salons, barbershops)

Most risky

Can not reasonably enforce safety protocols; indoors with limited circulation; mass gatherings or events not conducive to distancing; spaces conducive to yelling/singing

- Movie theaters
- Bars
- Concerts or sporting events
- Religious services
- Gyms/fitness studios

Can regions safely reopen most risky businesses?

Reopening should likely wait until cases are extremely low

- New daily cases were <20 when **Norway, Finland,** and **Hong Kong** reopened bars; all have remained open since
- **New Zealand** waited until it had multiple consecutive weeks of no new cases to reopen large gatherings and sporting events
- Concerts are still banned in a variety of successful countries, including **Germany** and the **Netherlands**

The "new normal" requires new standards and operating procedures

- Sports in **Norway** have reopened with strict measures determined by current infections, allowing for continuous operation
- Movie theaters throughout Europe and Asia have begun reopening, albeit with limited capacity, plastic dividers to separate staff/patrons, and limited concessions
- **Germany** instituted a singing ban for reopened churches

Authorities should be prepared to reclose if necessary

- It is likely too early to fully determine the impact of reopening higher risk businesses; reclosing may be necessary in light of rising cases
- **South Korea** quickly shut down bars and nightlife when an outbreak was traced to a series of clubs; they remain shut
- **China** broadly shut down high risk businesses after an outbreak in Beijing; they remain shut

Source: NYT, Business Insider, Michigan Live

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4. Learn to use the entire toolkit wisely so we don't have to use the hammer.

Blunt shutdowns are a crude tool and damage the economy the most. We must learn to purposefully use tools with demonstrated effectiveness.

As we've written elsewhere, extensive testing is a smart containment measure that will allow us to detect emerging risks early and deploy targeted suppression measures. Nationally and globally, the impact of COVID-19 is heterogeneous with some communities much more heavily impacted and others relatively untouched. Testing should be conducted both for people with symptoms, as well as random tests of high-risk groups and the general population. Optimal testing levels are indicated by a positive rate of < five percent.

Extensive testing allows for early detection at the local level – it's critical to pounce on an outbreak early before it precipitates broader lockdowns. Our proprietary Pandemic Navigator suite of forecasting assets allows you to see for a given geography where active cases and thereby hospitalizations are trending over the next several weeks, and helps hospitals and local officials predict when that hospital system capacity will be breached. This is typically a limit when local officials have had to ask businesses to close and citizens to stay home.

But testing alone is insufficient. Public health officials will need to immediately follow-up on positive or suspected cases (infected, or exposed people) to quarantine. Rapid tracing to test close contacts is essential for containing micro-regional outbreaks.

In worksites and other public areas (such as restaurants and retail stores), screen employees for COVID-19 symptoms and require masks for both employees and customers, particularly when people cannot maintain six feet of social distancing. Prohibit those who fail to comply from entering.

5. Aim for broader immunity.

If protective immunity is conferred by infection and lasts at least a year, and vaccine availability in mass scale is not expected for more than a year, we can then consider whether we are comfortable with the risks and implications of **purposefully** pursuing broader herd immunity through natural infection ahead of vaccine availability.

Let's assume for the moment that natural infection confers immunity for a year or more. In this scenario, an increase in the total number of cases acts as a brake on the spread of the disease, slowing down the average R(t) of the population proportionally for the same set of activities. For example, if 30 percent of the population is immune by a target date, then R(t) is reduced by 30 percent. This is important because it then means that we can deploy **fewer** suppression measures to keep R(t) below 1. The benefit of broader immunity is especially important to address seasonality concerns and prepare for a potential large outbreak in the winter.

There may be another brake to slow the spread of the virus in the future. Recent studies have revealed the novel coronavirus is transmitted heterogeneously, meaning some infected people cause very few new infections, while other infected people cause many. This is due to biological and behavioral variations in different segments of the population (for example, 20- to 30-year-olds tend to come into contact with more people than 70- to 80-year olds do). This in turn suggests the threshold for herd immunity may in fact be **lower** than the figures calculated from homogeneous models. In a homogenous model with R=2.4, herd immunity level is 88 percent, and the herd immunity threshold is 58 percent. We have modeled these variations in biology and behavior as differences in exposure and susceptibility among different segments of the population. Our modeling of this heterogeneous transmission rate suggests a lower herd immunity level on average for the total population, potentially by 20 percentage points or more. This dynamic is a critical input into developing long-term strategies to shield the elderly and other vulnerable populations, and in reducing the herd immunity level required for these sub-populations (for example, targeting <15 percent by the time herd immunity level is achieved) while maximizing herd immunity level for healthy young adults (for example, targeting >90 percent).

The obvious flipsides to these potential benefits are accelerated infections, hospitalizations, and likely even deaths.

What Might the Next Six Months Look Like?

Much of it depends on us. Can we shift our culture and embed critical behaviors into our daily lives across states, employers, and individuals? Can we creatively reopen some of the riskier settings (such as closing streets to traffic to allow for greater outdoor space for restaurants and bars and then shifting to a ski lodge mentality and having people dine outdoors in winter)? Can we protect our elderly and high-risk individuals as the healthier population circulates in society? Can we use data and technology to purposefully direct testing and any required re-closures? Can we accurately predict changes (especially increases) in disease transmission rates? Will the government implement control measures if transmission rates increase alarmingly? Will individuals comply with those measures and adopt changes to their daily routines?

If the answers to these questions are yes, then the second half of the year can begin the process of economic recovery and a return to a re-envisioned normal. Lessons from around the globe make it clear that while eradication is not possible at this moment, a return to public life is.

TOPIC COVID-19 Future Market Government Programs Infographics

NoiseNews

NoiseNews > Articles > UK Government Introduces New Covid Noise Limit For Bars, Pubs & Restaurants

UK Government Introduces New Covid Noise Limit For Bars, Pubs & Restaurants

29th September 2020

Featured, News & Press Releases, Noise at Work, NoiseNews Round-Up

The hospitality sector has had new temporary regulations imposed on it, in a bid to limit the spread of Covid-19. The amendment to the Health Protection (Coronavirus, Restrictions) (Obligations of Undertakings) (England) Regulations 2020 introduces a new Covid noise limit of 85dB(A) for any music played in cafes, bars restaurants and hotels and came into force on 28th September, as is enforceable by law.

> *(1C) A person responsible for carrying on a business of a public house, café, restaurant or bar (including a bar in a hotel or members' club) must, during the emergency period, ensure that no music is played on the premises which exceeds 85db(A) when measured at the source of the music.*
>
> *Public Health England, 2020*

Advice on keeping noise levels as low as possible was introduced when the UK's Coronavirus lockdown restrictions began to ease back in July. This new amendment to the law makes the Covid noise limit of 85dB(A) a legal obligation rather than a recommendation, meaning premises that don't comply could be hit with a fine of up to £10,000.

This new legislation only applies to pre-recorded music; live performances are exempt.

What this means for those working in the hospitality sector is that they should conduct regular noise level checks in areas where music is played to ensure that they are not in breach of these new restrictions as part of their preparations to be Covid-secure.

Cirrus Research can help you ensure you comply with the new Covid noise limit

These noise level checks can be conducted with a simple sound level meter, such as the CR:308/CR:310, but should be a Class 2 instrument as a minimum, as this is the standard requirement for the measurement of occupational noise, as dictated by the Health & Safety Executive. The CR:308/CR:310 is available to purchase as a standalone sound level meter or as part of Cirrus Research's 'Way-Back' Pack, which includes the products to help organisations get back to work safely amidst the challenges posed by the Covid-19 pandemic.

The Cirrus Research 'Way-Back' includes:

- CR:308/CR:310 entry-level sound level meter
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Message...

CDC coronavirus guidelines for the holidays: No singing, alcohol or loud music

By Ben Axelson | baxelson@syracuse.com

Updated Nov 18, 2020; Posted Nov 18, 2020

A view of the Thanksgiving feast at Zehnder's. (Courtesy of Zehnder's of Frankenmuth)Courtesy of Zehnder's of Frankenmuth

The Centers for Disease Control and Prevention have issued new coronavirus guidelines specifically for gatherings with family and friends around the holiday season. The guidelines list which celebratory activities are considered high risk for the spread of coronavirus, and suggest alternative, low risk ways to adjust your Thanksgiving, Christmas and other holiday season get-togethers this year.

What activities are high risk?

According to the new guidelines, people should modify their holiday plans to avoid singing or shouting, as these activities can increase exposure to respiratory droplets like saliva. They also recommend limiting the volume of music to prevent the need to shout, and limiting the consumption of alcohol to help keep judgement intact regarding Covid-19 prevention measures.

Shopping in crowded stores is also considered high risk, and many Black Friday retailers have taken steps to curb the regular holiday rush this year. Participating in or watching a crowded race and attending a parade or a large indoor gathering with people who aren't from your household are also all considered high risk. See the full guidelines here »

What activities are low risk?

There are still plenty of traditions you can uphold. For example, the CDC says it's still fine to do a sit down dinner, as long as it's with a small number of people who live in your household.

» Zoom lifting 40-minute limit on free calls so families can visit on Thanksgiving

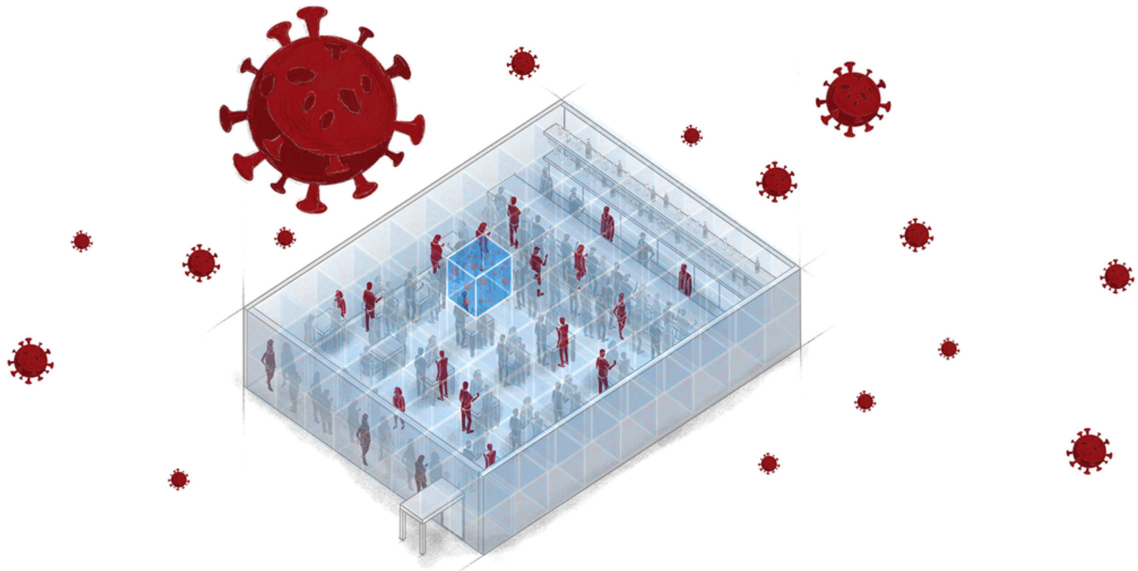
Shopping online, watching sports and parades on TV from home and gathering virtually with loved ones are all low risk. The key is to avoid large groups, and to stay vigilant about regular coronavirus prevention measures, like social distancing, mask use and regular hand washing and hand sanitizer use.

So, can I gather with family?

The holidays are what they are, and while the CDC recommends staying home and not attending large gatherings, there are ways you can still limit exposure if you absolutely must attend a large gathering:

- Quarantine for 14 days before and/or after the event
- Get tested before visiting people who aren't in your household
- Host your regular indoor gathering outside as much as possible
- Increase ventilation and air circulation by opening windows if possible
- Have guests bring their own food and drink. Avoid potlucks
- Maintain normal Covid-19 prevention measures, like social distancing, mask use, hand-washing and high-touch surface cleaning

It's also important to stay informed about the local regulations and Covid-19 risk assessments where your gathering is taking place. New York, for instance, has a 10-person limit for gatherings in private homes. You can also use this tool to see the odds of someone at your gathering having coronavirus for every county in the country.



Why bars are hot spots for COVID-19 transmission

Scientist explains how concentrations of COVID-19 can build up indoors within hours

Ramon Padilla, USA TODAY

Updated 12:20 p.m. EDT July 18, 2020

Recent reopenings and hasty reclosings of bars in Arizona, Florida and Texas and other states raise the question of whether bars are hot spots for COVID-19. Scientists and doctors offer reasons why drinking in a bar can be dangerous.

Social distancing for COVID-19 is often forgotten at bars

When you drink, you're more likely to forget about the virus and social distancing standards.

"Alcohol lowers your inhibition and judgment, and in the setting of loud music in a bar or nightclub, often makes you move closer to other people," says Dr. Robert Glatter, E.R. physician at Lenox Hill Hospital in New York.

Simply talking to someone a short distance away poses a threat of viral transmission. Dr. Julian W. Tang, associate professor at the University of Leicester in the U.K. conducted a post-pandemic flu study examining how temperature differences in warm exhaled air could be used to visualize different types of airflows produced by human volunteers.

This phenomenon can be viewed by two related airflow visualization methods, known as Schlieren and shadowgraph photography. The study used both methods to show how breathing, talking, laughing, singing, coughing and sneezing could carry air (and any virus it contains) to other people within a 3-foot distance.

“This study was originally conducted during 2010-12 after the 2009 flu pandemic, but it has developed a new relevance now in the current COVID-19 pandemic,” Tang says. The video below shows what it looks like when two people are talking:

Schlieren technique provided by Associate Professor Dr. Julian W Tang, University of Leicester, United Kingdom

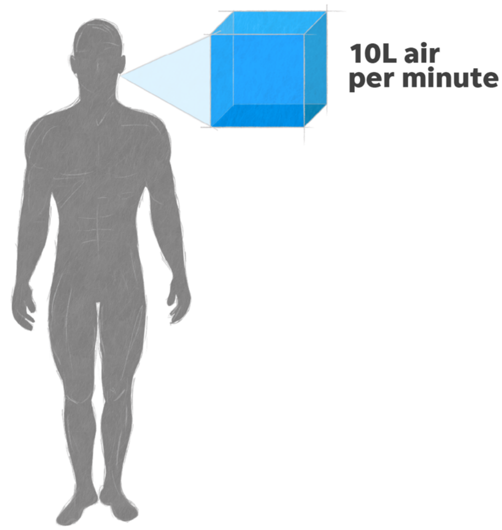
In a poorly ventilated bar, the COVID-19 virus can accumulate

Tang co-authored an open letter to the World Health Organization urging officials to acknowledge that the virus is transmitted via aerosols. The letter also asks the WHO to focus on improving ventilation and air filtration in public places such as bars.

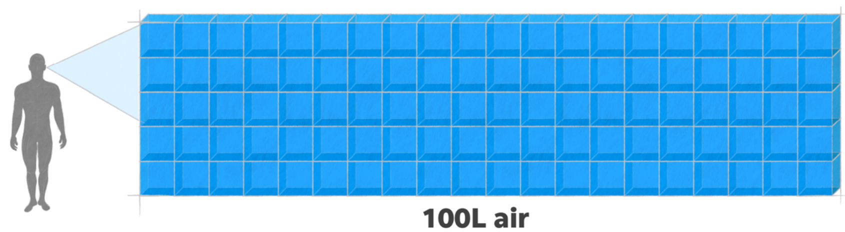
“Ventilation is the key control point for an airborne virus – and this is already in existing infection control guidance under the CDC's 'Engineering Controls',” Tang says. “Based on multiple studies done by the authors of this paper, we believe that optimizing ventilation is the way to move forward: to remove the virus from the air before people inhale it."

Tang explains in the example below how, in the absence of effective ventilation, the virus can fill a bar in a matter of hours:

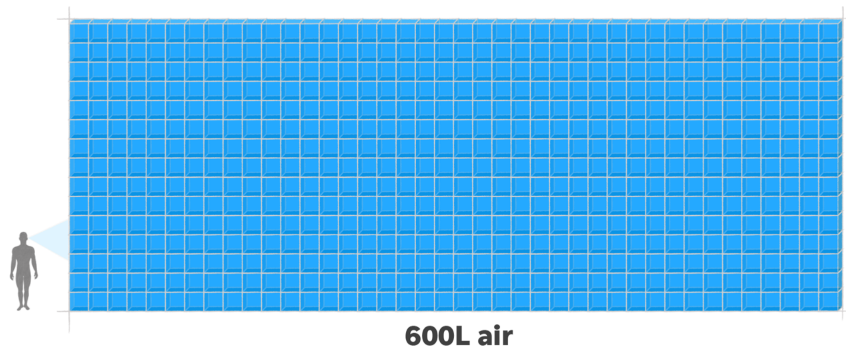
An adult breathes about **12-15 times a minute** - exhaling about 10 liters of air per minute.



In **10 minutes** one person can exhale about 100 liters of air.

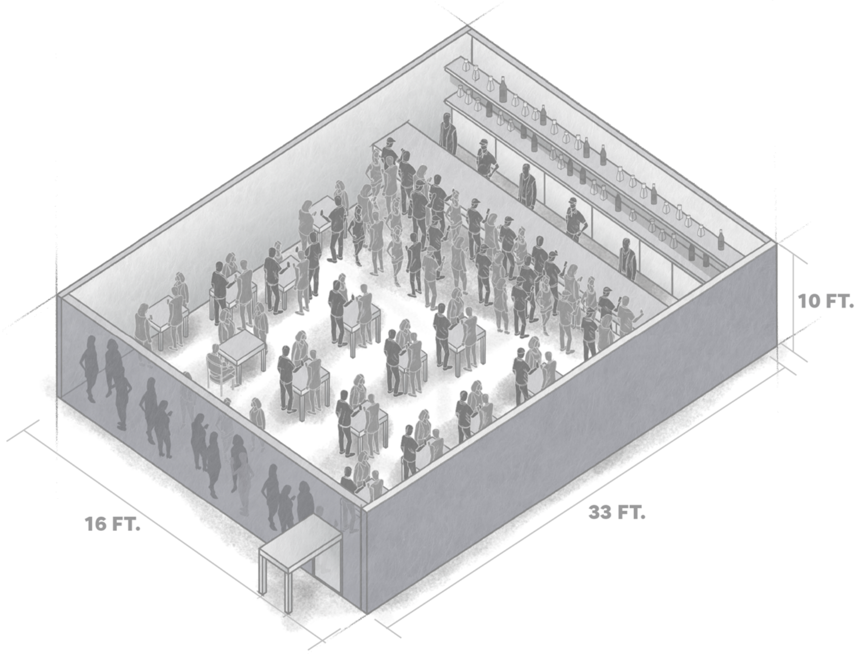


In **1 hour** (60 mins.) one person can exhale about 600 liters of air.

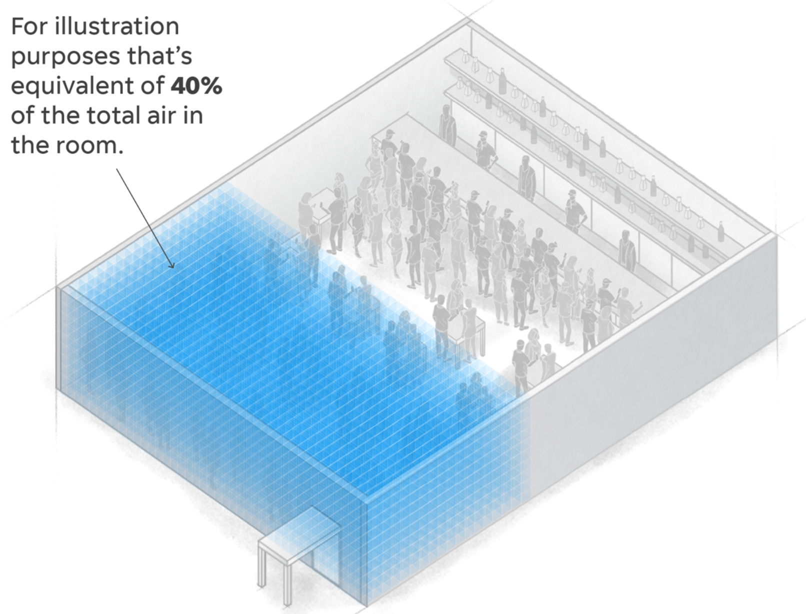


Let's say 100 people are in a bar:

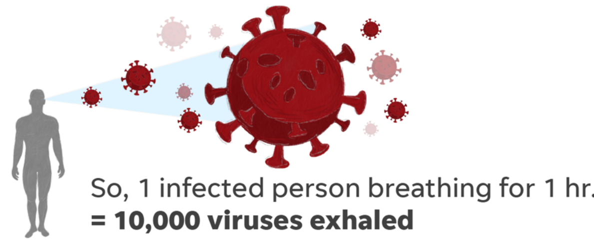
The bar is 10m long by 5m wide and 3m high (approx. 33x16x10 feet)
10x5x3 = **150 cubic meters or 150,000 liters**



Let's say the room lacks adequate air circulation and they stay for **1 hour**, breathing normally.
100 people breathing for 60 mins. = 100 x 600L = 60,000 liters of air total per hour

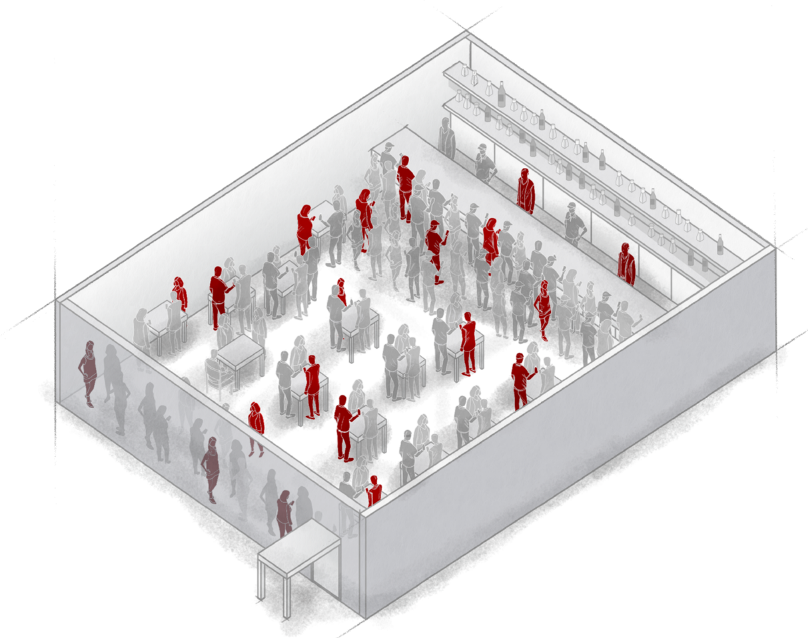


According to a 2013 study of people with flu, participants breath out: 1,000-10,000 viruses every 30 minutes.
Let's assume COVID-19 is similar and let's also use the mid-point of this - say 5,000 viruses exhaled over 30 mins. - or **10,000 viruses per hour**.

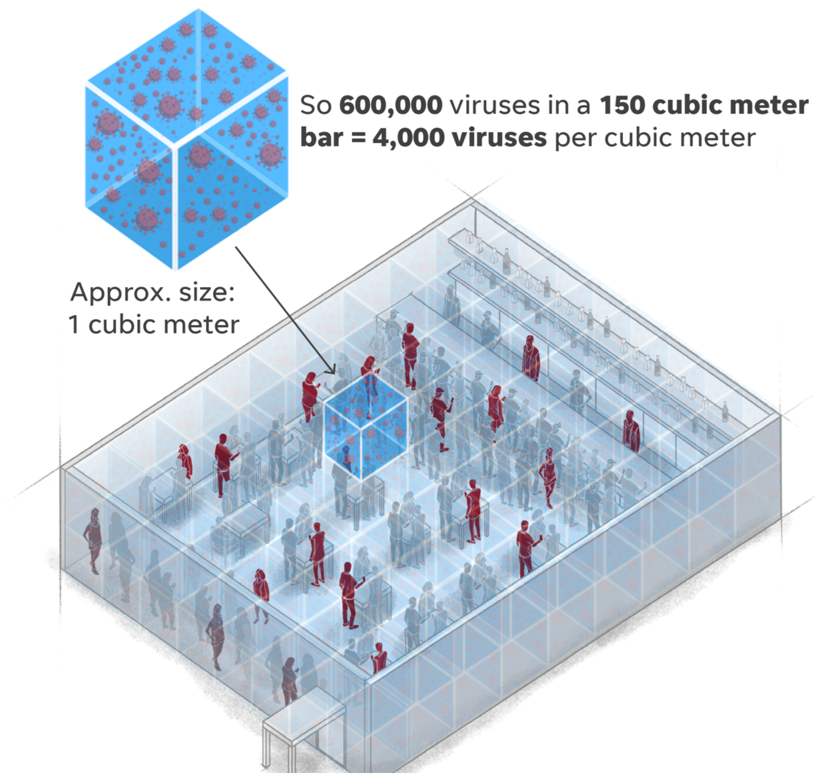


Let's say 20 people are infected in that same bar:

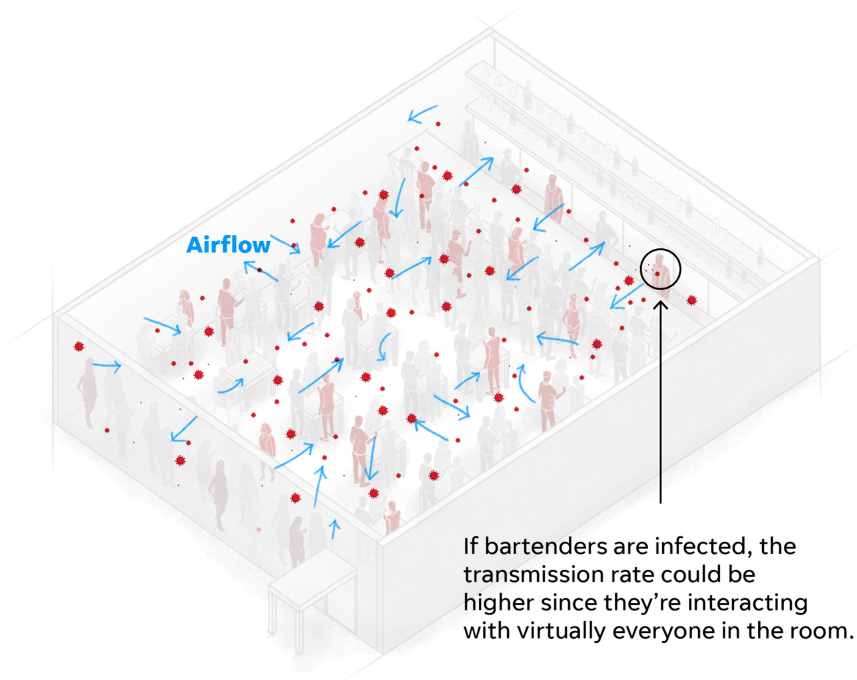
20 people x 10,000 = 200,000 viruses per 1 hr.
If there is limited airflow, this number will increase each hour by **200,000**.
According to studies the virus can survive in the air for up to **3 hours**.



So **200,000 per hour = 600,000** viruses in **3 hrs**.



Even limited airflow will move viruses around. People moving, along with the rising heat generated by their bodies, will mix exhaled viruses in the room.



Viruses in the air are not evenly distributed. They're most likely to be concentrated 4 to 7 feet from the floor, the space in which most people breath.

Leaning in to hear increases COVID-19 risk

In many bars, loud music or noisy crowds force you to move closer to hear.

“When I’m in a loud situation, I tend to turn my head or my ear towards that person's mouth, but then their exhaled breath comes straight towards my face, ” Tang says. “It makes me inhale even more of the air that they are exhaling that could be carrying virus. And louder speaking also expels more droplets.”

Laughing, singing, and loud voices expels more COVID droplets

People often laugh and sing when they drink, which produces larger exhalations than talking.

"As people become intoxicated, they tend to talk louder, tell jokes or sing, which spreads more droplets," Tang says. "If you are telling a joke surrounded by people laughing in response, you may get much more exposure to their exhaled air that may be carrying virus because they are laughing towards you."

It’s impossible to drink something while wearing a mask

"Without close monitoring to wear masks and practice social distancing, bars are certainly one venue ripe for transmission of the virus," Glatter says. "Bars are inherently one setting where social distancing is quite difficult to practice and enforce, primarily the result of alcohol's effects on social interactions."

A recent Twitter post from the Texas Alcoholic Beverage Commission shows an overcrowded scene at a Houston bar that was later closed. Few people were wearing masks or practicing social distancing:

Texas Alcoholic Beverage Commission
@TexasABC

UPDATE: Permits suspended for seven more bars as part of Operation Safe Open. Learn more: tabc.texas.gov/home/press_rel...
Video at The New PR's in Fort Worth and UnBARlievable (West 6th) in Austin 1/3

3:59 PM · Jun 21, 2020

180 136 people are Tweeting about this

Since it is difficult to mask and maintain social distancing inside, one way to reduce your risk is to take the party outside.

"There are three factors that are very effective in reducing transmission risk when outside," Tang says. "First there's a massive air dilution, so the virus will have more air to spread into. Second, if there is wind, this further dissipates the virus. Third, sunlight will damage the virus so it cannot replicate. So my message in the new COVID-19 normal is: 'Have fun - safely!'"

COVID-19 may spread via the air, WHO and medical experts say

The WHO and over 200 medical experts agree with new research that shows COVID-19 could be carried by cough droplets and travel up 26 feet.

ALEXIS ARNOLD, USA TODAY

Originally Published 10:36 a.m. EDT July 16, 2020
Updated 12:20 p.m. EDT July 18, 2020

The New York Times https://nyti.ms/2Z91GMk

A Virus Walks Into a Bar …

As communities open up, it’s becoming increasingly clear that the indoor bar scene is uniquely suited to transmission of Covid-19.

By Tara Parker-Pope

Published June 25, 2020 Updated June 30, 2020

Everything you love about your neighborhood bar — the ambience, the crowds, the music, the free-flowing alcohol — makes it the ideal place to catch Covid-19.

Around the country, bars are becoming a common source of coronavirus outbreaks. In Louisiana, at least 100 people tested positive for the virus after visiting bars in the Tigerland district, a popular destination for Louisiana State University students. In Idaho, health officials shut down bars in Ada County after reporting clusters of infections among young adults who had visited several bars in downtown Boise.

And several Florida bars are the source of large outbreaks. In Jacksonville Beach, a group of 16 friends went to a pub to celebrate a birthday — and within days all 16 tested positive for Covid-19. The Orlando Pride women’s soccer team was forced to withdraw from the upcoming National Women’s Soccer League tournament after six players and four staff members tested positive for Covid-19 — reportedly after younger players visited bars and nightclubs in the area that had reopened.

“Except for maybe a hospital with sick patients, I couldn’t imagine too many more risky places than a super cramped indoor bar with poor ventilation and hundreds of people,” said Dr. Asaf Bitton, executive director of Ariadne Labs at Brigham and Women’s Hospital and the Harvard T.H. Chan School of Public Health. “That to me is a concern from a public health perspective.”

What makes bars so risky? Every bar is different, but many bars are housed in dark, narrow, indoor spaces with no windows and little room to move around. Unlike restaurants, which can space tables far apart, bars typically have fixed bar stool seating along the bar and a layout that forces people to gather closely in clusters.

“People go to bars so they can drink and socialize with other people,” said Dr. Adaora A. Adimora, professor of medicine and epidemiology at the University of North Carolina School of Medicine in Chapel Hill. “They usually want to sit fairly close to each other so they can have intimate conversations. Most people are not going to want to sit six feet apart and yell.”

Long conversations in close contact are believed to play an important role in transmission of many viruses, including the novel coronavirus that causes Covid-19. Research shows that we can release up to 10 times more particles through speech than a cough. The pattern tends to hold up across languages, although for unknown reasons, a small fraction of individuals are “speech superemitters,” making them particularly risky for spewing a large volume of particles in close conversation.

Studies also show that the particles we emit during talking and loud speech are potentially more infectious than the larger droplets we expel during a cough or a sneeze. Smaller particles persist in the air for longer time periods before settling, increasing the risk that someone nearby could inhale them. Smaller particles also can travel further into the respiratory tract.

Studies using a special imaging mirror show how exhaled plumes during speech can easily reach another person’s breathing space during conversation. In the video, Dr. Julian W. Tang, a virologist at the University of Leicester, is having a normal-voice conversation with a student standing about one meter (about three feet) apart. The conversation was similar to “chatting over a beer or coffee,” he said. (The undulating background is caused by body heat.)

“You can see similar plumes exhaled from our nose and mouth, and how the airflow can be inhaled and exchanged between the two of us,” said Dr. Tang. “In a pub, bar or restaurant, if you’re sitting close enough to someone to smell their breath (garlic, curry or alcohol), you could be inhaling any exhaled virus, so this would be too close.”

Bars also tend to play loud music, which can prompt people to move closer together to talk, increasing risk for infection. “Bars have music, and you need to speak louder in order to be heard,” said Erin Bromage, a comparative immunologist and biology professor at the University of Massachusetts, Dartmouth. “You can’t social distance when it’s loud, and you need to move closer to hear a person.”

Dr. Bromage said he has advised bars trying to reopen that even if they move outdoors, they still should keep music levels very low. While quiet music changes the atmosphere, it also allows people to socialize without yelling and getting too close to each other’s faces.

Loud speech can be more risky for viral exposure than normal speech. Last year the journal Scientific Reports, published by Nature, reported that particle emission increases with the amplitude of speech. A person speaking quietly emits about six particles per second, while loud talking (without yelling) emits 53 particles per second. If a person has coronavirus, loud speech would increase the number of emitted particles and the risk of infecting another person nearby.

A spike in cases in South Korea shows the risks that barhopping can pose. In May, a 29-year-old man visited five bars and clubs in Itaewon, one of Seoul’s most popular nightlife districts. He later tested positive for coronavirus, and public health authorities have linked him to more than 100 cases of infection.

Another factor that makes bars so risky is alcohol. When people drink, they can forget that coronavirus is even a worry. “Alcohol of course can disinhibit people and perhaps promote even more breaches of social distance and sharing of drinks and food,” said Dr. Bitton.

While the bar scene is risky, it also depends on the bar. Bars in bigger spaces and newer buildings with good ventilation pose less risk than a crowded basement bar. Although it’s safest to avoid large gatherings altogether, an outdoor bar area with plenty of space to social distance is far less risky than a crowded indoor bar.

Bar owners say that many of the precautions needed to keep bar patrons safe — spaced seating and limiting capacity — would erase already razor-thin profit margins. Opening up sidewalks for bar patrons would require permission from local officials, but it might be a solution for saving neighborhood bars from permanent closure.

“Better to stay outside where the wind can remove the virus and the sunlight can kill it off,” said Dr. Tang. “It is very difficult to saturate the whole atmosphere with virus — even if there are 100 people outside, so the concentration of virus will not build up to high levels like indoors.”

The biggest challenge for slowing the spread of coronavirus may be the demographic group that likes to frequent bars. Around the country, more young people are testing positive for coronavirus after ignoring social distancing measures.

Doctors say more work needs to be done to convince young people to stay away from bars and adopt social distancing measures. According to the Centers for Disease Control and Prevention, there have been 395 Covid deaths in the United States in people between the ages of 18 and 29, and 1,137 in people between the ages of 30 and 39.

“They should consider the possibility that they could easily give infection to someone they love who’s older or who has medical problems that increase their risk of dying from Covid-19,” Dr. Adimora said. “Although young people are less likely to have severe illness from Covid, they can still die from it.”

Tara Parker-Pope is the founding editor of Well, The Times’s award-winning consumer health site. She won an Emmy in 2013 for the video series “Life, Interrupted” and is the author of “For Better: The Science of a Good Marriage.” @taraparkerpope

A version of this article appears in print on , Section D, Page 6 of the New York edition with the headline: How About a Coronavirus on the Rocks?