COVID-19 Campus Introduction and Gathering Risks for Reopening the University of Texas at Austin

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[The University of Texas COVID-19 Modeling Consortium](#)

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Summary

There are more than 50,000 students enrolled at the University of Texas at Austin (UT), with an estimated 80% from Texas, 93% from the United States, and 7% from abroad. The 2020-2021 academic year is scheduled to begin on August 26th. The university is taking steps to reopen safely in light of four COVID-19-related risks:

Introduction risks: UT students returning to Austin from other cities may arrive infected.

On-campus transmission risks: Transmission may occur during classes and other organized UT activities.

Off-campus transmission risks: Transmission may occur through off-campus interactions among members of the UT community.

Community amplification risks: Transmission may spill over from the UT community into the surrounding Austin community.

In order to assist the University of Texas at Austin in safely reopening, this report addresses elements of the first three risks. It provides estimates for (i) the prevalence of COVID-19 among returning students, based on the estimated prevalence of the virus in their home communities, (ii) the number of students that could test positive for COVID-19 in the first week of classes, and (iii) the chance that classes/gatherings will include one or more infected attendees, depending on the size of the group.

In brief, we assumed that 12,000 students are already in Austin and 10,000 additional students will be returning to Austin by August 26th. We note that this conservatively assumes that more than half of students enrolled at UT elected to remain in their home regions for the fall semester.

Using COVID-19 confirmed case data through August 13, 2020, we estimated the prevalence of COVID-19 in Austin and the home counties of returning UT students. The analysis suggests the following risks:

- The estimated prevalence of COVID-19 in the Austin-Round Rock Metropolitan Area as of August 13, 2020 is 0.33%.

- Based on mid-August estimates for local COVID-19 prevalence in the home counties of UT students, the expected prevalence of COVID-19 among the 22,000 returning UT students is 0.50%.

- Prevalence would be expected to be lower if students followed university guidance to quarantine for 14 days prior to the start of classes.

- Between 82 and 183 students may arrive infected during the first week of classes.

- If all UT students in Austin were tested in the first week, between 156 to 341 would be expected to test positive. This accounts for cases that continue to test positive for several weeks following infection but are no longer acutely infectious.

- If each student that tests positive has 10 or more traceable contacts, then thousands of other students may require immediate testing.

- For gatherings of 10 students, there is a 4.9% chance that at least one student will arrive infected; for a gathering of 100 students, this probability increases to 39.4%.

- For a gathering of 1,000 students, an estimated 5 students will arrive infected; for a gathering of 10,000, this number increases to 50.

- Introduction risks may be considerably lower if infected individuals who test positive or are sufficiently symptomatic self-isolate and do not attend in-person classes and events.

Background

COVID-19 emerged in China in late 2019, and began to spread rapidly across the world in early 2020. To mitigate risks of transmission among students, faculty, and staff, colleges and universities across the country migrated classes to a strictly online format during March of 2020. The University of Texas at Austin (UT) moved all classes online on March 17, 2020, through the remainder of the 2019-2020 academic year [1]. As colleges and universities plan for the 2020-2021 academic year, they hope to offer some in person instruction while ensuring the health and safety of students, employees and surrounding communities.

Like many universities, UT has students returning from cities across the US and globe. The risk that these students will arrive infected depends on the state of the pandemic in their home communities and the students' potential exposure to the virus. Such importations can spark outbreaks in the UT and greater Austin communities, leading to disruptions in university activities and strains on testing and healthcare resources. For UT, students returning from other cities in Texas pose a particular risk, given the summer surges in cases that have occurred across the state [2]. To mitigate these risks, UT is asking students to quarantine prior to engaging in campus activities as well as ramping up capacity for testing, contact tracing and isolation/quarantine of infected and potentially exposed students [3].

Here, we estimate the prevalence of COVID-19 among UT students in late August of 2020, based on mid-August estimates for the prevalence of the virus in the home counties of returning students. We account for uncertainty regarding the prevalence of COVID-19 and analyze several scenarios for the numbers of students returning. Using these estimates, we also project the number of students testing positive and the risks of student gatherings of different sizes.

Introduction risks

Using the methods described in Appendix A.1 below, we estimated the prevalence of the virus among UT students during the first week of the semester. We assume that 12,000 students were already in Austin as of August 13th and that 5,000-15,000 will move to or return to Austin by August 26, 2020. The estimates are based on the prevalence of COVID-19 in Austin and in the home regions of students who will be

returning to Austin by August 26th. We do not account for the possibility that social contacts among resident and returning students between August 13th and August 26th could exacerbate transmission and inflate prevalence.

Under the scenario of 12,000 students already in Austin and 10,000 returning before August 26th, we would expect that between 82 and 183 students would be infected during the first week of classes (Figure 1A, Table 1). This corresponds to 0.37%-0.83% of the UT student body living in Austin for the fall semester (Figure 1B, Table 1). These estimates depend on the number of students returning from outside of Austin. Intuitively, fewer students mean fewer people that could be infected. Moreover, the prevalence among returning students is expected to be higher than the prevalence among students who were already in Austin, based on COVID-19 case data through August 13, 2020.

Table 1. Expected prevalence of COVID-19 among UT students in Austin on August 26th. Estimates are provided both as a number infected and a percent of the student body infected in Austin. In estimating the prevalence of COVID-19 in the home regions of Texas students, we *adjust* county-level and country-level reported case counts assuming that the case reporting rate is either 1 in 3, 1 in 5 or 1 in 10. These three values reflect the minimum, median and maximum reporting rates that we estimate across the 22 Trauma Service Areas of Texas [4].

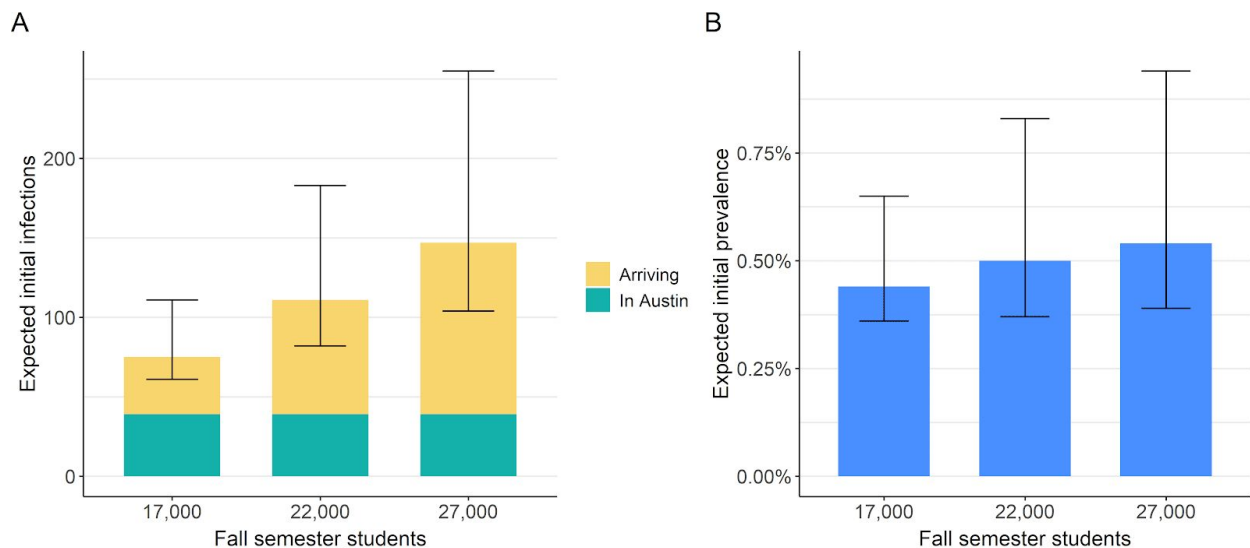| Case Reporting Rate	Number of returning students (plus 12,000 already in Austin)		
	5,000	**10,000**	**15,000**
1 in 3	61, 0.36%	82, 0.37%	104, 0.39%
1 in 5	75, 0.44%	111, 0.5%	147, 0.54%
1 in 10	111, 0.65%	183, 0.83%	255, 0.94%

Figure 1. Expected prevalence of COVID-19 among returning UT students on August 26, 2020. The estimates assume that 12,000 students are already in Austin as of August 13th and that either 5,000, 10,000 or 15,000 will return to Austin by August 26th (three different bars in each graph). (A) The expected number of students initially infected, stratified by those already in Austin as of August 13, 2020 (green) and those returning by August 26, 2020 (yellow). Based on data through August 13, 2020, we would expect roughly 39 of the 12,000 students already living in Austin to be infected. (B) The expected infected percent of UT student body in Austin during the fall 2020 semester. The error lines in both graphs reflect uncertainty in the prevalence of COVID-19 in the home regions of the students: the heights of the colored bars assume a 1 in 5 case reporting rate; the lower and upper bounds assume a 1 in 3 and a 1 in 10 case reporting rate, respectively.

Students testing positive for COVID-19

Infected individuals can test positive (via PCR testing) for over 30 days following symptom onset [5,6]. Thus, the number of students who could potentially test positive for COVID-19 in the first week of classes could be greater than the number of infectious students. Using the method described in Appendix A.2, we estimate the numbers and proportions of UT students in Austin that could test positive for COVID-19 in the first week of classes.

We find that the expected number of students that could test positive is roughly double the expected number of acutely infectious students, ranging from 117 to 473 potential COVID positive students (Figure 2, Table 2). Note that this is based on recent data on upper respiratory tract and nasopharyngeal swab PCR test positivity and may be different for other types of tests, including saliva PCR and serology tests.

Contact tracing and testing scenario

COVID-19 cases among returning UT students would pose not only a health and safety threat, but also a resource challenge. To roughly estimate the resources that will be required to suppress early spread of the virus, we calculate the number of traceable contacts that will require testing under the following simple scenarios: (i) 15,000 students return to Austin in addition to the 12,000 already in Austin, (ii) all students are tested in the first week with a perfectly accurate test and (iii) each infected student has 10 close contacts that are traceable. In this scenario, we would expect that UT would need to test up to 2,750 contacts of positive cases in the first week from importation of cases alone. If fewer students return, fewer students are tested, or students have fewer traceable contacts, then the requirement would decrease.

Table 2. Expected test positivity among UT students in Austin on August 26th. Estimates are provided both as a number testing positive and a percent of the student body testing positive in Austin. In estimating the prevalence of COVID-19 in the home regions of Texas students, we *adjust* county-level and country-level reported case counts assuming that the case reporting rate is either 1 in 3, 1 in 5 or 1 in 10. These three values reflect the minimum, median and maximum reporting rates that we estimate across the 22 Trauma Service Areas of Texas [4].

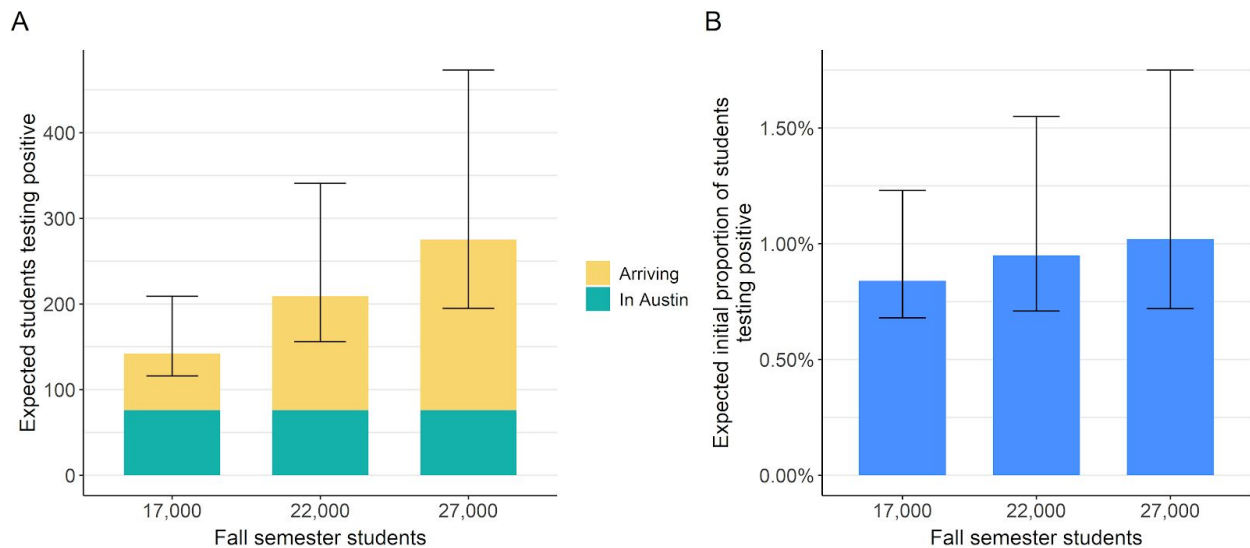| Case Reporting Rate	Number of returning students (plus 12,000 already in Austin)		
	5,000	10,000	15,000
1 in 3	116, 0.68%	156, 0.71%	195, 0.72%
1 in 5	142, 0.84%	209, 0.95%	275, 1.02%
1 in 10	209, 1.23%	341, 1.55%	473, 1.75%

A

B

Figure 2. Expected test positivity among returning UT students on August 26, 2020. The estimates assume that 12,000 students are already in Austin as of August 13th and that either 5,000, 10,000 or 15,000 will return to Austin by August 26th (three different bars in each graph). (A) The expected number of students that could test positive for COVID-19, stratified by those already in Austin as of August 13, 2020 (green) and those returning by August 26, 2020 (yellow). Based on data through August 13, 2020, we would expect roughly 76 of the 12,000 students already living in Austin to test positive from a recent or current infection. (B) The expected percent of students in Austin enrolled in the fall semester that could test positive for COVID-19. The error lines in both graphs reflect uncertainty in the prevalence of COVID-19 in the home regions of the students: the heights of the colored bars assume a 1 in 5 case reporting rate; the lower and upper bounds assume a 1 in 3 and a 1 in 10 case reporting rate, respectively.

Gathering risks

Using the approach described in Appendix A.2, we calculate the risks that classes and other gatherings of various sizes will be attended by one or more infected students. As above, we assume the following:

- 12,000 students are already in Austin as of August 13th

- 10,000 additional students will return to Austin by August 26th

- the prevalence of SARS-CoV-2 among students already in Austin will remain approximately 0.33% through the end of August

- the prevalence of SARS-CoV-2 among students returning to Austin between August 13th and August 26th depends on the prevalence in their home US county or non-US country, which we estimate from reported case counts assuming that 1 in 5 cases are reported

These four assumptions imply an **overall SARS-CoV-2 prevalence among the 22,000 students of 0.5%**.

We compare the risks of gatherings under two assumptions: (i) the SARS-CoV-2 prevalence among the attendees is 0.5%, as estimated for UT students, and (ii) the SARS-CoV-2 prevalence among the attendees is 0.33%, as estimated for Austin overall (Table 3, Figure 3). For a gathering with 100 people, the first scenario implies a 39.4% chance that at least one person will arrive infected, while the second implies a 28.1% chance of an infected attendee.

Table 3. Risks of COVID-19 infected attendees for gatherings of sizes 10, 100, 1,000, and 10,000, assuming prevalence estimated for either Ausin (Travis County) or the UT student body.

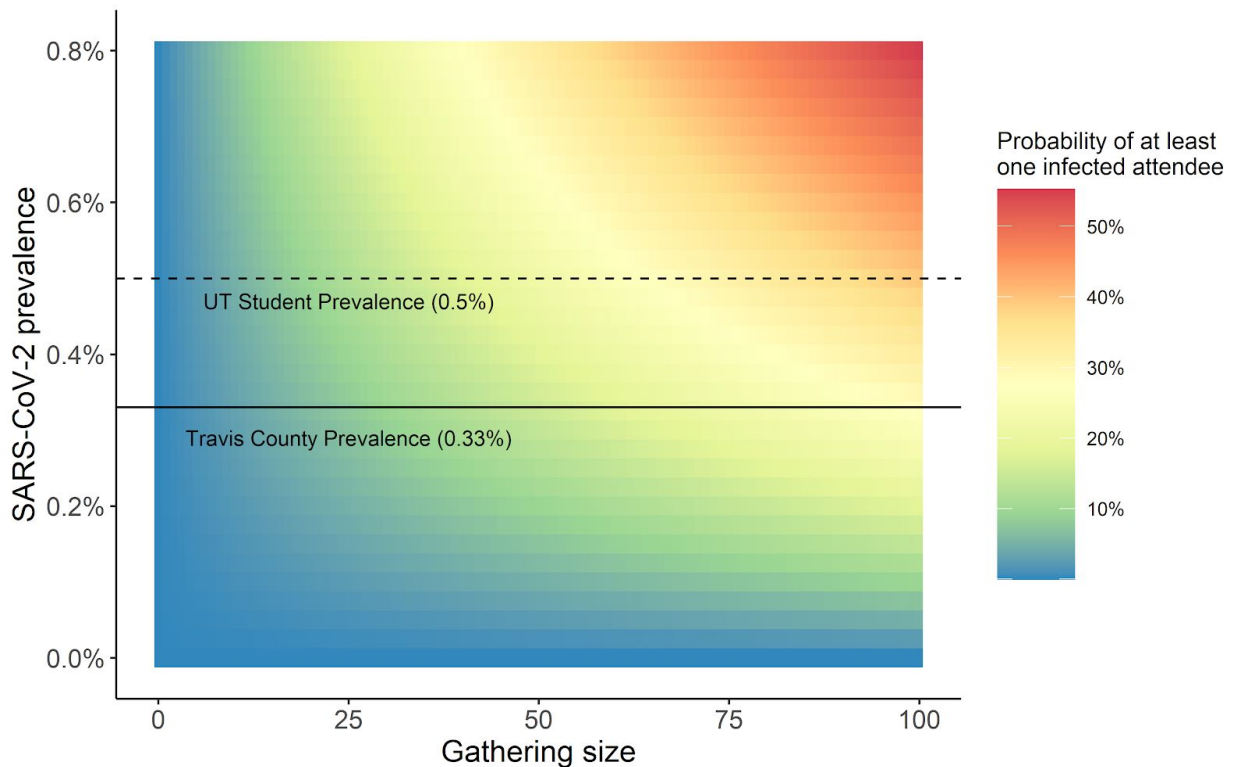| Gathering Size	Expected COVID-19 Infected Attendees		Probability of At Least 1 COVID-19 Infected Attendee	
	Travis County Prevalence (0.33%)	UT Student Prevalence (0.50%)	Travis County Prevalence (0.33%)	UT Student Prevalence (0.50%)
10	< 1	< 1	3.3%	4.9%
100	< 1	< 1	28.1%	39.4%
1,000	3	5	96.3%	99.3%
10,000	33	50	100%	100%

Figure 3. Probability at least one gathering attendee will be infected with SARS-CoV-2 depending on the size of the gathering and the prevalence in the population. Colors indicate the level of risk. The horizontal lines indicate the SARS-CoV-2 estimated for Travis County (solid) and the returning UT student body (dashed) on August 26, 2020.

Final considerations

Roughly 12,000 UT students live in Austin and up to 15,000 additional students are expected to move to or return to Austin between August 13 and August 26, 2020. Based on mid-August estimates for the prevalence of SARS-CoV-2 in Austin as well as the home counties and non-US countries of the returning students, we project that the prevalence of SARS-CoV-2 among UT students at the start of the UT semester may be higher than the overall prevalence of the virus in Travis County. Although recent control measures have succeeded in curbing the alarming early-June surges in COVID-19 hospitalizations throughout Texas, the virus continues to spread in communities throughout the state. Our analysis suggests that over one hundred UT students will likely be infected at the outset and that large gatherings will be risky. Contacts between resident and returning students may exacerbate risks, fuel transmission and deplete public health resources. Thus, wearing of facemasks, social distancing, self-isolation when symptomatic and other risk-reduction measures will be key to ensuring a safe reopening of UT [7].

This approach can be applied broadly to assess the risks of reopening universities. Similar calculations are provided by Georgia Tech's COVID-19 Event Risk Assessment Planning Tool [8] and Tufts University's COVID-Positive Estimator [9].

We emphasize that these estimates should be interpreted merely as **rough guideposts** to inform effective risk communication and mitigation planning. They are based on the following key assumption: the chance that a student will be infected with COVID-19 at the start of the year is equal to the overall prevalence of the virus in their home community. In fact, the prevalence of COVID-19 often varies across age groups, through time, geographically and socioeconomically. Therefore, the risk that a returning student arrives infected may be overestimated or underestimated by the overall prevalence of the virus on August 13th in their home community. As noted above, the introduction risks may be considerably lower if individuals quarantine and self-isolate to prevent spread of the virus and if there is extensive and rapid testing coupled with voluntary precautionary behavior to make reopening safer and more feasible.

Appendix: Estimation Methods

Appendix A.1. Estimating introduction risks

To estimate the number of UT students who will return to Austin infected, we consider the prevalence of the virus in the US county or non-US country of residence for each student. For each home region, *r*, we define the following:

>   *n_r*: the number of UT students originating from region r

>   *p_r*: the probability that a student from region *r* is infected with COVID-19

The expected number of students that will arrive infected from that region is then the product of these two quantities:

$$i_r = n_r \cdot p_r.$$

While *n_r* is known, *p_r* must be approximated. We assume that *p_r* is equal to the background prevalence of COVID-19 in the region. For example, if there are 100 students from a given region with a COVID-19 prevalence of 5%, we assume that 5 students are currently infected. In order to calculate the expected total number of infected UT students *i*, we simply add up the expected number of infected students from each region that UT students come from:

$$i = \sum_r i_r.$$

To determine the number of students originating from various US counties and countries, we obtained county and country-level data for the more than 51,000 students enrolled at the University of Texas at Austin as of July 2, 2020.

Estimating the prevalence of COVID-19 for returning students

For a given home region *r* of a returning student, the prevalence of SARS-CoV-2 *p_r* is the fraction of the population that are currently infected and capable of infecting others. To approximate prevalence, we consider the following four quantities:

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1. **Incidence in reported cases in region _r_, _t_ days ago** $(C_{r,t})$**.** We obtained confirmed case count data from the New York Times and Our World in Data [10,11].

2. **Reporting rate in region _r_** (k_r)**.** Many infections are never reported because they are asymptomatic, mild or not tested for other reasons [12]. In Austin, we estimate that one in three cases is reported [13]. Elsewhere in Texas, we estimate that the reporting rate may be as low as one in ten cases reported [13]. In the analysis below, we assume a 1 in 3 reporting rate for Austin and consider three possible scenarios for reporting rates outside of Austin: 1 in 10, 1 in 5, and 1 in 3.

3. **Duration of the infectious period** (τ)**.** We make the simplifying assumption that newly detected infections are infectious for 7 days after detection [14].

4. **The population size of the region** (N_r)**.**

First, we estimate the number of current infections in a region as

$$I_r = \frac{1}{k_r} \sum_{t=1}^{\tau} C_{r,t}.$$

We then estimate the prevalence in region _r_ as

$$p_r = \frac{I_r}{N_r}.$$

Estimating COVID-19 test positivity for returning students

To account for the fact that some infected individuals can still test positive for COVID-19 many weeks after infection, we modify our prevalence calculation by discounting the number of new student infections with the assumption that 100% infected individuals can test positive on day 1 of infection and that this proportion declines linearly until day 23, at which point none of these individuals test positive. We use the following values to make this estimation.

1. **The number of new student COVID-19 infections _t_ days ago** (i_t)**.**

2. **Maximum duration of positivity period** (γ)**.** We assume that 0% of infected people test positive on day 23 of infection.

We estimate the number of new student infections i_t' on day t that are expected to test positive today as

$$i_t' = (1 - \frac{1}{\gamma}t)i_t.$$

Accounting for uncertainty

To account for uncertainty in the number of UT students returning infected by August 26, 2020, we vary the following:

1. The COVID-19 case reporting rate outside of Austin: 1 in 10, 1 in 5, or 1 in 3.

2. The number of UT students returning to Austin (in addition to the assumed 12,000 students already in Austin): 5,000, 10,000, or 15,000.

We do not know exactly how many and which students will return to Austin. For each of the above scenarios, we took 100 random samples of students from a list of 25,669 students who were registered for at least one in-person class as of July 2, 2020 and are not Austin residents. We report the mean number of expected infections from these 100 samples.

Appendix A.2. Estimating gathering risks

To quantify gathering risk, we estimate two metrics:

1. The probability that at least one individual infected with COVID-19 attends an event of size n (q_a).

2. The expected number of attendees infected with COVID-19 (n_i).

To calculate the probability that at least one individual attends an event of size n, we assume that each attendee has a probability of being infected with COVID-19 equal to the background prevalence q. The probability that at least one attendee is infected is then

$$q_a = 1 - (1 - q)^n.$$

To estimate the expected number of attendees infected with COVID-19, we again assume that each attendee has a probability of being infected equal to q.

$$n_i = n \cdot q.$$

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