SARS-CoV-2 Outbreak at a College with High COVID-19 Vaccination Coverage — Connecticut, August–September 2021

Stephen M. Bart, PhD,[1,2] Christina C. Curtiss, MEd,[3] Rebecca Earnest, MPH,[4] Rachel Lobe-Costonis, BA,[4] Hanna Peterson, BS,[4] Caroline McWilliams, BSN,[4] Kendall Billig, BS,[4] James L. Hadler, MD,[4] Nathan D. Grubaugh, PhD,[4,5] Victor J. Arcelus, PhD,[3] Lynn E. Sosa, MD[2]

[1]Epidemic Intelligence Service, CDC, Atlanta, Georgia, USA

[2]Connecticut Department of Public Health, Hartford, Connecticut, USA

[3]Connecticut College, New London, Connecticut, USA

[4]Department of Epidemiology of Microbial Diseases, Yale School of Public Health, New Haven, Connecticut, USA

[5]Department of Ecology and Evolutionary Biology, Yale University, New Haven, Connecticut, USA

Corresponding author:

Stephen M. Bart

sbart@cdc.gov

410 Capitol Avenue

Hartford, CT 06134

United States

Abstract

Background: During August–September 2021, a Connecticut college experienced a large SARS-CoV-2 Delta outbreak despite high (99%) vaccination coverage, indoor masking policies, and twice weekly reverse transcription-polymerase chain reaction (RT-PCR) testing. The Connecticut Department of Public Health investigated characteristics associated with infection and phylogenetic relationships among cases.

Methods: A case was a SARS-CoV-2 infection diagnosed by RT-PCR or antigen test during August–September 2021 in a student. College staff provided enrollment data, case information, and class rosters. An anonymous online student survey collected demographics, SARS-CoV-2 case and vaccination history, and activities the weekend before the outbreak. Multivariate logistic regression identified characteristics associated with infection. Phylogenetic analyses compared 115 student viral genome sequences with contemporaneous community genomes.

Results: Overall, 199/1788 students (11%) had lab-confirmed SARS-CoV-2 infection; most were fully vaccinated (194/199, 97%). Attack rates were highest among sophomores (72/414, 17%) and unvaccinated students (5/18, 28%). Attending in-person classes with an infectious student was not associated with infection (adjusted odds ratio [aOR] 1.0; 95%CI 0.5–2.2). Compared with uninfected students, students reporting an infection were more likely sophomores (aOR 3.3; 95%CI 1.1–10.7), attended parties/gatherings before the outbreak (aOR 2.8; 95%CI 1.3–6.4), and completed a vaccine series ≥180 days prior (aOR 5.5; 95%CI 1.8–16.2). Phylogenetic analyses suggested most cases derived from a common viral source.

Conclusions: This college SARS-CoV-2 outbreak occurred in a highly vaccinated population with prevention strategies in place. Infection was associated with unmasked off-campus parties/gatherings, not in-person classes. Students should stay up-to-date on vaccination to reduce infection.

Keywords: COVID-19, Delta, SARS-CoV-2 transmission, higher education, vaccine breakthrough

Background

At the beginning of the fall 2021 semester, a private, residential, undergraduate college in Connecticut experienced an outbreak of 199 SARS-CoV-2 infections among 1788 students. The outbreak was initially identified on Monday, September 6, 2021, after 20 students experiencing symptoms of COVID-19 tested positive for SARS-CoV-2 by rapid antigen test at the student health clinic. Beginning September 7, the college cancelled student activities and moved in-person classes online. Infections among students were identified over the next ~2 weeks. No faculty or staff infections were identified during the outbreak.

Notably, this outbreak occurred despite enforcement of multiple prevention strategies by the college. Students were required to provide proof of COVID-19 vaccination or to receive an exemption prior to the fall semester. Additionally, all students were screened for SARS-CoV-2 by reverse transcription-polymerase chain reaction (RT-PCR) testing upon arrival to campus and twice weekly throughout the semester, regardless of vaccination status or symptoms. Masks were required in college indoor spaces, including classrooms. Students signed an agreement prior to the semester affirming compliance with the college's COVID-19 prevention strategies, including a pledge that they would not visit bars or attend parties or similar social gatherings.

During August–September 2021, all counties in Connecticut experienced substantial or high levels of community SARS-CoV-2 transmission (>50 cases per 100,000 population per week) [1]. Statewide, nearly all sequenced specimens were the Delta variant.

The Connecticut Department of Public Health investigated factors associated with SARS-CoV-2 transmission and phylogenetic relationships between cases during this outbreak, which occurred in a highly vaccinated population living in a congregate setting with strict prevention strategies in place.

Methods

The college had 1788 students enrolled during the fall 2021 semester. A case was defined as a SARS-CoV-2 infection diagnosed by a RT-PCR or point-of-care antigen test during August–September 2021 in a college student. College staff provided student enrollment data, SARS-CoV-2 testing records, COVID-19 vaccination data, class rosters, and contact tracing data. During contact tracing calls, college staff asked students testing positive to report students with whom they had close contact (≤6 feet for ≥15 minutes) during the 48 hours before symptom onset or the positive test if asymptomatic. Some students reported potential exposures that preceded their illness [2]. Students identified as close contacts were notified by phone or email and given instructions to monitor for symptoms. Additionally, unvaccinated close contacts were required to quarantine. Attack rates stratified by characteristics of interest were compared to characterize the outbreak and preliminarily identify factors associated with infection.

To investigate whether classroom SARS-CoV-2 transmission might have contributed to the outbreak, we used college case data to identify students who could have attended class while pre-symptomatic or asymptomatic during their infectious period (2 days before positive SARS-CoV-2 test through the end of isolation). Students who tested positive for SARS-CoV-2 on September 7 or 8, or who tested positive on September 6 but reported never experiencing symptoms, were considered potentially infectious during September 6 classes. Students sharing at least one class with a potentially infectious student on September 6 based on class roster data were considered exposed. We used multivariate logistic regression to calculate whether potentially exposed students were more likely to test positive for SARS-CoV-2 on September 9 or later (to accommodate an incubation period of 3–14 days) when adjusting for academic year and gender.

Viral genome sequences collected from 115 college students (sequenced at the Broad Institute, Cambridge, Massachusetts) and contemporaneous community genomes from GISAID were used to deduce phylogenetic relationships. Maximum-likelihood phylogenetic trees were

reconstructed using IQ-Tree with a general time-reversible nucleotide substitution model using outbreak and community genomes [3].

In parallel, an anonymous, voluntary online survey invitation was sent to all students' college email addresses on October 10. Because of the large spike in cases observed starting on Monday, September 6, the survey asked questions regarding Labor Day weekend (September 2–5) activities alongside questions regarding demographics, SARS-CoV-2 testing, and COVID-19 vaccination. Characteristics associated with SARS-CoV-2 infection during the outbreak were compared between case-students (those students reporting a laboratory-confirmed SARS-CoV-2 infection in the survey) and non-case-students (those students not reporting SARS-CoV-2 infection) using univariate (e.g., chi square and Fisher's exact tests) and multivariate (logistic regression) methods. The multivariate analysis included demographic characteristics and factors identified as associated with transmission in univariate analyses, during contact tracing, and in other reports, such as sharing a bedroom [4]. Unvaccinated students and those receiving a vaccine other than Pfizer-BioNTech, Moderna, or Johnson & Johnson were excluded from the multivariate analysis because of sample size limitations.

Students were considered fully vaccinated if ≥14 days had passed since the completion of a primary series of a COVID-19 vaccine approved or authorized by the US Food and Drug Administration or listed for emergency use by the World Health Organization. At the time of the outbreak, booster doses were neither authorized nor recommended in the United States for any COVID-19 vaccine.

This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy (e.g., 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq).

Results

Characterizing the outbreak

Most (1770/1788, 99.0%) students were fully vaccinated prior to the outbreak. From August 19–September 16, 199 cases were identified among 1788 students (11.1% attack rate) (**Figure 1**). Most (188/199, 94.5%) cases were identified on or after September 6, and almost all (194/199, 97.5%) occurred in fully vaccinated students. Symptoms were reported by 74.3% (148/199) of case-students. Two students sought care at the emergency room; no students were hospitalized or died.

College-provided data were used to initially characterize the outbreak. The attack rate was higher among sophomores (17%) than other academic years (**Table 1**). The attack rate was 28% (5/18) among students who were not vaccinated—2.5 times greater than the 11% (194/1770) attack rate among vaccinated students (p=0.02).

The role of classroom transmission

In-person classes were held on Monday, September 6, the day that the outbreak was first identified, then moved online the next day. Infectious pre-symptomatic, mildly symptomatic, or asymptomatic students might have attended classes on September 6 and exposed classmates. Sixty-one students were identified as potentially infectious during September 6 classes, and 992 students were considered potentially exposed. When adjusting for academic year and gender, students who had a potentially infectious classmate were not more likely to test positive on or after September 9 than other students (adjusted odds ratio [aOR] 1.0; 95% confidence interval 0.5–2.2).

Contact tracing

During college-performed contact tracing, 160 case-students were named as contacts of at least one other case-student (**Figure 2A**). SARS-CoV-2-infected students reported close contacts at parties/social gatherings and bars. Additionally, contact tracers identified multiple cases among members of athletic teams and in students sharing living spaces with infected students, indicating potential spread among teammates and roommates. Several students who themselves later tested positive attended an off-campus social gathering early during Labor Day

weekend (September 2-5) with a mildly symptomatic student. This student later received a positive RT-PCR test result for a specimen collected during screening testing on the day of the gathering (**Figure 2A, arrow**). The other students attended social events later during the weekend, including one party that was attended by >30 students who went on to test positive for SARS-CoV-2. We hypothesized that cases prior to Labor Day weekend were acquired off campus and identified by college arrival testing, while the remaining outbreak cases were associated with infection among students during Labor Day weekend.

Phylogenetic analysis

Specimens from 115/199 infected students were available for viral genome sequencing, and a phylogenetic analysis of 4134 genomes compared outbreak genomes with other genomes from Connecticut and surrounding states. All sequenced outbreak viral genomes were the SARS-CoV-2 Delta variant. Consistent with our hypothesis, genomes from specimens collected on or before August 31 were unrelated to other outbreak cases (**Figure 2B**). All but one of the remaining college viral genomes were highly related and clustered together away from other contemporaneous Connecticut genomes. A viral genome from the symptomatic student linked to the off-campus gathering fell at the cluster root (arrow, **Figure 2C**). Only one genome from a Connecticut resident not associated with the college and two from residents of nearby states clustered with the outbreak viral genomes. These epidemiologic and genomic data are consistent with a common viral source leading to this college outbreak.

Analysis of student survey data

To supplement college-provided data, an anonymous online survey was used to gather additional details. We received 475 responses (response rate 26.6%). Female students were overrepresented among survey respondents compared with the student body overall (**Table 2**). Fifty respondents (11%) reported having an outbreak-associated SARS-CoV-2 infection, consistent with the 11% attack rate calculated for all enrolled students. Among fully vaccinated respondents, a greater proportion of case-students (8/49, 16.3%) reported completion of a

vaccination series ≥180 days prior to the outbreak than non-case-students (15/388, 3.9%). Other demographic and clinical factors including race/ethnicity, academic year, vaccination status, and prior COVID-19 diagnosis did not significantly differ between case-student respondents and non-case-student respondents in univariate analyses.

Most survey respondents reported participating in activities during Labor Day weekend. More than 80% of respondents reported participating in small (≤5 persons) indoor or outdoor gatherings; fewer students reported attending large (≥6 person) indoor (67.8%) or outdoor (58.5%) gatherings (**Table 3)**. Case-students were more likely than non-case-students to report participating in large indoor gatherings (80.0% vs 56.0%, p = 0.0019). Further, case-students were more likely to report attending a party or social gathering, visiting a bar, or eating in a group on campus. This effect was stronger for students who tested SARS-CoV-2-positive earlier during the outbreak (September 6–8) than those who tested positive later (on or after September 9). Attending a party (early: 24/30, 80% vs. late: 10/17, 59%), visiting a bar (early: 10/30, 33% vs. late: 2/17, 12%), and eating in a group on campus (early: 20/29, 69% vs. late 8/17, 47%) were more common among students who tested positive during the earlier part of the outbreak than those who tested positive later, though these differences were not statistically significant. Few students reported wearing masks at bars (7/59, 12%) or parties/social gatherings (31/210, 15%). In contrast, most students reported wearing masks during campus activities which were not associated with transmission like studying in the library (312/337, 93%) and participating in student organization activities (143/160, 89%).

We performed a multivariate analysis of survey data to identify factors associated with SARS-CoV-2 infection. Selected factors included demographics, activities or characteristics associated with infection in univariate analyses or during contact tracing, and clinical factors like vaccination status or prior COVID-19. Sophomore status (aOR 3.3, 95%CI 1.1–10.7), attendance at parties or social gatherings (aOR 2.8, 95%CI 1.3–6.4), and completion of a primary vaccine series ≥180

days prior to the outbreak (aOR 5.5, 95%CI 1.8–16.2) were associated with student cases (**Table 4**). Sharing a room or participating in an athletic event were not associated with infection.

Discussion

We report a large college SARS-CoV-2 outbreak in a highly vaccinated population that likely originated from a common viral source. This outbreak was detected when symptomatic students voluntarily sought testing at the college health clinic. Students who were sophomores, attended a party or social gathering (especially large, off-campus gatherings), and were vaccinated ≥180 days prior were more likely to test positive for SARS-CoV-2 during the outbreak. Notably, no students in this highly vaccinated population were hospitalized or died during this outbreak, and no staff cases were identified.

As resources permit, CDC guidance recommends testing of college/university students at arrival and twice weekly in areas of substantial or high community transmission, and increased serial screening testing during outbreaks, at minimum for students not up-to-date on vaccination [5]. This investigation demonstrates the utility of frequent screening testing during a campus outbreak, regardless of student vaccination status. While twice weekly screening testing did not prevent this outbreak, it critically contributed to rapid detection of cases regardless of symptoms, outbreak scope characterization, and outbreak control. Students testing SARS-CoV-2–positive were isolated in designated isolation housing on campus or hotel rooms off-campus. Reported close contacts of these students were notified and required to quarantine if not vaccinated. While campus quarantine and isolation space might be limited—especially during larger outbreaks—effective isolation of students during this outbreak likely disrupted spread and prevented transmission into the surrounding community. Testing and isolation should be maximally used to identify infections and disrupt transmission during college/university outbreaks [5]. Most importantly, persons experiencing symptoms consistent with COVID-19 should seek testing before interacting with others [6]. During this outbreak, no staff cases were

identified, and transmission was not associated with in-person classes, suggesting that on-campus prevention strategies were effective.

Outbreaks of the SARS-CoV-2 Delta variant among fully vaccinated persons have been previously reported in community and congregate settings [7–10]. During this outbreak, time since vaccination was associated with infection. The highest odds of infection were observed for students vaccinated ≥180 days prior to the outbreak. While booster doses were not yet recommended for students when the outbreak occurred, these students would not be considered up-to-date on vaccination under current CDC recommendations [11]. To reduce the risk of SARS-CoV-2 infection, CDC recommends that all persons receive all vaccination doses for which they are eligible [11].

While sharing a bedroom has been previously linked to SARS-CoV-2 infection in university students [4], we did not observe an association during this outbreak. The rapid identification and isolation of cases likely limited transmission between roommates. It is not clear why sophomore students had higher odds of infection during this outbreak, but this finding might be related to transmission within student social networks. Contact tracing and survey data analysis suggested that most transmission occurred in settings like parties and social gatherings where prevention strategies like masking and distancing were not employed. Participation in social activities (such as those linked to fraternity and sorority events) has been linked to SARS-CoV-2 infection among university students [12,13]. Nearly half of students reported attending parties or social gatherings during the first weekend after classes started despite pledging to avoid such gatherings. During this outbreak, one party with dozens of attendees was identified during contact tracing. Limiting gathering sizes can reduce SARS-CoV-2 transmission by limiting exposure to infected persons. The college's strong prevention measures including required indoor masking, testing, and vaccination, likely reduced the risk of severe COVID-19, contributed to outbreak detection and control, and minimized on-campus transmission during university activities such as in-person classes or university athletic activities.

This investigation is subject to several limitations. Though the demographics and case breakdown of survey respondents were similar to the student body overall, students who were more motivated to respond might be more likely to practice prevention strategies or otherwise limit SARS-CoV-2 exposure. The survey was taken several weeks after the outbreak, potentially contributing to recall bias. The classroom exposure analysis could be biased if students did not attend class on the day of interest or if a student attended class despite experiencing symptoms; the direction of any potential bias, however, is difficult to determine. Lastly, the small number of survey respondents reporting being unvaccinated or vaccinated with a vaccine listed for emergency use by the WHO precluded those students' inclusion in the multivariate analysis of survey data.

These data from a SARS-CoV-2 Delta outbreak provide insight into effective strategies for outbreak management in congregate settings like universities. Students are recommended to remain up-to-date with COVID-19 vaccinations and be aware of risks associated with attending large social gatherings without prevention strategies in place, especially during times of widespread SARS-CoV-2 transmission.

NOTES

Acknowledgments

The college students; Matthew Cartter (Connecticut Department of Public Health); Kristine Bisgard, Hannah Kirking, and Jacqueline Tate (CDC); Broad Institute.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Funding

R.E. is supported by CTSA Grant Number TL1 TR001864 from the National Center for Advancing Translational Science (NCATS), a component of the National Institutes of Health

(NIH). The contents of this manuscript are solely the responsibility of the authors and do not necessarily represent the official view of NIH.

Disclosures

NDG is a paid consultant for Tempus Labs and the National Basketball Association. They claim CDC contract [75D30120C09570], a sponsored research agreement with Tempus Labs, a sponsored research agreement with the National Basketball Association, and a sponsored research agreement with the National Football League. JLH received payments for their institution from the State of Connecticut Department of Public Health for COVID-19 research. They received payments for their institution from the Centers for Disease Control and Prevention (CDC) for surveillance of emerging infections and for Yale School of Publica Health staff support. They are also the Chair of the New Haven City Board of Health. LES received funding for their institution from the Centers for Disease Control and Prevention (CDC) and serves on the advisory council for the elimination of tuberculosis. CC, CW, HP, KB, VA, RE, RLC, and SB report no conflicts of interests.

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FIGURE LEGENDS

Figure 1. Epidemic curve SARS-CoV-2 infections (n=199) in students during a college outbreak — Connecticut, August–September 2021.

Figure 2. Contact network and phylogenetic analysis of genomes from respiratory samples collected from SARS-CoV-2-infected persons identified during the college SARS-CoV-2 outbreak and from community samples — Connecticut, August–September 2021
A) Network of SARS-CoV-2-infected close contacts identified through college contact tracing. Each circle represents a student infected during the outbreak; larger circles represent students reporting more close contacts. An arrow indicates a student who attended a social gathering before Labor Day weekend while symptomatic. Generated with MicrobeTrace.
B) Phylogenetic analysis of 4134 SARS-CoV-2 Delta genomes, including genomes collected from students during the college outbreak (circles) and genomes from Connecticut and surrounding states (GISAID; terminus of each horizontal line). Blue circles represent genomes collected after move-in weekend during screening or symptomatic testing; orange circles represent genomes collected during arrival testing. The x-axis reflects genetic distance from the Wuhan Hu-1 SARS-CoV-2 genome (GISAID) root. A cluster of closely related college genomes are indicated by the black box. The arrow indicates a genome from the student in marked with an arrow in A). Generated in NextStrain. See **Supplementary Appendix** for acknowledgments.
C) Zoomed in view of the box from B). Blue circles represent genomes collected from students during the college outbreak, while gray circles represent genomes collected from other persons in Connecticut and surrounding states. The arrow indicates a genome collected from the student marked with an arrow in A).

Table 1. Demographic and vaccination characteristics[1] of college students during SARS-CoV-2 outbreak — Connecticut, August–September 2021

	Overall (n = 1788)	Case-students (n = 199)	Attack rate (Overall = 11.1%)
Academic year (no., %)			
First-year	515 (28.8%)	35 (17.6%)	6.8%
Sophomore	414 (23.2%)	72 (36.2%)	17.4%
Junior	430 (24.0%)	55 (27.6%)	12.8%
Senior	429 (24.0%)	37 (18.6%)	8.6%
Gender (no., %)			
Female	1052 (58.8%)	118 (59.3%)	11.2%
Male	736 (41.2%)	81 (40.7%)	11.0%
Housing (no., %)			
On-campus	1735 (97.0%)	196 (98.5%)	11.3%
Off-campus	53 (3.0%)	3 (1.5%)	5.7%
Vaccination status (no., %)[2]			
Fully vaccinated	1770 (99.0%)	194 (97.5%)	11.0%
Not fully vaccinated	18 (1.0%)	5 (2.5%)	27.8%

[1]College-provided data.
[2]Students were considered fully vaccinated if they completed the primary series of a vaccine that is approved or authorized by the US Food and Drug Administration or listed for emergency use by the World Health Organization ≥14 days prior to the outbreak.

Table 2. Univariate analysis comparing characteristics of college student online survey respondents during SARS-CoV-2 outbreak by SARS-CoV-2 infection status — Connecticut, August–September 2021.

	Overall (n = 475)	Non-case-students (n = 425)	Case-students (n = 50)[1]	p-value[2]
Academic year (no., %)				
First-year	117 (24.6%)	109 (25.6%)	8 (16.0%)	0.28[3]
Sophomore	109 (22.9%)	93 (21.9%)	16 (32.0%)	
Junior	115 (24.2%)	102 (24.0%)	13 (26.0%)	
Senior	134 (28.2%)	121 (28.5%)	13 (26.0%)	
Gender (no., %)				
Female	333 (70.1%)	297 (69.9%)	36 (72.0%)	0.76[3]
Male	142 (29.9%)	128 (30.1%)	14 (28.0%)	
Race/Ethnicity (no., %)				
White	340 (71.6%)	301 (70.8%)	39 (78.0%)	0.72[4]
Hispanic/Latino	46 (9.7%)	44 (10.4%)	2 (4.0%)	
Asian	34 (7.2%)	30 (7.1%)	4 (8.0%)	
Black	9 (1.9%)	9 (2.1%)	0 (0%)	
Multiracial	19 (4.0%)	17 (4.0%)	2 (4.0%)	
Other	6 (1.3%)	5 (1.2%)	1 (2.0%)	
Decline to say	21 (4.4%)	19 (4.5%)	2 (4.0%)	
Vaccination status (no., %)[5]				
Fully vaccinated	471 (99.2%)	422 (99.3%)	49 (98.0%)	0.36[4,6]
Pfizer-BioNTech[7]	301 (63.9%)	271 (64.2%)	30 (61.2%)	
Moderna[7]	131 (27.8%)	117 (27.7%)	14 (28.6%)	
Johnson & Johnson[7]	33 (7.0%)	28 (6.6%)	5 (10.2%)	
Other[7,8]	6 (1.3%)	6 (1.4%)	0 (0%)	
Not fully vaccinated	4 (0.8%)	3 (0.7%)[8]	1 (2.0%)	
Time since vaccination[10]				
14–59 days	26/437 (5.9%)	25/388 (6.4%)	1/49 (2.0%)	**0.0090[4]**
60–119 days	126/437 (28.8%)	113/388 (29.1%)	13/49 (26.5%)	
120–179 days	262/437 (60.0%)	235/388 (60.5%)	27/49 (55.1%)	
≥180 days	23/437 (5.3%)	15/388 (3.9%)	8/49 (16.3%)	
Prior COVID-19 diagnosis	42 (8.8%)	41 (9.6%)	1 (2.0%)	0.11[4]
Share bedroom with another student	191/466 (41.0%)	168/416 (40.4%)	23/50 (46.0%)	0.45[3]
Share bathroom	439/466 (94.2%)	390/416 (93.8%)	49/50 (98.0%)	0.34[3]

High-risk medical condition[11]	77/461 (16.7%)	72/411 (17.5%)	5/50 (10.0%)	0.18[2]

[1] A case was defined as a SARS-CoV-2 infection diagnosed by a RT-PCR or point-of-care antigen test during August–September 2021 in a college student.
[2]p-values<0.05 were considered significant.
[3]Chi-square test
[4]Fisher's exact test
[5]Students were considered fully vaccinated if they completed the primary series of a vaccine that is approved or authorized by the US Food and Drug Administration or listed for emergency use by the World Health Organization ≥14 days prior to the outbreak.
[6]Comparison between case-students and non-case-students status of fully vaccinated or not fully vaccinated.
[7]Percentages reflect percentage of fully vaccinated students.
[8]Other vaccines included AstraZeneca, Sinovac, Sinopharm, and Covaxin.
[9]Includes one student who was partially vaccinated (i.e., had not completed both doses of a 2-dose vaccination series) during the outbreak.
[10]Among fully vaccinated survey respondents who reported a final dose of a vaccine series. The remaining fully vaccinated students did not report a vaccine series completion date.
[11]https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html

Table 3. Univariate analysis of comparison of activities conducted by college student online survey respondents during Labor Day weekend by SARS-CoV-2 infection status, September 2–5, 2021, preceding a SARS-CoV-2 outbreak —Connecticut, August–September 2021.[1]

	Overall (n = 475)	Non-case-students (n = 425)	Case-students (n = 50)	p-value[2,3]
Small outside gatherings[4]	424/473 (89.6%)	379/423 (89.6%)	45/50 (90.0%)	>0.99
Small inside gatherings	400/471 (84.9%)	354/421 (84.1%)	46/50 (92.0%)	0.21
Large outside gatherings	318/469 (67.8%)	280/419 (66.8%)	38/50 (76.0%)	0.25
Large inside gatherings	275/470 (58.5%)	235/420 (56.0%)	40/50 (80.0%)	**0.0019**
Studied in library	337/473 (71.2%)	299/424 (70.5%)	38/49 (77.6%)	0.39
Rode in a car with someone you don't live with	278/466 (59.7%)	246/417 (59%)	32/49 (65.3%)	0.49
Went shopping	279/471 (59.2%)	252/421 (59.9%)	27/50 (54.0%)	0.52
Attended party or social gathering	210/468 (44.9%)	175/418 (41.9%)	35/50 (70.0%)	**0.0028**
Studied in a group	205/464 (44.2%)	182/415 (43.9%)	23/49 (46.9%)	0.80
Ate in group on campus	202/469 (43.1%)	172/420 (41.0%)	30/49 (61.2%)	**0.010**
Attended a student organization meeting	160/464 (34.5%)	147/416 (35.3%)	13/48 (27.1%)	0.33
Participated in athletic team events	151/467 (32.3%)	135/418 (32.3%)	16/49 (32.7%)	>0.99
Visited gym	150/469 (32.0%)	128/420 (30.5%)	22/49 (44.9%)	0.059
Used public transit	126/466 (27.0%)	114/417 (27.3%)	12/49 (24.5%)	0.80
Visited restaurant	91/466 (19.5%)	77/417 (18.5%)	14/49 (28.6%)	0.13
Attended a large outdoor event	81/464 (17.5%)	74/415 (17.8%)	7/49 (14.3%)	0.67
Visited bar	59/466 (12.7%)	46/416 (11.1%)	13/50 (26.0%)	**0.0055**
Attended a religious gathering	39/465 (8.4%)	38/416 (9.1%)	1/49 (2.0%)	0.10[5]
Attended a large indoor event	38/467 (8.1%)	33/418 (7.9%)	5/49 (10.2%)	0.78

[1]Students could report participation in multiple activities.
[2]p-values<0.05 were considered significant.
[3]All p-values were calculated by chi-square test unless otherwise noted.
[4]Small gatherings were defined as ≤5 persons; large gatherings were ≥6 persons.
[5]Fisher's exact test

Table 4. Multivariate logistic regression of factors associated with SARS-CoV-2 infection among student survey respondents (n=475) during SARS-CoV-2 outbreak — Connecticut, August–September 2021.

	Adjusted odds ratio (95% CI)[1]
Academic year	
First-year	ref
Sophomore	**3.3 (1.1–10.7)**
Junior	2.1 (0.6–7.6)
Senior	1.2 (0.3–4.3)
Gender	
Female	ref
Male	0.9 (0.4–1.9)
Race/Ethnicity	
White	ref
Asian	2.1 (0.5–7.4)
Hispanic/Latino	0.4 (0.1–1.4)
Multiracial	1.2 (0.2–5.5)
Other	1.0 (0.05–5.8)
Decline to say	1.0 (0.1–4.0)
Time since vaccination	
14–59 days	0.5 (0.03–3.2)
60–119 days	0.9 (0.4–2.0)
120–179 days	ref
≥180 days	**5.5 (1.8–16.2)**
Vaccine product	
Pfizer-BioNTech	ref
Moderna	0.7 (0.3–1.6)
Johnson & Johnson	1.5 (0.4–4.8)
Prior COVID-19 diagnosis	0.2 (0.01–1.1)
Share bedroom	1.3 (0.6–2.9)
Labor Day weekend activities	
Attended party or social gathering	**2.8 (1.3–6.4)**
Visited bar	2.0 (0.8–5.1)
Ate in group on campus	1.5 (0.8–3.0)
Participated in athletic team events	0.7 (0.3–1.5)

[1]Adjusted odds ratios were considered significant if the 95% confidence interval excluded 1.

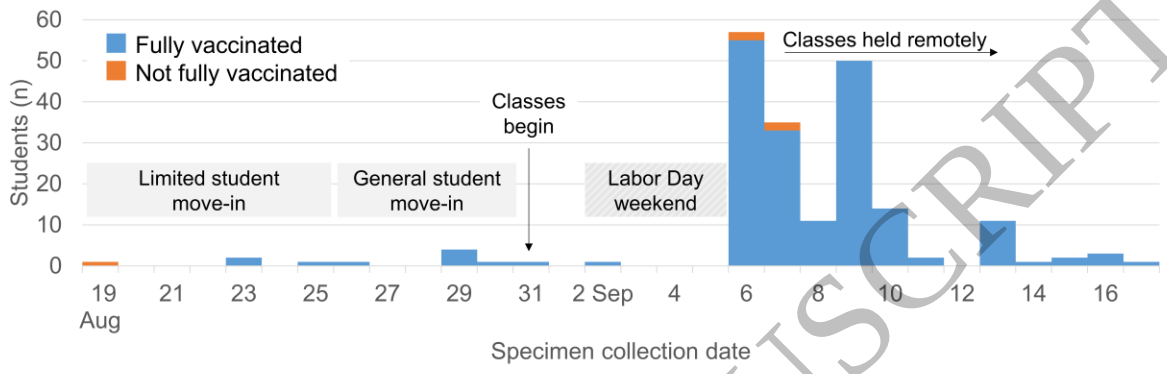

Figure 1
165x93 mm (.61 x DPI)

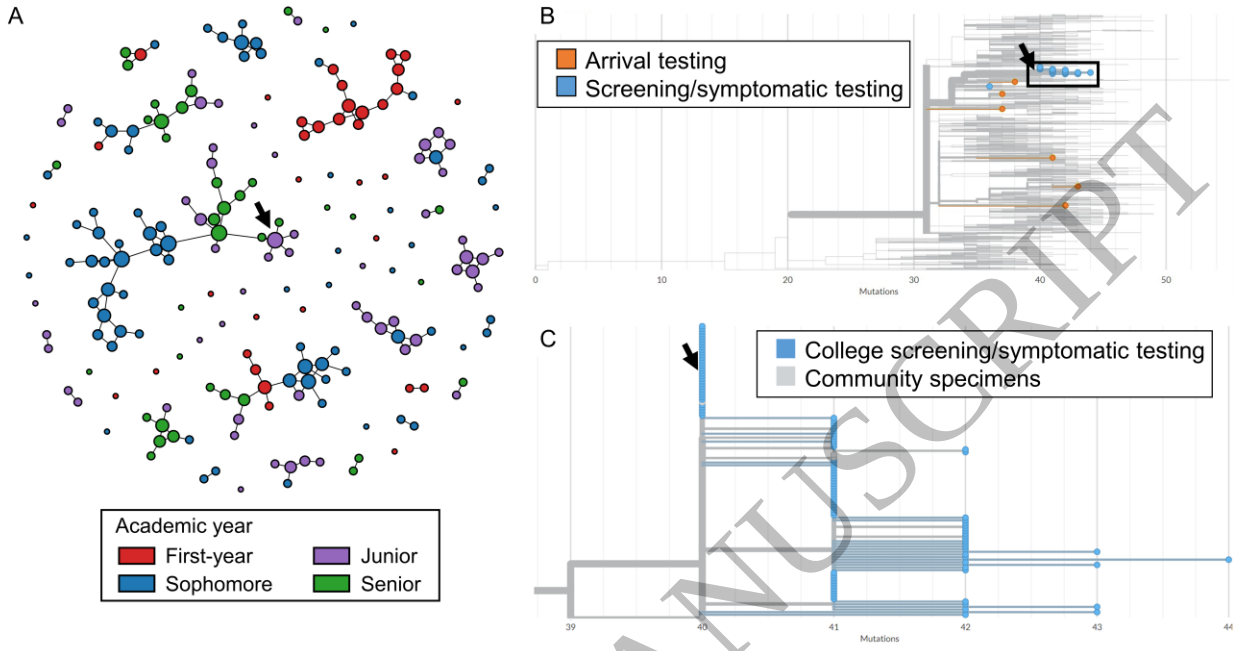

Figure 2
165x93 mm (.61 x DPI)