

A Screening Program for SARS-CoV-2 among University of Hawai'i at Mānoa Residence Hall Students during the COVID-19 Pandemic

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Abstract

The University of Hawai'i at Mānoa (UHM) created a COVID-19 pandemic team to collaborate, plan, and mitigate the spread of COVID-19 across the campus. The purpose of this study was to identify asymptomatic and pre-symptomatic cases of SARS-CoV-2 among unvaccinated UHM residence hall students during 3 distinct intervals (semesters) within the COVID-19 pandemic. Supervised self-administered nasal swab testing samples were collected from unvaccinated UHM residence hall students and sent to a clinical laboratory for COVID-19 RT-PCR testing to detect SARS-CoV-2. Positive cases were contacted and placed in isolation while contact tracing was initiated. The screening program performed 2219 tests on 725 unique persons with the identification of COVID-19 infections in 38 asymptomatic unvaccinated students and an additional 10 cases through contact tracing. A positive correlation existed between the screening program case numbers and the state of Hawai'i 7-day average positive cases as demonstrated with a Pearson coefficient of 0.79 and $P < .001$. The COVID-19 positivity rate was greater during Spring Semester 2022 compared to both Spring Semester 2021 ($P < .001$) and Fall Semester 2021 ($P < .001$). This program served as a component of a larger strategy to mitigate the effects of the COVID-19 pandemic on the UHM campus. Additional benefits of the program included opportunities to increase COVID-19 awareness, enact health policy measures, evolve to meet changing pandemic demands, and maintain a safe UHM campus.

Keywords

SARS-CoV-2, COVID-19, University of Hawai'i, Screening Program, Screening Testing, Residence Hall Students, Congregate living, COVID-19 Response Team

Abbreviations

CDC = Centers for Disease Control and Prevention
COVID-19 = Coronavirus Disease 2019
DLS = Diagnostic Laboratory Services
HDOH = Hawai'i State Department of Health
HWBWG = Health & Well-Being Working Group
NCAA = National Collegiate Athletic Association
RT-PCR = Reverse Transcription Polymerase Chain Reaction
UHM-CRT = UHM COVID-19 Response Team
UH = University of Hawai'i
UHM = University of Hawai'i at Mānoa
UHSM = University Health Services Mānoa

Introduction

The SARS-CoV-2 virus has infected more than 768 million people worldwide since the beginning of the Coronavirus Disease 2019 (COVID-19) pandemic through July 2023.¹ Transmission of SARS-CoV-2 can occur via direct or indirect contact with saliva and respiratory secretions of both symptomatic and as-

ymptomatic infected persons, making it difficult to contain.² In response to the expanding pandemic, the state of Hawai'i issued a mandatory statewide shelter-in-place order, shutting down all non-essential businesses and schools, including the University of Hawai'i at Mānoa (UHM) campus on March 23, 2020. During this shut-down, only essential employees were permitted to come onto the UHM campus and nearly all in-person instruction was converted to remote learning for the remainder of the 2020 Spring and Summer instructional semesters.

In response to the COVID-19 pandemic, many institutions of higher education across the United States established teams to collaborate, plan, and mitigate the spread of COVID-19 across their respective campuses. Baylor University developed health and safety protocols that included requiring face coverings, social distancing, universal entry screening, testing before arrival on campus, randomized screening testing, diagnostic testing of symptomatic and exposed individuals, and wastewater surveillance testing for SARS-CoV-2.³ The University of California, Berkeley, launched its own pop-up SARS-CoV-2 testing laboratory to enable an asymptomatic screening testing program for the campus community.⁴

Options for SARS-CoV-2 testing include surveillance testing, screening testing, and diagnostic testing. Surveillance testing is used by public health officials to track the prevalence and rate of spread of an infectious disease outbreak such as COVID-19. Since surveillance testing is performed on de-identified laboratory testing specimens, the results are not traceable back to specific individuals, and thus cannot be used for independent case management.⁵ Waste-water testing is a form of surveillance testing involving the detection of SARS-CoV-2 RNA which is shed in the feces early during the clinical course of disease by infected persons.⁶ Screening testing refers to laboratory tests performed on persons who do not have symptoms of COVID-19 infection or are not known close exposures of individuals with active COVID-19 infection. An advantage of screening testing is that results can identify asymptomatic or pre-symptomatic SARS-CoV-2 infections early so that actions can be taken to prevent further transmission.⁷ Diagnostic testing is a form of testing used to diagnose and assist in the management of persons who present with symptoms possibly due to COVID-19 infection or who are known close contacts of COVID-19 cases.^{5,7}

In March 2020, the University of Hawai'i (UH) established a COVID-19 Health & Well-Being Working Group (HWBWG) comprised of UH health professionals from various disciplines to

provide guidance on how to mitigate the effects of the COVID-19 pandemic on the UHM community, in coordination with the Hawai'i State Department of Health (HDOH) and the Centers for Disease Control and Prevention (CDC). The HWBWG established a UHM COVID-19 Response Team (UHM-CRT) based at University Health Services Mānoa (UHSM), whose responsibilities were to investigate any reported UHM student and employee COVID-19 cases, assess infection transmission risks to University spaces occupied by recent positive cases, conduct contact tracing, provide support and contact with persons who were in isolation or quarantine, and serve as an educational resource for the UHM community. The HWBWG also created a UHM campus COVID-19 testing program that targeted the campus populations at highest risk for infection using best practices for COVID-19 testing, positive case management, and contact tracing.

While the health and safety of all UHM employees and students were acknowledged, the HWBWG identified students living on campus in the UHM residence housing as the most COVID-19 vulnerable campus population. The enhanced infection risk was due to their congregate living situations, ample social interactions, low priority for early vaccination, and potential for vaccine reluctance.⁸ The purpose of this effort was to implement a testing program and identify asymptomatic and pre-symptomatic cases of SARS-CoV-2 among unvaccinated UHM residence hall students during 3 semesters of the COVID-19 pandemic.

Methods

Study Population

Inclusion criteria for the UHM COVID-19 screening study population were all UHM residence hall students who were not vaccinated against COVID-19 during the academic semesters of Spring 2021, Fall 2021, and Spring 2022. Exemptions from inclusion were granted to those unvaccinated students who: (1) were within 90 days of recent COVID-19 infection; and (2) who submit valid test results obtained external to the testing program. The testing population numbers varied by semester based upon the current availability of COVID-19 vaccines and status of full vaccination completion. To the authors' knowledge, no residence hall students had achieved full vaccination status during the Spring semester 2021 (January 11, 2021- May 12, 2021) since the newly Emergency Use Authorization-approved COVID-19 vaccination series was not available to most UHM students until the late spring and summer of 2021. Consequently, all UHM residence hall students were required to participate in the UHM COVID-19 screening program during Spring semester 2021. COVID-19 vaccines subsequently became widely available during the 2021 summer which led to the university mandating that all students living in UHM residence halls must be fully vaccinated against COVID-19, effective August 23, 2021. Exemptions from the vaccination requirement were only granted for those who had religious or

medical reasons. Fully vaccinated residence hall students were not required to take part in the screening program. University of Hawai'i employees were similarly required to be vaccinated against COVID-19 between August 23, 2021 and March 28, 2022, with only medical or religious exemptions to the vaccine requirement. Any unvaccinated UH employees were required to be tested weekly through a separate statewide testing program and not included in this residence hall student COVID-19 screening program. This study was approved by the UH Human Studies Program as exempt from federal regulations pertaining to the protection of human research participants.

SARS-CoV-2 Screening Program Protocol

During the Spring 2021 semester, in which COVID-19 vaccinations were not available for most college students,⁹ the majority of UHM courses were still not being held in person and residence housing facilities were open for students at approximately 50% capacity. Due to clinical laboratory COVID-19 testing capacity limitations, all residence hall students could not be tested each week. Instead, testing was limited to approximately 60 randomly selected residence hall students using a random number generator. Individuals selected for testing were determined in proportion to relative census of each residence hall. During the 2021 summer instructional sessions, UHM campus housing was closed and testing was paused.

Throughout the Fall 2021 and Spring 2022 semesters, COVID-19 vaccines were widely available and required for all UHM residence hall students. Testing was conducted on all unvaccinated residence hall students, rather than a random sample as in the Spring 2021 semester. Students with clinical symptoms possibly due to COVID-19 or who were known close contacts of COVID-19 cases were referred to their own health care providers for further care and were not included in this screening program.

COVID-19 screening test samples were collected by a self-administered nasal swab under the observation and guidance of a UHSM staff member wearing personal protective equipment in an open air location at the UHSM campus building. COVID-19 nucleic acid amplification testing based on reverse transcription polymerase chain reaction (RT-PCR) to detect SARS-CoV-2 was performed at the John A. Burns School of Medicine Tropical Medicine Clinical Laboratory (Spring 2021) and Diagnostic Laboratory Services (DLS) Clinical Laboratory (Fall 2021 & Spring 2022). Test results were generally available within 24-48 hours from collection.

Positive Results

COVID-19 positive results were provided to the UHM-CRT with the consent of the students being tested. Positive cases were contacted and advised to begin their isolation periods while contact tracing was initiated. Residence housing directors

helped to coordinate the isolation process, identify potential person and common area exposures, facilitate further testing, and ensure proper facility sanitation procedures. The UHM-CRT served as a patient-centered, empathetic source of daily support and health monitoring for students in isolation or quarantine.

Statistical Analysis

Microsoft Excel version 16.75.2 software (Microsoft Corp., Redmond, WA) was used for data compilation, simple statistical analysis using chi-squared tests, and Pearson coefficients for correlation. Statistical significance was set at $P \leq .05$.

Results

A total of 725 unique residence hall students participated in this COVID-19 screening program for an overall number of 2219 COVID-19 tests. Study participants' mean age was 19.8 years ($SD=4.2$) and stated sex was 66.8% female, 32.9% male, and 0.3% unknown.

Spring Semester 2021 (Vaccine not yet widely available)

During the 17-week Spring semester 2021 (January 10, 2021-May 8, 2021), nearly all 1101 UHM residence hall students were unvaccinated and subject to weekly randomized COVID-19 RT-PCR screening which was conducted from February 1, 2021 to May 5, 2021. Over this period, 676 COVID-19 RT-PCR screening tests were performed, yielding 2 positive results for a positivity rate of 0.3% (Table 1). Both positive cases were assessed medically and placed in isolation. Contact tracing conducted by the UHM-CRT led to the identification of 4 additional close contact students who were tested and placed into quarantine to reduce the risk of further disease transmission.

Summer Instructional Sessions 2021 (Vaccine available)

COVID-19 screening testing was not conducted during the UHM 2021 summer instructional sessions (May 24, 2021-August 13, 2021) due to the low on-campus population and residence hall census numbers.

Fall Semester 2021 (Vaccine required)

During the 16-week Fall semester 2021 testing period (August 22, 2021- December 11, 2021), of 2752 total residence hall students, 176 students were unvaccinated (mainly those who were partially vaccinated or had medical/religious exemptions) and were required to undergo weekly COVID-19 PCR screening testing. Screening was conducted from August 23, 2021 to

December 8, 2021. Overall, 871 COVID-19 PCR screening tests were performed, which produced 6 positive test results and a positivity rate of 0.7% (Table 1). Newly diagnosed cases were placed in isolation and contact tracing was conducted by the UHM-CRT, resulting in the identification of 2 additional student close contacts who were placed in quarantine per current CDC guidance. As the semester progressed, the number of students in the screening program gradually declined, due to students who moved out of campus housing, became fully vaccinated, or tested positive for COVID-19 and were exempted from testing for 90 days.

Spring Semester 2022 (Vaccine required)

During the 19-week Spring semester 2022 (January 10, 2022-May 14, 2022), of 2612 total residence hall students, 55 unvaccinated students (mainly partially vaccinated and those with medical or religious exemptions) were required to undergo weekly COVID-19 PCR screening, which was conducted from January 10, 2022 to May 5, 2022. Overall, a total of 672 COVID-19 RT-PCR screening tests were performed on these unvaccinated students, which produced 30 positive test results and a positivity rate of 4.5% (Table 1). Newly diagnosed cases were similarly placed in isolation and contact tracing was conducted by the UHM-CRT, resulting in the identification of 4 additional close contact students who were placed in quarantine. Effective December 2021, the CDC changed close contact quarantine guidelines, so that fully vaccinated, asymptomatic close contacts would no longer be required to be placed in quarantine. Due to high vaccination rates, this action significantly reduced the numbers of close contacts who were subject to quarantine.

Comparison of COVID-19 Test Positivity Rates by Semester

The COVID-19 positivity rates were significantly higher during Spring Semester 2022 compared to both Spring Semester 2021 ($\chi^2= 24.1$, $df=2$, $P \leq .001$) and Fall Semester 2021 ($\chi^2=22.5$, $df=2$, $P \leq .001$). The positivity rate did not differ significantly between Spring Semester 2021 and Fall Semester 2021 ($\chi^2=1.1$, $df=2$, $P= .29$).

Correlation in Case Counts between UHM Residence Halls and the State of Hawai'i

Figure 1 displays the weekly positive COVID-19 case numbers for the UHM residence hall screening program and the State of Hawai'i at large. A strong positive correlation exists between these case count numbers, as demonstrated by a Pearson coefficient of 0.79 and $P \leq .001$.

Table 1. Summary of COVID-19 Screening Results of 3 Semesters, University of Hawai'i at Mānoa				
	Spring Semester 2021 (1/10/21-5/8/21)	Fall Semester 2021 (8/22/21-12/11/21)	Spring Semester 2022 (1/10/22-5/14/22)	All Semesters
Screening Dates	2/1/21-5/5/21	8/23/21-12/8/21	1/10/22-5/5/22	
Total Unvaccinated Student Positive Cases	2	6	30	38
Total Unvaccinated Students Screened	676	871	672	2219
Positivity Rate	0.30%	0.70%	4.50%	5.50%
Additional Positive Cases Identified through Contact Tracing	4	2	4	10
Chi-squared Test Compared to Spring Semester 2022	($\chi^2=24.1$, $df=2$, $P<.001$)	($\chi^2=22.5$, $df=2$, $P<.001$)	-	-

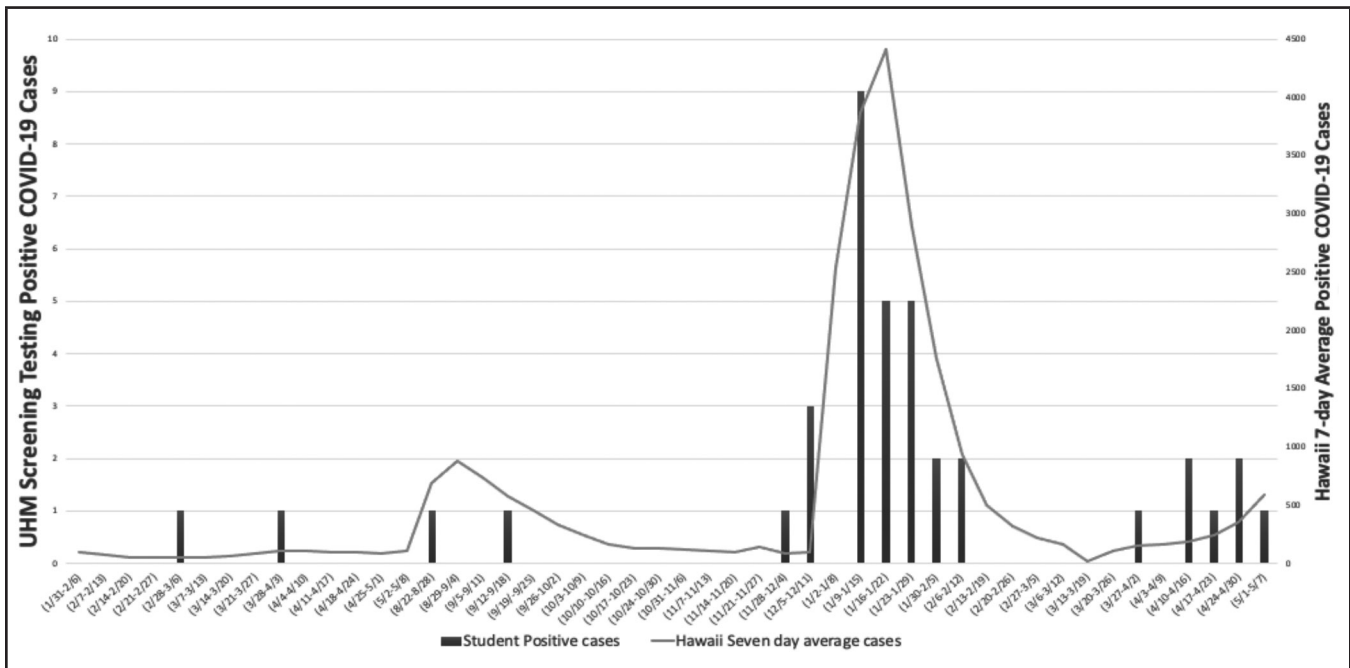


Figure 1 Residence Hall Screening Testing Positives vs Hawaii State Positives February 2021-May 2022
 University of Hawai'i at Mānoa (UHM) residence hall COVID-19 screening program weekly positive test results (blue bars) compared to Hawai'i State 7-day average COVID-19 positive test (orange curve) results from February 2021-May 2022.¹⁶ Left vertical axis refers to positive case numbers by week from UHM residence hall testing program. Right vertical axis demonstrates 7-day average weekly positive case numbers. Correlation using Pearson coefficient = 0.79; $P<.001$.

Discussion

The 3-semester duration UHM COVID-19 residence hall student screening program identified 38 COVID-19 positive cases and an additional 10 cases through contact tracing. In assessing the impact and effectiveness of the screening program, it is important to recognize that it served as only 1 component of a larger strategy to mitigate the effects of the COVID-19 pandemic on the UHM campus. The screening program positive case counts does not include cases among symptomatic and exposed residence hall students, non-residence hall students, and employees who were diagnosed with COVID-19 through having undergone diagnostic testing at UHSM, through their medical providers, or at community testing sites which were widely available at the time.

The impact of COVID-19 infections on the UHM campus was likely mitigated further by an adherence to CDC contact tracing, isolation and quarantine standards; shift to remote learning and work; enhanced facility cleaning; limited physical person gatherings; facial masking; staying home when sick; public health education; and COVID-19 vaccination. It is possible that this screening testing program raised awareness of COVID-19 on the UHM campus and altered behaviors, by further deterring large group gatherings, parties, and concerts. The presence of the screening testing program may also have decreased the earlier stigma associated with testing positive for COVID-19, as affected persons were not ostracized but temporarily isolated until they were healthy enough to resume regular activities.

Many institutions conducted COVID-19 screening programs in various forms for their campus populations. Due to significant differences in testing protocols, target populations, and available resources, it is difficult to provide any direct comparison of the results of the UHM COVID-19 screening program to those of other institutions of higher education.^{3,10,11}

Over the course of each semester of the screening program, the numbers of unvaccinated residence hall students who were subject to mandatory testing steadily declined. This was likely due to the: (1) the 90 day exemption from testing for those who had a recent COVID-19 infection; (2) submission of test results obtained external to the testing program, such as that required for National Collegiate Athletic Association (NCAA) student-athletes; (3) achievement of a fully vaccinated status; and (4) moving out of the residence halls. It seems possible that the inconvenience of weekly testing and evolving relaxed quarantine requirements for vaccinated as opposed to unvaccinated close case contacts may have provided further incentive for students to complete their COVID-19 vaccination series.

The HWBWG chose SARS-CoV-2 RT-PCR laboratory testing as the preferred methodology over rapid antigen testing given its higher sensitivity, advantage of requiring less frequent testing, reduced need for follow up confirmatory testing, and availability

in UHSM affiliated clinical laboratories with existing result reporting procedures. A recent study of 225 individuals who tested positive for SARS-CoV-2, demonstrated that antigen test sensitivity was 64% compared to 84% for RT-PCR tests collected on the same day.¹²

The evolution of COVID-19 variants played a role in the varying numbers of positive cases identified during the screening program. Notable spikes in COVID-19 positive case numbers occurred at the beginning of the Fall semester 2021 as a likely result of recent travel by students returning to campus during the Delta variant surge, and similarly early Spring semester 2022 due to recent student travel and the Omicron variant surge. Both variants exhibited higher relative transmissibility, and the Omicron variant was more likely to cause reinfections and affect persons who were fully vaccinated.^{13,14}

A limitation of this screening program was that a number of COVID-19 infections were likely missed among the fully vaccinated asymptomatic students, since only unvaccinated residence hall students were included in the program. A survey of 1378 NCAA student athletes across 15 states who tested positive for SARS-CoV-2, found that 22.4% were infected despite having received full COVID-19 vaccination.¹⁵ UH leadership's decision to include only unvaccinated residence hall students in this testing program was based upon the limited availability of laboratory testing resources and determination that unvaccinated residence hall students were the most vulnerable campus population.

COVID-19 clinical laboratory testing capacity limits also affected study sampling criteria which evolved from randomly selected unvaccinated students during Spring 2021 semester, to all unvaccinated students in Fall 2021 and Spring 2022 semesters. This change in sampling criteria is a potential study limitation and may have resulted in an underestimation of the *P*-values provided. Finally, symptomatic, unvaccinated residence hall students who were referred and evaluated medically for possible COVID-19 infection were not concurrently included in the UHM screening program, an effect that most likely affected the program's case positivity numbers.

Conclusion

This study demonstrates that a COVID-19 screening program of unvaccinated university residence hall students was able to identify a substantial number of asymptomatic/pre-symptomatic COVID-19 infections and additional cases through contact tracing during the COVID-19 pandemic. The results additionally show that spikes in the numbers of positive screening program COVID-19 cases coincided with the State of Hawai'i 7-day average positive case counts. This program served as only 1 component of a larger strategy to mitigate the effects of the COVID-19 pandemic on the UHM campus, with additional potential benefits of the program including opportunities to

increase COVID-19 awareness, enact health policy measures, evolve to meet changing pandemic demands, and help keep the UHM campus safe.^{3,8}

Conflict of Interest

None of the authors identify a conflict of interest.

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