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Multi-Faceted Approach to COVID-19 Surveillance at a Large University Campus in the Southeastern United States

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Abstract

The coronavirus disease 2019 (COVID-19) pandemic continues to present unique public health challenges both within the United States and across the globe. Institutions of higher learning are tasked with preventing and responding to COVID-19 on campus while also considering implications for the surrounding communities. The process of re-opening campus, whether at full or partial capacity, has tasked these institutions with overcoming complex challenges associated with balancing the resumption of campus operations while simultaneously protecting university affiliates and surrounding community members from COVID-19 through robust surveillance, contact tracing, and testing efforts. Here, we provide a concise outline related to the development and implementation of the comprehensive and sustainable COVID-19 surveillance program at the University of Florida. We also critically discuss the successes and pitfalls of this program while also providing recommendations for the development of similar programs in the future.

Although much progress has been made in the context of transmission control and herd immunity, the coronavirus virus disease 2019 (COVID-19) pandemic continues to present unique public health challenges both within the United States and across the globe. Many institutions of higher learning were, and still are, tasked with preventing and responding to COVID-19 on campus while also considering implications for the surrounding community. This was a particular challenge during the beginning stages of the pandemic as young adults accounted for increasing proportions of laboratory confirmed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections across all regions within the United States. Furthermore, this population of young adults between the ages of 20 and 39 y contributed to large regional increases in COVID-19 cases in the southern United States during June 2020.¹ During this time, many institutions of higher learning began the process of re-opening and were, therefore, tasked with novel challenges pertaining to both the campus environment and the surrounding community. Despite the lack of national-level guidelines for institutions of higher learning at the time, the University of Florida (UF) began the development and implementation of a comprehensive and sustainable COVID-19 surveillance program, with a novel educational training component, before returning to campus in April 2020. This program, termed UF Health Screen, Test & Protect (STP), was developed through interdisciplinary collaboration between various departments and colleges on the university campus as well as with the local health department. These collaborative efforts are essential for rapid response to the continually changing pandemic in the context of testing, epidemiological investigations, and vaccine distribution.

The complex development and implementation of this program at an institution of higher learning needed to account for surveillance components unique to the university campus (eg, dormitories, Greek life,² other student organizations, classroom monitoring for face-to-face courses, university-affiliated athletics, etc.) as well as components at the intersection of the university and the surrounding community (eg, university-affiliated K-12 school and 3 daycare centers, 3 university-affiliated hospital systems, use of state communicable disease and vaccine databases, etc.). This program also used a variety of university and state resources to develop a comprehensive database for surveillance efforts (eg, REDCap³, Merlin⁴, Epic⁵, Salesforce⁶, and Florida SHOTS [FLShots]⁷). Furthermore, university resources were harnessed to conduct molecular surveillance to monitor SARS-CoV-2 variants and wastewater surveillance for COVID-19 on campus congregate housing, providing community-level data to inform targeted testing. This program could be used as a replicable model for other similar institutions or be modified for use in the context of other communicable diseases in the future. The goal of this

article is to provide a concise outline related to the development and implementation of the comprehensive and sustainable COVID-19 surveillance program at the University of Florida. This article will critically discuss the successes and pitfalls of this program while also providing recommendations for the development of similar programs in the future.

Results Discussion

Surveillance Components Unique to the University Campus

There are multiple components of the COVID-19 surveillance program that are unique to a university campus, including undergraduate and graduate dormitories, Greek life and other student organizations, classrooms for face-to-face courses, essential in-person work on campus, research, university-affiliated athletics, health-care-related coursework and research, and the university-affiliated Student Health Care Center (Table 1). While each of these components presented unique challenges in the context of transmission control, they also proved to be important and effective targets for both passive and active surveillance of COVID-19. Throughout the development and implementation of the surveillance program, STP followed and adapted to all COVID-19 case definitions and guidelines related to isolation, quarantine, and vaccinations put forth by the Centers for Disease Control and Prevention (CDC) (Table 2).

University-Wide Sentinel Surveillance

The surveillance efforts for the individual components are supplementary to the university-wide weekly symptom-based screening for all university-affiliated individuals. Every 7 d, all university-affiliated individuals were prompted to complete a brief COVID-19 symptom questionnaire. Individuals are also encouraged to use this questionnaire at any point in time to report any COVID-19-like symptoms or exposures, or to register for testing. When an individual reports symptoms indicative of a suspect SARS-CoV-2 infection, they are directly prompted to schedule an appointment for COVID-19 testing at a location on the university campus at no cost. The university surveillance program receives notification of individuals with symptoms related to COVID-19 and automatically “withholds” the individual from campus. In this context, withholding is defined as students, faculty, and staff members being unable to attend face-to-face courses, access communal areas such as libraries or recreational centers, work on campus, or reside in undergraduate dormitories. All individuals who are under active isolation or quarantine precautions are withheld (unless an individual is previously deemed to be an essential employee, in which case, mandatory testing at day 5 and day 9 is required to continue to hold a “cleared” status). University affiliates also have the option of self-reporting to the surveillance program in the context of experiencing COVID-19-like symptoms, receiving a positive test result from an outside laboratory, or being in contact with a known case of COVID-19. Individuals who self-report by either completing the online symptom survey or calling into the main phone line are followed up with by a disease investigator who functions as an employee of the Florida Department of Health (FDOH)-Alachua and has the authority to implement isolation and quarantine protocols. The use of both active and passive surveillance methods further strengthens the comprehensive nature of the surveillance program.

Undergraduate Dormitories

As of the Spring 2020 semester, students living on-campus in undergraduate dormitories were required to complete testing every 14 d for COVID-19. These saliva-based polymerase chain reaction (PCR) tests were scheduled by the student through the university’s health screener, and testing could be completed at any testing site on the campus. In the event of a positive case, identified contacts, or an individual with COVID-19-like symptoms without a current lab result (eg, a probable or suspect case), students living in the congregate undergraduate dorms were moved to alternative residence halls dedicated to isolation or quarantine of COVID-19 cases, contacts, and suspects, respectively. The university surveillance program and the University Housing Department coordinated this temporary move the same day, unless the “withhold from campus” status was received after 7:00 PM. During this time, students with on-campus meal plans were provided with meals to minimize the need for students to leave isolation or quarantine. Alternatively, students were given the option to complete isolation or quarantine off-campus at a private residence or with local hotels that were contracted with the university. Contacts are sent a daily text or email asking them to complete a daily questionnaire to monitor the development or the progression of their symptoms. If individuals who are identified as contacts begin to experience symptoms related to COVID-19, they are then considered a probable case and will be investigated by the university surveillance program.

Greek Life

Similar to individuals residing in a university-affiliated dormitory, those who reside in Greek housing and those with an active meal plan through their Greek organization were required to complete bi-weekly testing for COVID-19. In the event an individual is classified as a probable or confirmed COVID-19 case, a comprehensive investigation takes place in which disease investigators contact the case and inquire about Greek life-specific activities such as chapter meetings, social events, intramural sports participation, volunteer or philanthropic events, routine meals (twice per day), and other special events. If the investigation suggests that an outbreak may be occurring, disease investigators must consider the number of potentially affected cases and contacts in comparison with in-house members of that organization. If an entire Greek house has been exposed, currently exhibiting symptoms, or the majority of their current residents are probable or confirmed cases, a protocol will be set in place in which asymptomatic and negative contacts move to temporary housing while cases reside in the house. Furthermore, symptom-based sentinel surveillance is conducted to detect potential cases that may occur in-between routine testing dates. In this setting, sentinel surveillance involves the passive collection of data from university-affiliates (through self-report by means of an online portal) related to COVID-19 (being exposed to a case, receiving a positive test result that has not been reported [eg, at-home testing or out-of-state testing], experiencing symptoms of COVID-19, etc.) that may inform STP of potential transmission on campus. Such a protocol allows for the proactive implementation of tailored interventions (including testing and public health education) to limit the spread of COVID-19 within the Greek house and other locations on campus. The success of these interventions is dependent on the collaboration of Greek leadership, Greek organization presidents, and the Greek disease investigator team responsible for handling Greek-life-related investigations and surveillance activities.

Table 1. Key components of COVID-19 campus surveillance

Surveillance component	Definition or explanation
Affiliated hospital data	University-affiliated hospital system provides data on COVID-19 admissions and deaths as well as the minimal health status of affiliates and employees.
UAA athletics testing	University-affiliated athletic programs are tested according to the Southeastern Conference (SEC) guidelines. Positive tests are reported by SEC testing coordinators if results are not automatically piped into the REDCap system.
Classroom monitoring	In-person classes are monitored weekly for a high proportion of students who were “withheld” as cases, contacts, or suspect cases, and assessed whether spread in the classroom was possible and identify mitigation strategies.
Greek life organizations	Greek life organizations take part in a novel sentinel surveillance program. Additionally, daily reports identify cases by house affiliation, in-house status, and include in all in-house roommate data.
High-risk groups	High-risk groups include individuals engaging in activities that may predispose them to a higher risk of transmission. Such groups include individuals living in congregated living facilities (undergraduate dormitories), Greek affiliates (in-house and out-of-house), teaching or taking face-to-face classes, or interacting with patients or research subjects in-person.
Molecular epidemiology	Molecular sequencing of SARS-CoV-2 samples is offered to select persons as approved by STP administration. This includes vaccine breakthrough cases (eg, individual has a positive COVID-19 test after being fully vaccinated) and individuals within transmission clusters of interest to determine strain information.
Occupational health	The university-affiliated hospital system and patient facing practitioners and students to handle health-care-associated COVID-19 cases.
Routine testing	Identified high-risk student groups are required to complete a health screener to report symptoms, exposures, and sign up for routine biweekly testing.
Health screener	A voluntary health screener is sent every week to all main campus UF-affiliates to report symptoms, exposures, and access testing appointments
Self-reporting	University affiliates are encouraged to self-report by means of the university portal or by calling STP for potential COVID-19-like symptoms, exposures, and contacts of COVID-19.
Sentinel surveillance	Members of Greek life organizations participate in sentinel surveillance. Occurrence of COVID-19-like symptoms are collected by the president or other point of contact and are reported weekly by means of an emailed survey. If symptoms are reported in the house, targeted testing is implemented.
State communicable disease database	The state communicable disease database (Merlin) is accessed at 3 scheduled times per day to identify university-affiliated and community cases of COVID-19 for investigations throughout the state of Florida. Using Merlin, it is possible to identify university-affiliated COVID-19 cases that may have otherwise been missed due to either out-of-county status (eg, using parental residence address) or being tested outside of the university program.
State vaccine database	During the contact tracing process FLshots is used to verify vaccine information for university affiliates.
Targeted testing	Targeted testing is implemented for groups deemed to have possible active transmission occurring. A text/email is sent recommending testing within 48 h. Examples of targeted testing include detection of SARS-CoV-2 in wastewater samples, clusters of cases in Greek houses, dormitories, and classrooms.
Wastewater surveillance	Wastewater from potential high-risk locations (eg, undergraduate dormitories and Greek Houses) is routinely tested for COVID-19. Detection by means of wastewater surveillance results in targeted testing.

Classroom Monitoring

During the Spring 2021 semester, all individuals participating in face-to-face courses were required to complete testing for COVID-19 every 14 d to remain “cleared for campus” and eligible for in-person attendance. Campus clearance status is visible to instructors through their class rosters. Similar to the STP Greek Team, the STP Classroom Team is composed of Disease Investigators who are assigned to lead the surveillance and investigation efforts for classroom-related activities. The university surveillance program collaborated with the instructors for these in-person courses to complete thorough investigations and minimize the risk of transmission in the university community.

Student Health-Care Center

In addition to identifying cases of COVID-19 among university affiliates through collaboration with the local health department and use of state-wide communicable disease reporting system (Merlin), cases identified through medical evaluations and testing at the Student Health-Care Center—the primary center for all student health-care services—are directly reported to the university surveillance program by means of a 1-way electronic portal. This facilitates an immediate change in campus clearance status

for individuals with either positive labs or those who meet the criteria of being a probable case.

University Athletics

All student-athletes and University Athletic Association (UAA) affiliates are required to adhere to both Southeastern Conference (SEC) and university guidelines to work, practice, and compete through the organization. This is monitored by the STP Athletics Team. Similar to the previously mentioned teams, this team is composed of disease investigators who are assigned to lead the surveillance and investigation efforts for UAA athlete-related activities through daily communication and collaboration with the UAA management staff, health-care workers, and student-athletes. Additionally, student-athletes are subject to routine testing (according to SEC guidance⁸: “For high-risk sports, PCR surveillance is required weekly during practice and 3 times weekly during competition periods. Intermediate- and low-risk sports may be tested at less frequent intervals.”), making this a reliable asset when functioning proactively to prevent sport-related outbreaks. In the event a student-athlete tests positive, their respective athletic trainer will conduct a brief interview with the case to identify symptoms, date of symptom onset, and potential exposure to any teammates. Subsequently, the STP Athletics Team is notified

Table 2. COVID-19 case and contact definitions

	Symptoms	Type of test	Definition	Isolation/quarantine	Campus clearance	Exceptions
Confirmed case	Acute onset of cough, shortness of breath/difficulty breathing, or new olfactory/taste disorder OR acute onset of 2 or more of other symptoms such as fever, chills, rigors, myalgia, headache, sore throat, nausea or vomiting, diarrhea, fatigue, and congestion or runny nose OR asymptomatic	NAAT (PCR)	An individual with a laboratory-confirmed positive NAAT test for SARS-CoV-2 who is either experiencing symptoms or is asymptomatic	Isolation for 10 d following the date of symptom onset, or date of NAAT test if asymptomatic, with the end of isolation contingent upon absence of fever for 24 consecutive hours before day 10 as well as improvement of all other symptoms	Withheld from campus for the entirety of the isolation period	None
Probable case	Acute onset of cough, shortness of breath/difficulty breathing, or new olfactory/taste disorder OR acute onset of 2 or more of other symptoms such as fever, chills, rigors, myalgia, headache, sore throat, nausea or vomiting, diarrhea, fatigue, and congestion or runny nose OR asymptomatic	Rapid antigen/none	An individual with either no test results or a positive result by means of a rapid antigen test who is either experiencing symptoms or is asymptomatic who has known and documented contact with a confirmed or probable case (within 6 feet for 15 cumulative minutes)	Isolation for 10 d following the date of symptom onset, or date of antigen test if asymptomatic, with the end of isolation contingent upon absence of fever for 24 consecutive hours before day 10 as well as improvement of all other symptoms	Withheld from campus for the entirety of the isolation period	Fully vaccinated probable cases may end isolation if they receive 1 negative NAAT test result between 1-5 d of symptom onset. Partially vaccinated or unvaccinated probable cases may end isolation if they receive 2 negative NAAT test results between 1 and 5 d of symptom onset that are taken more than 24 h apart.
Suspect case	Acute onset of cough, shortness of breath/difficulty breathing, or new olfactory/taste disorder OR acute onset of 2 or more of other symptoms such as fever, chills, rigors, myalgia, headache, sore throat, nausea or vomiting, diarrhea, fatigue, and congestion or runny nose	None	An individual with no test results who is experiencing symptoms and has no known or documented contact with a confirmed or probable case (within 6 feet for 15 cumulative minutes)	Isolation for 10 d following the date of symptom onset with the end of isolation contingent upon absence of fever for 24 consecutive hours before day 10 as well as improvement of all other symptoms	Withheld from campus for the entirety of the isolation period	Fully vaccinated suspect cases may end isolation if they receive 1 negative NAAT test result between 1 and 5 d of symptom onset. Partially vaccinated or unvaccinated suspect cases may end isolation if they receive 2 negative NAAT test results between 1 and 5 d of symptom onset that are taken more than 24 h apart.
Close contact	NA	NA	An individual who is within 6 feet of a probable or confirmed case of COVID-19 for a total of 15 cumulative minutes during the case's infectious period (beginning 48 h before symptom onset or positive test)	Quarantine for 14 full days following the last day of contact with the case (if the individual has ongoing contact with the case, the 14-d quarantine period does not begin until the end of the case's isolation period)	Withheld for the entirety of the quarantine period	Fully vaccinated close contacts are not required to quarantine if asymptomatic.

Abbreviation: NAAT, nucleic acid amplification test.

and conducts a full case interview to gather in-depth information that may extend outside of UAA events and requirements. All remaining UAA staff investigations are completed entirely through the STP Athletics Team. Full case interviews gather essential information regarding the locations visited and individuals contacted during the designated exposure and infectious periods. This is imperative given that each sport and department follow different schedules in terms of training, practice, meetings, and other events. After conducting case interviews, the STP Athletics Team quickly establishes correspondence with any reported contacts to assess potential symptoms and establish proper quarantine protocol. UAA contacts also abide by updated university surveillance program criteria for vaccination exemptions. Specifically, UAA contacts are not required to quarantine and are instead tested between day 3 and day 5 postexposure. If unvaccinated, UAA contacts follow university-wide protocols by adhering to quarantine. They are eligible for release after receiving a negative PCR test on day 9 postexposure. Regardless of vaccination status, all UAA contacts are subject to probable case protocols in the event of symptom development. If a contact becomes a probable case, the UAA is notified immediately, and a full case investigation is required and implemented. Positive cases are not cleared until the individual completes the minimum isolation requirement. Additionally, student athletes are subject to additional medical evaluations⁸ and must obtain clearance from their team physician before returning to activities play.

Surveillance Components at the Intersection of the University Campus and Surrounding Community

Surveillance for a University-Affiliated Charter School and Daycare Center

The university is currently affiliated with a K-12 developmental research school, PK Yonge, comprised of approximately 1150 students. In conjunction with the FDOH and school staff, all PK Yonge COVID-19-related investigations of affiliates of this school are handled by the university STP School Surveillance Team due to unique guidelines for contact tracing and return-to-school testing policies for children in schools that are distinct from that of the general population. The university also encompasses a childcare center servicing university-affiliated families with children ages 6 wk to 5 y. This center has 3 physical locations on the university campus and is handled by the university STP School Surveillance Team. STP follows state and federal guidelines for protocols pertaining to individuals in K-12 school and daycare settings.

Collaboration With the University-Affiliated Hospital and Academic Health Center

The university is affiliated with a large hospital system encompassing approximately 1162 beds, 10,324 employees, and 1209 physicians. The STP surveillance program STP Occupational Health Team collaborates with the hospital's Infection Prevention and Control department and Occupational Health Services department to facilitate contact tracing for all clinic- and hospital-affiliated faculty, staff, and students. The STP Occupational Health Team also facilitate contact tracing for the 6 colleges of the UF Academic Health Center (College of Dentistry, College of Medicine, College of Nursing, College of Pharmacy, College of Public Health and Health Professions and College of Veterinary Medicine). As with the university-affiliated school, the STP Occupational Health Team is a designated team of disease

investigators who are trained and assigned to handle all activities related to this health science system.

Use of University Resources and Technology for Additional Surveillance Methods

Environmental Surveillance and Wastewater-Based Epidemiology

As previously stated, wastewater-based epidemiology is used to identify campus locations with the potential for transmission of COVID-19. To assist in monitoring of potential on-campus transmission, university-affiliated laboratory teams sample wastewater thrice weekly from utility access holes that service specific building sites on the UF campus, including dormitories and Greek-affiliated houses. The laboratory teams then analyze the data and compile and send reports to the surveillance team that includes a list of residential buildings that have been determined to be high concentration positive, low concentration positive, or are a negative result. Targeted testing is recommended and provided for the affected residents of the buildings with either high or low concentration positive results, allowing disease investigators to take a proactive approach to contact tracing investigations.

Molecular Epidemiology

To monitor which SARS-CoV-2 isolates are circulating in the population and identify lineages (or "variants") associated with vaccine breakthroughs or increased transmissibility, molecular sequencing of SARS-CoV-2 from saliva samples is performed by a university lab at the UF Emerging Pathogens Institute. Vaccine breakthrough cases (eg, cases of COVID-19 that occur after an individual is considered fully vaccinated) or cases within potential clusters of interest are contacted by disease investigators and asked to voluntarily provide an additional saliva sample for further molecular analysis. Although not part of the local health department protocol, molecular epidemiology provides the surveillance program with important and potentially actionable information pertaining to currently circulating strains and to clusters derived from the same SARS-CoV-2 genotype.

Development and Use of Comprehensive Databases

The surveillance program used, and in some instances developed, large comprehensive databases to integrate several types of vital information for the purposes of contact tracing and surveillance activities. REDCap[®] was used to develop databases to document and track information related to cases, contacts, COVID-19-like symptoms, and COVID-19 test results for tests administered through the University of Florida. These databases included all necessary information for the completion of a full interview by the local health department. In addition to all required information, these REDCap[®] databases were used to collect important information related to the university campus (eg, in-person courses, dormitory assignments and roommates, student organization involvement, affiliation with sports or Greek life, etc.). Once interviews are documented in REDCap[®], designated disease investigators transfer all information into the state communicable disease database (Merlin) for the local health department records. Cases are directly uploaded to the REDCap[®] database from Merlin if they are identified as university-affiliates through frequently scheduled queries. The cases are then investigated, and information is documented in the REDCap[®] database to be

manually entered into Merlin following completion, including a PDF of the case profile generated from REDCap®. In addition to handling comprehensive information related to COVID-19 surveillance on campus, the REDCap® database is used to ensure disease investigators can work simultaneously, if needed, without requiring the use of a DOH-issued laptop (Merlin can only be accessed directly through a DOH-issued laptop, which are limited in number). Additionally, disease investigators use both Merlin and FLShots to acquire information related to COVID-19 test results and related vaccination, respectively.

Use of Public Health University Students/Faculty/Staff to Create an Impromptu Workforce

At the beginning of the pandemic, the university developed an impromptu volunteer workforce, comprised of students, faculty, and staff of both public health and medical colleges, to develop and implement the surveillance program. The program was further defined, solidified, and provided funding from the university with support from the Florida Department of Health in Alachua County. All individuals in the program hold an affiliation with both state intuitions; however, the funding for each position is dependent on their individual role (eg, some individuals were officially hired by the local health department while others were employed directly by the university). Alternative to employment, eligible students were offered independent study course credit through the university to participate in the surveillance program on a semesterly basis. All individuals, whether employed or receiving credit, are required to have an affiliation with both agencies and to complete certain training (eg, HIPAA, FERPA, etc.) before participating.

Development of Novel COVID-19 Training Modules Before Implementation of State or National Training Guidelines

At the time the surveillance program was developed, there was no national or state-level training available in the context of COVID-19 contact tracing. Therefore, the program developed a comprehensive internal training program composed of 7 online modules with built-in assessments covering vital topics, including HIPAA, biology and epidemiology of SARS-CoV-2, disease transmission, principles of contact tracing specific to COVID-19, skills for completing successful and comprehensive case and contact interviews, public health education on limiting spread, and use of the REDCap® and Merlin database for data collection. Following completion of these modules, all disease investigators are required to pass a live mock interview for both cases and contacts with an experienced senior investigator. To ensure the program reflected the most up-to-date information pertaining to the pandemic, the contact-tracing portion of the training now requires completion of the COVID-19 Contact Tracing course offered by Johns Hopkins University.⁹

Adapting to Evolving Guidelines During Development and Implementation Phases

To swiftly adapt to continually evolving guidelines related to COVID-19 (eg, changes in case definitions, criteria for close contacts, recommended isolation and quarantine periods, testing criteria, etc.), the surveillance program implemented a weekly meeting for all members and affiliates of the program. In addition, to providing the most up-to-date information related to both state and national-level COVID-19 guidelines, weekly meetings

provided opportunities to discuss, provide feedback, and optimize various components of the program. When protocol updates are established, dedicated disease investigators promptly update the program's Standard Operating Procedure and distribute documented summaries of specific adjustments to all team members by means of email after the meeting is concluded. Subsequently, a designated REDCap® support team implements any necessary changes in real-time to the REDCap® database to minimize potential complications stemming from changes in protocol.

Limitations

Successes and Barriers Related to Development and Implementation of a University Covid-19 Surveillance Program

The development of the surveillance program during the initial stages of the pandemic has provided our STP team with unique perspectives related to the advantages and disadvantages associated with distinct components of COVID-19 surveillance in a university setting. In Table 3, we summarize the strengths and weaknesses associated with each component of the program.

Conclusions

Recommendations for the Future Development and Implementation of a Similar Surveillance System

While some components of the COVID-19 surveillance program are disease-specific, the framework outlined here could be adapted for use with other infectious diseases of interest within this population (eg, other respiratory infections like influenza, common gastrointestinal infections, etc.). However, the substantial funding necessary to sustain a program of this magnitude is an important limiting factor. Therefore, it is worth discussing the cost-effectiveness of specific subcomponents of this surveillance program. For example, using environmental surveillance and wastewater-based epidemiology to identify high-risk groups with potential transmission (eg, dormitory residents) is most actionable when case prevalence is low. When case prevalence is high, SARS-CoV-2 will most likely always be detected in wastewater samples for either 1 building or groups of buildings sharing the same sewage system, rendering targeted testing for incident cases ineffective. Similarly, molecular epidemiology is useful for identifying and confirming specific outbreaks as well as tracking the presence of certain SARS-CoV-2 variants of concern or interest.¹⁰ within the population. While informative, this component is not necessary for a successful COVID-19 surveillance program. However, this method of surveillance may be useful for the early detection of other infectious diseases important to a university population, such as viral meningitis. This is feasible considering that many viruses, including enteroviruses that cause meningitis, can be reliably detected by means of PCR in both human feces and raw wastewater.¹¹ Early detection may present an opportunity for swift intervention (eg, campus vaccination campaigns, enactment of infection prevention protocols, etc.).

Apart from funding, another crucial factor necessary for the success of a surveillance program for infectious diseases is strong collaboration with both local and state health departments. In our case, many disease investigators were fully employed and trained by the local and state health department, giving them access to tools and databases necessary for identifying and tracking cases of COVID-19 affiliated with the university. Conclusively,

Table 3. Strengths and weaknesses of key COVID-19 campus surveillance components

Surveillance component	Description	Strengths	Weaknesses
Affiliated hospital data	Data pertaining to COVID-19 among health-care workers or HSC patient-facing students.	Important for identifying health-care workers that work both within the hospital and on main campus.	NA
Athletics testing	Routine testing of student-athletes and coordination across athletic administration (eg, communication between athletes, athletic trainers, other staff, and disease investigators).	Essential to minimizing risk for sport-related outbreaks. Routine tests ensure comprehensive surveillance and quick detection of positive cases.	NA
Classroom monitoring	Information pertaining to in-person classes is automatically uploaded into each university-affiliated case when applicable. All individuals in each class are listed as potential contacts.	Useful for identifying potential contacts in the classroom setting. The individual case, associated contacts, and instructor for the course may provide helpful information.	Without adherence to a seating chart, it is difficult to identify potential contacts for large in-person classes. Cases may not know the individuals near them or have their contact information.
Greek life organization monitoring	Disease investigators collaborate with the president and house director of each Greek house to identify potential cases or contacts and implement targeted testing when applicable.	Collaboration with Greek house presidents allows STP to actively monitor Greek houses for symptomatic individuals that may benefit from targeted testing.	Utility of this component is dependent on collaboration with each president or house director. Targeted testing is voluntary and may not be used by all in-house members when recommended.
High-risk group monitoring	Groups with increased risk of transmission (eg, students living in dormitories, Greek houses, athletics teams, etc.) are directly monitored. Targeted testing is implemented when applicable.	Similar to Greek houses, other high-risk groups are monitored to quickly detect any potential cases in these populations. Targeted testing may be implemented.	Utility of this component is dependent on collaboration with the high-risk group of interest. Targeted testing is voluntary and may not be used by all individuals in these groups.
Molecular epidemiology testing	Molecular testing identifies the genetic lineage and strain/variant designation of SARS-CoV-2 within samples of interest. Genetic lineage and strain information allows STP to identify outbreak clusters associated with a particular location or identify strains associated with vaccine breakthrough cases.	Useful for identifying or confirming outbreaks on campus or in the surrounding area; also provides variant information when assessing vaccine breakthrough cases.	Information on the strain or variant is not necessary for surveillance or contact-tracing. Strain/variant identification is not useful without indication of potential new strains of interest in the region.
Occupational Health	Occupational Health Department through the university-affiliated hospital handles all COVID-19 cases among health-care workers and some patient-facing HSC students.	Enables a comprehensive investigation for health-care workers in which Occupational Health focuses on workplace and STP focuses on community and campus transmission.	Occupational Health focuses on information pertaining to the workplace (hospital). STP/FDOH is responsible for collecting information and providing guidelines pertaining to the community. Therefore, most health-care workers will need to be interviewed twice.
Routine testing	NAAT testing at routine intervals to detect cases of COVID-19 and prevent spread on campus.	Essential for preventing and identifying potential outbreaks on campus.	NA
Self-reporting	University affiliates can self-report positive COVID-19 test results, contact with a COVID-19 case, or symptoms of COVID-19 by means of a 1-way online portal directly to STP.	Essential for the identification of many suspect or probable cases. In many cases, self-reporting allows STP to monitor these individuals before reporting of valid test results in the state system.	Self-reported information is not always accurate. Some self-reported positive test results are from at-home tests that cannot be verified in the state database.
Sentinel surveillance	Passive reporting of COVID-19 cases from hospitals, urgent cares, and the student health-care center.	Useful for preventing and identifying potential outbreaks on campus.	Passive nature of sentinel surveillance renders it less useful than other program components.
State communicable disease database	Merlin	Essential for identifying cases who did not receive testing through the university. It is also essential for collaboration with the local health department as all case data are uploaded to this system following investigation by STP.	NA
State vaccine database	FLShots	Essential for verifying vaccination status for university affiliates; impacts potential quarantine periods and testing recommendations.	Information pertaining to vaccines received outside of Florida will not automatically be uploaded. Individuals who received vaccines outside of Florida are asked to send their vaccine information to STP by means of confidential email.

(Continued)

Table 3. (Continued)

Surveillance component	Description	Strengths	Weaknesses
Targeted testing	Targeted testing is indicated for certain groups through results from wastewater epidemiology, sentinel surveillance, and monitoring of high-risk groups (eg, students living in dormitories, Greek houses, athletics teams, etc.).	Useful for early identification of COVID-19 that may result in an outbreak. Early detection allows for implementation of isolation/quarantine protocols to reduce transmission to others within the high-risk group.	This is most actionable when case prevalence is very low. Otherwise, SARS-CoV-2 is almost always detected and is less informative.
Wastewater surveillance	Wastewater from campus buildings is routinely testing for the presence of SARS-CoV-2. When detected, targeted testing may be implemented.	Useful for early identification of COVID-19 that may result in an outbreak. Early detection allows for implementation of isolation/quarantine protocols to reduce transmission to others within the high-risk group.	Wastewater manholes are not always specific to 1 building on campus. Detection of SARS-CoV-2 in 1 manhole servicing multiple different buildings is less actionable. This is most useful when case prevalence is very low. Otherwise, SARS-CoV-2 is almost always detected and is less informative.

collaboration with either state or local health departments provides invaluable insight and a larger perspective regarding disease transmission in the community surrounding the university campus.

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References

1. **Boehmer TK, DeVies J, Caruso E, et al.** Changing age distribution of the COVID-19 pandemic — United States, May–August 2020. *MMWR Morb Mortal Wkly Rep.* 2020;69(39):1404–1409. doi: [10.15585/mmwr.mm6939e1](https://doi.org/10.15585/mmwr.mm6939e1)
2. **Vang KE, Krow-Lucal EER, James AE, et al.** Participation in fraternity and sorority activities and the spread of COVID-19 among residential university communities — Arkansas, August 21–September 5, 2020. *MMWR Morb Mortal Wkly Rep.* 2021;70(1):20–23. doi: [10.15585/mmwr.mm7001a5](https://doi.org/10.15585/mmwr.mm7001a5)
3. **Harris PA, Taylor R, Thielke R, et al.** Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform.* 2009;42(2):377–381. doi: [10.1016/j.jbi.2008.08.010](https://doi.org/10.1016/j.jbi.2008.08.010)
4. **Tembey P, Gavrilovska A, Schwan K.** Merlin: application- and platform-aware resource allocation in consolidated server systems. In: Proceedings of the ACM Symposium on Cloud Computing, SOCC '14. Association for Computing Machinery; 2014:1–14. doi:10.1145/2670979.2670993
5. Epic. Software. Accessed May 24, 2021. <https://www.epic.com/software>
6. **Salesforce.com.** The customer success platform to grow your business. Accessed May 24, 2021. <https://www.salesforce.com>
7. Florida SHOTS. Home. Accessed May 24, 2021. <https://www.flshotsusers.com/>
8. SEC. Medical guidance task force requirements for COVID-19 management: Spring Sports. Accessed May 29, 2022. <http://a.espncdn.com/sec/media/2021/SEC%20Task%20Force%20Recommendations%20Spring.pdf>
9. **Gurley E.** COVID-19 contact tracing. Accessed August 1, 2021. <https://www.coursera.org/learn/covid-19-contact-tracing?edocomorp=covid-19-contact-tracing>
10. CDC. SARS-CoV-2 variant classifications and definitions. Published February 11, 2020. Accessed October 5, 2021. <https://www.cdc.gov/coronavirus/2019-ncov/variants/variant-info.html>
11. **Xagorarakis I, O'Brien E.** Wastewater-based epidemiology for early detection of viral outbreaks. *Water Qual.* Published online March 30, 2019:75–97. doi:10.1007/978-3-030-17819-2_5