The University of Illinois is using its own saliva polymerase chain reaction (PCR) assay to test students and others on campus for COVID-19.

THE GIANT UNIVERSITY COVID EXPERIMENT

Despite COVID-19 running rampant in many US states, institutions are welcoming millions of students back to their campuses. **By Emma Marris**

On 16 August, waves of eager students began moving into campus housing at the University of Illinois at Urbana-Champaign. Besides dealing with tearful parents and finding sheets to fit non-standard dormitory mattresses, undergraduates are also spitting into a tube for a quick COVID-19 test before they get their keys. It's the first time of many: the university plans to test every student, staff member and faculty member twice a week.

Football practice began on 17 August at Texas A&M University in College Station, where students can already sign up for US$325 home-game passes for a range of sports, including the ten-game football season, which starts on 26 September. The stadium will be only half full and masks will be mandatory, but up to 55,000 fans could be belting out the university's 'Aggie War Hymn' at full volume in little over a month's time.

In the absence of any national strategy for tackling the coronavirus pandemic, colleges and universities in the United States are on their own when it comes to deciding whether and how to bring students back for the autumn term, which has already started for some institutions. Many are relying on their own experts, resulting in a wide range of approaches, from

telling students to attend online classes from home to bringing everyone back and testing them three times a week. Some are welcoming limited numbers of students with a face mask stamped with the university's mascot, a bottle of hand sanitizer and plans to test only a fraction of people on campus. It all amounts to a gigantic, unorganized public-health experiment — with millions of students and an untold number of faculty members and staff as participants.

Bringing so many university students to crowded campuses is uniquely risky in the United States, which has seen the largest number of deaths from COVID-19 of any country and has active community transmission of SARS-CoV-2, the virus responsible for the pandemic. Other large countries with surging infection rates, such as India and Brazil, are not opening up campuses to the same degree.

According to the College Crisis Initiative, a research project at Davidson College in North Carolina, more than 1,000 four-year colleges and universities in the United States will bring students back to campus in some form, with 42 operating "fully in person", another 421 as "primarily in person", and more than 600 offering various combinations of online and in-person classes as of 18 August (see 'Back to school').

But plans change daily, with many universities that boldly planned to hold in-person classes deciding at the last minute to switch to virtual versions. The University of North Carolina at Chapel Hill (UNC) announced on 17 August that, because of outbreaks of COVID-19 among students, it would shift all undergraduate classes online, a week after bringing students back to campus.

University presidents who have pushed for some semblance of normal classes have emphasized students' eagerness to return, and the risk of "failing to provide the next generation of leaders the education they need and to do the research and scholarship so valuable to our society", as John Jenkins, president of the University of Notre Dame in Indiana, wrote in an opinion piece for *The New York Times* in May. On 18 August, Notre Dame announced it would suspend in-person classes for two weeks because of the rapid rise of infections there.

Universities have justified calling students back to campuses for educational purposes, but some experts say there is a less-exalted motivation: institutions need the money. More than in many other countries, universities in the United States have increasingly come to rely on tuition income and fees, including payments for housing and meals, to stay afloat, according to higher-education researcher Kevin McClure at the University of North Carolina Wilmington. Higher-education consultants SimpsonScarborough, based in Alexandria, Virginia, surveyed more than 900 would-be first-year students in July and

found that 40% might put off attending university, potentially slashing tuition income. For institutions that opt to hold only virtual classes, revenue from dining halls, housing, gyms, parking and other facilities that charge fees will drop precipitously. University presidents have been projecting massive budget shortfalls: $96 million at Boston University in Massachusetts, $100 million at the University of Wisconsin Madison, $120 million at the University of Kansas in Lawrence, $375 million at Johns Hopkins University in Baltimore, Maryland.

BACK TO SCHOOL

Most of the four-year universities and colleges in the United States are welcoming students to their campuses in some form, although many have embraced online classes.
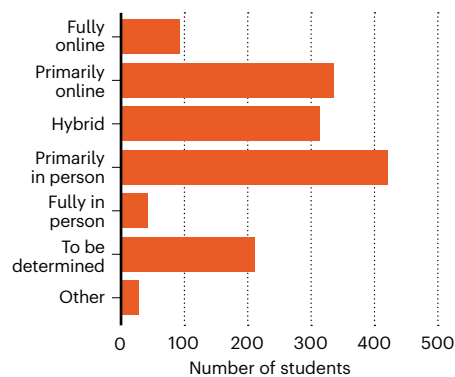
Although the US Congress allocated $14.25 billion in emergency spending for universities and colleges earlier this year, that is much too little to fill the financial holes that they face. And so the economic pressure to reopen, retain students and get bodies into residence halls and cafeterias is intense. "Had universities been provided with resources that would have allowed them to shut down in the fall and operate virtually, I think every single one of them would have done it," McClure says.

Testing before exams

Texas A&M is one of the country's largest universities, with about 64,000 students overall, and 76% of them plan to return to campus, provost Carol Fierke said during a 7 August town-hall meeting. Masks will be mandatory on campus. Students can sign up for COVID-19 tests procured from Curative in San Dimas, California, a company founded in January to churn out the tests, which also supplies the US Department of Defense. Results take two to three days to come back. Some faculty members will teach behind large plastic screens.

Pre-medical student Cameron Roy is not optimistic. "I feel that all levels of schools should look to take this year's education to online," he says. "It will save thousands of lives." He plans to return to campus, but will continue to assess the risks "as the situation unfolds".

Johns Hopkins University, by contrast, has cancelled all in-person instruction, because

case numbers remain high in Baltimore. Tom Inglesby, director of the Center for Health Security at the Johns Hopkins Bloomberg School of Public Health, is one of the faculty members in the university's Health Advisory Group. He is disappointed but thinks it is the right call. He adds that universities are making these decisions on their own, without much help from the US Centers for Disease Control and Prevention in Atlanta, Georgia. "There's not a lot of guidance about whether a university should proceed," he says. "For ultimate decision-making, [institutions] are left to their own devices."

At Cornell University in Ithaca, New York, president Martha Pollack announced that the campus would be reopening because mathematical modelling suggested that there would be fewer COVID-19 cases that way. If the campus were kept closed, many students would still live in shared housing in and around Ithaca, a survey found. These students would drive an outbreak of some 7,200 cases, according to a model created by operations researcher Peter Frazier and his colleagues. That could be mitigated if the students were on campus and being tested regularly. In that scenario, the model predicts just 1,200 cases.

Others question Cornell's rationale. Inglesby says universities should tell students from outside the area to stay at home, rather than tailoring a plan around their desire to show up. "That's not making decisions in the right order," he says. Cornell sociologist Kim Weeden pointed out in a tweet that the survey was carried out in late spring, when cases were declining — and it didn't poll the parents of students. "Whoever is footing the bills may have quite different ideas on the subject," she wrote.

Frazier says that merely urging students, many of whom have already signed leases, to stay at home would be a toothless request. And although fewer students might show up than planned to do so in May, his model still suggests that keeping them on campus, where testing can be required, is safest overall. "The conclusion that residential is safer than online is really, really, robust to the number of students returning," he says.

Cornell does plan to test students, faculty members and staff frequently, using pooled testing to keep costs down, Frazier says. "We have enormous capacity in our vet lab, set up for epidemics in dairy cows." The exact frequency depends on exposure: a staff member who works in food services will be tested more often than someone on the landscaping team, for example. Those testing positive will be housed in one of the 1,200 hotel rooms Cornell has reserved in Tompkins County throughout the term. Contact tracing will be handled by the county's health department.

In May, participants in a meeting of the Association of Independent Colleges & Universities in Massachusetts teamed up to
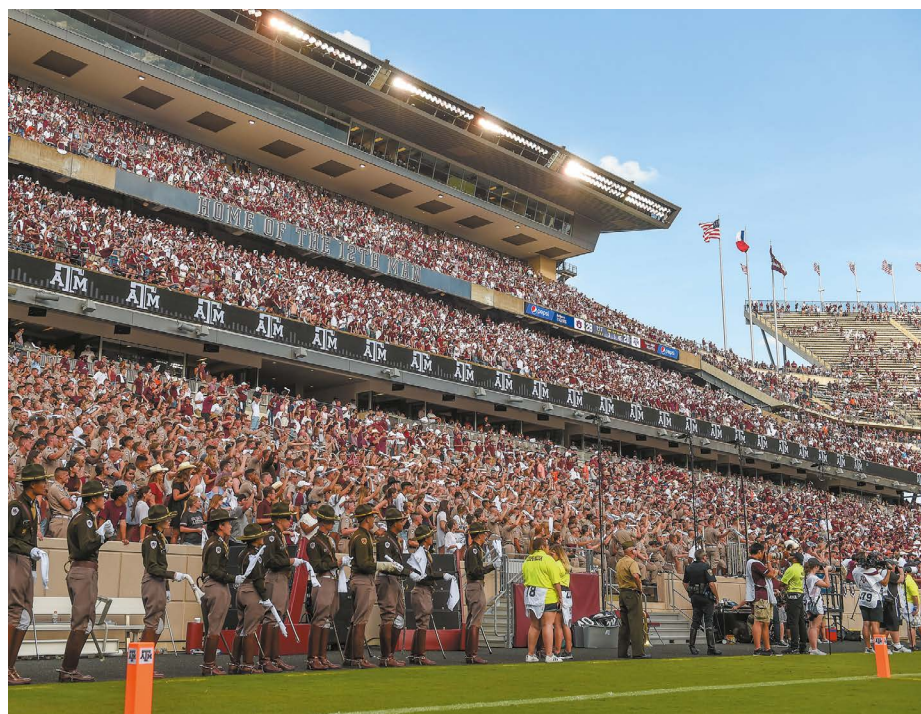
Pandemic plans will halve the crowd at Texas A&M University's football games.

model COVID-19's spread on campuses. The resulting analysis (A. D. Paltiel *et al. J. Am. Med. Assoc. Netw. Open* **3**, e2016818; 2020) suggests that outbreaks can be prevented during an 80-day shortened semester if students are tested every 2 days, even if the tests don't catch every case. The cost would be about $470 per student. In response, a number of universities, including Harvard University in Cambridge, Massachusetts, and Yale University in New Haven, Connecticut, plan to test their residential students multiple times per week. They also plan to isolate students who test positive, and to trace their contacts.

Researchers who are advising universities say that models are imperfect, but they remain one of the few scientific tools available to guide reopening decisions. "There is going to be no clinical trial; we have to model this," says Rochelle Walensky, chief of the Division of Infectious Diseases at Massachusetts General Hospital in Boston, and a co-author of the analysis of potential COVID-19 campus spread. She is also a member of the Harvard reopening committee, and says she has spoken to "many university opening committees".

The University of Illinois at Urbana-Champaign is able to test all its 50,000 students, 2,800 faculty members and 8,200 staff twice a week with its own saliva polymerase-chain-reaction test (D. R. E. Ranoa *et al.* Preprint at bioRxiv https://doi.org/d62z; 2020), which costs just $10 a pop. Students will get a notification on the Safer in Illinois app, and then head to one of 50 kiosks on campus. "You walk up, you swipe your card, you dribble into a tube, you drop it into a bag and you are done — and within 3 hours it is in your phone,"

says chemist Martin Burke, who helped design the test. Those who don't get tested won't be able to access campus buildings. "This is 2020, not 1918. We don't want to just revert to the methodologies from back then," says Burke. "How do we leverage the tremendous power of modern science? We can crush this thing."

The University of California, Berkeley, is planning limited in-person classes. It had some luck over the summer in quashing an outbreak among undergraduates with an app being tested by public-health researcher Maya Petersen. The app included daily questionnaires about physical symptoms as well as anxiety about coronavirus, plus an easy way to sign up to get a free test, no questions asked. In designing it, Petersen used what she had learnt in her research on controlling HIV transmission — including the importance of not shaming people (such as, in the case of COVID-19, students who aren't socially distancing). Petersen says her non-judgemental app was such a hit that students were recommending it to each other, and it managed to help catch and corral an outbreak centred around fraternity parties. "There was cluster of cases, but the students talked to each other and told each other about the study. And they did it in droves. They self-referred each other."

At the University of California, Irvine, campus managers will keep an eye on how crowded buildings are, using a system that has been under development for years with a grant from the US Defense Advanced Research Projects Agency. As students' phones and laptops search for Wi-Fi signals in buildings, they generate 'probe events' that will be used to estimate how many people are in each area. A

dashboard alerts managers to overcrowding, which can then be addressed by putting up signs, moving furniture around or giving students a stern talking-to. In the future, students might also get an alert if they have shared space with a person known to have COVID-19.

The system strips away IP addresses and other identifying info, but students who are still unhappy about having their data collected can opt out. Sharad Mehrotra, a computer scientist who leads the project, says it will help the university limit transmission of COVID-19. "When the pandemic started and things were locked down, the responsibility of handling the situation largely resided with the government," says Mehrotra. "But as things open up, the responsibility shifts to the community. It shifts to individuals, but also to organizations. What roles organizations can play has not been settled yet."

Some faculty members aren't happy with reopening plans, and are making that known. Thirty tenured academics at the UNC, which had started in-person classes on 10 August, published an open letter asking students to stay away. "We need you to stay home in order to protect yourselves and your fellow students, your teachers, the many workers who serve you on campus, the residents of Chapel Hill and Carrboro, and your own family members and loved ones," the letter said.

Before shifting to online classes, the UNC's dorms were at 60% capacity; many students have since left. Masks were required and testing was available, but only for those in high-risk groups or with symptoms, or who are suspected to have come into contact with an infected person.

Almost all plans for a physical return to campus include masks, social distancing and bans on social gatherings, potentially removing the core motivation for many students to attend in person. Two of the biggest American football conferences, the Big Ten and Pac-12, announced on 11 August that they won't play this autumn, in what many see as a sign that most collegiate sports will be postponed until at least next spring.

Some researchers say it will be difficult to stop informal gatherings and off-campus parties, no matter how many apps students download or pledges they sign. Many question whether it is realistic to expect young people in the most intensely social phase of their lives to follow rules to the letter. Less than 60% of the students SimpsonScarborough surveyed said they were willing to "avoid social events and parties with more than 10 people".

McClure has strong doubts about the autumn. "Never in my lifetime have I seen the level of compliance that is being expected for this to work."

Emma Marris is a freelance writer in Klamath Falls, Oregon.