Report of the Massachusetts Higher Education Testing Group[1]

Developing an Integrated COVID-19 Testing Strategy: Considerations for Institutions of Higher Education in Massachusetts[2]

Executive Summary

The purpose of this report is to help colleges and universities better understand the current state of COVID-19 testing and to suggest a framework for institutions to consider as they develop plans to repopulate their campuses. This report also provides information about The Broad Institute's proposal for a comprehensive surveillance testing program in partnership with Massachusetts higher education institutions. A copy of the Broad's "Safe for School" proposal is attached as Exhibit A to this report.

As colleges and universities prepare for resumption of in-person classes and residential life, institutions should consider multilayered strategies for minimizing the risk of infection of students, faculty and staff and the surrounding communities. These layers include education, wearing masks, social distancing, hand hygiene, self-reported diagnosis, active health screening, improved ventilation, cleaning, preemptive surveillance testing, contact tracing, quarantine and isolation.[3] Recognizing the diversity of the state's colleges and universities – public and private; small and large; commuter and residential; rural and urban -- institutions should consider where

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[1] The Massachusetts Higher Education Testing Group was initiated by the Massachusetts Higher Education Working Group, chaired by Worcester Polytechnic Institute President Laurie Leshin, to provide additional guidance on testing as part of the Framework for Reopening Higher Education in Massachusetts. The MA Higher Education Testing Group is chaired by Paula A. Johnson, MD, MPH, President, Wellesley College. The members of the Higher Education Testing Group are (in alphabetical order): Robert A. Brown, PhD, President, Boston University; David A. Bunis, JD, Senior Vice President and General Counsel, Worcester Polytechnic Institute; Michael F. Collins, MD, Chancellor, University of Massachusetts; Richard J. Doherty, President, AICUM; Moon Duchin, PhD, Associate Professor of Mathematics, Tufts University; Sandro Galea, MD, MPH, DPH, Dean, Boston University School of Public Health; Alan M. Garber, MD, PhD, Provost, Harvard University; David H. Hamer, MD, Professor of Global Health and Medicine, Boston University Schools of Public Health and Medicine; Deborah C. Jackson, President, Cambridge College; Michael Klompas, MD, MPH, Associate Hospital Epidemiologist, Brigham and Women's Hospital Professor of Population Medicine, Harvard Medical School and Hospital Epidemiologist, Brigham and Women's Hospital; Laurie A. Leshin, PhD, President, Worcester Polytechnic Institute; Rob McCarron, JD, General Counsel, AICUM; Anthony P. Monaco, MD, PhD, President, Tufts University; Ravi I. Thadhani, MD, PhD, MPH, Chief Academic Officer, Partners HealthCare; Rochelle Walensky, MD, MPH, Chief, Division of Infectious Diseases, Massachusetts General Hospital.

[2] This report is not intended to set standards for all institutions. Rather, we offer considerations to help institutions develop campus-specific strategies to minimize the risk of infection. We recognize that the state of knowledge about testing and COVID-19 is rapidly evolving and that there will be new discoveries and more refined understandings in the coming weeks and months.

[3] The scope of this report is limited to testing. Click HERE for the CDC's "Health Considerations and Tools for Colleges, Universities and Higher Learning." Click HERE for the CDC's general Covid-19 health guidance, titled "How to Protect Yourself and Others." Click HERE for the Massachusetts Department of Higher Education's COVID-19 Information and Resources. Click HERE for information regarding Governor Baker's Plan for Reopening Higher Education.

each of these interventions might be most effective and feasible as part of a campus-specific reopening strategy.

We suggest a framework to help institutions consider how COVID-19 testing might fit into each campus's reopening plans, understanding that one size will not fit all. Testing strategies can be grouped into three categories, each of which may be implemented separately or as part of a comprehensive testing protocol:

1. **Onboarding testing**: Upon arrival on campus, all students, faculty and student-facing staff are tested in order to identify infections and isolate any positive cases as soon as possible.
2. **Symptomatic testing**: Individuals reporting COVID-like symptoms via a daily screening app are tested as soon as possible, with isolation of symptomatic cases and robust contact tracing and quarantining of all their close contacts.
3. **Asymptomatic or presymptomatic surveillance testing**: Students, faculty and student-facing staff are tested periodically in order to identify individuals who are infected but who are not exhibiting symptoms, so that isolation and contact tracing protocols can be initiated.

While symptomatic testing is currently available and covered by insurance, the other categories of testing are more challenging, and the third strategy above -- asymptomatic or presymptomatic surveillance testing -- presents the greatest potential challenges in terms of complexity and cost. In general, individuals more likely to become infected (based on their local environment and interaction frequency) might be tested more frequently than those at lower risk of transmission. In order to minimize the risk of transmission on campus and in the surrounding communities, we recommend the following framework for thinking about the relative risks of different campus populations:

- **Highest:** Residential students and individuals with high contact hours with residential students. Individuals with limited contact hours with residential students who have medically defined risk factors for severe COVID illness
- **Medium:** Nonresidential individuals who transit to campus, have limited contact hours with residential students, and work in environments with appropriate protocols to limit the spread of infection
- **Low:** Staff who transit to campus who have little or no contact with students and others working in environments with appropriate protocols to limit the spread of infection
- **Lowest:** Students, faculty and staff who engage only in virtual learning, activities and events. No residential component

While there are no established standards for determining who should be tested and how often, and the state of knowledge about testing is rapidly evolving, we have studied several current mathematical models as a means of acquiring some insight into surveillance testing frequency. While the models differ in terms of their assumptions and approach, they all conclude that surveillance testing, in addition to other layers of protection to reduce transmission, is a robust and promising strategy for identifying and isolating people from the community while they are contagious. All of the current models suggest testing frequency paradigms ranging from testing every 2 days to every 12 days, with relative frequency depending on factors such as the risk of infection and rate of transmission. One way of operationalizing these findings is to consider testing the populations most at risk every 2 to 7 days with the outer limit being 12 days under the most favorable circumstances.

The Broad Institute has proposed a comprehensive testing program which includes: providing institutions with testing kits in sufficient numbers, transporting samples from each campus to the Broad, testing analysis, and reporting testing results in less than 24 hours of pickup. The Broad could also provide a smartphone app, customized for each institution, which allows individuals to report their symptoms, track their testing dates, and receive test results. The cost proposed by the Broad is in the range of $25 per test.

Introduction

As colleges and universities prepare for resumption of in-person classes and residential life, strategies are being evaluated for optimizing COVID-19 testing, symptom tracking, and rapid, efficient contact tracing. Additionally, strategies are being assessed for adjusting environments and protocols for use of residence halls, classrooms, clinical service operations, dining facilities, laboratories and spaces for recreational, performance and sporting activities. It is imperative to provide a multilayered strategy that best protects the health of students, faculty and staff as well as surrounding communities.

The most effective strategies to reduce the transmission rate of COVID infection between members of our communities will require multiple approaches or layers of protection because no single intervention can prevent an outbreak by itself. The Massachusetts High Technology Council (MHTC) has recently published a useful report which illustrates the theoretical effect of various interventions such as wearing masks, social distancing, hand hygiene, self-reported diagnosis, health screening, improved ventilation, cleaning and separately, the impact of testing and contact tracing. It also includes ample practical information about each of these layers, our current knowledge, and where relevant, sources for procurement.

The MHTC report provides a helpful overview of the Commonwealth's short-, medium- and long-term COVID testing phases and considerations for contact tracing platforms:

Short-Term:

- Utilize existing 30k tests/day (state current capacity) with expanded testing
- Continue centralized testing through a handful of large diagnostic companies
- Existing health care infrastructure used whenever possible

Medium-Term:

- Production ramped to 50-100k tests/day (45k state target by July)
- Public/private/non-profit partnerships for testing and contact tracing
- Phase in antigen testing for asymptomatic / employer testing
- Prepare for surge / flu season testing

Long-Term:

- Universal at-home testing kits including point of care tests
- Saliva-based
- Drive down costs per test

An integrated residential and work environment strategy should fold in appropriate layers of protection against transmission with the most effective being wearing of masks, distancing (and hence de-densification), self-reported diagnosis via a symptom tracking app, and modifications to work environments (e.g. increased ventilation and cleaning).

Emerging health surveillance approaches are not as clear about the added value and feasibility of surveillance COVID testing and contact tracing, with further health advice and modeling needed in the weeks ahead. One factor influencing optimal COVID testing frequency for an effective surveillance strategy is the ill-defined rate of asymptomatic spread of the infection especially in younger age groups. The CDC has not yet provided definitive guidance on surveillance testing but has provided risk levels and logistical precautions for higher education to implement layers of protection in both residential and work environments.

At this stage of planning, colleges and universities should take into account each campus's unique characteristics and consider where in their individual campus strategy each of these interventions might be most effective and feasible to implement. In this document we will use the medium-term and long-term distinctions from the MHTC report for COVID testing. Plans for both residential and work environments can be updated to reflect new developments.

We offer the following framework for thinking about relative risks of infection transmission within campus communities, with the general observation that individuals at a higher risk of spread might be tested more frequently than those at lower risk. This framework would need to be tailored to individual campuses, as even among residential campuses the residential context varies widely, and risks may be materially impacted by rates of infection in the surrounding communities.

Populations in your campus community might be differentiated by four levels of risk, with all residential students in the highest category and off-campus commuting students split into highest and medium risk groups depending on sustained close-contact activities:

1. **Highest:** Residential students and individuals with high contact hours with residential students. Individuals with limited contact hours with residential students who have medically defined risk factors for severe COVID illness
   - Residential students and dormitory staff
   - Some clinical service employees and first responders
   - Commuting students and employees who spend many hours on campus in close contact activities
   - Student-facing faculty and staff who are at higher risk for severe illness. See CDC "Guidance for People Who are at Higher Risk for Severe Illness"
2. **Medium:** Nonresidential individuals who transit to campus, have limited contact hours with residential students, and work in environments with appropriate protocols to limit the spread of infection
   - Commuting students residing off-campus attending in-person classes with limited cocurriculars
   - Student-facing employees (faculty, teaching staff, student services, certain dining and custodial staff)
3. **Low:** Staff who transit to campus either full or part-time, with little required contact with students and others with appropriate work environment protocols
   - Facilities, grounds staff
   - IT, finance, advancement, legal, HR staff
   - Other administrative, research and academic support staff.
4. **Lowest:** Students, faculty and staff who engage only in virtual learning, activities and events. No residential component.

In addition to the four relative risk categories outlined above, it may be useful to distinguish colleges into the following two groups, understanding there is significant variation within each group:

1. **Residential campuses** with in-person classes, many cocurricular activities and a mixture of highest and medium risk groups interacting on a regular basis.
2. **Nonresidential colleges** with little or no residential component and populated mostly by individuals in the medium and low risk categories.

Surveillance testing might be considered for those in the highest risk categories and for those at medium risk if they are regularly interacting with students from the highest risk category on residential campuses, depending on the unique characteristics of each campus. However, surveillance testing may not be warranted on nonresidential campuses with few high-risk individuals and environments more similar to the general work environment, where surveillance testing is not being recommended at this stage unless a very inexpensive 'long-term' COVID test was available.

Considerations for COVID-19 Testing During the Initial Onboarding Process

Testing should be considered for on-boarding of students, faculty and student-facing staff upon arrival into the campus population to set a baseline and remove COVID positive cases. Some institutions are considering testing all students, faculty and student-facing staff before returning to campus in order to identify and isolate positive cases before arrival especially if they are returning from locations with high prevalence of infection. This option presents considerable challenges in terms of logistics (students may not have access to testing where they live) and affordability (commercial laboratories currently charge $100+ per test).

Considerations for COVID-19 Testing in the Symptomatic Population

The purpose of surveillance testing is to identify asymptomatic and presymptomatic cases so that they can be quickly isolated, rigorous contact tracing performed and quarantine protocols activated. Students, faculty or staff that report symptoms of COVID infection by self-reporting or through an app, should be COVID tested as soon as possible. Consider the most rapid sample to test result possible in order to intervene with appropriate protocols to prevent transmission. Many colleges and universities have developed partnerships with commercial companies or local health care providers who are currently providing symptomatic testing in CLIA certified labs. This approach could be continued in the Fall as symptomatic case numbers should be low, and current prices are around $100/test. These tests are usually covered by health insurance. A list of labs and health care providers with CLIA certification that would allow them to perform high complexity testing can be found here.

Considerations for COVID-19 Testing in the Asymptomatic or Presymptomatic Population

Further guidance from CDC, state health care experts and mathematical modelers will be forthcoming on the added value of surveillance testing and contact tracing for different populations on college and university campuses. Current CDC guidance does not have specific recommendations for testing in the college and university populations. We present current models for approaches to surveillance testing, but given the evolving technology and availability of COVID-19 testing, the Higher Education Testing Group will continue to meet over the next academic year and may update this report.

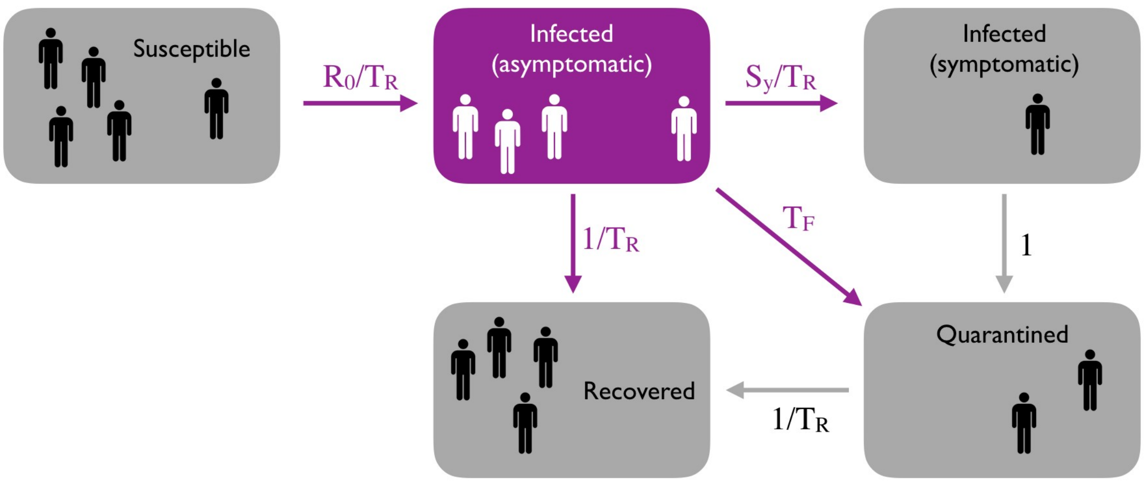
Mathematical models, such as those discussed below, can offer insight into how to analyze the frequency of screening for COVID-19 based on a presumed R_t; that is, the severity of disease spread in the context of behavioral measures to prevent it, which ultimately dictates the rate of transmission. These models do not establish standards or best practices but rather are presented here only to help colleges and universities understand the relevant considerations in evaluating the potential value of surveillance testing strategies. It is important to remember that screening is only one of many components in a multi-faceted approach that includes the use of masks, social distancing, hand hygiene, self-diagnosis and symptom screening which are all are effective in decreasing R_t.

Models translate that R_t into a transmission frequency that can be diminished by screening and isolation of those identified with disease. Examples of several mathematical models are outlined below. These models were built and parameterized by independent research groups, and it is reassuring that they converge on similar qualitative answers. They each suggest slightly different testing approaches but each suggest frequency paradigms that range from testing every 2 days to every 12 days.

For example, Drs. A. David Paltiel (Yale School of Public Health) and Rochelle Walensky (Massachusetts General Hospital), built a model that includes only students in residential colleges (unpublished at time of release of this document); they describe outcomes for several different scenarios: a best case of R_t 1.5 (rate of transmission of 1.5 persons per COVID-19 positive case), a base case of R_t 2.5, and a worst case of R_t 3.5. They examine the characteristics of the test: its sensitivity and specificity (where sensitivity = true positives or proportion of people with the disease who have a positive test; and specificity = true negatives or proportion of people without the disease who have a negative test) as well as its frequency and costs (examining scenarios that assume costs of $10/$20/$50 per test for sensitivities of 70/80/90%). (For comparison, The Broad Institute has proposed pricing at $25 per test with 80-90% sensitivity.)

This model suggests that frequency of testing has a more powerful impact on cumulative infections than the sensitivity of the test employed. In the best case scenario R_t 1.5, a test with 99.7% specificity and 70% sensitivity requires screening one time per week to keep cases low (<50) over 80 days. In the base case (R_t 2.5), a test with 98% specificity and 70% sensitivity requires screening every 2 days (five exogenous infections/week) to keep cases low (<150) over 80 days.

A second model for considering the potential value of surveillance testing is offered by the work of the IDSS COVID-19 Collaboration, Munzer Dahleh, Sarah Fay, Peko Hosoi and Dalton Jones. This second group of researchers used a mean field model for the rates of cases coming into an infected asymptomatic pool (purple) and leaving that population as infected (symptomatic), quarantined or recovered.



They conclude that surveillance testing, in addition to other layers of protection to reduce transmission, is a robust strategy for isolating people from the community while they are contagious. The model is based on a random or rolling testing strategy. Opting out of testing using this strategy -- as with any strategy that relies on testing for control -- should be discouraged as it has a detrimental effect on contagion control through surveillance testing even at relatively low percentages. For rates of transmission of 1.5, 2.5, and 3.5, and a test with 70% sensitivity, this model estimated that testing frequencies required to control the spread of the virus are 6, 18, and 30% of the population per day respectively, which equates to testing every 17, 6 or 3 days. In other words, this model suggests that in the base case of a 2.5 rate of transmission, 18% of the population would be tested each day, or each person would be tested every 6 days.

Another strategy to consider is pooling or sampling within small group units to reduce testing costs, although the pooling sensitivity and specificity needs to be carefully piloted. What this means is that multiple samples would be taken from each individual within a group (e.g., a small group or one floor of a dormitory) and the samples would be pooled, with only one test run on the pooled sample. For a mathematical treatment of pooling strategies click [HERE].

Testing frequency could also be adjusted in real time if the rate of transmission rises in the campus population and testing could be prioritized in residence halls with recent COVID positive students, high student to bathroom ratios or multiple small group units along the same corridor. In addition, if prevalence of infection in the population is very low, re-testing strategies could be adjusted to avoid quarantining large numbers of individuals based on a potential false positive.

Testing Technology

Testing in this document refers to tests that detect the SARS-CoV-2 virus. Methods to detect active viral infection include those that detect viral RNA (PCR) or viral proteins (antigen tests). Although tests that identify antibodies to the virus, also known as "serology" tests, are helpful in identifying past infection, their utility in determining immunity is not yet known. This schematic from the MHTC report describes the various test types:

Ⓑ Testing Strategy: Test Types & Innovations

	PCR	Antigen	PCR Pooling	Antibody (Serology)
	• **Viral DNA/RNA test** from nasal/throat or saliva • Samples typically **processed in scale clinical labs or large hospitals** with complex testing equipment	• **Nasal swab test to detect viral surface proteins (antigens)** • Samples typically **processed in at-home, at doctor's offices or clinics** with $500 readers	• **Pooling of PCR samples** to run same process reducing cost for low-risk testing • **Useful for large populations like colleges**	• **Detection of the antibody response to the virus** • **Backwards looking surveillance tool** • Samples typically processed In large hospital or clinical **labs**
Timing	**Early** (can detect ~2-3 days before symptoms present)	**Later than PCR** (often detection commences in line with onset of symptoms)	**Early** (in line with PCR testing)	**During or after-the-infection**
Accuracy	**High** (95% sensitivity) reported but lower (80%) in practice	**Medium** (80% PCR sensitivity) lower in practice (limited data)	**High** same as PCR, but requires additional follow up testing	**Medium** with false positives (~5%) a concern
Commercial Cost	**Medium** (~$100+ fully-loaded cost, ~$30-50 'at cost')	**Low** (~$20-30 fully-loaded cost)	**Low** (~$15-20 pooled / test)	**Medium** (~$50-120 cost)

Sources: FDA, CDC, Bain & Company Analysis, Ginko Bioworks "How to deploy millions of COVID-19 tests per day", expert interviews

Testing technology is rapidly evolving. The ideal long-term test for surveillance in the higher education setting is a low-cost point of care test with moderate sensitivity and high specificity. These tests are in development but are not widely available at the time of this report.

The method of obtaining the specimen is also important. The early tests that involved swabbing of the nasopharynx is both invasive and difficult to self-administer. Current tests are performed by swabbing anterior nares (nostrils), which is easier for individuals to self-administer. Other sampling techniques are saliva and oral mucosal swabs.

The Future Beyond the Fall

Given the evolving technology of COVID-19 testing, the Higher Education Testing Working Group will continue to meet over the next academic year and may update this report.

Exhibit A

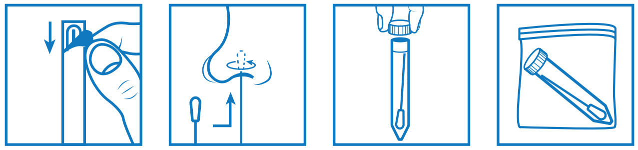
Broad Testing Service (BTS)

Safe for School Program

BROAD INSTITUTE | CLINICAL RESEARCH SEQUENCING PLATFORM

Broad Testing Service (BTS)[1]

Safe for School Program



What's the goal?

Keep schools safe, by interrupting viral transmission on campus.

What's the plan?

Test students, faculty, and staff twice per week.

Why test twice a week?

The serial interval of the SARS-CoV-2 virus (the time between a person becoming infected and transmitting to someone else) is about six days.[2]

To keep an academic community safe, it is important to detect infections *before* there's been much opportunity for transmission and to decrease spread through measures such as masks and physical distancing.

Testing — rather than relying on symptoms — is important because the majority of transmission occurs from people who don't know they are infected — that is, presymptomatic or asymptomatic individuals.

Mathematical modeling indicates an optimal testing frequency of every three days.[3]

What to do if there is a positive?

If an infection is detected, it's important to ensure that (a) the infected individual reports to the Health Services, receives medical attention and engages in supported isolation while they are infectious; (b) any close contacts are rapidly identified, supported and tested frequently, and may self-quarantine as appropriate, and (c) cleaning and other immediate steps are undertaken to protect the community.

Who can be enrolled in the testing service?

- Students
- Faculty
- Staff

1. BTS is a service of the Clinical Research Sequencing Platform, an LLC of The Broad Institute.
2. He, X., et al. (2020). Temporal dynamics in viral shedding and transmissibility of COVID-19. *Nature Medicine.* https://dx.doi.org/10.1038/s41591-020-0869-5.
3. R. Wollensky. Model assumes typical value for viral reproductive number of Rt = 2.5. Optimal frequency is every two days for higher Rt = 3.5 and weekly for low Rt = 1.50.

What would people enrolled in a college's program do?

- Pick up a supply of test kits, consisting of anterior nasal swabs and tubes.[4]
- On their scheduled testing days, swab the front of their nostril (following simple written instructions, with a supplementary video), place the swab into a tube, close the tube, and submit.[5]
- Receive their results through email and/or a school-approved app, within 12-24 hours of dropoff (depending on distance and coordination of load balancing).
- Follow the school's protocol if they test positive.

What would a college do?

- Commit in June to a constant volume of daily-testing throughout the fall term.
- Before term, provide necessary information about the people eligible for testing (with updates possible during the term).
- Designate a single ordering physician for the college.
- Create a site where people can pick up test kits.
- Create a staffed kiosk where people can drop off their test kits, with staff printing and affixing a barcode.
- Distribute and collect test kits on a regular basis.
- Receive confidential results each day on all tested individuals, through a simple interface.

What would the Broad Testing Service do?

- Provide a detailed playbook for colleges and train personnel through webinars.
- Provide a system for receiving results.
- Provide test kits for pickup (swabs, tubes).
- Provide equipment for drop-off (barcode printers, barcode scanners, collection boxes).
- Arrange for courier pick-up of collection boxes and delivery to the testing lab.
- Perform COVID-19 viral tests on each sample.[6]
- Report results to tested individuals, the ordering physician, the college health service, and, in the case of positive results, the State Department of Public Health.
- Where possible, report results to a college-approved app.

Timing to opt in

Sign-up by June 24 with number of tests per day; execute contract by June 30.

What would testing cost?

If the total volume committed across all colleges exceeds 50,000 tests per day, the Broad Testing Service can make a commitment to provide the above testing services at a cost at or below $25 per test.

4. Anterior nasal swabs are like Q-tips, with polyester rather than cotton at the end. To use them, a person moves them in a circular motion around the inner surface of the front portion of a nostril.
5. BTS currently offers observed self-swabbing and is pursuing FDA approval for unobserved self-swabbing through the EUA mechanism.
6. Viral testing is performed at the CRSP CLIA-certified lab, using an RT-PCR assay.

Exhibit B

TESTING COHORTS AND TESTING FREQUENCY

MOON DUCHIN, TUFTS UNIVERSITY

My lab has created a scenario-building tool (`https://mggg.github.io/uni-calculator/`) to help university leadership arrive at plans for COVID testing cohorts and frequency for the Fall 2020 semester. Our intention is to help universities plan a bulk testing commitment this month, such as (but not exclusively) the testing service to be offered by the Broad Institute.

Models of testing frequency

Quick review of testing frequency suggestions for *surveillance testing with isolation* strategy, without assumptions on contact tracing.

- Rochelle Walensky's team (Harvard Med) recommends Q3 (that is, every three days) testing in order to keep the total number of infections minimized while keeping costs in reasonable range.
- Peter Frazier's group (Cornell operations research) recommends Q5 testing but does not consider exogenous shocks, may increase frequency when that parameter is added.
- The IDSS COVID Collaboration (contact: Peko Hosoi at MIT) finds that Q12 testing suffices for stability (i.e., to prevent exponential outbreak within campus) with $R_0 = 2$ and 100% sensitivity, and Q5.6 suffices with $R_0 = 2.5$ and 70% sensitivity. The group's survey of models indicates that Q12 testing could result in over half of campus infected, while Q3 is likely under 1%.

Bottom line: a strategy where every individual is tested twice weekly would be in line with all available credible models. A weekly strategy is still extremely helpful for maintaining a steady and tolerably low infection rate on campus.

Prices

Recall that Q7 means testing once weekly and Q3 means every three days, etc. The per-test cost at Broad will likely be between $22 and $25.

[per person costs for 80 days @$**25**: Q7 $286, Q4 $500, Q3 $667]

[per person costs for 80 days @$**22**: Q7 $251, Q4 $440, Q3 $587]

Building testing cohorts

One way to approach the planning problem is to build a high-testing cohort (H) and a medium-testing cohort (M) to decide on the testing volume you will commit to. Further testing can be handled by bundling ad hoc and low-frequency testing into a low-testing cohort (L). We won't focus on the L group here.

Here is one way to consider your cohort construction: build the high and medium cohorts from people who will come to campus at least weekly. Let the high cohort consist of people who are on campus **at least three times per week** and the medium cohort include those who come to campus **one–two times per week**.

For the purpose of scenarios, we are separating tenure-stream faculty from other instructional faculty and including the latter with staff numbers.

How to use the calculator tool

Find your university in the dropdown, which will pre-fill student numbers. You must enter the faculty and staff numbers to start with. Choose a scenario from the four provided below, or build your own. This lets you arrive at the number of individuals in the H and M cohorts. Specify the testing frequency for each you can calculate a per-person price for the term.

Date: June 15, 2020.

Scenarios – strictly illustrative

Scenario 1: A large highly residential university. The student life is very campus-centric and there are a large number of grant-funded research labs that need staffing. A large number of students are from overseas and are unlikely to be able to return to campus in person.
student enrollment 70% of usual
80% of enrolled students come to campus at least weekly
(70% visit $\geq 3\times$, 10% visit 1-2$\times$)
80% of tenure-stream faculty come to campus at least weekly
(50% visit $\geq 3\times$, 30% visit 1-2$\times$)
60% of usual campus staff workforce comes to campus at least weekly
(30% visit $\geq 3\times$, 30% visit 1-2$\times$)
and an additional 250 contract staff come to campus $\geq 3\times$/week
(no occasional contract staff)

Scenario 2: A large, less-residential university. In normal times, many students commute. Larger number of part-time instructional staff.
student enrollment 40% of usual
90% of enrolled students come to campus at least weekly
(45% visit $\geq 3\times$, 45% visit 1-2$\times$)
60% of tenure-stream faculty come to campus at least weekly
(30% visit $\geq 3\times$, 30% visit 1-2$\times$)
50% of usual campus staff workforce comes to campus at least weekly
(40% visit $\geq 3\times$, 10% visit 1-2$\times$)
and an additional 250 contract staff come to campus $\geq 3\times$/week
(no occasional contract staff)

Scenario 3: A medium university with graduate programs. This campus has a very limited number of adjunct-style instructional faculty. However, a substantial share of the tenure-stream faculty are electing for either all-virtual instruction or for hybrid teaching with one day per week on campus. The campus-employed staff can mostly work from home, and only a small number of staff are deemed essential for lab research operations.
student enrollment 85% of usual
90% of enrolled students come to campus at least weekly
(80% visit $\geq 3\times$, 10% visit 1-2$\times$)
65% of tenure-stream faculty come to campus at least weekly
(15% visit $\geq 3\times$, 50% visit 1-2$\times$)
25% of usual campus staff workforce comes to campus at least weekly
(25% visit $\geq 3\times$, 0% visit 1-2$\times$)
and an additional 150 contract staff come to campus $\geq 3\times$/week
(no occasional contract staff)

Scenario 4: A small college with very high residency rate and limited dormitory space. No feasible options for de-densification at full residency. A decision has been made to limit campus residency to first- and fourth-years (say), with all second- and third-years studying virtually.
student enrollment 90% of usual
50% of enrolled students come to campus at least weekly
(50% visit $\geq 3\times$, 0% visit 1-2$\times$)
50% of tenure-stream faculty come to campus at least weekly
(40% visit $\geq 3\times$, 10% visit 1-2$\times$)
50% of usual campus staff workforce comes to campus at least weekly
(40% visit $\geq 3\times$, 10% visit 1-2$\times$)
and an additional 0 contract staff come to campus $\geq 3\times$/week
(no occasional contract staff)