

Report and Recommendations of the Massachusetts Higher Education Testing Group¹ May 4, 2021

I. Executive Summary

The purpose of this report is to update our [June 2020](#) recommendations and to provide updated guidance for higher education institutions to consider as they develop plans for students, faculty and staff to fully repopulate campuses in the fall of 2021. The underlying assumption of this report is that campuses will be open and able to operate (following the recommendations herein) at near full density, in classrooms, labs, offices and residences. Our specific recommendations for higher education institutions are set forth in Section III. We also provide information about The Broad Institute's Fall 2021 proposal for COVID-19 testing in partnership with Massachusetts higher education institutions. A copy of the Broad proposal is attached as Exhibit A to this report.

Even though the science is still evolving, continued efforts to minimize COVID-19 infections on campus will be essential as we work to re-densify. Specifically, very high levels of vaccination will be essential to safely repopulate campuses at full density and without physical distancing restrictions. **We recommend that campuses do everything possible to ensure very high levels of vaccination on their campuses.**

The modeling described in Section III.C of this report shows that vaccination levels above 80% are essential -- and levels above 90% will be most effective -- in controlling infections on residential campuses.² Additionally, to plan for operations in the fall, institutions must know the percentage of their campus community that has been vaccinated, and **we therefore strongly recommend campuses focus on ensuring vaccine status disclosure for anyone who will regularly come to campus.**

¹ The Massachusetts Higher Education Testing Group was initiated by the Massachusetts Higher Education Working Group, chaired by WPI 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; 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; Anette "Peko" Hosoi, PhD, Associate Dean of Engineering, MIT; Deborah C. Jackson, President, Cambridge College; Michael Klompas, MD, MPH, Hospital Epidemiologist, Brigham and Women's Hospital and Professor of Population Medicine, Harvard Medical School; 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, Mass General Brigham.

² We recognize that campus vaccination rates will need to be adjusted downward to account for the fact that COVID-19 vaccines are not yet approved for children under the age of 16.

Even with high levels of vaccination among students, faculty and staff, periodic asymptomatic testing will remain an essential tool to minimize infections and control outbreaks on residential campuses, at least as we begin the fall semester. Surveillance testing also will be an important tool for monitoring occurrence of new variants and watching for degradation in the efficacy of the vaccines. **While a range of frequency and approaches are possible, we recommend residential campuses consider weekly testing for students and student-facing faculty and staff.**

We recognize that there may be differing views on the ethics of mandating vaccination and treating unvaccinated individuals differently.³ Each campus will need to make its own decisions on these issues in various contexts, including whether only unvaccinated individuals should be required to participate in the testing protocols we recommend in Section III.C. This report makes the assumption that the vaccinated and unvaccinated members of the campus community will not be differentially treated. Our testing guidance assumes inclusion of both vaccinated and unvaccinated students, faculty and staff.

The Recommendations of the MA Higher Education Testing Group include:

- A. INSTITUTIONS SHOULD STRIVE TO GET THEIR CAMPUSES AS CLOSE TO 100% VACCINATION RATES AS POSSIBLE.
- B. INSTITUTIONS SHOULD REQUIRE EVERYONE IN THE CAMPUS COMMUNITY TO DISCLOSE THEIR VACCINE STATUS AS SOON AS POSSIBLE.
- C. INSTITUTIONS SHOULD REQUIRE REGULAR ASYMPTOMATIC COVID-19 TESTING FOR STUDENTS AND STUDENT-FACING FACULTY AND STAFF, AT LEAST AT THE BEGINNING OF THE FALL SEMESTER.
- D. IN CONJUNCTION WITH REGULAR ASYMPTOMATIC TESTING, INSTITUTIONS THAT ACHIEVE 80+% VACCINATION RATES MAY RELAX PHYSICAL DISTANCING RESTRICTIONS BUT SHOULD CONTINUE TO REQUIRE THE OTHER MULTI-LAYERED INFECTION CONTROL STRATEGIES WE RECOMMENDED IN OUR ORIGINAL REPORT.

The Broad Institute is offering pooled testing at a cost of \$25 for up to 10 test swabs in a pool (compared to \$25 for each individual PCR test). Reimbursement for COVID-19 testing costs

³ See e.g. Emanuel, E. J., Glickman, A., & Diana, A. (2021, April 14). These people should be required to get vaccinated. *The New York Times*. <https://www.nytimes.com/2021/04/14/opinion/coronavirus-vaccinations-mandate.html>; Kershner, I. (2021, February 18). As Israel reopens, 'whoever does not get vaccinated will be left behind.' *The New York Times*. <https://www.nytimes.com/2021/02/18/world/middleeast/israel-covid-vaccine-reopen.html> ; see also [Vaccination Ethics](#), for a collection of articles on the subject of ethical issues surrounding vaccination; Oxford University Press. (2021). *Vaccination ethics*. Oxford Academic. Retrieved April 30, 2021, from <https://academic.oup.com/phe/pages/vaccination-ethics>

incurred through September 30, 2021 will likely be available through the Federal Emergency Management Agency.

II. INTRODUCTION

The world has changed – and we have learned a great deal – since we issued our original report on June 16, 2020. As of that date, there were 7.5 million COVID-19 infections and 425,000 deaths worldwide. Tragically, just ten months later, more than 150 million people have been infected and 3.1+ million people have died worldwide. In the United States, more than 32 million people have been infected and more than 575,000 have died. In Massachusetts, more than 686,000 people have been infected and more than 17,500 have died.

Through experience, we have learned that the multi-layered strategies we recommended in June 2020 – importantly including periodic asymptomatic surveillance testing of campus populations – were largely effective in minimizing the risk of infection and avoiding larger outbreaks on residential campuses.⁴

The most important new development since our June 2020 report is the development of COVID-19 vaccines. In December 2020, the FDA granted emergency use authorization (EUA) for COVID-19 vaccines distributed by Pfizer-BioNTech (for individuals aged 16 and older) and Moderna (18 and older). In January 2021, the FDA granted EUA status to a vaccine produced by Johnson & Johnson (18 and older).

We are still learning about vaccine efficacy, although early indications support very high levels of efficacy against severe disease, hospitalization, and death. See CDC publication titled “[COVID-19 Vaccines Work](#)” updated April 7, 2021 (“So far, research on mRNA COVID-19 vaccine effectiveness in real-world conditions is reassuring.”) Based on known biology of the response to vaccine, the rate at which vaccinated individuals acquire the virus and/or their ability to transmit the virus is low. We do not yet know the rate at which those who are vaccinated will develop mild symptomatic disease⁵ although there are some data among health care workers suggesting very low rates of symptomatic infection, but not zero.⁶ We do not yet know about the longevity of

⁴ For the MA colleges participating in The Broad Institute’s higher education testing program, approximately 7.9 million tests were performed from August 2020 through March 2021 with an overall positivity rate during that period of 0.3%.

⁵ The rate will depend on community incidence (viral pressure). For comparative distribution of symptomatic vs asymptomatic disease in vaccinated vs unvaccinated people see Hall VJ, Foulkes S, Saei A, et al. COVID-19 vaccine coverage in health-care workers in England and effectiveness of BNT162b2 mRNA vaccine against infection (SIREN): a prospective, multicentre, cohort study. *Lancet*. 2021.

⁶ See Bouton, T. C., Lodi, S., Turcinovic, J., Weber, S. E., Quinn, E., Korn, C., Steiner, J., Schechter-Perkins, E. M., Duffy, E., Ragan, E. J., Taylor, B. P., Schaeffer, B., Miller, N., Davidoff, R., Hanage, W. P., Connor, J., Pierre, C., & Jacobson, K. R. (2021). COVID-19 vaccine impact on rates of SARS-CoV-2 cases and post vaccination strain sequences among healthcare workers at an urban academic medical center: a prospective cohort study. *MedRxiv : the preprint server for health sciences*, 2021.03.30.21254655. <https://doi.org/10.1101/2021.03.30.21254655> ;

vaccine effectiveness, although initial data show at least 6-month effectiveness in Phase 3 studies of the mRNA vaccines distributed by Pfizer-BioNTech⁷ and Moderna⁸ and likely longer.⁹ Such understanding of effectiveness over time will lead in the coming months to guidance on boosters and the possibilities of regular vaccinations against COVID.

We are also still learning about the longer-term impact of COVID-19, but there is good evidence that post-COVID-19 conditions¹⁰ – including “long COVID”¹¹ – are experienced by some proportion of those who have both milder and severe infection. See [“Post-COVID Conditions”](#) published by the CDC, April 22, 2021.

Regev-Yochay, G., Amit, S., Bergwerk, M., Lipsitch, M., Leshem, E., Kahn, R., Lustig, Y., Cohen, C., Doolman, R., Ziv, A., Novikov, I., Rubin, C., Gimpelevich, I., Huppert, A., Rahav, G., Afek, A., & Kreiss, Y. (2021). Decreased Infectivity Following BNT162b2 Vaccination (SSRN Scholarly Paper ID 3815668). *Social Science Research Network*. <https://papers.ssrn.com/abstract=3815668>; Keehner, J., Horton, L. E., Pfeffer, M. A., Longhurst, C. A., Schooley, R. T., Currier, J. S., Abeles, S. R., & Torriani, F. J. (2021). SARS-CoV-2 Infection after Vaccination in Health Care Workers in California. *The New England Journal of Medicine*, NEJMc2101927. Advance online publication. <https://doi.org/10.1056/NEJMc2101927>.

⁷ Pfizer BioNTech. (2021, April 1). Pfizer and BioNTech confirm high efficacy and no serious safety concerns through up to six months following second dose in updated topline analysis of landmark COVID-19 Vaccine study” [Press Release]. <https://www.pfizer.com/news/press-release/press-release-detail/pfizer-and-biontech-confirm-high-efficacy-and-no-serious>

⁸ Doria-Rose, N., Suthar, M. S., Makowski, M., O’Connell, S., McDermott, A. B., Flach, B., Ledgerwood, J. E., Mascola, J. R., Graham, B. S., Lin, B. C., O’Dell, S., Schmidt, S. D., Widge, A. T., Edara, V.-V., Anderson, E. J., Lai, L., Floyd, K., Roupheal, N. G., Zarnitsyna, V., Kunwar, P. (2021). Antibody Persistence through 6 Months after the Second Dose of mRNA-1273 Vaccine for Covid-19. *New England Journal of Medicine*, 0(0), null. <https://doi.org/10.1056/NEJMc2103916>

⁹ We recognize that the longevity of vaccine effectiveness will likely be impacted by the potential threat of novel variants of concern escaping vaccine coverage. Current vaccines have about four-fold less activity against the B.1.351. variant. Greater understanding of this issue will require further study.

¹⁰ According to the CDC, “although most people with COVID-19 get better within weeks to months of illness, some do not. CDC and experts around the world are working to learn more about short- and long-term health effects associated with COVID-19, who gets them, and why. CDC uses the term post-COVID conditions to describe health issues that persist more than four weeks after first being infected with the virus that causes COVID-19.” .More detailed information about post-COVID conditions can be found on the CDC website. CDC. (2020, February 11). *COVID-19 and your health*. Centers for Disease Control and Prevention. <https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects.html>

¹¹ According to the CDC, “long COVID” is defined as “a range of symptoms that can last weeks or months after first being infected with the virus that causes COVID-19 or can appear weeks after infection. Long COVID can happen to anyone who has had COVID-19, even if the illness was mild, or they had no symptoms.” More detailed information about Long Covid can be found on the [CDC website](#). CDC. (2020, February 11). *COVID-19 and your health*. Centers for Disease Control and Prevention. <https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects.html>

III. OUR RECOMMENDATIONS

A. INSTITUTIONS SHOULD STRIVE TO GET THEIR CAMPUSES AS CLOSE TO 100% VACCINATION RATES AS POSSIBLE.

To safely repopulate campuses without physical distancing,¹² it is imperative that higher education institutions take significant steps to ensure that as close to 100% of their campus community as possible are vaccinated.

At the very least, we strongly recommend that every institution should achieve vaccination rates of at least 80 percent – and preferably 90+ percent – before fully repopulating in the fall.¹³

Each institution will need to decide the best way to maximize vaccination percentages on their own campuses. Some campuses may choose initially to require everyone in the community to be vaccinated as a condition of returning to campus in the fall.¹⁴ Many colleges and universities have already announced plans to mandate vaccination for students and non-unionized employees.¹⁵ Other institutions may choose to start off by mandating vaccines for all students and employees

¹² To avoid confusion, we emphasize that physical distancing restrictions may only be reduced or eliminated if – and only if -- institutions achieve very high levels of vaccination and also follow the other recommendations in this report.

¹³ Professor Hosoi’s modeling (Section III.C, below) demonstrates that if > 80% of the adult (18+) population on campuses is vaccinated “we are likely to be in a regime where testing 1x/wk or every other week will suffice to control outbreaks.”

¹⁴ There is a consensus in the higher ed legal community that COVID-19 vaccine mandates by private colleges and universities are consistent with state and federal law. This includes a consensus that EUA status of the vaccines is not an impediment to a COVID-19 vaccine mandate. See Cohen, I.G. & Rubinstein Reiss, D. (2021, March 15) Can colleges and Universities Require Student Covid-19 vaccination. *Harvard Law Review Blog*.

<https://blog.harvardlawreview.org/can-colleges-and-universities-require-student-covid-19-vaccination/>

; Briefing: National Association of College and University Attorneys. (2021, April 12) To mandate or not to mandate the vaccine: Issues to consider. <https://www.nacua.org/program-events/briefings/to-mandate-or-note-to-mandate-the-vaccine-issues-to-consider>.

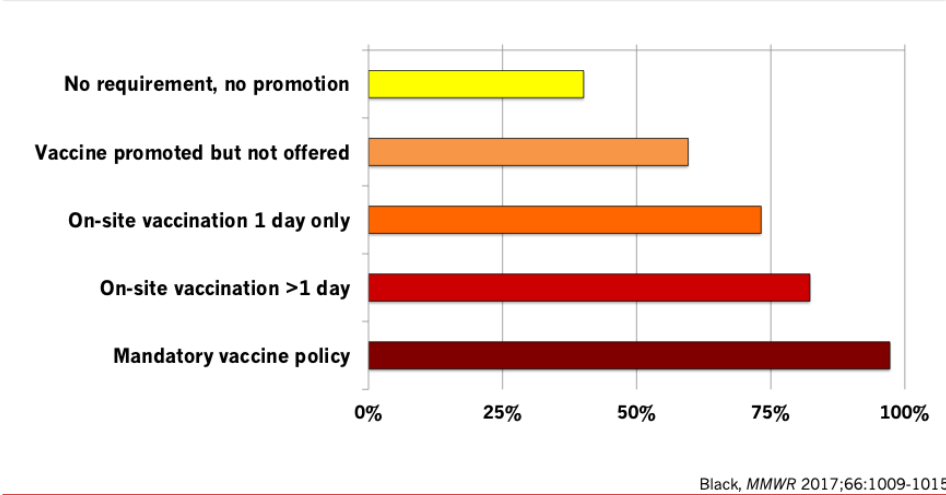
The availability of religious and medical exemptions for students varies from state to state. In Massachusetts, schools are required to allow such exemptions for the measles, mumps and rubella required vaccines, including diphtheria, pertussis, tetanus, measles, and others. [M.G.L. c. 76, § 15](#); 105 CMR 220.600(D). Notably, the law also provides that religious exemptions need not be recognized during an epidemic or declared public health emergency. [M.G.L. c. 76, § 15](#) (“In the absence of an emergency or epidemic of disease declared by the department of public health, no child whose parent or guardian states in writing that vaccination or immunization conflicts with his sincere religious beliefs shall be required to present said physician's certificate in order to be admitted to school.”)

¹⁵ Zahneis, M. (April 23, 2021). A tipping point? Dozens of public colleges announce COVID-19 vaccine mandates. *The Chronicle of Higher Education*. <https://www.chronicle.com/article/a-tipping-point-dozens-of-public-colleges-announce-covid-19-vaccine-mandates> ; Redden, E. (April 8, 2021). Some colleges confront political headwinds in adopting COVID vaccine mandates. *Inside Higher Ed*. <https://www.insidehighered.com/news/2021/04/08/some-colleges-confront-political-headwinds-adopting-covid-vaccine-mandates>

who live in student housing¹⁶ while strongly encouraging vaccination for faculty and staff. Others may start off by strongly encouraging vaccinations for everyone while at the same time letting everyone know that a vaccine mandate may be necessary if the community does not achieve high vaccination levels a voluntary basis. Institutions considering vaccination mandates versus voluntary compliance should consider studies showing that a mandatory vaccine policy for healthcare workers was more effective in achieving 90%+ flu vaccination rates compared to voluntary vaccine campaigns and promotions.¹⁷ See Chart of Healthcare Worker Vaccination Rates below.

Healthcare Worker Vaccination Rates

USA, 2016-2017 Flu Season



From our perspective, the best approach is the one that will be most effective for your campus. As the Massachusetts Higher Education Working Group noted a year ago in its [Framework for Reopening Colleges and Universities in Massachusetts](#), “In the face of COVID-19, campuses will need to make their own tailored plans for safe operations.” Higher education is not a one size fits all industry. Every institution must consider its own vaccination “campaign” strategy.

¹⁶ American College Health Association. (2021, April 1) American College Health Association recommends COVID-19 vaccination requirement for all on-campus college students in Fall 2021 [Press Release] https://contentsharing.net/actions/email_web_version.cfm?ep=Bs5tCOlBi8Lxp4pGut4F98s90Vk0B2f82qYX1rJae3U3ildiwJ6WcLJHteA7WpwHlicnWyZ0KvUdkjhmn4D749BhFJZwmwSXL6_7z1biBYGrYr3EBKj5E8YuAnthaJl (“Therefore, where state law and available resources allow, ACHA recommends COVID-19 vaccination requirements for all on-campus college and university students for fall semester 2021, in accordance with the IHE’s normal exemption practices, including exemptions for medical contraindications.”)

¹⁷ Black, C. L. (2018). Influenza vaccination coverage among health care personnel—United States, 2017–18 Influenza Season. *MMWR. Morbidity and Mortality Weekly Report*, 67. <https://doi.org/10.15585/mmwr.mm6738a2>

B. INSTITUTIONS SHOULD REQUIRE EVERYONE IN THE COMMUNITY TO DISCLOSE THEIR VACCINE STATUS AS SOON AS POSSIBLE.

Given the critical importance of vaccinating at least 80-90% of the community, campuses cannot plan unless they know the percentage of the campus population that is vaccinated. Many institutions are already requesting that students and staff disclose their vaccine status and upload a copy of their COVID-19 vaccination card to a centralized tracking database.¹⁸ Institutions should consider a communication strategy where vaccine status disclosure requests are accompanied by vaccine campaign information and offers of assistance to anyone who needs help to get vaccinated. **We strongly recommend that every institution should require confidential vaccine status disclosure as a condition of coming to campus in the fall.**¹⁹

C. INSTITUTIONS SHOULD REQUIRE REGULAR ASYMPTOMATIC COVID-19 TESTING FOR STUDENTS AND STUDENT-FACING FACULTY AND STAFF, AT LEAST AT THE BEGINNING OF THE FALL SEMESTER.

Mathematical models, such as those discussed below, can offer insight into how to analyze the frequency of screening for COVID-19. Professor Annette Hosoi, Professor of Engineering at MIT and Dr. David Paltiel of the Yale School of Public Health have revised their models included in our earlier report to consider the impact of vaccination on the transmission of COVID-19 and the resulting implications for asymptomatic testing.

As a growing fraction of the population is vaccinated, the effective reproduction number (i.e. the average number of people who contract the virus from a single infected individual) will decrease. For example, suppose an infected person infects 4 people in an unvaccinated population; if that same person is put in an environment where 50% of the population is vaccinated, on average only half of their contacts will contract the virus and the disease will be passed along to only 2 people instead of 4. Specifically, we expect that the effective reproduction number in the fall will be reduced by a factor of approximately:

$$1 - (\text{effectiveness of the vaccine}) \times (\text{fraction of the population vaccinated})$$

¹⁸ Thomason, A., (2021, April 29) Here's a list of colleges that will require students or employees to be vaccinated against COVID-19. *The Chronicle of Higher Education*. <https://www.chronicle.com/blogs/live-coronavirus-updates/heres-a-list-of-colleges-that-will-require-students-to-be-vaccinated-against-covid-19>

¹⁹ Mandatory disclosure of vaccine status need not trigger HIPAA or other legal concerns, but institutions should take steps to safeguard the private information. See U. S. Equal Employment Opportunity Commission. (2020, December 16) What you should know about COVID-19 and the ADA, the Rehabilitation Act, and other EEO laws. *Technical Assistance Questions and Answers*. <https://www.eeoc.gov/wysk/what-you-should-know-about-covid-19-and-ada-rehabilitation-act-and-other-eeo-laws>; Lazzarotti, J. (2021, January 18). Want to know if your employees received the COVID-19 vaccine? Some best practices to consider. *The National Law Review*. <https://www.natlawreview.com/article/want-to-know-if-your-employees-received-covid-19-vaccine-some-best-practices-to>.

In the models developed by Professor Hosoi, the estimated impact of this factor on testing requirements is shown in the figure below for a vaccine efficacy of 80% and reproduction number $R_0 = 3.75$ (chosen as a baseline estimate of R_0 for the more transmissible variants).

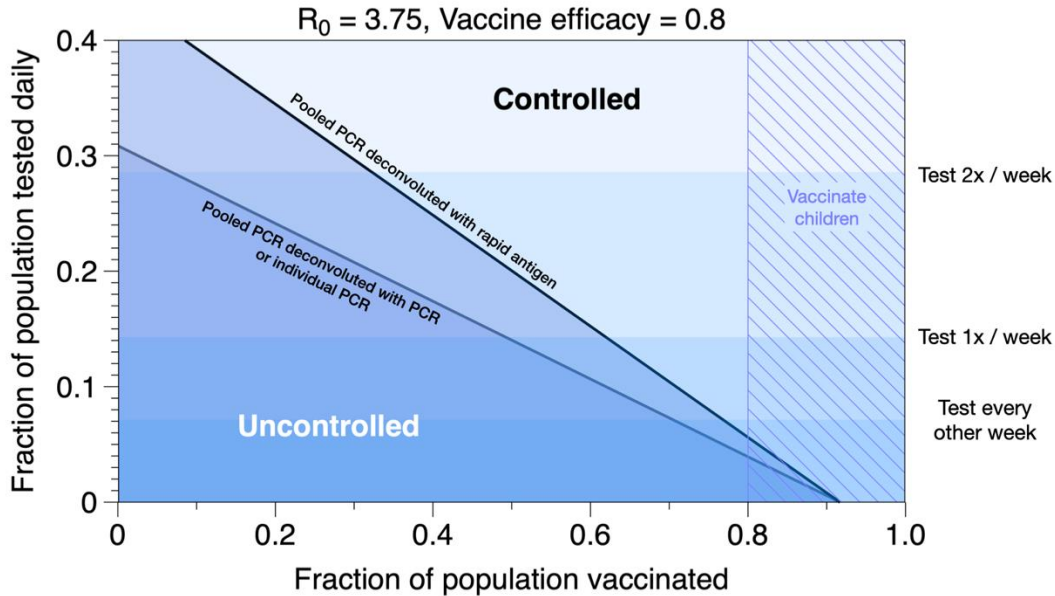


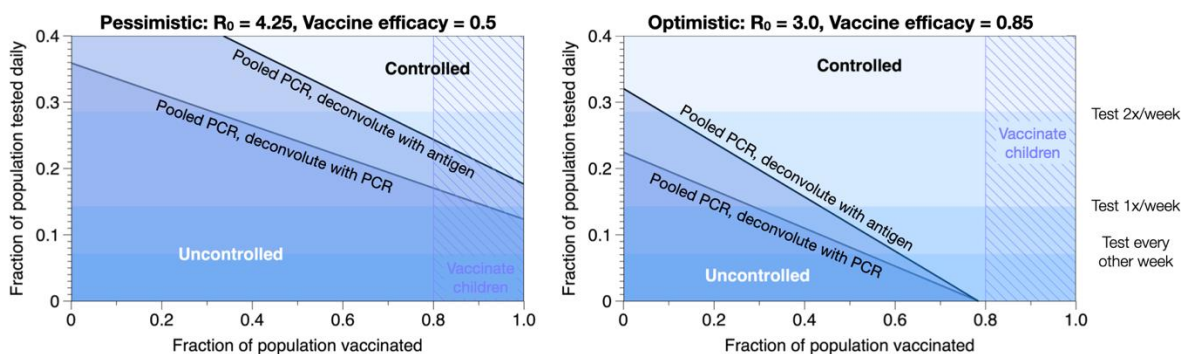
Figure 1: Amount of testing required for three different test types – individual PCR, pooled PCR deconvoluted with individual PCR, and pooled PCR deconvoluted with rapid antigen -- as a function of vaccine uptake. Here we have assumed sensitivities of 99% and 70% for PCR and rapid antigen, respectively. Selecting testing cadences in the controlled region will, on average, find infected people and isolate them before they pass the virus on to another person.

Vaccines may still not be approved for children in the fall so, even if we have nearly perfect uptake among adults, 20% of the general population will remain unvaccinated and the virus is likely to continue to circulate, primarily off college campuses. Given that constraint, the plot above suggests that if we vaccinate > 80% of the adult (18+) population on campuses, we are likely to be in a regime where testing 1x/wk or every other week will suffice to control outbreaks. **Based on this modeling, we recommend weekly pooled testing for students living in congregate housing and for student-facing faculty and staff.**

Variants. One of the unknowns for the Fall is the effectiveness of the vaccines against current variants and the rate of emergence of new variants. Current data suggests that the most aggressive new variants are about 50% more transmissible than the old strain. Different studies report different levels of vaccine effectiveness against these strains ranging from approximately 50% (both J&J initial tests) to 85% (recent studies on Pfizer in Israel).²⁰

²⁰ Rubin R. COVID-19 vaccines vs variants--determining how much immunity is enough. JAMA. April 6, 2021;325:1241-1243.

Given the uncertainty in the variants, we should be prepared to pivot to a range of testing scenarios as illustrated in the figures below (developed by Professor Hosoi).



The effective R_0 is higher on college campuses owing to communal living and dining; highly transmissible variants become prevalent and early studies showing 50% efficacy of vaccines against variants prove to be accurate.

At least 35% of the population continues to wear masks and observe social distancing (including no communal dining); vaccines prove to be highly effective against the variants.

Updated analyses performed by Professor David Paltiel lead to similar conclusions to Professor Hosoi’s models, when using similar assumptions regarding effectiveness of the vaccine and rate of transmission. Dr. Paltiel’s model is based on considering only transmission among the student population. These conclusions indicate that asymptomatic testing of students from preferably once per week, with a minimum of every other week, should be adequate to contain outbreaks of COVID on our campuses among students.

The assumptions used in the model are conservative and take into the account the potential emergence of more transmissible and resistant variants, which we know are already present in Massachusetts. Another consideration leading to a more conservative set of assumptions is the potential acceptance of vaccines from outside of the U.S. on our campuses, which may have decreased efficacy. It is important to note that the re-population of our campuses will also include faculty and staff, who will have a variety of exposures to COVID.

Views. To date, one of the primary reasons for testing on campus has been to isolate infected people and control outbreaks. This objective is likely to continue into the fall, but it may not be the only (or even the main) rational for testing. People returning to campus are likely to hold a wide spectrum of views ranging from high anxiety to impatience to return to pre-pandemic conditions; evidence from testing may be helpful in bridging this divide. Other testing objectives that may prove to be equally important are:

- To reassure the community as people prepare to resume campus interactions;
- To monitor the effectiveness of our mitigation strategies as we shift to higher densities;

- To gather intel on the variants, particularly efficacy of the vaccines (which will in turn impact testing cadence and other mitigation strategies).

Counting exercise to estimate amount of testing required. The underlying principle behind the computed testing cadence is to find and isolate infected people at a faster rate than the infection spreads. The rate at which the infection spreads is proportional to R_0 (which may be modified by masking and other mitigation strategies); the rate at which people are detected is proportional to the fraction of the population that are tested daily, ν . This second rate (the rate of removing infected people from the population) is augmented by the recovery rate. Combining these three effects and requiring that the rate of people entering the infected population is less than the rate of people leaving, we find:

$$R_0 \leq 1 + \nu(D - 1)$$

where D is the average number of days a that person is contagious. Controlled areas in the plots above indicate regions where this inequality holds. The description here is presented as a mean field argument however the stability result is identical for stochastic transmission along a heterogeneous network. Details available at: <https://arxiv.org/abs/2012.08755>.

D. IN CONJUNCTION WITH REGULAR ASYMPTOMATIC TESTING, INSTITUTIONS THAT ACHIEVE 80+% VACCINATION RATES MAY RELAX PHYSICAL DISTANCING RESTRICTIONS BUT SHOULD CONTINUE TO REQUIRE THE OTHER MULTI-LAYERED INFECTION CONTROL STRATEGIES WE RECOMMENDED IN OUR ORIGINAL REPORT.

In our original report, we recommended that institutions adopt a multi-layered “integrated residential and work environment strategy” including periodic asymptomatic COVID-19 testing, physical distancing, mask wearing, hand hygiene, increased ventilation, surface cleaning, contact tracing, and quarantine and isolation facilities.

Based on experience, we now update our recommendations for each of the “layers” identified in our original report. ***The following recommendations should be understood in the context of our recommendations for achieving community vaccination rates of at least 80+% (described in Section III.A, above) and our recommendations for periodic asymptomatic testing described in Section III.C, above.***

1. Physical distancing. Based on Professor Hosoi’s modeling, physical distancing restrictions may be lifted on campuses where: a) 80+% of the community is vaccinated; b) infection rates remain low; c) periodic asymptomatic testing is utilized; and d) mask wearing and handwashing protocols are followed.
2. Wearing face masks. Masks have proven to be effective in protecting against COVID-19 infection. We have found no published data about mask wearing in

environments where most people are vaccinated. We continue to recommend that institutions follow CDC "[Guidance for Wearing Masks](#)" and MA [state guidance](#) governing mask wearing in public places. Institutions should closely follow mask wearing guidance that will likely evolve in the coming months. Wearing masks in re-densified classroom and other indoor environments on campus will be especially important as campuses resume more normal density operations. Over time with low infection rates and experience, such mask wearing mandates may be able to be relaxed.

3. Hand hygiene. We recommend that institutions should continue to educate their communities about the importance of frequent handwashing.
4. Cleaning protocols. We recommend that institutions follow CDC guidance on "[Cleaning and Disinfecting Your Facility](#)" which has been updated to reflect data showing that "in most situations, the risk of infection from touching a surface is low." See "[Science Brief: SARS-CoV-2 and Surface \(Fomite\) Transmission for Indoor Community Environments](#)." These guidelines suggest that institutions may reduce the intensive surface cleaning protocols introduced early in the COVID pandemic.
5. Ventilation protocols. Aligned with the increased understanding of the importance of airborne transmission indoors, we recommend that institutions continue to follow protective ventilation practices and interventions as [recommended by the CDC](#).
6. Contact Tracing. Because we are still recommending regular testing going into the Fall, and because there will likely be some level of COVID infection on campuses, either from unvaccinated individuals or in the form of "breakthrough" cases of vaccinated individuals, maintaining some capability for contact tracing on campus will be important to prevent outbreaks.
7. Quarantine and Isolation. Students who become infected with COVID will still need to be isolated, and following [CDC](#) and MA [state](#) guidance, unvaccinated community members who are close contacts will need to quarantine as required by [CDC](#) and MA [state](#) guidance. Thus, campuses should consider how they will accommodate these needs, especially among the residential population. With a highly vaccinated population, these needs should be significantly lower than in the 2020-21 academic year.

E. ADDITIONAL CONSIDERATIONS FOR COVID-19 TESTING

1. INSTITUTIONS SHOULD CONSIDER TESTING ON A RESIDENTIAL CAMPUS AS PART OF THE INITIAL ON-BOARDING PROCESS.

As in our initial set of recommendations, 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. We would expect the number of positive cases to be much lower than they were in the fall of 2020. Given that the expected rates of COVID positive cases is expected to be considerably lower, a single asymptomatic test may be considered in the on-boarding process. Last fall, some institutions considered 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 were returning from locations with high prevalence of infection. This option presented 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).

2. INSTITUTIONS SHOULD CONDUCT 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 who report symptoms of COVID-19 infection by self-reporting or through an app, should be tested as soon as possible. Consider the most rapid sample to test result possible in order to intervene with appropriate protocols to prevent transmission. These tests are usually covered by health insurance.

F. Non-Residential Colleges

Non-residential colleges may be considered similar to other non-residential settings such as health science campuses, K-12 schools, or office buildings. Data has shown that transmission in K-12 classrooms is rare, but these data were obtained in classrooms using variable distancing from 3 to 6 feet and before the arrival of more transmissible variants.²¹ Although the residential setting increases the risk of acquiring and transmitting COVID infection, other settings pose their own set of risks with students, faculty and staff living with unvaccinated children or with unvaccinated adults. Given what we understand today about the spread of COVID-19, if non-residential colleges plan to fully re-densify their classrooms, they may benefit from considering asymptomatic testing on a schedule that is amenable to their campuses **and** falls within the overall guidance given in this report.

²¹ van den Berg, P., Schechter-Perkins, E. M., Jack, R. S., Epshtein, I., Nelson, R., Oster, E., & Branch-Elliman, W. (2021). Effectiveness of 3 versus 6 ft of physical distancing for controlling spread of coronavirus disease 2019 among primary and secondary students and staff: A retrospective, statewide cohort study. *Clinical Infectious Diseases*, ciab230. <https://doi.org/10.1093/cid/ciab230>

EXHIBIT A

DESCRIPTION OF THE BROAD INSTITUTE FALL 2021 TESTING PROGRAM

Broad Institute COVID-19 Testing Service

College Testing Program, Fall 2021

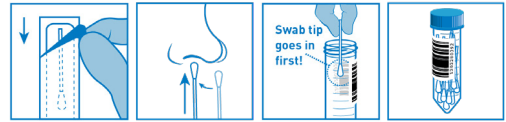
Diagnostic, Pooled, Reflex Testing



BROAD
INSTITUTE

CLINICAL RESEARCH
SEQUENCING PLATFORM

Fall 2021 COVID-19 Testing Program: Diagnostic, Pooled, Reflex Testing



Fast COVID-19 Testing

- 24/7 lab operations
- Turn-around time for results of <24 hours from arrival at the lab

Flexible Program Planning

- Choose from diagnostic and pooled testing for different cohorts to meet campus needs
- Customized pooling approach—pre-assign cohorts and/or pool-on-arrival
- Use PCR reflex testing and/or BinaxNow (rapid antigen test; answer in 20 min) to deconvolute positive pools
- Adjust program in response to changing conditions, such as vaccination, positivity rates

What's new for the Fall 2021 semester?

- The option to incorporate pooled testing into your program
 - Reflex test with diagnostic PCR and/or BinaxNOW testing
- A custom-built ordering and resulting system
 - In-platform switching between diagnostic, pooled, and reflex testing modalities
- Pre-labeled tubes for pooled testing

What's the same for the Fall semester?

- Turn-around time for results of <24 hours from arrival at the lab
- Observed and unobserved diagnostic test options
- Same lower nostril (AN) swab(s), sent dry in tube
- Test price of \$25/tube—diagnostic or pooled test
- Supplies included
- Courier included for MA

Pooled testing system at the Broad

- Serial testing (at least once per week)
- Effective surveillance method when there is low rate of positives
- Swab pooling:
 - Testing site pools swabs taken from 2-10 individuals in a large tube
 - Pre-labeled tube
- Reflex testing:
 - Platform allows for performing BinaxNOW and/or diagnostic PCR test
- Option for individuals to be notified of presumptive positive or negative results by text and/or email

Pros

- Reduces costs by analyzing up to 10 participants in one test
- Fewer resources used for the number of individuals tested
- No printers involved for pooled testing workflow; order tests using multiple device types

Cons

- Not an individual diagnostic report
- Individual reflex test required when pools are positive
- Longer turnaround time to detect individuals who are positive

Regulatory Considerations

New guidance has recently been issued from the FDA on the path to add serial pooled testing to existing EUAs. Implications on the operational and implementation process to be determined over the next month.