

REOPENING SCHOOLS: A PRIMER FOR STATE AND LOCAL LEADERS

MARGARET BOURDEAUX • ALEXIS MONTOURIS CIAMBOTTI • ADAM NAGY • WILL MARKS



Executive Summary

On March 18, the Berkman Klein Center for Internet & Society at Harvard University, Harvard Medical School's Program in Global Public Policy and Social Change, and the Belfer Center for Science and International Affairs at the Harvard Kennedy School of Government, co-hosted "Reopening Schools: How States Can Ensure Safe Buildings, Testing Capacity, and Contact Tracing Programs for Students and Staff." This memo summarizes some of the key lessons and resources that can help state and local leaders reopen their schools safely. Expert panelists highlighted the risks and consequences of keeping schools closed, including "virtual dropouts" and food insecurity issues,¹ as well as mental and physical health risks.² Many students do not have sufficient digital access to engage in virtual learning, and the pandemic has "disproportionately impacted marginalized communities in the infection rates, the health inequities, and access to both testing and vaccines."³

Reopening schools requires a commitment to keeping students, teachers, and staff safe from COVID-19 exposure and transmission. There are multiple strategies state and local leaders can leverage to this end. This seminar focused on two that require investment and input on the part of state and local leaders: improving the indoor air quality of school buildings and implementing screening test programs at schools "to detect and prevent outbreaks quickly."⁴

Part 1: Improving Air Quality

Airborne COVID-19 can permeate an entire classroom that has poor ventilation. **When individuals inhale, they take in a certain amount of other people's breath,⁵ so if there is poor indoor ventilation, even if students are six feet apart, they can contract COVID-19.** Robust air ventilation and filtration systems can decrease the risk of COVID-19 transmission in schools.⁶

An interactive piece in *The New York Times* featuring **Dr. Joseph G. Allen** simulated a low-ventilated New York City classroom, in which an infected student's breath is escaping their mask. Dr. Allen observes that the aerosol the student expels, which is more concentrated in the air around this individual than elsewhere, "accumulates pretty evenly throughout the room very quickly." This continues until ventilation or filtration (or both) reduce the infectious particles in the air.⁷

Enhanced air ventilation and filtration can reduce the concentration in the room. The simulation shows that ventilation systems in the classroom would reduce the concentration of

1 Dr. Joseph G. Allen, "Reopening Schools: How States Can Ensure Safe Buildings, Testing Capacity, and Contact Tracing Programs for Students and Staff. Video & Podcast: A Seminar for State & Local Leaders," March 18, 2021, Berkman Klein Center for Internet and Society, Harvard University (hereinafter "Reopening Schools"), 2:50-3:42, <https://cyber.harvard.edu/events/reopening-schools-how-states-can-ensure-safe-buildings-testing-capacity-and-contact-tracing>.

2 President Anthony Monaco, "Reopening Schools," 30:23-31:54; see also, Allen, 3:05-3:42.

3 Monaco, "Reopening Schools," 31:09-32:15; B. Auxier and M. Anderson, "As Schools Close Due to the Coronavirus, Some U.S. Students Face A Digital 'Homework Gap,'" Pew Research Center, Mar. 16, 2020, <https://www.pewresearch.org/fact-tank/2020/03/16/as-schools-close-due-to-the-coronavirus-some-u-s-students-face-a-digital-homework-gap/>.

4 Dr. Margaret Bourdeaux, "Reopening Schools," 0:30-2:46. See also Allen, "Reopening Schools," 2:44-29:16; Monaco, "Reopening Schools," 29:17-42:44; Dr. KJ Seung, "Reopening Schools," 43:12-44:35; The Hon. Joseph A. Curtatone, "Reopening Schools," 44:49-47:43 and 53:51-58:46; and Vice Provost Caroline Attardo Genco, "Reopening Schools," 47:57-53:25 and 58:47-1:00:30.

5 This is termed the "rebreath fraction."

6 The foregoing from, Allen, "Reopening Schools," 6:19-11:08.

7 Id. 6:19-8:32; N. Bartzokas, M. Gröndahl, K. Patanjali, M. Peyton, B. Saget, U. Syam, "Why Opening Windows Is a Key to Reopening Schools," *The New York Times*, Feb. 26, 2021, <https://www.nytimes.com/interactive/2021/02/26/science/reopen-schools-safety-ventilation.html>.

aerosols and decrease it further with the addition of an air filtration system. **“This is important because all of the outbreaks of three or more people have been attributable to time spent indoors,”** Dr. Allen emphasized. “And nearly every single high-profile outbreak you’ve heard about or read about,” including venues besides schools, “have been conditions with time indoors, low to no ventilation, with attack rates that can approach 90%, meaning one person can infect 90% of the people in the room. **It’s because of this long-range aerosol transmission.”**⁸

Safely reopening schools demands a holistic approach composed of intersecting interventions.⁹ In a recent report *Risk Reduction Strategies for Reopening Schools*, Dr. Joseph Allen and his team at the **Harvard T.H. Chan School of Public Health’s Healthy Buildings Program** recommended interventions across five categories: classrooms, buildings, policies, schedules, and activities.¹⁰ During the session, Dr. Allen discussed the core elements of the buildings tranche of school reopening and accompanying performance indicators.

What are the Core Elements of a Healthy Buildings Strategy?

The healthy buildings strategy consists of infrastructure, policy, and monitoring interventions to reduce the risk of COVID-19 transmission through improvements to air quality and, to a lesser degree, the cleanliness of surfaces and inanimate objects (fomites).

Air Quality Improvements: Maximize Outdoor Air Ventilation, Filter Indoor Air, and Use Portable Air Cleaners

For schools with mechanical ventilation (i.e., HVAC system) adjustments can be made to maximize fresh air, continue operation before and after school hours, and ensure intake ducts are safely located to avoid contaminants. For schools without mechanical ventilation, the primary intervention to increase ventilation is a combination of open windows and doors, with “window fans or box fans positioned in open windows to blow fresh outdoor air into the classroom via one window and indoor air out of the classroom via another window.” This is important because “devices that simply recirculate the same indoor air without filtering it or replacing it with fresh air are not helpful in reducing any airborne virus present in the room (including most window air conditioning units, fans used in rooms with closed windows, and fan coils and radiators).” Mechanical ventilation systems should be fitted with the highest efficiency air filters possible, ideally “with **MERV ratings** of 13 or higher.” These filters will need to be inspected for installation problems and replaced at regular intervals. Moreover, “portable air cleaners with high-efficiency particulate air (HEPA) filters” can supplement ventilation and filtration efforts. Selecting the correct device or devices for each use case will depend on several factors such as the size of the room, the clean air delivery rate (CADR), and the ability to circulate air. The airflow in the room, how people are positioned in the room, and the volume of the device are also important considerations in selecting the device and deciding how many to use.¹¹

8 Allen, “Reopening Schools,” 8:32-11:08.

9 E. Jones, A. Young, K. Clevenger, P. Salimifard, E. Wu, L.M. Lahaie, M. Lahvis, J. Lang, M. Bliss, P. Azimi, J. Cedeno-Laurent, C. Wilson, M.N. Segule, Z. Keshavarz, W. Chin, S. Dedesko, S. Parikh, J. Vallarino, J. Allen, *Healthy Schools: Risk Reduction Strategies for Reopening Schools*, Harvard T.H. Chan School of Public Health Healthy Buildings program, November 2020 (hereinafter *Healthy Schools: Risk Reduction Strategies for Reopening Schools*).

10 Id.

11 Id., 31-35.

Monitoring and Performance Indicators

The goal for schools is to achieve “4 to 6 air changes per hour (ACH)” in each room through “any combination” of ventilation, filtration, and portable air cleaner interventions.¹² Ventilation should be maximized, but “the minimum ventilation rate specified by **ASHRAE 62.1** should be met while other strategies such as enhanced filtration and air cleaning are used to achieve a combined 4-6 ACH from ventilation and filtration.”¹³ The 4-6 ACH metric is based on the standard adopted by hospitals.¹⁴ Professionals should ensure that mechanical ventilation systems are not pulling air from contaminant sources, that the filters are system-appropriate filters, and installed properly.¹⁵

School officials and teachers can assess air ventilation rates using a variety of techniques. For mechanical ventilation systems, an air flow capture hood or balometer can measure rates.¹⁶ For natural ventilation, schools can measure steady-state CO₂ levels using a handheld device.¹⁷ Teachers can input factors like the number of students, classroom size, and level of activity into **an online ‘Maximum CO₂ Concentration Calculator’ tool created by Dr. Allen and his team** to calculate a ‘do not exceed’ CO₂ level that they can self-monitor.¹⁸

Selection and placement of portable air cleaners also require some degree of expertise and case-by-case analysis. An important metric to consider is the clean air delivery rate (CADR). The report states “that for every 250 square feet of space, a CADR of about 100 cubic feet per minute (cfm) is desirable.”¹⁹ Decisions regarding the selection of an appropriate portable air cleaner can be informed by an **online tool created by the Healthy Buildings for Health Team**. For detailed instructions on checking ventilation rates, consult **the 5-Step Guide to Checking Ventilation Rates in Classrooms created by Dr. Allen and his team**.

Reducing Surface and Object Transmission

According to Dr. Allen, the greatest defense against fomite transmission is frequent handwashing.²⁰ In general, fomite transmission risk is low and schools should not conduct costly ‘deep cleanings’ with harsh chemicals.²¹ If feasible, existing infrastructure such as doors, water-fountains, and soap dispensers can be replaced with no-contact versions.²² High-touch surfaces must be cleaned and disinfected throughout the day and custodial staff must have the personal protective equipment and training they need to clean safely and effectively.²³

Bathrooms are a heightened risk area for both fomite and airborne transmission. No-contact infrastructure, frequent cleaning, and hand-washing rules/monitoring can reduce fomite transmission from bathrooms. To mitigate the risk of bioaerosols generated by toilet flushing and

12 Allen, “Reopening Schools,” 11:00-12:15; *Healthy Schools: Risk Reduction Strategies for Reopening Schools*, 31.

13 *Healthy Schools: Risk Reduction Strategies for Reopening Schools*, 33.

14 Allen, “Reopening Schools,” 26:40-28:30.

15 *Healthy Schools: Risk Reduction Strategies for Reopening Schools*, 32-33.

16 Allen, “Reopening Schools,” 12:40-13:30.

17 Id., 13:30-15:00

18 Id.

19 *Healthy Schools: Risk Reduction Strategies for Reopening Schools*, 34.

20 Allen, “Reopening Schools,” 17:40-18:45

21 Id.

22 *Healthy Schools: Risk Reduction Strategies for Reopening Schools*, 37.

23 Id., 38.

of crowding bathrooms should constantly run exhaust fans and pull in new air; toilets should all have lids and lids should be down when flushing; and congregations should be avoided through scheduling or other policy interventions.²⁴

Costs and Benefits

The interventions detailed above are practical, cost-effective, and proven.²⁵ There are advanced air quality techniques that may also be appropriate and are detailed in the report, such as “to maintain indoor relative humidity to between 40-60%” or to use “ultraviolet germicidal irradiation (UVGI),” but such interventions are generally difficult and more costly to implement.²⁶ For this reason, improving ventilation and filtering should be the number one short-term priority.²⁷ Many of these interventions are immediate, stop-gap solutions that can be implemented quickly and cheaply.²⁸ Long term, system-level upgrades to ventilation require hiring external commissioning agents and require more investment, but these revamps pay for themselves through reduced energy costs.²⁹ They also yield benefits beyond combating infectious disease, such as improved scores, sleep quality, lower absenteeism, and lower rates of asthma exacerbation.³⁰ States can allocate some of the stimulus funding to support these interventions.³¹

Part 2: Screening Tests

It is crucial that schools quickly detect infected individuals to prevent outbreaks from occurring at school and in households.³² According to the CDC, “screening tests are intended to identify infected people who are asymptomatic and do not have known, suspected, or reported exposure to SARS-CoV-2,” which “helps to identify unknown cases so that measures can be taken to prevent further transmission.”³³ **Screening tests can be done on an individual basis or through pooled testing**, in which multiple individuals’ samples are contained within one pool of tests and which can be a cost-efficient method of large-scale, high-cadence testing.³⁴ While laboratories and point-of-use (i.e., on-site) test programs can undertake individual tests, only labs can undertake pooled tests.³⁵ Routine screening test programs allow for effective health surveillance so that public health

24 The foregoing from id., 39.

25 Allen, “Reopening Schools,” 12:10-12:35.

26 *Healthy Schools: Risk Reduction Strategies for Reopening Schools*, 36.

27 Allen, “Reopening Schools,” 20:00-20:30.

28 Id.

29 Id., 20:30-21:20.

30 Id., 21:20-22:20.

31 Id., 2:50-3:02.

32 See Monaco, “Reopening Schools,” 29:17-42:44; Curtatone, “Reopening Schools,” 44:49-47:43 and 53:51-58:46; and Genco, “Reopening Schools,” 47:57-53:25 and 58:47-1:00:30.

33 “Overview of Testing for SARS-CoV-2 (COVID-19),” Centers for Disease Control and Prevention (CDC), updated Mar. 17, 2021, accessed Mar. 29, 2021, <https://www.cdc.gov/coronavirus/2019-ncov/hcp/testing-overview.html>.

34 “Pooled Sample Testing and Screening Testing for COVID-19,” Federal Drug Administration (FDA), updated August, 24, 2020, accessed March 26, 2021, <https://www.fda.gov/medical-devices/coronavirus-covid-19-and-medical-devices/pooled-sample-testing-and-screening-testing-covid-19#pooled>.

35 “Pooling Procedures,” Centers for Disease Control and Prevention (CDC), updated Oct. 23, 2020, accessed Mar. 29, 2021, <https://www.cdc.gov/coronavirus/2019-ncov/lab/pooling-procedures.html>; “Point-of-Care Testing,” Centers for Disease Control and Prevention (CDC), updated Mar. 12, 2021, accessed Mar. 29, 2021, <https://www.cdc.gov/coronavirus/2019-ncov/lab/point-of-care-testing.html>; Office of the Assistant Secretary for Health, “Guidance - Proposed Use of Point-of-Care (POC) Testing Platforms for SARS-CoV-2 (COVID-19),” SARS-CoV-2 (COVID-19) Fact Sheet, accessed Mar. 29, 2021, <https://www.cdc.gov/coronavirus/2019-ncov/downloads/OASH-COVID-19-guidance-testing-platforms.pdf>.

interventions can be quickly made to stamp out clusters of positive cases by catching index cases before the spread can occur. As Bourdeaux, Cameron, and Zittrain **wrote** in *The New York Times*, “Without rapid results, it is impossible to isolate new infections quickly enough to douse flare-ups before they grow.”³⁶

Case Study: Tufts University and the City of Somerville, Massachusetts

Safely reopening schools requires a comprehensive testing and tracing program, one that is able to effectively screen for COVID-19 so that schools can detect and prevent outbreaks. In Summer and Fall 2020, President Anthony Monaco spearheaded Tufts University’s efforts to set up a screening test program with Vice Provost for Research Caroline Attardo Genco and Chief Information Officer Chris Sedore, who led the mobilization of volunteers, in partnership with the **Broad Institute** at MIT and Harvard University.³⁷ After piloting this process at a small scale with individual testing “to establish a baseline of what positivity rates were” among staff and students returning to school,³⁸ Tufts rolled out voluntary pooled polymerase chain reaction (PCR) testing 1-2 times per week, at 10 individuals per tube sent to the lab.³⁹ Frequent surveillance testing can keep positivity rates low, as Tufts’ high cadence testing resulted in a positivity rate much lower than that of the State of Massachusetts.⁴⁰ This program also provides data about the conditions under which viral transmission occurred.⁴¹

Tufts is also working with schools to optimize flows so that children can be tested as soon as they arrive, rather than during the school day to avoid interrupting instructional time for students and so results can be returned more quickly. Parents receive email notifications of results, and if the pool is positive, all the individual parents in that pool would be contacted. In turn, students would return to undertake individual testing to see if they were infected.⁴²

As President Monaco observed, PCR tests provide “equally sensitive, efficient and reliable results” for a group of samples.⁴³ Pool testing is a more cost-effective method for testing many people.⁴⁴ While individualized tests had cost \$25 per test, Tufts administered pooled tests at \$25 for each pool of 2 to 10 samples.⁴⁵ Tufts also set up its own information technology (IT) infrastructure to facilitate testing, a component that Vice Provost Genco notes was crucial.⁴⁶

In addition to the above benefits of the tests, PCR also helps with genetic sequencing of positive samples and identifying the consent demographics, which are key to understanding the extent to which the impact of this process is equitable.⁴⁷ With respect to contact tracing, “Tufts has contracted with Jumbo Health Center to serve as the university’s notification team for contact

36 Margaret Bourdeaux, Beth Cameron, and Jonathan Zittrain, “Testing Is on the Brink of Paralysis. That’s Very Bad News,” *The New York Times*, July 16, 2020, <https://www.nytimes.com/2020/07/16/opinion/coronavirus-testing-us.html>.

37 Genco, “Reopening Schools,” 47:57-50:34. See also Monaco, “Reopening Schools,” 32:15-42:44.

38 Genco, “Reopening Schools,” 47:57-50:48.

39 Monaco, “Reopening Schools,” 32:15-40:00.

40 Id., 33:00-34:38.

41 Id., 34:39-34:57.

42 Genco, “Reopening Schools,” 51:51-53:24.

43 Monaco, “Reopening Schools,” 38:20-39:11.

44 Monaco, “Reopening Schools,” 37:15-38:17; “Pooled Sample Testing for COVID-19,” FDA.

45 Monaco, “Reopening Schools,” 37:15-38:17.

46 Genco, “Reopening Schools,” 50:45-50:56.

47 Monaco, “Reopening Schools,” 40:01-42:20.

tracing,” and the program supports an isolation process as well.⁴⁸ In the case of public schools, local or state public health authorities should **contact trace** positive cases, and the locality should support a **quarantine and isolation program**.⁴⁹

Tufts University then sought to assist its surrounding communities keep their students, faculty, and staff safe and formed partnerships with the cities of Somerville and Medford, Massachusetts.⁵⁰ In its response to the pandemic, the City of Somerville sought expertise from the University and its partners, according to Mayor Joseph A. Curtatone.⁵¹ “What motivated us was to understand how we could execute our responsibilities to interrupt the transmission of the virus from person to person,” Mayor Curtatone said.⁵²

How Can States and Localities Launch Screening Test Programs?

As seen in the case study above, there are several key elements that states and localities can consider for implementing pooled screening test programs. States can allocate the funds they receive from the federal COVID Relief bill to support these measures for school districts:

1. **Partnering with Laboratories and Universities.** School systems can consider reaching out to labs and/or local universities to support pooled tests. Somerville and Medford, for instance, have partnered with Tufts and the **Broad Institute** at MIT and Harvard, a lab that has “**processed more than 10 million tests so far**.”⁵³ If schools do not have access to pooled tests, they can also explore traditional PCR tests with a partnering lab or point-of-use tests where the results can be obtained within 15 minutes on site. As demonstrated in the City of Somerville, jurisdictions can benefit from partnering with local universities undertaking robust screening test programs, for both the exchange of expertise and assistance in implementation.
2. **Notification Protocol.** States need a protocol by which to communicate test results to state public health authorities, to parents, or others. At Tufts, those who test negative **receive** an email notification, from the school or medical system, while those who test positive receive a phone call “by a healthcare clinician/provider and given instructions for appropriate next steps and care, and will be able to begin isolation, which also initiates the contact tracing process.”⁵⁴ However, a digital divide exists in many areas and email-based notification of parents may not be feasible.⁵⁵ States will need to use a different protocol if parents and/or students cannot access email. Based on Tufts’ engagement with the community to date, SMS (text messaging) offers promise.

48 “Testing at Tufts,” Tufts University, accessed Mar. 26, 2021, <https://coronavirus.tufts.edu/testing-at-tufts>.

49 See, e.g., “Retrospective Contact Tracing: How States Can Investigate COVID-19 Clusters. Video & Podcast: A Conversation with Experts on How US States Can Implement Retrospective Contact Tracing,” Berkman Klein Center for Internet & Society, Harvard University, Nov. 12, 2020, <https://cyber.harvard.edu/events/retrospectivecontact-tracing-how-states-can-investigate-covid-19-clusters>; “Organizing, Budgeting, and Implementing Wraparound Services for People in Quarantine and Isolation. Video & Podcast: Lessons from the COVID-19 Pandemic and Considerations for Future State Responses,” Berkman Klein Center for Internet & Society, Harvard University, Feb. 23, 2021, <https://cyber.harvard.edu/events/organizing-budgeting-and-implementing-wraparound-services-people-quarantine-and-isolation>

50 Genco, “Reopening Schools,” 47:57-50:34. See also Monaco, “Reopening Schools,” 32:15-42:44.

51 Curtatone, “Reopening Schools,” 53:51-55:08.

52 Id. 45:15-47:08.

53 Genco, “Reopening Schools,” 47:57-50:34; Monaco, “Reopening Schools,” 32:15-42:44; and “COVID-19 Testing,” Broad Institute, accessed, Mar. 29, 2021, <https://www.broadinstitute.org/covid-19-testing>.

54 “Testing at Tufts” (supra).

55 See, for example, Genco, “Reopening Schools,” 51:24-51:42.

3. **Contact Tracing.** Contact tracing is essential to mitigating the spread of the virus, as explored in a **previous Berkman Klein Center event**.⁵⁶ The process involves “the identification, monitoring, and support of the individuals (contacts) who have been exposed to the patient and possibly infected themselves” and “process prevents further transmission of disease by separating people who have (or may have) an infectious disease from people who do not.”⁵⁷ Screening test programs need to coordinate with contact tracing such that results are reported quickly and people who have been exposed can keep away from others until it can be determined if they have been infected.
4. **Additional Personnel.** To allow people to safely return to school, schools will likely need to hire extra staff, as in Somerville,⁵⁸ to administer the tests, manage the samples, monitor and record results, and notify parents and public health officials of cases.
5. **Community Support.** Screening tests should be voluntary. To garner public support for the program, the community has to understand why it is important, how their data will be used and protected, and feel confident they will receive the social and medical support they need if they or their child test positive.
6. **Information Technology and Logistics.** As Vice Provost Genco points out, “the IT infrastructure” to execute testing is crucial to the program’s success.⁵⁹ States can invest in this logistical component to ensure that the testing programs are well coordinated.

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For further information and to discuss the content of this memo: contact the Program in Global Public Policy at Department of Global Medicine & Social Change at Harvard Medical School (annmarie_sasdi@hms.harvard.edu)

56 “Retrospective Contact Tracing,” Berkman Klein Center for Internet & Society (supra).

57 “Contact Tracing - CDC’s Role and Approach,” Centers for Disease Control and Prevention, accessed March 26, 2021, <https://www.cdc.gov/coronavirus/2019-ncov/downloads/php/contact-tracing-CDC-role-and-approach.pdf>.

58 Curtatone, “Reopening Schools,” 53:51-55:39.

59 Id., 50:45-50:56