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Reopening Schools After a Novel Coronavirus Surge

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Abstract: The SARS-CoV-2 pandemic is the worst global respiratory viral emergency since the pandemic influenza of 1918-1919. As of December 2020, nearly 70 million people have been infected and 1.5 million lives have been lost to coronavirus disease 2019 (COVID-19). Schools worldwide were drastically impacted as they closed due to illness and absenteeism, transmission, and risk to vulnerable members of the school community, and community concerns. The decision to reopen school during a pandemic will have important implications for the educational and social well-being of school children, but schools must be kept safe from viral spread to ensure the safety of children, families, and teachers and staff. Keeping schools closed may socially isolate children and provide suboptimal educational experiences, especially for youth with special needs. Lower-income families may have limited computing assets and/or online access. Reopening schools requires careful consideration of benefits, risks, and necessary precautions. Our aim in this paper is to highlight risk-mitigation strategies in schools during the COVID-19 pandemic based on our experiences in the United States. These include fundamental principles of disease control requiring school-directed initiatives (physical distancing and mask use, hand/face and surface cleansing, administrative and engineering controls for air quality and outdoor activities). Most risk mitigation approaches depend on individual-level risk reduction based on maximal adherence to guidelines. School-initiated "top-down" approaches and individual-level "bottom-up" approaches must be synergized, as no single method will ensure safety. Safety principles, disease control strategies, and other critical policy issues are key to feasibly and safely reopening schools.

Keywords: Coronavirus, COVID-19, Education, Pandemic, Quarantine, Reopening, School, Disease Control Strategies, Safety, Children, Children's Health

1. Introduction

"Plans are worthless, but planning is everything." (United States President Dwight Eisenhower)

Given the impact of the coronavirus disease 2019 (COVID-19) pandemic on every facet of society, the quote from the late President Eisenhower speaks to the need to rigorously think through operations and be adaptable. Kindergarten through Grade 12 (K-12) schools were closed in early March, 2020 across the United States. Given the high individual and societal costs of these closures, as well as the adverse impact of school closure on children's growth and mental health, nations have placed a high priority on reopening schools. Planning for school reopening as COVID-19 case numbers have remained high in many U.S. states presents challenges. The unique nature of each school must be considered and will require a tailored solution for each geographic zone. This article aims to present general guidance that can be adapted by K-12 schools as they develop a safe reopening plan that will consider the needs of the children, their families, and staff at the

school. Information provided in this paper is not a comprehensive guide, nor are requirements or standards presented.

COVID-19 is an infectious disease caused by a coronavirus identified in late 2019, the so-called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The virus is primarily spread is by respiratory droplets among close contacts. Aerosol transmission can also occur in indoor, crowded, and inadequately ventilated areas. Respiratory aerosols are characterized by a diameter of fewer than 5 micrometers (μm), while droplets are larger (Milton 2020). Evidence strongly suggests that the COVID-19 virus can be transmitted through fomites and contact with contaminated surfaces (Santarpia 2020).

Approximately 15 to 45% of SARS-CoV-2 infections are asymptomatic cases (Nishiura et al. 2020). Individuals infected before being symptomatic are termed "pre-symptomatic". They may harbor high viral loads before they feel ill, potentially transmitting viruses efficiently. The role that asymptomatic cases play in the transmission of SARS-CoV-2 is unclear, given their typically lower viral loads (Vermund and Pitzer 2020). One may speculate that lower efficiency of transmission per encounter could still add up to a high transmission burden due to more encounters taking place since an asymptomatic person is less likely to physical distancing compared to a person who feels ill.

While children can be infected with SARS-CoV-2, the incidence of COVID-19 disease in children is lower compared to adults; children who contract COVID-19 are more likely to remain without symptoms or have moderate symptoms (Dong et al. 2020). Youth deaths are less frequent than they are represented in the general population (Dong et al. 2020). One hypothesis suggests that milder cases of this disease in children may be attributable to lower levels of angiotensin-converting enzyme 2 (ACE2) gene expression in children compared to adults. Rarely, children may present with the multisystem inflammatory syndrome in children (MIS-C). MIS-C is a condition where different organs become inflamed, including the heart, lungs, kidneys, brain, skin, eyes, or gastrointestinal organs. Fortunately, COVID-19 related MIS-C is extremely rare, with an incidence of 2 per 100,000, and it is treatable with symptomatic and anti-inflammatory measures (Henderson et al. 2020).

Children and adolescents tend to have closer interactions with each other compared to older age groups and younger children may be less likely to follow guidance on mask use and proper hand hygiene. Adult supervision and regular positive encouragement of safe personal behaviors are required to promote adherence to recommended COVID-19 public health practices. Children are likely to spread the virus to more vulnerable individuals in their close contacts or households (Somekh et al. 2020). Controlling disease outbreaks in children is likely crucial to protect the well-being of the community as a whole. Effective planning of administrative and engineering controls for risk reduction, communication across the school community, and partnerships with local public health organizations are all key to effective disease prevention.

Disease control can be categorized as approaches that are directed by the school administration (top-down) and those that are dependent on the personal behaviors of students, teachers, and administrative staff in the school (bottom-up) (Figure 1). Top-down approaches include the elimination of physical contact, administrative controls, and engineering controls, ranked in decreasing order of effectiveness of reducing transmission risks. Bottom-up approaches are focused on individual-level actions such as face masks use and good hand hygiene, cleaning, and disinfection behaviors. No single control measure will eliminate infectious disease risk. Layering multiple strategies from both approaches is critical in creating a safer school environment during the COVID-19 pandemic.

In this article, we introduce key issues in COVID-19 and school reopening. We will discuss guiding principles and the hierarchy of disease control related to school reopening in a respiratory viral pandemic. The application of these safety principles will also be discussed for specific school spaces in the supplement. Finally, we will highlight special considerations for vulnerable student populations and school mental health support in a pandemic.

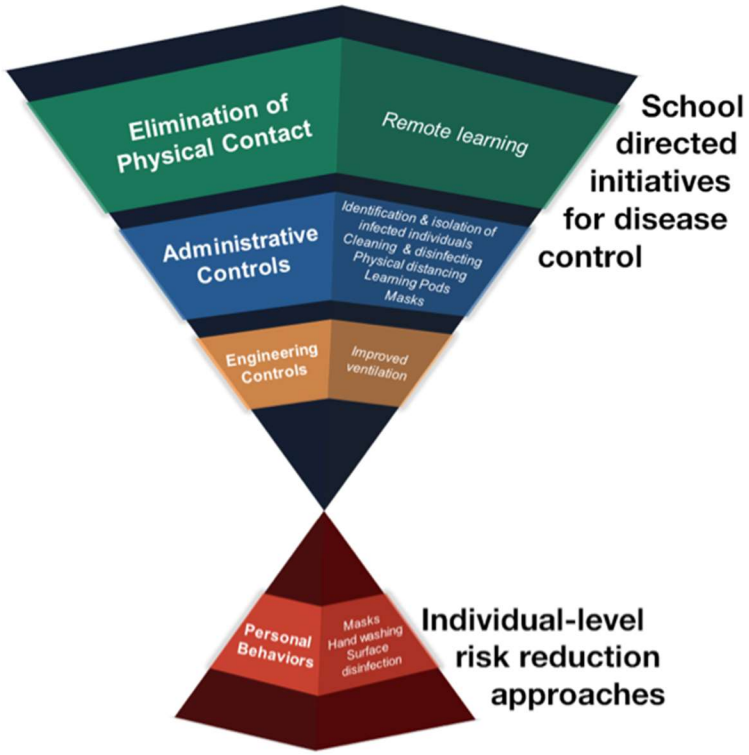

Figure 1. School directed (top-down) and student/teacher (bottom-up) risk reduction strategies to decrease disease transmission.

2. School Directed Initiatives for Disease Control

2.1. Elimination of physical contact

Eliminating physical contact is the most effective method to reduce the risk of disease transmission (National Institute for Occupational Safety and Health 2020a; American Society of Safety Professionals 2020), which requires shifting learning to a virtual format -- a challenge for many schools. The development of a virtual learning program is essential to accommodate students and teachers who are at high-risk for COVID-19 infection. In-person courses should be prioritized for academic experiences that cannot be achieved virtually. Teachers and parents may benefit from training sessions discussing effective remote learning techniques. The school should be aware of students without access to a computer with high-speed internet and provide necessary support. Remote learning can be a powerful tool that offers students and teachers the safety of learning from home while mitigating the harms of foregoing the in-person academic experience.

2.2. Vaccination

Vaccination is the most effective and safest intervention to prevent infectious diseases. Vaccines contain a weakened version or a component of a disease-causing microorganism, which stimulates one's adaptive immunity, acting as the first exposure to the organism without making one sick. Getting a flu vaccine is especially important during the pandemic, as it will reduce the burden of flu illnesses (which have similar symptoms to

COVID-19) and conserve scarce medical resources for the care of COVID-19 patients. When COVID-19 vaccination becomes available to the school members, it is critical for the schools to take the initiative and get as many members vaccinated as possible. Parent education, combined with school-based vaccination-clinics, raises the vaccination rate significantly. Schools should be encouraged to require vaccinations for in-person attendance. These school entry laws have been effective in increasing vaccination compliance.

2.3. Administrative controls

The risk of infection can be minimized through the implementation of school-initiated administrative controls. These control measures as related to academics, logistics, and school staff/teachers/visitors are summarized in Figure 2.

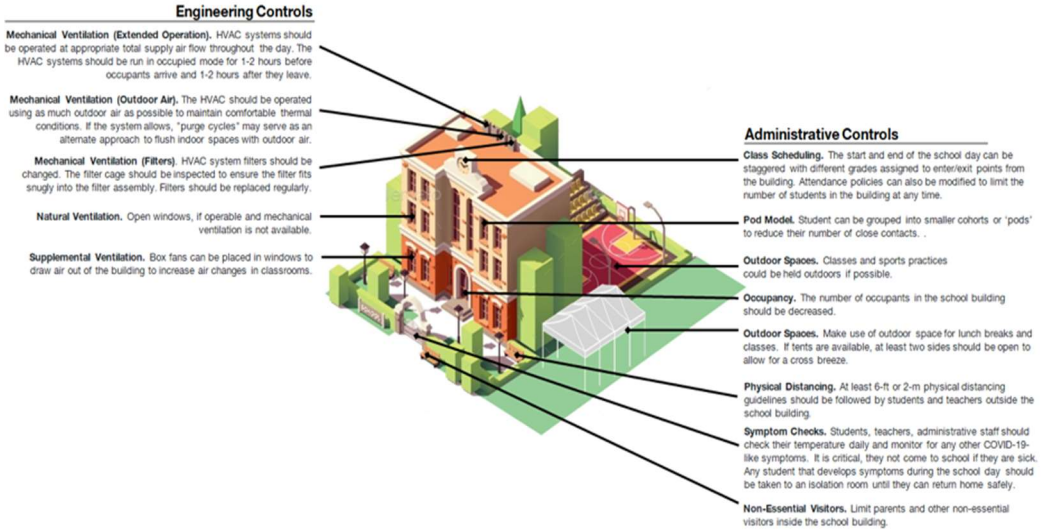

Figure 2. Administrative and engineering controls that can be implemented across the school to reduce risk of disease transmission.

2.3.1. Academics

The academic calendar and class schedule should be adjusted to maximize physical distancing at all times. Staggering and extended arrival/departure times, recess, lunchtimes, and locker access are all potential strategies to minimize people interaction. Extended recess allows staff to provide air ventilation time between different groups of students. Having a hybrid schedule in which students take virtual classes for a portion of the week and in-personal classes for the remainder of time may be useful to reduce occupancy. Holidays like fall breaks can be readjusted to avoid travel during the semester.

2.3.1.1.".Pod" model

Smaller cohorts or 'pods' can be created to limit class sizes and large-group interactions (Connecticut State Department of Education 2020; Moroney 2020; North 2020; Cullotta 2020; Moyer 2020). Each pod can eat, have classes and perform school activities together. If a student within a pod becomes sick, this model reduces the risk of a larger outbreak across the wider school community. Pod size can be strategically adjusted based on the different learning and social needs of different age groups. The number of students in each pod must balance both adherence to guidelines and also transmission control. If possible, setting up different entrances, exits, or buildings for different pods can help to mitigate risk further. Asking each pod to use the same classrooms and teachers to rotate between spaces can minimize item-sharing and people-mixing.

2.3.1.2. Activities

Activities present challenges as students from across the school community have the potential to interact. Large student gatherings with prolonged close contact in indoor spaces are also present higher risk. Some examples include school assemblies, field trips, arts events (e.g., drama, music, dance), sports events, and "homecoming" (common in the United States). These higher-risk gatherings should be held in a virtual online format to maintain the students' social networks while reducing risks for the school community.

2.3.2. Logistics

2.3.2.1. Physical distancing

Physical distancing requires individuals to maintain a safe distance from others to limit disease transmission (Centers for Disease Control and Prevention 2020a). This has also been called "social distancing", which is imprecise with unfavorable connotations of social isolation. Six feet of distance has been suggested following droplet deposition dynamics (Santarpia et al. 2020; Bi et al. 2020). Accounting for aerosol transmission necessitates increased physical distancing, in particular for higher-risk indoor environments (i.e., music rooms, cafeterias) (Prather et al. 2020). Schools can implement various strategies to achieve physical distancing. Removing extra furniture from classrooms can free up floor space.

2.3.2.2. Cleaning and disinfecting

Scheduled disinfecting and cleaning is essential to reduce the risk of viral transmission from commonly touched surfaces. Those that appear to be dirty must be cleaned before being disinfected. Recommended disinfectants for use against SARS-CoV-2 have been compiled by the United States Environmental Protection Agency (EPA) (United States Environmental Protection Agency 2020). The school's COVID-19 coordinator can monitor and maintain the school's inventory of personal protective equipment, hand sanitizers, disinfection wipes, soap, paper towels, and other cleaning and disinfection products. Custodial staff training on the proper use of disinfectants (i.e., sufficient contact time) and personal protective equipment is necessary. Limited-touch options (i.e., sensor-activated, foot-operated pedals) can further reduce disease transmission. If one is suspected to be COVID-19 positive, access to any spaces recently used by this individual should be restricted until thorough cleaning and disinfection is completed.

2.3.2.3. Noise

Sound level is a proxy for aerosol release -- speaking loudly, yelling, or shouting can release more aerosols (Asadi et al. 2020; Asadi et al. 2019). Visual displays of sound levels are also available in the form of a traffic light. The National Institute for Occupational Safety and Health (NIOSH) Sound Level Meter is an available app that can indirectly inform and remind students to keep sound levels low (National Institute for Occupational Safety and Health 2020b).

2.3.2.4. Symptom checks

COVID-19 symptom-check apps are powerful tools to remind students and teachers to report symptoms and check their daily temperature. The apps can notify the school officials when a COVID-19-like symptom arises, allowing immediate actions to encourage students to stay at home, conduct testing, and conduct contact tracing. These apps can also record student attendance, movement, family member attendance, and parent and teacher communications. These data allow the immediate identification of high-risk individuals. While convenient, the use of these apps requires access to a digital oral thermometer, which presents challenges for some low-resource school communities. For schools without apps, conducting non-touch temperature checks before students enter the school building may help mitigate risks. However, a warmly bundled child in a cold winter may

run a transient higher fever simply from warming; similarly, a child having walked to school on a hot day may also have a transient low-grade elevated temperature. Sending healthy students ("false positives") home will be disruptive for both families and schools so sitting a child in a quiet, temperature-controlled setting for ten minutes and then re-checking the temperature is advisable.

2.3.2.5. Testing and quarantine

We recommend that schools have the necessary devices and medical supplies to monitor symptoms. If a student becomes sick while in school or shows any COVID-19 symptoms upon arrival, the student must be isolated until a parent or guardian comes to guide the student off the school property. Access to personal protective equipment (PPE) is crucial for school staff when interacting with a potentially ill student.

Anyone who might have been exposed to a potentially infected individual should be notified and quarantined immediately. The United States Centers for Disease Control and Prevention considers contact to be the proximity of fewer than 6 feet for at least 15 minutes. Anyone who qualifies as a contact must be quarantined. If a case is confirmed, the responsible school official must file a report to the local health department. Parents or guardians and the student's pediatrician must be notified immediately so that an ill child can return home for at least 14 days of isolation. Medical attention is needed for children with severe illness. Furthermore, education on prevention strategies must be provided to avoid a family cluster outbreak.

For boarding schools, all students and staff arriving on the school campus are recommended to be "gateway" tested. Ideally, a test within four days prior to arrival followed by 14 days of quarantine and repeat testing at day 12-13 or so would help eliminate false-negative cases and those that are incubating. Or, students should get tested during the first full day of arrival, and get another test no sooner than 4 days after the first screening test. Students should quarantine until they receive two negative COVID-19 test results. The schools may need to quarantine students in their rooms, until the test results are confirmed as negative. Food should be delivered, and laundry facilitated. Particularly limited use schedules for bathroom and shower use, with students or staff helping clean bathrooms after use, is advised. Any student must be re-tested if presenting with any symptom or exposure (contact definition of fewer than six feet for at least 15 minutes) to infected individuals. Boarding schools and colleges/universities can also track epidemiologic trends across the county to judge the needed frequency of routine testing (Centers for Disease Control and Prevention 2020b).

2.3.3. Teachers, staff, and visitors

2.3.3.1. Workforce and communications

School operation is contingent on faculty and staff resuming their teaching and administrative responsibilities. These individuals also play a critical role in mitigating risks through continued communication of disease control strategies to students and the supervision of students to ensure safe personal behavior. Being good role models and communicating with all school personnel daily can help reinforce health messages. Regular meetings can be held to evaluate the intervention plans and strategies, reinforce safety principles, and community/school health status updates. Sending reminders can reduce risks and build consumer confidence in the efforts being made to keep children and staff safe. Teachers and staff need to stay home if they feel sick. Schools should anticipate that the number of days taken for sick leave over the academic year is likely to be higher than in the past. It may be necessary to remove any barriers for taking additional leave from school, such as medical documentation (Edwards et al. 2019). It is important for schools to build the necessary staffing capacity to fulfill these responsibilities and to fill any staffing gaps that may arise without exacerbating crowding.

2.3.3.2. Non-essential visitors

Visitor access should be restricted inside the school building, with a designated outside pick-up area for parents/guardians. In exceptional circumstances, all visitors must be chaperoned and need to wear a face mask that covers their nose and mouth. Establishing a time and location limit for visitors can also be useful in reducing risks.

2.4. Engineering Controls

Establishing well-ventilated school buildings is essential in reducing risks associated with the airborne transmission of SARS-CoV-2. Poorly ventilated indoor spaces can lead to increased exposure of virus-laden aerosols. Engineering controls can be implemented in a school to improve ventilation through (i), increasing the amount of outdoor air introduced into the building; (ii), improving filtration of recirculated air; (iii), increased the volume of air exchange per hour; and (iv), use of supplementation controls in individual classrooms, such as portable air cleaners and window-mounted box fans. The optimal configuration of controls will be unique to each school. Figure 3 presents a flow diagram to evaluate potential risk reduction controls that may be feasible based on the school's existing infrastructure.

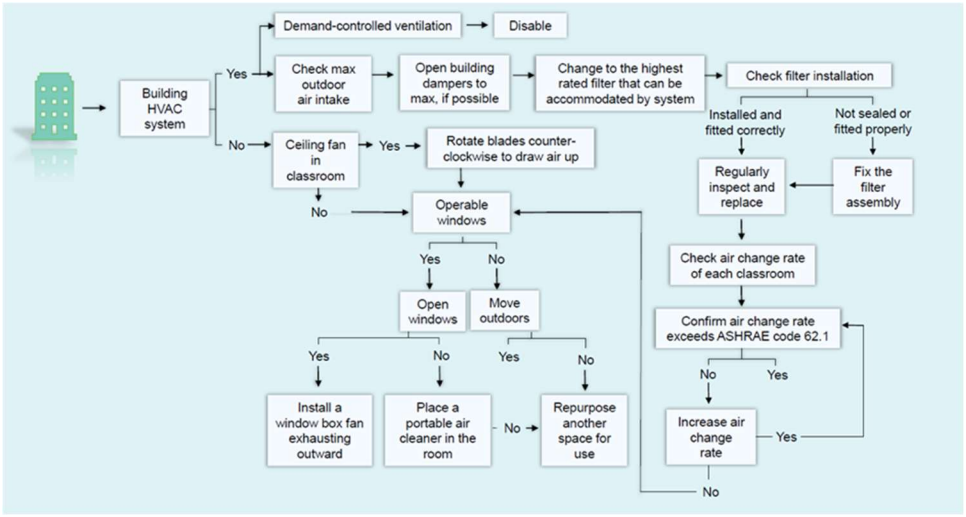

Figure 3. Engineering control flow diagram for optimizing ventilation in schools.

2.4.1. Mechanical ventilation

School buildings that are equipped with heating, ventilation, and air conditioning (HVAC) system are recommended to discuss current operation protocols and system capabilities with facility managers or an HVAC professional. The HVAC system must be commissioned before school reopening to verify the expected performance: commissioning will confirm that: (i), filters, dampers, as well as economizers seals and frames are intact, clean, functional, and responsive to control signals; (ii), temperature and relative sensors are appropriately calibrated and communicating with the building automation system; and (iii), air handling systems are providing sufficient airflow to individual rooms and exhaust fans are functional and venting outdoors.

The operation of ventilation systems with 100% outdoor air, eliminating recirculation of viral material in the building, offers the most significant risk reduction concerning engineering controls. However, during extreme weather, or for regions with extreme hot or cold temperatures, increased outdoor air use may be challenging to maintain thermal comfort for school occupants, and may introduce issues to the HVAC coils. Adjusting building temperature set points to parallel outdoor conditions will enable effective use of outdoor air and provide an additional option for disease control. Buildings with HVAC

systems that cannot accommodate 100% outdoor air may decide to run a short (10 to 15 minute) 100% outdoor air purge cycle during the day (i.e., after or during the lunch break). Schools running their HVAC system using less than 100% outdoor air will recirculate some amount of air. Some HVAC systems are designed to adjust air flows in individual classrooms and offices automatically based on occupancy load monitored using carbon dioxide sensors. Demand-controlled ventilation sequences need to be disabled to maintain HVAC operation at maximum air flows independent of the number of students, teachers, and administrative staff in the school building.

In the HVAC's air handling unit, filters can be used as the first line of defense in removing virus-laden aerosol from recirculated air. Minimum Efficiency Reporting Value (MERV) is often used to evaluate the performance of air filters at removing different types of particles. MERV13 rated filters has 90% single-pass removal efficiency of aerosol sized between 0.3 and 1 μm diameter (Azimi and Stephens 2013), it has been recommended for use in HVAC systems as a risk reduction strategy for COVID-19 (American Society of Heating Refrigerating and Air-Conditioning Engineers 2020a). If possible, filters should be upgraded to the highest-rated filter (i.e., High-Efficiency Particulate Air filters) that can be accommodated by the system. While a MERV13 filter is recommended for use, it is important to ensure that a building's HVAC system can accommodate the necessary flow required by a higher rated filter.

Beyond simply upgrading and periodically changing the system's filter, it is also critical to ensure the filter cage is maintained; any gaps in the housing assembly will impair filter efficiency. Regular inspection of the filter and filter assembly, as well as following manufacturer recommended maintenance, are critical to ensure proper operation. Filter changes are recommended to be carried after a period with no or less building occupancy (i.e., weekend, holiday) following findings from studies evaluating the stability of SARS-CoV-2 on surfaces (van Doremalen et al. 2020). When it is possible, a 10% bleach solution or another appropriate disinfectant can be used for disinfecting filters before removal. Once removed, filters can be placed into a bag for disposal as general waste.

Increasing the number of air changes in a classroom will allow for sequential removal of airborne viral material on each pass through the filter. The number of air changes per hour (ACH) in an indoor space can also be increased to enhance ventilation. ACH should be evaluated for each classroom in relation to the size of the room and occupants' activities. The amount of airflow into each schoolroom should ideally exceed the minimum American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) standards with a goal of 5 to 6 ACH.

HVAC systems in some school buildings may have displacement ventilation capabilities. This system feature introduces conditioned air at a low flow from supply diffusers positioned near the floor and exhaust air near the ceiling to provide enhanced air mixing. The use of displacement ventilation in classrooms and offices is another effective engineering control that provides enhanced air mixing, moving potential contaminant air from students and teachers.

2.4.2. Natural ventilation

For buildings using natural ventilation, operable windows, doors, skylight, or roof ventilators can be opened when outside temperatures and humidity levels permit. In buildings with an HVAC system, the interlock with the windows should be disabled in the building automation system. Portable air cleaners can be used in lieu of HVAC systems when outside air is too hot or too cold.

2.4.3. Supplemental controls

Air purifiers, window-mounted box fans, and ultraviolet germicidal irradiation (UV-GI) are supplemental controls that have been used in various indoor environments to reduce virus-laden aerosol. Supplemental controls can be used in combination with other risk reduction strategies, as guided by the flow diagram shown in Figure 3.

2.4.4. Unintended exposures from outdoor environments

While maximizing outdoor airflow is recommended in indoor spaces, it is important to be aware of potential contaminants in outdoor air and take precautions that minimize/prevent school occupants from exposure. For buildings with mechanical ventilation, outdoor air inlets should not be positioned near exhaust air outlets to avoid re-entry of potentially contaminated air. In schools using natural ventilation, outdoor airborne contaminants can readily enter the building spaces through open windows, including air pollutants derived from traffic and industrial sources, allergens, pests, and insects. It will be important to consider potential exposure to these contaminants and be selective on which operable windows are used. Considering the potential exposure of students and teachers, exposure to these outdoor factors is also important if scheduling outdoor classes.

2.4.5. Sensors to monitor building performance

Achieving the optimal performance of an HVAC system requires regular commissioning. Indirect measures of system performance can also be evaluated using air pollutant sensors. Carbon dioxide sensors can provide useful information about occupancy load and activity levels in relation to the ventilation capacity of the classroom. Airflow may require adjustments if levels of exhaled carbon dioxide steadily increase while occupants are in the space. Additional sensors are available to evaluate ventilation of air pollutants from other sources such as particulate matter 2.5 μm or less in diameter, and volatile organic compound sensors.

3. Student and Teacher-Directed Risk Reduction Strategies

COVID-19 public health guiding principles include physical distancing, hand/face/surface hygiene, use of face masks covering the nose and mouth, improved air quality and ventilation, and appropriate testing and follow-up (isolation, quarantine, and contract tracing). Adherence to all of these strategies is key to improving the safety of the school community. This section discusses how individual-directed principles may be applied.

3.1. Masks

There is strong evidence from epidemiology and economics that supports the use of masks to limit community spread of COVID-19. Face masks provide inward and outward protection. All members are recommended to wear face masks throughout the day while on school property (Centers for Disease Control and Prevention 2020a). Education on how to safely choose, wear, care for, clean or discard, and store masks can be useful to encourage adherence. Promoting personalized masks with the school logo or creating masks for students in different classes, houses, clubs, or sports teams may also encourage use. Fun masks for younger children may include favorite cartoon characters.

Masks made from cotton fabrics with high thread counts and random fiber orientation seem promising for preventing release and exposure to droplets and aerosols (Dbouk and Drikakis 2020). They are also highly cost-effective (Abaluck et al. 2020). In contrast, elastic fabric materials are not recommended due to the large pore size, resulting in lower filtration efficiency. Masks should be appropriately sized and provide complete coverage of both the nose and mouth (Centers for Disease Control and Prevention 2020c). Face masks with an exhalation valve are not recommended as they offer inward protection but no outward protection; thus, they will not prevent the spread of the virus from the mask

wearer (Ippolito et al. 2020). Reusable masks can be washed or stored 2 to 3 days between use (Hao et al. 2020; Yang 2020; World Health Organization 2020a). Rotating between at least three masks will allow for safer reuse of masks. Face shields are not a replacement for marks. Face shields have limited utility for reducing risk toward airborne transmission (Perencevich et al. 2020). A face shield could be worn in addition to a mask, but face shields should not be worn without a mask unless substantial physical distancing is also possible.

In situations where masks cannot be worn (i.e., eating), other precautions can be taken to increase safety, such as using plexiglass to create a physical barrier. Alternative arrangements should also be made for students who are unable to wear a face mask due to developmental, respiratory, young age, or other physical conditions. Members of the school community must understand that wearing a mask is not a replacement for physical distancing or other guiding public health principles, or vice versa.

Masks can create challenges in certain pedagogical cases, such as language classes. Foreign language instructors may need to be seen by students to appreciate mouth movements needed to make certain sounds. Video assistance should be considered, or a shield combined with an increase in their physical distance to the students to 12 feet may be considered so that students can see the instructor mouthing the words to be learned. In these cases where teachers do not wear masks, the duration of the class time without a mask could be minimized, and additional engineering controls for ventilation can be used in the classroom to offer enhanced risk reduction approaches. In situations where lip-reading is required, and physical distancing may make it impossible for the deaf or hard of hearing student to read lips, communication may be possible using a mask with a transparent mouth window. While not ideal, teachers using only face shields can stand near an portable air cleaner or window-mounted box fan. These lessons can be held outdoors, if the weather permits.

3.2. Hand hygiene

All students, teachers, and school administrators should be consistently reminded to wash their hands as frequently as possible. Hands should be washed with soap and water for at least 20-30 seconds. That is longer than most people realize, the time it takes to sing "Happy Birthday to You" twice. When lacking soap and water, hand sanitizer that contains at least 60% alcohol can be used. For hand sanitizer to be effective, all surfaces of the hands must be covered and then rubbed until dry. It is especially important for students, teachers, administrative staff to wash their hands after touching common surfaces or their face after they cough or sneeze, and after using the restroom (Pradhan et al. 2020). Courtesy greetings such as shaking of hands should not be avoided.

4. Conclusion

The fundamental principles for keeping schools safe are similar to those for any indoor environment during influenza season, but the needs of children and adolescents must be brought to the fore in this time of greater risk. These elements include universal mask use, physical distancing, hand hygiene for hands, optimized indoor air quality, outdoor teaching and activities whenever possible, limiting crowds, abundant testing, and enhanced supports for vulnerable students and adults. Universal influenza vaccine is highly advisable. Provision for temporary isolation or quarantine, along with contact tracing, is needed. Boarding schools, colleges, and universities that host students from far away may need to invoke their *locum parentis* and provide health care, quarantine, isolation, and contact tracing on behalf of distanced parents and guardians.

The feasibility of maximum safety will vary with local attitudes and resources. If political leaders, parents/guardians, educational administrators, or school staff do not take COVID-19 control seriously, much damage can occur if necessary, precautions are not taken appropriately. Improved air quality, masks, hand sanitizers, grab-and-go meals,

outdoor tents, smaller class sizes, and accommodations for vulnerable individuals all take extra resources. Governments must acknowledge this and provide these resources in this time of COVID-19 before the availability of excellent treatments and vaccines.

The current crisis calls for a shift in culture that recommends universal, routine mask use. Behavioral adherence must be reinforced and incentivized. Vulnerable groups must be protected, whether students, vulnerable people living with the students, teachers, or other staff. Mitigation measures hopefully enable us to open up schools in lower incidence settings around the world. Virtual online learning has become the preferred method of education in the face of high viral transmission in a school's particular community.

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