Preparing School Buildings for a COVID Informed Return

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Presentation Overview

• Types of COVID Transmission - Fomite, Droplet, and Aerosol
• Primary Risk Reduction Strategies
  • Managing Vacant School Buildings for a Safe Return
    • Heating, Ventilating and Air Conditioning (HVAC) Systems
    • Water Quality
  • Touch Surfaces and Social Distancing
    • Cleaning and Sanitizing
    • Touchless Plumbing Conversion
    • Hand Washing / Sanitizing
    • Social Distance Preparations
  • Air Quality Preparations
    • Restroom Preparations
    • Ventilation and Filtration
    • Review of Additional Technologies
• Expert Summary Guidance:
  • Harvard School of Public Health
  • American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
• Next Steps and AAPS Recommendations
### Types of COVID Transmission

<table>
<thead>
<tr>
<th>FOMITES</th>
<th>DROPLETS</th>
<th>AEROSOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fomites</strong></td>
<td><strong>Droplets</strong></td>
<td><strong>Aerosols</strong></td>
</tr>
<tr>
<td>Are contaminated objects and surfaces that transmit coronavirus from your hands to your eyes, nose or mouth. Fomite spread is more likely on hard, non-porous materials like metals and plastics. Regular use of hand sanitizer and vigorous hand-washing can prevent fomite spread.</td>
<td>Are moist particles expelled from speaking, breathing, coughing and sneezing. They are considered to be the primary vector of COVID-19 infection. Virus-bearing droplets can spread coronavirus through your eyes, nose or mouth. Droplets do not remain airborne long: 6 feet of distance limits exposure, but masks covering the mouth and nose are the best prevention.</td>
<td>Are tiny particulates that infected carriers exhale, especially when shouting, singing, or speaking. Aerosols are mostly inhaled as a means of transmitting the virus. Unlike droplets, aerosols can remain airborne for several hours, can travel further than 6 feet, and may accumulate, especially in poorly ventilated, closed spaces. Masks, worn snugly and properly, are extremely effective at containing aerosols. Remaining outdoors, where aerosols cannot accumulate, also prevents transmission.</td>
</tr>
</tbody>
</table>

**Hand washing**

**Hand sanitization**

**Mask wearing**

**Eye protection**

**Social distancing**

**Staying outdoors**

**Ventilation**

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Source: Centers for Disease Control (CDC)
Fomite, Droplet, and Aerosol Transmission

Source: https://www.sciencedirect.com/science/article/pii/S0196655316305314
How Big is a Micron?

Small and Smaller
Estimated diameters in microns (millionths of a meter)

75 MICRONS
Human hair
(But they vary greatly)

50 MICRONS
Smallest visible respiratory droplets

5 MICRONS
Respiratory nuclei, called an aerosol

0.15 MICRONS
Coronavirus

SOURCES: Kimberly Prather; WHO Research Gate/Gary Haq
GRAPHIC BY ROBERT ROY BRITT
Risk Reduction Strategies

CDC Hierarchy of Controls

- **Elimination**
  - Physically remove the hazard
- **Substitution**
  - Replace the hazard
- **Engineering Controls**
  - Isolate workers from the hazard
- **Administrative Controls**
  - Change the way work is performed
- **PPE**
  - Protect the worker with personal protective equipment

More effective

Less effective
Primary Risk Reduction Strategies

Source: Centers for Disease Control (CDC)

Tips for Reducing Risk of Getting COVID-19

Things that Increase Risk
- No Masks Worn
- Indoor Space
- Crowded Place

HOT SPOT

Things that Decrease Risk
- Masks Worn
- 6 Feet of Space Between People
- Outdoor Space

SAFE SPOT

Source: Centers for Disease Control (CDC)
Risk Reduction Strategies

SCHOOLS FOR HEALTH
Risk Reduction Strategies for Reopening Schools
COVID-19

HEALTHY BUILDINGS
- Increase outdoor air ventilation
- Filter indoor air
- Supplement with portable air cleaners
- Verify ventilation and filtration performance
- Consider advanced air quality techniques
- Use plexiglass as physical barrier
- Install no-contact infrastructure
- Keep surfaces clean
- Focus on bathroom hygiene

HEALTHY CLASSROOMS
- Wear masks
- Wash hands frequently
- Maximize physical distancing to protect individuals
- Maximize group distancing to slow transmission chains
- Disinfect objects between users

HEALTHY ACTIVITIES
- Provide meals
- Modify physical education
- Reimagine music and theater classes
- Continue sports with enhanced controls
- Add structure to free time

HEALTHY SCHEDULES
- Manage transition times and locations
- Make lunchtime safer
- Redrisk transportation
- Modify attendance

HEALTHY POLICIES
- Establish and reinforce a culture of health, safety, and shared responsibility
- Form a COVID-19 response team and plan
- Prioritize staying home when sick
- Promote testing and antibody testing
- Establish plans for when there is a case
- Support remote learning options
- Re-densify school buildings
- Protect high-risk students and staff
Risk Reduction Strategies

**SCHOOLS FOR HEALTH**
Risk Reduction Strategies for Reopening Schools

**COVID-19**

**RISK REDUCTION STRATEGIES**

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Managing Vacant School Buildings for a Safe Return
Managing Vacant School Buildings for a Safe Return

Heating Ventilating and Air Conditioning (HVAC) Systems

• While the buildings are unoccupied, HVAC systems are run at a minimum of two hours twice per week to keep them in good working order
• Increase filter changes to 3x per year and increase filter density where feasible
• Deep Clean and Commission all HVAC systems
Water Quality
- While buildings are unoccupied, completely flush the plumbing systems weekly to help prevent the growth of Legionella bacteria which can cause Legionnaires disease
- Complete the bi-annual replacement of all drinking water filters
- Test all school buildings for Ecoli and Legionella
Preparing School Buildings for a Safe Return to In-Person Instruction
Cleaning and Sanitizing

- Frequently touched surfaces including light switches, doors, benches, bathrooms, will be cleaned every four hours with an EPA-approved disinfectant.
- Staff will wear appropriate personal protective equipment when cleaning.
- Custodial staff to regularly check and restock soap, hand sanitizer and paper towels.
- Hallway and classroom doors will be propped open to minimize touch surface contact where feasible.
- Hand sanitizer will be provided in all occupied spaces and when arriving at school.
Plumbing Systems - Fixture Modifications

- Remove all drinking fountain bubblers and cap openings
- Install water bottle fillers at locations of drinking fountain bubblers where feasible
- Begin transition to touchless restroom fixture operation for sinks, toilets, and urinals
Plumbing Systems - Convert to Touchless Operation

Examples of Specified Touchless Fixtures for sinks, toilets and urinals:
Health and Wellness Signage

AAPS has retained Stantec consulting architects and planners to develop informational signage and social distancing strategies. Signage will be placed throughout the schools including:

• “In-Only” and Exit-Only” door locations
• Social Distancing Reminders
• Self-Screening Reminders
• One-Way hallway and staircase traffic circulation - Walk on the right side only- “Stay in Your Lane”
• Maximum Occupancy for Elevators
• Maximum Occupancy for Restrooms
• Hand Washing Reminders in Restrooms

Stantec
Health and Wellness Signage - Typical Floor Plan
### Health and Wellness Signage - Overall Legend

<table>
<thead>
<tr>
<th>TYPE</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ENTER ONLY SIGN</td>
</tr>
<tr>
<td>2</td>
<td>EXIT ONLY SIGN</td>
</tr>
<tr>
<td>3</td>
<td>DO NOT ENTER SIGN (ON BACKSIDE WHERE APPLIES)</td>
</tr>
<tr>
<td>4</td>
<td>ALL VISITORS USE MAIN ENTRY SIGN</td>
</tr>
<tr>
<td>5</td>
<td>EMERGENCY EXIT ONLY SIGN</td>
</tr>
<tr>
<td>6</td>
<td>CORRIDORS - SOCIAL DISTANCING FLOOR CLING DOTS - 'STAY IN YOUR LANE' - 2 COLORS - LOCATE OUTSIDE OF DOORS AND AT 15' OC MAX, TYP</td>
</tr>
<tr>
<td>7</td>
<td>MAXIMUM OCCUPANCY SIGN</td>
</tr>
<tr>
<td>8</td>
<td>WELLNESS CHECK-IN LOCATION SIGN</td>
</tr>
<tr>
<td>9</td>
<td>ENTRANCE SCREENING POSTER</td>
</tr>
<tr>
<td>10</td>
<td>DRAPE-OFF EVERY OTHER CHAIR IN RECEPTION AREA</td>
</tr>
<tr>
<td>11</td>
<td>SOCIAL DISTANCING REMINDER SIGN</td>
</tr>
<tr>
<td>12</td>
<td>SELF SCREENING REMINDER SIGN</td>
</tr>
<tr>
<td>13</td>
<td>HAND WASHING AT SINKS SIGN</td>
</tr>
<tr>
<td>14</td>
<td>HAND SANITIZER STATION</td>
</tr>
<tr>
<td>15</td>
<td>ISOLATION ROOM LOCATION</td>
</tr>
<tr>
<td>16</td>
<td>DRINKING FOUNTAIN SOCIAL DISTANCING FLOOR CLING SET</td>
</tr>
<tr>
<td>17</td>
<td>STAIR SOCIAL DISTANCING FLOOR CLING SET</td>
</tr>
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</table>
Health and Wellness Signage - Entry Poster

Posters will be placed outside of each school with entry requirement reminders. Entrance posters will be translated into multiple languages as needed.
Health and Wellness Signage - Entry and Exit

Entrances and Exits will be clearly labeled to promote In-Only and Exit-Only locations to minimize crossing circulation pathways.
Health and Wellness Signage - Hallway Circulation

Hallway Circulation floor dots will be installed in hallways to promote one-way hallway circulation.
Health and Wellness Signage - Cue locations and Stairway Circulation

Social Distance floor dots will be installed in stairwells and potential cue locations such as water bottle filling stations, offices, cafeterias, etc.
Health and Wellness Signage - Maximum Occupancy

Maximum Occupancy will be designated for shared spaces such as restrooms, media centers, elevators, etc.
Health and Wellness Signage - General Health Reminders

General health reminders and masking reminders will be posted throughout the schools.

Students: Let’s work together to stop the spread of COVID-19

- **KEEP SPACE BETWEEN YOU AND OTHERS**
  - when outside: 6 FT
  - in the classroom: 6 FT
  - on the bus: try to skip a row if possible

- **Stop the spread of germs that can make you and others sick!**
  - Wash your hands often
  - Wear a mask
  - Cover your coughs and sneezes
  - Keep 6 feet of space between you and your friends

[Images of posters showing health guidelines]
Health and Wellness Signage - Hand Washing Reminders

Handwashing reminders will be posted at all sinks and restrooms.
Social Distancing Preparations - Physical Distance vs. Group Distance (Cohorts)
Social Distancing Preparations - Classroom Layouts

Classroom, Offices and other occupied space will have furniture arranged to maximize social distancing. Unused furniture will be secured and labeled.

- SAMPLE Classroom Layout - Stantec / American Institute of Architects
Social Distancing Preparations - Sneeze Guards

Sneeze Guards will be installed in all offices and other transaction locations where maintaining social distance is not feasible

- Skyline High School
Ventilation in Restrooms

Studies have shown that toilets and other restroom fixtures can be a risk of generating airborne droplets and droplet residues that could contribute to transmission of pathogens.

- Keep toilet room doors closed, even when not in use.
- Put the toilet seat lid down, if there is one, before flushing.
- Vent separately where possible (e.g. turn exhaust fan on if vented directly outdoors and run fan continuously).
- Keep bathroom windows closed if open windows could lead to re-entrainment of air into other parts of the building.
- Remove Forced Air Hand Dryers
Heating Ventilating and Air Conditioning Systems (HVAC) - VENTILATION

AAPS has retained Fishbeck as consulting engineers to assist in maximizing the healthy operation of our school buildings’ HVAC systems. The work has focused in several areas:

- Maximizing the provision of fresh outside air
- Maximizing the effectiveness of air filtration systems
- Developing algorithms for operating AAPS buildings in an Enhanced Indoor Air Quality Mode through the District’s Building Automation System (BAS)
ENHANCED INDOOR AIR QUALITY VENTILATION

- Review control system
- Modify sequences and setpoints to allow for an increase in outdoor air
- Implement emergency mode ventilation sequences
Heating Ventilating and Air Conditioning Systems (HVAC)

Enhanced Indoor Air Quality

MECHANICAL VERIFICATION AND TESTING
ABBOT ELEMENTARY

Recirculated Air

Building Automated System (BAS) Graphic of Unit Ventilator

Classroom Unit Ventilator

Outdoor Air Ventilation

Increased Ventilation
Outdoors air ventilation between 40% to 100% based on heating demand. Functions tested by Engineer.

Optimized Air Filtration
- Meets minimum code?
- Highest level of filtration allowed by equipment?
- Effectiveness of filtration?

Extended Equipment Schedules
Continuous operation and extended equipment schedules provide additional air changes to flush the building before and after each school day.

Above & Beyond
CO2 monitoring automatically brings in additional ventilation as CO2 levels increase.

Temperature Monitoring and Alarms
Heating, Ventilating, and Air Conditioning Systems (HVAC)

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Outdoor air ventilation between 40% to 100% based on heating demand. Functions tested by Engineer.

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ENHANCED INDOOR AIR QUALITY

AIR FILTRATION

- Verify outdoor and exhaust air paths – Inspect filters, air intakes, and control devices
- Recommend filter upgrades based on fan capability and space available in units

MERV-8 to MERV-13
1” or 2” up to 4” thickness

HEPA Filter
12” thickness

Considerations: Physical size, pressure drop (fan capacity to maintain airflow), availability, and cost vs. benefit
Aerosols potentially carrying coronavirus are approximately 5µm (5 microns).

Current AAPS Air Filters

AAPS Design Standard for 2019 Bond
Minimum Efficiency Reporting Value (MERV)

Study based on one contagious person with the flu virus in a room with 35 people for 8 hours. With no filtration of the air there is a 32.3% of spread, or on average 11 people would become infected. The rate of infection drops rapidly as air filtration is introduced.

Source: Wells-Riley & HVAC Filtration for infectious airborne aerosols, NAFA Foundation Report
Other Technologies for Cleaning Air

Other Technologies to Consider:
• Vaporized Hydrogen Peroxide (VHP)
• Ultra Violet Light - Whole Room Disinfection
• Ozone Disinfection
• Gas-Phase Air Cleaners (Carbon Filters)
• *Ultra Violet Light - In Air Supply Disinfection*
• Bipolar Ionization
• Portable Air Cleaners
Vaporized Hydrogen Peroxide (VHP)

- Liquid hydrogen peroxide (H2O2) is vaporized and the vapor fills the space to disinfect all exposed surfaces.
- Space MUST be unoccupied during VHP treatment.
- Requires spaces to be sealed, including all doorways, plumbing/electrical penetrations and HVAC supply and return vents, to prevent vapor from escaping.
- The effectiveness and safety of VHP when generated inside active HVAC ducts and occupied spaces has not been rigorously studied.
Ultra Violet Light (UV-C) - Whole Room Disinfection

• Banks of UV-Lamps installed on a portable fixture
• Used for surface disinfection
• System operates remotely to avoid exposure to direct or reflected germicidal ultraviolet rays, since they cause painful eye irritation and reddening of the skin. Typically used in highly sensitive medical environments.
Ozone Disinfection

- Ozone (O3) is a reactive gas that can disinfect air and surfaces by killing viruses, bacteria, and fungi.
- Ozone is harmful for health and exposure to ozone creates risk for a variety of symptoms and diseases associated with the respiratory tract.
- Should only be considered for disinfection in unoccupied spaces; it should never be used in occupied spaces.
- Available scientific evidence shows that, at concentrations that do not exceed public health standards, ozone is generally ineffective in controlling indoor air pollution.
Gas-Phase Air Cleaners (Carbon Filters)

- Gas-phase air cleaners are those used to remove smoke, volatile organic compounds and other odors from the air.

- Most contain sorbent materials such as carbon (e.g., activated charcoal).

- While there may be exceptions, most sorbent beds alone are not generally efficient at removing viruses from airstreams.
Ultra Violet Light (UV-C) - In Air Supply Disinfection

• Banks of UV-Lamps installed inside HVAC systems or associated ductwork.

• Requires high UV doses to inactivate microorganisms on-the-fly as they pass through the irradiated zone due to limited exposure time.

• Lamps pose imminent danger if used without taking the proper precautions. You MUST avoid exposure to direct or reflected germicidal ultraviolet rays, since they cause painful eye irritation and reddening of the skin.

• Typically used in highly sensitive medical environments.
Bipolar Ionization / Needlepoint Ionization and Other Ion or Reactive Oxygen Air Cleaners

• Technologies utilize various methods to create reactive ions in air that react with airborne contaminants, including viruses.

• Systems are reported to range from ineffective to very effective in reducing airborne particulates and acute health symptoms.

• Convincing scientifically-rigorous, peer-reviewed studies do not currently exist on this emerging technology; manufacturer data should be carefully considered.

• Systems may emit ozone, some at high levels.
Portable Air Cleaners

• Portable device located in the room where air cleaning is desired.

• Air is pulled into the device, and cleaned air is returned to the room.

• Devices may include any or combinations of air cleaning technologies (HEPA filters, sorbents, UV, etc.). Users are advised to carefully determine that the application of the technology is appropriate for their need.

• The rate of particle removal from air is termed the Clean Air Delivery Rate (CADR), typically in units of cubic feet per minute (CFM).
Harvard School of Public Health Summary Recommendations

TARGET IS AT LEAST 5 TOTAL AIR CHANGES PER HOUR (ACH)

- **Ideal (6 ACH)**
- **Excellent (5-6 ACH)**
- **Good (4-5 ACH)**
- **Bare minimum (3-4 ACH)**
- **Low (<3 ACH)**

Prioritization of Engineering Controls to Reduce Long-Range Airborne Transmission
Air Changes per Hour (ACH) is a measure of how often the air in a room is replaced by either outside air or recirculated filtered air.

**SAMPLE CALCULATION**

Room Size is 30’ wide x 30’ long x 10’ high = 9,000 cubic feet of air

Ventilation system provides 1000 cubic feet per minute (CFM) of fresh and/or filtered air.

\[
1000 \text{ CFM} \times 60 \text{ minutes} = 60,000 \text{ cubic feet per hour}
\]

\[
\frac{60,000 \text{ cubic feet per hour}}{9,000 \text{ cubic feet}} = 6.6 \text{ Air Changes per Hour (ACH)}
\]
Harvard School of Public Health Summary Recommendations: Air Changes per Hour (ACH)

- Code minimum ventilation rates are approximately 2.8 - 3.5 ACH for schools
- Recommended rates for creating better air quality is 5+ ACH
- When operating in the Enhanced Indoor Air Quality Mode, AAPS building mechanical systems are generally able to provide between 5 and 11 ACH depending on the room and/or school mechanical systems. In some older buildings ACHs in a limited number of rooms have been calculated to be below 5.
- Portable Air Cleaners can provide 1-4 additional ACH depending on room size and equipment model.
Harvard School of Public Health Summary Recommendations: Air Changes per Hour (ACH)

Increasing Air Changes per Hour (ACH) reduces the probability of virus transmission

Chart is based on the Wells-Riley model developed as part of a study of a measles outbreak in NY public school in the 1970s.
It is likely, but not yet conclusively shown, that COVID-19 could be spread through the air.

Air cleaning and increased ventilation can help mitigate disease transmission.

Options for air cleaning include: HVAC systems optimization and In-Room devices.

Technologies that can be effective include:
- Mechanical Air Filters
- Electronic Air Filters/Air Cleaners
- UV-C Systems
- Other Emerging Technologies

Care and professional judgment should be taken to understand choices for ventilation, filtration and air disinfection, pros and cons of each and impact(s) on existing buildings systems.
Next Steps and Recommendation

NEXT STEPS

• Continue flushing water systems
• Continue installation of touchless water fixtures
• Continue commissioning HVAC systems
• Continue HVAC filter replacements and upgrades
• Continue to work with Teachers, Administrators and other Staff to implement building preparedness for a safer return to in-person instruction

RECOMMENDATION

• Purchase Portable Air Cleaners to further enhance indoor air quality for a safer return to in-person instruction