Back to Normal?
How to Revert to Pre-COVID-19 Hospital Conditions with OSHPD
08.13.20

Panelists Introduction

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How to Revert to Pre-COVID-19 Hospital Conditions with OSHPD – Seminar - 08.13.20

Agenda

Latest Research & Developments

ASHRAE Position on COVID-19

Infectious Disease Control Strategies

Questions & Answers

Recommendations and Lessons Learned

Makeshift Negative Pressure Patient Rooms In Response to COVID-19

Everyone knows that installing new HVAC systems and equipment within an existing hospital requires extensive research, design, regulatory permits and, most importantly, time. But when you must create a large number of negative pressure hospital patient rooms in response to a pandemic, you don’t have much time. Instead, you can create these rooms using appliances such as portable high-efficiency particulate air (HEPA) exhaust fan units, with guidance from relevant codes and standards and by following hospital licensing requirements.

Appliances move in and out of hospitals routinely, although drawings and standards defer appliances differently; they generally refer to units that are not handscotched, plumbed or directly attached to the building structure, floor, walls or ceilings. Throughout the use of appliances such as the portable HEPA exhaust fan unit, the authors were able to isolate infectious patients, while meeting or exceeding the requirements of applicable codes.

HVAC systems within a hospital, if designed properly, can help mitigate airborne transmission of diseases. Ventilation and filtration provided by HVAC systems can reduce the airborne concentra- tion of SARS-CoV-2, the virus responsible for the coronavirus disease (COVID-19), and thus the risk of transmission through the air. The “ASHRAE Position Document on Infection Control” states, “Some diseases are known to spread by infectious aerosols. The risk of pathogen spread, and the relative number of people exposed, can be affected both positively and negatively by HVAC and local exhaust ventilation (LEV) systems.”

Building codes and health care regulations throughout the country require that hospitals have a minimum number of negative and positive pressure isolation rooms. A negative pressure isolation room isolates a patient to prevent others in the hospital, while a positive pressure isolation room is designed to protect a patient.
Makeshift Negative Pressure Patient Rooms
In Response to COVID-19

Top Ten Lessons Learned
- The pandemic has taught us that the healthcare system can respond quickly to crises.
- The use of negative pressure rooms can help prevent the spread of infectious diseases.
- The importance of proper ventilation in healthcare facilities.
- The need for continued training and education for healthcare workers.
- The value of collaboration and communication among healthcare professionals.
- The significance of patient privacy and comfort in healthcare settings.
- The potential for technology to improve healthcare delivery.
- The importance of maintaining physical distancing in healthcare facilities.
- The necessity of addressing the mental health needs of healthcare workers.
- The role of the community in supporting healthcare providers.

How to Revert to Pre-COVID-19 Hospital Conditions

Latest Research & Developments
What Do We Know So Far About Infectious Disease Spread?

Respiratory Droplets vs. Airborne Transmission

- Spread Through Respiratory Droplets
- Droplet Particles are Greater Than 5 µm To 10 µm In Diameter
- SARS-CoV-2 (COVID-19)

- Microbes Within Droplet Nuclei
- Generally Considered to be Particles Less Than 5 µm In Diameter
- Droplet Nuclei Can Remain in the Air for Long Periods of Time
- Tuberculosis (TB)


ASHRAE Position on COVID-19

DATA SOURCE: ASHRAE. 2020. STEPS FOR OPENING A BUILDING DURING THE COVID-19 PANDEMIC. ENGINEERING IN PUBLIC BUILDINGS.
How to Revert to Pre-COVID-19 Hospital Conditions with OSHPD – Seminar 08.13.20

ASHRAE Position on COVID-19

“transmission of SARS-CoV-2 through the air is sufficiently likely that airborne exposure to the virus should be controlled.”

OSHPD FDD
Deputy Director
Main Points

TREATING COVID-19 SIMILARLY TO TB

ASHRAE

“Health care emergencies or unforeseen events, such as an infectious disease outbreak, a disaster or mass casualty incident (generally related to a natural or human-caused disaster) may lead to a rapid influx or “surge” in patients. Facilities may request temporary approval with a program flex for an increase in patient accommodations, surge tent use, or space conversions and improvements for treatment.”

OSHPD FDD is maintaining records of facilities utilizing PIN 4 and Surge Tents in order to provide this information to other state departments that may request it.

PIN 4 was initially written to respond to a rise in TB cases and the need for immediate patient care services that were beyond the inventory of current available patient services. COVID-2019 may be applied to patient isolation and facility spaces for treatment.

This PIN may be found on OSHPD’s website at: https://oshpd.ca.gov/ml/v1/resources/document?rs:path=/Construction-And-Finance/Documents/Resources/Codes-and-Regulations/Policy-Intent-Notices-PINs/PIN-4-Review-of-Existing-Facilities-for-Airborne-Infection.pdf.

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The current EO may be found at: https://www.gov.ca.gov/wp-content/uploads/2020/03/3.4.20-Coronavirus-SOE-Proclamation.pdf.


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# ASHRAE Position Document on Airborne Infectious Diseases: Nine Strategies

**Table 1: Airborne Infectious Disease Engineering Control Strategies: Occupancy Interventions and Their Priority for Application and Research**

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Occupancy Categories Applicable for Consideration</th>
<th>Application Priority</th>
<th>Research Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Dilution ventilation</td>
<td>All except 7 and 11</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>2 Temperature and humidity</td>
<td>All</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>3 Personalized ventilation</td>
<td>1, 4, 6, 9, 10, 14</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>4 Local exhaust</td>
<td>1, 2, 8, 14</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>5 Central system filtration</td>
<td>All</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>6 Local air filtration</td>
<td>1, 2, 3, 5, 6, 8, 9, 14</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>7 Duct and air-handler UVGI</td>
<td>1, 2, 3, 4, 5, 6, 8, 9, 14</td>
<td>Medium</td>
<td>Highest</td>
</tr>
<tr>
<td>8 In-room flow regimes</td>
<td>1, 6, 8, 9, 10, 14</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>9 Differential pressurization</td>
<td>1, 2, 7, 8, 11, 14</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

Note: In practical application, a combination of the individual interventions will be more effective than any single one in isolation.

*Occupancy Categories:
1. Health care (residential and outpatient)
2. Correctional facilities
3. Educational + age 8
4. Educational + age 8
5. Food and beverage
6. Internet café/game rooms
7. Hotel, motel, dormitory
8. Residential shelters

**DATA SOURCE:** ASHRAE POSITION DOCUMENT ON AIRBORNE INFECTIOUS DISEASES, FEBRUARY 5, 2020

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**ASHRAE Position Document on Airborne Infectious Diseases: Nine Strategies**

1. Dilution Ventilation
2. Temperature & Humidity
3. Personalized Ventilation
4. Local Exhaust
5. Central System Filtration
6. Upper Room UVGI
7. Duct & Air Handling UVGI
8. In-Room Flow Regimes
9. Differential Pressurization

**DATA SOURCE:** ASHRAE POSITION DOCUMENT ON AIRBORNE INFECTIOUS DISEASES, FEBRUARY 5, 2020
Infectious Disease Control Strategies

ASHRAE STRATEGY

1 Dilution Ventilation
**ASHRAE STRATEGY 1: Dilution Ventilation**

- Dilution ventilation requires supplying additional outside air to a space

- Right is the 2019 California Mechanical Code requirement for ventilation air changes within different kinds of OSHPD occupancies

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>MINIMUM OSA AIR CHANGES</th>
<th>MINIMUM TOTAL AIR CHANGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airborne Infection Isolation Room</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>General Exam / Treatment / LDRP</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Operating Room</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Patient Corridors</td>
<td>No Requirement</td>
<td>2</td>
</tr>
<tr>
<td>Patient Rooms</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Waiting Rooms</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Administration</td>
<td>Per ASHRAE</td>
<td>No Requirement</td>
</tr>
</tbody>
</table>

DATA SOURCE: CALIFORNIA MECHANICAL CODE, 2019, TABLE 4-A

**OPERATIONAL EFFECTS OF ADDITIONAL DILUTION VENTILATION**

- Increased outside air puts additional strain on the cooling and heating requirements of the facility
- Increased utility costs
- Increased maintenance
- Possible equipment retrofits

**WHAT CAN BE DONE?**

1. Exceed OHSPD requirements for OSA air change rates
2. Implement energy recovery strategies to offset increased energy usage
   - Heat recovery chillers
   - Economizer cycles
   - AHU heat recovery heat exchangers
ASHRAE STRATEGY 2: Temperature & Humidity

- ASHRAE Finds no strong correlation between air temperature, relative humidity, and airborne infection survival.

<table>
<thead>
<tr>
<th>2019 CMC TABLE 4-A SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUNCTION</td>
</tr>
<tr>
<td>Airborne Infection Isolation Room</td>
</tr>
<tr>
<td>General Exam / Treatment / LDRP</td>
</tr>
<tr>
<td>Operating Room</td>
</tr>
<tr>
<td>Patient Corridors</td>
</tr>
<tr>
<td>Patient Rooms</td>
</tr>
<tr>
<td>Waiting Rooms</td>
</tr>
<tr>
<td>Administration</td>
</tr>
</tbody>
</table>

DATA SOURCE: CALIFORNIA MECHANICAL CODE, 2019, TABLE 4-A
Higher Room Relative Humidity (RH)?

ASHRAE Standard 170 requires a minimum of 20% RH for most hospital areas, and 30% to 40% for intensive care. Patient rooms and nursing facilities have no minimum requirements.

ASHRAE’s Position Document on Infectious Aerosols recommends: “Maintain temperature and humidity as applicable to the infectious aerosol of concern.” and “This position document does not make a definitive recommendation on indoor temperature and humidity set points for the purpose of controlling infectious aerosol transmission. Practitioners may use the information herein to make building design and operation decisions on a case-by-case basis.”

DATA SOURCE: TAYLOR ENGINEERING COVID-19 WHITE PAPER
ASHRAE STRATEGY 3:
Personalized Ventilation


ASHRAE NINE STRATEGIES
1. DILUTION VENTILATION
2. TEMPERATURE & HUMIDITY
3. PERSONALIZED VENTILATION
4. LOCAL EXHAUST
5. CENTRAL SYSTEM FILTRATION
6. UPPER ROOM UVGI
7. DUCT & AIR HANDLING UVGI
8. IN-ROOM FLOW REGIMES
9. DIFFERENTIAL PRESSURIZATION

ASHRAE STRATEGY
4
Local Exhaust

IMAGE SOURCE: DESIGNED BY 8PHOTO / FREEPIK
ASHRAE STRATEGY 4:
Local Exhaust

- OSHPD identifies space types where local exhaust of the space is required.

- Consideration should be given to expanding the list of exhausted spaces based on the likelihood of airborne infection transmission.

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>ALL AIR EXHAUSTED</th>
<th>LOCAL RECIRCULATION ALLOWED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airborne Infection Isolation Room</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>General Exam / Treatment / LDRP</td>
<td>No Requirement</td>
<td>No Requirement</td>
</tr>
<tr>
<td>Operating Room</td>
<td>No Requirement</td>
<td>No</td>
</tr>
<tr>
<td>Patient Corridors</td>
<td>No Requirement</td>
<td>No Requirement</td>
</tr>
<tr>
<td>Patient Rooms</td>
<td>No Requirement</td>
<td>No Requirement</td>
</tr>
<tr>
<td>Waiting Rooms</td>
<td>Yes</td>
<td>Yes, but HEPA required</td>
</tr>
<tr>
<td>Administration</td>
<td>No Requirement</td>
<td>No Requirement</td>
</tr>
</tbody>
</table>

DATA SOURCE: CALIFORNIA MECHANICAL CODE, 2019, TABLE 4-A

ASHRAE STRATEGY 5
Central System Filtration

IMAGE SOURCE: DESIGNED BY 8PHOTO / FREEPIK

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ASHRAE STRATEGY 5:
Central System Filtration

OPERATIONAL EFFECTS OF ADDITIONAL CENTRAL FILTRATION
✓ Increased filtration puts additional strain on the fan power requirements of the facility
✓ Increased utility costs
✓ Increased maintenance
✓ Possible equipment retrofits

WHAT CAN BE DONE?
1. Exceed OHSPD requirements for central filtration
2. Implement strategies to offset increased energy usage
   • Implement maintenance program to replace filters to avoid high pressure drop
   • Variable speed fans

Virus Size*

- **CORONAVIRUS:**
  0.06 to 0.15 microns
  (0.11 mean)

- **INFLUENZA:**
  0.08 to 0.12 microns
  (0.10 mean)

- **SARS:**
  0.08 to 0.15 microns
  (0.11 mean)

High-efficiency particulate air (HEPA) filters remove 99.97% of particles whose diameter is equal to 0.3 Micron (Micrometer). Also refer to NASA study for filtration effect below 0.3 Micron.
ASHRAE STRATEGY 6:
Upper Room UVGI

- Ultraviolet Germicidal Irradiation
- Wall-mounted over 7 feet
- Non-reflective baffles create columnated UV-C beam
- Natural air currents lift contaminated air into disinfection zone and inactivates pathogen
- Safe for occupied spaces
A-B-C of UV

1. UV-A: Long-Wave  400-315 nm (nanometer), skin tanning & wrinkles
2. UV-B: Medium-Wave  315-280 nm (nanometer), Primarily responsible for erythema and skin cancer
3. UV-C Short-Wave  280-200 nm (nanometer), Most effective Ultraviolet Germicidal Irradiation (UVGI)

ASHRAE STRATEGY

7

Duct & AHU UVGI
ASHRAE STRATEGY 7: Duct & AHU UVGI

Three typical means of applying UV-C for air and HVAC surface:

- **HVAC Airstream**
- **Upper Level Room Air**
- **HVAC Coil Surface**

**Pathogen Susceptibility to UV-C**

Viruses like influenza, measles, SARS, coronavirus and smallpox tend to be more susceptible to UV-C inactivation in an airstream.
ASHRAE STRATEGY 8:
In-Room Flow Regimes

Operating rooms use laminar flow over the table to protect the patient.
**Displacement Ventilation: Typical Application High Ceiling, No Heating**

- High Ceiling
- No Heating
- Low Velocity
- Away from Occupant

Displacement ventilation is a room air distribution strategy where conditioned outdoor air is supplied at a low velocity from air supply diffusers located near floor level and extracted above the occupied zone.

**ASHRAE STRATEGY 9**

Differential Pressurization
ASHRAE STRATEGY 9: Differential Pressurization

- OSHPD identifies space types where maintaining space differential pressurization is required.
- Additional consideration may be given to applying differential pressurization for additional space types.

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>PRESSURIZATION</th>
<th>ALL AIR EXHAUSTED</th>
<th>LOCAL RECIRCULATION ALLOWED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airborne Infection Isolation Room</td>
<td>Negative</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>General Exam / Treatment / LDRP</td>
<td>No Requirement</td>
<td>No Requirement</td>
<td>No Requirement</td>
</tr>
<tr>
<td>Operating Room</td>
<td>Positive</td>
<td>No Requirement</td>
<td>No</td>
</tr>
<tr>
<td>Patient Corridors</td>
<td>No Requirement</td>
<td>No Requirement</td>
<td>No Requirement</td>
</tr>
<tr>
<td>Patient Rooms</td>
<td>No Requirement</td>
<td>No Requirement</td>
<td>No Requirement</td>
</tr>
<tr>
<td>Waiting Rooms</td>
<td>Negative</td>
<td>Yes</td>
<td>Yes, but HEPA required</td>
</tr>
<tr>
<td>Administration</td>
<td>No Requirement</td>
<td>No Requirement</td>
<td>No Requirement</td>
</tr>
</tbody>
</table>

DATA SOURCE: CALIFORNIA MECHANICAL CODE, 2019, TABLE 4-A

OPERATIONAL EFFECTS OF ADDITIONAL SPACES WITH DIFFERENTIAL PRESSURIZATION

- Requires control of supply and return and/or exhaust from each space
- VAV boxes typically provide control over supply air
- VAV boxes on the return and/or exhaust may be required to create additional differential pressure environments
- Increased maintenance
- Possible equipment retrofits

WHAT CAN BE DONE?

1. Exceed OHSPD requirements for maintaining differential pressures
2. Implement strategies to offset added cost of controlling pressure
   - Routinely balance the facility to ensure pressure balance is maintained
   - Provide controls to monitor fan offset airflow, room pressures, and airflow rates to ensure airflows are within specified ranges
Questions & Answers

Additional Questions?
Contact Frank Shadpour
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858.946.0333