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Ventilation, Filtration and UVC Germicidal Light

Critical factors to mitigate the aerosol spread of SARS CoV-2 virus

Major Airborne Transmission Routes of Viral Infections

Close contact: short range airborne

- *Droplets* are larger, > 5 microns
- Spread more affected by gravity and proximity to source
- Droplets land on nearby surfaces up to 3 meters.
- Critical management period: immediate ie. social distancing, face coverings and fomite (surface) disinfection

Distant Airborne: longer range airborne

- *Aerosol* particles are smaller, < 5 microns. These particles typically contain more virus since they are generated from deep in the lungs.
- Spread more affected by air currents/velocity, ventilation and relative humidity factors
- Aerosols remain suspended loner up to 8 meters (26 feet) distance and 16 hours duration
- Critical management period: 10 minutes to 1 hour ie. Ventilation, Environmental controls and air disinfection.

Ventilation

- Ventilation rates of < 5 L/s per person will impact acute respiratory infections.
- Outdoor air supply rates < 25 L/s per person increases the risk of sick building symptoms, increase short term sick leave and decrease wellness and productivity.
- ASHRAE recommends 6.7 L/s per person of outside air or a minimum of 3.5 ACH (air changes per hour)
- The *air exchange rate* is a calculation of how much outside air is getting into a building and gets replaced with air from the outside in an hour. Most experts agree that 6 ACH (air changes per hour) is adequate. A 2016 study of air exchange rates in a Hong Kong hospital suggested that a minimum rate of 9 ACH reduced the spread of SARS, MERS and H1N1 up to 85%.
- Levels of Co2 above 1,000 ppm may be an indicator of poor air ventilation.
- A recent study performed in a low ventilation dorm recording 1490 ppm of Co2and receiving 2 L/s per person of ventilation reported 47 out of 109 ARI (acute respiratory Infections) occurred from occupants in that conditioned air space.
- In 2019, researchers reported a TB outbreak at Taipei University where Co2 levels were > 3,000 ppm. When engineers improved air circulation and lowered Co2 to < 600 ppm, there was a *97% decrease* in transmission.

Filtration

Increased filtration can be a meaningful supplement to fresh air ventilation in reducing the

overall viral load when needed fresh air changes are not possible.

- Research performed by Aerobiotix and other experts in Health Care to reduce SSI in an OR setting have shown that the greater the airborne concentration and spread of RPC (respirable particle counts) at .3 microns to 10.0 microns, the higher the rate of microbial (bioaerosol) contamination. Airborne particle loads were measured using the Biotrak LIF system after a repeated 30 minute periods of CUVC operation (HEPA filtration combined with UVC germicidal irradiation). The results were reported at a 95.1% reduction of VPC (viable particle counts)
- A minimum rating of MERV 13 is needed for a filter in a forced air system to significantly decrease the airborne viral particle loads being dispersed through the forced air system.
- The use of portable HEPA/UVC air purifiers can effectively reduce particle and viral loads in targeted areas. An effective CADR (clean air delivery rate) of the unit is defined as reducing airborne RPC's within the service area by at least 80%.

UVC Germicidal Light

UV-C Germicidal Light can be an effective supplement to the critical management of the aerosol spread of viral loads when needed fresh air ventilation rates cannot be provided that would flush out and dilute the infective load.

- UV-C light at 253.7 nm damages DNA/RNA and reduces the infectivity of the virus. The infected surface reduction is relative to dose and exposure time.
- Upper Air Disinfection utilizing UV-C, > 10 uW/cm2 is effective in reducing viral loads in the longer range areas of aerosol transported virus.
- UVGI using PCO (photocatalytic) technology and PHI (photo hydro ionization) emitting UV bulbs installed inside forced air systems are documented to provide higher inactivation rates to the bypass air and ambient air environment. Air velocity rate not exceeding 2.2 meters/second provide optimum irradiation conditions. Higher RH%, >85% affects the inactivation rate.
- CUV-C (crystalline) technology using
- UVC PCO emissions passing through a patented photolytic chamber slightly reducing the air flow rate has been validated by independent testing to inactivate the SARS CoC-2 viral load by 99.9% in one single air pass. This C-UVC technology developed by Aerobiotix is being used in critical healthcare applications for enhanced environmental controls on a global basis. It is being used successfully in many busy settings such as schools, restaurants and nursing homes and using the GermZone 100 UV unit.
- UV-C technology used as UVCGI to mitigate the SARS Coronavirus is supported by the CDC, ASHRAE and the NADCA.

References:

- National Academy of Sciences, Engineering and Medicine
- Wei j and Li Y (2016) American journal of Infection control
- College of Engineering & Applied Science
-ASHRAE Chapter 62
-UVDI March 2020 News Release

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