

The Most Overlooked Factor Regarding the Spread of the COVID-19 Virus

The constant flow of news articles, television interviews, blog posts and “man-on-the-street” talk revolves around constant and careful hand hygiene. This is, in fact, a critical issue related to combating the spread of disease. The most overlooked issue, the one getting the least serious attention, is the issue of pathogenic bioaerosols containing the virus.

When you understand that the size range of viruses is $\sim 0.02\text{-}0.30\text{ }\mu\text{m}$ (microns) and understand a few facts that are not commonly circulating then you can be fully engaged with the process of protecting yourself. These bioaerosols usually consist of a mixture of mono-dispersed and aggregate cells, spores, or viruses, carried by other materials, such as respiratory secretions and/or inert particles. So, let's look at a few facts:

The average adult breaths in excess of 16,000 cubic feet of air a day, including whatever it contains. Compare that to approximately a kilo of food a day and a few liters of fluid a day and you will realize the main entrance into your body is respiratory. Along with Nitrogen (78%), Oxygen (20.95%), Argon (0.92%) and Carbon Dioxide (0.04%) all those deadly fungi, bacteria, yeasts and viruses are entrained in the air you breathe. When you add in chemical and non-volatile particulates, it makes a potentially deadly soup.

Now let's consider the fact that indoor building environmental systems, heating and air conditioning, typically recirculate the indoor air 8-10 times per hour. The indoor concentration levels will rise over time because any aerosol of bacterial, viral, or fungal origin capable of initiating an infectious process in a susceptible host will build up exponentially in a closed environment.

Respiratory disease agents are expelled from the respiratory tract of infected people within a matrix of mucus and other secretions that typically begin to desiccate upon expulsion. Particles expelled from humans during coughing, sneezing, or even talking, although laden with moisture from respiratory secretions, begin to dry immediately upon expulsion to the air. The dried residuals are called droplet nuclei. Their size changes as they are aerosolized and exposed to environmental factors (RH, temperature) that favor desiccation or hygroscopicity. With rapid desiccation, the resultant smaller aerosols can remain airborne longer. Larger aerosols may initially fall out and then become re-suspended after desiccation. Excess gravimetric weight makes them become surface contamination posing additional physical contact risks.

Particle drying, while dependent on atmospheric RH and temperature, typically proceeds rapidly, thus changing the aerodynamic diameters to the droplet nuclei range. A sneeze can generate as many as 40,000 droplets, most of which can evaporate to particles (droplet nuclei) in the $0.5\text{ to }1.2\text{ }\mu\text{m}$ (micron) range. The ability of infectious microbes to initiate and spread disease depends on how well they survive (ability to reproduce) and maintain infectivity (ability to cause infection).

For humans, the initiation of some diseases such as the current Wuhan Corona Virus requires only small infective doses because the agents have an affinity for specific tissue and possess one or more potent virulence factors that render them resistant to inactivation. Remember that toxicity = dose x duration. Understanding the total infection control matrix absolutely requires at least a basic understanding of this concept and how the indoor environmental system plays an important role. An overall strategy to prevent the spread of disease in buildings must be logical and complete. It breaks down as follows.

- **Source Management:** Patients with active infections can be housed in negative-pressure rooms, required to wear respiratory protection, and/or placed in laminar-flow beds until confirmed as non-infectious. Sources can also be managed through a program of building maintenance, cleaning, and disinfection that also ensures routine inspection of potential sources, such as various HVAC components.
- **Activity Management:** This is the process of ensuring that a building or section of a building is used for the activities that it was designed to accommodate, and if not, that proper renovations have been carried out within a framework of operational infection control practices. For example, if a section of an existing hospital or any other temporary building is to be used for immunocompromised or infected patients, then renovations must ensure a dedicated HVAC system, with high-efficiency air filtration, and patient rooms operated under positive pressure. The use of a facility in the way that was originally intended also facilitates and promotes a routine program of inspection, maintenance, cleaning, and disinfection.
- **Ventilation and Filtration:** Dilution is the process used to make airborne pollutants less concentrated by replacing contaminated air with clean air. For the capture of infectious particles, this is typically combined with controlled air flow and high-efficiency filtration, and should be done in conjunction with continued air treatment through micro-vaporization of an anti-pathogenic product. A study investigating airborne TB control showed that ventilation plus recirculating air filtration could achieve reductions of droplet nuclei concentrations with 30-90% effectiveness.

An exhaustive 10-year study by this author investigating airborne bioaerosol control showed that ventilation plus recirculating air filtration could not however, achieve complete effectiveness. The study was conducted in the United States as well as S.E. Asia. HEPA type filtration cannot be applied in most circumstances due to the installed systems inability to draw air through a true HEPA filter. This causes fan cavitation and system malfunction. Micro-vaporization treatment is highly effective when the configuration of system air distribution is carefully studied and is properly applied and combined with an EPA, FDA, OSHA approved disinfectant solution.

- **Micro-vaporization disinfection: *The M3 System*^o** was developed to automatically disinfect buildings. It is capable of being installed in virtually any building configuration and will feed an organic based anti-pathogenic solution as needed by frequency and

amount. Developed in conjunction with Path-Away Anti-Pathogenic Aerosol Solution®, currently effective against approximately 170 individual fungi, bacteria, yeasts and viruses is a part of preventing to spread of the current viral scourge as well as other pathogens affecting people.

The antiquated concept of ***SBS, Sick Building Syndrome***, has been updated and upgraded. The main causal agent of bioaerosol dissemination is the HVAC system and thus the old adage of ***SBS*** has been brought into the present and defined as HVAC (Heating, Ventilation and Air Conditioning) Syndrome© by this author. It can more appropriately be defined as, "***An indoor environmental condition where infectious pathogens live, flourish and contribute to unstable infection rates and respiratory distress. The main causal agent allowing this to happen is a contaminated HVAC system that was overlooked in the normal environmental assessment process***".