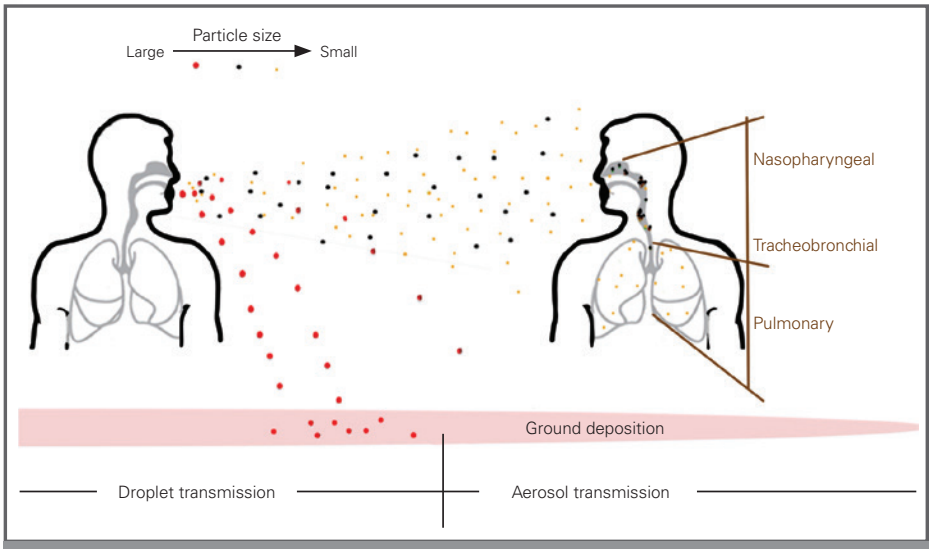
Needlepoint Bipolar Ionization (NPBI™) Turns Senior Living HVAC Systems into Powerful Tools for Pathogen Reduction

Senior Living healthcare-associated infections (HAIs), such as MRSA, C. diff, influenza and other viruses that cause respiratory infections, impact thousands of Long Term Care facilities across America every year. According to the U.S. Department of Health and Human Services, HAIs lead to $673 million a year in preventable healthcare costs.[1] Aerosol and droplet transmission of disease has been a challenge for Senior Living operators for decades and made even more consequential by SARS-CoV-2, the virus that causes COVID-19.

Senior Living Operators Need to Attack SARS-CoV-2 Where Residents Live and Interact

The CDC (NIOSH) completed a multi-year study of air samples and concluded that 42% to 53% of the influenza viral RNA was contained in respirable aerosolized particles less than 4 microns in aerodynamic diameter.[2,3,4] Based on data from the Society for Applied Microbiology and evidenced by the chart below, these small particles serve as an effective vehicle for transmission, capable of causing more severe and potentially fatal disease.[5]

Research published in the CDC's *Emerging Infectious Diseases Journal* indicates SARS-CoV-2 can survive in the air and remain suspended for up to 16 hours[6] and can be found as far as 15.75 feet away from COVID-19 carriers.[7] This means that residents and staff could continue to be exposed to the virus, even when maintaining physical distance from an infected person or when the infected person is no longer present, as evidenced by the CDC's evaluation of a superspreader event at a choir practice in Washington state.[8] In addition, the virus could be introduced by airflow to residents and staff in other areas of the building.



Smaller particles can potentially travel farther and be inhaled deeper into lungs.[5]

[1]"Chapter 8: Long-Term Care Facilities, Section B. Burden of HAIs in LTCFs." U.S. Department of Health and Human Services, National Action Plan to Prevent Health Care-Associated Infections: Road Map to Elimination, Apr. 2013, health.gov/sites/default/files/2019-09/hai-action-plan-ltcf.pdf.
[2]Blachere, FM, et al. "Measurement of Airborne Influenza Virus in a Hospital Emergency Department." Clinical Infectious Diseases: an Official Publication of the Infectious Diseases Society of America, U.S. National Library of Medicine, 15 Feb. 2009, pubmed.ncbi.nlm.nih.gov/19133798/.
[3]Lindsley, WG, et al. "Distribution of Airborne Influenza Virus and Respiratory Syncytial Virus in an Urgent Care Medical Clinic." Clinical Infectious Diseases: an Official Publication of the Infectious Diseases Society of America, U.S. National Library of Medicine, 1 Mar. 2010, pubmed.ncbi.nlm.nih.gov/20100093/.
[4]"CDC - Seasonal Flu in the Workplace - Activities: Transmission Research - Workplace Safety and Health Topic." Centers for Disease Control and Prevention, Centers for Disease Control and Prevention, 28 Mar. 2018, www.cdc.gov/niosh/topics/flu/transmission.html.
[5]Pan, M., et al. "Collection, Particle Sizing and Detection of Airborne Viruses." Society for Applied Microbiology, John Wiley & Sons, Ltd, 26 June 2019, sfamjournals.onlinelibrary.wiley.com/doi/full/10.1111/jam.14278.
[6]Fears A., Klimstra W., et al. "Persistence of Severe Acute Respiratory Syndrome Coronavirus 2 in Aerosol Suspensions - Volume 26, Number 9-September 2020 - Emerging Infectious Diseases Journal - CDC." Centers for Disease Control and Prevention, Centers for Disease Control and Prevention, Sept. 2020, wwwnc.cdc.gov/eid/article/26/9/20-1806_article.
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[8]Hamner L, Dubbel P, Capron I, et al. . "High SARS-CoV-2 Attack Rate Following Exposure at a Choir Practice - Skagit County, Washington, March 2020." Centers for Disease Control and Prevention, Centers for Disease Control and Prevention, 14 May 2020, www.cdc.gov/mmwr/volumes/69/wr/mm6919e6.htm?s_cid=mm6919e6_w.

HVAC Systems Can Reduce Exposure to HAIs

In a statement on airborne transmission of SARS-CoV-2, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) has discussed the importance of HVAC systems in reducing airborne exposures.[9] Any infection control measure that relies exclusively on filtration or purification of air in HVAC system ductwork could neglect a significant amount of aerosolized particles, potentially putting residents and staff at risk.

Reducing Exposure to Infections Depends on Combining Measures, Including the Installation of Ozone-Free[9] NPBI Technology

ASHRAE cautions: "even the most robust HVAC system cannot control all airflows and completely prevent dissemination of an infectious aerosol or disease transmission by droplets or aerosols."[10] This is why the consideration of HVAC upgrades must take the efficacy of other infection control measures into account and augment them. **With this in mind, all Senior Living buildings should immediately consider modifying their HVAC systems with a 3-pronged approach.**

1. **Increase outdoor air ventilation** as much as the system will allow without negatively impacting the temperature and humidity needed to keep residents safe and comfortable.
2. **Upgrade filtration** to MERV 13 or the highest level HVAC systems will allow based on size and/or pressure ratings achievable.
3. **Install NPBI** to enable existing HVAC systems to proactively reduce exposure to pathogens.

The Plasma Field Emitted by NPBI Installed in Existing Air Handlers Generates Billions of Ions to Purify the Air

Carbon fiber filaments, immune to corrosion, use electrodes to generate a plasma field filled with a high concentration of both positive and negative ions that react with airborne contaminants, including viruses. This method has been shown in the *Journal of Aerosol Science* to be more effective than competing monopolar systems[11] while also neutralizing static electricity.

NPBI devices are easily installed into all air handlers in HVAC systems and flood buildings with billions of ions. NPBI devices are designed to match the CFM of each air handler they are installed into. This ensures the proper ion density of 1,500 to 5,000 ions per cubic centimeter will be achieved in the spaces being served. For perspective, this is similar to levels of ionization that can be found in nature.[12]

[9]Certified UL2998 – fewer than five parts per billion of ozone emissions
[10]ASHRAE Position Document on Infectious Aerosols. The American Society of Heating, Refrigerating and Air-Conditioning Engineers, 14 Apr. 2020, www.ashrae.org/file%20library/about/position%20documents/pd_infectiousaerosols_2020.pdf.
[11]Hyun, Junho, et al. "Application of Corona Discharge-Generated Air Ions for Filtration of Aerosolized Virus and Inactivation of Filtered Virus." Journal of Aerosol Science, Pergamon, 11 Feb. 2017, www.sciencedirect.com/science/article/pii/S0021850216302798.
[12]Jiang, Shu-Ye, et al. "Negative Air Ions and Their Effects on Human Health and Air Quality Improvement." International Journal of Molecular Sciences, MDPI, 28 Sept. 2018, www.ncbi.nlm.nih.gov/pmc/articles/PMC6213340/

Several Invisible Contaminants Circulating through Air Are Addressed by NPBI

1. **Particulate Matter** – A paper published in the *Invertis Journal of Science & Technology* studied the efficacy of bipolar ionization and found NPBI reduces airborne particles (e.g., pollutants, dust, allergens, mold, bacteria and viruses) through agglomeration.[13] Ions attach to airborne particles and these particles are subsequently attracted to one another, effectively increasing their mass and size and forcing them to fall to the ground or be more easily captured by the air filtration system.

2. **Odors** – Volatile organic compounds (VOCs) are broken down into basic harmless compounds. NPBI breaks down 520 common gases with an Electron Volt (eV) Potential less than or equal to 12.[14]

3. **Organic Materials** – NPBI inactivates pathogens by creating positive and negative ions, which collide with these pathogens to disrupt their surface proteins. Independent laboratory testing confirmed this technology proven to inactivate common causes of HAIs, including norovirus, MRSA, E. coli, Staphylococcus and Legionella.[15] Most notably, the CAP-, CLIA- and AABB-certified laboratory Innovative Bioanalysis tested Global Plasma Solutions' NPBI technology on SARS-CoV-2 (the virus that causes COVID-19) and found it can inactivate up to 99.99% of the virus in 30 minutes.[16]

UL Study Found NPBI Ozone-Free and Issued 2998 Certification

In contrast to other kinds of bipolar ionization that emit ozone, such as corona discharge, the carbon fiber needlepoints used in NPBI were designed to use a low voltage that prevents them from interacting with oxygen. These needlepoints are able to limit ozone to less than 5 parts per billion (ppb) – well below ASHRAE's recommended level of 10 ppb.[17] NPBI from Global Plasma Solutions has earned UL certification 2998, confirming this claim.

HVAC Systems' Filtration Capabilities Are Upgraded with the Installation of NPBI

Filters with higher MERV ratings capture more particles, which is desirable, but filters with higher MERV ratings can also tax HVAC systems due to increased static pressure.[18] In fact, National Research Council Canada's "Field Evaluation of GPS Needlepoint Bipolar Ionization" found NPBI, when combined with a MERV 12 filter, removed as many 2.5 micron particles as a MERV 16 filter.[19]

In addition to more effectively removing particles from the air, NPBI reduces the need for preventive maintenance, since the ions are generated immediately prior to the coils. This means the coils are constantly showered with millions of ions resulting in no organic growth from mold, mildew or slime that requires cleaning and reduces efficiency.

[13]Mohammad, Seraj. "Managing and Monitoring Indoor Air Quality Using Bi-Polar Air Ionizer." Indian Journals, Invertis Journal of Science & Technology, 2019, https://www.indianjournals.com/ijor.aspx?target=ijor:ijst1&volume=12&issue=3&article=005.
[14]"Electron Volt (EV) Potential for Common Industrial Gases." Global Plasma Solutions, Electron Volt (eV) Potential for Common Industrial Gases, https://globalplasmasolutions.com/library/GP030-eV-Potential-Paper.pdf.
[15]"Reducing Airborne Virus." Global Plasma Solutions, 28 July 2020, globalplasmasolutions.com/pathogen-reduction/.
[16]Inactivation results based on sensitivity testing conducted by independent third-party testing laboratory using control chambers. Multiple data points are used to formulate performance validation statements. The technology is used in a wide range of applications across diverse environmental conditions. Results in non-lab environments will vary; clients should evaluate their individual application and environmental conditions when making an assessment regarding the technology's potential benefits. For all independent laboratory results, contact your TELS Representative. The use of this technology is not intended to take the place of reasonable precautions to prevent the transmission of pathogens (including COVID-19). Comply with all applicable public health laws and guidelines as well as CDC guidance.
[17]"Filtration/Disinfection: Ozone." The American Society of Heating, Refrigerating and Air-Conditioning Engineers, www.ashrae.org/technical-resources/filtration-disinfection#ozone.
[18]Bailes, Allison. "The Unintended Consequences of High-MERV Filters." Energy Vanguard, 9 Nov. 2018, www.energyvanguard.com/blog/unintended-consequences-high-merv-filters.
[19]Nilsson, Greg. "Field Evaluation of GPS Needlepoint Bipolar Ionization." 27 Mar. 2019.

Ionization Will Make Operators' Current PPE Investment More Effective

During the COVID-19 pandemic, the average Skilled Nursing Facility is spending $2,000 per month on masks alone. Part of this investment is rooted in filtering out potentially infectious particulates prior to being inhaled by a resident or staff member. Ionization can increase the efficacy of many forms of face coverings, including N95 and surgical masks. According to research from the Center for Health-Related Aerosol Studies at the University of Cincinnati, N95 mask effectiveness for very small particles was increased from 98% to almost 100%, and surgical mask effectiveness increased from 80% to 98%.[20]

NPBI is the Superior Option for Improving Indoor Air Quality

The benefits of NPBI are superior to many other HVAC enhancement alternatives and lead to a superior return on investment. NPBI will never require replacement parts and the only preventive maintenance is a simple annual cleaning. In contrast, other technologies, such as UV-C, photocatalytic oxidation and even older forms of bipolar ionization, all require periodic replacement parts. Further, NPBI goes beyond what most air purification technologies can do to address the three main kinds of contaminants that pollute indoor air: pathogens, particles and odors.

Considering the up-front costs are comparable and NPBI may augment other infection control measures such as PPE and filtration, NPBI will yield greater efficacy on all applicable fronts.

[20]Lee, B.U., Yermakov, M. and Grinshpun, S.A. (2005). Filtering Efficiency of N95- and R95-Type Facepiece Respirators, Dust-Mist Facepiece Respirators, and Surgical Masks Operating in Unipolarly Ionized Indoor Air Environments. *Aerosol Air Qual. Res.* 5: 25-38. https://doi.org/10.4209/aaqr.2005.06.0003