Understanding Environmental Considerations Before Executing an ICRA Protocol

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Contents

Overview

When looking at infection control in a healthcare setting, a holistic approach must be taken. Understanding the environment and pre-existing conditions as part of the protocol development and execution is vital to the success of the project and safety of patients and staff.

This piece seeks to address environmental considerations prior to the execution of an Infection Control Risk Assessment (ICRA) protocol in the areas of air control and air quality, negative vs. positive air pressure, proximity to potential areas of contamination, and testing and controls to ensure effective containment.

Managing Air Quality

Knowing the capabilities and balance of the HVAC system that serves the area where the activity is to be executed is crucial. Additionally, the areas and the activities conducted in the spaces above, below, and adjacent to the contained space must be understood. This includes the HVAC systems and system requirements of the adjacent areas. Exterior environmental factors must be considered and mitigated if possible.

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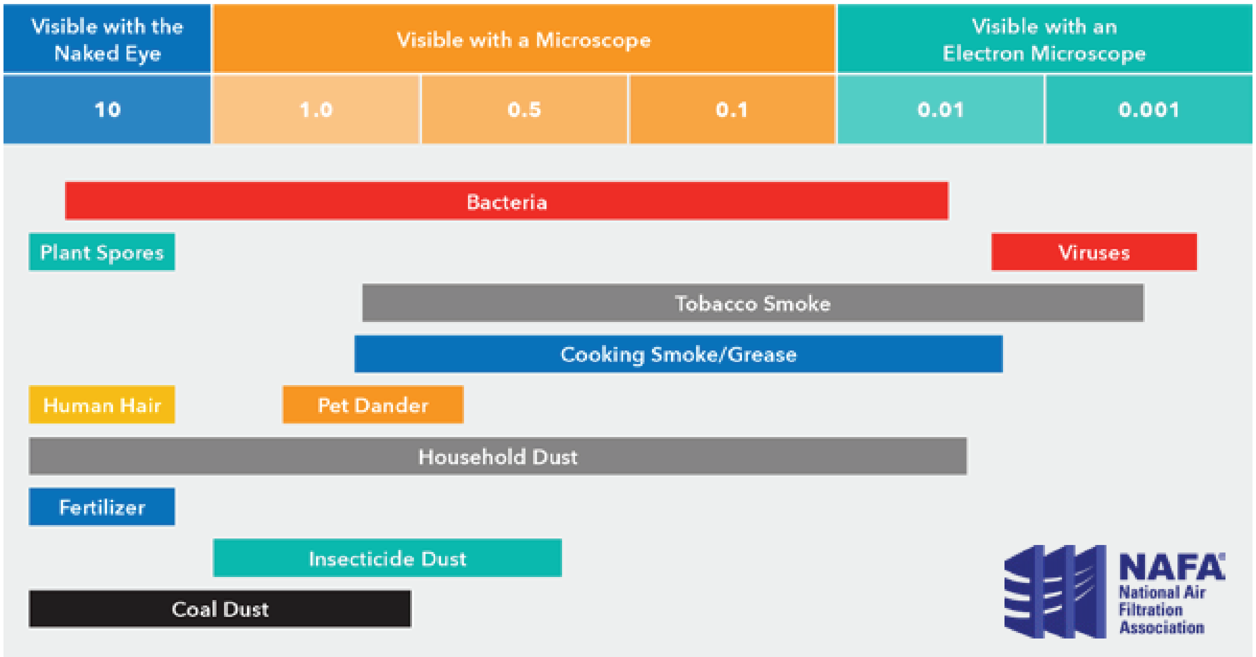
Filters within the air handling units (AHU) are rated using a Minimum Efficiency Reporting Value (MERV) that rates the effectiveness of the filter. MERV was developed by the American Society of Heating, Refrigeration and Air Conditioner Engineers (ASHRAE). MERV values vary from 1 to 16. The higher the MERV value is the more efficient the filter will be in trapping smaller and greater quantities of airborne particulate. Whatever the filtration level of the filters, they will only remove a given percentage of whatever the particulate load is within the air drawn into the system.

The volume of particulate in the air drawn through the filter will have a direct impact on the particulate load that will pass through that filter, and will be disbursed through the supply vents into the occupied space. Assuming there is MERV 12 filtration of the return/fresh makeup air, the filter will trap 80%-89% of airborne particles in the 1.0 - 3.0 micron size. For easy math, let's use 80%. If there are 1,000 particles per cubic liter (1.0 - 3.0 microns in size) drawn in with the return/fresh makeup air, then 200 of those particles that size and smaller will pass through the filter. Those particles will be

Particle Size in 100 Microns



evenly dispersed through the supply vents into the occupied space. Mold and bacteria predominantly fall into the 0.3 - 3.0 micron range, the particulate size range most important to containment. This is the size likely to be liberated and entrained in the air flow whenever the building envelope, plumbing, electrical,-mechanical systems, or finishes are disturbed. Humans don't begin to see particles with our naked eyes until the 10 micron size and larger.

Let's say there's a hospital room that a team is doing a finish remodel/refurb of. The project is going to take a week to a week and a half, and there will be negative air running 24/7. However, what if they don't think about the floor drain or the shower drain in the bathroom, or the sink traps. If water is not running through them for the entire duration of the construction, that water is going to evaporate and potentially become empty. Now, the negative pressure has changed because of the additional source of make up air and they're sucking sewage gas through the space.

Another scenario to consider is when everything is balanced, but then changes occur after the containment is up. For example, if you take out a ceiling tile in the construction zone after you've set your air pressure, the pressure changes and it needs to be rebalanced. Changes to the environment need to be considered beforehand. Part of the whole process is understanding the scope of work that is going to be done, the level of impact it's going to have as the scope of work progresses, and what happens when an action needs to take place that is going to affect the pressure, like removing a ceiling tile from the room.

Changes in the area volume must be accounted for and pre-planned before balancing the room and setting up the containment. It's an ever-changing formula that has to be monitored and addressed constantly throughout the work.

According to a study by Yale University, a human's presence in a room can add 37 million bacteria to the air every hour. Our very presence in that built environment has an ongoing negative contribution to the bioload that is present. For healthy people, exposure to the lower levels of airborne particulate has little impact. For immunocompromised patients, however, it can be lethal. Indoor airborne particulate levels will be greater during times of high activity, for example during doctor's rounds or visiting hours. The particulate load in the outside environment is constantly changing, as the outside air quality index indicates.

Whatever the particulate load is in the outdoor environment will have a direct percentage relationship with the indoor air quality. These and other influences are constantly changing the paradigm in that space.

The physical location of the hospital can play a significant role on the quality of the air being drawn into the building. For example, if a hospital is next to a highway or a busy traffic area, the air quality is going to change during rush hour, morning, and at night. Is there construction or excavation adjacent to the building, blasting happening underground, are there raging forest fires impacting the air quality? Whatever the particulate load is in the outdoor environment will have a direct percentage relationship with the indoor air quality. These and other influences are constantly changing the paradigm in that space. By monitoring the particulate at a given time and location outside the building and inside the air handling unit (AHU) zone impacted by the activity, you can determine and demonstrate that the HVAC system is functioning to the appropriate level of efficiency. It is important to establish this prior to the start of any activity related to the scope of work that is or will be dictated within the ICRA plan.

Managing Air Pressure

First know that you always want clean air to flow to dirty never the other way around.

Inside the containment, establish negative pressure to the area outside of our containment ensuring that there is always clean air flowing to the dirty area. The target range is between .02 -.04 inches of water column as read on the manometer or magnehelic gauge. The volume of air exhausted to create the negatively pressurized space (as compared to the area outside of the containment) must be calculated and the appropriate equipment installed to support it. Depending on what is adjacent to your containment, simply adding equipment to create negative pressure within the containment without knowing what impact that environmental change may have on the adjacent space, could be catastrophic.

For example, the emergency department is under negative pressure if the building is properly tested and balanced with the HVAC system. Negative pressure is keeping the dirty air from getting to the clean air, and because it is not known what is coming into the emergency department, the facility does not want the air to be positively pressured and pushing back into the rest of the hospital. The v System is pulling more air out of the space constantly than it's returning into the area. Labor and delivery rooms will be positively pressured because the facility doesn't want to pull dirty air into areas

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with patients most prone to complications from a hospital-acquired infection.

After gathering that information and verifying it along with all Interim Life Safety Measures (ILSM) required, the crew needs to understand what the pressure is in the space where the work will be performed, and how to obtain the correct amount of negative air flow. There may be an Environmental Services (EVS) trash/cleaning materials storage closet across from the containment. This closet is designed to be under negative pressure. However, if not measured and monitored, it is possible to install so much negative pressure within the containment, (requiring excessive makeup air from outside), that it over powers the low volume needed within the storage closet. Should this occur the EVS closet designed to pull odors, bacteria and germs out of the occupied space is now having all of that dirty air unintentionally pulled into the clean air.

Conclusion

What we are doing with containment and negative pressure is controlling particle size. Mold and bacteria can be dormant for years and still be viable and deadly to an immunocompromised patient. We don't want to tear out a ceiling or wall and release a bunch of viruses that could be lethal. We want to control all the particles that are in the size range of bacteria, fungi, and mold.

The whole goal with containment is to control that .3 micron to .9 micron size. Because that's the size range that the mold spores and the bacterial spores and organisms are going to be in.

What I can see isn't the problem. If it can be seen, it can be cleaned. It's the .3 to .5 micron range that can't be seen that encompasses all the pathogens that could potentially be liberating and exposing the census of the hospital. I don't care how dusty it is inside my containment, and I don't care what the rest of the hospital is. I care that the airborne particles in the .3 to .5 micron size outside my containment are equal to or less than the particles in the undisturbed areas served by the same AHU. If this is the case then I know that my containment strategy is working.

You need to monitor what's going on in the outside environment. Monitor daily how what's outside is influencing the inside environment, and then monitor outside of the containment to ensure that it's not elevated. It's that simple. You should know inside and out exactly what you're controlling.

It comes down to understanding the building, the systems, and the test and balance. Only then can you understand what impact your activity (from a containment standpoint) could have. These crucial details are often overlooked by those building and managing containment.

About the Author

Norris Gearhart is the President & CEO of Gearhart & Associates, LLC, a consulting firm with industry expertise in Infection Control Risk Assessment (ICRA) training, Infection Control and Prevention Strategies, and Facilities Risk Management. Norris has been involved with disaster response, mitigation, and restoration services since 1985 and holds multiple national and international certifications and professional designations. He provides technical consulting across the United States, Europe, Asia, Panama, Mexico, and Australia and served as an expert for testimony in numerous legal cases.