

100% OUTSIDE AIR IN HEALTHCARE: BALANCING PATIENT SAFETY WITH OPERATIONAL EFFICIENCY

As someone who frequently works with healthcare facilities nationwide, I've noticed a renewed interest in 100% outside air (OA) systems. This concept has been around for a long time but has been highlighted since the 2020 pandemic. Recently, I had the opportunity to discuss this topic with three of our BSA mechanical engineers from different climate regions, and their insights revealed the complex relationship between patient safety and operational efficiency in healthcare ventilation.

The concept behind 100% outside air is straightforward: bring in fresh air from outside rather than recirculating indoor air. This approach initially gained momentum because outdoor air typically contains fewer pathogens and volatile organic compounds than indoor air, making it particularly appealing for critical care areas like operating rooms.

What fascinates me is how regional differences affect implementation. Regional differences affect system design, you do not have to be an HVAC engineer to understand that, but that gets amplified when discussing 100% OA. In any climate, running 100% outside air systems can skyrocket energy costs compared to traditional systems that use 20-30% outside air—however, the discussion changes when you consider Florida's humidity versus Colorado's relative dryness.

The cooling demands in Florida are enormous, requiring larger equipment to accommodate peak loads. Not only are there high peaks, but the load is consistently elevated and more often uses more energy to drop moisture out of the air. The good thing is that there is no need for preheating or adding humidification to meet the required relative humidity in spaces per ASHRAE 170. Denver is dry, so the lower latent load makes a big difference in the summer but consistently provides a humidification challenge. Meanwhile, facilities in the Midwest get the worst of both worlds (or best, if you are an "I love the seasons" person). They must humidify and heat the air in dry, cold winters, then dehumidify and cool in warm, humid summers. This dual requirement adds complexity to system design and operation, especially when considering the resiliency required for critical buildings.

The COVID-19 pandemic brought ventilation strategies into sharp focus. Many facilities implemented what became known as "pandemic mode" – temporarily converting specific areas to 100% outside air operation. This takes much more planning and consideration than most owners expect. Existing facilities have many constraints due to the systems not being designed to do this. As stated previously, it was not the industry norm, but 2020 reintroduced its importance across the globe. New facilities in design face challenges, too; how much

do you oversize to make “pandemic mode” work? It is cost-prohibitive to size an entire hospital; emergency departments are priority ones, but I recommend considering having a patient floor or two to make that switch as well. Up-front conversations with owners on expectations are a must. These challenges on both existing and new are a testament to how healthcare design is consistently changing and engineering solutions are needed to adapt to those needs.

Maintenance considerations have proven more intricate than many initially assumed. Conversations with our engineers taught me about a hospital that discovered their air intake location near a kitchen exhaust that created odor issues throughout multiple wings. The intake was far enough for code, but it created an issue with prevalent winds and increased outdoor air intake. They solved this through specialized carbon filtration systems, but it highlighted the importance of careful planning in intake placement. Similar challenges arise from proximity to helicopter pads or even in regions affected by wildfires. The smoke and contaminants can carry miles.

The future of healthcare ventilation excites me. I’m seeing the emergence of advanced control systems incorporating artificial intelligence to optimize equipment operation. Some facilities are exploring chilled beams, which use water instead of air as the primary cooling medium, potentially reducing energy consumption significantly. There are still requirements for total air changes and outdoor air changes to meet. The conversation on what the owner is comfortable with is crucial. There are many stakeholders, such as patients, maintenance, infection prevention, and clinicians, and they all can be affected in different ways by their choices.

Air quality monitoring systems represent another promising development. Instead of constantly running 100% outside air, these systems could automatically adjust outside air levels based on detected contaminants. This creates an opportunity for energy savings while maintaining safety standards. Additionally, I have seen an uptick in our clients’ standard minimum filtration levels. They are often willing to discuss going above and beyond code minimum. UV light and

other pathogen-reduction technologies are showing promise as complementary solutions that could provide additional protection while reducing the need for constant maximum outside air intake.

I’ve learned from these discussions that successful implementation requires balancing multiple factors. Patient safety remains paramount, but the conversation must include energy efficiency, maintenance capabilities, regional climate considerations, costs, and risks. While 100% outside air systems provide excellent protection against pathogen transmission, each healthcare facility must carefully evaluate its specific needs and capabilities. This article is not intended to indicate that 100% outside air is the only path.

Many healthcare administrators view the increased energy costs not as a penalty, but as an investment in patient safety. A local client of ours with a hospital that uses all 100% OA systems with energy recovery believes it performed significantly better than others in keeping patients safe during the pandemic. This perspective shift is crucial, and data sharing can help everyone understand – it’s not just about managing expenses, but about determining what best serves the facility’s mission of patient care.

As we continue to evolve our approach to healthcare ventilation, the key lies in finding the sweet spot between protection and practicality. That is only done with early conversations with all stakeholders and the right expertise. The lessons learned during the pandemic, combined with emerging technologies, are shaping more sophisticated and adaptable solutions. While 100% outside air remains an important tool in our arsenal, its implementation must be thoughtfully tailored to each facility’s unique circumstances, and I am always excited to work through the next challenging solution.



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