VIEWPOINT

Safe Air in Schools

Maintaining indoor air quality has gained renewed importance as K–12 students around the country prepare to return to in-person learning full time.

It's one of the timeliest, most important methods of keeping learning environments safe as the COVID pandemic winds down. And the more we learn, the more we refine and revise what we thought we knew.

Our guest today is Scott Huffmaster, a health spaces expert at Trane Technologies, Inc. He oversees the improvement of indoor air quality for commercial spaces from schools to office buildings. He's here to tell us a little more about the steps that schools can take to create a clean, safe environment for teachers, students and staff.

This interview originally took place on the *Schools in Focus* Podcast. If you prefer to listen to the interview, Click Here for that episode.

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S4L: Can you tell us a little bit about yourself, your professional background and what you do now?

Scott Huffmaster: Sure. So, I earned my bachelor's degree in electrical engineering from University of Texas, graduated back in 2002. Been in this industry since then; actually, started my career at another company. Spent about four years with Johnson Controls. And for the last 15 years, I've been with Trane Technologies.

My role at Trane initially was in a sales role—about the first half of my career—and I've been in different leadership positions for the last seven years. Most recently, for my current role, I actually managed four offices for Trane in South Texas: Austin, San Antonio, Corpus Christi, and Rio Grande Valley. In December, actually moved into this role I'm in today, which was a new role that was created. The role is as the Commercial HVAC Leader for Indoor Air Quality for North America. So, I have responsibility for United States and Canada, with a focus on indoor air quality and healthy spaces.

And have you been doing a lot of different stuff around the country for different schools? Or are you mainly focused on a certain region?

Absolutely. Everywhere from the northeast, to Florida, to Texas, to California, to Hawaii—really, across the board. Looking at schools now, today, the states are receiving a bit more focus due to stimulus dollars that have come out. However, there's still a need, even in Canada, as well. So, we do have an opportunity to work with teams there, as well.

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Looking at some notes that we had put together, there were two projects that I wanted to talk about. One of them was from the Austin Independent School District, and one was the Adams 14 School District in Denver. But before we jump into those, kind of, two specific case studies or examples, I wanted to talk a little bit more generally about kind of what you've been doing and what you look for. What are some specific measures that can be followed for proper ventilation and airflow in schools?

Yeah, I think what you'll find is, each school really has its unique needs, depending on what type of system that they have, what technologies they've used, age of the facility, location. So for us, when we're looking at working with the customer—working with the school district, consulting engineer that supports a school district, a servicing contractor, you name it—the big thing we want to do is really evaluate the building before we promote or recommend a solution or a specific technology. That is one of the biggest challenges here: There are so many different challenges to making those spaces safer and healthier. There's not a one-size-fits-all. I think we all wish that there was, but I will tell you there's not. What you might need to do where I live in Austin, Texas, could look very different than what you might need to do in Chicago, Illinois, for instance.

Even inside a specific climate, what you need to do, again, where I live in Austin, could be very different on a high school with a chilled water system than it might be on a middle school with a variable refrigerant flow system, versus an elementary school with a DX rooftop system. So, there's so many different system types, so many different locations, age of systems, condition, maintenance levels, deferred maintenance challenges, it's really not one-size-fits-all—other than developing a plan and working with a professional to come up with a plan on how to address and improve that facility.

In Austin—looking at the Austin project specifically—it said you completed an indoor air quality assessment before getting started with recommendations and the work. That indoor air quality assessment, is that kind of your first step on whatever project you tackle, wherever you are?

Oh, absolutely. So, now, I have a little bit extra motivation when we talk about Austin ISD. My elder daughter actually goes to elementary school with Austin ISD. We, as a company, were blessed with the opportunity to work with Austin ISD to help them develop their plan for reopening and be a part of evaluating the actions that they might take. As we started those discussions this past fall, one of the things that came up was the challenge I mentioned earlier: different-age facilities, different system types, different building uses. What was decided was to do preliminary assessments on four different schools; we looked at two high schools, one middle school, and one elementary school. We looked at older facilities and newer facilities; four different buildings, three different typical uses, again, with elementary, middle and high school. And what we found were areas for improvement and needs really varied by system type, as we expected going in. As a part of that process, we helped to provide recommendations to Austin ISD on actions that they could take on their own behalf, did not require Trane to take those actions; we're, again, helping them develop their

plan. And now we're in discussion with them about potentially expanding that program, to look at additional schools, as they're evaluating ways to utilize stimulus dollars that have been allotted to Austin ISD.

When you look at a handful of schools, do you worry that the two or three or four schools that you pick at the beginning aren't necessarily representative of everything in the district?

Well, again, the purpose of that is not to solve every building at once with just a sample size. The purpose is to help identify potential action, to help identify potential budget needs, to build a program. Again, as you look at the challenges our schools are facing today around stimulus dollars, there are a lot of different ways that schools can utilize those funds. There's a lot of different needs that schools are facing, whether that be teacher funding, learning loss, connectivity, remote learning—those things haven't gone away today; many schools are still not back in person. So, what I would say to that is, if we work collaboratively with our customer, we can usually get in a feasible range of budgeting a program by picking a sample set. You know, I recommend looking, again, at different building types. Again, whether that's elementary, middle and high school separately. Also, don't only look at your old facilities; that may lead to more budget than you may need. Don't only look at your new buildings; that could lead to not as much budget as you may need. You know, just try and come up with a good sample set. And hopefully that can get a school within 5 to 10 percent of what their budget needs will be versus 30 to 40 percent, plus or minus, of where they may end up needing to achieve their goal.

The indoor air quality assessment looks like it focuses on four critical areas of indoor air quality. Can you tell us a little more about each of those and maybe a couple specific examples of each of those in a given school or a given assessment?

Sure. So, when we look at indoor air quality, there are four critical pillars. And this is something that comes from ASHRAE. ASHRAE, American Society of Heating, Refrigerating and Air-Conditioning Engineers, that is a governing organization for our industry to help us follow the correct standards and make the right decisions. Those four key pillars are dilute, exhaust, contain and clean. And they're all important in different ways.

When you look at dilute and exhaust, I many times tie those two together. Because essentially, if you're exhausting air, you're going to be diluting; if you're adding additional dilution, you'll be doing more exhaust, but there is some specifics on how the two are controlled separately. Dilution is really about the concept of bringing in more outside air, more clean air, to a space. It is quite possibly the best strategy you could have. However, there can be cost concerns to that in certain climates, with certain systems. Sometimes it's less feasible because your building wasn't built to handle the additional outside air that some of the recent guidance has asked for us to provide.

When you look at exhaust, you're really looking at getting bad air out of your building. ASHRAE recommends keeping your restroom exhaust fans running 24/7, as an example—get that bad air out of the building.

The other two pillars: "Contain" is one that can very much be impacted by the dilution pillar. The contain pillar is around maintaining proper humidity levels inside the space. And why is that important? Studies show that if humidity levels drop below 40 percent, we can see things like an airborne virus pathogen. The rates of transmission can increase dramatically. This is why we have the term "flu season" in the fall and the winter. When humidity levels drop, aerosol viruses spread much easier. So, if we do something like bring in a lot of outside air in a dry climate, we could be solving or making things better by having more outside air, yet creating a different problem—that now the space becomes more dry than is designed to be, and that leads to easier aerosolization of an airborne virus. So you really have to look at it holistically. If you're going to do more dilution, you need to make sure you're not going to cause an issue in your contain pillar.

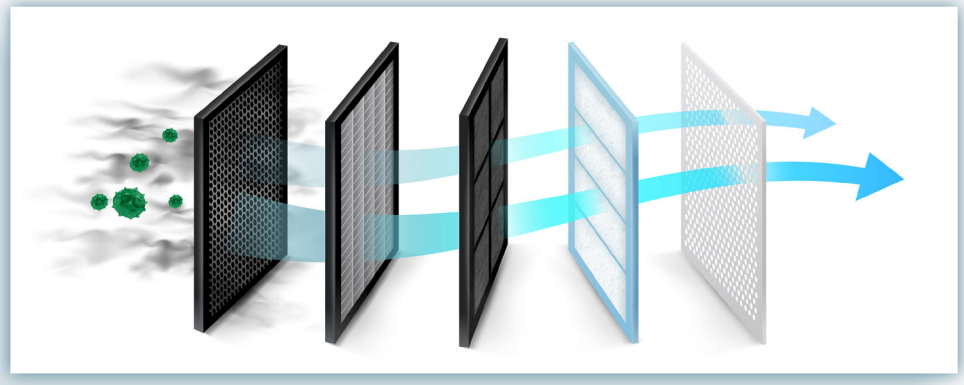
The fourth, which is probably the one that leads to the most debate, but it's also the one that's had the most research—really, a tremendous development in the past year during the pandemic—is the clean pillar. So, what do we do to make sure the air is clean? If we clean the air, does it have to come from outside? Well, it depends. If we have enough outside air, then if we do a good job of cleaning our return air, we don't necessarily need more air from outside.

How do we do that? ASHRAE recommends, as does Trane, that you achieve a target of a minimum MERV 13 filter for your system. This is an improvement over previous requirements of, at minimum, a MERV 8 filter for any system that causes condensate. Essentially, any system that does cooling needed a MERV 8 filter in the past. Now, we're asking to get to at least a MERV 13.

ASHRAE also acknowledges, as does Trane, that some systems are not designed to handle that higher filtration. For this reason, at times, we need to look at other technologies that can deliver effective MERV 13 or better. ASHRAE's primary recommendation is around utilization of UV lighting, what's called UVGI, as an additional technology to deliver effective MERV 13 or better. There's also recommendations in the industry around technologies such as bipolar ionization, photocatalytic oxidation, etc., that can do a strong job of actually cleaning the air that's being delivered to the space.

Now for Trane, we also look at additional technologies that can impact the space itself. And what do I mean there? It's one thing to provide clean air as it comes through ductwork and reaches a space. It's another thing to actually have a safe cleaning agent that is in the zone that we're in, in the air that we breathe. There's a new technology—I call it new, it's become more prevalent, obviously, due to the pandemic, but it's been around for over a decade—called dry hydrogen peroxide, that allows a system to put a molecule, a dry gas phase hydrogen peroxide molecule, in the active zone that will actually attack that bad air as we breathe it out.

Now, we'll have people say, "Hey, is that safe? I'm breathing in these hydrogen peroxide molecules." Studies have shown that the technology that's used is safe; the way that we've tested it, and the way we would implement it, is considerably under limits for exposure. We actually have hydrogen peroxide in our lungs as we breathe as it is today. So, we believe that can be one of the best technologies to really impact the clean pillar.



Now that technology is specifically—you mentioned, in Denver, Adams 14 School District. That is the technology that that school district decided to implement because it gave them a way to take very quick action. We used a portable dry hydrogen generator in 427 locations throughout the district. And that allowed them to essentially get a device, install it, plug it in the wall. Did not require the redesign, ordering new equipment that could take months to manufacture and install. Allowed a much quicker action for that school. I do believe they still have an intent to make HVAC central system upgrades, but a big piece for them was to implement a technology that could be implemented quickly. And that's why they chose the dry hydrogen.

Looking at some of these different technologies—the dry hydrogen peroxide, the bipolar ionization, UV light—how feasible are some of these different options? Because it looks like some of the technology is new. I know that in the last year, with the pandemic, clean air has kind of suddenly become a lot bigger issue. It's not that it wasn't important before, but right now, it's the main focus. And so how feasible is it for some kind of random average school district to be able to take advantage of some of these new technologies? And just in terms of cost, or just the logistics involved with manufacturing and stuff like that, as you talked about, is one that's better than another?

Well, again, I think that's where you've got to look at the application before you can really answer that. I like to compare improving a building's health the same way you would look at improving a person's health. Again, when I think of health, I think of a human being first. If you, as a human being, wanted to be healthier, would you go and buy a medication before you knew that that's the medication you needed? Now, most of us would say no. What we start with is going to the doctor. The doctor, you know, runs our blood pressure, does bloodwork, does other things, gives us an exam. Based on the information they find, they may prescribe a medication to make us healthier; they may ask us to change behavior, eat different things, work out

more, whatever that may be.

It works the same way for building health. You know, that's where assessing the space, assessing the building, is the first piece. And then determining, is an upgraded filter the best approach? Is a UV light the best approach? Is a bipolar ionizer the best approach? Maybe it's dry hydrogen peroxide. We have looked at facilities where our recommendations have included all four things I just mentioned. We worked with customers where we've recommended filter upgrades for certain spaces, UV lights in others, ionizers in others, and dry hydrogen in others. I would not say that there is a single technology that stands above another. I would continue to reinforce: Work with a professional, whether it's Trane, a professional engineer, a competitor of ours that you believe can deliver, to really help diagnose your building—diagnose your situation—before you go and pick a technology.

Can you give a quick layperson-type explanation of how you know which technology is right for which space?

Different technologies have different strengths and different weaknesses for application. As an example, I'll point out our position on bipolar ionization. In our recent testing that was performed in fall of 2020—and again, this testing was done to really prove out efficacy versus an airborne pathogen, a requirement of the CDC's recent guidance, where we can show we've tested in an as-used condition. What we determined was to prove efficacy, we needed to have measurable ion intensity in a zone, and that is very much achievable with certain system types. Where we can get a device close enough to the active space, we can get enough airflow, we can have active ion concentration measurable in the breathing zone. That will cause agglomeration to remove a pathogen out of the air, thus reducing the chance of transmitting an airborne pathogen.

Now, in the same scenario, if you have a very large space—let's say you have 60–80-foot ceilings, you have a very long duct run from a central-station air-handling unit—those applications can be very difficult to get the ion concentration that would align with our testing result as an actual condition in the zone. For a large-volume space, we typically look at potentially other technologies, like improved filtration, like UV lighting, like photocatalytic oxidation, that have very strong efficacy for cleaning the air that's coming to that large space. In the same regard, if you have, you know, a rooftop unit on a classroom, you've got a 10-foot ceiling, you've got a short duct run, ionization could work very well because you can get ion intensity in the zone. The cost is typically less than putting in UV lights or upgrading your fan motor. To get to MERV 13 filters—again, depends on your building type, depends on your system type, as to what technology is going to be the best technology, from not just an efficacy standpoint, but an investment and a maintenance standpoint.

Once a new technology has been installed, and once it's kind of up and running, once it's been going for a month or two, is there anything that school officials, principals or maintenance workers or whatever, can do to keep an eye on it, to make sure it's working, to kind of maintain it?

Yes, absolutely. And that's, again, that's part of the program is, as you look at a technology potentially you're less used to, or you made another modification to your system to upgrade, improve it, make your building healthier, safer, you need to understand how to maintain those products. The maintenance schedule for the different offerings can be very different. How you prove efficacy for the different solutions can be different. Again, if you used efficacy for a filtration system, you're going to look at particulates in a space. If you're looking at efficacy for an ionizer, you're looking at ion concentration in a zone. If you're looking at efficacy for a photocatalytic system, you might look at VOC, something like that. So, there are different markers to help determine whether a system is working.

And thankfully, there are a lot of new sensors on the market, even some that have a lot of time on the market to help determine, "Are your systems working?" This is where Trane has actually partnered with some pretty big manufacturers and partnerships we're very proud of—one being Aircuity. Aircuity is a company that provides really a comprehensive indoor air quality monitoring system. It is a solution that can integrate with the Trane control system or another third party. That data really provides that visibility to help us make the right decisions on what's going on in a space.

We have another partnership, a company named Awair, that provides more of a point solution, a smaller-investment solution, to provide visibility to things that again, historically, we didn't look at. Historically, we looked at temperature, maybe humidity, maybe CO2. But now people want to look at things like VOC levels, particulate matter in the space. And both of those manufacturers—Aircuity and Awair—provide the ability to allow visibility to those technologies.

Circling back a little bit, can you tell us a little bit more about your work with the Adams 14 School District in Denver?

Adams 14 is an example of working collaboratively with a school system to understand what their goals are, to provide open feedback on how they can develop their plan for improving the safety of their district, phasing in their plan. You know, the early phase being utilizing dry hydrogen peroxide. We work with a company named Synexis to provide dry hydrogen peroxide that can really make those spaces safer. And this is something that they implemented as their early phase and put one in every single classroom. Working with them on future phases as they have additional stimulus dollars, they're looking at older systems, deferred maintenance upgrades for HVAC systems and control systems, to really bring their buildings up in ability.

As teachers and students go back to school, is there anything that those ground-level employees can do or be aware of? Do you have any kind of general advice for education professionals, teachers, students that they can do to make the environment just a little bit safer?

I think it's important that administrators communicate their plan and their action so that, at a minimum, the teachers—certainly students as possible—understand what's being done. I'll give an example: One action that a school might take would be to put an in-room, air-cleaning device in place. Most instances, those devices are going to make a little bit of noise; they have a fan built into them to provide that active air cleaning. Heard a lot of stories where teachers don't really like to deal with the noise coming from the device, and then they'll go unplug it. If your intent was to have a healthier space, and an intervention happens from a teacher or student, or someone unplugs the device—well, now it's not working anymore. We advise to keep on a mask when we're indoors to maintain six-foot distancing. You know, in today's climate, we advise to make sure your systems are continuing to function. Make sure those in the spaces allow those systems to do their job.

You said that your daughter attends an elementary school in the Austin Independent School District, where you did some work. Does that dual perspective as a parent and a professional affect how you've been evaluating schools and getting them ready to reopen?

Yeah, I mean, obviously, the work we do has always been very important for me. With my daughter being at times a remote

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student to now back in person, this has become much more real and more tangible for me. Really a lot of pride, on my side, to be a part of the solution. Makes me feel good to be a part of the work that's going to help get kids back in the classroom and help families. Not just my own—my neighbors, people I know, and people that work for us are very proud to be a part of the solution.

If there's one statement I would make around this entire challenge that we face: Work with a professional to help you develop a plan. Work with someone that can bring that knowledge to develop a plan that's going to achieve your goals. The other thing I would say is: This is a generational opportunity with the stimulus funding that has been approved for schools. We have an opportunity to do something that will allow us to invest in our indoor air quality, versus spend. And what do I mean? We can use stimulus dollars to make our buildings safer, healthier, and we can do it in a way that will save on energy in the future, it will save on maintenance costs in the future. And when we save on energy, that also means we're reducing greenhouse gas emissions coming out of our power plants that serve our electrical grid. We have an opportunity here to really make a change in the world as we invest in our infrastructure for education. And I really hope to see our customers, to see the schools, really make those intelligent decisions.

Do you have any other projects lined up next?

More than we can count, I guess I would say. Pretty much every school in the country has some level of stimulus that they're needing to evaluate how they utilize. And so, the opportunity here is great.

What are some trends that you've seen in the technologies related to the pandemic that have been coming out?

Yeah, so generally, we've seen really a lot of confusion in the market. How do we meet CDC guidelines? ASHRAE guidelines? Those guidelines have changed. Early in the pandemic, we didn't need masks. Then we did. Then we didn't. Kind of the same thing has happened with guidelines from CDC and ASHRAE: Go 100-percent outside air. You don't need to go 100-percent outside air. And so that's one of the challenges we've seen, is the guidelines have consistently been moving. We're trying to help make sure that we are keeping up-to-date, and helping our customers stay up-to-date, on those latest guidelines.

Also, obviously, we've seen the role of indoor air quality, the focus on that, increase considerably. As we learn that this pathogen spreads less likely off of surfaces and more likely through the air, that's led to a big shift in focus. Not unusual to see policies in place not shift as fast as the science. As an example, we still see a lot of spend on surface-cleaning, hand-washing, things like that. I'm not suggesting that we shouldn't be washing our hands, that we shouldn't have clean surfaces. Please don't mistake. But when our focus is, "Where do we invest on reducing an airborne pathogen?", that investment should be on safer air first. And that's not always been the case in what we've seen. Again, many that are keeping up with the latest science have seen that air quality is becoming a bigger issue. And so we have seen, you know, a lot of interest on improving indoor air.

The other trend I would say is indoor air quality assessments. Again, you know, mentioned earlier Trane's involvement in that with several customers, including where my daughter goes to school with Austin ISD. Purpose of that: really develop that holistic approach with the customer to achieve their goals. It's really about taking that comprehensive audit, looking at the entire system, not just the component. Develop a holistic approach for how you want to upgrade your building. I would say those are the biggest trends we're seeing today: confusion, consistent change, and update of policies. And customers are recognizing the need to involve professionals to help them make the right decisions.

Kind of at the broadest level, the work that you did in Austin and Denver, how can those set an example for other schools moving forward?

At the broadest level, I would say the example is to work collaboratively to develop a solution.

Is there anything else that you wanted to address before we wrap up for the day?

Yeah, again, I would say, you know, this continues to move. We all know this continues to move. I really appreciate the opportunity to be a part of this podcast and share the latest and greatest. You know, what we say in June of 2021 might be a little bit different. We're continuing to learn. We're here about a year-plus into learning. And so, just understand: We're going to continue to learn. We're going to continue to improve. I will also say, you know, for anyone that wants to maybe hear from me again, I will be involved in Trane Technologies' Healthy Spaces podcast. That is something else that we offer, and that's something you can look up. Google it, you'll find it. You can hear from me again in the future. ■