Eric Schiff:

Well, so good day to all of our listeners and welcome to this research and technology forum. I am Eric Shift, director of the New York State Center of Excellence in Environmental and Energy systems. Today's webinar is about reducing COVID-19 infections in classrooms and related places, such as offices. In particular, we will be talking with two experts about how to avoid airborne infections. These are the ones that come from breathing in the same area an infected person in the room is breathing.

Eric Schiff:

Airborne transmission of COVID-19 is now widely accepted by experts after some early confusion. At the end of today's program, we will be taking questions from you, our listeners. So please send these in using the chat option during the program. Today we won't be talking much about two of the best ways of reducing infection in classrooms and other places, which are keeping infected people away from the classroom and also careful masking. Instead, we will be talking about the relatively unusual occasion when a highly contagious person without symptoms enters the room.

Eric Schiff:

We can reduce the subsequent spread of infections by the two main tactics. We can either purify the air that's in the room or we can replace it with clean air from ventilation systems or windows. We will be speaking first with Vinny Lobdell, Jr. Among other responsibilities, he is the president of the Health Way family of brands. Health Way employer up in Pulaski, New York in manufacturing extensive line of products for filtering air. These include portable air purifiers which are one of the tools that schools and companies can use to remove COVID-19 virus particles from the air.

Eric Schiff:

So, Vinny, your company is a major manufacturer of these purifiers and related products. Can you just sort of introduce your company's products and the role used for C4 in reducing the spread of COVID-19 infections?

Vinny Lobdell:

Sure, thank you for having me on, and thank you everyone for joining us today. For the last 40 years, Healthway is really been at the fore front of air cleaning, really, solutions based focus, not really technology based focus. We've developed and engineered a range of air cleaning technologies and solutions to really address any indoor air quality issues. So, whether it is a portable air cleaner or whether it's a large engineered solution, we've modularized air cleaning technology to really look at it from a holistic stand point.

Vinny Lobdell:

How do we develop a solution for the space not necessarily a product? As relates through our role, we've been working in the commercial air cleaning space for several years. Pre-COVID, the commercial air cleaning space wasn't really a growing space and now as we look at this virus and how it's impacting people getting to back to work in school, we've deployed our technology across the board at the UAE ministry of health, some of the top facilities, New York city health and hospital, the FDNY, and most recently the New York city public school system. We provided a range of portable solutions in New York to public schools and, again total integrated solutions to provide a true solution to the air pollution issue that we're facing today.

Eric Schiff:

Okay, thanks very much for that introduction. I'd like to ask some questions from a classroom teacher's perspective. Let's just start with an old fashion classroom with just radiators and windows, so New York City special, and assume that a student, asymptomatic, no symptoms, but infected and breathing out virus, he's in the class and some virus laden air is escaping the mask that the student is wearing. I'm going to guess that you'd be recommending installing a portable air purifier in this otherwise closed off room. First of all though, how do you know that air purifiers are effective at getting rid of COVID virus particles in the air?

Vinny Lobdell:

Well, we always tell people that during an outbreak of a new virus like COVID-19 there's really no product that exists on the market that can make a claim specifically to kill or capture the virus. This is really due to the simple fact that the virus isn't really available to test and it can take up to one year to get a viral claim approved by a regulatory agency. However, the US has enacted a hierarchy based policy which basically means that if a company's product has been found to be effective against harder to kill or capture viruses, surrogate or a proxy, that it's likely to kill or capture a virus like SARS COVID 2. We recommend doing your research and finding products that have been tested to demonstrate the removal of a similar sized virus over three intervals of 24 hours. And the key to that is to really understand that there's no re introduction of the virus back in the space and that's why you do 24 hour testing. We want to make sure that we're capturing and we're permanently removing, that's why filtration is so important, we're permanently removing that virus from the breathing zone.

Eric Schiff:

Okay. I know your company manufactures a wide variety of products. How would you go about recommending the size of a purifier you'd put in a classroom?

Vinny Lobdell:

Well, we manufacture, again, from very small air cleaners to large capacity systems. I think this creates a unique challenge in the educational space because we don't want to be counter intuitive or counterproductive to the learning environment. What happens here nowadays is we want a system that obviously going to recirculate and exchange the air as many times as possible. The more times you exchange the air, the more effective an air cleaning unit is going to be. However, it has to be conducive to the learning environment, quiet enough for that learning space. Right now what we're doing, depending on the size of the space, we're deploying two machines if one machine is too loud for a typical classroom environment. It really goes to understanding the space. It's not just a one size fits all solution. What size is the space? How does the product work in that environment to create a good air change rate and reduce the particle load in the space?

Eric Schiff:

Okay. You mentioned that one solution to keeping the air purifier silent enough would be to have, I guess, two units running at a lower rate as opposed to one larger and presumably noisier unit. Would it make much difference where you put the purifier or, in this case, a couple of purifiers in the room?

Vinny Lobdell:

It does make a difference. We think that centrally locating purifiers in the classroom setting with no obstructions within two to three feet of the machine are crucial. That's ideal for maximum air

exchanges. We also want to make sure that the flow patterns, and I think this is something that Jensen will talk about, the expert in that space, is that the flow patterns maximize mixing of air in the classroom environment. That's really crucial, depending on whether the windows are open or not open you want to make sure that the machines are centrally located in between the occupant and the open window to ensure that we're capturing as much micro droplets as possible.

Eric Schiff:

Let me just follow up quickly on that comment. Does it make sense to run a purifier if the windows are open?

Vinny Lobdell:

A lot of research on this, but I think essentially what's happening is when you open a window you're bringing in a lot of fresh air from the outside. We always tell people a really simple thing, a laymen thing the teacher can do or an administrator can do is check the AQI on your weather app to make sure the outside air quality is healthy. A lot of the time you can bring in a substantial amount of pollution by opening a window. But dealing with COVID specifically, obviously what we're trying to do is flush the space and bring in as much fresh air as possible. When you're doing that, the science basically has gone back to strategically locating that purifier in between as close to the student and the window. What's going to happen with that ventilation is you're going to get some of the ventilation out the window but also some micro droplets pulled into that machine. In a COVID case, that's what we would recommend is driving that machine as close to the occupant as possible and then also the ventilation is going to be extracting pollution from the environment.

Eric Schiff:

Okay. Now I'd like to push on to more modern classrooms. These usually have what's called forced air ventilation, which means there's a system like in most people's houses with a fan that draws air out of the rooms through a register and then blows new air back into the rooms through a different register. Can you explain where the air being blown into the room comes from?

Vinny Lobdell:

Yeah, so the air being blown into the classroom generally comes from a central air handling system. This system's mixing return air from all classrooms with outside air and it's basically redistributing that throughout the building.

Eric Schiff:

I see. Okay. Now, forced air systems already purify air to some degree. When would you recommend on top of the forced air system putting in an additional purifier, portable purifier into a classroom?

Vinny Lobdell:

Honestly speaking I think that right now traditional forced air systems have been designed to heat and cool. There hasn't been a lot of emphasis on filtration. So the filtration deployed in most of these systems have been set up to protect the health and integrity of the HVAC system, not the building occupant. I think that's what you're going to see a major shift. I think this is really going to raise all shifts here because now the manufacturers of these machines are really going to have to start focusing on how we have a system that can really deploy high efficiency filtration systems. We recommend increasing the HVAC filtration to the highest level MERV rating. A standard MERV 13 filter, if you just

look at the charts, is only capturing 30-50% of small particles. Installing air cleaners with a proven total system efficiency of HEPA or higher, and HEPA does a great job, will significantly reduce the ultra fine particle load in the space. We also feel... And it will also give you additional air change support to reduce the likelihood of cross contamination.

Vinny Lobdell:

Also, what we've found in a lot of schools that we visited is a lot of times there's modification and construction or reconfiguration of classrooms. When this happens, part of the space could not be ventilated properly so we recommend adding additional standalone air cleaning to those environments where they may not be traditionally laid out as the mechanical engineers or designers originally anticipated. We see that happening often in spaces where they really don't get into a cap expend where they do a smaller change out in the space. We find that traditional ventilation has been changed. When that traditional ventilation's changed that's where you really need to add these standalone air cleaners to really make an impact and exchange the air but also bring the particle load down substantially.

Eric Schiff:

Okay so in this situation with both of your portable purifier as well as the central system running, does that modify where you'd place your purifier inside a classroom?

Vinny Lobdell:

We think that the machine should be placed in a position without good ventilation. So even when you have a central HVAC running, put it in the area where the ventilation is reduced the most or it's not getting fuel and then as centrally located as possible and that's going to give you the best change to maximize the air in the space.

Eric Schiff:

Thanks very much to Vinny. I'm going to switch to Jensen for a few more questions. Please stay on the line to respond to the Q&As we get from the listeners later on.

Eric Schiff:

So Jensen Zhang is also with us today. He's a professor of engineering at Syracuse University. He's also the director of a unique research lab that studies indoor air quality and he's associate editor of the journal Science and Technology for the Building Environment. Of particular local interest a couple of years ago, Jensen was responsible for bringing the International Building Physics Conference to Syracuse. So let me ask a few general questions first and then let's get into air handling.

Eric Schiff:

Two months ago, Jensen, you were one of the dozens of scientists who signed a letter to the World Health Organization. It stated that virus laden particles exhaled by a person are likely an important route for transmission of COVID-19 disease. These particles, of course, float in the room air for minutes or hours and this is in addition to the direct transmission from close contact, touching an infected person, or picking up the virus that way. Can you explain in simple and briefly terms, but in any case can you explain the evidence that led you and the other experts to conclude that airborne transmission was significant?

Jianshun 'Jensen' Zhang:

Yes, I think the first is the same principle that when people breath, speaking, we actually generate particles from the size of .3-10 microns. There's a wide range of aerosols we generate. So if someone is infected, the virus can be transported through those particles in the air. That's just from the principle point of view. And then these particles can stay in the air for a long time just because of their size.

Jianshun 'Jensen' Zhang:

There's a few cases that also provided some evidence about the COVID-19 virus transmission by air. I think one of the most evident case was the one in Guangdong, China Guangzhou restaurant in which they have basically three tables in a section that is not very well ventilated and does only have airflow recirculation. One of the tables has a single infected person and it infected all the other two tables. People at the other two tables in which they do not have any prior close contact, either prior, after, or during the dining event. I think that was evidence really that airborne transmission played a key role there. The researchers went back to measure the ventilation and the air change rate is very low, it's only about .7 air changes per hour. That's also an indication that ventilation is very important factor.

Eric Schiff:

Would you say that's an example of a super spreader event in that particular case, the restaurant case, or the other well publicized cases where one person spreads to a lot of other people?

Jianshun 'Jensen' Zhang:

I'm not sure I would call it a super spreader because these people was obviously talking but there is another case which talks about a super spreader which people were singing. It was a choir case that there's a lot of people getting infected. Because when people are singing, they actually exhale a lot more particles in the case of infecting a person and they inhale generally a lot more particles, viruses.

Eric Schiff:

I see.

Jianshun 'Jensen' Zhang:

So a super spreader for example can spread, can generate 10 times more virus than just a regular speaking person.

Eric Schiff:

Interesting. In a recent article you published you've been discussed how engineering the flow of air, where the air is moving inside a room, might be able to reduce airborne transmission of COVID-19 from an infected person. Perhaps for our listeners we could start, if you could just review in simple terms how air is likely to flow in a typical classroom and here I am assuming there's a forced air system, it's not just a radiator and a window.

Jianshun 'Jensen' Zhang:

Mm-hmm (affirmative). In a typical classroom, most classrooms we have this so-called mixing type regulation system, which means the air typically comes from a diffuser which is located close to the ceiling level. This diffuser is designed to create a jet, like a small jet, air jet that will mix with the ambient air to cause the mixing because of the flow turbulence. Then there's a return air from, whether it's a... in some cases is just a door itself serves as a return or in other cases they have a ceiling type of return

register. This is how a typical classroom in the case they have a centralized HVAC system. I mean we can always view this as a well mixed system and the one thing I would say is that it's designed that way and it be important to check indeed there is enough ventilation flow coming out of diffusers.

Jianshun 'Jensen' Zhang:

A very simple case, for example, people can use is like a toilet paper, just a sheet of toilet paper and stick on the diffuser and just see whether it actually gets blown in a horizontal direction. That's a very quick way to check whether there is enough airflow coming out. Another way to look at that is, in terms of ventilation rate, would be to use a very low cost co2 sensor to measure, just monitor the co2 level. In the case of a typical classroom in a traditional design you want to maintain below 1,000 ppm but in the case of preventing the Coronavirus it should be maintained at or below 500 ppm. We're talking about reducing it by a factor of two in terms of the co2 levels.

Eric Schiff:

So, that would require that the building engineer basically increase the amount of the outside air that is mixing in with any returned air to the classrooms?

Jianshun 'Jensen' Zhang:

Yeah, that's one [crosstalk 00:18:55]

Eric Schiff:

How do they actually do that?

Jianshun 'Jensen' Zhang:

Yes. That's one approach and the other approach is simply by reducing the number of occupants. The number of occupants you have you increase the amount of regulation rate. I think I would encourage using both approaches just to be on the safer side.

Eric Schiff:

I see. Okay. In the same article you also discuss what you call semi open partitions and I know a lot of people have been talking about putting up partitions or plexiglass shields and things of that sort. So perhaps you could expand a little bit about what you mean by a semi open partition and how they might work to reduce disease transmission?

Jianshun 'Jensen' Zhang:

Yes, thanks Eric. In the partitions, if you look the many, it has been used in many office spaces so we have done some research previously, actually 20 years ago there's already some research looking at how the partitions impact the airflow, air diffusion in the space. What's interesting when I look at those original data and they actually play a key role in reducing the cross contamination between the person. So not only just providing good air to everyone in a mixing type regulation system. Those semi open partitions, by semi open what I mean is open on the top and open on the bottom. Just so you have a way for the ventilation flow to get to the occupants and there's a way for the pollutants to get out of the occupants. So what the semi open partition does is actually is basically acting as a blockage to the contaminants transfer from one person to another. The study shows that with the semi open partitions,

even under the mixing type regulation system, a typical mixing type ventilation system they can reduce the risk by a factor of two in terms of cross contamination.

Eric Schiff:

Do you think it's realistic for teachers or building managers in schools to put up some kind of light duty partitions that would help or does that take more of an expert?

Jianshun 'Jensen' Zhang:

I think it is possible. I think what's important there is the need to able to understand the airflow pattern. The typical classroom let's say you have a square diffuser on the top and typically air is spreading like this, going horizontally on the side then coming back from the floor level. So you form this kind of recirculating flow pattern in this classroom. So in this case, the air basically is going to get to all the people. It was designed that way. What needs to be the partition should not be blocking this air. The partition can be lay along the airflow path and separate the people sitting beside to the partitions. In this way, the partition does not block the airflow but at the same time providing the blockage to the cross contamination.

Eric Schiff:

Right.

Jianshun 'Jensen' Zhang:

I emphasize the semi open. It has to be semi open because the existing flow typically gets to the person from the bottom, actually each of us generating heat we generate a thermal plume moving up which controls the air we breathe from below not from up there, from below. So these partitions, as long as it's semi open it's not going to block those flow to get to the person and then the contaminated, the soiled air will move up and be extracted [inaudible 00:23:15]. I would say ask someone who at least understands the general airflow pattern to look at the individual classroom because I understand every classroom can be different.

Eric Schiff:

Yeah.

Jianshun 'Jensen' Zhang:

Not so difficult to set up, a semi open partition, in my view.

Eric Schiff:

Right. Well, I'm not sure how many people in the HVAC business understand some of these things today but I guess we'll be seeing expanded interest in the future. It's unlikely that COVID-19 will be the last pandemic our country undergoes. Just looking forward to the future, would you recommend different ways of thinking about airflows in offices and classrooms as we remodel or build new classrooms and offices that would be designed in to prevent this sort of cross contamination that makes the spread of disease worse?

Jianshun 'Jensen' Zhang:

Yes, what I've always been thinking and promoting is basically personalize the ventilation that allow individuals to have adequate ventilation and also remove the contaminants locally. I think that's the ideal case, the ultimate goal. To implement some of the ideas with the current system I think a more immediate way is to look at displacement ventilation as opposed to the mixing type ventilation.

Eric Schiff:

I'm sorry, what is displacement ventilation?

Jianshun 'Jensen' Zhang:

Displacement ventilation is to provide the ventilation flow at lower part of the room. So you spread the ventilation flow across the floor instead of supplying from the top. So this flow gets to the person generating heat so all the air would raise and move up. The nature of this, displacement ventilation, when the pollutants move up they exhaust them out of the room from the ceiling level. So in this way you would reduce the mixing between the polluted air and the incoming air. First of all, the displacement ventilation in concept is opposite to the mixing ventilation. The mixing ventilation currently used we try to maximize the mixing, while displacement ventilation is to minimize the mixing, therefore we reduce the cross contamination.

Jianshun 'Jensen' Zhang:

Now the traditional displacement is limited in fact in terms of cross contamination prevention. Whether we can, in the future I would say we should combine that with the semi open partitions. So in this way it is possible to reduce the cross contamination by a factor of 100 instead of three or four currently. That's something I look forward to, to getting more data and also plus design procedures for such systems so that people can implement that.

Eric Schiff:

Okay. So, that concludes the questions and answers that we prepared. For the listeners, I'd now like to invite listeners if you haven't already to send in any questions through the chat facility of the... and we will take some of those. Let's see, I think I'm just getting one now. Let's see, that looks pretty interesting. Someone has written in, I'm sorry I don't know who it is, "I'm the director of a library with three branches. It was suggested to put plasma air bipolar ionization units on our HVA system. What is your opinion on the effectiveness of this option?" So I think I'll ask Vinny to pick up that question since I know your company does some related work.

Vinny Lobdell:

Sure. Again, we believe in all technologies, it's really the utilization of technology. So, bipolar is a technology that's getting a lot of traction right now generally because of the cost. It's lower cost and it's easy to install. Our methodology and what I think experts would agree on is permanently removing this from the air stream with a high efficiency filter is what we always recommend. Whether it's a HEPA or better than HEPA filter an ULPA filter or any technology that does that. What we really emphasize is permanent removal of the substance from the air is going to be what we recommend. I always ask, inform people to get the research on these products, make sure they're not putting off unhealthy levels of byproducts in the space. What we've found with some bipolar ionization, some of the products we've tested is that you'll get basically a collection of particles to duct systems and if they're not permanently collected they can be re dispersed in the environment. That's really our only thoughts on bipolar at this point and Jensen may have some thoughts on that.

Jianshun 'Jensen' Zhang:

Yeah, this is very great question. I think the technology has potential but I think that there's one thing we need to cautious about its byproducts in this case like ozone generation. This is a, I think maybe, not just to bipolar but any air cleaners that have a voltage involved in corona voltage ionization has the potential to generate ozone. I think the device should have measure to reduce or minimize the ozone generation to acceptable level. You can look at California, I find it kind of funny actually, has standard to limit the ozone byproduct generation from air cleaners.

Vinny Lobdell:

I think on that, Eric, you can just go to UL867 and there's a really simple guideline for people to follow that shows safe levels of ozone production, unsafe levels of ozone production. And they've actually gone down now to basically say what a non ozone producing device is. We can share that offline but it's really easy to relate data. I think, as Jensen mentioned, that's really the one... not enough research being done on this quite yet.

Eric Schiff:

Okay. We've got a second related question. I think Vinny again would be probably the first person to talk to. "I work in a school library. It's an interior room with doors that I can leave open, no windows. Air quality isn't great." Okay, we hadn't really thought about school libraries as opposed to classrooms but in any case. "I've thought of putting an air purifier near the desk but it's a very large room. Would it make a difference in the area around me or would the overall size of the room lessen the effect?"

Vinny Lobdell:

Well, it's certainly going to make a... we call that a point of view solution. So putting that right next to her space where he or she is spending the most time will certainly have a greater impact there. But the larger the space the less of an impact that machine's going to have on the total environment. That's why it's really important to understand the size of the space and how an air cleaner's sized to effectively deliver a solution in the environment. She's stuck in a situation where she doesn't really have any ventilation so there's some other things she should be looking at. But also if she wants it to protect her or the occupants, she'd really need to size the machine properly and then also take into consideration noise levels. I would likely recommend, depending on the size, placing one or a majority of machines in there to effectively address that situation.

Eric Schiff:

Okay. We have a question now which I'll start with Jensen just to change things up, but I think either of you could answer it. The question is "What is the effectiveness of the best forced air MERV filters versus the best HEPA filters in stand alone units?" So we'll let Jensen field that for a moment and then Vinny you can chime in [crosstalk 00:32:08]

Jianshun 'Jensen' Zhang:

It's a great question. First of all, from a ranging point of view, these filters are rated based on efficiency in filtering the different size of particles. The MERV 16, there are no HEPA filters have a better efficiency than the MERV 16 HEPA filter. MERV 16 is the highest rating on the MERV rate. Now I have to emphasize that it's not only the efficiency that matters. It's also the amount of airflow rate through the filter that matters. It's the product between the two. So if you have very high efficiency but a little airflow flowing

through it, the amount of clean air flow rate becomes the [inaudible 00:33:04]. The equivalent of outdoor air flow rate is still very small.

Jianshun 'Jensen' Zhang:

I think to address this question, one has to look at two things; the efficiency of the filter itself times the amount of flow rate that system can deliver. So in a simple system, for example, if you put a HEPA filter, a MERV 16 filter on the existing air delivery system, the fan, and we know this high rating HEPA filter will create a lot more flow resistance through the system. In the fan, the nature of the fan is when the flow resistance increase the amount of flow rate the fan can deliver will be cut off. Therefore, the product flow rate times efficiency will end up being smaller compared to a MERV 13 or 14 filter. I think that's why they actually recommend MERV 13 as opposed to MERV 16 for existing system. If you're upgrading the HVAC filter it's better to go with a MERV 16 or HEPA filter with a stronger fan. That's the most ideal situation. Otherwise, MERV 13 or 14 with sufficient air low rate can also reduce the risk of infection.

Vinny Lobdell:

Eric, I think depending on the level of competency with the people we have on the call today just for people to understand what MERV is. MERV is a minimum efficiency rating value of filter. The higher number of MERV rating, the higher efficiency of the filter. That's also the higher the pressure the air that's required to push through that. So that's really what people, I don't think they understand. HEPA is above the highest rated MERV filter. The question you asked on the standalone purifiers, they're utilizing their own blower, their own motor to drive air through a HEPA filter so they can do that much easier. What we've found is 95% of the existing buildings today cannot handle anything greater than a MERV 13 filter. They'll burn out the blower. They'll burn out the motor. So that's why you have this movement towards installing the highest rated MERV filter you can handle which essentially is a MERV 11 or a MERV 13 and supplementing that with a high efficiency air cleaner. That's going to give you the removal.

Vinny Lobdell:

So I think the challenge that we all have as a collaborative effort is how we can get our HVAC systems to adopt to higher efficiency air cleaning systems and then how we can offset them with portables. But portable systems, for the most part, I just challenge people the word HEPA is too commonly used. A system that's truly delivering HEPA certified air is a system that's delivering total system efficiency of 99.97% cleaner air. Many of the HEPA systems out there today on the market are not doing that. They're using a HEPA type filter but they're nowhere near delivering a real HEPA air quality performance. I think that's where the research comes in. There's companies out there that aren't doing this. And it's important to do the research and understand if you're going to buy a system like that make sure it's really delivering that type of air quality.

Eric Schiff:

Okay, there's another great question that has come in, which I kind of neglected when I was designing some of the questions. This one is "Among the factors to consider for purifiers and ventilation should room occupancy be a consideration?" So why don't I start with Jensen on that one.

Jianshun 'Jensen' Zhang:

Well, certainly. The reducing flow ventilation, for example, is really specified for per person basis. So, if you reduce the number of occupancy in a building you're effectively increasing the ventilation rate per

person. Also occupancy, another important factor is how do you space people like that in a classroom, the spacing, the distancing is still very important. Again, we're talking about cross contamination. It's not just the overall average air quality in a space, we're talking about reducing the cross contamination. When people are sitting six feet apart, no partitions, no semi open partitions still you will have a decay of the concentrations in this virus [inaudible 00:38:03]

Eric Schiff:

So let me go ahead and use my moderators privilege and follow up on that. I know when we talk about the number of people in the room we're often talking about the carbon dioxide level and everybody's about the same for that, roughly speaking. But in the case of COVID, isn't it the single individual who somehow gets through the system and is pushing out a lot of COVID into the air that's the real problem as opposed to the actual total number of people in the room? I'll let Jensen follow, following up with you, Jensen. Throwing you a curve ball here.

Jianshun 'Jensen' Zhang:

It's a great question. Indeed, that's why we now emphasize the index, the indoor air quality index is not an average concentration level like co2. That is just one indicator to indicate how much ventilation you ought to have per person basis.

Jianshun 'Jensen' Zhang:

By the way, you talk about the spread of the virus from one person to another, if you have this higher ventilation rate but it has more dilution problem. Which means when this virus generated from one person, because this person had a high ventilation rate it dilute very quickly before it traveled to the next person. So that high ventilation rate is key player role there.

Eric Schiff:

Okay. There's another question which I will also direct to Jensen and at least one more for Vinny. "How could a room be retro fitted with displacement ventilation? Is that even possible?"

Jianshun 'Jensen' Zhang:

Well, I think it is possible. Let's say you have a ceiling, in the current system you have a ceiling supply air and what's needed is basically a duct there. You can use flexible ducts to a lower level and they simply will spread that air, same air spread across the floor to occupied space where people are. That's what creates a very simple displacement ventilation.

Eric Schiff:

Okay. Here's a follow up question on ultra violet c light. That's the kind that is commonly recommended for disinfection so I'll put this question to Vinny. "What about UVC light directed only up vertically, no contact with humans to eliminate upper cross contamination in combination with semi partitions? Didn't this used to be implemented in tuberculosis clinics?" I'll see what Vinny can do with that one.

Vinny Lobdell:

We've developed a lot of UV systems over the past, 253.7 nanometer bulb systems are very, very effective at deactivating mold, virus, bacteria, and fungi but it all comes back down to the contact time. How much contact time does a viral particle have within that bulb? We believe that UVC is very

impactful when it's tied in with high efficiency filtration. Again, if we're not collecting something and giving that UVC bulb the appropriate amount of contact time to deactivate that viral load or that bacteria or mold load then it's very difficult to show a long term kill rate. You certainly will get some and UVC is a very, very effective technology but again, it goes back down to a total solution. Does that UVC bulb have enough contact time in front of that virus, which this virus in and of itself is not very hardy it actually dies very quickly. What we find is if that UVC bulb does not have enough contact time, it could bypass that. And also measuring the degradation of the bulb, the shielding of particles, and all that are some of the challenges we've found around UVC. But in general, UVC is very, very effective if designed and engineered properly in the environment that it's intended for.

Eric Schiff:

All right, here's a question that says basically if we've got a normal classroom with four stair ventilation and we've already worried about the filters and the central ventilation system, do you have an opinion about what would be the most cost effective next step? So, partitions, portable air purifiers, anyway so what would you do after the building engineer has improved the filtering and has maxed out his ventilation system?

Vinny Lobdell:

[crosstalk 00:42:53] I'm not real familiar with the cost of partitions but any time you look at changing the built environment or having to build something out there's generally a more exorbitant cost to that. I think there are low cost, effective, portable air cleaners depending on the space that are cost effective and can be an immediate deployable solution. It's not an end all, of course. One of the things we've talked about and I know Harvard's Joe Allen always talks about is the benefit of portable air cleaners is they're an immediate solution and they can be re deployable based on other environments. So it's not like you're just spending now and having to deal with it later and not have a solution later, you can re deploy that. As it relates to partitions I'll let Jensen touch on that because I'm not up to speed on partitions.

Jianshun 'Jensen' Zhang:

Well, I think that I would agree that as a supplementary measure the standalone air cleaner is actually a low cost solution. I look at what's on the market, I think it is 500, 600 dollars. You can get one that delivers about 300 to 400 CFM flow rate. That's enough, I was talking about 20 CFM per person that already provides you quite a bit of airflow rate to supplement the ventilation.

Jianshun 'Jensen' Zhang:

The partition certainly in the classroom I would recommend. It's very easy to just install between the teacher and the students. Some semi open partitions that could be a very simple solution, I believe, in terms of protecting the teacher is one. I know a lot of teachers had concerns about coming back and this could be something to look at. But it's important, again, someone should be looking at case by case basis to make sure it does not interfere with the existing airflow pattern that is supposed to deliver ventilation flow to everyone in the space.

Eric Schiff:

All right, we've got another interesting question down in the weeds about how to operate in the classroom. So this person wrote "Is it advisable to keep the classroom doors to the corridors open if there is no return ventilation from the room and then also run a high efficiency air purifier in that space?

That may be two questions on top of each other." Why don't we go ahead and ask Jensen to start with that one.

Jianshun 'Jensen' Zhang:

I think it's a very interesting question. I think my answer would be it really depends. If you have standalone air cleaners that is made to maintain the space that are low risk. In that case, I wouldn't keep the door open, I would close the door because when you open the door you try to clean a lot more air. But this is under the condition that you should start with enough ventilation flow. Using air cleaner has to be supplementary measure as opposed to the primary one. Be sure to make sure first you have ventilation, if your central system has enough ventilation keep the door closed and have your standalone air cleaner to supplement the ventilation. That will ensure you have enough in the classroom.

Vinny Lobdell:

I tend to agree with Jensen. I think the purpose of a portable air cleaner that we call a point of use solutions. The more you limit the variable the higher the impact the portable air cleaner's going to have. So always think about it. That's why in Asia where outdoor pollution's very bad. You see that you can't open windows in big buildings. So limiting the variable and reducing the inflow of outside pollutants is going to give you the best chance to create the highest level of air cleaning effectiveness. Not efficiency, of actual air cleaning impact or effectiveness in that space.

Eric Schiff:

Let me ask Vinny to field this one. "How important is the humidity level in a room and at what levels does it impact the efficiency of an air cleaner if it does at all?" Did I lose somebody?

Jianshun 'Jensen' Zhang:

Vinny? Okay I can [crosstalk 00:48:09]

Vinny Lobdell:

I'm sorry, I lost you there.

Eric Schiff:

Why don't you Jensen, Vinny seems to be offline for the moment. Okay go.

Vinny Lobdell:

Hello?

Jianshun 'Jensen' Zhang:

Do you want me?

Eric Schiff:

I was asking you, Vinny if he wanted to comment on the humidity level if you're on still.

Vinny Lobdell:

Well, humidity has a substantial play in the virus but as it relates to the efficiency of a mechanical filter, humidity doesn't really play a role. If you have a 100% sealed mechanical filter you're dealing with a penetration rate. So what's happening is those particles actually have to go through that filter. It shouldn't impact the efficiency of a filter at all, to answer the question directly.

Eric Schiff:

But humidity is important as far as susceptibility to the disease goes? Is that correct?

Vinny Lobdell:

Yeah, if you do a superficial Google search you'll find that humidity and temperature do play a role in how viruses thrive in the environment.

Eric Schiff:

Right. Okay. Here's another interesting one. "Is there any reason to consider using dual window fans to" I think that means two window fans "to increase both exhausting of room air and pulling in outside air in a mixed ventilation HVAC system?" So they want to mix exterior ventilation with interior ventilation.

Jianshun 'Jensen' Zhang:

I can go for that.

Eric Schiff:

Please do, Jensen, please do.

Jianshun 'Jensen' Zhang:

Okay. Really you need only one fan to either push the air in and have one window on the other side open so the air goes out from the window on the other side. The better approach I would think if you could use the exhaust fan by putting one fan to draw the air out of the space and have one window on the opposite side or the other side of that wall open so that fresh air will come in. That single fan can create enough pressure throughout to allow the air come in.

Eric Schiff:

Okay. All right, let's just take one final question which goes back to partitions again. "How effectively do partitions block transmission of the virus by aerosols? Can't the aerosols just be carried on air currents around or over the partitions?" And I think it's a Jensen question.

Jianshun 'Jensen' Zhang:

Yeah, that's why the semi open partition has to be placed in connection with the airflow pattern. Which means that the partitions not only just to block it, it's actually the airflow around the person, like each of us generating heat we pull all the air up so the partition would minimize the flow across from one person to another. So this air that moved up has to be exhausted from the top so that before it would have the chance to come back to mix with the flow around another person. So the principle though it's not just the partition itself, it's the partition working with the airflow, the thermal flow generated by the person.

Eric Schiff:

All right. Thanks very much. Our time is pretty much up today for this research and technology forum. The forum will be available soon, hopefully today or tomorrow as a podcast, the video will be removed and we'll be sending the link to the podcast to all the registrants for today's forum. I want to thank Vinny and Jensen, our distinguished panelists today and also behind the scenes Carry Marshall, Tammy Frizanio, Laura Wilson, and Paul McCarthy who all helped out with today. Have a good day and good health to us all in these extraordinary times.

Jianshun 'Jensen' Zhang:

Thank you, Eric. Thank you all.

Eric Schiff:

Thanks Vinny and Jensen.

Vinny Lobdell:

Thank you everyone.