Virtual Event Transcript
Let's Clear the Air: An OSTP Discussion on COVID and Clean Indoor Air
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Dr. Alondra Nelson: Hello and thank you all for joining us for today's discussion of clean indoor air. I am Alondra Nelson and I lead the White House Office of Science and Technology Policy. Over the past century we have made astonishing gains in public health by focusing on the basics of clean water, food safety, sanitation and clean outdoor air. But not as much on clean indoor air. Our experience with the COVID-19 pandemic has demonstrated clean indoor air is a vital part of our pandemic preparedness toolkit and our public health toolkit.

Taking steps to have cleaner indoor air, which can be achieved by improving the ventilation the strengthening air filtration and disinfecting air will not only improve health and well-being now, it is an investment that will benefit future generations and improve people's long-term health.

I want to be very clear COVID-19 is transmitted through the air. As the CDC has said since May 2021 on the website and the scientific brief on SARS COV 2 transmission, a main way it spreads is through inhalation of air carrying very fine droplets and aerosol droplets that contain infectious virus. The same publication said that current evidence strongly suggests that contaminated services does not contribute substantially to new infections.

Bringing more clean air into a room reduces airborne disease transmission and reduces COVID-19 transmission for example having five air changes per hour can reduce transmission risk by 50% or more. This is an achievable goal for our schools and our workplaces. I believe it's also enormously, it is also an enormously empowering piece of information. Improving indoor air quality does not have to be in conflict with our goals of energy efficiency either. Combined with whole building tune-ups, tuning up the ventilation and air filtration systems needn't increase energy consumption.

Today is the latest of multiple efforts by the Biden Harris administration to promote clean indoor air. We identified improved indoor air quality as an important tool to fight airborne pandemic diseases in the American pandemic preparedness plan last September. The national COVID-19 preparedness plan prioritized indoor air again earlier this month. And two weeks ago the administration launched the Clean Air in Buildings Challenge.

Clean indoor air can help protect schoolchildren, essential workers, and all Americans as we go about our everyday lives, at work, shopping, traveling or dining out, from getting sick from COVID-19. Alongside vaccines, masks and other forms of individual protection, clean indoor air can be a powerful multiplier of protection against COVID-19 infection. Of course, clean indoor air is also about more than just COVID. It helps improve public health writ large. Against other

common airborne diseases like influenza and against indoor pollution sources like smoke and gas stoves that can harm our health such as by exacerbating asthma.

It's also an issue of equity which is one of the cornerstone commitments of the Biden-Harris administration. Everyday essential workers may encounter people who are not vaccinated or who may not be wearing masks so cleaner indoor air can make a huge difference for their lives and their health. Also low income rural and urban communities, communities of color and native committees are more likely to live at the fence-line of industrial facilities. And areas with worse outdoor air pollution, facing higher rates of asthma and other health harms. And these same communities tend to live, learn and work in older buildings without good air cleaning systems. Technologies and efforts to improve indoor air quality must be deployed in the communities most affected by poor indoor air quality. And so that in turn all Americans can lead healthier lives.

Many steps to improve indoor air quality can be easy and low cost such as using a portable HEPA filtration system like the ones available at many local stores. You can even build your own with an affordable do-it-yourself option like the four filter and the box fan called the Corsi-Rosenthal box.

Today you will hear from several experts who long before the pandemic began and since then have devoted their efforts and in some cases their entire careers to improving indoor air quality for the public good. They will explain the science behind clean indoor air and what you can do to put the science into action and make a difference in your own community. This is important because there are steps that all of us can take to make our indoor air cleaner. Not only for ourselves but also for our friends, family, neighbors and coworkers. We are all in this together and once you know what you can do, you can help spread the word about what we all can do or ask for to make indoor, being indoors together safer.

Because there's actually a lot we can do, and a lot that your government is doing to make possible, the moment really is a historic opportunity. Last year's American rescue plan made available hundreds of billions of dollars for schools, universities, state and local governments, nonprofits, nursing homes, offices and businesses like restaurants and gyms funding that can in fact be used to improve indoor air quality. For example $122 billion were made available through the elementary and secondary school emergency relief fund to help schools prevent the spread of COVID-19, including through ventilation improvements. Your school district will know how to apply for these funds through your state education agency. Another example, $350 billion were provided through the state and local physical recovery funds to help state local and tribal governments support their local businesses, nonprofits and the public sector. You can reach out your local government to learn more about these resources.

Additionally, the recently bypassed bipartisan infrastructure law will make available tens of billions of dollars for improving the health and safety of building occupants. With improved ventilation and airports, bus terminals and other transportation hubs, along with commercial buildings, low income housing and other buildings. For example, the department of transportation's airport terminal program provides $5 billion to upgrade, modernize and rebuild

airport terminals across our nation, which can include upgrading environmental systems that would improve indoor air quality.

So this is just a sampling of the resources that are available. These investments matter but it's also about our values. And frankly it is a value that we all share. This is one of the most basic commonalities that unites us as human beings that we all breathe air. That is why healthy and clean indoor air should become an expectation for all of us. It is a fundamental commitment that we must make to our children, to all of America's workers, to those who are medically vulnerable, and to every person in the country. For decades Americans have demanded that clean water flow from our taps and pollution limits to be placed on our smokestacks and tailpipes, and our indoor air should be clean and healthy too. It's just as important as the food we eat and the water we drink.

At the White House Office of Science and Technology Policy, our aim is to elevate the expertise, drive the innovation and communicate the science that will make clean indoor air possible for all Americans. But we know what really matters is where the rubber meets the road, and this is where many of you play a key role. So before we turn to our first speaker I want to give a special shout out to those of you who are engaged in the care and in the work of keeping our buildings healthy day in and day out. The mechanical engineers and HVAC experts, the union health and safety specialists, the industrial hygienists and environmental engineers, the building and facilities managers, the janitors and maintenance staff and the state and local public health officials. Thank you all. Your expertise and efforts are crucial to making clean indoor air a reality. We are so grateful to you for the work that you do, and we are so glad that some of your with us today.

Before we get started I want to thank all of you who shared comments and questions in advance. We have been asked whether the content will be available afterwards for people unable to join. I can share that OSTP will post a transcript of the discussion on the website within the next week. We hope to address many of your questions related to the science behind airborne transmission, how to identify evidence-based solutions and tangible ways to improve air quality throughout the event. As part of your registration, a number of you shared useful resources and innovations with us, and as we continue to make progress on this important topic we want to continue to engage with you. So please do share your thoughts, ask questions, and share your work by emailing us at indoor air... One word at OSTP dot EOP. gov.

I now have the great pleasure of introducing our first guest Dr. Zeynep Tufekci. Zeynep is a technologist who studies the intersection of society and technology she's a New York Times tall columnist at NYT principal researcher to the Carolina Center for information technology and public life and a faculty associate at the Harvard Berkman Klein Center for Internet and Society at Harvard University. Zeynep thank you for joining us.

Dr. Zeynep Tufekci: Thank you so much for inviting me to this event.

Dr. Nelson: It is great to see you. You have been a leader in this space and I want to get started right away diving and because I know we do not have a lot of time. I know in a little while but folks joining us will get to hear about the science behind airborne disease transmission. But

before we got to that, I wondered if we could start with a bit of the history of airborne disease transmission and public health which you have both studied and written about. Yeah. Please go ahead.

Dr. Zeynep Tufekci: I didn't mean to interrupt you. I'm sorry. There was a single second delay.

Dr. Nelson: No, I was just going to ask you to say something about your work, about the sort of scientific discourse around airborne transmission in the 19th and early 20th centuries in the public health space and what we can learn from the public health history or other work we need to do today.

Dr. Zeynep Tufekci: Absolutely. So first, I want to thank you for the introduction. If we had started the pandemic on the kind of framework you outlined just in that short brief introduction I believe we would have had much better outcomes because we would have been more accurately informed and empowered to combat this virus. So that is incredible to hear.

So to go back to your question why did it take until now to be having these kinds of discussions, what could have happened earlier, and why was the kind of sort of challenge that it was goes right back to what you're asking me. And as you noted, we will be hearing shortly from Dr. Marr, Dr. Allen, people who have studied this their whole lives and are at the forefront of it as early as February and March 2020, alerting us to the airborne transmission with this virus and the emerging evidence back to the reason it was so difficult to get here and we have so much more things and we have so much more to do does indeed go back to the history that you are talking about because transmission, how do diseases transmit, I mean it is one of the big open questions of human history.

We have grappled with it for all our history, because infectious diseases in humanity we coexist and it has been a challenge and a scourge for all of our existence. Some of the earliest theories did indeed think that these diseases transmitted through the air, you go back to the earliest writings but of course we didn't have germ theory of disease until 19th century. In fact we didn't have a good understanding of what was going on. And for a long time in the modern era including a 19th century, there was a lot of debate about what could be causing a disease to go from one person to another or from a place to another. And there was this belief that the bad air that was smelly, stinky, terrible like that made you feel terrible was the cause of a lot of disease. Just the noxious air. And these could be termed like the miasma theories of disease. They were onto something, because places that are poorly ventilated and smelly, and the polluted places that are more likely to be inhabited by the poor, you do see a lot more diseases in such places but it is not because of some fantastical, the smell itself causing the disease. It is a correlation more than an actual cause. And of course this caused challenges in understanding things like waterborne diseases, because you are trying to tell people that the smelly terrible air wasn't causing the cholera, but it was the sort of clear glass of water where they didn't have germ theory. They didn't have microscopes and could not see it. You are trying to convince them this is what is causing the illness and not the smelly air itself. And that was this huge era of scientific advancement with a better understanding of modes of transmission. In fact the beginning of

epidemiology as a science is often traced to Jon Snow who figured out that cholera was transmitted through the water rather than the air. And there's a lot of interesting history there.

But just like now, then that was resisted both by let's say the medical establishment and for people just that they took a long time to establish this. And that partly led to let's say an aversion to theories of transmission through the air, because it was considered to be unscientific version. Like the miasma, just the smell itself rather than what we now know to be the true version, which is that yes, indeed especially respiratory viruses that we breathe, are traveling through the air.

So early 20th century while we saw this incredible understanding and advances in sanitation as you know, which did cut down waterborne disease dramatically, which is essentially a public health miracle that we now take for granted, I didn't grow up being able, I grew up in Turkey and when I was growing up tap water wasn't considered safe. It took me such a long time in the United States to just psychologically think, I can drink the tap water. I can drink the tap water. You know that is just, because I lived through it, it is such an incredible advancement. And we just take it for granted here.

So water got a lot of attention which is great, and a lot of other kinds of sanitation and we understood about mosquito transmission it got a lot of attention that was great. But public health remained adverse to the idea that diseases were transmitted through the air. But of course they were transmitting from person-to-person. So something was happening and in the early 20th century a theory develops, and it's like I'm just going to summarize it. The idea was that it was the things we kind of emit out of our mouths like big droplets of almost like watery stuff that falls to the ground quickly, were the reason that people were infecting each other, person to person. So it was seen as that it is something that happens because we are kind of spitting out, so to speak, spraying, spray borne stuff and it was considered that once they fell to the ground, within about a meter or two, 3 to 6 feet, that is that they can't go anywhere else and this was considered the droplet theory.

And very interestingly, as a sociologist kind of outlook on this, the public health people thought, and they wrote about this, the leaders who got the theory going, thought that if people believe that it is through the air they will be so scared that they won't do anything. Like there was this idea that if we tell them the air is at fault or is risky that... You know because it's everywhere as you know that we breathe air, they will be so scared that they won't do anything for they will not wash their hands. They won't do it. There was both like an understandable fear of having the wrong version of the theory but also mistrust of the public, that if we tell them something they are just going to get scared. And somehow in that period the idea that the spray droplets that only traveled a short distance were the cause of that kind of respiratory transmission got established, I would say as a dogma, because if you dig into the history, and I'm sure Dr. Marr and Allen can tell you all about the science can dig into it there were a lot of evidence and scientific reasons to think that is not what was happening. And as they will explain, the aerosols we breathe out, those little things that do float in the air are also more concentrated around the person. So distance does matter. They just don't necessarily fall to the ground, plop ballistically. That was the error. So evidence kept a team-leading through the 20th century. It was either discounted, resisted, I have heard so many stories that are other guests will be able to say more but they lived through it, or

that they would try to submit to leading journals with evidence that they would be dismissed essentially because we know it is droplets.

This is how we entered the pandemic. And in fact we did not, because there wasn't a lot of evidence. There was a lot of assumptions. So fast-forward, and when the pandemic started this droplet dogma also immediately got repeated as if it was happening and when it started, you know, that's all I knew too, because unlike Dr. Marr and Dr. Allen I'm not 70 who has worked on this her whole life, when I started digging into it and when I started to see epidemiological evidence, which things like a choir, where one person, this happened in the United States in March, a choir where one person I believe infected 51 people out of 60 which is an incredible number in one session even though they were so trying to be careful in the way that they were told to be careful. That they didn't touch the doorknobs, they propped open the door. One person being able to infect like... 80, 90% of the people in the room is not really going to happen through the touch or sort of the short distance stuff it's clearly and it is a choir. Aerosols are produced more during the singing and there was the diamond Princess ship where it was clearly spreading from person-to-person even the people are confined in their room and droplet precautions as they were called were taken. There is emerging evidence that was saying this is not just traveling a short distance. It was not transmitting outdoors. There's so much going on.

And that's when I got interested and started trying to write about this. And what I witnessed was that efforts by scientists and in fact at some certain points hundreds of scientists to appeal to the WHO, to appeal to the CDC, were rebuffed. Which is kind of tragic. WHO called saying that it was airborne to be misinformation. And that tweets where it says it wasn't misinformation is still up unfortunately and the late corrections that came up were muted and silent and there was a sort of institutional inertia to admitting that yeah, we got something wrong and we didn't recognize the emerging evidence, when it was coming out. So it took a very lengthy, difficult and I know personally difficult for the scientists involved, who were trying to make the case, difficult process to get the introduction you gave, which is incredible I think for going forward.

And sociologically speaking also once you admit a respiratory disease is airborne not just this one, but probably all the others, there is a collective responsibility to treat it the way we treat sanitation. We don't tell people we need to have a chemistry lab in your own house, and test your water all the time and filter it. Otherwise it's not your problem. We as a society, we expect clean tap water to be a right. And when that fails that's a scandal. That requires attention. And it took a lot of effort to get here but when you admit it is airborne, that is the kind of thing you need to then move on to. And you say well what do we do about it? because yes you can wear the N95 masks that are more protective as a person for a wild but you need systemic solutions. You need the schools to have the right kind of air filters and ventilation. You need the energy-efficient versions of it you need the research and all other things going forward. And that is the part that I think is both tragic in some sense, that we did not move faster, but also really hopeful going forward because as terrible as this pandemic is, COVID is not the only respiratory disease and from RSV to influenza to others having better indoor air quality, and listening to the aerosol scientists and the other biophysicists and other people and virologists and immunologists who are on top of this topic early on, of which there were a few, having that kind of interdisciplinary

cooperation and the government investment in the infrastructure and the correct informing of the mechanisms of this disease and all respiratory diseases transmission can help lower disease burden overall. Because the other diseases, they also cause a lot of pain and suffering. So that is kind of where we are. So I'm both very sociological story as much as a scientific story is much as it happens often, but also now that we are here, I think all lot of hope going forward if we act the right way starting today is better than yesterday. Sorry what I mean is like today is the best day to get started. Yesterday would have been better. But whenever we start is great.

Dr. Nelson: Here here to that. Thank you for that certainly the scientific community has an excellent job of doing rapid studies and highlighting the latest science on what was two years ago a novel disease, and one that today continues to evolve. It has been I think a challenge for lots of different sectors in the public health community and I think the CDC has worked to incorporate the latest science in their guidelines trying to provide the best public health recommendations, but you know, it takes time and it has taken time for CDC and WHO and others to recognize the importance of airborne transmission. But we are here now together.

So I wanted to talk a little bit, you wrote an article in 2020 that was prescient, that said we needed to talk about ventilation. So I am mindful of time but I wanted to say that one of the things that we recognized here at the White House is of course the importance of ventilation and clean indoor air as one of the tools in the toolkit for improving public health. In addition to vaccines and masks and diagnostics and the like. So can you talk about how efforts to improve ventilation indoor air quality are part of the toolkit, and also if you have, I'm going to be mindful of time so I will ask you to be concise, how we might think about advancing equity in this space. How do we work with workers, those who are most at risk and what is the benefit of ventilation to them and how does ventilation compared to some of the other tools that we have in our toolkit?

Dr. Zeynep Tufekci: That's an amazing question. I will be brief. But once you have the correct scientific theory of how the respiratory disease is transmitted you actually have this incredible toolkit that opens up so many venues. And it is absolutely essential for equity. So to start with, if this virus is transmitting through the air, you have, we focus on masks, and masks are a very powerful tool, but there are all these things you should be doing to get the virus to be diluted or filtered out of the air you are breathing before it even gets to you. So one of the things you can do is once again ventilation, which is have more indoor outdoor air exchange, so that is kind of diluted outside in fact this is exactly why there is so much less transmission outdoors. It dissipates much more quickly. It can't concentrate as much because there is so much more air moving around. And indoors it can accumulate. It can sort of float and float and float, accumulate in unventilated spaces.

I know Dr. Allen has done some work on this about how do you make ventilation compatible with energy efficiency. That is something we are going to have to work on. It also means you can move certain things outdoors, and you can be more outdoors which is healthier in general. But of course that's not the only thing because ventilation is not always either available in certain places, but we have proven standards, HEPA filters, MERV filters for air conditioners do a great job of filtering the virus through the air and they can be the, they need to be sort of the correct

power so to speak to be able to do a great job depending on how many people. There's also as you know these cheap do-it-yourself options the Rosenthal boxes where you can take the powerful filters that are quite cheap that can filter air and just take them to a box fan, and it does work. So you have those kind of options.

Also the equity part is absolutely crucial because just as you know, just like every other kind of pollution, every other kind of disease burden, the indoor air quality is demonstrably and systematically worse in poorer communities, which overlap greatly of course with communities of color. I am currently in New York and there are alike this direct correlation you see when you see the air quality studies, and air quality in poorer schools, and sort of the, and how bad it is. So if you improve air quality, indoor air quality, it helps kids concentrate.

It lowers burden like asthma and because allergens are also filtered out through the HEPA filters less respiratory disease is not just COVID but fluids and RSV and this and that. And also for a lot of us, for people like me, an academic, a writer I could work from home but those people that we call the central but we did not treat them with the respect they deserved early on in the pandemic, they ended up working indoors with lots of other people without the protections of the ventilation and the filtering. And it may seem like oh, could we really do that? I feel like not only could we really do that. It would have been cheaper. It would have been cheaper than the disease burdens cost if you are just thinking about the finances, and that doesn't even go into the human suffering that would have been avoided.

And some of the sort of solutions were likely HEPA filters that are just available for absolutely within reach of a wealthy country like ours and also other countries too. And in the long run it will both be cost saving and health improving. So it is this incredible opportunity to do to the air indoor air what we did to sanitation and water that is no longer really within living memory in wealthy countries but it was a terrible burden on human existence, and what we did to outdoor air, which people don't remember, but the first Earth Day in New York you couldn't even read the sign in the photos because of the smog. And we decided, and the pollution and when we decided to move on that, we did get a great sort of result in just a generation. So it is this opportunity to put the clean air as a human right at the center of how we design our buildings and live our lives and how kids go to school and ask the question how do we make this happen and as I noted with the questions of equity too, because these burdens tend to fall on the more disadvantaged people.

So again we are where we are. I wish we were here earlier. But it is what it is. But starting and doing to indoor air what sanitation has been to water, indoor water and the water we drink, it will be an enormous advance. And I'm super excited to see scientists who are about to follow me who worked on this their whole lives and to see the kind of work they do finally have the kind of positive results that it's capable of.

Dr. Nelson: Thank you so much, Zeynep, for your research, for your candor, for running into the breach to do the great research and writing you have done over the last two years that have just been so important for helping us make sense of the pandemic. So just to wrap up our time together I want to say that the White House is really committed to working and engaging on this

topic, including with you and other stakeholders on this call. And it's going to really take a whole of government approach and coalition and innovative approaches to doing that. And we are really grateful for your leadership and those of the other experts from all across the country, across disciplines who really made clean indoor air their mission, including through the recently released EPA Clean Air in Buildings Challenge, which we will talk a little bit about later. We are happy to roll up our sleeves with you and others to leverage science-based resources developed on this topic over the past few decades and the new findings over the course of the next two years.

So to begin our next session it is now my pleasure to turn things over to my White House colleague OSTP Senior Advisor for Biotechnology and Bioeconomy, Dr. Georgia Lagoudas. Over to you, Georgia.

Dr. Lagoudas: Thank you, Dr. Nelson and thank you for the next session, and next we will move into the next portion of the program the basics of why you should care about indoor air and we will have two experts talking about the science behind indoor air and the importance of ventilation. First Dr. Linsey Marr and Dr. Joseph Allen. Who are both leaders in this area and clean indoor air champions many of us have seen their writing an op-eds and scientific publications so we are so happy to have them here with us today.

First I have the pleasure of introducing Dr. Linsey Marr who is a Professor of Civil and Environmental Engineering at Virginia Tech. Dr. Marr is an expert on aerosol virus transmission, exactly what we are talking about today. Her research group studies pollutants that are both indoor and outdoor air and in particular how the tiny viruses and how these microscopic organisms are in the air she's published over 140 scientific articles and has worked with places like the Centers for Disease Control and prevention and the National Academies to really update and support new understanding of virus transmission so thank you Linsey it is so great to have you here today.

Dr. Marr: Thank you so much for the introduction. I'm excited to be here and share my knowledge about airborne transmission of viruses and how we can protect ourselves. Early in the pandemic one of the biggest questions was how is the virus transmitting. And the answer is critical because it determines how we can best reduce the risk of transmission. If someone is infected, really what we want to know is how does the virus get from them to another person. Well it does not just ooze out of our bodies the coronavirus is in our respiratory fluid, it’s in saliva, snot, and the fluid lining our lungs and comes out not as naked virus but in tiny bits of this fluid. If you look at the slide here, it shows what medical experts had thought or assumed was happening, that transmission was occurring by large droplets that come out of their mouths when we cough or sneeze. They contain virus and they can spray into someone's eyes, nostrils or lips or potentially contaminate another object and they enter the body of the other person the person would become infected. These droplets are pretty large and they fall quickly to the ground within a distance of 6 feet typically. So for a long time that is what was assumed to happen with most respiratory diseases, with a couple of exceptions, and that was assumed early on for COVID. Next slide.

But here is what really happens. We do release some large droplets when we talk, cough or sneeze, but we also released hundreds of tiny ones that are too small to see called aerosol particles or just aerosols. We also release the aerosol particles even when we are just breathing. These can carry the virus. In fact, they carry more virus than we would expect, given their small size. And they are small enough that they can float around in the air for a long time. They are about the same size as cigarette smoke particles. So they move around in the same way. You can see if the person on the left is infected and the other person is close by, and in the jet or plume of respiratory aerosols they are going to be breathing in a lot of these. In fact at almost all distances, unless they are really uncomfortably close, the person is going to breathe in more of the aerosols than they will have the large droplets land on them.

Now over time (next slide). These aerosol particles can build up in the room. The person on the left, the infected person is still there releasing them into the room. These continue to float around, just like cigarette smoke. They don't stop at 6 feet. They can travel easily across the room. Even if the air in the room feels still, there's always some movement that is carrying these tiny particles around.

Next slide. So if the room is poorly ventilated, those are going to continue to build up over time. Next slide. And this would happen not just in the workplace for example, that is shown here, but also in restaurants or bars, gyms classrooms, houses of worship and people's homes. Really anywhere that is indoors. So now we see that the person who is further away is being exposed to the virus particles in the aerosols and is breathing them in. If she breathes in enough of them she could potentially become infected too. Next slide.

So how do we reduce the exposure of people in the room? We need to reduce the amount of aerosols in the room and have well-established ways of doing that. The first is ventilation. If we move more air through that room, bring in outdoor air that is virus free, and push out the stale air that contains all the viral aerosols, then we will reduce or dilute the amount of virus that is in the room reducing the amount that people in the room are going to breathe, people at a distance. And this can be something as simple as opening the windows or adjusting the heating ventilation and air-conditioning system so that it's bringing in more outdoor air and using less recirculated air. Next slide.

Filtration is another good option for reducing the amount of aerosols in a room. This figure shows a portable air cleaner, sitting in the middle of a room. And what happens is that it pulls air through it, and it has a filter that is very efficient at trapping viruses and other particles on there. And then it pushes clean air out through the other side. So this effectively reduces the amount of aerosols in the room. You have probably heard of HEPA filters. There are others too. And you may have heard that they achieve for example 99% removal at a certain very small size. And you may think well does that mean that all smaller particles get through? And in fact that is not what happens. Not what happens. Filtration is not like sieving or sifting through and allowing things that are smaller than a certain size to get through. The way filtration works in fact is that smaller particles then that critical size actually are trapped with even higher efficiency. I know it sounds weird but that is how it works. That's how the physics works.

So in this case there are fewer aerosol particles in the room and a lower chance that other people are going to become infected. Now with disinfection I want to touch on that. For most situations ventilation and filtration should be the first options to consider. And disinfection is an option for high-risk spaces such as cafeterias and schools, in nursing homes. Disinfection kills the virus but does not physically remove it. You can see that we still have some red dots here, the infectious viral aerosols, but we have killed off a lot of the virus and now those are shown by the gray, the little gray circles. Hospitals have used germicidal UV for a long time near the ceiling. And this kills off virus that passes through the upper air and again the air is constantly moving in a room so constantly it does end up getting there even if it is lower down. These types of systems need to be carefully spec-ed and installed in order to be effective and safe to avoid exposure of UV to people. There's also a number of emerging technologies. I would look for those that have been proven in independent real-world studies before investing in them. You can stop sharing now please.

So I hope I have left everyone with a better understanding of how airborne transmission works. And how it is important to have clean indoor air to reduce the risk of transmission. And I would like to emphasize that ventilation and filtration are effective tools that everyone can use to help ensure clean indoor air.

Dr. Lagoudas: Thank you so much it is important to understand how the particles move around in the air even though we often do not see them. So I want to take a few minutes to ask a few questions. I know that the many zoom attendees that registered, we received many questions during registration in particular about how someone would know if ventilation improvements are actually helping them. So I just wanted to start off to understand a little bit more about the particles in the air. So how long can the virus SARS COV2 last in the air and how far can the particles travel.

Dr. Marr: Yeah. That actually has two parts. How long can they last physically, well depending how long the carrier particle is, again we don't have naked virus running around, it’s in respiratory droplets and aerosols and even if the water evaporates there is a ton of other salts and proteins left as goo essentially coating the virus and depending on how big that is it can last in the air anywhere from minutes to hours, in terms of physically floating around. And now another question is, how long does the virus actually survive or remain infectious, and we know from sampling studies in hospitals, where they have detected infectious virus from the air, and also from laboratory studies, like laboratories conducted lots of these with other viruses, they can easily survive for an hour or more when they are floating around in aerosols. They do gradually decay over time there may be kind of a fast decay at first but they definitely are there and they can infect you.

Dr. Lagoudas: Understood. That makes a lot of sense. And a related question thinking about the image of virus particles in the air I just want to understand can you explain why don't we get sick every time we are in contact with the sick person? And in particular what does this have to do with ventilation and the number of particles in the air?

Dr. Marr: There's a number of factors that contribute to why we don't get sick when we are in the room with an infected person. They may not be shedding enough virus into the air to fill the air with viruses. Some people shed more than others. They could be later stages of infection when they are not shedding much, it could be that we are not there for a long enough time to breathe in enough of the viruses in the air to have enough enter our body to cause infection. And as you saw in some of those figures, good ventilation keeps the level of virus in the air low. So if you happen to be in a room with someone who is infected, they are shedding a lot of virus, if you have good ventilation that's going to rapidly remove the virus from the air, greatly reducing the chance that you're going to breathe in enough of them to become infected. And then finally there is, different people have different immune responses, and even if you are exposed there's always a chance that you will not become infected.

Dr. Lagoudas: Right. Right. That's really helpful to understand. I am curious if you could tell us a little bit more about the science behind how much can ventilation lower your risk of getting infected with COVID?

Dr. Marr: That is something we are still studying. We know from basic physics things I have shown you. If you have better ventilation there's less virus in the air, you will breathe less of it and certainly there's going to be a lower chance of you getting infected. I can mention a couple of studies. There is one from the University of Maryland performed by Don Milton and colleagues. He has been studying transmission of viruses through the air longer than most of us and they looked at one dormitory with low ventilation, another with high ventilation, and they found that the one in the one with low ventilation the rate of respiratory infections in students was four times higher, than in the other dormitory.

There's been another study that just came out of Italy on COVID and this has not been peer-reviewed yet, but the results are consistent with what we would expect based on modeling and physics. So they went into schools and they installed HVAC systems in some of those schools and they found that compared to the base case where they had no additional ventilation, where they added low mechanical ventilation from the HVAC system, that seemed to reduce the risk of transmission by about 40%. When they had medium ventilation it was reduced by over half. And when they had high ventilation they were able to reduce the risk of transmission by more than 80% or there was that association. So there's potentially a big effect.

Dr. Lagoudas: Yeah, those are really really powerful numbers to hear. And like you said, we are still learning about the science, but it is great to know the ventilation can have such a big impact on disease transmission. I wanted to ask one other question. And Zeynep touched on this a little bit at the beginning but if you wanted to add a little bit more on understanding why is it that ventilation is so effective, and really what does this mean about how COVID spreads between people and how we are understanding that the majority of transmission occurs indoors instead of outdoors. Can you share a little bit more about the science behind that?

Dr. Marr: Yeah, ventilation we think of like N95s for example as the gold standard for reducing exposure to virus. It filters out virus so we end up breathing in a lot less then we would otherwise and this greatly reduces our risk of becoming infected. Well ventilation achieves the same thing

and it does it for everyone, and they don't need to be wearing a mask. If you have great ventilation you can reduce the amount of virus that is in the air by a factor of five. Maybe even a factor of 10. And that is going to reduce everyone's individual risk. We are all breathing all the time. We can't avoid it. We are all sharing the air. So this is why ventilation has such great potential to help us with reducing the risk of transmission of COVID and other respiratory diseases.

Dr. Lagoudas: Excellent. Thank you so much Linsey, we really appreciate your time today and appreciate that you have dedicated your career to studying this really important topic and helping us understand virus transmission through the air so thank you so much for helping us understand and providing such thoughtful explanations today.

Dr. Marr: Thank you. It has been a great pleasure.

Dr. Lagoudas: Excellent. Well to continue this second session I'm really excited to introduce the next speaker, Dr. Joseph Allen. Joe is an Associate Professor at the Harvard TH Chan School of Public Health and he began his career leading health investigations of buildings across the private sector those with hazards in the air or other environmental challenges and now he directs the healthy buildings program at Harvard. Joe is a public health expert in the field of infectious disease research, with over 80 scientific publications. And he also works, is working with large companies on implementing their healthy building strategies into their global portfolios. So we are so excited to have you with us today, Joe.

Dr. Allen: Well, thanks for the nice introduction and I want to thank Dr. Nelson and the White House for inviting me it's a privilege. Going to jump in and say something I wrote two years ago that is a simple truth. Our buildings can make us sick or keep us well. And this virus was novel, but only in the sense that it was novel to our immune systems. It wasn't novel in terms of how it spread, and what we had to do to control this. In fact we know how to keep people safe in buildings from a hazard, biological, chemical, physical, radiological hazards. It all starts with Dr. Marr said you have to understand how it is spread because than the control strategies flow naturally and if you had knowledge that airborne spread is happening than the building matters. In early on in the pandemic this was missed. Because we focused on surfaces and that led to the control strategy of cleaning doorknobs, cleaning elevator buttons, people cleaning their groceries. That was a big mistake. It all flows from airborne transmission. Then those strategies that Dr. Marr mentioned. We have to remove the virus from the air. We can move it out of the building through ventilation we can clean it out of the air through filtration. We can inactivate it through germicidal UV light. It is really that simple.

Now if we talk about the evidence for how we know this works, Dr. Marr talked about this there's multiple lines of evidence for the first I agree it starts with basic physics and basics of public health really that if you increase ventilation filtration and reduce the amount of virus in the air, you are reducing the intensity of your exposure, or the inhaled dose, the amount of virus you actually inhale. That decreases your risk. You also look at the data that shows there's hardly any spread outdoors. Why is that? Unlimited ventilation, unlimited dilution. We can look at the spread that happens indoor look at all the super spreading events. All time indoors and under

ventilated under filtered locations. Doesn't matter if it is the choir practice, restaurant, bus, spin class it is the underlying factor that these viral particles and particles that carry the virus are accumulating indoors. We can also look at decades of scientific literature that shows higher ventilation is associated with decreases of transmission of other respiratory disease like measles, tuberculosis, influenza and SARS1 over a decade ago.

But here is the problem we have designed the buildings to bare minimum standards, not health-based standards. In fact, I think most people would be surprised to know that the standard that governs ventilation in your coffee shop, your school, your office, your home, is designed, is by-name the standard for quote unquote acceptable indoor air quality. I don't know about you, or anybody else, I do not want acceptable air quality I want healthy air-quality or optimal indoor air quality. So we have choked off the air supply in our buildings for decades. We have got a virus that spread nearly entirely indoors and that sets us up for this massive problem. We have the same problem on the filtration side. Here again we use bare minimum filters that are designed to protect the equipment, not designed to protect the people. That is a mistake.

So I want to talk about solutions. That is the point of this meeting and as my brother always said if we just talk about the problem without solutions that is called complaining. So let's get to the solutions. First and foremost you want to tune-up your building. Everybody who has a car has dealt with this knows that you have to get your car a tune-up. It is not going to function the same way if you don't change the oil and get it a tune-up periodically. We don't do this for buildings consistently. So we have a minimum design standard that our buildings are designed to. Not enough for health but over time we do not give them a tune-up and the building starts to perform worse.

So first and foremost, bringing the building back up to the way it was designed. Then you understand your systems and then you can start to make the improvements to go above and beyond. I also want to point out that if you do that, this process of giving your building a tune-up or what we call commissioning, improves overall air-quality and improves energy efficiency. Lawrence Berkeley national Lab estimates this can decrease energy use by 10 to 20%. That is bottom-line savings right to the building owner and it is great for climate of course. So as we think about what else we have to do here we think about the multiple benefits that come from doing this. Right? We are going to clean the air and this is great for COVID, but there are many other benefits here and I want to start with schools in particular. Many studies have shown higher ventilation rates, higher filtration associated with better reading scores, better math scores for students, decreases in absenteeism. We have a study my team wrote a couple years ago called Schools for Health, over 200 studies showing that the building, the school building influences student health, student thinking and student performance. And I actually think about the American Rescue Plan and the generational opportunity, this once in a generation opportunity to finally address the decades of neglect of our school infrastructure. This is a powerful tool we are not leveraging to protect our kids and also all the adult workers in the school. The benefits don't just stop with schools. We see this in offices and workers everywhere. Higher ventilation rates associated with fewer missed workdays, better cognitive function, so being able to think more clearly, less fatigue, less headaches, and I will say this is all really common sense and you have

all experienced it is. You've all been in a stuffy conference room, a stuffy classroom, stuffy house. You feel tired. You lose your alertness and what happens when the door opens or the window opens? Life literally and figuratively gets breathed back into the room. That is ventilation and that is the power of ventilation.

I want to make the case that this is also just a good business decision. Because fundamentally building performance drives human performance drives business performance. I will make the case on three levels. On an individual level our own research on the benefits of ventilation and cognitive function shows that at a cost of $40 per person per year we see benefits to the business on the order of six to $7000 per person per year. That is what happens when you include health and productivity benefits in the analysis. If we look at what happens in the business, I wrote a book Healthy Buildings with Harvard business professor John Macomber looking at the economic benefits to better ventilation and healthy building strategies more broadly and find when businesses do this they can see a 10% benefit to the bottom line of the organization. Last if we think of this from the investor perspective, or the owner perspective, our friends and colleagues down the road at MIT just did a study showing that healthy buildings, the buildings that are designed and operated to a helping building standard command effective rents 4 to 8% higher per square foot. So healthy buildings are just good business decisions. Last I want to say healthy buildings in this conversation in ventilation infiltration is really broader than COVID and just ventilation and filtration and air quality. My team released a report we call the nine foundations of a healthy building talking about all of these factors that influence our health and buildings. Like water quality, the chemicals that are in the materials we purchase in our homes, feeling safe and secure in our buildings. The reality is we are in indoor species. We spend 90% of our time indoors. It is intuitive and logical then that the indoor environment has an outsized impact on our health, and we have been ignoring it for too long.

The last thing I want to say is to echo Dr. Nelson's sentiment here that the unsung heroes of the healthy buildings movement are the people who design, operate, and manage our buildings facility managers and building managers and I want to say thank you for keeping us safe. Thanks.

Dr. Lagoudas: Thank you, Joe. I will echo your last remark to say that today with us we know that from registered attendees we have HVAC engineers, we have facility managers, we have school building owners, we have restaurant owners, we have many people that think about the health of their buildings and how to keep their occupant safe. And so I think you are speaking to an audience that is happy to hear the message. I wanted to start, Joe, to ask, you outlined so clearly the economic benefits, the health benefits related to COVID, the benefits beyond COVID. Why has it taken so long to recognize this importance or why have we designed buildings without thinking about having a healthy building and really having this positive impact?

Dr. Allen: Yeah. I think we have made mistakes over the past couple decades. We have lost our way with a focus on energy efficiency and tightening up our building envelopes and a misunderstanding that we can't have both a healthy building and a green and energy-efficient building. The reality is we can and we must have both. We can't have an energy-efficient building that causes disease for people in the building. We can't have a healthy building that then

causes downstream effects through fossil fuel combustion and downstream effects through climate change. So it has been a false dichotomy. That we have been presented with. It's one or the other when in fact it has to be bold and there are ways to do it and many good examples of how to do it. I don't want people to think that healthy building strategy is somehow at odds with the green building movement.

Dr. Lagoudas: Okay. That is helpful to understand. But I wanted to raise a question that we had many attendees submit, which was what are the indicators of good air quality? So I work in an office building, when I walk in what numbers could I look at to know whether the air in my building is good or bad?

Dr. Allen: Yeah this has been the real challenge and why many organizations have stayed with the so-called hygiene theater where you see people cleaning services all it's very visible at the circles on the floor telling you where to stand. Good air quality is invisible and I think organizations have to include that in the communication plan to make the invisible, visible. One, talk about it promote it, let people know what you have done you have increased ventilation rates and put in MERV 13 filters the higher grade filters that help people and we need to get to start to merge the healthy building movement with the smart building movement, using low-cost real-time sensors for things like carbon dioxide which is a great proxy for ventilation rate which starts to put a number on air quality. You can go into a building and actually see what the CO2 level is, the carbon dioxide level and that gives you a hint or sense of whether it will be stale air in there or a lot of fresh outdoor air is coming inside so we have to start leveraging these new tools, and I think events like this and quite honestly leadership in the White House is putting this on the map in a big way, and expectations are changing. People are going to walk into buildings in their coffee shop and their school and demand to know what the air quality is like.

Dr. Lagoudas: And Joe can you tell us a little bit more about CO2? Why is that a proxy for virus? What does it mean?

Dr. Allen: Yeah really good question it's not a proxy for the virus necessarily but we all know exhale CO2 and we use it as an indicator of how well the space is ventilated. If CO2 is high it means you have low ventilation and vice versa. So it's not a perfect proxy because CO2 just tells you about the ventilation strategy. If you have low CO2, you are in good shape. If you have high CO2, meaning ventilation might be poor it doesn't necessarily mean that it's bad from a COVID standpoint because you could have excellent filtration. Filters do not capture CO2. So like all things it's another tool in the toolbox we have to be careful but it's a great tool. I am measuring it in my office right now portable air quality sensors people can take these things and buy them on the Internet and walk into a place and it will tell you roughly what the CO2 concentration is and give you a quick estimate of how good the air quality is.

Dr. Lagoudas: Got it. One last question. We also have a number of online attendees that are from church or faith-based organizations, and one of the questions that was submitted during registration was about COVID safety during worship. And the question was, is there any level of indoor air cleaning that will suffice to allow indoor maskless singing in groups, like in church choirs?

Dr. Allen: The answer is absolutely yes. We have seen spread happen in places doesn't matter if it is a choir or church or whatever, when we do not meet those fundamentals. But if you are in a choir or a church you can definitely do this safely if you pay attention to all these other factors. I mean honestly we should talk about the fact is, if you are vaccinated and boosted, number one, get that done that has reduced your risk of severe disease, hospitalization, and death. On top of that we have to put in these great ventilation filtration strategies but yes. We can keep people safe in any building once we know the hazard, we know how it is spread the controls flow from that, and we have done this successfully for the past two years for the organizations that got on top of this and recognize that this is spread through the air and we hope everybody follows that opportunity.

Dr. Lagoudas: Excellent. Thank you so much, Joe we really appreciate having you here today and sharing your expertise with us.

Dr. Allen: Thanks so much. It is a pleasure to be here.

Dr. Lagoudas: Thank you to both of the speakers. You provided clear explanations for why we should care about indoor air and the steps we can take. So thank you for your tireless work on the topic and next I would like to pass it on to my colleague at OSTP Dr Steph Guerra who is Senior Policy Advisor for Security

Dr. Guerra: Thank you, Georgia and thank you so much to the for speakers. It's really a who's who of indoor air. It's been a pleasure to introduce you this morning I can now introduce the next expert Mr. Ken Martinez, who will share the basics of how we can take care of indoor air. Ken is an environmental engineer and industrial hygienist with experience in leading and conducting large-scale research and managing programs in occupational safety and health and emergency response. He has more than 33 years of experience at the CDC in hazardous agent exposure characterization and mitigation control practices in the manufacturing and healthcare industries. Mr. Martinez is a recognized subject matter expert in biological agents, and currently serves as the Chief Science Officer at the Integrated Bioscience and Built Environment Consortium. Ken, thank you so much for joining us.

Mr. Martinez: Thank you for the introduction. I want to thank OSTP at the beginning for the opportunity to present this is a high-level overview of environment strategies that can be used to reduce the risk of airborne disease transmission in the built space. Vaccination is important. Human diagnostic testing is critically important as well during the pandemic but given that the primary route of COVID-19 transmission is airborne and you have heard this echoed from Dr. Nelson and from Dr. Marr and Dr. Allen that environmental control strategies should be complementary. Okay we need to continue this discussion further to cement what we learned about healthy built environments as a result of COVID-19. All of my remarks today are traceable to my work history of 40 years in the indoor air quality and bio-aerosols including focus on infectious disease transmission. It's also based on CDC recommendations, guidance from the integrated bioscience and built environment consortium and the American Industrial Hygiene Association if you are interested in a more detailed collection of digestible information on the specific topics I will refer you to the Commit to Care website which is in a partnership we have

with the American Hygiene Association. Commit to Care is a grassroots campaign that is a partnership as I said between IBEC and IHH to provide awareness and understanding of environment strategies and the space there's no charge to participate.

So let's start on a very basic assessment risk assessment, each of us conducts risk assessment as we move through the world every day. We consider the risks and things we do such as choosing to drive a car. Some of us choose not to wear seatbelts. Choose to ride a bike, some of us without helmets. We eat foods that are perhaps unhealthy and we play contact sports that put us at risk of injury. How do we assess risk when it comes to highly transmissible infectious diseases, such as COVID-19? And how will this assessment impact choices regarding moving in a new normal? For example, we all understand that healthcare workers are high risk because of the potential to interact with someone who is infected with COVID-19. I encourage you to consider your server at a restaurant to be high-risk. They come to a table where people by design are eating unmasked, talking and laughing and breathing and so that server does not know if someone is infectious, if they are vaccinated. So they are unprotected when they interact in space.

And we have boiled down the risk factors to risk factors and risk mitigation considerations into a simplified process that I want to present to you here today, and we call that the four Ds. With regard to risk factors you heard Dr. Marr talk about the disease distance, or rather the aerosol concentration of the individual. But let's consider a group of people as we did in the restaurant, all sitting around talking, eating, discussing. Well, you do not know who is vaccinated and who is not even if those people who are not wearing masks, they could be unvaccinated and you don't know who is infected because a lot of times that we are seeing today is that in the vaccinated state you could present with symptoms at all, so someone in the group of people could be disseminating airborne viruses. So density, you need to consider that when walking into the room.

The second point is duration. How long will you be in the room where there could be potential aerosol particles in there that have virus in them? So you need to consider how long. The longer you are there at the greater the increase for disease transmission. Regarding risk mitigation factors we focus on distance and dilution. Two things that all of the speakers here this morning have addressed. Distance has to do with what Dr. Fauci said it distance does matter but as you saw from Dr. Marr's slides as you move away from the infected individual the particles tend to disseminate, they spread apart, so the concentration that you come in contact with at a farther distance is less, but the scientific literature is abundant with case studies on super spreader events where people have been infected at distances of 10, 20, 30 feet away when they are in the same boat so distance becomes important but remember that it is not everything.

Dilution is the everything and you heard this from Dr. Allen and Dr. Marr the more we can ventilate the indoor space through filtration and outdoor air conduction the better we can become. So let's focus on those concepts as far as dilution, when we look at big buildings larger buildings are designed to bring in outdoor air and that serves two primary functions. One of which come more outdoor air dilutes pollutants. When I was going to engineering school we were always taught the solution to pollution is dilution. The second function is that it provides free cooling and heating during certain times of the season. For example during the springtime,

when it is cooler outside, we can increase the amount of outdoor air and we don't have to cool the air because it is already chilled if you will. However, when we increase the amount of air, it does increase energy costs and you heard Dr. Nelson allude to this as well as Dr. Marr as well and Dr. Allen so you need to consider the impact on energy costs. When we look at our homes it is rare to have outdoor air introduced into an HVAC system that is installed into a home. Therefore, outdoor air only comes into the home through opening windows. Now I will also say as far as ventilation, increasing outdoor air if you open up a window in a building that has a ventilation system you will impact the air quality in that space because this tends to have a negative impact on how the HVAC system is moving air.

Next I would like to focus on filtration. ASHRE currently recommends increasing filtration rates to MERV 15 that gives you approximately 80% efficiency removing various sizes of particles. The problem we have is will the system work with increased filtration because as you increase filtration efficiency you also create greater resistance to air movement. That results in making your HVAC system motor components working harder. So I would refer you to the HVAC professionals who understand if that is really going to work for you. As I said before, opening windows can have a negative impact on the components of the HVAC. I will give you a quick example of a church that I supported here locally. They had four different ventilation systems in the building but they were all home type units. And they were in very very tight spaces. When I looked at the filter box, they had no room to include or substitute in higher efficiency filters. So I worked with them to install portable air cleaners in rooms that they use quite a bit, the great Hall and the sanctuary, and we also put ceiling fans in the top to get better air mixture. Because if you just put a portable air cleaner in there it's going to tend to recirculate the air in a limited space. With regard to homes, same as buildings. The system that is in your home may not be able to handle the increased resistance to newer systems are more likely to work. Older systems not so much. As I mentioned previously homes rarely have the capability built in to introduce outdoor air. However openings windows and doors works very well in a home environment. But it is seasonal dependent.

You heard some of the speakers before talk about supplemental air technologies. There are two tried-and-true technologies, portable air cleaners, preferably HEPA filters you do not need supplemental technologies other than the tilt filter however carbon is okay because carbon does a really good job in these odors. With regard to GUV germicidal ultraviolet radiation it is a proven technology. It's used widely in healthcare and laboratories. However, there are maintenance and implementation issues that include potential health impacts if not installed properly. And personally, I do not recommend the use of these systems for the home. With regard to a lot of the emerging technologies that we are seeing right now as a result of COVID-19, I ask the buyer to beware. Research the seller, request that they supply evidence on the science and please avoid technologies that kill microorganisms in occupied spaces. So conclusion I invite you to join the Commit to Care Campaign. Again it is no cost and would also ask you to consider visiting the IBEC website to learn more about that body of work. Steph?

Dr. Guerra: Thanks so much Ken. You fit a lot of information into a very short period of time so impressed by that and I appreciate you talking to the practical steps that any of us can take to

improve indoor air quality. I just want to follow up with another question based on feedback we got from our attendees today. From what you said so far it seems there are many different actions we can take and at the best choice will vary by building setting. So for example we received a question from one of our attendees from Hawaii who asked about how to improve air in facilities that don't have HVAC systems. So could you give us a few more examples from your work about how you can customize your action plan depending on the setting?

Mr. Martinez: Yes. It is about directional flow of air. So with the example you provided about Hawaii, if you open up the windows on one side of the building and windows on the other side you're hoping to get the wind and pressurization to move the air through the building. If you open up only one side of the window you are not going to get the movement. The same could be true as I was, in my work with CDC we were involved with tuberculosis control in health clinics and jails and whatnot. So if I knew there was infectious patient in a particular space and they did not have a new or upgraded ventilation system I would put, I might put a fan that blows outside to create a negative pressure space that would again create the air movement and keep the contaminated air in the room, and push it outside to the outdoors. And therefore the hallways and other parts of the building would remain uncontaminated.

Dr. Guerra: Great. Thanks so much. As you alluded to in your remarks we received a lot of questions about new technologies out there that claim to be safe and effective for cleaning indoor air. If you could speak a little bit more about how folks can discern the real deal from potentially ineffective or even harmful machines and technologies.

Mr. Martinez: It goes back to what I said before. Anytime you put something in the air that is occupied and they say we can tell this percentage of particles, understand that we are nothing more than a compilation of cells. Microorganisms. So it's going to kill bacteria, fungi, virus is likely to have an impact on us as well so that's why I ask the buyer beware. Ask for the scientific evidence. A lot of these technologies that you are seeing on the market today are largely unproven by third-party sources that are looking at these things very carefully. The best thing you can do is go back to what we know does work. Filtration. If you need to, ultraviolet or germicidal ultraviolet radiation has been proven effective as well. So go back to the things that do work. Outdoor air filtration and they are the least expensive of the options as well.

Dr. Guerra: Great. Thank you. And now we are all going back out into the world, sometimes without masks, how can people be aware of indoor air so when you enter a public space what are the building features you look for when you are thinking about whether or not the indoor air is for you to breathe?

Mr. Martinez: That is a more complicated question, Steph. That's why I presented the one component on risk assessment. Every time you walk into the room you want to look to see if people are gathering, they are not social distancing we know a lot of the mandates regarding mask mandating being pulled so you still want to keep your distance. If you see someone had put a portable air cleaner in there you can tell yourself to feel grateful they care about the air quality, they are doing something supplemental. Because you will not be able to see the increased filtration in the building system so it's about conducting your own risk assessment in my opinion

and weighing the risk factors. Duration, spend shorter amount of time in there. Looking to see if they are diluting the air through portable air cleaners. Keeping your distance from other folks as well, and not gathering as tightly as we would have before.

Dr. Guerra: Great. Well we are close to time. Time really flies when you're clearing the air here, so one last question for you Ken, what is the one thing you hope more people do to take care of indoor air as a result of this conversation?

Mr. Martinez: Become more aware of what they can do. I go back to what I said before about our Commit to Care program. Simply the reason we gave it the name is because we wanted people to commit to caring about their family members, their neighbors, their coworkers, the community by learning what are the basic things they can be aware of and do with regard to dilution, density, direction, and density and keeping those in mind and showing a commitment to protecting not only themselves, but others as well.

Dr. Guerra: Great, wonderful. Thanks again Ken, for giving us actionable guidance. I want to say there are additional resources available online including EPA's recently released Clean Air In Buildings Challenge that can help you dive deeper into these decision points. Now it's my pleasure to pass the zoom microphone over to my colleague Dr. Erica Kimmerling Senior Policy Advisor for Public Engagement in Science.

Dr. Kimmerling: Thank you. It is my pleasure to introduce our last speaker for this event, a person I know to be passionate about improving public health, Ms. Tracy Washington Enger who has worked at the Environmental Protection Agency for 25 years creating safe, healthy, pristine school indoor air environments. She works with communities from around the country and internationally, facilitating events which generate action to address critical health and environmental issues. She received her BS and MS from journalism from Ohio University in Athens Ohio. Thank you so much, Tracy for joining us here today. As I said, you worked on this issue for 25 years, can you tell us a little bit more about you work at the Environment Protection Agency.

Ms. Enger: Absolutely. It is my pleasure, Erica. Thank you for having me here today and getting to share some of my passion for indoor air quality in schools, and like you said, so the first thing I want people to understand is that while we are enjoying a great moment of attention and urgency around indoor air quality, EPA has been at this since 1988 so we have been on the playing field for air quality for a long time and our focus on schools began in 1994, with the introduction of the indoor air quality tools for schools kit that was a response to a GAO report that indicated how many schools were having issues with building facilities and especially with the HVAC systems.

So we put together this action kit for schools to take action on improving indoor air quality. We put it together to be used in action so there are checklists and model plans and wheels and videos and we were so excited when we put it out there and it was not just guidance to put in a shelf and had a great--- closure that made a satisfying sound when it opened up so we were really excited about it. And when it did not fly off the shelves we were shocked because we knew people needed this and were asking for it. So after we put the kit out there we then went out and actually

talked to school districts. We did this thing that government seldom does, but we should do, and we are doing more of where we talk to the end-user about why they were or were not using it. And based on that we put together our framework for continuous success and effective management and it addressed things like organization and communication which Dr. Allen was talking about the importance of communication, all of these continuous improvement strategies that created a roadmap for schools to use to put it into place. Then we identify the areas that they really needed to address. Everything from HVAC systems, but also mold and moisture and the integrated pest management and source control, all of these issues. And that became our knowledge base. Then we grabbed all of those folks who were using the kit, and we turn them into our faculty, really peers mentors for other school districts across the country and we put in place like our professional training webinar series, where we could then connect all of those folks out there in our network to all of our knowledge resources. And that kind of comprises all of the components of the program that we have to help school districts put in place comprehensive IEQ management plans.

Dr. Kimmerling: One of our other speakers actually got to this a little bit about why air quality is specifically important in schools but I think it's important to take a step back and talk about why it matters in a school setting, what is different about it and can you get into that a little bit more for us.

Ms. Enger: Absolutely. I think it's important for people to understand that where students learn is just as important as what they learn and we put investments into having the best instructors, having the best equipment, having the best curriculum, but what I want people to understand is that that school building, that school building facility is a part of the curriculum. It has that much impact on the kind of outcomes we are trying to achieve in schools. What I mean by that is we talk about is clean indoor environments and healthy learning environments being propped up on a truly good school facility management certainly. How we are managing the facilities is important but it is important because of the impact that it has on health of the occupants. And that health of the occupants extends beyond just the moment that we are in but with the pandemic, but with all control of numerous impacts, health impacts that are there. And we know that health is not just the absence of disease. It is really looking at the overall health that helps address things like absenteeism. If you have a student... A, if you have a school that can't be open because of indoor air quality or you have a student who cannot be there because of absenteeism due to asthma, or flu, or the pandemic, that is learning that you're not going to get back. That is a learning loss that is a cost that you cannot recoup. And the cost is also associated with presenteeism as well if you have students in the classroom that are unable to attend that's the third leg of the stool talking about academic performance. So indoor quality has a direct impact not just on the facility but on health outcomes schools are trying to achieve, in the academic performance outcomes they are also trying to achieve.

Dr. Kimmerling: So, you and I were talking yesterday about how schools have unique benefits and unique challenges and one thing you said to me is that kids are not just mini adults and that it actually matters for interventions. It's important to get into a little bit about the who is in the building and why that matters for how we approach this.

Ms. Enger: Absolutely. We have unique challenges when we address air quality in schools because of the vulnerable populations in there. We take our children, we take our national treasure in there and children are not scaled down adults. Physiologically they are different. They breathe deeper and faster. So they are more vulnerable and more susceptible to a lot of the exposures. They have hand to mouth activities they are what one of my friends called belly botanists. They are on the ground all the time touching their faces and touching their noses and touching all of these things. So they are especially susceptible and are in an environment that is a unique facility that is not like a commercial space or like a home.

There are activities going on in a school building that are kind of unique to the school building. In addition to the food preparation and the bus idling and the equipment that is there. So in addition to those spaces often being overcrowded, and spaces being used in the way that they were not designed to be used. So we have offices in custodial closets, I have seen it. So we also have to think about how we are controlling for indoor air quality in the unique space recognizing we are dealing with unique and vulnerable populations, our children and how we then make choices for about not just the HVAC system but everything from the roof to the flooring, and everything in between. How we make smart choices about source control and about making smart material selections. How we control for pests. How we control for mold. Everything, because of the importance of the impact that it's going to have on those vulnerable kids and staff likely to be in the building for four times as long as any student.

Dr. Kimmerling: As we said, you have been on the issue of clean air before it was cool. And I think we can say it is cool now. And in a recent NPR article you describe the pandemic as being a little bit of a hallelujah moment. I want to get into what you mean by that and what it means for indoor air and what has changed now.

Ms. Enger: Yeah, so I don't want anyone to think that I'm celebrating the pandemic but I'm celebrating the moment that we have that we are able to seize on because I call it the three A's of what has changed. It is awareness kind of what Ken was talking about the importance of raising awareness around the issue and the urgency, but also led us to a point where we have better ability to address these issues now because of all the resources and all the guidance and all of the investments that are being made, and that allows us to move into better action. So we see more schools putting our guidance into action and we want to come out of this crisis with ongoing and lasting outcomes and commitments.

So we are really trying to help create a lasting change because what we have seen is the school districts which came into this pandemic already with our program in place, having proactively taken steps to put our program in place, were grounded in the best practices and the best policies and the best principles. So when the pandemic came, it really was just a tweaking. It was a pivot for them. They were able to pivot and make the changes that were necessary but they were not starting from Ground Zero. The thing is, if you want to pivot, and we hear that word so much right now. If you want to pivot, you have to have 1 foot grounded in something if you are not grounded solidly, you are not pivoting. You are just reeling and spinning out of control. And we have seen that unfortunately. So we want to come out of this with more school districts grounded

in a solid IEQ program that will allow them to pivot successfully when the next crisis comes along. Because we know it's coming.

Dr. Kimmerling: So, on the point of being nimble and taking action, in our last question I want to talk about what are the resources, what's available, materials, tools. We want people to leave with an idea of where they can go to keep engaging on this topic.

Ms. Enger: Absolutely. One of the benefits that has come out of this moment is that EPA, all of the resources that we have that I mentioned for you, the indoor air quality program but also our friends at Department of Energy have their sustainable and healthy schools initiative focusing on the false dichotomy, the fake sort of what Dr. Allen talked about really balancing quality and energy and it doesn't have to be some Faustian choice. We really can do both. Along with unprecedented amounts of funding that are finally being directed towards through infrastructure through EPA funds so we have assets and resources we can leverage in this moment. I just want to make sure that we do not squander them.

So the Clean Air in Buildings Challenge and the fact sheet has provided opportunity for us to really coalesce around this with all the White House attention that has brought the Biden-Harris administration commitment to indoor air quality as a family, a place to marshal our resources to get at. So when you look at the fact sheet, it really is like, when you look at the fact sheet it's like a portal for you to be able to enter into a galaxy of resources that you can tailor to get specific outcomes for your specific to school facilities so the secret sauce of the fact sheet is in the links do not skip the links. Click on the links so you can really design what you need for your school and for your facility because the thing is, this fact sheet, all of this information, everything that we are doing is only as good as what people do when they put it into action. And it is critical right now, something that has become my tagline but I mean it, we take this moment that we have that has been brought to us by the pandemic, that we take this moment and see it turning into a movement as school districts are putting things into action but if we are careful and with intentional design and use these resources that we have take the moment that is becoming a movement and take it to create a monument for lasting indoor air quality and lasting health and learning spaces for students for generations to come. We cannot squander this moment.

Dr. Kimmerling: Thank you so much, Tracy. I wish we had more time to get into it, I could talk to you all day. Thank you for your passion and your years of public service. I know it has made me more excited to work on this topic to talk to you. So thank you so much for everything and your time with us here today.

Ms. Enger: Well, thank you as well and I look forward to the work that we will continue to do in support of school districts across the country. Really excited so thank you.

Dr. Kimmerling: So it is now my pleasure to bring on one final speaker. We are bringing on Mary Wall, the Senior Policy Advisor for the White House COVID response team to share a little bit more information about the Clean Air in Buildings challenge that Tracy mentioned and when she said click on the links that’s the Clean Air in Buildings challenge, Mary, can you tell us a little bit more about it and the White House team?

Mary Wall: Yeah thanks Erica. Good afternoon. It's great to be with you all want to say thanks off the top to Dr. Nelson in convening the important conversation today. Also want to say thanks to everyone else who's here on the call. It's an important community and conversation to learn from so thank you for that and as I have said many times to the people here who you have heard from today, I think that all the work that the administration is championing right now is really standing on decades of experience from our federal experts and from experts outside of government as well. And work that we have seen across and before the COVID-19 pandemic so as a way to say thank you for all that you have done in really making sure that it's easy for people to access change on this important topic. We, had put together the national COVID-19 preparedness plan and this is the president's path for the next phase of the pandemic, released in early March. That plan is really focused on kind of a couple of core activities one is protecting against COVID-19, number two is preparing for new variants, and number three is preventing economic and educational shutdowns and on the last piece we are really focused in on indoor air quality.

The Clean Air in Buildings Challenge has been launched I think somewhere in the neighborhood of 10-ish days ago came from the fact sheet that Tracy had mentioned and links to the document from the EPA. It's providing a clear distillation and synopsis of actions that any building leader could take in order to improve indoor air quality. This really does serve as a call to action for buildings operators and certainly schools and other community settings but we also think this applies in the commercial and other sectors as well and we really want to make sure that everyone can use this moment to take action. It is a guide that is especially for, I say this with all the love and respect to experts here, it tries very hard to really kind of boil down as much information as possible into two pages and as Tracy mentions has a lot of links to learn more and this is the idea we wanted to be a first step in place to come together with your community, create an action plan and make the improvements. It is both about the things that I know I heard Ken talk about earlier that are quick wins and quick fixes. It's also about long-term investments. We are grateful that we have the infrastructure, the Bipartisan Infrastructure Law as well as the American Rescue Plan to support this and a lot of our public spaces, but again we really want to promote beyond that as well and make sure that all buildings can take action.

So I will leave it there, and just saying that this is, we really do view as the White House and as the administration the improvement of indoor air quality as a key component both in the fight against COVID-19, in preparing for the future of this pandemic that is still with us, as well as to reap all the health benefits and learning benefits and community benefits that comes with having high-quality indoor air. So excited to have this partnership with everyone who is joining here today. And I will toss it back to you Erica.

Dr. Kimmerling: Thank you so much, Mary, for all your hard work on the COVID response team. I want to wrap up by thanking the amazing group of experts who joined us today to share insights on the essential topic and thank all of you for tuning into this discussion the science behind indoor air, and why we should care about the issue and take action and I do hope all of you who joined us will be inspired to act. We at the White House Office of Science and Technology Policy are committed to engaging on this topic including with the stakeholders that

are on this call. And we are committed to building a whole of government coalition to drive forward innovative practices and technologies for pandemic preparedness. This work is actually already begun through our pandemic innovation task force, which in addition to work on accelerating safe effective vaccines, therapeutics, antivirals, early detection and so much more, is working on ways to reduce indoor air transmission. This team aims to drive technology and implementation and innovation in building design, in indoor air quality monitors, pathogen sensors, and air detection technologies and is also working to elevate indoor air quality interventions as key parts of our public health strategy and to establish federal buildings as an exemplar of indoor air quality innovation.

Thank you all so much for joining us and enjoy the rest of your day.