

Jonathan Zittrain:

Okay, well hello everybody, welcome to the second of what turns out to be a more interminable than we want it to be series about COVID-19, the global pandemic, the national US scene, what we're learning, and what we should be doing about it. Due to the dynamics of Zoom, people are still pouring into the holding pen area for the webinar, so we're going to get to get to a rolling start. My name is Jonathan Zittrain. I teach on many things digital at Harvard University, and I am pleased with Dr. Margaret Bourdeaux and our colleague Urs Gasser to co-chair a unit at The Berkman Klein Center for Internet & Society on digital pandemic response and as part of that we're doing a series of Zoomcasts or whatever we're calling these things these days where we talk with colleagues and people we'd like to be our colleagues about the dynamics of the pandemic and what's happening. What we know. What we don't know. And what you should know as a random person tuning in on Zoom or watching this after the fact.

Jonathan Zittrain:

So we should introduce the rest of our three-person panel here. Dr. Bourdeaux, Margaret, you are coming to us from probably from a COVID standpoint the safest possible place. You're in the middle of a national park, is that right?

Margaret Bourdeaux:

That's right. I'm at Glacier National Park. I'm about 20 miles south of the Canadian border.

Jonathan Zittrain:

Ready to make a quick escape.

Margaret Bourdeaux:

There is some ambient noise around from the train and from folks riding their motorbikes through the park but it's beautiful here and yes, hopefully relatively COVID free.

Jonathan Zittrain:

Wonderful. And Joe Allen, you teach at Harvard University as well in... It's a weird way to put it, but this pandemic can basically be no more up your alley than any other event, right? This is basically the moment you were waiting for.

Joseph Allen:

Well, yeah. I wish it wasn't happening and unfortunately yeah, this is something that we do. Exposure risk assessment and healthy building so yeah, it's right in the alley of this pandemic, unfortunately.

Jonathan Zittrain:

Wonderful. And again, everything has an asterisk but it's really great to have you here and to have the benefit of your expertise as so many of us are trying to sort out what's going on. And we're starting a slight affectation just curious as we check in right now for both you and for Margaret what three words, compound words are okay as a single word, you would use to describe roughly the state of play of the pandemic in the United States of America on today, August 18th, 2020. Joe, what would your three words be?

Joseph Allen:

Thoroughly fouled leadership.

Jonathan Zittrain:

All right. Three words that work together and capturing a certain level of disappointment. Margaret, what would you say?

Margaret Bourdeaux:

Right. Well, I'll keep my word from last time which is reckoning on a bunch of different fronts. Tragic is the other thing I think we have to include now and third is chaotic. I think we're entering a moment of particular chaos as we go into the fall with some places having rising caseloads, other places trying to reopen schools and universities and businesses and it's really very little direction as Joe said in the way of leadership and then sometimes malignant leadership.

Jonathan Zittrain:

And I imagine we'll have a chance to unpack all of those things over the course of our specifics and what we thought we would do is first get a quick update since our last Zoomcast on the state of testing which Margaret you and I talked about with Beth Cameron and KJ Seung. So it'd be great to get a quick snapshot of that situation and then to talk about some of the evolving knowledge we have around the dynamics of COVID, particularly how it transmits indoor, outdoor and under what conditions buildings pose particular challenges, indoor spaces, and then get to school reopenings and talk about that and then get to any questions if we haven't hit them already, from people who are tuned in.

Jonathan Zittrain:

If you're on Zoom there's a Q&A button you can press to lodge a question. If you're on YouTube I think you may be SOL. So with that said, why don't we turn to you Margaret and just fill us in since last time we talked it was a hair on fire moment around the state of testing, in particular, the delays in returning so-called molecular PCR testing. From the time you get tested, it gets hauled off to a lab. Maybe one of just two corporate labs a lot of the time, Quest and LabCorp and then can take so long that the point of having gotten tested, especially if you're supposed to self-isolate if you test positive, is lost when it takes so long to get the answer back.

Jonathan Zittrain:

So Margaret, how are we doing since we last talked?

Margaret Bourdeaux:

Well, again I'm never very cheery on this subject. Not a lot has changed. The states are scrambling to try to make alternative arrangements. So Georgia and Montana where I am right now actually, I actually had to get a COVID test here. One of my kids spiked a fever, and so I had to go and get a COVID test in Montana. They recently announced they had switched labs. They were not going to be using Quest or LabCorp. Massachusetts is working very hard to be less dependent on Quest and LabCorp but still, it's not good. I don't think we're in a better place and I think we're just seeing the result of that which is rising caseloads. We still don't have our arms around this.

Margaret Bourdeaux:

I wish I could be positive but I'm just not. We do see a lot of announcements about new testing modalities that are coming out and a lot of enthusiasm for what might be able to be accomplished once they do but... I'm all about implementation and I just don't see... We need the cavalry right now, not in a few months, so I still feel not great about it. I do think there is a lot of movement behind the scenes because of the testing issue to get governors to work together to make a more coordinated plan. So I do think that is starting to get some traction and there is some movement, so I think that's a silver lining but yeah, I wish I had better news.

Jonathan Zittrain:

Got it. So there might be a rabbit out of a hat at some point but we don't see tips of ears yet even with some of our colleagues attempting I think to help extract the rabbit talking a lot about serological testing, cheap testing that you can do at home as easily as testing your water hardness or something.

Margaret Bourdeaux:

Exactly. I'm also going to [inaudible 00:07:14] back to plug in my phone so... But yes, I don't see any rabbits in any hats. I think this is all about hard work. It is about systematic planning. It is about leadership and not counting that there's going to be some miracle cure, some miracle intervention that is going to save us. We are going to have to actually do the work that is required to control this outbreak and we just have to grow up and do it.

Jonathan Zittrain:

Got it. All right, well while you figure out a car charging scenario why don't we go to you and I don't know if there's anything that you want to add on testing, feel free, but otherwise I'm happy to get right rolling on [crosstalk 00:08:00].

Joseph Allen:

I think I have one thing on testing. Really a colleague of mine at the Harvard School of Public Health, Michael Mina, and others have been in charge for trying to pull this rabbit out really around managing tests and this rapid saliva-based at-home testing. Different from what the NBA and Yale announced at the weekend which is still a saliva-based test but it's also a lab-based test.

Joseph Allen:

There is the technology available for at-home rapid tests. To Margaret's point, we need it now. It can be ready but really it's been a hold up on the FDA's part. So if you're interested in this topic, I would suggest following Michael Mina. He's been writing about it. We put out a video over the weekend on daily quick tests. If you #DailyQuickTest you'll find it. It's got over 100,000 views already that explains the problem with current PCR testing. What these quick tests can do for us and really help people start pushing on the FDA to approve it.

Joseph Allen:

It takes a different mentality. It's not a diagnostic test like we expect at the doctor's office. It's a tool to control the pandemic or help control the pandemic, so we need a mindset shift here and think about how we think about testing. So anyway that's something that I see as on the uptick right now in terms of awareness of new push for one of these rabbits out of the hat.

Jonathan Zittrain:

Got it. And you were mentioning the FDA. Does that mean that there are other countries where this is commonplace, and we're just behind or is the world struggling to do these serological quick tests?

Joseph Allen:

No, not serological tests but yes, others are starting to get on this too, into paper-based tests. And the thing is it's rapid. You can get an answer back in 15 minutes so this is the idea. If you mass-produce them and get them down to real cheap like on the order of a dollar per test and the idea is well, if you can drop these into a hotspot that's experienced an outbreak, you're no longer flying blind. If the accuracy isn't perfect, it doesn't matter if it's every day and rapid. Right now, as Margaret said, we wait seven days. That's a useless test. You get a result back after seven days.

Jonathan Zittrain:

Sorry, this is antigen testing and the antigen is trying to detect the virus itself.

Joseph Allen:

Exactly.

Jonathan Zittrain:

Got it. Okay, let's start talking about ventilation as a path towards talking about school reopenings and for that it'd just be great to in one place get a sense of indoor versus outdoor. So for example, if you're outside and there's a lot of people around. All those pictures of people on beaches, whether or not you're using a fisheye camera, you're passing people on maybe a busy sidewalk but you're outdoors. That kind of thing. How much viral matter might you be receiving if you're passing people who are transmitting?

Joseph Allen:

I can jump in there. The reality is we don't know the dose-response to this virus yet. It's one of the things we need to know, but we do know that time spent outdoors is much lower risk. If you look at all of the outbreaks of three or more people, nearly all of them are related to time spent indoors. It makes sense.

Joseph Allen:

We know how this virus is transmitted and several modes of operating and so if there's been a lot of feet shaming out there, others in our field have been talking about this a lot, but the reality is people can still have as good time as they can during a pandemic as long as they're being safe and outdoors is a great time to do it and in fact, we should be taking advantage of these periods where we have this nicer weather to get outside at a safe distance because your risk is absolutely lower.

Joseph Allen:

One of the key reasons, for one, you have more space but two is that you essentially take this ventilation question off the table. Outdoors we have a hundred percent dilution really. So your risk is much lower for the buildup or exposure to any airborne viral particles even at close distances.

Jonathan Zittrain:

I suspect this is a question you're going to hate to answer but this is classic clueless consumer question I ask on my own behalf, not just a friend. If you had to spend an hour in a public place where would you rather be, indoors with a mask or outdoors without one?

Joseph Allen:

Margaret, I know my answer. What's yours?

Margaret Bourdeaux:

Well, I would do outdoors for sure but...

Jonathan Zittrain:

Still wear a mask, I get it.

Joseph Allen:

No question. I'm with Margaret there.

Jonathan Zittrain:

And how bad is a typical modern indoor space compared to say badly ventilated ones and the outdoors?

Joseph Allen:

Well, the reality is we've been under ventilating our indoor spaces for decades. We are in the sick building era ushered in by our energy crisis in the 1970s where we started tightening up our building envelopes, choking off the air supply to conserve energy. And so the standard-setting body that sets ventilation standards for your home, my home, airplanes, schools, offices, sets a minimum ventilation standard. In fact, by name, it's the standard for acceptable indoor air quality. Ventilation for acceptable indoor air quality. I don't know about you, I don't want to be in a place with acceptable indoor air quality. You want good, right? Or healthy.

Joseph Allen:

But that's the problem. We're in this era of this acceptable minimum and it's set for energy, not human health. Going back to the early 1900s, we used to set ventilation based on infectious disease transmission, and we lost our way. We started tightening up the envelope, driving down ventilation rates so then you have these conditions where people spending time indoors, there's not a lot of airflow. Indoor pollutants build up and that's everything from viral effluent, chemical exposures and in this case, airborne viral particles.

Joseph Allen:

So we're paying the consequence right now for our choices that we've stopped designing buildings for people and I know we'll talk about schools. I could tell you horror stories about the state of U.S. schools and ventilation which is worse than what I just shared now.

Jonathan Zittrain:

And can I ask, how much is carbon dioxide, CO<sub>2</sub>, basically our breath coming out with oxygen going in a proxy for viral purposes how dangerous a space is? I have my CO<sub>2</sub> meter right here. It looks like my space is at 712, is that right?

Joseph Allen:

Yep. 712 parts per million. Yeah, so for background majority of indoor CO2 is from human exposure. Some contribution from what's coming outside. We use it all the time in my field to get a sense of the ventilation rate. So at some point, CO2 will hit steady-state in your room. A level where it's in balance. You could also look at the decay after you leave a room to get a sense of how much it's ventilating.

Joseph Allen:

So if you're meeting this minimum standard in most places you'll be at right about a thousand parts per mill. In fact, I'm a forensic investigator of sick buildings. For a long time, a lot of people in my field will use a thousand as a quick cutup. You go into a place, is it a thousand? It gives you a quick sense. There's lots of caveats around that but people use it as a quick rule of thumb. You should be under 800 now, even closer to 600 ideally.

Jonathan Zittrain:

And outdoor is 400?

Joseph Allen:

Yeah, outdoor is 400 and rising because of climate rising quickly. Our other slow roll crisis that's been put on hold for a few months here. But yeah, it's a useful proxy. You have to be careful about how you use it. But my team, for example, we wired up... Harvard Business School just had a pilot day. A test day. A mock run to get people back to classrooms. So we wired up an entire classroom with these sensors measuring CO2 to get a sense of the spatial and temporal variability as a real-time check that the school was bringing enough outdoor air into that space.

Jonathan Zittrain:

And is the relationship linear or geometric? For instance, if it jumps from 400 to 500 and 500 to 600, is each one 100 units of additional parts per million CO2 just a linear progression or is it getting much worse for every jump you might detect?

Joseph Allen:

It's a great question. And in terms of what we know about let's say ventilation [inaudible 00:16:02]. We know that higher ventilation is associated with a lot of positive outcomes. Reduced infectious disease transmission. I'll talk about it in a second. Reduced or lower worker absenteeism, fewer missed school days, higher cognitive function performance. For this virus, by itself, we don't know this dose-response shape yet. We can't put a number on it that says hey, at 800 your absolute risk is X.

Joseph Allen:

What we are doing is putting these relative terms on it to say well, we know for example, let's take a school and put a ventilation rate on this. We know at about the minimum standard, the target is 15 cfm per person. Cubic feet per minute per person. That equates to about two air changes per hour. Now an air change means the entire volume of air in the space you're in changes with fresh outdoor air. So two air changes per hour means every 30 minutes the full volume is cleared out. So if you target four air changes, five air changes, six air changes, you're getting down to every 10 minutes that air is cleaned out.

Joseph Allen:

So you can see the step functioning relative risk reduction. We don't quite know. We just know it's better. There's a lot of unknowns though which is you want to be in an area that's above these minimum ventilation standards that we know are not set for infectious diseases. These higher rates have been associated with lower risk of things like influenza transmission. We just don't have the exact number for SARS-CoV-2.

Jonathan Zittrain:

And how much could just for a space you might be in but you don't own or control, so you might be a student in a classroom or a patron at a restaurant just visiting, how much could opening a window make a difference for how safe that space is with respect to the breath of other humans?

Joseph Allen:

It makes a massive difference. You mentioned the restaurant. There's a high profile investigation that went around in Guangzhou. This restaurant was recirculating air only. No fresh outdoor... They had an air conditioner. Nothing wrong with air-conditioning unless you're just running it on recirc mode. So they're possibly recirculating the air, and they did computational fluid dynamic modeling to show the air recycling over three tables. A lot of people got sick, even people who were downwind of the infector, the sick person because you have this confined space and build-up of pollutants including the virus.

Joseph Allen:

So if you think about ventilation, we can mechanically ventilate. Like a HVAC system on the roof. But if you open windows it can reach dramatic reductions, and we modeled this for example in cars, showing that even cracking a window three inches significantly reduces anything that's in the air, viral particles in the air.

Joseph Allen:

We just wrapped up testing at a whole bunch of schools which I was supposed to share with my town on Friday but the takeaway here is that it shouldn't be surprising, you open up the windows the air exchange rate goes way up. It's going to depend on pressure differentials, temperature grades and things like this but everybody knows that in the house. You don't need a study to show you this. You open up the window and create a cross breeze. It cools off. You can screen off this cool air outside and you can feel the air. So you can get these dramatic reductions.

Jonathan Zittrain:

So here may be just if only to preclude a patent by just stating it outright so now there's prior art in the public domain. Somebody could build a little device, a gizmo, that you put up in the room like a smoke alarm and it's basically a CO2 detector and if it, taking into account other factors, crests above a certain level says time to open a window or get out.

Jonathan Zittrain:

Is that potentially a way to outfit indoor spaces so that it's not as they say safe space or an unsafe space but say that safety is going to be a function of a lot of the stuff including how many people are crammed into one particular place and how the wind is blowing that day that would let people adapt as they go? Is that a crazy idea, a good idea, a bad idea?

Joseph Allen:

Great idea. So your million dollar idea, unfortunately, is taken. These exist. They're out in the world. My lab at Harvard, we built these from scratch. There's a whole bunch of companies that sell lower-cost real-time monitors of air quality. Some of these can connect to the building information system so in real-time it can to your point, hey, your CO2 hit a certain level. Let's open up the dampers in here. In fact, it's called demand control ventilation. A lot of sophisticated buildings have that. Demand control means if a lot of people came into my room right now if you had demand control ventilation the ventilation would kick up and bring air in.

Joseph Allen:

I really like this as a strategy. My book on healthy buildings came out in April, co-authored by Harvard Business School Professor John Macomber, and we talk about the need to take the pulse of buildings like medical professionals do. It's a signal of some physiological indicator where here we want to pulse of the building and to do that you take real-time measurements of CO2, temperature, humidity, even airborne particles, VOCs, as a way to sense... Buildings are changing every second. When you're in the room it's changing. Certainly they change over a few hundred years, decades, we see this but they actually change within a day.

Joseph Allen:

And so the only way to really know what's happening is to take the pulse of the building and take these real-time measurements so that you can course-correct facts. Consider that Harvard Business School example I gave. We had all those people in there. What happened if the ventilation system went down? No one would know it. We might describe hey, it's getting stuffy in here. It's a little uncomfortable. The temperature's off. You can sense it but you don't know it. And especially not at these levels we're talking about, the 800 parts... You can detect CO2. So the only way to know is to be taking these measurements. Your real-time indicator will say hey, we got to do something different, the room dynamics are changing.

Jonathan Zittrain:

Got it. It does sound like that could either then be ideally the responsibility of whoever runs the building possibly compelled to do it by some form of regulation or failing that, I guess those monitors can be cheap enough that you could have patrons of a restaurant or students in a school designate one student to bring one or have the teacher have one at the desk and if it goes off, we've got to peel off a few kids, or we're going outside. I know it's cold today or something like that.

Joseph Allen:

Yeah, we talk about this with commercial building owners. For years the paradigm was I'm a certified industrial hygienist. These are the people that go out, take measurements and in past years, we'd go out, take an air sample, send it to a lab. The data comes back and it's owned by the company and protected usually. And everything's filtered through the company. Well now, employees are coming in with this \$100 sensor, and they don't need a fancy test or industrial hygienist. They just go hey, I just told you a thousand's this limit. John, when you into your work, and they say it's 1,200 in here and you send that to your facilities person.

Joseph Allen:



So it's democratized this healthy buildings idea and people are sharing that data. They are sharing that. Buildings are getting labeled sick buildings. You actually see this on websites like Glassdoor. They don't just talk about their salary, their title, how much money they're getting. People say this place smells like garbage. The ventilation's poor. I've been measuring it, the air quality is off. And so these kind of labels are getting stuck on buildings now and it's because of the democratization. People can finally make the invisible visible with these cheap sensors.

Jonathan Zittrain:

We have... Oh sorry, go ahead Margaret.

Margaret Bourdeaux:

I was going to say. Two other questions that's fascinating but I'm sure that just to set the stage for our audience, one is, is COVID transmitted through the ventilation system and I think that's one thing. Given the data that you have right now, is COVID able to travel through air ventilation systems and how far can it travel?

Margaret Bourdeaux:

And then two is, I'm sure a lot of folks are thinking well this all sounds good, but we're in Boston and it's cold outside. We have tough winters. How do we deal with the elements in the winter? Opening up windows seems... I saw the pictures from New York City of all the kids sitting in their toots and coats and having outdoor school in the winter during the flu pandemic of 1918. But those two things. I'm sure you get those questions a lot.

Joseph Allen:

It's a really good question and interestingly enough Dr. Fauci was with us at the School of Public Health two weeks ago on the floor and I got to ask a question and I asked him about his position on airborne transmission. It's worth bringing it down for a second in that there isn't evidence yet and I think it's unlikely that it gets transmitted through the duct into an adjacent room where someone can get sick. But there is plenty of evidence that the virus can be transmitted airborne within the room and that's beyond this magical six-foot buffer. And so it's worth breaking it down a minute to understand where that came from.

Joseph Allen:

And where it comes from is this. Revered organizations like WHO still say this that five-micron particles... So first, let's back up. If I'm sick and I cough or sneeze or just talk, I emit a continuum of different particle sizes. Some will settle out quickly through the gravitational forces. Some will float into the near field if we're talking and some will float beyond. WHO says most five-micron particles settle out quickly before that six-foot buffer but that ignores the laws of physics and many in my field are quite... We don't understand where that comes from because the reality is a hundred-micron particle is what settles out within three to six feet. A five-micron particle will stay aloft for 30 minutes or more and if you look at even basic airflow in a room it can travel across the room. We know this from aerosol physics. There's no question.

Joseph Allen:

So the science there tells us this can happen and the reality is you emit a continuum particle sizes but very quickly within a second the large particles in respiratory droplets evaporate. So they might be large

at the beginning, but they become what we call droplet nuclei, smaller airborne particles that can spread airborne. So let's break that down. That's one line of evidence in the airborne physics of this.

Joseph Allen:

Second, we've got air sampling. We've now detected the viral RNA in places that can only be reached through airborne transport like in ducts. Not saying it's infectious but showing that it travels certainly beyond where a patient would be in the hospital. The pushback is then well that's not viable. That's just RNA. Last week someone isolated viable virus 16 feet from a patient. Again showing that not only is it ready to pass that six-foot magical barrier but that it can be viable.

Joseph Allen:

Third, we go to case studies and this is right in my wheelhouse with the examples of the choir practice, the restaurant outbreak. My team has modeled the cruise ship outbreak and in each of those, we've shown quantitatively through modeling that airborne transmission is occurring. In fact in the cruise ship example, we estimate that around 35 to 40 percent of the transmission were aerosol beyond that six-foot buffer.

Joseph Allen:

And lastly, at the epidemiology we have the super spreading events which certainly suggest like other airborne viruses, traditional airborne viruses, that have a higher transmission through airborne. So I think if you look at the totality of evidence there. Physics, the air sampling, the quantitative modeling and the epidemiology, it certainly all supports the notion that transmission's happening beyond six foot and for me, I said this going back to the first piece I wrote in early February, it's likely airborne transmission is happening, so we should be prudent in putting controls. The scientific community will argue this for decades. We still argue about influenza transmission modes. So we're going to argue... We won't be resolved forever. There'll be a thousand papers on this but right now in the pandemic I want practical, I want implementation.

Joseph Allen:

So bring in a little more fresh outdoor air and you know what, if we're wrong about airborne transmission and it's like 2%, okay you brought in more outdoor air but if we're right and it's 40%, and you're not putting in that control and adding that to mask-wearing and hand washing and distancing, well, that's a major problem and that's where we are right now and I think all the evidence, every piece of evidence since February supports it. There has been nothing to refute it, so I think it's really practical and prudent that people take these healthy building control strategies and put it in their arsenal of risk reduction strategies.

Jonathan Zittrain:

Kind of a nice way of illustrating that maybe the esoteric debate between the respiratory droplets or aerosols is itself sort of esoteric both because of the 1% doctrine you're mentioning which is like if there's even a small risk that this could be a significant factor we should be accounting for it now and because it sounds like there can be a shift back and forth even between those categories.

Jonathan Zittrain:

Maybe that's a way into talking about school openings because so far it's sounding like if you can open a bunch of windows you're in better shape but a lot of schools, as at least two of our questioners have

pointed out, tend to be built possibly because of oil shock with windows that don't open and otherwise poor ventilation. Yet you're bullish on opening the schools. You've written positively about that and it'd be great to understand more about thinking about school reopening in that way.

Joseph Allen:

Bullish I don't think is quite right. Look, there are two conditions precedent. One, you have to control the spread and two, you have to make enhancements to your risk reduction strategies within the school. So it's the when and the what. When to open and what has to be done and so that's where I've been bullish to say hey, if you do those things, sure, schools should open.

Joseph Allen:

But if you look at what's happening say in Georgia where they went back to schools and there were cases. Well, look what they did. Community spread is outrageously high and well beyond the methods we proposed with others at Harvard about what's acceptable for reopening. So they failed that and then on the what to do, you see the pictures in there. It's overcrowding. No mask-wearing. I've read their plan. They don't talk about ventilation filtration. So they failed on both. So it's not really a surprise that we've had cases in schools when they failed to follow those two aspects of what metrics have to be met.

Joseph Allen:

I am confident if we meet those metrics you'll have low community spread and the probability of entering into the school and your new cases lower, that's obvious as a numbers game. And then if you put these other strategies in place which we know work in hospitals and elsewhere, including and beyond airborne transmission, it's mask-wearing, it's de-identification, it's managing flows of people and queues of people. If you do those things we know we can really drive down risk. So it's not quite that I'm saying hey everybody... I'm not doing the Trump here. Everybody get back to school without giving a plan or strategy or resources that says if you meet these conditions, sure, get back and if you don't then you should expect cases like we saw in Georgia.

Jonathan Zittrain:

Margaret, I know you've been thinking a ton about this too.

Margaret Bourdeaux:

Well, yeah. My concern, as Joe has already mentioned, is really what is the context in which you're opening schools and I go back to if basically your community transmission is not really controlled... And it's really two things. It's not just how many infections you have in your community. That's certainly part of it. But it's also really understanding how robust your public health measures to end community transmission are and I still feel like people treat this like a hurricane. They're like, well the wind speed has gone down so it must be safe to go outside. It's like actually it's not a hurricane. It's stuff that we actually have to take action on to drive down community transmission rates and levels of the virus circulating in the community and then take those actions and then let's talk about reopening and taking on more risk or at least have that context in mind.

Margaret Bourdeaux:

So that's where I think there's just a tremendous amount of magical thinking where we just think oh well, okay yeah. We've put some money in public health. Oh yeah, we have a contact tracing program. We've told people to wear those masks. But actually our testing is still very weak. We still are only

detecting about 10 to 20, maybe at most 30% of our active cases that are infectious cases in our communities in general and that's just... I think it leads people to believe that things are safe and that they're acting responsible when they're not.

Margaret Bourdeaux:

So the other thing that really bothers me, just to say, is we do need a national plan. We need a strategy and that is to coordinate resources, to set standards across states and communities, to have a clear-eyed view of how we're even measuring community transmission. That isn't in place and so that's where my frustration is. Is in that we're not having a very intelligent conversation about really what we're dealing with to date and so that's not related to schools and whether schools could be made safe. They absolutely can be made safe. We've seen buildings like hospitals as Dr. Allen has pointed out. We can make places safe but I think that it's asking a lot to say okay, let's reopen schools when we're not having a smart conversation about where we stand with community transmission in general. I don't think that's that controversial but that's my soapbox.

Jonathan Zittrain:

Thank you. That absolutely to accord between the two of you with the need for a national plan. In the meantime, given that we don't have one, it sounds like what you're each saying is there are conditions in time or somewhere within the U.S. where I guess transmission rates appear to be at their lowest where maybe it would be okay to hazard a reopening, ready to spring the trap shut again if we see community transmission going up. Is that the basic idea?

Margaret Bourdeaux:

Yeah, I think that that's right. I think in some senses the K through 12 public school reopenings are in a better place to consider that then we are in universities because there's something called interstate transit where people come to universities from other states bringing with them potentially the virus, and so we are... I guess I feel a little bit like a worm on a hook where we are trying to cope with uncapable things and conditions, instead of trying to turn around and face them and fight for them.

Margaret Bourdeaux:

We need to fight for a national plan. We need to fight for a cross-state plan where we get our governors to agree on standards and approaches and share resources intelligently, and so I think that my point is that let's embrace that challenge in addition to trying to make do. But I don't want to just continue to just say okay, well they just have to make do. We live in a democracy. We live in a country that we govern ourselves, so we can put pressure on our leadership to do better and to work together. So I just want to let people off the hook of that particular challenge as we pivot to talking about things like school reopening.

Jonathan Zittrain:

And how much should part of the formula be whatever insights the community is coming to, the scientific community, the medical community, about the dynamics of this particular illness among kids because we've heard a lot of different things about it. All else equal and with your interstate travel piece out of the equation, let's just say K through 12 or Pre-K through 12, is it a different thing with a daycare center versus a third grade versus a seventh grade because of anything we know about how susceptible people of different ages are?

Margaret Bourdeaux:

This is interesting because Dr. Allen and I might weigh this a little differently. I'm a pediatrician by training and I think this has really been a struggle for me personally. We're dealing with a virus where yes the evidence in general shows that children either certainly don't seem to be getting as sick from it and don't seem to transmit it as readily but I really have to say there's some things that really give me pause.

Margaret Bourdeaux:

This is a new virus. We really don't understand the long-term sequelae. I am worried about being overly reassuring in this regard when I don't really understand the risk. That being said I think the risk of keeping kids out of school is tremendous and that's a known risk. So I really struggle to balance known risk which is significant against unknown risk that might be from very low risk to a very significant risk. Dr. Allen, how have you felt about that?

Joseph Allen:

It's really interesting. You're right in it. You're a pediatrician dealing with the kids. My background is exposure risk but in public health so it's population statistics. I think about this virus as not [inaudible 00:38:46] in many ways but in a lot of ways with kids it has and there were made three really additional important questions when you think about this reopening questions around schools. And by the way, I just want to say quickly that the plans we put in place, that my team put out, also is intended to protect adults so not minimizing teacher and administrator risk but just talking about kids for now for a second.

Joseph Allen:

They're less likely to catch this than adults, so I think that's pretty robust at this point. It becomes a joint probabilities question here because then if they get it they're less likely to suffer the most severe consequences. A really large serial prevalence study just came out of Europe. 358,000 cases in kids. 11 deaths. So the infection fatality rate is nothing over three in a hundred thousand. And of course, it can happen. Fortunately, it's rare but the infection fatality rate risk is quite low for kids really. The unknown potential long-term effects notwithstanding, of course, the impacts of relatively minor infection but on a fatality question, they're spared there largely relative to adults. And there are step functions at certain age groups in that risk.

Joseph Allen:

Third is the transmissibility question and it also violated the full body that looks like kids transmit less than adults. Certainly, the zero to nine-year-olds do. In the one big study out of South Korea it's about two or three times less. A lot of people are jumping on that South Korea study that showed... There's a big headline in the New York Times unfortunately that said 10 to 19 years olds transmit the same or more than adults. Well, a lot of us flagged that when it came out. We looked at the data. There wasn't something quite right in that age group. It didn't look like the immediately younger age group and the immediately older age group. They looked like 70-year-olds. It didn't make sense. A lot of us were concerned about the methodology there. About identifying who is the index patient and when and it turns out just last week that study was largely corrected.

Joseph Allen:

It was an erroneous finding. It was an erroneous headline a couple weeks ago but that headline hit millions of people. You'll see everybody said well 10 to 19-year-olds they spread the same as adults and

the correction, maybe it got a dozen likes on Twitter or something like this. Anyway at that was three big questions. They're less likely to die from it. Really robust. Looks like they transmit it less and again to what Margaret said, these massive cost of keeping kids out of school. It's a story that's not being told right now.

Joseph Allen:

We hear stories of cases and importantly we do but there's this stat recently, 17 million kids don't have access to high-speed internet. 10,000 kids in Boston in May were virtual dropouts. Only half the kids in Philadelphia in May in elementary school checked in each day. I've had emails from teachers saying look in June, I haven't heard from my students since March. I don't even know if they're okay. I'm worried if we don't go back what's going to happen to them. So the stories right now, over the next couple weeks, will be cases in schools. Headline news but next year public health headlines are going to be horrific. If we don't think there are consequences to keeping tens of millions of kids outside of school, they're at higher risk of abuse and neglect, exploitation. The loss of learning. The loss of socialization. Over 30 million kids rely on schools for meals.

Joseph Allen:

These are massive costs and it's horrifying to recognize that our country hasn't prioritized this. Getting kids back knowing that these consequences are so severe, and yet we're screwing around on the edges here honestly with reopening bars and restaurants and not doing the thing that is our first and number one priority which is getting kids back to school and keeping community spread low. So anyway that's a lot of monologue there but really I think it's important to think about risk not just in the classroom but there's bigger conversation of risk and put it in context, and we're not seeing those stories. It's a missing story because these kids are missing.

Jonathan Zittrain:

Maybe I can ask something to tie together a lot of what we were just talking about with your mention of the study that then turned out to be retracted. As is no doubt well known to people in public health trying to communicate a message that people can easily grasp and hear while they're dealing with yapping kids and juggling the groceries and everything is very different from capturing every last subtlety and difference and I wonder if that translates to public policy as well.

Jonathan Zittrain:

That trying to have too many different factors about when you can reopen and then you have to shut again and what data you'd measure to know when you are in one zone or another. That how much should the policy guidelines be rather crude even at the risk of missing some of the distinctions that you've both been so nicely talking about particularly when, if I'm just projecting out a little bit, it sounds like if we were to be more discerning it would probably mean that communities that have the budgets and the buildings to already be healthy or make them healthier then thanks to the subtlety they start going back to school but communities that have worse physical infrastructure, less of a prospect of ameliorating it and more community transmission because we know this is hitting poorer marginalized black and brown communities significantly more than the baseline.

Jonathan Zittrain:

Does that mean we would basically end up with a tiered system where thanks to the various subtlety that we're trying to capture in when it's okay to reopen you end up with communities where everything

feels fine and then you have communities left behind still stuck online because we didn't have the rising tide try to lift all of the boats.

Joseph Allen:

Yeah, it's a really good point this equity question. Like we've seen already, this virus is exposing deep fissures within our society, the structural racism that's in our society that exists within these schools. If we keep kids all at home that's going to exist for the exact same reason and if you bring back some, well that inequality, inequity is going to exist and be exacerbated as well. There's no simple answer here other than honestly it's a systemic issue that needs to be fixed and fixed fast.

Joseph Allen:

And we haven't put forward the resources. Think about what we've done for stimulus right here. Where has the real stimulus been for schools? And I don't mean starting August 18th. We should have been working on this in March when these schools closed. How are we going to get these kids back? What resources do we need to fix our schools? 90% of schools don't even meet that minimum ventilation we were talking about in the beginning. 90% of U.S. schools don't even meet the minimum virtually about half, and so we have failed as Margaret said with this national response.

Joseph Allen:

The resources aren't there. The seriousness is not there and that's the way honestly because different communities can... Some people can lock it up and say my kid's going to learn from home. That's great. Well, I bet you have resources. I bet you have money. Maybe two parents in the house working or high-speed internet. Maybe you have two computers and an iPad. Okay, but that's not the reality for the vast majority of the country and so this has to be fixed.

Joseph Allen:

Margaret mentioned this nicely. This has to be fixed at a national level. This ad hoc approach. Every community doing something different is not working. In fact everyone's fighting without some centralized message and the message is totally lost and confused because we shouldn't be a small Harvard program on healthy buildings putting out guidance for schools. This should be done by the CDC and where is that national guidance and leadership? It's just been so absent since March and it's exacerbating the structural issues in our society like everything else this virus has exposed.

Jonathan Zittrain:

It seems like a key message that should come in stereo. So, Margaret?

Margaret Bourdeaux:

I can barely talk about it. When you really step back and take a full measure of what's happening here it's a horror movie. It's watching everybody stampede for the exits and trample on each other. I'm a big fan of zombie movies because the theme of zombie movies is always... It's not the zombies that are scary. It's what we're willing to do to each other that's the horror of the zombie movie and that's very much how I feel about this.

Margaret Bourdeaux:

So to your point, I think basically it's a damned if you do, damned if you don't kind of situation whereas kids that are most in need of school who are most going to suffer tremendous consequences if they can't go to school are also being... Their option for school is the least healthy option and the one that's exposing them the most and of course, they are likely to be children of parents who are not so much essential workers as they are disposable workers. People who cannot stay at home to work. That don't have health insurance. That don't have work protections. That are being forced into job scenarios where they are having to interact with lots of people and in dangerous situations.

Margaret Bourdeaux:

So it really is... I don't even know the word frankly... Horrifying. But that's where we're at. So let's get real here and start to think about... I think the way that I would say it is when I got into public health I have to admit, I'll just say this is my own bias, I thought about okay, you're going to do the intervention that's going to help 80% of folks and okay, then you'll work to try to address the 20% that you leave out. That's true of medicine too. You're like okay, let's think of the intervention that's going to help the most. Kind of a utilitarian approach but really what we have to do is the opposite. We have to start on the margins. We have to throw our weight towards the people who are the most vulnerable, the most exposed. That's where resources should be going because as they become more protected, safer, healthier, that's going to actually have the knock-on result of helping the 80%.

Margaret Bourdeaux:

So anyway, that's been my own realization or journey about how I've started to flip this because I think there's just a lot of shrugging. Oh, of course, poor people are going to suffer more. We shouldn't tolerate that as our starting position. We need to flip that.

Jonathan Zittrain:

So given the absence of national leadership here and the chaotic scramble that's happening right now, the really scary part of the zombie movie as it were, are there best practices that are emerging that would be able to leap from one school superintendent to another even across jurisdictional boundaries, one public health authority to another or even one parent to another trying to make a decision in the interests of their child about whether to send them to daycare or to elementary school or even back off to university?

Jonathan Zittrain:

Have there been ways in which we've seen islands in which this is being done right that we can try to light a taper from that and spread given the absence of national leadership and understanding this is a distant second or third best but are there things we're learning that are simple and concrete enough that could be captured as best practices?

Joseph Allen:

I think that answer is definitely yes. I have to say through all of this the one bright spot has been I think the scientific and medical communities for the first time in history, the whole world, every scientist and medical professional is focused on the same problem and breakthroughs are happening, really. And they might be not on the headline news all the time but I'll give you one example for school.

Joseph Allen:



So we put out a guidance report, and then we paired up with other scientists at Harvard and beyond and said it's like this machine, inside the machine that's percolating just under the radar and social channel... People I've never collaborated with. Hey, I like that report. This is my field. Can we take your report and make a checklist? I'm going to get it out to every superintendent. And that's what we did with Ariadne Labs which is a tool [inaudible 00:51:30] runs it now but that was like a collaboration. They were really good at talking to superintendents. I didn't have that connection. They liked our report. They took it.

Joseph Allen:

And so these kind of things are happening. And that's one of a million stories. I have all these new collaborators I've never worked with in the past but once because people are just saying my problem's solved. Hey, you have this. I have this. Let's get together. Let's get a message out. We did this last weekend, new colleagues of mine out in Portland said we want to put together references for parents. I said great. We made a website. 20 questions every parent should ask before sending their kids back to school. Questions you should ask. Little blurb on what you should expect for the answers. Things like this are really happening. Spreading through social media.

Joseph Allen:

The unfortunate thing is maybe we're hitting some fraction of the population. I'm sure there are other people doing the same thing. It's just not cohesive so the message isn't tied everywhere but it's certainly happening but it's ad hoc really which has its own problems. But the message is getting out. To your point about what do we know about how it's spread. They're also about these control strategies and tips that people can use. We built an online tool for people that helps select important air cleaners for schools [inaudible 00:52:45] how do you do it? So we built this little tell tool. Another set of professors built another tool on how to assess risk in dorms. They're like Google sheets but people can plug and play in them and I think they're really helpful to people so that's what's percolating, it just hasn't bubbled up to some cohesive national strategy really. It's all ad hoc.

Margaret Bourdeaux:

You can take it as a positive thing or negative thing but the fact is that if you look at basically any state or even any community where the infection was rising, you see people individually, collectively trying to take actions. I'm very amused that one of the funny things I feel like has been a commentary throughout this entire process is this nay-saying about Americans. They're like well Americans will never shut down. Americans will never wear a mask. Americans will never blah blah blah. And actually every single time you've told Americans do it, this may help you, by and large, they have. We have 75% of Americans saying that we want a national mask mandate. This idea that we can't...

Margaret Bourdeaux:

So I totally agree and I think there's tremendous energy and people are working to try to figure out what to do and how to be helpful and how to open their schools. How to support their communities. That cannot be denied. That is definitely happening. I do want to say, usually in these situations, however, whenever you have a DIY public health response there are the losers, there are usually the most marginalized and vulnerable and that just is a tragedy, and we shouldn't tolerate that but I agree, there is a lot of effort and people with a lot of great ideas so that's a good thing.

Jonathan Zittrain:

Well, I can't help but be trying to grasp for the practical even acknowledging the implausibility of a sudden transformation of national leadership in the near term and I just wonder is there a category of idea that's doable while still quite big and probably politically only doable if others are seen doing it?

Jonathan Zittrain:

An example would be a kind of standard outfit for an outdoor heated tent in which... Put it in the baseball diamond of the school or the football field or the parking lot and that becomes a year-round place in which to do classes or a way of staggering groups. Things that are not just let's punch a hole through the wall and ventilate our classroom and otherwise do it as we normally doing it. Is there work being done on things like that that really would require a certain commitment but that don't seem like having to plant a flag on the moon?

Joseph Allen:

I like that question and this motivated a piece we wrote at the Washington Post at the end of July, I wrote it with another professor, which was we're short on time and resources. To your point, what can schools do? We're not going to put new mechanical systems on the roof. I've heard some people saying every dock should have UV lights in it. That's not going to happen in the next two weeks here. So we talked about the strategies that can really reduce risk, and we reached the School SMART with SMART as an acronym. S is stay home when sick. That eliminates some fraction. That's obvious. We have asymptomatics, you have to do everything else.

Joseph Allen:

M is mask up. Everyone should be masking by now. A is where I think it gets interesting. An air cleaner in every classroom. So I talked to an air cleaner manufacturer to hear what their capacity would be. If we had a stimulus, a billion dollars, we could put one of these in every classroom. What can a portable air cleaner do if they have to filter? Well, what we were talking about earlier in this podcast about air changes per hour. Remember, schools might have two, one air change per hour. You want to get to five or six air changes. You can have a portable air cleaner in a room you're in. It can give you four to five air additional air changes per hour.

Joseph Allen:

So for a couple hundred bucks, you're essentially giving that... That's a solution. Plug and play. Plug it in and the filter sits in the middle of the room. That's an important strategy that I think could be done to your point like what's now. It's not that technologically savvy. It doesn't have to be. It can be equitable. Shift these things all over the place. The manufacturer is on board. We're providing stimulus for vaccine makers. Let's get the manufacturers of these portable air cleaners to put one in every classroom. I think that's doable. That can be done in the next couple weeks.

Joseph Allen:

Four is R refreshing the air and the ventilation and T to your point, it's temporary classrooms. Let's put some tents. Let's use the ball field. Let's get creative. Look at what the medical community did. The Javits Convention Center and in Boston, they were turned into hospitals. They were tents in Central Park. We should turn convention centers into schools. Let's put tents in every park. We can get real creative here instead of saying well, we have this old crumbling infrastructure, what are we going to do? Let's just jam a thousand kids back into it and do everything the same way. Instead, I think there are some creative solutions out there.

Joseph Allen:

To your point, we're running real short on time here but there are things that can be done, and we know these reduce risk. We know it. Masks and ventilation. Air quality. Hand washing. It's really all they're do... Not all they're doing in hospitals, but they're doing it really well. They don't physical distance. High-risk environment. We know these things can work.

Jonathan Zittrain:

Gosh, instead of a chicken in every pot it's a HEPA cleaner in every classroom. It doesn't have the same ring to it.

Joseph Allen:

It does to me.

Margaret Bourdeaux:

Yes, it does to me too.

Jonathan Zittrain:

So we're coasting the top of the hour. I think it would be great after we formally adjourn, any of the participants who want to stick along, feel free. We'll just quickly rifle through the remaining questions as the deleted scenes but to bring us in for a landing, it'd be great if each of you could give us what you figure the headlines are going to be six or nine months from now and maybe to make it not too bleak if I'm anticipating where you would go, feel free both to share the headlines that you plausibly would like to see if things could come together.

Jonathan Zittrain:

But start with what's the likely headline? What's going to be, nine months from now, what would normally be maybe looking towards the end of a school year in May or June or something, what do you expect to be top of mind, front-page stuff with respect to the pandemic? I don't know, Margaret, you want to go first?

Margaret Bourdeaux:

Sure. I'll try to be more positive. Let's see. Well, my hope is that the headline would be something like governors rise to the challenge. Ensure struggling school districts have resources to keep their students safe. The school year ends with... Despite fears that it ends on a lot better note than we thought, and we are now bridging into a national plan that is coming together with the next administration, whatever it may be.

Jonathan Zittrain:

And filter media company producers stock is at an all-time high. Pays out massive dividend. Okay, and Joe, but feel free also not just to give the desired headline but the plausible one. I'd love a crystal ball gaze.

Joseph Allen:

Yeah, I'll be plausible. And I actually am optimistic, I'm not going to lie. I think the headline for next spring will be the Biden/Harris administration starts to follow the science again. Reelevate scientists and

put in a cohesive national strategy. Elevate CDC again. Start following recommendations, and we get our testing strategy in order. We should have been doing this in January, and we failed. So I'm hopeful there.

Joseph Allen:

I think I had in our piece in Washington Post in July about six signs for optimism talking about things that I think will come. I think therapeutics are looking pretty good. I think everyone's waiting for the vaccine at the end but therapeutics... Hopefully, we have some already for the most severe and ill but other therapeutics for those even with relatively minor infection. I think that looks good. I hope that we have a new set of tools for the doctors of the world to treat people with ahead of the vaccine, so I'm hopeful there. I'm hopeful for these rapid at-home tests that say hey, you're looking to get back to work. Well, pop your 15-minute daily quick test and let us know that you're most likely clear and it's a way to tamp down explosive super spreader events.

Joseph Allen:

So I think those are all doable. I think they have been doable since January. Look, we've known there was a plan to save lives and livelihoods right from the beginning. We knew since March. Other countries did it so it's not like this is rocket science at this point what needs to be done. As Margaret said earlier, it's about hard work. It's about doing the real work. Everyone given their own responsibility in terms of our own personal behavior change but also relying on ultimately government to do their part in putting this plan to put us in the path towards a happier spring where kids are actually back in school. Wouldn't that be great? I'd be thrilled if I'm back on the baseball field with my kids next spring. That would be a home run. And I'm taking next summer off too by the way.

Margaret Bourdeaux:

Exactly. We're all going on a cruise, right?

Jonathan Zittrain:

Well, that's the sequel to the horror movie. Okay. This episode of our Zoomcast, sponsored by Princess Cruise Lines but... Joe, Margaret, I'm thanking you... You're co-hosting but I'm thanking you both so much for, to use a perhaps fittingly airborne metaphor, dissipating some of the fog around these topics. Really grateful for it. Looking forward to checking in again as we go, and we can compare against our predictions, and we'll try to see if there's other links we want to paste into the conference room, referring some of the stuff. I'll get Michael Mina's Twitter account posted there too, and we'll go from there. To our participants, thank you for sticking along with us.

Jonathan Zittrain:

We will now just pause a moment for station identification and then I'd love to just run through some of these Q&As of people who put them in while we were talking if that's all right and that'll just be a little extra bonus at the risk of losing some cohesion. So okay, let's go right to it. It almost seems like a... I'd almost hit the buzzer for each one.

Jonathan Zittrain:

[Ryan Budish 01:03:35] asks looking ahead to a post-COVID-19 world, fingers crossed, does any of this work on rapid testing vaccines et cetera going to be useful for any other diseases, virus or other medical issues? Are we going to cure the common cold out of this after all? That's Ryan's spin on his question.

Joseph Allen:

Go ahead, Margaret.

Margaret Bourdeaux:

I'm not sure but I think there will certainly be real advances on how we understand this class of virus and I also think... I am optimistic that we are going to come out of this with a new and revised and rebuilt public health system in this country and a new way of delivering healthcare in general. So I think there's all sorts of great benefits that are going to come out and yes, I do think we are going to have some advances in therapies and countermeasures against coronaviruses in general.

Jonathan Zittrain:

Got it. Couple questions about transmission. Have there been any known transmissions outdoors?

Joseph Allen:

There have, yeah. Really limited but the vast majority are confirmed to be indoors especially when it's multiple. But yeah, there have been a small fraction, sure.

Jonathan Zittrain:

That's just interesting to see in this also era of protests and such, the number of people mingling together like that, sometimes with masks, sometimes not. Quite something. If it's 40% airborne transmission, what's the other 60%? Surface contacts or does airborne transmission just mean beyond six feet?

Joseph Allen:

Really good question and so a caveat. That's our modeling based off the cruise ship which is like an ideal experiment. You know the infector. You know the time course. Who got sick when. Where they were in the ship. And what we're doing is taking that and using that model to build a tool that anybody can use in any indoor environment. You plug and play your dimensions in your space and estimate risk. So that'll come out in the next week or two. Our team's finishing this web-based model. [inaudible 01:05:52] caveat there. That's our estimate. Others have estimated different numbers.

Joseph Allen:

We don't know... Like I said, we're going to be talking about this for decades, what that number is, but we know that other modes of transmission are operating. Close contact, large droplet transmission is happening. There's some contribution from [inaudible 01:06:09] or contaminated surfaces. Looks like it's less big roll. In terms of aerosol-based, really interesting, what's happening is that distance still matters. You can imagine, if Margaret and I are talking face to face and even if the large droplets settle out quickly, she's going to get a bigger dose of aerosols at three feet than six feet versus 12 feet. So distance still matters.

Joseph Allen:

There'll be fewer particles at the other end of this room than there will be close to me. Imagine if I'm smoking a cigarette at three feet it's going to be really noxious, six feet noxious but at the back of the room you'll smell it unless there's great ventilation then you won't even smell it. So I think that's a useful

way to think about it. You still want to distance and all modes of transmission are operating. I'm not saying open up the windows and forget about hand washing. Absolutely wear a mask too.

Jonathan Zittrain:

And there's not just distance, there's time I suppose. If you had a perfectly sealed room with a big cloud of virus in it of all the various sizes and distributions if you just wait for a while, does it disintegrate on its own?

Joseph Allen:

I've got news there. These particles will stay aloft indefinitely. In fact, they're going to be removed in one of four ways really. Eventually, they'll impact on the walls. That's a small contribution. They'll be diluted through ventilation. They'll be cleaned out of the air through filtration, or they deposit in the lungs and of course, we're trying to avoid that last one and I mention it but this isn't a minor thing. When you do indoor air quality modeling you have to account for loss in the lungs. You model risk in a school classroom a certain number of these particles are being breathed in and so those are removable.

Joseph Allen:

These small particles, they just stay aloft. These aren't like orphaned puppies, if they can't find a lung to adopt them within a certain period of time they waste away. Over a certain amount of time, the virus can be a little less active but really, if you're staying in a room and I'm coughing in this room and I'm infectious and releasing this viral, it's going to increase, increase, increase until one of those cleaning mechanisms happen. Removal mechanisms. Dilution, air cleaning through filtration or it's going to get absorbed through the lungs and that's the reality.

Joseph Allen:

Over days, yeah, that's different. Of course, nothing's a perfectly sealed box. You close your windows, buildings are still breathing. A typical home has half an air change per hour. You think well my windows are all closed. Yeah, your building's still breathing through little cracks and crevices. So there's always some dilution happening. Fortunately, no one's in a perfectly sealed box.

Jonathan Zittrain:

That raises the question about filtration. At least a couple people have asked about... They're trying to wade through should they get a little filtering unit for their room or their office and if so all of the constellation of words HEPA and MERV 13 and all that. Is there anything that cuts through that or...?

Joseph Allen:

Let's demystify that because it's not that hard but I understand for a lot of people it's a first time they're thinking about these things. Let's demystify it entirely. Let's start with HEPA. A lot of people see HEPA on a box. These are high-efficiency particulate air cleaners. And you maybe have seen 99.97% removal. And some people say well then it doesn't catch the small ones but the reality is filters are rated on their worst performance particle size. So .3 microns for a lot of reasons, I could tell you why, is the hardest for filters to capture and bigger particle sizes near a hundred percent but small it's near a hundred. So remember that. If you see 99.97 that's nearly a hundred percent prevent the particle sizes we're interested in here.

Joseph Allen:

These can work and actually we have that tool on our school website if you want to say oh, would it work in my bedroom or office, measure the size of your space, high to your ceilings. We have a five-step thing. How do you select what we call clean air delivery rate for your HEPA filter? It's really straightforward. So anyway, that's HEPA filtration.

Joseph Allen:

If you're in a building and you have mechanical systems up in the ceiling let's say, you still want to use better filters to capture your circulated air. The ratings system's not HEPA based. It's called MERV. M-E-R-V. Typical building has a MERV 8 filter. Captures a small percent of airborne particles, not designed for professional control. You want to upgrade to a MERV 13 or better and that'll capture a greater percent. So really simple. MERV 13 in your mechanical system say in your office or your central air and if you're thinking about a portable air cleaner for your school or home or even your dorm room, it has to be HEPA based. And avoid the gimmicky stuff. You don't need a air cleaner... You see something with plasma or ion generation or UV. You don't need it. Just a HEPA filter works really well.

Jonathan Zittrain:

Got it. Margaret, anything we're missing from your point of view?

Margaret Bourdeaux:

No, I would defer all questions to that effect... I'm learning here too.

Jonathan Zittrain:

All right. Well, let me just plow right ahead then. On filtration, one thing is to have some central way of treating the air in the room. The other of course is to stick a filter over your mouth which I guess is a mask although not typically the way we're thinking about the build-your-own masks which are about preventing your output more than it is filtering your input. How close are we, how possible is it to have sufficiently good masks, I don't know if we're talking N-95, P100 or those are the MERVs of masks, that could make it so that you could wander into that still rooms that has a miasma of virus in it and feel relatively secure?

Joseph Allen:

So, I'm not saying we should go into those spaces. If they're under-ventilated you should leave. But the masks are doing a really fine job here and you might be surprised that even these homemade masks we're using and even gaiters, despite that headline that came out, can actually be effective and here's why.

Joseph Allen:

Normally if you're in a healthcare setting or let's say a worker in an industrial setting wearing N-95. You're protecting yourself. There's no other control on the other side. Take two people wearing masks in a room at 50% efficiency. Not anywhere close to N-95. The particles that come out of my mouth. 50% [inaudible 01:12:23] through my mask and then another 50% through your mask. That's 75% reduction. That's pretty good for a mask that doesn't work that well and everyone can get a hold of anywhere and put on their face. Some of these masks it's 60 or 70%. The combined effect of two masks then starts to push 85% or greater. You can get up to 90%.

Joseph Allen:

So this is the importance of universal masking. If you were going to go into a really high-risk environment, no one's wearing masks, people are sick, then you better have something like an N-95 on. A doctor would wear one. Once everybody has these source control masks on, it drives others... And I'll tell you, all the risk calculators including the one my team is building from the cruise ship that are out there now, even some that are based in Excel, based on old equations that we use to estimate risk. You can drive down risk through engineering controls pretty good. The only way to really drive it down is universal mask-wearing indoors. Once you add the mask to the equation, that's when risk really drops. Before that, you're around the margins. You're doing a good job. 50% reduction, 60% reduction. Great. You hit it. Everyone wearing masks you can drive it to 99% reduction.

Jonathan Zittrain:

At which point you have the exponential curves in your favor, if you can do that long enough you just could kill it, right? Because that exhausts itself among the people where it lives.

Joseph Allen:

Yeah, so the engineering controls are happening and also we haven't really talked about this but dose matters. This is going back to [inaudible 01:13:49]. Dose makes the poison here and it looks like that evidence is starting to show too that it's that first hit you get... Mask is eliminating, you get one viral particle or some really smaller... That's going to be a lot better in terms of the likelihood of infection too [inaudible 01:14:04] at the depth of the infection. It's about dose control too and all of that's playing a really important role.

Jonathan Zittrain:

Got it. Back to testing. So from Margaret, is anybody doing it right in America? Is there any jurisdiction you can point to where it's like at least within their [inaudible 01:14:22] they're doing it?

Margaret Bourdeaux:

Yeah, for sure. Lots of states have transferred over to... So first all, testing for which purpose? Just a quick and dirty way to describe it. There's three venues where testing is happening and it's a little correlated to why you test. So testing is happening in hospitals when patients show up who are sick and a lot of hospitals have their own internal labs that can do testing, and they're turning those around quite readily and in general, I think hospitals by and large are doing a pretty good job of controlling the infection and taking care of patients when they come.

Margaret Bourdeaux:

The other place that testing is happening is to the purpose of drawing down community transmission and that's where we struggle. So that's where primary healthcare centers and community health centers are taking patients who've told they've been exposed, they need a test or you have mild symptoms and want to get tested. And that was really tricky because a lot of those folks places and primary care centers are locked into Quest and LabCorp but many have found alternatives to that and are now turning around testing more quickly.

Margaret Bourdeaux:

And then the third place is with the state popup ad hoc testing centers. And these might be in the parking lots of CVSs or there might be a program where they go through and test everyone in a nursing



home and states were also sending those tests to Quest and LabCorp as well and were having significant delays. So a lot of states are trying to figure out alternatives and some are successful in doing so.

Margaret Bourdeaux:

So there's definitely some progress in that regard to some degree. As Dr. Allen mentioned, we are really reliant on one type of test that has to be done a certain way, and we're having some shortages with the reagents you need to run those tests and it's a complication but by and large, testing is happening and it's starting to turn around in some places so that's awesome and just to say, we're all really hoping that not only will we get some more efficiencies out of that approach to testing in the very short term, but we're also hoping that we're going to have other ways of testing and other approaches to testing that hopefully can be harnessed and governed and allocated in ways that really give us much better control. So it's not all bad news.

Jonathan Zittrain:

All right. Last question. Any best practices similarly in school reopenings whether school districts, K through 12 or universities, any good models to point to or possibly models that are models of what not to do?

Joseph Allen:

I think I'd point to models of what not to do. I think those are easy to find even if you look at the outbreak in Israeli schools where people are saying well, look what happened in Israeli schools but the reality is this report came out just two weeks ago too. What happened was they had a heatwave, and they closed the windows, turned on the air-conditioning, only recirculated air, and they took their masks off during this. So it really wasn't surprising then again.

Joseph Allen:

And same thing with the Georgia schools. The Georgia camp same thing. Read the CDC report there, where there are 15 kids in these cabins. They said no ventilation. Windows closed. Doors closed. They're all singing in the cabin and no masks and then people say well, it's shocking that the kids got sick here. It's like it's obvious especially when community spread is really high so a lot of lessons to be learned on what's gone wrong.

Joseph Allen:

The harder thing is what's gone right because there are a lot of those stories, but they're hidden. They're not headlined where even in our town daycares have been open and no cases and camps through the summer. YMCAs in New York City stayed open in March, in New York City during the peak. Very few, if any cases. Very low... They managed to control risk. So a lot of these learnings from what's gone right are harder to find and I think this is something we really need to improve as a country that my fear is we're going to get to December, we'll have sporadic outbreaks in some schools. Some schools will be just fine. And since we're not systematically collecting the data, we're just not going to know why.

Joseph Allen:

So we'll be in the same boat that we are right now trying to guess what strategy works but imagine we systematically collected that and tracked it. We'd be able to say hey, you know what's working and not working? Where a school doesn't mask and doesn't have this in place is where we're seeing the outbreaks.

Jonathan Zittrain:

And that lack of data collection is a leadership thing or it's a... Just nobody's gotten around to being able to... There's no time to navigate. We're just trying to aviate here.

Joseph Allen:

This is all doable. It'll come down to enterprising scientists. Someone somewhere is going to create the database. This is how it's been going. This total ad hoc thing. It should be centralized. How do we manage this thing without using the data collection problems we've had through the first couple months of this but it really concerns me with schools in particular because there's so much to learn and even what we've learned about what's gone wrong or right are totally anecdote. I know a few stories from my town. We have that from YMCA. We know the Georgia schools. That's like five things. There's so much more we could know. It's deeply frustrating and my concern is that we're just going to do the same thing for the next couple months and never really know what worked or didn't until way after the fact.

Jonathan Zittrain:

Well, despite just how troubled the times are and how dodgy a place we're in, I come away from this conversation feeling a little more comfortable that we've got really smart talented people on the case here and really thinking about the public interest and how we might be able, whether it's from mutual aid or otherwise, to fill in the large gaps that exist in leadership and in coordination in trying to take on this problem.

Jonathan Zittrain:

Joe, thank you so much for joining us. Margaret, you're a total hero for coming in from a national park to do this and great cell reception.

Margaret Bourdeaux:

Yeah, thank you so much Joe for being on the call. It's fascinating, and we just really appreciate your leaning in and really showing up here at this moment of need and Jonathan thank you, also to you for facilitating such a awesome conversation.

Joseph Allen:

Thanks, I enjoyed it. Really interesting. Learned a lot too.

Jonathan Zittrain:

Very good. We'll catch you in the future week and thank you as well to our participants. Till soon.