COVID Information Commons (CIC) Research Lightning Talk

Transcript of a Presentation by Paul Westerhoff (Arizona State University), February 10, 2021

Title: Disinfection and Reuse of Health-Care Worker Facial Masks to Prevent Infection Coronavirus Disease

Paul Westerhoff CIC Database Profile

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Youtube Recording with Slides

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Transcript

Paul Westerhoff:

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Great, thanks. Michael set us up pretty well thinking about these airborne particulates. Then how do you get rid of them is to wear masks, and so if we think back to the Fall, we didn't have many of these masks. The purpose of this study was to understand the viability of reusing masks, so this is our group at ASU, both in engineering and chemistry.

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I'm going to actually start with the broader impacts, because I think as all of us have kind of alluded to it. It's pretty easy to understand them over the last year or so. Really what this project allowed us to do is to have some core capabilities and flexibility to help people. We're able to, kind of, aerosolize particles in a nebulizer. Then we could put in different mask materials, kind of right in this interface, and we could measure particle size distributions in the air before and after this mask to understand the efficiency of different masks. We think back to the Spring -there were lots of people saying “what about using used t-shirts and other things as masked materials?” Our team has really helped a lot of different groups locally understand the viability of cloth masks and other things.

Our team was able to provide data for the student team at ASU which actually won the ‘X’ prize competition for the next generation mask. They won half a million dollars, and they were able to use data from, you know, Pierre's lab in terms of looking at this filtration efficiency during their pitch to show that their masks actually functioned. Congratulations to that team. Also, what we were looking at was how to help first responders. These first responders back in the spring didn't have enough masks or other PPE. They didn't want to treat them with chemicals because it's hot in Arizona. They didn't want to put wet masks on them. They really had wanted to be able to treat them in between break sessions, at in this case, a firehouse. After several iterations, we came up with the design that these firemen are showing here that they actually deployed and used to disinfect their masks. There were UV lights on the top and bottom, kind of a grill in the middle, kind of like a barbecue, and within about 30 seconds to one minute, they could disinfect their masks and reuse them again.

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We did, of course, more scientific studies here as well in terms of answering the basic question: not only can you reuse masks but does applying UV light in a non-chemical way to use these masks damage the polymers that are responsible for removing these airborne viruses? We looked at both low pressure lamps and LEDs. It actually turned out in the Spring and Summer, it was really difficult to purchase some of these, and so there's a little rush on this. We did look at focusing on these UV lamps. Here's an example. We're able to disinfect these masks using one joule per square centimeter, so it’s obviously about 10 times higher than we really needed. Then we went all the way up to 10 joules per square centimeter that would show multiple recycling efforts, and essentially in all cases, we're able to remove greater than 95 percent of these airborne particles. Clearly UV light can be used to treat these masks.

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We went deeper into understanding the polymer chemistry of these masks. They're multiple layers. We looked at irradiating each layer at pretty high UV doses with the fundamental chemistry and showed that the UV light really would not change the chemistry of these fibers. These are not small pores that remove particles by size exclusion. They're pretty big because you have to be able to push your air through them, so it actually becomes the electrostatic interactions.

Slide 5

We're able to, kind of, continue this look at different types of masks as well.

Slide 6

Finally, I want to say where are we going to keep us on time here. We're interested in particles in the air that have different charge and masks that have different charges. It turns out that when you look at these masks again, you move air through them, so they're fairly porous, but it's a charge on the mask. We've been measuring the electrostatic charge of these masked materials to see how they interact with positively or negatively charged particles in the air.

Slide 7

This is to give you some idea of the relative importance of the charge on the membranes in these filters. This red looks at very high removal efficiency of masks as you purchase them and even after reuse, but if you remove the charge, you get really only about half the treatment efficiency. The methods that you use to make the masks, but also to clean and recycle the masks, are really important. It turned out that UV light did not impair this electrostatic performance. Here I focus mostly on the masks, but we did a lot of work on light-emitting diodes and a disinfection range, helping various startup companies bring products to market fairly quickly by looking at disinfection on surfaces as well. Again, we have publications in process, but it was really the fun part in our group to get the students in our labs engaged in solving a real world problem. Well I've actually created a lot of good synergy amongst our research students in this work because it could really be used and helpful to the broader public. With that, I'd like to thank NSF for their funding.