COVID Information Commons (CIC) Research Lightning Talk

Transcript of a Presentation by Naomi Senehi and Pedro Alvarez (Rice University), February 10, 2021

Title: RAPID: Molecular Imprinting of Coronavirus Attachment Factors to Enhance Disinfection by a Selective Photocatalytic "Trap-and-Zap" Approach

Pedro J Alvarez CIC Profile

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Transcript

Naomi Senehi:

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So good morning. As Katie mentioned, my name's Naomi and today I'll be presenting on our work in using nanomaterials to what we call trap and zap coronavirus in water treatment. And I'm presenting this on behalf of Pedro Alvarez and Jane Tao who are both at Rice University.

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So, the motivation for this work came from us thinking about how will COVID-19 be impacted by the water cycle and vice versa. So, we knew from the last outbreak of SARS in 2003 that it could be spread through wastewater aerosolization. And where we saw this was in Hong Kong, where in an apartment complex, one family had gotten infected with SARS and afterwards many families in this complex were infected and it was in trace- it was traced back to some leaky bathroom pipes combined with poor air ventilation systems. And since that time and since the start of COVID-19, we've seen SARS-CoV-2 or the virus that causes COVID-19 being detected in wastewater, but we really haven't seen it spread this way. And so, we were wondering why? Especially when you look at how we reuse waste water today. After it's treated, it typically goes to agriculture, even recreational water bodies, and sometimes back into our aquifers. Additionally, there are many wastewater treatment plant workers that have had to work through the pandemic and are exposed to these aerosols at the treatment plant all day. But we found that one scientific advancement that hasn't really been fully made yet and that was impeding our answer to this question was that we can't yet isolate or detect infectious SARS directly from the wastewater.

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And when we look at why this might be, our current methods of detecting and isolating SARS in the wastewater really highlighted. So right now, we take about a liter of wastewater and we have to concentrate it onto like a paper dip basically, which means pulling a liter of waste water through this apparatus and concentrating it all on a film. And the reason that we have to use so much waste water is because the virus is really diluted in the waste water and once we have it on this paper, we actually have SARS and a bunch of other viruses. We even have a lot of other bacteria solid materials with it. So then when we think of how are we going to isolate SARS, it becomes a needle and a haystack type of problem, but we can use a very specific method, which we've all heard of a lot now called PCR to only detect the SARS from this complicated sample. But unfortunately, PCR cannot tell us whether or not the virus is infectious. It just tells us whether or not it's there.

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So, what we wanted to do is try to take a nanomaterial that also acts as a disinfectant and use it to trap or capture only the infectious SARS and then disinfect it. And what we tried to do was take this disinfectant surface and put this sort of putty-like material- this pink material here and stamp an infectious virus in the material. So, we stamp it. So, we pull the virus out to leave this cavity. And we would add this material into the waste water treatment plant or the wastewater treatment sample, and the virus would be attracted to those cavities and stick to the surface of our disinfectant. And then because our disinfectant works with light, what we do is we'd expose it to some light so sunlight or UV [ultraviolet] and we'd more efficiently capture and degrade the virus on that disinfectant surface.

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And we wanted to use this strategy because it's pretty widely available. So, we could use it in the lab to better concentrate our virus. We could also modify it for other viruses. We can stamp any virus into that material or we can even stamp a different pollutant and capture a different pollutant in that material. And we can apply it to a variety of surfaces. So here, we chose to apply it to a disinfectant surface- a nanomaterial, but we could also apply it to air filters or masks. So, it's very versatile and our understanding of this would advance our fundamental knowledge of this technology for other applications. And so, with that, I'd love to take your questions as Katie mentioned at the end of the seminar. Thank you very much.