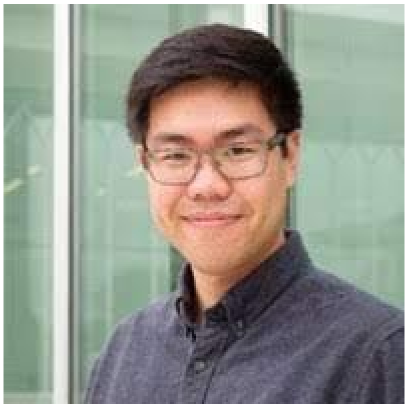
COVID Information Commons (CIC) Research Lightning Talk

Transcript of a Presentation by Brian Chang (Clark University), April 14, 2021



Title: *Predicting Coronavirus Disease (COVID-19) Impact with Multiscale Contact and Transmission Mitigation*

Arshad A Kudrolli / Brian Chang CIC Database Profile

NSF Award #: 2030307

YouTube Recording with Slides

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Transcript Editor: Macy El Moujabber

Transcript

Brian Chang:

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Alright. Hi everyone, my name is Brian Chang and I'm a postdoc working with Arshad Kudrali who is the PI of this NSF grant, which is called Predicting Coronavirus Disease Impact with Multiscale Contact and Transmission Mitigation. This talk is just going to be an overview of all the work that we have been doing in the past past year, actually. And it's really broken down into two different teams so we have this physics team of excellent undergraduate and graduate physics majors here at Clark University. And we have a medicine team made up of doctors and nurses and respiratory health practitioners as well from the University of Massachusetts Medical School Baystate. And in this image below, you can see that there's our artificial sneeze with a long exposure which we'll talk about more later on.

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So the main point of this grant initially was to develop a stochastic model to predict how the coronavirus spreads from two different populations. So if you imagine here this is Boston for example and over here this is Worcester, Massachusetts then we're trying to figure out how the coronavirus or how any disease spreads from one population to another. And as we were developing these models we start to we started to realize we can plug in pretty much any parameter we wanted to predict how to match how the coronavirus has spread based on past outcomes. But that really got us thinking - what are some of the mechanisms for these parameters and really how can we use fluid dynamics and soft matter physics to help predict future outcomes?

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And so we went about this by developing some experiments, some physical modeling to determine the spatial temporal dispersal of mucosalivary droplets. So over here we have an artificial sneeze. The evolution of our artificial sneeze cloud over time and which was matched with human sneezes so it was matched with human sneezes in literature and really what we're interested in doing is trying to determine how these sneeze droplets would spread depending on exhalation strength, mucus rheology, and also the different mitigation strategies we can employ to reduce the dispersal of mucosalivary droplets. And really this is important because we need to develop a systematic measurement of the droplet dispersal travel distances and how long the droplets stay in the air, and also the evaporation rates as a size of the droplet - as a function of this droplet size distribution in order to really fully characterize the transmission rates in our stochastic mode. And this is really important because we know that inhalation of these virus-laden droplets is the main mode of transmission for Covid-19 spreading. And it's also very important for various other diseases that are transmitted by inhalation of other people's exhalations, such as tuberculosis and influenza. So this has importance for future pandemics and future health crises as well.

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So one of the first things we did was really look at the spatial dispersal. For example, how far do the droplets go and where do they end up landing? So one of the key questions we're interested in is how is also how does the rheology of the fluid affect the dispersal patterns. So here we have simply just water being exhaled outwards, and then as we increase the musing concentration, basically the stickiness of the fluid, we start to see different dispersal patterns. And one of the key features is that as you increase the Mucin level to someone who is relatively unhealthy then we start to see narrower lobes or narrower dispersal patterns but the droplets travel a much further distance. So what we start to- another thing you might notice is that the number of large droplets, these speckles that kind of look like stars, the number of these large droplets start to increase as well once you start reaching higher Mucin concentrations. And we've also started looking at the temporal dispersal- in other words how long do they stay in the air? So if we look at the falling speed of a sneeze cloud versus the size of the cloud, we can see these trends that occur and we can model these quite accurately as well. And you can find more information in this paper that we published back in October 2020.

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Furthermore we've been collaborating with doctors at UMass Medical Hospital to determine how aerosols are escaping from these oxygenation devices. For example, here you have a nasal cannula which is these tubes that go into your nose and we put this onto a medical mannequin and we show that the aerosols can travel quite a distance. So you can see - imagine if there was a healthcare worker standing right above this patient then they would get direct exposure to the aerosols. But just by placing a - by placing this mask over the patient we can reduce and redirect the aerosols. Furthermore, we have a simple oxygen mask which sprays the aerosols in two directions, and then once again we placed a mask over the simple O2 mask to redirect the aerosols.

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So overall, we were trying to use fluid dynamics and soft matter physics to plug in as parameters to improve these transmission rate models first for disease transmissions.

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Thank you for your time and I'll be happy to answer any questions.