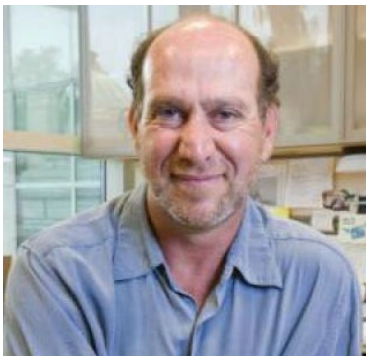
COVID Information Commons (CIC) Research Lightning Talk

Transcript of a Presentation by Mark Lurie (Brown University), January 31, 2023



Title: Computational Theory of the Co-evolution of Pandemics, (Mis)information, and Human Mindsets and Behavior

Mark Lurie CIC Database Profile

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YouTube Recording with Slides

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Transcript

*Slide 1:*
Good afternoon, everyone. Thank you for being here and thanks to the CIC group for organizing this and other seminars. I'm honored to be here representing my team from Brown University. Many people from the School of Engineering, School of Public Health, Departments of Computer Science, Philosophy, and others - too many to list on the current slide. But if any of them are listening along today, know that I appreciate all of their meaningful collaborations. I'm going to talk today about new - newish projects that's just started with NSF funding.

*Slide 2:*
Many people - some people will be familiar with a relatively recent NSF mechanism listed here [Predictive Intelligence for Pandemic Prevention Phase I: Development Grants] and I'm going to speak about it a little bit, partly because our funding comes from this mechanism, but also two of the other speakers who are with us today will also be speaking about their project from the same mechanism. So the NIH, sorry, the NSF, asked us to think to the future. To think in a, kind of, five to ten year span about knowledge methodologies and data that, in that period of time, could potentially be available that would put us on more solid footing to be able to prevent and predict future pandemics. So that was the call for proposals - to have a grand vision of an area of intelligence that we could address that in five to ten years would leave us on better footing to allow us to, hopefully, prevent the next pandemic before it occurs.

*Slide 3:*
Our study and our project is focused on all aspects of human mobility and social mixing. So why are we interested in mobility and social mixing? I'll give you two or three slides on that as some background. The first is the obvious statement that infectious diseases move from people to people Therefore, how we move through space and time will be a major determinant on potential for a new pathogen to spread through populations. More importantly, knowing the details about how people interact will give us, in the future, more refined tools that'll allow us to implement more effective and more nuanced interventions. All of us remember back to the beginning of this pandemic when, essentially, the interventions that were implemented were those - many of them - were aimed at cutting our social networks and limiting the number of people that we interact with in order to to slow the spread. And because, I argue, that we didn't at that time have really good quality information about how people interact, we were forced to apply a hammer to the situation. An unrefined tool so that that forced, essentially, all mixing to stop. If we are successful in the future, we'll better be able to map mixing that is conducive to spread and mixing that doesn't involve spread of new pathogens. Therefore, we can be more nuanced in the interventions that we propose in the future.

*Slide 4:*
As an epidemiologist, I think of this in in another way as well. That is, I'm sure many are very familiar with this, the epidemiological concept of the basic reproductive number which really tells us the likelihood of a pathogenic spread. It tells us, on average, how many new infections will occur in a population when a primary case is introduced into that totally susceptible population.

*Slide 5:*
And R0, the basic reproductive number, is dictated by three components. The first is how likely transmission is to happen between any contact. The second is how long is the period of infectiousness. And the third is about how frequently people who are uninfected come in contact with infected people. It's this large piece, the C shown here, that is really the focus of our work. In essence, the other two variables are largely biological variables that are going to differ depending on the new pathogen that emerges. The human behavioral aspect is really contained in C here and that's, in essence, what we focus our MAPPS project on.

*Slide 6:*
I'm going to talk now briefly about the main components of our project. We have four main components, and then one overarching sort of proof of concept exercise.

*Slide 7:*

First, to articulate what our grand challenge was specifically, essentially, we're asking how we can best use data on mobility and population mixing to inform real-time pandemic responses across a range of pathogens and under conditions of uncertainty while still balancing benefits, risks, and harms.

*Slide 8:*
To do that, we focus on four different areas shown here and I'll mention - I'll speak briefly about what we do in each of these four different thrust areas.

*Slide 9:*
The first one relates to data. Clearly, there's some, though I would argue not nearly enough, data on how we interact in different places and in different contexts. So we're not the first people to collect or want access to this kind of data. What we're recognizing is the existence of some data already. What we're trying to do here is create a catalog and make publicly available online a federated database that contains a multitude of different studies that focus on social mixing and mobility. We hope that this will be a resource for modelers and for pandemic researchers who are interested in incorporating social mixing and mobility into their study. [We want them] to be able to go to one central clearinghouse and find available data hopefully already in a format that can be used in their models.

*Slide 10:*
The second aspect that we focus on is around developing devices. So we work very closely with engineers here at Brown and biomedical engineers trying to develop new technologies for measuring mobility, social interaction, and eventually, biometrics. Right now, we're focused on a phone app which I'm going to talk about about in a bit, but there are potentially other devices and either other methodologies that can help us to understand people's movement.

*Slide 11:*
The third aspect that we focus on is around modeling and prediction. So the data that we collect through our apps and through our wearables and the data that we store and process in the first thrust are are meant to feed our predictive models. What we're hoping to do here is to develop a library of models that are flexible enough to be able to respond to new pathogens that emerge. So we're looking at a variety of different models that incorporate social mixing and human mobility to make them again flexible enough so that they're not specifically COVID-focused but are able to be adapted to the epidemiological context for a new pathogen about which we don't yet know anything.

*Slide 12:*
Finally, a lot of our work is around ethics. And although it's listed as one of our thrusts, in a way, it really permeates all of the work that we do. To collect and catalog the kind of data that we're

talking about means to possess people's private and confidential information. So we need to be exceedingly careful about how we do that - what data we collect, how we use that data, and how we keep it in a in a safe and respectful way. We've just finished a week-long workshop where we brought together ethicists, public health folks, computer science people, and cryptographers to help us think about the technical challenges that we can address when when using the kind of data that we're talking about. And we want to do so in a respectful and ethical way.

*Slide 13:*
So those are the four main thrusts or areas of work that our project is involved in. And I wanted to speak now very briefly about an overarching proof of concept exercise that we're doing that brings together all of these different thrusts all at once.

*Slide 14:*
The idea is that using the university where myself and my collaborators are based [Brown University] that we would like to try to measure the entire social network at the university. So imagine if everybody at the university had downloaded our app, which is still in development. The app will use bluetooth to measure who's in your vicinity. That is to say, it'll measure the interactions that you're having, the duration of those interactions, and the distance of those interactions. That allows us to build a dynamic model of the social network at the university. What we then want to do is simulate the introduction of a new pathogen into that into that network and assign to the pathogen some specific epidemiological characteristics, whether that's the probability of transmission or specifically how transmission occurs, whether that's within five feet for 10 minutes, or whatever those particular characteristics are. It allows us to understand not only how the pathogen spreads through the network under different epidemiological characteristics but also to identify points of intervention. That is, things that we could change in the way that we mix and interact with others that could be effective in eliminating or containing the virtual pathogen.

*Slide 15:*
Our goal here is within the next 18 months to do a pilot within the School of Public Health. We've already been engaged in some deep community engagement, speaking with leadership, students, faculty, staff, potential users of this device about some of their requirements for the device and suggestions for how the device might look and feel. We're also addressing concerns about data security and data privacy. We're hoping to get second phase of funding for this project that would allow us to expand our work beyond the School of Public Health and to try to map the entire social network at the university. And beyond that, we're hoping eventually to add other measurements, including biometric measurements, potentially other measures that we don't haven't even yet thought about, that could be used for not only mapping and understanding social networks but also to populate models that allow us to predict and therefore prevent future pandemics.

*Slide 16:*
So that's all I'm going to say at this moment. I'm happy to answer questions and be involved in discussion about what it is that we're doing.

*Slide 17:*
I just do want to show this final slide here. If anyone is interested in the workshop that I mentioned a couple of slides back where we focused on privacy and ethics and pandemic data collection, you can find some of the talks and slides there as well as some of the background materials and daily summaries from that workshop. So I'm going to leave it at that and I will stop sharing and turn over to my colleagues for the next presentation. Thank you.