COVID Information Commons (CIC) Research Lightning Talk

Transcript of a Presentation by Aditya Kulkarni (University of Minnesota), September 2020

Title: *Human Mobility Patterns Linked to COVID-19 Prone Locations*

Information about the CIC Student Paper Challenge

YouTube Recording with Slides

July 2021 CIC Webinar Information

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Transcript

Aditya Kulkarni:

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Hello everyone. I am Aditya Kulkarni and I'll be talking on human mobility patterns linked to COVID-19 prone locations. I'm going into my senior year in high school and I've been taking university classes for the past few years.

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The motivation behind the problems that I was trying to solve was that I was seeing during the early days of the pandemic and on the news was that there are a lot of outbreaks at restaurants and bars and that they are significant spreaders of COVID-19. I also saw that policy makers were trying to find the best ways to reopen businesses safely, so I came up with the question: what is driving outbreaks at COVID-19 prone locations?

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I then decided to take a look at the COVID Info Commons' NSF awards and PI database, as well as the Lingo4G explorer, and I was able to find a RAPID NSF-funded project that was looking at the efficiency of COVID-19 quarantine metrics, and how to improve those measures by comparing COVID-19 case numbers and testing procedures across countries that had very restricted levels of mobility. Specifically, I saw two RAPID projects that were analyzing mobility patterns: one was the survey of senior citizens about their daily locations and activities, and the second one had taken more of a Big Data-driven approach, and that was to find hotspots in isolated populations and a real-time location data set.

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From then, I decided to look into two main data sources that I'd use for my research. The biggest one was SafeGraph, which is a Nationwide Spatio-Temporal Visit Dataset. Just in Minnesota, it has over 350 individual anonymized devices, which are primarily composed of cell phones, and they cover almost 90,000 point-of-interest locations. These visits are spread across 264 different business categories, and there are more than 6 million POIs across the US.

The data goes down to the Census Block Group Level, and for my analysis, I used the weekly patterns, which are POI visits by their weeks and durations, as well as the core places, which has more information on the POI, such as NAICS code, as well as other factors. I also looked into the Minnesota Department of Health Reports, and they had specifically named bars and restaurants that were linked to COVID-19 cases each month. In order to be named on this report, a bar or restaurant had to have an outbreak. That's defined as seven unrelated cases from seven different households where each case is someone who visited only one restaurant or bar establishment during that month.

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From then, I decided the best way to do my experiment is to better understand the cause of COVID-19 hotspots and hangout locations, so I developed drafts that are showing time series of long duration visits to bars and restaurants and for context, as follows. These are through different periods of the pandemic, as Minnesota had two shutdowns followed by two consecutive openings. There is also a middle period where all types of bars and restaurants were open, as well as regular locations. I did this by comparing both outbreak locations and non-outbreak locations for two cases during the re-openings and for the regular periods between March and October, where there were not many restrictions on mobility. I looked into a variety of durations, that is being from 21-60 minutes, 61-240 minutes, and greater than 240 minute visits to these locations. On the right is a map that shows both the outbreak locations and non-outbreak locations that I looked at, which are around 75 locations.

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So my first result looks at the reopening of June and July. I compared 15 bars and restaurants that did have COVID-19 outbreaks which were listed in the report and then 15 that did not have outbreaks. Specifically, I tried to keep fixed variables between both groups and that is by having matched pairs. So each of these locations had a similar number of visits prior to the COVID-19 pandemic and they were also within a similar location. So if you are considering about these two locations being in a city, that would be in a matter of about a few blocks, but if they are in a more rural or suburban area, that would be in a matter of a few miles between both the outbreak and non-outbreak location which were selected.

In this case I am looking at only visits that are greater than 20 minutes as these tend to be riskier visits. That could be someone who went inside a restaurant or bar and took off their mask and was eating or drinking a meal, rather than a visit by, suppose, a delivery driver who was fully masked and just dropping something off on the outside, which would likely not turn into a COVID case, as there wasn't that much exposure.

You can see that in the outbreak location within the reopening, which is in the first week of June, there's a rapid rise in the term of long duration visits. The outbreak location reached its prior level in COVID-19, almost 100 percent recovery, rather than the non-outbreak location that did not get COVID-19 cases had only wound up to about 50 percent of their prior pandemic. Just these 15 bars in restaurants in June were linked to 783 COVID-19 locations in June of 2020.

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I also looked in during the August outbreak. This was during bars and restaurants had been open for a few months, so I specifically looked at bars and restaurants that did have the outbreaks. They are through 4 different durations, and you can see that there's a spike here during the month of the outbreak, so there's a spike in long duration visits in the same month that there was an outbreak at these restaurants.

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I also see a similar result in October, where these are the 15 bars and restaurants that had COVID outbreaks in October, and you can see that there's this sustained multi-week rise in long duration visits followed by a subsequent retraction. After this, there was a shutdown of both indoor dining at bars and restaurants and a few other locations such as gyms, and this was due to a significant rise in COVID-19 cases across Minnesota.

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Then, after the re-opening was lifted and bars and restaurants were allowed to have indoor dining, there was the re-opening in January and February, and you can see that there was a similar number of visit counts prior to the shutdown, but after the re-opening, you can see that there's a visible difference in terms of both the outbreak and non-outbreak locations.

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Ultimately, I counted in both the positive and negative examples by comparing outbreak locations with locations without outbreaks, while keeping as many variables as consistent as possible, these being close proximity, similar number of visits prior to the outbreak, and a similar business category of both bars and restaurants. I ensured that these results were not specific to one bar or restaurant, that being I used multiple groups of 10 or more locations, to show that these trends are not just outlier cases, but rather a tendency of the entire business category. Thus, long duration visits can show that it can offer insights into why outbreaks occur at certain locations and not others.

For future work, I am studying long duration patterns among disadvantaged racial and socioeconomic groups using economic data such as that of the U.S. Census. I am also analyzing the correlation between long-duration visits and the indoor atmosphere of locations in terms of the amount of air ventilation, distance between visitors inside the location and the density and crowdedness, as that could shed light onto other factors seen in association with long duration visits.

Getting access to other COVID-19 data for other business categories apart from bars and restaurants can strengthen the link between long duration visits and disease outbreaks at business locations more broadly. Thank you.