NEW YORK STATE GIS ASSOCIATION

2021 Geospatial Applications Award WINNER

Delphine Protopapas (Brooklyn Technical High School)

In the Spring of 2020, COVID-19 pandemic transformed New York City's hospitals, with as many as 1,673 single-day, new admissions for COVID treatment and many more for testing. This resulted in the infection of nearly a thousand NYC hospital workers by mid-April 2020. Therefore, knowing where these essential workers lived can help increase understanding as to whether they contributed to the transfer of illness back to their communities. This research investigated this topic by employing cellphone footfall data collected during April 2020, at the height of the COVID-19 pandemic in New York City, and examining it in the context of both COVID-19 infection rates and overall social vulnerability at the census block group (CBG) level. The home census block group was mapped for people working at 8 NYC area hospitals who visited nearby businesses. These are displayed in the context of the CDC social vulnerability index rating, the quantity of hospital workers in a specific CBG and the COVID-19 infection level end of April 2020. Critical to this is the overlaying of major transportation routes. The visualization provides a strong qualitative representation of COVID-19 community spread between hospitals and highly infected communities of already high social vulnerability.

Starting in March 2020 and peaking a month later, the first wave of the COVID-19 pandemic spread throughout the five boroughs of New York City, disrupting the daily goings of millions of individuals and resulting in the hospitalization and death of thousands. While the number of infections, hospitalizations, and deaths from the virus are relatively well-documented, the transmission routes are less known. There were a trio of motivators for this study. First was the handful of high-profile cases of traveling health professionals becoming super-spreaders in clusters of nursing homes. These provided clear examples of how essential workers could become the unwitting agents of infection. Second was the disproportionately high COVID-19 infection levels in socio-economically disadvantaged neighborhoods, and third was the large number of essential workers who lived in those types of neighborhoods. Specifically, this project undertook the task of examining the potential of NYC hospital workers and those in nearby businesses as agents of community transmission to their families, neighbors, and local facilities in their neighborhoods. By identifying patterns within the motion of the virus, the path of variants and other similar viruses will become more apparent and easier to mitigate in the future.

The mapping was created from anonymized cellphone foot traffic data for points of interest (POI). A POI is a specific location someone may find interesting, like a school, bank, or cafe. The Safegraph Consortium "Monthly Places Patterns" dataset was used, which provides visit data sorted by month for POIs. For New York, Safegraph estimates that 20% of all cell phones are tracked through data culled from various apps. The month of April 2020 was selected, which was the height of the first wave of the COVID-19 pandemic in New York City. This monthly dataset, in the form of a CSV file, contained rows of POI and their locations, with columns for the number of people who visited that POI during the month, in which census block group (CBG) they worked, and in which CBG they lived.

The team selected 8 NYC area hospitals and devised a Python code to process the data. The starting point was identifying the zip code of each hospital and all POIs that shared that zip code. The CBG for each hospital was also identified. As the hospitals are very large, they typically occupy the entirety of the CBG. Next the previously identified POIs were searched for visitors with a work CBG of the local hospital. This meant that someone who worked in the hospital visited a local business. The home CBGS of visitors to those businesses were then also identified from the Safegraph data. These home CBGs were then plotted.

The map gives insight into the movement of NYC hospital workers across the city. The map reveals that many of the neighborhoods with high COVID-19 rates had high social vulnerability levels and were heavily populated by hospital workers. This combination of factors meant that these areas likely served as secondary hotspots for the spread of the COVID-19 pandemic in NYC during the first wave. Another interesting result to note is the formation of "corridors" of health workers living in census block groups bordering certain subway lines that also corresponded to high areas of COVID-19 infection. These corridors, which can be observed using the NYC Subway Lines layer, are particularly visible along the J line in northern Brooklyn and southwestern Queens and the N line in Southern Brooklyn. Visualizing the movement of these workers during April 2020 alongside the COVID-19 infection rate maps at the beginning and end of the month allows researchers to better understand these types of community infection transfer mechanisms so as to better plan future mitigation efforts.

This GIS application was done by two New York City area high school students during the period of June-August 2021 under the supervision of Prof. Debra Laefer. Funding was provided by the Applied Research Innovations in Science and Engineering (ARISE) program and the National Science Foundation award 2027293 "DETER: Developing Epidemiology mechanisms in Three-dimensions to Enhance Response"

It is with great pleasure that we recognize Delphine Protopapas for her achievements in the work she did in conjunction with NYU on Mapping NYC COVID-19 Community Transmission via Hospital Workers.

Awarded: September 2021

Chris Badurek, President

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