APRIL 29, 2021

Mobility Changes in the Spread of Coronavirus in Dense Urban Environments

By Dr. Peng Chen, Assistant Professor, Urban & Regional Planning

BACKGROUND

Coronavirus (COVID-19) infections have surged worldwide and this ongoing crisis reminds us of the importance of evaluating its impact on human mobility and understanding the disease diffusion pattern in urban spaces. In the United States, the coronavirus first presented in Seattle, then outbroke in New York City (NYC) at a larger scale with increasingly explosive growth in large cities such as Los Angeles, Miami, and Houston, and eventually spread across the U.S. Most states issued stay-at-home orders in late March 2020 to intervene in the spread of the virus. People's daily lives have been greatly impacted. Given the financial pressure, many states took a stepwise path to reopen the economy in late May/early June 2020. Despite the related actions ordered to protect people from infection—such as social distancing, wearing face masks in public spaces, and canceling non-essential events—several states soon experienced the sharp increment of positive COVID-19 cases after reopening the economy.

Transit and public bike operations have a profound impact on people's daily mobility. It is worthy of investigating the joint effect of transit ridership, public bike usage, and responsive policy tools on the coronavirus diffusion. Besides, early studies had attended to the effect of density and sociodemographic factors on the coronavirus infection. In NYC, density and mixed land-use appear to be significant variables for the spread of the disease. Nevertheless, there are high-density and mixed land-use world cities that have effectively mitigated the spread of COVID-19, such as Hong Kong, Singapore, and Tokyo. Urban form factors alone cannot explain the diffusion of coronavirus. Public policy plays an important role in slowing down disease diffusion. After the first case was confirmed back in March 2020, NYC took a series of actions as responses, such as the PAUSE order and multi-step economy reopen.

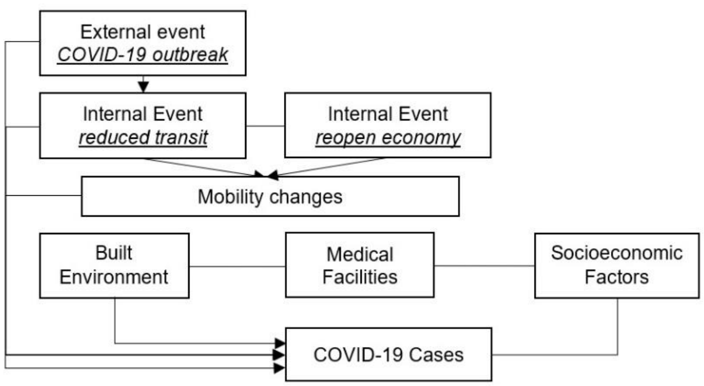

Figure 1: Modeling framework

RESEARCH DESIGN

This analysis examines the coronavirus diffusion in relation to mobility changes under the joint impact of the external event (coronavirus outbreak) and the internal events (responsive policy tools, such as reduced transit and economy reopen) at a microscopic level, where the effect of socioeconomic factors, medical facilities, and the built environment are controlled for, as shown in Figure 1. The unit of analysis (zip code) is the smallest geographic unit that the city has documented, as shown in Figure 2.

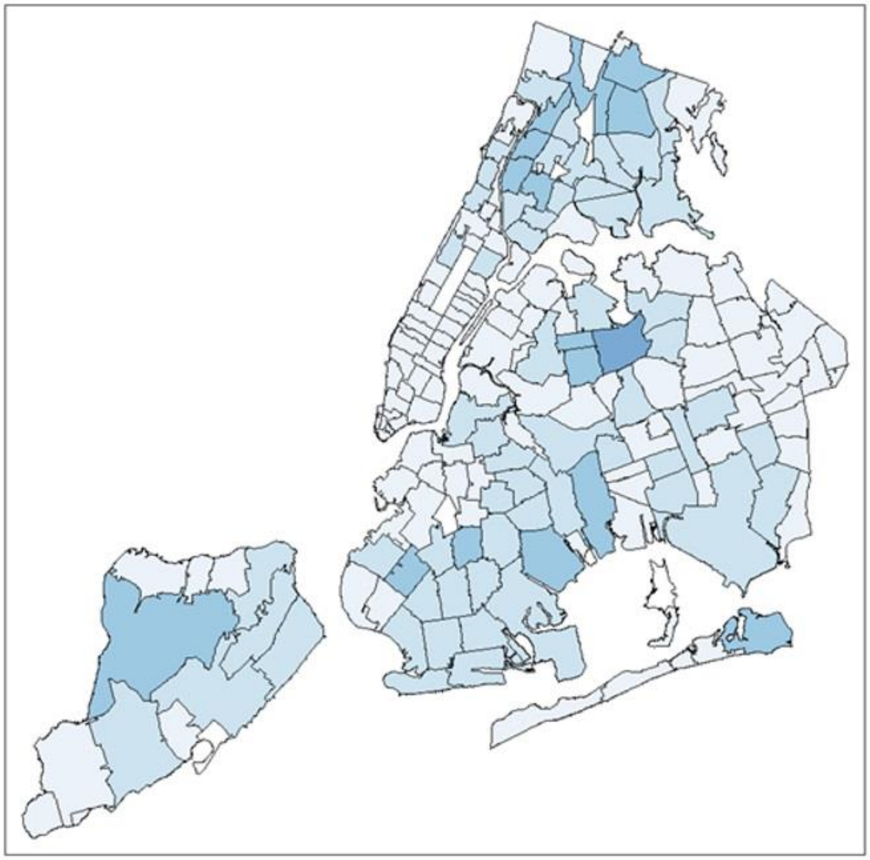

Figure 2: The spatial distribution of positive coronavirus cases in NYC

FINDINGS

Transit, Bikeshare, and Telecommuting

This analysis incorporated daily subway ridership and the policy of reduced transit services during the pandemic to model the impact of transit operation on the coronavirus infection. The results suggested that reduced transit services helped prevent disease diffusion, while transit operations facilitated the spread of coronavirus, and such an effect continued over time. The implication of this finding is debatable. To avoid infection, transit must operate cautiously with well-designed preventive strategies and sanitary measures. However, most people from the vulnerable group cannot afford a car in NYC, and transit is the most affordable transportation mode to obtain mobility services for jobs and critical activities. The Metropolitan Transportation Authority (MTA) can only place additional regulations on transit riders—such as wearing face masks, making hand sanitizer available to riders in stations, encouraging riders to travel during less busy times, and creating passenger limits—to avoid overcrowding and support social distancing. The public needs safer and more alternative mobility options.

Public bike use suggested a negative relationship with the number of coronavirus cases. As noted, public bike use was tripled during the three months in 2020. People who are concerned with the risks of riding transit may switch to using public bikes. This result provided support to the expansion of Citi Bike in NYC by adding more stations and bikes.

Areas with a higher percentage of telecommuting suggested a negative association with the number of coronavirus cases. The percentage of individuals working from home increased to 42% during the pandemic. The outbreak of coronavirus provided an opportunity to explore the potential of telecommuting. Working from home has many advantages, such as saving operational costs and rent, reducing travel time, mitigating road congestion during peak hours, and giving individuals the freedom to manage their schedules. If employees can maintain the same level of work performance, companies are encouraged to keep telecommuting as an option.

Is the built environment guilty?

This analysis partially confirmed the second hypothesis that coronavirus is more likely to diffuse in a dense urban environment. Population, residential areas, and the sum length of streets—which represent measures of density and connectivity—showed positive effects on coronavirus cases. The other built environmental factors were insignificant. Human activity concentration was greatly reduced at workplaces and public spaces during the pandemic, possibly due to the stay-at-home orders. Mixed land-use showed no significant effect on coronavirus cases. In contrast, people may feel safe in their neighborhoods, and consequently, they may not keep the same level of preventive awareness when they walk and ride bikes on streets near their homes. Additionally, even if people are infected in another place, the location where they were initially infected is mostly unknown, and their records will simply mark their home zip code as the infection site. Alternatively, infected individuals that lack identifiable travel history or exposure signals contribute to community transmission. The way of reporting brings difficulties to tracking the disease diffusion pattern and this misleads scholars and practitioners to consider some neighborhoods as more risky environments.

According to the modeling result, a high-density urban environment like NYC was not resistant to disease diffusion. The performance of NYC in this pandemic informed us to have additional reflections on conventional urban planning thoughts. A dense neighborhood with mixed land-use and connected streets is what planning scholars have advocated for decades. All good features seem to be the conditions for disease diffusion, and suddenly makes them undesirable planning principles. Yet, is density a core determinant for disease spread? Cities like Los Angeles, Miami, and Houston are all low-density cities where the coronavirus wave is explosively rising. In comparison, in high-density Asian cities like Singapore, Hong Kong, and Tokyo the coronavirus is much controlled. Therefore, density is only a sufficient condition, but not a necessary condition for disease diffusion. The core determinant of coronavirus diffusion is face-to-face contact without adequate protection.

A **recent study** argued that people may favor isolated neighborhoods, sprawled urban form, and decentralization post-pandemic without providing solid evidence to support such claims. Another claim is that "**rural is not the answer**." **Residential mobility** is a complicated decision outcome and the reasons are greatly varied by individuals. **Most people relocate** for job placements, promotions, retirement, affordability, school quality, and life course events such as marriage, divorce, and the birth of children, etc. Panic may only exist for a short period of time and coronavirus can hardly be a cogent reason for mass relocation. For more affordable housing opportunities and a better quality of life, given the increased popularity of telecommuting, there are many other stronger reasons for relocation. However, it is not reasonable to place excessive criticisms on conventional planning thoughts and discourage **compact development**.

CONCLUDING REMARKS

Planners lead public processes and effect social change, in addition to envisioning the future of a city/community. When facing possible harm to the public, planners in local agencies should collaborate with other departments, bringing the risks of each policy tool to the table and negotiating with related stakeholders to sort out the best solutions. No generalizable rule can be applied to all settings. Planners in local agencies should engage people and present the needs of senior citizens, low-income, and people of color to the public.

Examining the relationship between the built environment, mobility changes, and highly infectious diseases contributes to the development of safer and cleaner cities. Individual-level data with contact tracing is desired for improving the accuracy of analytical results and informed decision-making from a behavioral perspective. The U.S. Census is implementing a three-phase Pulse Survey. More microscopic data is expected, which can facilitate the examination of the disease diffusion pattern at a finer spatial granularity. Qualitative research is highly encouraged to better understand the needs of people from the vulnerable group, gain knowledge from an individual level, and provide additional insights into the process of the coronavirus infection.

With lessons learned from NYC, decision-making is challenging during the pandemic, and each decision presents a comprised solution by weighing benefits against costs. Solutions can greatly vary by case. There are rooted political, financial, cultural, and physical differences across different cities and states. Planners should actively participate in the decision-making process, engage people online, collaborate with all related departments, and reach reasonable solutions with adequate considerations on all aspects in the local environments.