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Capping the number of visitors to restaurants can significantly reduce COVID-19 infections.

HOW TO STOP RESTAURANTS SEEDING COVID INFECTIONS

US mobile-phone data suggest restaurants and gyms can be virus hotspots — and reveal ways to slow spread.

By David Cyranoski

In cities worldwide, coronavirus outbreaks have been linked to restaurants, cafes and gyms. Now, a model using mobile-phone data to map people's movements suggests that these venues could account for most COVID-19 infections in US cities.

The model, published in *Nature*, also reveals how reducing the occupancy of venues can cut the number of infections (S. Chang *et al. Nature* https://doi.org/ghjmt2; 2020).

The model "has concrete pointers as to what may be cost-effective measures to contain the spread of the disease, while at the same time, limiting the damage to the economy", says Thiemo Fetzer, an economist at the University of Warwick in Coventry, UK. "This is the policy sweet spot."

To predict how people's movements might affect viral transmission, the research team input anonymized location data from mobile-phone apps into a simple epidemiological model that estimated how quickly the disease spreads. The location data, collected by SafeGraph, a company based in Denver, Colorado, came from ten of the largest US cities, including Chicago, Illinois; New York; and Philadelphia, Pennsylvania. It mapped how people moved in and out of 57,000 neighbourhoods to points of interest, such as restaurants, churches, gyms, hotels, car dealerships and sporting-goods stores for 2 months, starting in March.

When the team compared the model's number of infections in Chicago neighbourhoods between 8 March and 15 April with the number of infections officially recorded in those neighbourhoods a month later, they found that the model had predicted the case numbers.

"We are able to faithfully estimate the contact network between 100 million people for every hour of the day. That is the secret ingredient we have," says team leader Jure Leskovec, a computer scientist at Stanford University in California.

The team then used the model to simulate different scenarios, such as reopening some venues while keeping others closed. They found that opening restaurants at full capacity led to the largest increase in infections, followed by gyms, cafes, hotels and motels. If Chicago had reopened restaurants on 1 May, there would have been nearly 600,000 extra infections that month, whereas opening gyms would have produced 149,000 extra infections. If all venues had been open, the model predicts that there would have been 3.3 million extra cases.

But capping occupancy for all venues at 30% would reduce the number of extra infections to 1.1 million, the model estimated. If occupancy was capped at 20%, new infections would be reduced to about 650,000.

"The study highlights how real-time big data on population mobility offers the potential to predict transmission dynamics at unprecedented levels of spatial granularity," says Neil Ferguson, an epidemiologist at Imperial College London.

The mobility data also suggest why people from poorer neighbourhoods are more likely to get COVID-19: because they are less able to work from home, and the shops they visit for supplies tend to be more crowded than those in other areas. The average grocery shop in poorer neighbourhoods had 59% more hourly visitors per square foot, and visitors stayed, on average, 17% longer than at shops outside those areas. Leskovec says that people living in these areas probably have limited options to visit less-crowded shops, and, as a result, a shopping trip is twice as risky as it is for someone from a wealthier area.

But Christopher Dye, an epidemiologist at the University of Oxford, UK, says these patterns need to be validated with real-world data.

Global trend

Broadly speaking, Fetzer says, the modelling study corroborates much of what has been learnt from contact-tracing studies worldwide, which have identified restaurants, gyms, choir practices, nursing homes and other crowded indoor venues as sites of superspreader events, where many people are infected at one time.

Last month, Fetzer published a report showing that a UK government programme called Eat Out to Help Out, in which restaurant meals were subsidized during August, led to a huge surge in restaurant visits and accounted for up to 17% of new COVID-19 infections that month (see go.nature.com/32f5fiy).

But restaurants might not be hotspots everywhere. Contact-tracing data from Germany have shown that restaurants were not the main source of infection in that country, says Moritz Kraemer, who models infectious diseases at the University of Oxford. That might be because it can be hard to identify the source of an infection using contact-tracing data. Although the model's prediction of overall infection rates in cities was validated with real-world data, Kraemer says, more-detailed contact-tracing data will be needed to test whether the model correctly identified the actual location of infections.

Leskovec says that all models have some amount of error. But because many of his team's model's predictions align with observations, he adds, there is no reason to think that it wouldn't work at smaller scales.

If the model is found to accurately predict the risk of visiting specific locations, health officials could use it to fine-tune social-distancing policies, says Ferguson.