Retail operations models could streamline COVID-19 logistics

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Where to site COVID-19 testing facilities and how to stock them. How to triage patients and allocate hospital resources. The best ways to manage supply chains for food and other essentials.

Solutions to these logistical puzzles posed by the COVID-19 crisis may lie in operations models used in the retail sector, says Siqian Shen, an engineering researcher at the University of Michigan. She has written a report that pairs COVID-related problems with operations engineering research that may lead to solutions.

"We have a large body of research that has traditionally been used to site retail stores, to optimize inventory and production, to manage stock levels as demand for products varies by season," said Shen, an associate professor of industrial operations and engineering and civil and environmental engineering. "The COVID-19 pandemic presents a very similar set of challenges, but the tools to meet those challenges haven't always made it the people who need them. I'm doing what I can to change that."

The report includes information on these and other issues:

- Designing and staffing testing facilities, including how many test kits to send to each facility. Commonly used integer programming models can be used to help find the best locations and staffing levels based on factors like population density and prediction of the disease-spread paths.

- How to triage patients and allocate hospital resources: This is a well-researched topic in operations engineering, and Shen offers several studies that can help planners manage hospital admissions to treat patients as effectively as possible and how to manage the flow of patients through emergency rooms.
- Managing the supply of food and other essentials: Shen provides a variety of modeling resources that dissect the relationships between warehouse location, inventory levels, shipment logistics and other factors, and shows how they can smooth supply chains and get goods where they're needed.

In the future, Shen plans to make open-source analytical software freely available online. For now, she suggests that [decision makers](link) who don't already have access to analytical expertise turn to universities, as well as the authors of the resources in her online repository, for help.

Mining best practices

In addition to adapting models from other applications, Shen is tracking COVID-related success stories from around the globe, gleaned from the countries in Asia and Europe that were among the first to deal with the crisis.

"One of the things that makes a global crisis so difficult is that every country is different," she said. "Something that works in China may not work here in the United States. But taking a step back and analyzing what works elsewhere can help us design our own solutions more quickly."

Some of the examples she cites include:

- Germany, which has emerged as a leader in how to manage the allocation of ICU resources. Its approach to deciding when to

admit and discharge is believed to play a role in the country keeping its COVID-19 fatality rate around 0.4%, lower than other European countries like Italy, where that figure is nearly 10% (the breadth of testing may also be contributing to this disparity, in addition to other factors). Hospital beds may play a role, too: Germany has eight hospital beds per 1,000 people, as compared to Italy's 3.18 beds. In the United States, the figure is 2.77.

- South Korea, whose network of drive-through testing sites has provided 10,000 tests per day in a country of 50 million. Testing there is free and universally accessible, and the nation is analyzing test results around the clock. Shen underscores that extensive testing is a key to understanding disease spread and building public support for social distancing measures.
- China, which has implemented a publicly available online system that provides daily updates on the spread of the disease, as well as death and recovery rates. Such tracking has enabled decisions about how to manage social distancing measures, and has made the public more aware of their effects.

Shen's report is a work in progress. She invites industrial operations experts and others to share resources they believe could be helpful.

"I very much encourage people to contact me if they have something from their area of expertise that they believe could be relevant," she said. "I'm glad to add it, to cite their research. My ultimate goal is to make this a very detailed document that pulls together the best resources and successes from across the globe."

More information: From Data to Actions, From Observations to Solutions A Summary of Operations Research and Industrial Engineering Tools for Fighting COVID-19: www-personal.umich.edu/~siqian … hting-covid19_v1.pdf

Provided by University of Michigan

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