

# How to distribute scarce medical supplies in a pandemic, and do it fairly

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Supplies in the National Strategic Stockpile in November 2020. Credit: Department of Health and Human Services/Flickr.

In the spring of 2020, with global supply chains for medical equipment crumbling under the stresses of the COVID-19 pandemic, states turned to the federal government for help. Since 1998, the United States has maintained the Strategic National Stockpile, a cache of pharmaceuticals and medical supplies intended for emergency use. The stockpile held

ventilators, N95 masks, gloves, and gowns—the very things states desperately needed.

But for the Federal Emergency Management Agency (FEMA), which took charge of the stockpile during the early months of this crisis, figuring out how to distribute supplies posed major challenges. They couldn't give away everything they had to the first states that asked, because it was likely the virus would soon surge in other places.

"What makes the problem challenging is the fact you don't know what's going to happen," explains Vahideh Manshadi, a professor of operations at Yale SOM. "It's a delicate balance between how much to save for the future versus how much to use today." You can be too conservative in the name of preserving supplies for the future, which disadvantages states in crisis now, or you can be too aggressive, leaving nothing for states suffering later.

In a new paper, Manshadi and her co-authors outline a way to solve the problem of distributing scarce goods under uncertain conditions. With Rad Niazadeh of the University of Chicago Booth School of Business and Scott Rodilitz, a graduate of Yale SOM's [doctoral program](#) now at the Stanford Graduate School of Business, Manshadi developed an approach called projected proportional allocation—a formula that allows [decision-makers](#) to calculate what percentage of demands it will fulfill at any given time, using the best information available at the moment.

With projected proportional allocation, the researchers sought to fulfill three major goals: efficiency (not wasting any supplies), fairness (treating every state equitably), and transparency (making decisions easy to understand from the outside).

Distributing supplies on a first-come, first-serve basis until the stockpile is exhausted would be efficient and transparent but not very fair.

Committing to fulfilling a fixed percentage of each state's demands, regardless of how conditions might change in the future, would be transparent, but it can be unfair if supply runs out, and inefficient if supply does not. Making behind-the-scenes calculations of each state's allocations might be efficient and fair but not transparent. (It's still unclear what approach FEMA actually took; state leaders expressed frustration at what they saw a lack of consistency and clarity in the agency's decisions.)

Projected proportional allocation combines aspects of these three frameworks. "If you're a governmental agency or nonprofit and you want to come up with something that is fair, but also easily interpretable, you can do what we propose," says Rodilitz. "You're still able to guarantee a strong level of efficiency and a strong level of fairness."

Although the [federal government](#) did not know exactly what was going to happen in the future, it did have publicly available projections of when the virus was expected to peak in each state—projections that were being constantly revised as new data arrived. Manshadi, Niazadeh, and Rodilitz developed a simple formula that incorporated those projections and the current supply levels in the stockpile to generate a fill rate—the percentage of each state's requests FEMA could meet that week. The following week, FEMA could use the same formula again with new data, resulting in a new fill rate.

Essentially, projected proportional allocation allows [decision](#) makers to turn up or down the dial in response to new information, while also treating all states fairly by aiming to fulfill a consistent percentage of their requests.

"What we're saying is, even in this world where we don't know exactly what's going to happen in the future, just pretend like you know, based on all the information that you have available to you, and then make your

decision proportionally based on that," Rodilitz explains. "And then when you make your next decision, incorporate all the new information and make a new decision."

While the approach was developed in response to the COVID-19 pandemic, the researchers believe it could be adapted to other situations, including food distribution or natural disasters, where governments or nonprofits face highly uncertain and gradually arriving demands for scarce resources.

What makes these situations different is the need for fairness; after all, every person has an equal right for their government aid in a disaster. And while existing research in resource allocation offers a wealth of advice on how decision-makers can be more efficient, it hasn't had much to say about equity—a gap the researchers hope their work can help to fill.

They recognize it's a hard goal to achieve in disaster scenarios, where needs may change hourly. "Just the fact that things realize at different times can make making fair decisions more difficult," Manshadi says—but no less vital.

**More information:** Vahideh Manshadi et al, Fair Dynamic Rationing, *SSRN Electronic Journal* (2021). [DOI: 10.2139/ssrn.3775895](https://doi.org/10.2139/ssrn.3775895)

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