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Perspective
EXPERT INSIGHTS ON A TIMELY POLICY ISSUE

ELIZABETH HASTINGS ROER, ISLA GLOBUS-HARRIS

A Mechanism to Reduce Medical Supply Shortfalls During Pandemics

During a pandemic, there is a high risk of medical supply shortfalls. Shortfalls can result from not only insufficient supply levels but also inefficient distribution of supplies. Areas with high levels of need may not be able to obtain sufficient supplies, while areas with lower levels of need might hang on to or acquire surplus supplies because they expect their need to increase later. Yet if regions do not all face pandemic peaks simultaneously, supply shortfalls in regions that are suffering high infection caseloads (*hot spots*) can potentially be alleviated by incentivizing regions that have low infection caseloads (*cool spots*) not to hold onto or acquire medical supplies in return for a guarantee from the federal government or other entity that those regions, in turn, will receive supplies when they need them.

The objective of this Perspective is to explore a mechanism to help the federal government or other responsible entities increase the flow of medical supplies where they are most needed at any given point in time by discouraging resource-hoarding.

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This Perspective is intended as a conceptual overview of a mechanism that may be timely, efficient, and useful during pandemic responses.

Specifically, we discuss a *backstopping mechanism* that assures current cool spots that, if they relinquish inventoried supplies to hot spots and delay acquiring new resources, they will receive priority access to a corresponding quantity of newly produced resources in the future. If new resources are not produced as quickly as expected or if the cool spot suffers an outbreak earlier than expected, the promise will be fulfilled by drawing from a dedicated centralized resource pool. This backstopping mechanism multiplies the value of a centralized pool of resources, such as the Strategic National Stockpile, by leveraging it to increase the share of resources going to high-need areas.

For this mechanism to work, it must draw in more resources over critical periods than the centralized pool could otherwise provide through direct allocation. **Thus, the mechanism's success depends on the participation rate among cool spots and the overall rate of production of critical supplies. Two supplemental policies increase the probability that the mechanism will be effective: ensuring the existence of a marketplace for pandemic-related medical supplies and subsidizing the production of new supplies.**

This Perspective is intended as a conceptual overview of a mechanism that may be timely, efficient, and useful during pandemic responses. Many of the policy's details still need to be determined. Moreover, this plan does not address the allocation of supplies across hot spots; rather, it focuses on maximizing the quantity of supplies available for immediate needs and remains agnostic to how those supplies should be distributed.

Although our proposed mechanism is general, it could apply to the current coronavirus disease 2019 (COVID-19) pandemic. As newly produced supplies roll off the line and the pandemic progresses through geographically dispersed peaks and troughs, implementing this backstopping mechanism may offer an opportunity to reduce shortfalls in hot spots.

The Need to Augment Existing Strategies to Alleviate Shortfalls

In this Perspective, we follow a deductive approach and apply economic principles—primarily from the subfields of mechanism design and macroeconomics[1]—to assess the barriers to allocating the maximum amount of available resources to areas suffering acute resource shortfalls, and we propose a mechanism to improve the situation. In this section, we outline two key drivers of pandemic resource shortfalls: First, high costs and uncertainty can limit the stockpiling of resources in advance of a crisis. Second,

because of either the pre-pandemic distribution of medical resources or the dispersion over time and geography of pandemic waves and resource production, some regions might end up holding onto or acquiring medical resources that they do not need in that moment but that other regions do. Also in this section, we review two alternative baseline mechanisms sometimes used for alleviating supply shortfalls during a pandemic; later, we contrast these two against our proposed mechanism.

Expense and Uncertainty over Value Deter the Stockpiling of Supplies to Meet Full Pandemic Requirements

It is costly for governments and other public or private entities to acquire and maintain a large stockpile of medical supplies. Supplies must be acquired and then stored in facilities with appropriate security and environmental control, and the supplies might require periodic inspection and maintenance. In addition, many medical supplies degrade over time, necessitating replacement,[2] and some supplies may become obsolete as technology changes.

Meanwhile, the value of such a stockpile is realized only during a pandemic or other disaster, and the timing and frequency of such events are uncertain. Thus, a stockpile may be maintained for years before it provides any value to society. Some uses of the stockpile may be limited (such as during a localized epidemic or natural disaster), while others may be widespread (such as during a national or global pandemic).

It may be a challenge for governments and other responsible entities in both the public and private sectors to justify diverting funds from certain and near-term requirements in order to fund and maintain a stockpile of uncertain value. Consequently, stockpiles may be insufficient for the needs of large, low-likelihood events (such as a global pandemic). These stockpiles are useful for smoothing out gaps in medical supply chains and providing short-term relief as supply chains ramp up; however, they may be insufficient for providing complete supplies over an entire pandemic. Our proposed backstopping mechanism multiplies a stockpile's ability to provide this short-term relief; specifically, the multiplier enables the stockpile to provide additional aid without increasing in size.

Inefficient Allocation of Scarce Resources Exacerbates Shortfalls

During a pandemic, because of the pre-pandemic distribution of medical resources or the dispersion over time and geography of pandemic waves and resource production, some regions might end up holding onto or acquiring medical resources that they do not need in that moment but that other regions do need. Consequently, it may be possible to reduce pandemic resource shortfalls by transferring resources from each moment's cool spots to each moment's hot spots. For example, hot spots can receive critical supplies from cool spots, and, in exchange, the cool spots are promised access to future resources—a form of *intertemporal trade*, or trade across time. Likewise, cool spots can delay purchases of new medical resources and instead let those supplies go to hot spots in exchange for a promise of access to future resources when produced. Such opportunities for intertemporal trade exist if (1) the pre-pandemic distribution of medical resources results in early cool spots possessing idle inventories, (2) a pandemic's progression

results in caseload peaks and troughs at different times in different locations, or (3) new production ramps up at different speeds in different locations or is otherwise unevenly distributed. Because the second and third conditions might emerge throughout the pandemic, there may be gains from trade available throughout a pandemic's timeline. Exploiting intertemporal trade between hot spots (which are in dire need of supplies) and cool spots (which may have a temporary excess of supplies) increases the availability of critical supplies when and where they are needed.

Two Alternative Baseline Mechanisms for Alleviating Pandemic Shortfalls May Not Resolve Inefficient Allocation

To illustrate how our proposed approach might provide benefits over existing methods, we first describe two baseline mechanisms: a free-market approach and a central-planning model.

In a *free-market approach*, individual health care facilities and other first responders use their own inventories and submit orders to suppliers for more resources. During a pandemic, individuals and organizations with excess resources sometimes donate or sell them. However, barriers, such as lack of information or uncertainty, may hinder beneficial trades and donations, leaving some resources unused or unavailable to hot spots. For instance, supply-holders in cool spots may be unwilling to part with their goods because they lack incentives to do so, are uncertain how to ensure that the transferred supplies go to high-need areas, or are uncertain whether they will be able to replace the supplies if or when needed. Thus, uncertainty and lack of information and incentive will lead cool spots to keep their supplies even when other areas have greater needs.

In a *central-planning model*, government entities collect information about requirements and then appropriate supplies (with or without payment) as needed, directly distributing needed resources. One drawback of this method is that it is challenging to collect this information, particularly because appropriation incentivizes supply-holders to hide their supplies. In addition, if supply-holders in cool spots believe that the government will appropriate any newly produced supplies (in addition to reallocating existing cool-spot resources), that might also encourage cool spots to preemptively acquire excess supplies because they anticipate not having access to new production later. Similarly, central planning can be challenging if the market for newly produced items is large, complex, or dynamic; under such conditions, the government might not be able to gain control over newly produced resources to coordinate their allocation. In addition, central-planning approaches can deter investments in production capacity if firms are concerned that they will not be fairly compensated for their products. Government-led appropriation early in a pandemic could set a precedent that further exacerbates these consequences. Thus, a central-planning approach might not effectively appropriate as many supplies as could be possible using our proposed backstopping mechanism.

The mechanism we propose sits between these two baseline responses. Relative to both approaches, the backstopping mechanism may improve information flow and better align the incentives of cool spots and hot spots. Unlike the free-market approach, it leverages the power of a central government (or other large and influential

coordinating entity) to overcome barriers that slow the adaptation of medical supply chains to pandemic circumstances. Unlike the central-planning model, our mechanism induces the voluntary disclosure of idle inventories and the delayed acquisition of supplies that are not immediately required. In the next section, we describe our proposed mechanism.

A Backstopping Mechanism for Leveraging a Centralized Resource Pool to Alleviate Pandemic Shortfalls

We propose that a centralized pool of dedicated resources—a *backing pool*—can be leveraged to facilitate the transfer of key medical supplies from cool spots to hot spots during a pandemic. Regions that are not facing high pressures on their medical systems can send resources to current hot spots or delay acquisition of new resources so those can go to hot spots; in return, current cool spots will be promised priority access to newly produced resources as soon as they are available. A key feature of the mechanism is that the promise made to cool spots is guaranteed by a centralized pool of resources from which cool spots can draw if production is delayed or they need the resources earlier than anticipated. To increase the efficacy of this mechanism, the government or coordinating entity could create a centralized marketplace for pandemic medical supplies and subsidize the new production of supplies.

To the best of our knowledge, no one else has proposed or implemented a mechanism similar to what we are suggesting in the context of pandemic response. In particular, we are not aware that anyone has proposed leveraging a centralized resource stockpile as the supplier of last resort to guarantee transfers of critical supplies.

We propose that a centralized pool of dedicated resources—a *backing pool*—can be leveraged to facilitate the transfer of key medical supplies from cool spots to hot spots during a pandemic.

How the Mechanism Multiplies the Value of Resources in a Centralized Pool

The key innovation of this approach is that it multiplies the value of resources in a centralized pool. For example, maintaining one ventilator in the pool can allow for the release of more than one ventilator to pandemic hot spots, which we illustrate in the next section. More specifically, instead of serving simply as the primary holder and supplier of equipment, the pool is used to incentivize the

donation or sale of medical supply inventories from around the country, which increases the total available supply.

In this mechanism, the *multiplier* is the amount by which the value of the backing pool is increased when used as a backstop rather than as a direct source of supplies to hot spots. As a hypothetical example, if the coordinating entity can use the 100 masks it has in its backing pool to assure a cool spot that it is safe to transfer 500 masks to a hot spot, the available supply of masks would be increased from 100 to 500—a multiplier of five. (These example numbers reflect that the coordinating entity anticipates having to use supplies from the backing pool 20 percent of the time.) The multiplier emerges from the willingness of cool spots to relinquish existing and new supplies to hot spots; the more that cool spots are convinced that they do not need to preemptively secure supplies, the higher the multiplier.

The key to building confidence is the size of the backing pool relative to default rates, and those rates depend on how quickly supplies can be produced.

Critical to implementing this approach is identifying the probability that the trade will *default*—that is, that new supplies for cool spots will not be available when needed, and the coordinating entity will thus have to send the supplies from the centralized pool. The coordinating entity cannot overextend itself by promising to cover more trades than it can fulfill given uncertainty about the rate of future production. The lower the default rate, the higher the multiplier on the value of supplies in the backing pool. Additionally, cool spots will be more willing to participate in the mechanism the more confident they are that the backing pool is not overextended. The key to building confidence is the size of the backing pool relative to default rates, and those rates depend on how quickly supplies can be produced.[3] But even if one in two trades defaults, using a centralized pool of resources as a supplier of last resort would effectively double the supply available.

Illustrative Examples of How This Mechanism Would Work

Although our mechanism does not specify the exact process by which intertemporal transfers are executed, we can illustrate some examples. For instance, consider that Hospital A has excess personal protective equipment (PPE) today but anticipates needing it to fulfill contracts in the future, while Hospital B is out of PPE today. Hospital A agrees to send PPE to Hospital B today, and Hospital B will repay Hospital A in several weeks using supplies purchased from Supplier C, which is currently in the process of increasing production. If Supplier C fails to produce the new supplies in time, the coordinating entity steps in and

fulfills the contract using supplies from the centralized resource pool.

Suppose that the risk that Supplier C fails to provide products in time is 20 percent. Then, on average, the coordinating entity would be supplying resources from its backing pool for 20 percent of transactions. So, if the backing pool has 1,000 units of supplies, it can guarantee transactions covering roughly 5,000 units of supplies because it expects to pay out (or distribute) only 20 percent of transactions from its own coffers. Thus, the backstopping mechanism would increase the supplies available to hot spots by a factor of five. In reality, the coordinating entity would likely use a more conservative model to avoid running out of its own supplies, which might be particularly important early in a pandemic when the production rate and other factors may be very uncertain. By using a centralized pool of supplies to back intertemporal trades rather than directly distribute those supplies to hot spots, the total quantity of supplies available to hot spots increases.

As another example, consider that a company has just produced ten new ventilators. The government has agreed to purchase four, and two hospitals in cool spots are getting three each. Meanwhile, hot-spot hospitals are in critical need of additional ventilators. In one scenario, the government could simply send the four ventilators it purchased to the hot spots. Alternatively, it could use the four ventilators it bought to create a backing pool and then use this backing pool (in conjunction with expected new production) to convince each of the cool-spot hospitals to postpone their ventilator orders. Essentially, the government would write a contract specifying that the cool-spot hospitals are each guaranteed three new ventilators when they are produced next week, and, in the meantime, those six ventilators would be sent to hot spots. If one of the cool-spot hospitals needs supplies earlier than anticipated, the government would step in to send three ventilators from its backing pool. As long as, on average, the government needs to rely on its backing pool for, at most, two out of three such contracts, it will have sufficient resources in the backing pool to follow through on its promises. Meanwhile, the hot spots would have access to six ventilators instead of four.

Complementary Policies

The following two policies would complement the backstopping mechanism to draw out existing resources and reduce the risk of defaults, thus increasing the multiplier.

Creating a Dedicated, Unified Marketplace for Pandemic-Related Medical Resources

One way to increase the amount of resources is to reduce information barriers and otherwise coordinate needs with available suppliers. For instance, a supplier may have a significant inventory of N95 masks that it is willing to sell or donate, but it has no way of knowing how to connect to a high-need recipient.

Marketplaces offer many benefits over alternative means of performing these communication and coordination functions because, in addition to providing a central location to aggregate information about demand and supply, market incentives draw out hard-to-find private resources that may remain otherwise hidden. Additionally, the information about future supply provided by a transparent market may provide assurances to cool spots that they will be able to acquire supplies in the future, making them more willing to give up access to supplies today.

A dramatic increase in the production of new medical supplies supports the viability and effectiveness of the proposed backstopping mechanism.

Because of the economic disruption that potentially accompanies a pandemic, markets existing prior to the pandemic might not function optimally during the crisis; thus, there may be a role for public policies to ensure a well-functioning marketplace for pandemic response resources.

Given the diversity of institutions that may be supplying and receiving resources, such a market could allow for very flexible pricing terms for suppliers, as traditional payments may not be appropriate in many cases. The term *price* could imply a profit motivation, but, in this context, a *price* is anything that persuades a supplier to give up goods by resolving whatever dilemma is currently preventing it from supplying. For example, some suppliers may be willing to donate supplies, while others may need promises of repayment either in currency or in guaranteed future supplies.

Markets usually serve as a mechanism for allocating scarce resources across competing users or consumers. But it might be undesirable for markets to perform the role of allocating to users during a pandemic. Moreover, the value of a marketplace in supporting the backstopping mechanism is not related to resource allocation among users. Rather, the mechanism described in this paper serves to gather as many resources as possible to maximize available supplies, leaving the responsibility of allocation to other government entities and their policy decisions.

Subsidizing Medical Resource Markets

Subsidies—government expenditures on supply beyond the prevailing market price—have a role to play in supporting the backstopping mechanism. In particular, subsidies can help quickly increase the amount of supplies produced. A dramatic increase in the production of new medical supplies supports the viability and effectiveness of the proposed backstopping mechanism in two ways. First, a reliable and large increase in production improves cool spots' confidence that future supplies will be available when needed. Second, new production helps centralized resource pools avoid becoming overextended by reducing the default rate. Reducing the default rate also increases the multiplier.

In a well-functioning market, market prices provide producers with information and incentives to produce the optimal quantity of supplies. However, medical supply markets may not quickly adjust to high demand during a pandemic: Prices may be naturally sticky (i.e., slow to adjust), and anti–price-gouging laws may prevent medical supply prices from rising.

Meanwhile, the marginal cost of producing medical supplies is likely to be higher during a pandemic than otherwise, so historical prices may not be high enough to ensure adequate supply. For example, increasing production might require producers to pay their workers overtime or hazard pay or provide additional sick leave benefits, all of which will increase costs. Also, new producers entering the market may face high production or other costs from having to, for example, retool factories, invest in new equipment, or train workers in new methods.

Subsidies can help correct these deficiencies. The promise of a subsidy alleviates some of the uncertainty faced by producers, which will be more willing to make investments if they know they will be able to recoup costs.

Applying the Backstopping Mechanism to the COVID-19 Pandemic

In this section, we offer some observations on how to evaluate whether a backing pool is the most efficient use of a centralized pool of resources and whether the proposed mechanism could provide benefits over alternative responses in the ongoing COVID-19 pandemic. We also discuss implementation design details that may affect the feasibility and efficiency of employing the mechanism during this pandemic. Assessing the value of the backstopping mechanism for the COVID-19 pandemic and determining optimal implementation details would require analysis that is outside the scope of this Perspective.

Assessing the Value of the Backstopping Mechanism

Is a Backing Pool the Most Efficient Use of a Centralized Pool of Resources?

For a backing pool to draw in more resources than it could allocate directly to hot spots on its own, *at least one* of three conditions must be met:

1. There must be inventories of idle supplies.
2. Orders from cool spots must represent a substantial portion of demand for newly produced supplies.
3. There must be dispersion over time and geography of disease outbreaks or medical supply production.

In a rapidly evolving situation like the ongoing COVID-19 pandemic, it can be challenging to evaluate the inventory of idle resources. Numerous areas around the United States are expected to experience large caseloads in the near future.[4] Nonetheless, there might be idle inventories spread across areas that are not expected to suffer large caseloads in the near future. For example, in early April 2020, Washington state returned 421 ventilators to the national stockpile,[5] and California returned 500 ventilators to the national stockpile for "temporary use by other states with a more urgent need."[6] A well-designed market could potentially induce those with idle inventories to self-identify, thus overcoming the challenge of finding idle assets.

It may also be challenging to evaluate the extent to which cool spots are competing with hot spots for future production in the ongoing pandemic. There is evidence that states are undertaking significant efforts to acquire equipment and supplies,[7] but each state might have hot spots in need of supplies, so it is difficult to tell the extent

to which such efforts are targeting current versus anticipated future needs.

Finally, there is evidence that employing the backstopping mechanism could be justified based on the likely dispersion of COVID-19 caseloads and medical supply production over time and space. The COVID-19 pandemic is likely to last for an extended period of time,[8] and as the pandemic progresses, there might be waves of outbreaks.[9] Because the mechanism improves the allocation of resources across these waves, it may be valuable even if it is not implemented until the pandemic is well underway.

To evaluate the potential value of the backstopping mechanism, experts on the course of the COVID-19 pandemic and on patterns of medical supply production could more formally evaluate whether any of the three conditions described earlier are met. Even if none of the conditions is met for the current COVID-19 pandemic, the mechanism could potentially help in future pandemics to alleviate the types of supply shortfalls that have plagued early COVID-19 responses.

Does the Backstopping Mechanism Have Potential Benefits over Alternatives?

How the backstopping mechanism might perform in the COVID-19 pandemic compared with other responses, such as the free-market and central-planning approaches presented earlier, depends on features of the pandemic and prevailing conditions in the relevant medical supply markets.

If there is high uncertainty about future supply and need, the free-market approach might result in hoarding by cool spots. The proposed backstopping mechanism might reduce hoarding relative to the free market outcome. As discussed in the previous section, the magnitude of hoarding may be challenging to evaluate in the current pandemic. Nonetheless, there are indications of high uncertainty about availability of and access to future supply.[10]

In a centrally planned response, the government directly determines the allocation of resources—both existing excess inventories and new products rolling off of production lines—across potential users. The federal government and several state governments have started employing this approach in the COVID-19 pandemic.[11] Successful implementation of a central-planning approach requires that the government knows the location of idle resources and new products and has the ability to control the distribution of these resources. In contrast, the backstopping mechanism—particularly when paired with a centralized market—incentivizes cool spots to voluntarily relinquish claims on idle inventories and newly produced resources, at least temporarily.

Correspondingly, a centrally planned response might be relatively more effective if the government knows where excess inventories exist (for example, because there are centrally maintained records for a type of resource requiring inspection or certification at the unit level) or if the government controls or can intercept a high percentage of new production. The backstopping mechanism might be relatively more effective if it is hard for the government to identify excess resources or if new resources are produced by many manufacturers or in a complex market beyond direct government control.

In principle, different approaches could be used for different types of medical resources. In practice, there might be important interactions between resources to

consider. For example, in isolation, it might make sense to employ a centrally planned approach in one type of market but the backstopping mechanism in another. However, if the government starts appropriating cool-spot inventories or placing priority orders that displace cool-spot orders for one type of resource, or in one location, first responders might worry that such efforts will eventually be employed for other types of resources or across other locations. They might therefore take actions to preempt appropriation by hiding their excess supplies and working harder to acquire new products, undermining the effectiveness of any approach taken to direct resources from cool spots to hot spots.

Implementation Details Affecting the Efficiency and Feasibility of Employing the Backstopping Mechanism

The mechanism will work if decisionmakers in cool spots believe that, if they delay their acquisition of medical supplies or relinquish current inventories, they will still be able to access supplies when they need them, either from new production or from the central backing pool. Furthermore, the more that cool spots trust promises of repayment, the higher the multiplier will be and the more efficient the mechanism will be. In turn, the credibility of commitments made to cool spots depends on reliable and fast production of new supplies, as well as the future availability of supplies from the central pool if new production falls short when needed. In this section, we discuss conditions and implementation design features affecting mechanism credibility.

The mechanism will work if decisionmakers in cool spots believe that, if they delay their acquisition of medical supplies or relinquish current inventories, they will still be able to access supplies when they need them.

Rate and Reliability of New Production

Experts could evaluate production rates of the various types of medical supplies needed during the COVID-19 pandemic and assess the industrial bases for those supplies. The backstopping mechanism is most likely to work when resources' production rates can quickly and reliably increase significantly. Furthermore, fast production decreases default rates, which increases the multiplier and makes it more efficient to use central pools of assets for the backstopping mechanism. Finally, if future rates of production are reliable, it will contribute to the mechanism's credibility in making commitments. The industrial base assessment could also inform the design of complementary subsidy policies.

Credibility of the Centralized Pool to Backstop the Guarantee

Creating a Centralized Backing Pool

If the aforementioned analyses suggest to decisionmakers that the most efficient use of a centralized pool of supplies is to employ the backstopping mechanism, then there are a few ways to build such a pool. For the COVID-19 pandemic, a natural candidate would have been to divert some resources from the Strategic National Stockpile to serve as a backing pool.[12] However, as of April 1, 2020, it appears that the resources in the stockpile have been nearly expended.[13] Nonetheless, there are other potential sources for a backing pool that experts could consider, such as the following:

- The federal government could set aside some newly produced resources to serve as a federal backing pool.
- Philanthropic nongovernmental entities could attempt to accumulate reserves of resources to serve as a backing pool for geographically dispersed recipients.
- Coalitions of geographically dispersed entities could agree to divert existing inventory or newly acquired supplies into a backing pool to support member entities' participation in a subnational implementation of this mechanism.

As illustrated through an example presented earlier, backing pools can be created while simultaneously diverting new supplies to hot spots, avoiding the idling of resources.

Minimizing Risk of Reallocating Backing-Pool Resources

Our backstopping mechanism is designed to increase the quantity of resources available to hot spots at each point in time by convincing the cool spots at each period to release their idle inventories and delay acquiring new supplies. One challenge that might arise in applying the mechanism to the COVID-19 pandemic is tension between what is required to draw resources during early periods and the desire to send resources to highest-need areas in later periods. Failure to adequately resolve this tension would undermine the value of the proposed mechanism.

Maximizing total available resources in earlier periods requires making promises to early cool spots that if they release inventories and delay current acquisition efforts, they will be guaranteed access to a corresponding quantity of resources if they need them in the future. This promise allocates some future resources across future hot spots. But the future course of the pandemic is uncertain, and whoever controls the backing pool when the early cool spots' needs come due might favor an allocation of resources across hot spots that conflicts with promises made earlier.

For example, consider that Hospital A, which is experiencing a low COVID-19 caseload, releases an inventory of resources that are sent to Hospital B, which is experiencing a high caseload, in a transaction guaranteed by the backing pool. Subsequently, Hospital A has a need for supplies to save local lives. But now Hospital C also has a high caseload and patients who will die if Hospital C does not receive the supplies. If the entity controlling the backing pool is also responsible for choosing whether Hospital A or Hospital C receives the supplies, there is risk that the responsible entity will renege on the promise it had previously made to

Hospital A—for example, if Hospital C's need is somehow deemed more important.

Our mechanism is not intended to address the challenge of allocating scarce resources across simultaneous hot spots; rather, its function is to draw more resources into the aggregation of hot spots at any given moment. Nonetheless, if decisions to allocate across hot spots are conflated with decisions to honor the commitments from previous trades, cool spots may decline to participate in the mechanism. One potential solution to this conflict is to separate decisionmaking across multiple entities: One entity controls the central backing pool and another determines which facilities have the highest needs (but has no access to supplies in the backing pool).

In assessing the value of the proposed backstopping mechanism to the COVID-19 pandemic and—if deemed sufficiently valuable—in designing implementation details, experts should consider implementation methods for mitigating the risk of reallocating backing-pool resources.

The Role of Transparency and Analysis

If cool spots cannot readily assess the credibility of the backstopping mechanism—because of rapidly changing information about the state of supply (both stockpiles and the rate of new production), demand, or anticipated pandemic progression—successful mechanism design and implementation might require specific focus on helping participants gain visibility into the factors that determine credibility. For example, a centralized marketplace might be an efficient means of aggregating and continuously updating information about supply and demand so that each cool spot can undertake informed analysis of whether backstopping-mechanism guarantees are sufficiently secure to justify participation. Because cool-spot participants in the ongoing COVID-19 pandemic might lack immediate access to the expertise needed to evaluate mechanism credibility, this transparency could be supplemented by centrally coordinated, transparent, and credible estimation of default rates by qualified and independent experts.

Conclusion

The backstopping mechanism we present in this Perspective could potentially reduce resource shortfalls during pandemics by moving resources away from the cool spots of one moment and toward the hot spots of that moment. Under certain conditions, this mechanism multiplies the value of centralized stockpiles of medical supplies, such as the Strategic National Stockpile in the United States. Careful analysis and implementation are required to maximize the effectiveness of this mechanism.

This mechanism could prove useful not only in the event of a future pandemic but also potentially in the current COVID-19 pandemic. As long as the COVID-19 pandemic features uneven geographic distribution of pandemic peaks and troughs or uneven production of medical resources over time, there are benefits from directing resources away from cool spots and toward hot spots.

Although many of the mechanism's details are still to be determined, we hope that, in publishing this Perspective, we can bring this concept to the attention of policymakers who can assemble the necessary expertise to evaluate its potential value for the COVID-19 pandemic and, if it proves useful, to work through remaining issues and move ahead with implementation.

Notes

[1] For an introductory text on mechanism design, see Börgers, 2015. For a description of applying mechanisms in central banking that are similar to our backstopping mechanism, see Gorton and Metrick, 2013. In March 2020, in response to economic disruptions stemming from the COVID-19 pandemic, the Federal Reserve implemented operations that made it the lender of last resort for mortgage markets (Orton, 2020).

[2] U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response, 2020a.

[3] It may be more accurate to think of the default rate as the reserve-deposit ratio needed for a tolerable level of risk, given estimated default rates. This is particularly important if defaults are correlated across trades, which needs to be considered to avoid overextending the backing pool. For example, if the probability that a given trade will default (i.e., the resources will have to be pulled from the backing pool) is correlated with the probability that other trades will default, this needs to be considered when estimating the overall default rate (or tolerable reserve-deposit ratio). For an explanation of the *money multiplier*, which is the canonical implementation of the economic principles underlying the relationship between reserve-deposit ratios and multipliers, see, for instance, Mankiw, 2003, pp. 484–487.

[4] For a recent synopsis of COVID-19 pandemic projections, see Katz, Quealy, and Sanger-Katz, 2020. For links to several projections, see Johns Hopkins University, undated; Institute for Health Metrics and Evaluation, 2020; and Robertson, 2020. These references may not be comprehensive of all available projections.

[5] "Trump Again Promotes Use of Unproven Anti-Malaria Drug; Deaths in Country May Be Undercounted," 2020.

[6] Pereira, 2020.

[7] Goudie et al., 2020; Estes, 2020.

[8] Larson and Smith, 2020.

[9] Coyne, 2020.

[10] Westervelt, 2020.

[11] See, for instance, Levey, 2020; Johnson and Hellmann, 2020; Hughes, 2020.

[12] According to a government-maintained resource on the stockpile, the Strategic National Stockpile is a federal project consisting of a large supply of medical supplies, including PPE, ventilators, and pharmaceuticals. Exact details of the stockpile are classified for national security purposes. Although it was originally created to respond to chemical, biological, and radiological attacks, the stockpile has been used in response to various public health emergencies, including hurricane responses, the H1N1 pandemic influenza in 2009, and the Ebola outbreak in 2014 (U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness and Response, 2020b).

[13] During the COVID-19 pandemic, the Strategic National Stockpile failed to cover all needs, even relatively early in the pandemic's course. For instance, in March 2020, the *Washington Post* reported that numerous states had received only small fractions of the supplies they requested: Massachusetts received only 17 percent of the PPE it requested, and Maine received 5 percent of the N95 masks it requested (Goldstein, Sun, and Reinhard, 2020). By March 31, the *New York Times* reported that the stockpile was beginning to run out of key supplies, including PPE ("U.S. Emergency Medical Stockpile Nearly Out of Protective Gear as Demand Rises-Officials," 2020). By April 1, the *Washington Post* reported that the stockpile had been nearly expended (Miroff, 2020).

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About the Authors

Elizabeth Hastings Roer is an associate economist at the RAND Corporation. Much of her recent research examines supply-chain disruptions and other industrial base challenges. She is a former active-duty U.S. Air Force officer and received a Ph.D. in economics.

Isla Globus-Harris is an assistant professor of economics at Colgate University. Her research uses game theory to design incentives and policies to solve inefficiencies in markets, with a focus on environmental problems. She received a Ph.D. in economics.

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About This Perspective

During a pandemic, there is a high risk of medical supply shortfalls and inefficient distribution of medical supplies. If different regions face pandemic peaks at different points in time, supply shortfalls in regions suffering high infection caseloads (hot spots) can potentially be reduced by minimizing idle inventory and acquisitions of new supplies in regions with contemporaneously low infection caseloads (cool spots). This Perspective discusses a potential backstopping mechanism for addressing this inefficient distribution by assuring cool spots that, if they release inventoried supplies to hot spots and delay acquiring new supplies, they will receive priority access to a corresponding quantity of newly produced supplies in the future. If new supplies are not produced as quickly as expected or if the cool spot suffers an outbreak earlier than expected, the promise will be fulfilled by drawing from a centralized, dedicated pool of supplies. This backstopping mechanism thus multiplies the value of resources in a centralized pool by leveraging that pool to increase the share of resources going to hot spots. For this mechanism to work, the pool must draw in more resources over critical periods than it could otherwise provide by simply acting as a direct source of supplies. This paper also offers observations on how to evaluate whether the proposed mechanism could provide benefits over alternative responses in the ongoing coronavirus disease 2019 (COVID-19) pandemic.

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Peter Hussey, vice president and director, RAND Health Care
1776 Main Street
P.O. Box 2138
Santa Monica, CA 90407-2138
(310) 393-0411, ext. 7775
hussey@rand.org

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