

Weighted Lotteries and the Allocation of Scarce Medications for Covid-19

by LYNN A. JANSEN AND STEVEN WALL

Many different considerations—including a patient’s occupation, membership in a disadvantaged group, and potential to benefit from a particular drug—are relevant in allocating scarce Covid-19 vaccines and therapeutics. But how should these various factors be balanced with one another? A useful model for thinking through this problem employs a weighted lottery.

In response to the Covid-19 pandemic, researchers across the world worked at breakneck speed to develop therapies to treat the disease and vaccines to prevent its spread. Now that several vaccines have been developed that look to be effective and safe enough for widescale distribution, demand for them has exceeded supply. Efficient and adequate distribution of the drugs has proven to be more challenging than anticipated. Confronted with scarcity in the near term, state and local officials, hospitals, and health care providers all have been forced to think about whom should be given priority in receiving the vaccine. These decisions obviously raise ethical questions, and physicians and ethicists have begun to address them. Recommendations have been advanced, and guidelines have been proposed. Two recent articles from leading medical journals in the United States, for example, called attention

to a range of relevant considerations that bear on the just allocation of Covid-19 vaccines and therapeutics.¹ The authors of both papers acknowledged that different relevant considerations may come into conflict and that, as a result, they may need to be balanced against one another. But they did not provide a method or procedure for how the balancing should be done or how the different considerations should be prioritized.² Without an account of these fundamental matters, proposed guidelines for the allocation of Covid-19 drugs run the risk of being arbitrary.

Recently developed vaccines may prove to be as effective as hoped for, and improvements in the production and distribution of the vaccines may obviate the need to make difficult allocation decisions. It is also possible that new variants of Covid-19 will emerge that are resistant to current vaccines and the race to develop new vaccines and therapeutics will begin again. But however matters transpire over the next several months, the allocation issue remains important. Ethicists and health care providers need

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to think more rigorously and imaginatively about how best to distribute scarce medications under pandemic conditions.

This article proposes a model for thinking about how different considerations that are relevant to the distribution of vaccines and scarce treatments for Covid-19 could be integrated into an allocation procedure. The model employs a weighted lottery, which is a construct that has been employed in other contexts that involve the distribution of scarce resources.³ We highlight the advantages of applying a weighted lottery to the Covid-19 context and offer an illustration for how it might work in practice. Our primary aim is to articulate the structural features of a weighted lottery for this context and to bring out its advantages over other methods for allocating Covid-19 medications. But, in addition, we want to discuss some of the formidable challenges its implementation in practice would present. Doing so will lead us to sketch a procedure for its implementation, one that partially addresses the balancing problem. Naturally, many issues of detail will remain open. They will require judgment to resolve, and different resolutions are likely to be acceptable in different contexts. Yet our objective here is not to present a blueprint that solves all the hard problems but, rather, to defend a way of thinking about how the problems might be constructively addressed.

Why Not Maximize Benefit?

Lotteries come in two basic varieties. Unweighted, or simple, lotteries give each potential beneficiary an equal chance to benefit, whereas weighted lotteries do not. In weighted lotteries, some potential beneficiaries are given a greater chance to benefit than others. For example, if a lottery gives Allie a three in five chance of benefit and Belinda a two in five chance of benefit, then the lottery is weighted. Weighted lotteries might seem to be unfair on their

face, but if there are good reasons for the unequal chances to benefit, then this concern will be muted or offset.⁴ For instance, suppose that it is known that the drug being distributed by the lottery will benefit Allie a good deal more than Belinda. Giving the two individuals an equal chance to get it arguably would then not be fair.

Why should any lottery be employed to resolve a distributive decision involving scarce therapeutics or vaccines in a pandemic? After all, whether weighted or not, all lotteries leave something to chance. Many people find this disturbing; even if there are good reasons to employ a lottery for the distribution of scarce medical interventions, the public might not go for it.⁵ Better, it might be said, just to give the medications to those who are sickest or will benefit the most from them. In this way, benefits to patients overall will be maximized. Lotteries are irrational, according to this argument, because securing the optimal result should not be left to chance.

To take a simple example, suppose that we have only one dose of an effective Covid-19 vaccine, and suppose that Allie is very likely to benefit from it, while Belinda has only a small chance of doing so. In this case, most will think that Allie should get the vaccine and that we should not leave this decision to chance. Matters are less clear cut, however, if Allie's and Belinda's prospects for benefit differ only modestly. Suppose that Allie has a 60 percent chance of benefiting and that Belinda has 50 percent chance of benefiting. Many will think that Belinda has at least some claim to the vaccine, that she should have a chance to receive it even though her prospects for benefit are not quite as high as Allie's. A simple lottery, which would give both an equal chance of getting the drug, may not seem appropriate, but a lottery that gives Allie a somewhat higher chance to benefit than Belinda respects the fact that Belinda meets the eligibility criteria and so should be given an opportunity to

receive the drug while also respecting the fact that Allie has a stronger claim to receive the drug, given her greater likelihood of benefiting from it. A weighted lottery would be responsive to both Belinda's claim of eligibility and Allie's claim to be given priority.

Now those who favor allocations that maximize prospective benefit would reject the use of lotteries, except perhaps to break ties between potential beneficiaries who have an equal prospect for benefit,⁶ but they would agree that, in the example we have been discussing, a weighted lottery would be better than a simple lottery. The case for the weighted lottery becomes stronger, however, when we turn attention from simple numerical differences in prospects for benefit between potential beneficiaries to additional factors that may be correlated with these numerical differences. For example, imagine that prospects for benefit associated with a therapeutic agent for Covid-19 were found to be correlated with the absence of certain comorbidities and that these comorbidities, in turn, were correlated with membership in demographic groups that have been underserved in the past by the relevant health care system. The maximizing approach now would exacerbate the underlying health care disparities.⁷ Continuing with our example, if Belinda has a lower prospect for benefit than Allie does because Belinda has been unjustly denied adequate health care in the past, then there is a reason of health care justice to give her an opportunity to receive the vaccine. When this reason of justice is added to the claim that Belinda has by virtue of meeting the eligibility criteria for receiving the drug, the case for a weighted lottery over a maximizing approach starts to look compelling.⁸

But we are just beginning to scratch the surface. A multitude of other factors also seem relevant to the allocation of Covid-19 therapeutics and vaccines. Consider the following:⁹

1. Essential workers should be given priority.
2. Patients who have a higher probability of benefiting from the drug should be given priority over patients with a lower probability of benefiting.
3. Patients who stand to benefit more from the drug, as opposed to having a higher probability of benefiting, should be given priority over patients who stand to benefit less.
4. Those who have served others in the past should be given priority.
5. Those who have participated in research that led to the development of the drug being distributed should be given priority.
6. Priority should not be assigned on the basis of arbitrary considerations.
7. Priority should not be assigned on a first-come, first-served basis.
8. Priority should be assigned to facilitate the generation of evidence that bears on the drug being allocated.

The first three of these additional factors arguably can be subsumed under a maximizing approach that does not require and arguably is incompatible with a lottery. To maximize societal benefit across time, it may be necessary to prioritize now those who will be needed to help others in the future.¹⁰ And, other things being equal, prioritizing those who would benefit the most from the drug or have the highest prospect for benefit would plainly make sense with a maximizing approach.

By contrast, the next four considerations, if credited, clearly pull us beyond the maximizing approach. Considerations 4 and 5 are backward looking. They appeal to desert as opposed to what will be best for the fu-

ture. Suppose, for example, that Allie would benefit more from a medication than would Belinda but that Belinda played a role in the process that established its safety and efficacy. Here, consideration 5 would militate against the forward-looking 3.

The final three considerations all speak more directly in favor of random selection. Lotteries do not discriminate. And if first come, first served is rejected as a fair basis for allocation, then some alternative method of allocation, such as a lottery, will be needed. Lotteries also create randomization, which can further the generation of evidence by balancing

known and unknown confounding factors across classes of patients eligible for the medication under consideration.¹¹

Note, finally, that many of the factors listed here themselves raise complex questions. Exactly who should count as an essential worker? Should some essential workers, such as health care providers, receive greater priority than others, such as transportation workers? Is the size of expected benefit more important than the probability of an expected benefit? What kinds of discrimination are arbitrary? Presumably, race and ethnicity, gender, and sexual orientation qualify, but what about age or perceived quality of life? Addressing these questions requires further judgments of priority.

Tiers and Simple Lotteries

The case against the maximizing approach rests on the fact that there are relevant considerations for distributing scarce therapeutics

and vaccines for the Covid-19 disease that go beyond considerations of maximal benefit. There is a plurality of considerations to take into account. This, in turn, raises the problem of balancing; and that is a challenging one.

Rather than aiming to maximize benefit, an alternative approach would employ simple lotteries. The simplest such approach would fix general criteria for eligibility and then run an unweighted lottery to determine who should receive the medication.¹² This approach would avoid unfair discrimination, but it would be unresponsive to consider-

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ations that plausibly give some classes of patients a stronger claim to receive medication than others. Essential workers or those who stand to benefit the most from the medications would not have any greater chance of benefit than others, for example. A better approach would employ simple lotteries but limit them to tie-breaking contexts. Such an approach could establish tiers of priority.¹³ For example, essential workers might be treated first, those who have the highest prospect for benefit next, then those from disadvantaged groups, and so on. At each tier, an unweighted lottery could be employed if scarcity required it, but no lottery would be used to allocate medications among patients occupying different tiers.

There is much to recommend a tiered simple lottery. Relevant considerations, including the concern to maximize benefits, could be given priority, and lotteries could ensure that all patients at their tier level receive an equal chance to benefit. Further, if lotteries were conducted at

each tier, as needed, then the problem of arbitrary discrimination and the potential unfairness involved in first-come, first-served allocation would be avoided.

Attractive as it appears to be, however, this approach is not optimal, for at least two reasons. First, there are overlaps between the relevant priority considerations, and these overlaps are not captured by the tiers. For example, while it may be good to give priority to essential workers, it would be better to give priority to those essential workers who have the greatest prospect for benefit. Or, to take another example, among the tier of patients who are not essential workers but who have the greatest prospect for benefit, perhaps priority should be given to those from disadvantaged backgrounds. True, the problem here could be addressed by constructing ever more fine-grained tiers of priority. But this brings us to the second and more damaging problem. The tiered simple lottery approach establishes hard cutoffs between classes of eligible patients, with the result that some eligible patients in practice would receive no prospect at all for benefit. And, intuitively, it would be better, other things being equal, to give as many eligible patients as possible some prospect for benefit.

To see this more clearly, return to the simple world of Allie and Belinda, and suppose now that Allie and Belinda both fall within the tier of patients who are not essential workers but have the greatest prospect for benefit from the therapeutic. However, Allie, unlike Belinda, is a member of a disadvantaged group. Thus, on the fine-grained tier proposal, Allie would receive a prospect for benefit, but Belinda would not. (Assume here that there is not enough medication to give to patients beyond those at this tier level.) One might think that Allie is entitled to some priority over Belinda, but it would be better to give Allie priority while ensuring that Allie and Belinda both receive some prospect for benefit. This

could be accomplished by moving from simple lotteries at tier levels to a weighted lottery.

The introduction of weighted lotteries removes hard cutoffs. This is a clear advantage. In the tiered approach, within each tier, patients would have equal claims to receive the Covid-19 medication. But if those with equal claims should receive equal chances, then it is not plausible that slightly stronger claims should completely override or cancel slightly weaker ones.¹⁴ Better to proportion chances to the strengths of patients' claims, which is exactly what can be accomplished by a weighted lottery.¹⁵ Moreover, the flexibility afforded by the weighted lottery approach over the tiered approach becomes more compelling as the tiers become more fine-grained. Most likely, patients who occupy adjacent fine-grained tiers will have claims to benefit that do not differ greatly in strength.

In pressing this line of argument, we do not wish to claim that no hard cutoff could be reasonable, however. There may be some patients who should receive absolute priority in the allocation of the relevant Covid-19 medications. The class of patients entitled to this absolute priority could be as fine-grained as seems appropriate. Perhaps the class of essential health care workers who are needed to help others in the pandemic, who are not easily replaceable given their training, and who have a significant prospect for benefit are an example. The key would be for them to receive the medications before anyone else. And the justification for this absolute priority would be that an outcome that did not secure this absolute priority would be unacceptable and should not be left to chance.

The introduction of a hard cutoff of this kind is not fundamentally incompatible with the weighted lotteries approach. This approach is committed to two basic claims. First, lotteries should be used to determine allocation decisions for at least some substantial group of patients

who could benefit from Covid-19 therapeutics or vaccines; and second, weighted lotteries are preferable to simple lotteries for this purpose.

A minimal tiered approach would consist of one hard cutoff point, identifying a class of patients who should receive absolute priority in the allotment of the relevant medications. All other patients who met the eligibility criteria for the therapeutic would then be subject to a weighted lottery that would determine the allocation of the remaining medications. On reflection, this minimal tiered approach might prove to be the best approach for administering scarce Covid-19 drugs, but it is worth considering briefly what can be said in defense of a pure version of the weighted lottery.

A Pure Weighted Lottery: An Illustration

A pure version of the weighted lottery dispenses with all hard cutoffs. No patient is entitled to absolute priority under this approach, even though many patients are entitled to some priority. This pure approach would need to establish criteria for eligibility for the relevant medications. Patients who stood little to no chance of being responsive to a therapeutic would not be eligible to receive it, even if they wanted it. Still, in the pure version of the weighted lottery approach, there is pressure not to set the eligibility criteria too high. The pressure comes from the intuitive thought mentioned above, that it is better for as many patients as possible to have some prospect for benefit, and from the fact that the weights of the lottery can be adjusted to reflect the fact that those who have a higher prospect of benefit should have a higher chance of receiving the benefit. Suppose, for example, that reliable evidence emerges that there is a 75 percent chance that a certain Covid-19 therapeutic would be effective for Allie, but only a 25 percent chance that it would be effective for Belinda. To reflect this

fact, the weighted lottery could give Allie a chance three times higher than Belinda's to receive the therapeutic.

No doubt, prospects for benefit among different patients will often not be known with the degree of precision assumed in this example. Weighted lotteries are precisely calibrated, but real-life allocation decisions present challenges that involve vagueness and incomplete information. We will return to this concern shortly; first, we want to present an illustrative model of the kind of lottery that could be proposed for Covid-19 treatments. For illustrative purposes, the model will involve marbles and urns, but lottery tickets or computer programs could be designed to simulate the same kind of weighted randomization.

Each patient in our model who both wants to receive a Covid-19 medication and meets the criteria for eligibility for the medication receives ten marbles, which are then dropped into an urn from which draws will be taken. Each marble is stamped with a unique number that identifies its owner. Each eligible patient receives, at this initial stage in the allocation, the same number of marbles, reflecting the judgment that each person who could benefit from the treatment should have an equal chance of receiving it, other things being equal. Call this the *basic fairness claim*.

If basic fairness were all that mattered, then there would be no need for a further stage in the design of the lottery. But, as we have explained, there are considerations that are relevant to the allocation of Covid-19 medications that compel a departure from basic fairness. For simplicity, imagine that four considerations were judged to be relevant: essential work, prospect for benefit, membership in a disadvantaged socioeconomic group, and past participation in research.

Essential workers should receive high priority, and let us suppose that this is accomplished by giving them an additional fifty marbles. (The higher the priority we think they should have, the more

marbles we would give them.) Those who stand to benefit more from the medication, either because they have a higher chance of being responsive to it or because they would derive a larger benefit from it, also have stronger claims. For simplicity's sake, eligible patients would be divided into three groups based on their prospect for benefit—low, moderate, or high—and given zero, ten, or twenty additional marbles, respectively. All those from disadvantaged economic backgrounds or from racial and ethnic groups that had reduced access to health care resources in the past would be given ten additional marbles. Finally, those who partici-

The weighted lottery enables an institution to express in a vivid way its commitment to various considerations, such as the justice of giving priority to those from disadvantaged communities.

ated in the research that produced the medication would receive an additional ten marbles. With these adjustments in place, marbles would then be drawn from the urn until the supply of medication was exhausted.

Three noteworthy features about this model should be highlighted. First, the assignment of additional marbles to eligible patients would be transparent and open to debate. Justifications would need to be given for the weights that were assigned to the various criteria. It might be argued, for instance, that essential workers are entitled to their significantly greater chance of receiving the medication than others by virtue of their contribution to vital social needs and their greater exposure to the disease. Second, the different criteria that grant patients additional chances for receiving the medication are cross-cutting and overlapping, and the marble assignment neatly reflects this fact. To give an example, essential workers who have a high prospect for benefit and are from a

disadvantaged background would receive ninety marbles, thereby giving them a ninefold greater chance of receiving the medication compared to those who received only the ten marbles granted to them under the basic fairness claim. Third, the basic fairness claim is honored in the model. No eligible patient would be denied a chance to receive the medication in question.

Our simple model illustrates an important and intriguing feature of weighted lotteries. When different factors overlap, the significance of assigning one factor greater priority over others diminishes. For example, in our model, essential workers

were given an additional fifty marbles, and those from disadvantaged groups were given an additional ten marbles. But if a high proportion of essential workers were also members of disadvantaged groups (as seems to be the case¹⁶), then a reverse assignment of marbles—fifty marbles for membership in disadvantaged groups and ten marbles for being an essential worker—would yield similar prospects for many of those who intuitively have a very strong claim to receive the medication, namely, essential workers who are also members of a disadvantaged group. In this way, the overlap of factors reduces the significance of the initial weightings.

The model, as we described it, is very simple, but it could be made more complex as deemed appropriate.¹⁷ Increasing the number of factors that are weighted in the lottery, given plausible empirical assumptions, would increase the degree of overlap between different factors, thereby reducing the significance of the initial weightings overall. Still,

there are limits to the complexity that can be achieved. A good model must balance sensitivity to relevant considerations against the need for an allotment process, the workings of which could be understood by the relevant patient population, thereby making it more legitimate in their eyes.

The Importance of Process

A weighted lottery, whatever initial weights it assigns to different criteria, will be precisely calibrated in a way that does not reflect the messiness of the allotment decisions that need to be made. We may agree that essential workers should be given some priority in the distribution of Covid-19 medications, but why a sixfold priority instead of a five- or tenfold priority? Obviously, context matters. We need to know more about the properties and quantities of the drug to be allotted.¹⁸ No weights sensibly can be defined in the abstract, except for illustrative purposes. Further, even when context is attended to, in actuality, there will almost certainly be multiple ways of assigning weights to different criteria that are acceptable or reasonable.

Even if overlaps between different factors reduce the significance of the initial assignment of weights, they by no means eliminate it. Tough decisions regarding the priority of different factors remain. And the problem of balancing these factors cuts deep, for it is plausible to think that there is no uniquely correct assignment of weights for the factors that we have been discussing. A plurality of different weightings is, in all likelihood, equally defensible. Deliberation in a particular context might reveal more determinate rankings of relevant factors, but no uniquely correct assignment of weights is likely to emerge. For this reason, a legitimate implementation of the weighted lottery would need to arise from a fair and open process in which all relevant parties were included.

We hasten to add that a fair process of this kind would not be unconstrained. For example, if the fair and open process selected a simple lottery, then this would not be, in our view, a fair result. Further, there are some weightings of some factors that plainly would not be acceptable. A weighted lottery might assign substantial priority to a factor, such as ability to pay, that perpetuates unfairness, or it might fail to give enough weight to a factor that is clearly relevant, such as potential to benefit. A fair process in this context, in other words, is not purely procedural; it's an example of constrained procedural justice.¹⁹ It selects a particular profile of weightings from among the set of rationally eligible profiles of such weightings.

Our simple illustrative model singled out four factors: essential work, prospect for benefit, membership in a disadvantaged socioeconomic group, and past participation in research. We think the first three of these are the least negotiable. A fair weighted lottery should be responsive to them, but the precise weights of these factors cannot be settled by abstract rational argument. Some of the other factors, such as priority to those who have served others in the past or whose participation would facilitate generation of evidence, strike us as more contingent and more negotiable. But, again, context will matter, and we do not think that these matters can be settled rationally in advance. In all likelihood, different groups will legitimately make different decisions on these matters.

Our brief for the weighted lottery in the Covid-19 context has defended the proposal on its substantive merits. But what if our proposal were itself rejected by a fair and open process? Even if our argument for the weighted lottery is sound, not everyone will be persuaded. We do not wish to minimize the challenges of putting our proposal into practice. Our primary aim has been to describe the weighted lottery and to make the case for it. We caution against too much skepticism about its practi-

cality, however. Lotteries have been used in a range of contexts for allocating benefits and burdens and have been broadly accepted in a number of these contexts.²⁰ The public may be receptive to a weighted lottery for Covid-19 medications, especially if it is given assurance that its operations are transparent and that it arises from a fair process. Still, it is no part of our argument that a weighted lottery provides the only legitimate method for allocating scarce Covid-19 medications. Any legitimate method, we think, must give appropriate weight to the kinds of factors that we have been discussing, and this might be accomplished by different means, such as the tiered proposal, even if the weighted lottery would provide the best means for allocating the medications.

In short, our position is that a weighted lottery is the best method for allocating scarce Covid-19 medications, but for it to be legitimately implemented, it must arise from a fair and open process. This process need not be same process, or consist of the same members, as the process that determines the initial weights in the weighted lottery, and we will not attempt to describe it further here.

We do wish to identify a few key issues that would need to be addressed in the process internal to the weighted lottery, however.²¹ One of these is determining the appropriate site of the lottery. We have been writing as if the lottery would be implemented at the hospital level, but others may think that it would be better administered at the district or state-wide level.²² There is here the familiar tension between securing sensitivity to local concerns and establishing uniform treatment across larger populations of patients.

In addition, deliberative norms that structure discussion about the weights assigned to different factors must be selected. Such norms can be oriented toward achieving consensus or toward encouraging the expression of independent, and likely conflicting, judgments.²³ The latter orienta-

tion highlights the important issue of the voting rules and procedures that are appropriate for resolving disagreements that remain after deliberation. Finally, there is the crucial question of who gets included in the fair process. At a minimum, all of the following should be included in the discussion that sets the weights for the lottery—hospital or health center administrators, clinicians, nurses, medical ethicists, infectious disease experts, patient advocates, community leaders, and representatives from groups that have suffered from health care disparities. We think it is important both that the process be fair and that it be perceived as fair by the patient population. In this way, while some judgments of weight will appear arbitrary in one sense (why ten marbles instead of twenty?), they will be non-arbitrary in another sense (we needed to fix the priority weight at some numerical level, and ten marbles is what the committee decided on after appropriate deliberation.)

The weights established in the lottery have multiple advantages that we have not so far discussed and will mention in closing. First, unlike guidelines that leave it to individuals within the institution to balance different considerations according to their own judgments, the judgments of priority established by the weighted lottery are uniform. Whether or not a patient is denied a Covid-19 therapeutic or vaccine would not be a function of the idiosyncratic assessments of his or her clinician.²⁴ Second, the need to assign numerical weights to different criteria of priority forces an institution to take the balancing problem seriously. These hard questions need to be confronted and then resolved in a consistent way. Without a need to reach a determinate balancing of relevant considerations, it is all too easy for institutions to avoid doing so. Third, the weighted lottery has a valuable expressive function. It enables an institution to express in a vivid way its commitment to various considerations, such as the justice of

giving priority to those from disadvantaged communities.

Physicians and public health professionals have done a good job of identifying the kinds of considerations that bear on the just allocation of Covid-19 medications. They have not done nearly so well at identifying procedures for balancing the different considerations. Taking seriously the construct of a weighted lottery, whether in a pure form or in combination with tiers of priority, forces us to address that difficult problem and so can help with its resolution.

Notes

1. C. DeJong, A. Chen, and B. Lo., "An Ethical Framework for Allocating Inpatient Medications for Covid-19 in the US," *Journal of the American Medical Association* 323 (2020): 2367-68, and E. Emanuel et al., "Fair Allocation of Scarce Medical Resources in the Time of Covid-19," *New England Journal of Medicine* 382 (2020): 2049-55.

2. Both papers call for maximizing benefits, but they then go on to list additional factors without confronting the fact that giving weight to these additional factors would probably result in fewer benefits.

3. The classic defense of lotteries, including weighted lotteries, is J. Broome, "Fairness," *Proceedings of the Aristotelian Society* 91 (1990-1991): 87-101. See also Ben Saunders, "A Defence of Weighted Lotteries in Life Saving Cases," *Ethical Theory and Moral Practice* 12 (2009): 279-90, and M. Peterson, "The Moral Importance of Selecting People Randomly," *Bioethics* 22, no. 6 (2008): 321-27. For criticism, see I. Hirose, *Moral Aggregation* (Oxford: Oxford University Press, 2014).

4. Muted, but not necessarily silenced. Weighted lotteries of the kind we will be discussing are responsive to fairness considerations but are responsive to other considerations as well. Hence, there is no guarantee that the best version of a weighted lottery is the fairest version.

5. For critical discussion of public resistance to the use of lotteries, see J. Elster, "Taming Chance: Randomization in Individual and Social Relations," chap. 2 in *Solomonic Judgments* (Cambridge: Cambridge University Press, 1989). Elster observes that unease about lotteries may stem in part from the fact that human beings seem "to have a strong reluctance to admit uncertainty and indeterminacy into human affairs" (37).

6. It is possible that an indirect maximizing approach, such as that favored by rule utilitarianism, would support a weighted lottery in this context. If so, then those who favor the maximization of benefits could accept our proposal. We cannot explore this interesting possibility here, however.

7. H. Schmidt, "Vaccine Rationing and the Urgency of Social Justice in the Covid-19 Response," *Hastings Center Report* 50, no. 3 (2020): 46-49.

8. Schmidt notes this, but his considered position is that this factor should not be left to chance. *Ibid.*, 3.

9. The first seven factors are taken from DeJong, Chen, and Lo, "An Ethical Framework for Allocating Inpatient Medications for Covid-19 in the US," and Emanuel et al., "Fair Allocation of Scarce Medical Resources in the Time of Covid-19." DeJong et al. mention factors 1, 2, 5, and 6. Emanuel et al. discuss all seven factors. The eighth factor is mentioned in D. White and D. Angus, "A Proposed Lottery System to Allocate Scarce Covid-19 Medications," *Journal of the American Medical Association* 324 (2020): 329-30.

10. DeJong, Chen, and Lo, "An Ethical Framework for Allocating Inpatient Medications for Covid-19 in the US," 2367.

11. White and Angus, "A Proposed Lottery System to Allocate Scarce Covid-19 Medications," 330.

12. For a proposal roughly along these lines concerning influenza vaccines, see H. McLachlan, "A Proposed Non-consequentialist Policy for the Ethical Distribution of Scarce Vaccinations in the Face of an Influenza Pandemic," *Journal of Medical Ethics* 38, no. 5 (2012): 317-18.

13. An approach of this type was adopted by the United Kingdom for allocating vaccines during an influenza epidemic. The government's contingency pandemic plan established seven numerically ranked "priority groups." See Department of Health, HPIH&SD, and Immunisation Policy, Monitoring & Surveillance, *UK Health Departments' Influenza Pandemic Contingency Plan* (Department of Health Publications, October 20, 2005), http://news.bbc.co.uk/2/shared/bsp/hi/pdfs/19_10_05_bird_flu.pdf.

14. Here we follow J. Broome, *Weighing Goods* (Oxford: Oxford University Press, 1991), 196.

15. Or, more precisely, this is what can be accomplished by a weighted lottery of a certain type; not every weighted lottery will be proportionately weighted.

16. Assuming, that is, that essential workers are construed broadly to include nursing home aides, garbage collectors, supermarket clerks, and so on; see Schmidt, "Vaccine Rationing and the Urgency of Social Justice in the Covid-19 Response," 49.

17. An important complication that we pass over here is that a weighted lottery for Covid-19 medications would need to be temporally extended, not a one-off event. For discussion of some of the issues raised by temporally extended lotteries see G. Vong, "Fairness, Rescue by Lottery, and the Chancey Satisfaction of Moral Claims," *Utilitas* 27, no. 4 (2015): 470-86.

18. For ease of exposition, we have grouped Covid-19 therapeutics and vaccines together, but obviously, the differences between these medications and their respective contributions to public health are relevant to how they should be allotted.

19. The term "constrained procedural justice" is taken from A. Rid, "Justice and

Procedure: How Does 'Accountability for Reasonableness' Result in Fair Limit Setting Decisions?," *Journal of Medical Ethics* 35, no. 1 (2009): 12-16. The idea is that, within the constraints, the procedure determines the fair result.

20. Elster, *Solomonic Judgments*.

21. Some guidance for thinking about these procedural issues can be gleaned from discussions of the kinds of fair processes that have been proposed for the allocation of other types of scarce therapies. See, for example, N. Daniels and J. Sabin, *Setting Limits Fairly: Learning to Share Resources for Health* (Oxford: Oxford University Press, 2008), and Rid, "Justice and Procedure."

22. White and Angus, "A Proposed Lottery System to Allocate Scarce Covid-19 Medications."

23. L. A. Jansen, "Consensus and Independent Judgment: Or What Can an 18th Century Mathematician Teach Us about Ethics Consultation," *Journal of Clinical Ethics* 20 (2009): 56-63.

24. The same point supports national guidelines rather than leaving these decisions to each institution. But our focus here has been at the institutional level.