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## GLOBAL HEALTH INEQUALITY

# Covid-19: how to prioritize worse-off populations in allocating safe and effective vaccines

How should we decide which population groups receive covid-19 vaccines before others? **Harald Schmidt, Parag Pathak, Tayfun Sönmez, and M Utku Ünver** examine the existing frameworks and argue that prioritizing worse-off groups is urgent, justified, and feasible

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When compared with previous pandemics covid-19 is unique, not only in its substantial economic impact but in exposing the consequences of historical and ongoing structural disadvantages among minority groups,<sup>1–3</sup> particularly in the US. Minorities have experienced far higher rates of unemployment, infections, hospital admissions, and deaths.<sup>2–6</sup> So, as safe and effective vaccines become likely but in limited supply, should policy makers prioritize worse-off minorities in their allocation of stocks?

Traditional allocation focuses on maximizing overall benefits, with less regard to how these benefits are distributed among different population groups. Giving more vaccines to disadvantaged groups who are expected to live less long would generally be deemed undesirable. However, the current debate around covid-19 vaccines indicates a profound reorientation in what worse-off population groups are owed.

Recent interim guidance by the UK's Joint Committee on Vaccination and Immunisation notes that allocation programs “will need to ensure every effort is made to get good coverage in black, Asian and minority ethnic (BAME) groups.”<sup>7</sup> Guidance issued by the World Health Organization's Strategic Advisory Group of Experts on Immunization (SAGE) echoes such a focus but also gives a reason: simply applying traditional allocation frameworks can perpetuate and exacerbate existing injustices.

The WHO framework urges that “unjust disparities” should be reduced when allocating vaccines,<sup>2</sup> although its scope does not extend to how, practically, disadvantage might be mitigated. However, an important outline is provided in a recent proposal by the US National Academies of Science, Engineering, and Medicine<sup>3</sup> (NASEM), tasked by the National Institutes of Health (NIH) and the Centers for Disease Control and Prevention (CDC) to develop an overarching framework for equitable vaccine allocation. This would then be used by the Advisory Committee on Immunization Practices (ACIP), which traditionally develops concrete guidance for state and lower level health departments that ultimately determine allocation plans. Recent CDC guidance urges states to draw on NASEM and ACIP guidance in developing their strategies.<sup>8</sup> Significantly, the NASEM framework prioritizes worse-off groups through a statistical measure of disadvantage, amplifying prior proposals in this direction.<sup>1,9</sup>

The SAGE and NASEM reports mark a major and refreshing departure in the resource allocation literature, which has generally considered social justice peripherally at best—particularly outcomes in the worst-off income and racial groups. Implemented correctly, they can more effectively promote social justice now and in the longer term.<sup>1,3</sup>

### Saving the most lives and life years

The NASEM report includes a review of general resource allocation frameworks and those focusing on covid-19, as well as the context of vaccines more specifically. A dominant theme is to maximize benefits, or achieve the greatest good for the most people, in a way that sets aside the concrete historical, cultural, and social circumstances in which people, particularly disadvantaged groups, find themselves. The focus is on maximizing disembodied metrics—such as life years gained by an intervention or the total number of lives saved (an influential, multi-value framework suggests in its broad overview guidance that both aims should simultaneously receive the highest priority and that the worst-off groups should be prioritized only insofar as this aligns with maximizing benefits).<sup>10</sup>

But life years and lives belong to people in concrete societies. And societies have history, frequently committing to treating everyone equally but often failing to do so.<sup>1–3,11</sup> NASEM and SAGE recognize this, and they advise not just assessing the grand total of benefits that might be secured by different strategies but also which population groups stand to secure what share of benefits—urging planners to consider, in particular, the consequences for people experiencing past and ongoing societal injustice.

The primary goal of the NASEM framework is to “Reduce severe morbidity and mortality and negative societal impact due to the transmission of SARS-CoV-2,” and one of its three foundational principles is “maximum benefit.”<sup>3</sup> As such, it is in close continuity with dominant models. Yet the two remaining foundational principles are “equal concern” and “mitigation of health inequities,” which expressly recognizes a further important sub-theme in established and emerging frameworks, some of which urge more direct consideration of the worst-off groups and their situation.<sup>1,12,13</sup>

## Worse-off groups

“Worse-off” groups are most commonly conceptualized as people with higher risks of adverse health effects from an infection. But such risks are not distributed equally across the population, as covid-19 has demonstrated in cruel clarity. In the US, economically worse-off minority populations continue to experience a considerably disproportionate impact.

For African-Americans in particular, this exacerbates historical trends of systemic disadvantage. For example, when adjusted for age and compared with the white majority (mortality rate: 38/100 000), the ratio of deaths relative to the population share is 3.4-fold higher among Black people (131/100 000), 3.3-fold in Indigenous and Latino communities (125/100 000), 2.9-fold among Pacific Islanders (111/100 000), and 1.3-fold in Asian populations (50/100 000).<sup>4</sup> Likewise, there are significant inequities in general life expectancy, which can differ over small geographic areas by as much as 30 years, with people in better-off, whiter neighborhoods living into their 90s and many of those in worse-off minority areas dying in their early 60s, as consequences of systemic disadvantage and structural racism.<sup>3 14</sup>

The NASEM report, which seeks to mitigate disadvantage caused by social determinants, proposes allocating vaccines in four phases:

- Phase 1—High risk healthcare workers and frontline responders; high risk people of all ages with comorbidities and underlying conditions; and older adults living in congregate or crowded conditions
- Phase 2—Critical infrastructure workers at high risk of exposure; teachers and school staff; medium risk people of all ages with comorbidities or underlying conditions; people in shelters, group homes, prisons, or similar facilities and their staff; and all older adults not included in phase 1
- Phase 3—Young adults; children; and critical infrastructure workers not covered in phase 1 or 2; and
- Phase 4—All other people not included in previous phases.

Population groups within each phase have equal priority. However, “in each population group, vaccine access should be prioritized for geographic areas identified as vulnerable through the Social Vulnerability Index [SVI] or another more specific index.”<sup>3</sup>

This proposal is not mere armchair philosophy. At a committee meeting of the Advisory Committee on Immunization Practices, CDC staffers noted that the SVI could be integrated seamlessly in software developed to assist states in implementing vaccine allocation plans.<sup>15</sup>

The SVI was initially constructed to guide prioritization in disasters such as hurricanes and earthquakes. It assigns county or tract level geographic regions a numeric score that integrates: socioeconomic status; household composition; race, ethnicity, and language; and housing and transportation. As such, the SVI recognizes the close and troubling connection between health and place, as well as health and social status.<sup>13 5 6 14 16–18</sup> (Importantly, alternative indices exist—see box below.)

For example, owing to their age, two 70 year-old women will both be at increased risk of dying from covid-19. But a well-off white suburban woman still faces a lower risk than a worse-off inner-city Black woman. Likewise, while neurosurgeons and nurses are health workers, the former are at far less risk than the latter, at work and at home. Accounting for such differences can considerably improve fairness.

Still, prioritizing by SVI also raises deeper practical and ethical questions. Measures such as the SVI can capture levels of disadvantage, and not just single layers of disadvantage but potentially the cumulative effects of ethically important “clusters of disadvantage.”<sup>18</sup> But they offer no guidance on the critical question of who should receive what amount of vaccines and when. For this we need an external, value based reference point.

## Determining how to prioritize worse-off populations

NASEM is clear that it is not proposing to give all vaccine first only to people in high SVI areas. Instead, two pointers are provided. First, before distributing to states, 10% of the total amount should be reserved for the worst-off SVI quartiles in states. Second, states are instructed to “ensure that special efforts are made to deliver vaccine to residents of high vulnerability areas” (defined, again, as the worst-off SVI quartile). However, while there might be a reference point for a 10% reserve in a biblical tithe, such a cut-off can seem arbitrary. Likewise, while selecting the worst-off quartile as a priority population is pragmatic, it is not clear what separates the decile below from the decile above this threshold.

An equally practical, but normatively more fitting, way of constructing an external reference point for allocation would be to adjust reserves in such a way that more deprived people receive a larger share of vaccines in proportion to how much the average life expectancy is reduced in their geographic unit. Data on differences in life expectancy are robust,<sup>11 14 19</sup> and they offer a meaningful proxy for existing unfair distribution of opportunities throughout society.

An alternative—or additional—reference point could be the epidemic’s specific impact so far. Accordingly, worse-off groups could be offered progressively larger shares of vaccines in proportion to, for example, the relative share of covid-19 related death incurred by communities under a certain decile on the scale. Policy makers could justify such an approach by emphasizing the need to consider the situation of particularly hard hit communities, without getting into deeper discussions of racial and social injustice.

In taking the NASEM framework further, exploring the adequacy of these (or alternative) reference points will therefore help to more fully realize the framework’s promise of social justice and to provide necessary guidance in the US and elsewhere.

## Worst case scenario

The urgency of covid-19 vaccine development is poorly aligned with the development of allocation guidance. The administrative infrastructure required to implement nuanced national guidance may not be established or may be otherwise ineffective by the time the first vaccines are ready. What should we do then?

The worst case scenario would be allocation by “first come, first served”: demand will be met until supplies at the respective locations of distribution are depleted. This highlights the tension of rationing at national and lower levels, as shortsighted allocation to individual states will disadvantage worse-off populations in states where they make up a larger share of the population. Three basic models can be distinguished, which we illustrate here with the US as an example:

- An initial vaccine allocation could be proportionate to each state’s population, with states then adapting the NASEM framework as deemed appropriate. This seems likely to be the default option.
- Instead of a population based model, states’ vaccine reserves could be determined by calculating the share of populations that

fall into the respective categories in each of NASEM's four phases and then allocating accordingly.

- In a less granular way, a state's reserve could be varied by its overall score on a measure of disadvantage (such as the SVI or alternative measures).

With option 1 above, scarcity would be more severe for disadvantaged populations in states with above average shares. The second and third options might be inferior (although not necessarily so) in terms of maximizing overall benefits, but they offer a fairer chance for worse-off groups, and the third option is probably the easiest to administer.

States can take a pragmatic, rather than a perfectionist, approach in allocating vaccines geographically in the same way. The NASEM report already outlines what economists term a reserve system,<sup>9</sup> in suggesting to ringfence 10% for high SVI areas (and a reserve system is recommended in prioritizing by SVI). Reserve systems can also accommodate some of the more complex scenarios that will arise, including the likely need to establish priorities for several different vaccines and needing to reallocate surplus amounts when uptake is lower than predicted by models.<sup>9</sup>

## Conclusion

The recent WHO/SAGE and NASEM reports are significant in bringing in social justice from the periphery. In the next steps, clarifying exactly how disadvantaged groups should be prioritized, how reserves at the sub-national level should be constructed, and what index is the most appropriate and feasible will help to further fulfill their critical promise in the US and elsewhere.<sup>27</sup>

Reorienting allocation frameworks with social justice in mind can also reduce the risk of burnout among medical workers required to implement allocation strategies that may conflict, in their professional experience, with who should receive vaccines first.<sup>20</sup> For many, the far higher rates of covid related deaths and hospital admissions only continue an all too familiar pattern of worse-off groups experiencing poorer health from adverse socioeconomic circumstances and insufficient access to healthcare.

Reverting to "color blind" allocation models—ones that ignore the pandemic's vastly disparate impact, especially on worse-off minorities—would be to risk becoming complicit in structures that, once again, systematically disadvantage worse-off populations. The imperative is, therefore, to focus on a unique opportunity to become agents of change toward social justice. The NASEM framework provides a helpful starting point, both for planning the allocation of vaccines and for establishing disparate impact monitoring frameworks that may become necessary, given the flexibility provided to states.

### Why geography matters for determining vulnerability and scarcity

In addition to the Social Vulnerability Index (SVI) that NASEM centrally recommends, a number of other indices exist that could be used, raising practical and ethical issues about which clusters of disadvantage are captured and in which geographical areas.

For example, the Multidimensional Deprivation Index integrates standard of living, education, health, economic security, housing quality, and neighborhood quality.<sup>21</sup> Some indices combine SVI metrics with ones deemed particularly relevant for the pandemic context, such as the US National Institutes of Health's Covid-19 Pandemic Vulnerability Index (CPVI),<sup>22</sup> or the Surgo Foundation's Covid-19 Community Vulnerability Index (CCVI), also noted by NASEM.<sup>7</sup>

In the CDC's most comprehensive guidance published to date (albeit marked "interim"), the agency urges planners to consider NASEM's

forthcoming final and related guidance; to identify racial and ethnic minority populations who can be at higher risk of acquiring or transmitting the virus; and to refer to the Mapping Medicare Disparities Tool to "assist with investigating geographic and racial and ethnic differences in health outcomes and inform decisions to focus on certain populations and geographies."<sup>8</sup>

Aside from their conceptual focus, one constraint on all of these indices is that they either operate at the county level (which can include entire cities or other areas that differ considerably in their degrees of disadvantage) or, as the SVI, the census tract level, comprising 1200-8000 people—but these areas, too, can include much variation.

Overly coarse geographic allocation frameworks risk increasing the severity of rationing for worse-off populations—for, even if more disadvantaged counties were to receive larger reserves of vaccines, this alone does not ensure that people in worse-off sub-regions also have higher chances of receiving one (while better-off and well connected regions will likely have ways to work the system to their advantage).

The lowest level resolution is offered by the Area Deprivation Index (ADI), which focuses on neighborhoods (termed "block group level" by the Census Bureau) comprising 600-3000 people. Similar to measures used in Europe since the 1980s, the ADI captures more directly the impact of social determinants on health.<sup>23</sup> In not directly incorporating race and ethnicity—but still tracking them both closely, since a far larger share of disadvantaged populations are minorities—the ADI is also better positioned against possible legal challenges than the SVI (and those incorporating it, such as the Covid-19 Pandemic Vulnerability Index or the Covid-19 Community Vulnerability Index).<sup>6</sup>

Planners need to consider carefully the trade-offs that different available indices offer, in terms of the dimensions of vulnerability that are captured, their geographical resolution, and their likelihood to withstand possible legal challenge.

## Biographies

Harald Schmidt is an assistant professor at the Department of Medical Ethics and Health Policy at the University of Pennsylvania. His work centers on reducing disadvantage and improving opportunity for marginalized populations in the contexts of health promotion and healthcare priority setting.

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- 1 Schmidt H. Vaccine rationing and the urgency of social justice in the Covid-19 response. *Hastings Cent Rep* 2020;50:46-9. <https://onlinelibrary.wiley.com/doi/10.1002/hast.1113>.
- 2 World Health Organization. WHO SAGE values framework for the allocation and prioritization of COVID-19 vaccination. 14 Sep 2020. [https://apps.who.int/iris/bitstream/handle/10665/334299/WHO-2019-nCoV-SAGE\\_Framework-Allocation\\_and\\_prioritization-2020.1-eng.pdf?ua=1](https://apps.who.int/iris/bitstream/handle/10665/334299/WHO-2019-nCoV-SAGE_Framework-Allocation_and_prioritization-2020.1-eng.pdf?ua=1).

- 3 National Academies of Sciences, Engineering, and Medicine. Framework for equitable allocation of covid-19 vaccine. 2020.
- 4 APM Research Lab. The color of coronavirus: covid-19 deaths by race and ethnicity in the US. 2020. <https://www.apmresearchlab.org/covid/deaths-by-race#age>.
- 5 Economic Policy Institute. Black workers face two of the most lethal preexisting conditions for coronavirus—racism and economic inequality. 2020. <https://www.epi.org/publication/black-workers-covid/>.
- 6 Webb Hooper M, Nápoles AM, Pérez-Stable EJ. COVID-19 and racial/ethnic disparities. *JAMA* 2020;323:2466-7. doi: 10.1001/jama.2020.8598 pmid: 32391864
- 7 Joint Committee on Vaccination and Immunisation. Updated interim advice on priority groups for COVID-19 vaccination. 25 Sep 2020. <https://www.gov.uk/government/publications/priority-groups-for-coronavirus-covid-19-vaccination-advice-from-the-jcvi-25-september-2020>.
- 8 Centers for Disease Control and Prevention. Covid-19 vaccination program interim playbook for jurisdiction operations. Version 1.0. 16 Sep 2020. [https://www.cdc.gov/vaccines/imz-managers/downloads/COVID-19-Vaccination-Program-Interim\\_Playbook.pdf](https://www.cdc.gov/vaccines/imz-managers/downloads/COVID-19-Vaccination-Program-Interim_Playbook.pdf).
- 9 Pathak PA, Sönmez T, Ünver MU, Yenmez MB. Fair allocation of vaccines, ventilators and antiviral treatments: leaving no ethical value behind in health care rationing. *arXiv:2008.00374* [econ.TH]. [Preprint]. 2020.
- 10 Emanuel EJ, Persad G, Upshur R, et al. Fair allocation of scarce medical resources in the time of covid-19. *N Engl J Med* 2020;382:2049-55. doi: 10.1056/NEJMs2005114doi: . pmid: 32202722
- 11 O'Brien R, Neman T, Seltzer N, Evans L, Venkataramani A. Structural racism, economic opportunity and racial health disparities: evidence from U.S. counties. *SSM Popul Health* 2020;11:100564. doi: 10.1016/j.ssmph.2020.100564doi: . pmid: 32195315
- 12 World Health Organization Working Group on Ethics and Covid-19. Ethics and covid-19: resource allocation and priority-setting. 2020. <https://www.who.int/ethics/publications/ethics-covid-19-resource-allocation.pdf?ua=1>.
- 13 Nuffield Council on Bioethics. Rapid policy brief: fair and equitable access to covid-19 treatments and vaccines. 29 May 2020. <https://www.nuffieldbioethics.org/assets/pdfs/Fair-and-equitable-access-to-COVID-19-treatments-and-vaccines.pdf>.
- 14 Robert Wood Johnson Foundation. Life expectancy: could where you live influence how long you live? Updated Jan 2020. [https://www.rwjf.org/en/library/interactives/whereliveaffectsshowlongyoulive.html?rid=0034400001rlscZAAQ&et\\_cid=1675803](https://www.rwjf.org/en/library/interactives/whereliveaffectsshowlongyoulive.html?rid=0034400001rlscZAAQ&et_cid=1675803).
- 15 Advisory Committee on Immunization Practices. Public meeting, 23 Sep 2020. See meeting materials at: <https://www.cdc.gov/vaccines/acip/meetings/index.html>.
- 16 Link BG, Phelan J. Social conditions as fundamental causes of disease. *J Health Soc Behav* 1995;80-94. doi: 10.2307/2626958 pmid: 7560851
- 17 Karaye IM, Horney JA. The impact of social vulnerability on covid-19 in the US: an analysis of spatially varying relationships. *Am J Prev Med* 2020;59:317-25. doi: 10.1016/j.amepre.2020.06.006. pmid: 32703701
- 18 Wolff J, De-Shalit A. *Disadvantage*. Oxford University, 2007doi: 10.1093/acprof:oso/9780199278268.001.0001.
- 19 Dwyer-Lindgren L, Bertozzi-Villa A, Stubbs RW, et al. Inequalities in life expectancy among US counties, 1980 to 2014: temporal trends and key drivers. *JAMA Intern Med* 2017;177:1003-11. doi: 10.1001/jamainternmed.2017.0918doi: . pmid: 28492829
- 20 Wicclair M. Allocating ventilators during the covid-19 pandemic and conscientious objection. *Am J Bioeth* 2020;20:204-7. doi: 10.1080/15265161.2020.1777347 pmid: 32716798
- 21 US Census Bureau. Multidimensional deprivation in the United States: 2017. 21 May 2019. <https://www.census.gov/library/publications/2019/acs/acs-40.html>.
- 22 National Institute of Environmental Health Sciences. Covid-19 Pandemic Vulnerability Index (PVI). 2020. <https://covid19pvi.niehs.nih.gov>.
- 23 Kind AJH, Buckingham WR. Making neighborhood disadvantage metrics accessible: the neighborhood atlas. *N Engl J Med* 2018;378:2456-8. doi: 10.1056/NEJMp1802313. pmid: 29949490

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