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SEÇÃO: VARIA

Everything, everywhere, all at once: US vaccine distribution for COVID-19

Tudo, em qualquer lugar, de uma só vez: Distribuição de vacinas para COVID-19 nos EUA

Todo, en todas partes, todo a la vez: distribución de vacunas contra el COVID-19 en EE.UU.

John Sarnecki[1]
orcid.org/0009-0005-3394-6059
john.sarnecki@utoledo.ed

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Abstract: The development and early distribution of the COVID-19 vaccine was both a singular achievement and missed opportunity. In this paper, I argue that the consensus regarding the goals of an effective and morally responsible vaccine distribution program were often eschewed in favor of a reversion to the problematic pre-pandemic healthcare distribution practices. I examine the goals of vaccine planning in terms of the public health, economic and social impacts of a distribution plan against the "first come, first served" strategies that were ultimately employed. I maintain that the failure to implement a coherent top--down vaccine policy resulted in a proliferation of vaccine distribution programs that undermined efforts to combat the virus while also increasing pre-existing inequities in the healthcare system. The distribution of the vaccine according to a phased rollout strategy for individual groups often limited access to the vaccine for those most likely to suffer the worst outcomes of the disease. Future pandemic planning must learn from these outcomes and employ new technologies to limit the contagion and target at-risk groups most effectively.

Keywords: bioethics; COVID-19; public health; technology; vaccines

Resumo: O desenvolvimento e a distribuição precoce da vacina contra a COVID-19 foram ambos um feito singular e uma oportunidade perdida. Neste artigo, defendo que o consenso em torno dos objetivos de um programa de distribuição de vacinas eficaz e moralmente responsável foi muitas vezes ignorado em favor da inversão das práticas problemáticas de distribuição de cuidados de saúde anteriores à pandemia. Examino os objetivos do planejamento de vacinas quanto aos impactos econômicos, sociais e da saúde pública, de um plano de distribuição contrário à estratégia "primeiro a chegar, primeiro a ser atendido" que acabou sendo utilizada. Defendo que a incapacidade de implementar uma política coerente de vacinação por grupos prioritários resultou numa proliferação de programas de distribuição de vacinas que prejudicaram os esforços de combate ao vírus, aumentando simultaneamente as desigualdades pré-existentes no sistema de saúde. A distribuição de vacinas de acordo com uma estratégia de implementação faseada para grupos individuais muito limitou o acesso à vacina por parte das pessoas com maior probabilidade de sofrerem as piores consequências da doença. O planejamento de pandemias no futuro deve levar em consideração esses resultados e empregar novas tecnologias para limitar o contágio e atender os grupos de risco de forma mais eficaz.

Palavras-chave: bioética; COVID-19; saúde pública; tecnologia; vacinas.

Resumen: El desarrollo y la distribución temprana de la vacuna COVID-19 fue tanto un logro singular como una oportunidad perdida. En este artículo, sostengo que el consenso en torno a los objetivos de un programa de distribución de vacunas eficaz y moralmente responsable se ignoró con demasiada frecuencia en favor de revertir las problemáticas prácticas de distribución sanitaria anteriores a la pandemia. Examino los objetivos de la planificación de vacunas desde

[1] University of Toledo (Department of Philosophy and Religious Studies), Toledo, Ohio, USA.

el punto de vista de las repercusiones económicas, sociales y de salud pública de un plan de distribución contrario a la estrategia del "primero en llegar, primero en ser atendido" que finalmente se utilizó. Argumento que la incapacidad de aplicar una política coherente de vacunación por grupos prioritarios ha dado lugar a una proliferación de programas de distribución de vacunas que han socavado los esfuerzos por combatir el virus, al tiempo que han aumentado las desigualdades preexistentes en el sistema sanitario. La distribución de vacunas según una estrategia de aplicación por fases para grupos individuales ha limitado en gran medida el acceso a la vacuna de quienes tienen más probabilidades de sufrir las peores consecuencias de la enfermedad. La futura planificación de la pandemia debe tener en cuenta estos resultados y emplear nuevas tecnologías para limitar el contagio y dirigirse con mayor eficacia a los grupos de riesgo.

Palabras clave: bioética; COVID-19; salud pública; tecnología; vacunas.

Everything, Everywhere, All at Once

The value of the COVID-19 vaccines cannot be overstated. The health threat presented by COVID-19 could not be overcome through unchecked propagation of the virus through communities. This strategy though often advocated (Friedman, 2020) would have resulted in a human cost that vastly exceeded the already devastating worldwide death toll and the so far uncountable but enormous costs of recovery for many of those who have survived their original bouts with the disease. One recent statistical model suggests that over the course of one year, COVID-19 vaccines saved between 15 and 20 million lives (Watson *et al.*, 2022). These numbers do not include those who have died not from COVID-19 itself, but the lack of resources and access to medical treatments this crisis has fostered. A comprehensive vaccine strategy not only prevents deaths from the disease, but also mitigates risks that an uncontrolled spread of the virus would pose for health care capacity for any illness. The only practicable, not to say ethical, approach to herd-immunity goes through the distribution of an effective vaccine.

It is also clear that while public health measures, like isolation or masking, can attenuate and delay the impact of the virus, they are unlikely to remove the threat the virus poses long term. Consequently, vaccination was amongst the only means available to create the conditions under which society could safely reopen. This strategy was ultimately borne out by both the rapid development of more than a dozen safe and effective vaccines as well as the creation of sufficient infrastructure to efficiently deliver these medications to large numbers of the world population.

The speedy development of vaccines did not resolve the broader problems of distributing a vaccine to a large population. Early vaccine programs encountered problems of scaling and manufacturing enormous numbers of individual doses in addition to considerable challenges regarding the logistics of their distribution (Alam *et al.*, 2021). For example, the need for cold storage and transportation tethered some vaccines to specialized refrigerators that were not widely available, especially outside of urban areas where hospitals and research institutions already had built-in infrastructure. In some cases, there were shortages of pharmaceutical grade glass for distributing vaccines. Less technical, but also daunting, problems came with coordinating delivery, the sometimes-complicated requirements of preparing vaccines for injection, while also developing a system that coordinates the scheduling of two separate doses of the same vaccine.

The multifaceted nature of these challenges made it clear that, despite best intentions, the early rollout of any vaccine was going to be limited. Johns Hopkins bioethicist and member of the World Health Organization's COVID-19 Vaccines Working Group, Ruth Faden commented at that time, "[o]ne certainty is that whenever a vaccine becomes available, there's going to be way less of it than there will be people who need it it's a given, even under the best circumstances" (Pearce, 2020, n. p.).

The vaccine was only one example where demand outstripped supply during the pandemic. COVID-19 exposed numerous deficiencies in preparedness, supply chain management and leadership both in the production of medically necessary equipment and its fair distribution. The early response to the pandemic was marked by shortages in personal protective equipment (PPE), including surgical and N95 masks as well

as intensive care beds and ventilators. These shortages required rationing or withholding of resources, often based on principles determined by medical or administrative personnel that were defined on the spot for each individual case (Bernat, 2020). In these cases, priority has often been given to frontline health care or essential workers, but more typically has defaulted, especially in the case of medically necessary resources, to versions of *first come, first served* availability (see, e.g., Cohen & Rogers, 2020). Hospital beds and ventilators were largely distributed on the basis of immediate need without regard to other potentially relevant factors in treatment. A *first come first served* system is ultimately insensitive to many aspects of the crisis that appear to be relevant to apportioning care both ethically and effectively. For example, it largely ignores expectations of benefit according to the specifics of each case, while also skewing towards those with pre-existing access to healthcare – often at the cost of those who are more vulnerable but less likely to seek medical attention for financial or other reasons. These concerns underscore the importance of having in place an equitable and effective vaccination plan.

The vaccine distribution models I will consider here assume an American domestic setting rather than a global one. While many of the factors I consider will be couched in terms of the US healthcare system, this analysis is relevant to any national context where a strong top-down implementation strategy can be executed. The international distribution of vaccines lacked both the resources and the international cooperation necessary to equitably distribute the vaccine to more poorly resourced countries. This often chaotic international rollout exacerbated global inequities in healthcare distribution and auxiliary support. Even now, nearly three years after the development of vaccines against COVID-19, large portions of the developing world lack ready access to the vaccines or their boosters.[2] These challenges remain daunting, but they are also sufficiently dissimilar to warrant an independent analysis of their causes. The logistical and economic models of vaccine distribution in the developing world often differ in kind from resource models in wealthier countries – even if the moral principles that guide these efforts do not. For the purposes of this article, I will not consider the broader questions of the systemic distribution of vaccines in the developing world nor the moral culpability of wealthier nations in this process.

In the Fall of 2020, I presented a paper, "COVID-19, Vaccines and the Gift of Chance", at an earlier iteration of this conference, *Bioética V*, addressing strategies of vaccine distribution in the period prior to its approval and dissemination in the United States and Europe. The primary focus of that paper was to examine the suggestion that vaccine lotteries were the most equitable and efficient means of distributing vaccines to the general public. I argued that while there may be circumstances where vaccine lotteries may be appropriate, the broader goals of an effective vaccine strategy were not compatible with lottery distributions except in cases where rationed supplies were distributed between individuals for whom there were not any "minimally relevant moral differences". This argument presupposed a series of ethical and practical principles for vaccine distribution that would best satisfy the goals of a vaccination program. This current paper represents an attempt to grapple with some of the initial outcomes of the vaccine distribution models that were employed during the initial period of vaccine delivery, from the first US vaccinations from December 9, 2020, to April 19, 2021, when restrictions on vaccine access for adult Americans were removed. What we will find is that the proposed criteria for an effective vaccine program formulated there and by others in the field were at best met sporadically and often not at all. In this paper, I want to examine both where things went wrong in vaccine delivery and how we may better address these challenges as we face a world where pandemics are likely to become

[2] In a January 3rd, 2023 report to member states, WHO noted that while vaccine coverage is improving, countries experiencing poverty or conflict were especially unprepared for additional COVID-19 waves. In Africa, for example, only 27% of the population has received

more frequent.

I do this with imperfect data. Research on public policy in the context of vaccination coverage and outcomes during COVID-19 is very much in its infancy. The sheer volume of data is overwhelming, whether it addresses vaccine delivery strategies, public policy, social attitudes or vaccine disinformation. We are only beginning to sort through the aftermath of the public health crisis as it was presented during the first year and a half of the pandemic. Moreover, in many cases, the data itself was limited or unreliable. In others, it has been actively suppressed for political reasons (Maxmen, 2020). Consequently, the conclusions presented here must be regarded with some caution until we achieve a deeper understanding of the multitude of factors that had an impact on vaccine delivery during this period.

The Goals of a Vaccine Distribution Plan

How we choose to allocate scarce medical resources is a function both of our priorities and the expectations of their benefits. Pandemics create their own set of priorities – relative to the pathogen's severity, transmissibility, impact on the economy or other activities. How a pandemic pushes on each of these levers shapes the nature of any societal response. We can characterize these costs in three distinct ways, in terms of health, social impact and economic disruption. How we choose to allocate resources in managing these costs reflects our goals relative to public health measures and a vaccination program.

The most obvious and immediate cost of a pandemic comes with the challenges and strain it poses for community health and the health care system. In the case of COVID-19, this is self-evident. The initial surge of the pandemic overwhelmed hospitals and morgues alike. While much of this damage at the outset was blunted by effective public health measures (involving shutdowns, isolation and personal protective equipment), subsequent waves proved more difficult to control. While the exact cost in terms of deaths and long-term disability remain to be determined, by any measure COVID-19 has been a singularly destructive global medical crisis. In addition to illness and fatalities from COVID-19 itself, healthcare capacity was reduced across all healthcare modalities. Essential surgeries and treatments were often delayed at great cost, while preventive health measures were similarly impacted. Estimates of worldwide excess death from January 1, 2020, to December 31, 2021, were 18 million individuals – while COVID-19 directly accounted for nearly 6 million of those deaths (Wang *et al.*, 2022).

The impact of COVID-19 is not limited to public health, however. -19 has had an ongoing and often devastating consequences for economic output and social services. Loss of productivity from illness and public health measures forced many industries to stop or curb production for long periods. This created unprecedented job loss as well as supply chain disruptions that led to severe shortages across the spectrum of societal needs (Pak, 2020). Similarly, the impact of social distancing and isolation taxed unemployment, housing and social programs immensely. The impact of COVID-19 is not limited to health statistics. It can be measured in unemployment figures, in housing costs and forfeitures, production output and hunger. Unsurprisingly, as a consequence, the urgency with which institutions address the social and economic costs of a pandemic are fundamental to recovery and maintaining social infrastructure.

The costs of both these health and economic challenges were not born equally within communities and many of those who were most vulnerable disproportionately suffered from its effects. Social inequality, amongst the poor, the elderly, immigrants, and others, was exacerbated by the conditions of the pandemic, by the lack of health care, employment, housing and access to information. Health outcomes from COVID-19 were far worse for those who were socially vulnerable, while the economic conditions of the pandemic further extended gaps in income, education and

both doses in the COVID-19 vaccination series (World Health Organization, 2023).

access to resources amongst the disadvantaged (Kalpana *et al.,* 2021).

These crises are not unrelated. The healthcare challenges posed by COVID-19 and its attendant public health measures each contributed to the social and economic crises associated with the pandemic. Solutions to these challenges are not necessarily inclusive. We may address, for example, the health crisis without consideration of the impact our strategy has for economic or social disruption. Historically, there have been many instances where social and governmental institutions have addressed healthcare and economic challenges while underserving those most severely impacted by the social crises of unequal access and income inequality. If we argue, as I think we should, that each of the posited challenges must be addressed, any putative solution must be viewed holistically – addressing together the multiple costs of COVID-19 for the community. It is unlikely that any single solution or strategy can adequately address each of these crises simultaneously, but it is essential to recognize these individual challenges as both the targets for a vaccine program and the criteria against which they should be evaluated (see Gupta & Morain, 2020).

Three Vaccine Distribution Rationales

Most rationing methods of limited vaccine supplies have aimed to identify morally salient differences between individuals or groups to form the basis for prioritizing access to the vaccine. They may include, for example, considerations regarding those who are most at risk of serious illness or who serve essential services. These plans show a presumption in favor of the idea that principled, and primarily utilitarian[3], grounds for resource distribution should form the basis for any prioritization program. Privileging access for health care workers and those who directly contribute to the continued functioning of medical services fits this model. Similarly, providing access to those who would face the most severe or damaging outcomes from cases of COVID-19 most directly lessens the threats to specific individuals while also reducing the strain on hospital resources. In each case, the basis for these decisions depends on differences between individuals that are germane to meeting the goals of the vaccination program discussed above. Much the same reasoning would apply to any preferential apportionment of scarce medical resources.

However, some methods emphasize values that diminish the relevance of at least some individual differences. These are primarily motivated by egalitarian ideals of fairness or equal consideration. Lotteries have been advocated as one means to achieve fairness in vaccine allocation without specifying morally relevant differences between individuals receiving that vaccine. Perhaps the main reason for opting for a lottery system would be in circumstances where resource distributions are manifestly unfair. During the Vietnam War, for example, the American draft lottery was instituted to ensure that every eligible male had an equal chance to be selected for military service (Fienberg, 1971). Similarly, the primary motivation for a vaccine lottery would be to ensure that every person had an equal opportunity to receive the vaccine – and in so doing also avoid contentious debates about the worthiness of prioritized groups. Justifying such a strategy would require, at minimum, a rationale for ignoring differences that have historically guided the distribution of scarce medical resources. which themselves represent popular sentiments about vaccine prioritization. (Luyten *et al.*, 2022).

These rationales are suggestive of three distinct types of criteria for the rationing strategies that were used in ordering access to the vaccines for COVID-19. I will argue that how we employ each of these strategies depends, fundamentally, on how we determine our priorities for a vaccine program.

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[3] "Most of the literature took a line that was broadly either explicitly or implicitly consequentialist in nature, with a tendency to be focused on outcomes, with appeal to a good to be maximised or a harm to be minimised (such as greatest number of survivors, least illness

Subjective Ethical Criteria. These methods organize individuals according to an assigned value that corresponds to social metrics of worth. For example, during the draft lottery, exemptions were made for those who had children. Other values may involve levels of education or potential contributions to society. We might include age or life expectancy in this category.

Objective Clinical Criteria. These methods prioritize vaccine delivery based on clinical criteria regarding the effectiveness of the vaccine in particular individuals. For example, we may opt to offer the vaccine first to individuals who are most likely to receive the maximum medical benefit or those for whom it provides the largest measure of protection. Similarly, giving priority to health care workers contributes to maintaining a system which provides the best medical outcomes for those most at risk from the disease.

Chance. These methods are typically lotteries or other forms of random distribution that prioritize largely on the basis of equal opportunity for access (though these may be weighted or restricted to particular groups based on the criteria described above). Consequently, individuals are organized according to a system that either limits or ignores the consideration of differences between individuals in determining access to the vaccine. Sometimes *first come, first served* methods of distribution are characterized in these terms, but I will argue that these are neither based on equal opportunity nor chance.

I will not try to exhaustively defend the claim that many of the rationales supplied in the first two categories supersede the third. However, there are certainly situations where they can be manifestly unfair. Consider for example the so-called "Seattle God Committee" (Levine, 2009), a panel that presided over decisions regarding who could have access to life-saving hemodialysis when the technology first became widely available at a local hospital in the 1960s. This committee was empaneled to prioritize access to this technology while it remained in short supply. The standards developed to decide who was worthy of this life-saving treatment included many criteria that now appear deeply problematic – including assumptions about future potential, net worth (and thereby ability to support children), as well as mental health and age. The reliance on indicators of material wealth in these decisions provoked an outcry precisely because these methods did not value lives equally. In cases like these, a lottery system appears preferable, since it avoids any worries about privileging access on the basis of considerations of wealth, race or status.

Arguably, what makes cases like the draft lottery or the Seattle hemodialysis committee problematic depends on the fact that other methods of resource distribution were perceived as biased or unfair. However, there are clearly circumstances where utilitarian justifications can override concerns about fairness or equitable distribution. Equality of access might not be a just principle to apply in cases where a vaccine, for example, primarily benefits one segment of the population. If we suppose that it is ineffective for older people or has dramatic side effects in others, it would not be unreasonable or unfair to focus its application on specific groups to the exclusion of others. Similarly, if the targeted distribution of a vaccine could be more effective in preventing secondary or even tertiary infections, then it may appear that the most equitable method of distribution would involve protecting as many people as possible to disrupt the chain of transmission. In this essay, I will assume that strong utilitarian reasons will trump considerations of equal access where there are principled reasons for preferring one group to another – though of course these reasons must be themselves defensible.

These criteria reflect a broad consensus amongst bioethics and the public regarding the values that should guide the early distribution of a rationed vaccine (Luyten *et al.*, 2022). These models typically privilege objective clinical criteria over

or fewest deaths)" (Williams & Dawson, 2020, p. 4).

both subjective ethical values and equal access (or chance). These mitigation tactics appear to directly address the strategic goals of a vaccine program addressing the crises discussed above. In seeking to maximize benefits, bioethics researchers tend to emphasize treatment of those most under threat and those playing necessary roles in maintaining the health system and infrastructure (Dawson, 2020). A study of nonspecialists, this one of Belgian citizens, did not significantly differ from those of bioethicists. They showed that "[p]rioritizing essential workers, chronically ill and elderly were found to be the three most supported strategies. On the other hand, market, lottery or *first-come, first-served* strategies were clearly the least preferred strategies with at least 80% of the respondents ranking them at the bottom" (Luyten *et al.*, 2022, p. 350).

While the same studies found less consensus concerning the next steps, it does seem that addressing social issues was a priority. Advocates of these positions argued that vaccine access should then be extended to include members of hard to reach or stigmatized communities. Individuals in these groups have faced enduring challenges regarding access to healthcare and resources that would lessen exposure to COVID-19 or mitigate risk during an infection. Vaccination in these communities would help reduce stress on the health care system, while also supporting many of those most likely to play crucial roles in maintaining essential services. Each of these priorities is consistent with the stated policy goals for a vaccine delivery system.

This broad agreement between the public and specialists was reflected in the two major public models of vaccine distribution developed in the United States. The rollout schedule the CDC commissioned from the National Academies of Sciences, Engineering, and Medicine (NASEM) imagined four broad phases that emphasized the early vaccination of frontline healthcare workers and those with comorbidities or other risk factors. Subsequent phases focused on essential workers, educators and their students followed by the remaining adult US population. Subsequently, The Advisory Committee on Immunization Practices (ACIP) used NASEM's draft for their final proposal.[4]

The conversation regarding these models focused primarily on the order of the respective rollout stages or tiers. Should, for example, relatively low risk health care workers receive the vaccination before those with comorbidities? Should school-age children, who experience better outcomes with COVID-19, be placed ahead of some adult categories to help facilitate the re-opening of schools? What was largely ignored was the commitment to the tiers in the first place. The proposal for tiered groups in both plans created extremely large classes of individuals with no internal prioritization. The NASEM plan has tiers comprising tens of millions of individuals each with the same status and precedence as the others. Options were available to create a more finely grained system that would put a rank ordering (for example, by age or social vulnerability) distribution program with smaller and perhaps more tractable groups. One recent study has suggested that prioritization strategies based on multifactored risk assessments would have offered significantly improved outcomes (in terms of morbidity and disability) over those that only factored in single individual risk factors (Chapman *et al.*, 2022). One concern was that larger groups would create congestion and lines at vaccination centers, while simultaneously allowing more opportunities for line-jumping and fraud.

Perhaps the most striking departure from previous vaccination programs was the explicit inclusion of criteria addressing what has been called social vulnerability. Recognizing that the impact of the pandemic would be felt differently in different communities, especially among those unable to socially isolate or access healthcare, many agencies developed criteria designed to identify those most susceptible to negative outcomes. Consider, for example, how communicable

[4] While there are differences between the two proposals (determined primarily by emerging studies regarding the specific nature of COVID-19's threat to individuals), for our purposes they are minor. See (Schmidt *et al.*, 2021) for a graphic illustration of these differences.

diseases like COVID-19 can pose threats based on housing. One study found that "Latinx persons in California were over eight times more likely to experience exposure risks based on cohabitation with an essential worker or from cramped housing" (Bruckhaus *et al*., 2021, p. 26). Indices of social vulnerability were compiled in a number of different ways, but in each case, classifications reflected data involving income, access to health care and transportation, housing modalities, minority and language status, among others[5]. Sometimes each of these factors were compiled as part of a social vulnerability index (SVI), which allowed social services and state planners a way to classify individuals according to this metric. The CDC and several state agencies also contracted with data management company Palantir to use their healthcare data platform, Tiberius. In compiling a truly extraordinary amount of personal information, programs like Tiberius were used to identify social vulnerability across a broad variety of indices (Mann *et al*., 2022). Addressing social vulnerability allowed planners to direct resources in ways that countered the impact of the pandemic across each of the three crises outlined above. While vulnerable individuals were most likely to suffer negative health consequences of the pandemic, people from these groups were also much more likely to serve important economic roles as essential workers. Prioritizing these communities would also help temper the impact of covid in reinforcing current systemic equities defined by economics, wealth and race in the United States[6].

The inclusion of social vulnerability measures was also indicative of the kinds of vaccination programs that were considered undesirable. Polls showed, for example, that people did not believe that access to the vaccine should depend on one's ability to pay (Emanuel *et al*., 2020). *First come, first served* vaccine programs were also viewed as objectionable – not merely because they tended to skew towards those with the resources and scheduling flexibility to access these services – but also because they included a random or unprincipled allocation of resources. Indeed, a *first come first served* system does not maximize the benefits of a vaccine program in part because those who are most able to access it are often those who have a greater capacity to isolate and avoid early waves of the virus.

The plethora of distribution methods for the COVID-19 vaccine may suggest that there is no consensus regarding the best practices for vaccine delivery when they are in short supply. Even so, where there is substantive and almost universal agreement, the evidence suggests that policies that were explicitly at odds with preferred outcomes were pursued. Understanding what contrib2uted to the abandonment of these ideals during the rollout is absolutely essential to addressing future pandemic planning.

Mistaken Assumptions

A common assumption about vaccine distribution models, both those forwarded by Federal US agencies and those developed independently by bioethicists and epidemiologists, was that distribution strategies would accord with top-down or centralized management strategies. Federal guidelines would be followed in the distribution of vaccines both at the state and clinical levels. Indeed, the expectation within the CDC was that states would adhere to the basic categories and tier structure of the NASEM and ACIP proposals, though these models did allow for "state and local jurisdictions [...] flexibility to administer vaccine based on local epidemiology and demand" (CDC, 2020b, n. p.). The governing supposition, even in the cases of local vaccine management, was that the national program would guide the phased rollout of the vaccine according to the strategy developed by the CDC.

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5 These broadly conform to the general categories of the CDC's social vulnerability index. See (CDC, 2020).

6 These efforts were not limited to vaccine prioritization. Some jurisdictions used SVI to help aid in local vaccine access, communication and planning. "[U]sing place-based measures for targeted outreach, communication, appointment sign-up assistance and dispensing site planning are, therefore, critical, especially in jurisdictions with larger proportions of disadvantaged communities of color and others disengaged from healthcare systems" (Schmidt *et al.,* 2021, p. 1305).

This expectation was wrong at every level. While the Federal government developed and managed a national distribution campaign that delivered vaccines to individual states, these deliveries lacked any enforceable guidance regarding how they should be dispensed and were often and regularly ignored. The apportionment of vaccines from Federal agencies was itself inconsistent, often missing targeted allocations and bypassing state and county public health offices in favor of Federally administered health care facilities (like Veterans Affairs hospitals or Women, Infants and Children clinics) or private pharmacies. These deliveries were not coordinated with state agencies and consequently many states were unable to assess local and demographic demands for the vaccine at any given time (Hennigan *et al.*, 2021).

The lack of a "last mile" plan meant that state agencies were tasked with developing distribution policies on the fly. The states themselves often further devolved vaccine strategies to counties, municipalities and local health agencies. These varied enormously in terms of funding, planning and local political responsiveness to pandemic concerns (St. Fleur, 2023). As Federal allocations to health agencies (hospitals, clinics and pharmacies) were also made independently of state allocations, they were not coordinated to maximize the benefits to local communities (for example, pharmacies and clinics tends to cluster in relatively affluent communities). Delegating vaccine planning and coordination to local governmental authorities led to a multitude of individual vaccine strategies, many at odds with the stated Federal vaccine goals. These methods included each of the ones discussed above, both desirable and less so, all taking place at roughly the same time.

Everything, Everywhere, All at Once

The lack of a top-down strategy resulted in a remarkably diverse array of vaccine programs and policies – often within the same states, counties and districts. This proliferation of competing methods created what appears to be an unprecedented opportunity to evaluate the success of each strategy in the context of the largest vaccine distribution program in US history. Which vaccine strategies were most successful in achieving the stated goals of the vaccine programs? To what extent did different distribution methods lead to greater numbers of vaccinated individuals and improvements in public health?

The idea that the multiplicity of vaccine distribution strategies would generate the kind of experimental data that would enable us to choose between competing models is a naïve one. Aside from lacking many the basic scientific virtues of control groups and consistent experimental design, these systems are problematic in many ways relevant to adjudicating their success. Many districts kept poor records or forbade maintaining records of the implementation of pandemic vaccine policies (Gans, 2021). Many allocation and distribution strategies overlapped with others, frequently in the same district. Federal and state distribution programs often took place at the same time, coordinated with different agencies (the Veterans Administration, pharmacies, local country health departments) and targeting the same groups. This problem is compounded by the fact that differences in programs, eligibility and availability often meant that people moved between regions to find access to the vaccines.

The lack of a consistent vaccine delivery protocol also created a great deal of confusion about who was eligible or how vaccines were to be obtained. Since many different programs often operated adjacent to others, advertising or information programs often led to a confusing array of alternatives that were difficult to parse. As one study of vaccine distribution in New Jersey, New York and Pennsylvania noted, "[d]ifferently timed and defined phased plans for each state and city [...] caused inequalities and general confusion between major metropolitan areas and the surrounding suburban neighborhoods, even within specific states and especially across state lines" (Moss, 2022, p. 6). Many of the populations who were most at risk, elderly individuals, minorities, those with disabilities or comorbidities, were among those most likely to lack the skills necessary, technological, linguistic or otherwise, to

sort through contrasting guidance. Consequently, the lack of a unifocal vaccine delivery plan (and messaging strategy) was itself a confounder in efforts to determine which method of vaccine delivery was most successful.

Finally, there is no question that the complications arising from the manyfold variation in vaccine programs, distributions and delivery systems makes any study of their effectiveness extremely difficult. Noting, however, that caution is required (and indeed that definitive conclusions might not be possible), it remains true that a comprehensive review of strategies employed, insofar as we are able, offers the best evidence for how we can approach future pandemic planning.

Ideal Outcomes

Many of the changes states implemented in the ACIP tiers had a material impact on who could receive vaccinations and when. Individual state and local planning were often a significant departure from the guidelines established by the CDC. There is little doubt that in many cases this led to increased vaccine hesitancy or suppressed the overall uptake of the vaccine itself (Peters, 2022). However, it should also be clear that the CDC guidelines were themselves flawed. In this section, I will look at how the phased rollout proposed by the CDC and the ACIP recommendations would produce outcomes that did not meet their own stated goals to "maximize benefits, minimize harm", "promote justice" and "mitigate health inequities" (CDC, 2020b, n. p.).

Perhaps the most serious argument against the ACIP and NASEM recommendations is based on the size of the prioritized groups. The original phased rollout created cohorts that were far larger than the available vaccine could serve. The CDC's own data characterized the senior tier (those over 65 years of age) as comprising more than 55 million adults. Subsequent categories involving individuals with comorbidities between 16 and 64 years of age included more than 100 million Americans (CDC, 2020b). This resulted in shortages and competition amongst eligible individuals for the limited supply that would often advantage the most resourced individuals in the pool. For many, the fruitless search for an appointment or dose would prove sufficiently discouraging to prevent timely vaccination. Far from creating an "efficient, expeditious and equitable distribution and administration of approved vaccine" (CDC, 2020b, n. p.), the rollout groups exacerbated many of the inequalities inherent in the system.

The larger tiers were also inclusive of many individuals for whom early vaccination came at the cost of those who were more at risk. Including, for example, all healthcare workers in the first phase of the rollout meant that many individuals who were not working with patients had access to vaccination before more vulnerable older individuals or those in congregate care. The lack of discernment in the face of vaccine shortages meant that many opportunities to protect at risk individuals or groups were wasted. The reliance of unwieldy and overly inclusive tiers directly diminished the safety profile of the program as a whole (Parker *et al*., 2022).

One example of this phenomena was criteria that heavily tilted towards privileging access on the basis of age. While it is certainly true that COVID-19 posed increased threats to the elderly, the criteria, as employed, often ignored the risks associated with social vulnerability amongst older individuals. By establishing a large grouping of older individuals, these programs ignored factors like the capacity to isolate, comorbidities and other health risks, access to transportation or medical care. Those with the flexibility and wherewithal to navigate the complex vaccination process (and to do it twice) were often the ones that could most effectively maintain isolation or social distancing. Moreover, they also had better access to medical care if it became necessary. This system advantaged the significantly higher proportion of white Americans who are over seventy-five.

The ACIP and NASEM prioritizations also eschewed the use of online monitoring and demographic information. In using solely demographic information, opportunities to reduce transmission by identifying "hotspots" or geographical mea-

surements of risk were not pursued (McLaren, 2023). The lack of geographical strategies both for disease concentration and health risks was likely costly (Wrigley-Field *et al.*, 2021).

In opening vaccine distribution to large groups within the population, there was little effort to establish any form of prioritization or priorities within groups – even in cases where such methods could better serve each of the desiderata of a vaccine strategy. In fact, in many cases, state health agencies enlarged or eliminated tiers to streamline delivery.

The Old Ways Are the Best Ways

During the early vaccination period, there was considerable press coverage and local comment regarding what appeared to be frequent examples of individuals taking advantage of loopholes or fraud to jump into higher tiers within state mandated vaccination categories. It is difficult to quantify to what extent line jumping and corruption were common in the US. There is a considerable incentive to obscure data that points to irregularities in vaccine distribution – and these may include omissions or data reporting failures as well as using secondary considerations to justify distributions outside of prescribed procedures. Spoilage, missed appointments, geographical limitations, etc., have often been used to revert to *first come, first served* systems or even more problematic distribution systems through personal contacts or family members, for example.

Putting these circumstances aside, however, the evidence also suggests that within tier groups, priorities were not determined by program guidance. Considerations of risk, need, and social justice were largely overthrown in favor of traditional methods of American health care rationing. Instead, *first come, first served* models, arbitrary dissemination of limited vaccine supplies, group access tied to political or economic strata, and lotteries were used to apportion early allocations of vaccines.

Large tiers coupled with poorly targeted vaccine delivery strategies created in many instances precisely the kind of distribution systems that were explicitly rejected by bioethicists and the public at large. While many states targeted vaccine clinics for particular age groups or demographics, they often depended on *first come, first serve* models of access. Limited vaccine supplies were apportioned on the basis of those who could afford to wait in long lines (often in the middle of the day), in their cars, and at locations often far removed from public transportation. In Florida, where local state health officials overrode Federal prioritization procedures, long (often overnight) lines formed in anticipation of limited vaccine availability during clinic hours. As quoted by CNN, one member of the queue noted, "[a]lthough I'm grateful to get the vaccine, I feel that there's got to be a better way to distribute this [...] For people that really need it, elderly that might be disabled in some way, they can't endure this process, so there's got to be a better way to manage this" (Levenson *et al.*, 2020). The initial appearance of a targeted vaccine delivery system is undermined when these additional conditions are factored in.

Another consequence of the *everything all at once* strategy was that individuals who were proximate to different healthcare jurisdictions were able to cross county/municipal/healthcare district lines to pursue vaccination that others without transportation or other disadvantages could not. Once again, this depended on having the ready capacity to both locate the relevant opportunities and the financial resources to travel the necessary distances to access this supply – often at the cost of limiting the supply for those in the district for whom the distributions were originally reserved.

The data suggests that the reversion to customary American healthcare modalities led to exactly the kind of disparities a just system would avoid Measures of social vulnerability, wealth and race track familiar inequalities in American health care coverage. For example, studies have shown that vaccine coverage was lower in those communities that had the highest vulnerability to negative COVID-19 outcomes, while being much higher in those communities where social vulnerability was diminished, a finding largely driven by

socioeconomic disparities (Hughes *et al*., 2021). Similarly, regional wealth gaps, defined by median household incomes, were reflected in vaccine coverage. Wealthier zip codes often showed vaccine uptake nearly three times more than that of economically disadvantage neighborhoods (Goldhill, 2021). Another study showed striking racial disparities in those who were vaccinated in the early days of vaccine distribution. In Mississippi, African-Americans accounted for 42% of all deaths from COVID-19, but only received 15% of vaccinations during the review period. Texas showed similar results. While Hispanic-Americans accounted for only 15% of vaccinations, they made up nearly half of all COVID deaths in the state (Ndugga *et al.*, 2021).

Together these outcomes may suggest that the best way to avoid clustering around wealth and privilege in large vaccination cohorts would be the development of an intra-group lottery. Parker *et al.* (2022, p. 12) argue that "ACIP should have strongly recommended randomized lottery systems to allocate vaccines within phases." An in--phase lottery vaccine distribution method would also offer a simple means of delivering vaccines to individuals in ways that are less complex or exploitable. This would allow for the continuation of vaccine rollouts according to a large tier structure, but also sharpen the funnel in ways that level out the playing field. Access is not gauged to personal resources – in terms of time, travel, physical health or condition, for example. This assures a more equitable means of assigning vaccination opportunities amongst all individuals for whom vaccine priority is warranted. Parker *et al*. (2022, p. 12) contend that such a system "would have dramatically improved the alignment of the ACIP protocol with its principles."

If vaccine lotteries were seen as one way of avoiding unjust outcomes in vaccine access, many also viewed the primary advantage of vaccine lotteries as a means of accelerating the delivery of doses across the population. One of the biggest surprises of the early vaccination period was the speed at which surplus vaccines became available. An unexpectedly large number of Americans, fueled perhaps by vaccine disinformation, refused to pursue the vaccine once it became available, while efficiencies in manufacture and supply chain compressed delivery schedules. The original goal of universal access was pushed forward from October 2021 to April 2021. It was for this reason that many public health officials, including the future Whitehouse COVID Coordinator, Ashish Jha, publicly pressed for the use of vaccine lotteries (Jha & Wachter, 2021). The guiding principle of these arguments was not equal consideration or fairness but rather to accelerate progress towards the public health goals of mass vaccination and herd immunity.

Indeed, most objections to state and federal vaccination programs were couched in terms of increasing the pace of vaccine delivery. Targeting smaller groups in the early rollout phases or increasing vigilance with respect to rooting out line jumpers or fraud would only diminish the ability to get vaccinations into arms as quickly as possible – an outcome that could result in more cases and a greater impact for the disease than a more explicitly just system. I have argued that larger tiers (and inconsistent state guidelines) actually contributed to bottlenecks and inequities in the system that itself was designed to aid speedy delivery. Perhaps lotteries might be one means to rollout a vaccine without creating overwhelming line-ups and confusion?

Lottery assignments can be quick and offer criteria that is easily verifiable. Social security numbers could be used for adult populations or randomly selected birthdates, etc. While it is difficult to see how this streamlines weighted rankings that uses similarly accessible classifications (like age or location), the perceived advantage of such systems is that they could eliminate confusion and set up easily discernable criteria for quick access to vaccination opportunities.

However, a lottery system, given its goals, is easily overridden. Many considerations, including potential benefits, maintaining access to healthcare, threat to individuals, as well as other impediments to access/healthcare offer strong reasons to supersede a simple (or even

weighted) lottery system. This is especially true if we can provide an equally quick ordering of vaccine priorities that addresses concerns of social justice and access.

This infrastructure exists. Recognizing that speed of delivery remains a paramount consideration, structures that prioritize dosages based on ongoing threats need not be flawless. Software platforms like Tiberius and other emerging technologies in AI and big data processing will allow public health agencies to create finer and more targeted allocation strategies. While attempts to develop automated algorithmic methods for dispensing vaccines were problematic during this vaccine rollout (Wu & Isaac, 2020), future pandemic preparedness will make heavy use of these systems – and they can be turned towards offering more structured responses to public health priorities than a lottery system. Many of the features of big data and artificial intelligence systems that legitimately cause concern amongst privacy experts nevertheless provide the infrastructure to offer rank orderings of vaccination cohorts that better meet the explicit healthcare and wellness criteria for these programs. Moreover, they match the public's preference for prioritization systems that avoid random allocations in favor of principled rationales, while also better addressing the stated goals of these programs.

Conclusions

In this paper, I have argued that the strategies employed in pursuing a vaccine program for a limited stock of doses were far from ideal. The goals for a vaccination program in terms of addressing the public health, economic and social crises raised by the pandemic were often obscured by poor planning and execution amongst the authorities responsible for the rollout. I have argued that federal and CDC plans for a phased rollout of vaccines created group cohorts that were too large to effectively target those most at risk or in need of the vaccine. Instead, these large groups allowed for the pre-existing inequities of the American healthcare system to reproduce themselves in a different format. Those with the most resources and often the least pressing need were better able to secure the vaccine, while those who were most likely to suffer the worst consequences of the disease or continue its propagation at the workplace or home were often forced to wait. This prolonged all three crises and posed a large threat to individual health.

I have also explained that the loss of centralization in the COVID-19 vaccine deployment contributed to a multiplicity of distinct and often countervailing plans, many facilitating opportunities that explicitly diverged from federal guidelines and the outcomes they sought to determine. While I have explicitly faulted state programs for this bewildering array of strategies, it is also true that federal programs themselves often undermined local programs through direct disbursements to pharmacies and federally administered health care facilities. The broad variety of rollout strategies, occurring simultaneous across virtually every American healthcare jurisdiction, undermined the best attempts to maintain best practices in vaccine delivery. They created confusion through competing and often shifting eligibility criteria and multiple (and often inaccessible) vaccine delivery locations. They used technologies and delivery modalities that often privileged the wealthy and technologically fluent, and thereby exacerbated the unequal delivery of vaccines amongst those most vulnerable to COVID-19's worst outcomes.

Moreover, I have limited the discussion to just one example of a vaccine rollout program in a wealthy industrialized country. In examining the practical and ethical failures of a vaccine program in the US, it is important to remember that within the broader context, the vaccine nationalism of wealthier countries was indefensible. By the time vaccine lotteries were be considered to encourage vaccination amongst reluctant Americans, fewer than one in five hundred people were vaccinated in low-income countries. Not only would a more equitable distribution of vaccines worldwide prevent almost unimaginable suffering, but it would also contribute to creating a safer environment worldwide by reducing spread and the development of new immune evasive variants

(Ye *et al.*, 2022). Pandemics, by their very nature in an interconnected world, are global and a more equitable distribution of vaccines worldwide must be the priority moving forward, for both moral and public health reasons.

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John Sarnecki

Ph.D. in Philosophy, Rutgers University; BA in Philosophy, University of Calgary; Chair of the Department of Philosophy and Religious Studies at the University of Toledo. Areas of interest: Philosophy of Mind, Philosophy of Language, Theories of Concept Acquisition, Cognitive Science

Postal Address:

JOHN SARNECKI

Mail Stop 966, 2801 W. Bancroft Ave.

College of Arts and Letters

University of Toledo

Toledo, OH 43606

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