DISASTER VULNERABILITY

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Abstract: Vulnerability drives disaster law, yet the literature lacks both an overarching analysis of the different aspects of vulnerability and a nuanced examination of the factors that shape disaster outcomes. Though central to disaster law and policy, vulnerability often lurks in the shadows of a disaster, evident only once the worst is past and the bodies have been counted. The COVID-19 pandemic is a notable exception to this historical pattern: from the beginning of the pandemic, it has been clear that the virus poses different risks to different people, depending on vulnerability variables. This most recent pandemic experience thus provides a useful vantage point for analyzing vulnerability. Drawing on empirical data from the pandemic and experiences from past disasters, this Article identifies and discusses the policy implications of three dimensions of disaster vulnerability: the geography of vulnerability, competing or conflicting vulnerabilities, and political vulnerability. First, it explores the geography of vulnerability, using statistical analysis and geographic information system (GIS) mapping. The Article presents an innovative COVID-19 vulnerability index that identifies the country's most vulnerable counties and the leading driver of vulnerability for each county. It demonstrates how this index could have informed voter accommodations during the 2020 elections and mask mandates throughout the pandemic.

NOTE: Because not all platforms support graphics, the figures in this Article are archived at [https://www.bc.edu/content/dam/bc1/schools/law/pdf/law-review-content/BCLR/63-3/Graphics_Sun_et_al-A1b.pdf] [https://perma.cc/V69A-WA9T].

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The authors would also like to thank Jenna Shaw for her invaluable help with GIS mapping and data analysis and collection, and Shawn Nevers, Luisa Lloyd Gough, and Mariah Critchfield for their invaluable assistance with research. They would also like to thank Dan Farber, Rachel Moran, Michalyn Steele, Blake Hudson, the participants in the Ostrom Colloquium at the Indiana University Bloomington, and the BYU Law School faculty for their insightful feedback and critiques. Finally, the authors would like to acknowledge and thank the student editors of the *Boston College Law Review*.

The Article also shows how, going forward, similar modeling could make disaster management more proactive and better able to anticipate needs and prioritize disaster mitigation and response resources. Second, this Article explores competing or conflicting vulnerabilities—situations where policy-makers must prioritize one vulnerable group or one aspect of vulnerability over another. To illustrate this, it considers two other policy challenges: school closures and vaccine distribution. Finally, the Article explores political vulnerability, analyzing how disasters make already-vulnerable groups even more vulnerable to certain harms, including political neglect, stigmatization, disenfranchisement, and displacement. In sum, this Article draws upon the costly lessons of COVID-19 to suggest a more robust framework for policy-makers to assess and respond to vulnerability in future disasters.

INTRODUCTION

Understanding and addressing vulnerability is critical to effective disaster law and policy. Yet, disaster law scholars and policy-makers lack a clear empirical and policy framework for identifying and analyzing different aspects of vulnerability and for deploying vulnerability data to mitigate the impacts of disasters on the most vulnerable populations. Drawing on data and lessons from the COVID-19 pandemic, this Article models how *geographic vulnerability* data can illuminate patterns of vulnerability and enable proactive decision-making to improve disaster mitigation and response. At the same time, we acknowledge the limits and risks of this spatial, data-driven approach. To supplement the geographic data, we consider two other important aspects of vulnerability: *competing or conflicting vulnerability* and *political vulnerability*.[1]

The COVID-19 pandemic provides an ideal opportunity to examine disaster vulnerability. Although we are still learning about COVID-19, we have known since the virus's initial explosion onto the world stage that some people are more vulnerable to the virus than others. Older individuals, those with certain underlying health conditions, racial minorities, and the poor face much more serious risks and have suffered disproportionate harm.[2] This is not to say

[1] Competing or conflicting vulnerabilities occur when the interests of different groups conflict or when they compete for resources. It also may occur between individuals within a single, vulnerable group. *See* discussion *infra* Part III. Political vulnerability, on the other hand, refers to how the political environment exacerbates risk of harm. *See* discussion *infra* Part IV.

[2] *See* Amber L. Mueller, Maeve S. McNamara & David A. Sinclair, *Why Does COVID-19 Disproportionately Affect Older People?*, 12 AGING 9959, 9959 (2020) (noting that age "is by far the most significant risk factor for death due to COVID-19" and discussing underlying health conditions that also increase risk); APM Rsch. Lab Staff, *The Color of Coronavirus: COVID-19 Deaths by Race and Ethnicity in the U.S.*, APM RSCH. LAB (Mar. 5, 2021), www.apmresearchlab.org/covid/deaths-by-race [https://perma.cc/RHV7-WXCK] (reporting that "Pacific Islander, Latino, Indigenous and Black Americans all have a COVID-19 death rate of double or more that of White and Asian Americans, who experience the lowest age-adjusted rates" (emphasis omitted)); Monika Batra Kashyap, *U.S. Settler Colonialism, White Supremacy, and the Racially Disparate Impacts of COVID-19*, 11 CALIF.

that COVID-19 is unique in posing increased risks to vulnerable populations. Indeed, nearly a half-century of disaster research finds that disaster impacts almost always fall most heavily on marginalized and disadvantaged groups, particularly racial minorities and the poor, but also the elderly, people with disabilities and chronic illnesses, undocumented immigrants, women, and LGBTQ+ individuals.[3] History continues to demonstrate, time and time again, that disasters reveal and exacerbate existing vulnerability and inequity.[4] And it is not just disaster events that amplify disparities. Even well-intended disaster policy often backfires, further harming vulnerable communities and deepening and entrenching existing inequity.[5]

What is unusual about the COVID-19 pandemic, however, is that vulnerability has been front and center, not only for academics, but also for the public. We celebrate when we hear about a ninety-five-year-old who receives the vaccine and shudder when a seventy-year-old with heart disease gets diagnosed with the virus because we are attuned to the risks the virus poses to vulnerable populations. Even as we pay attention to vulnerability, however, we focus mostly on individuals rather than neighborhoods and communities. Although we track case-counts in different cities, counties, and states, we are less attuned to how vulnerability differs across geographies.

Yet, understanding geographic patterns of vulnerability is critical to developing just and effective disaster response policy. Geographic vulnerability is essential to determining, for example, where to locate COVID-19 testing centers and vaccine clinics, where to prioritize regulatory resources, including

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L. REV. ONLINE 517, 527–28 (2020) (summarizing the racially disproportionate impacts of COVID-19), https://www.californialawreview.org/settler-colonialism-white-supremacy-covid-19/ [https://perma.cc/H82S-6K96].

[3] *See* DANIEL A. FARBER, JAMES MING CHEN, ROBERT R.M. VERCHICK & LISA GROW SUN, DISASTER LAW AND POLICY 260 (3d ed. 2015) ("Women, children, the elderly, persons with disabilities, and immigrants (documented and otherwise) all suffer from disaster in ways that other victims do not."); Susan Cutter, *The Geography of Social Vulnerability: Race, Class, and Catastrophe*, SOC. SCI. RSCH. COUNCIL (June 11, 2006), https://items.ssrc.org/understanding-katrina/the-geography-of-social-vulnerability-race-class-and-catastrophe/ [https://perma.cc/W3UR-QCD5] ("Disasters are income neutral and color-blind. Their impacts, however, are not."). One notable departure from typical patterns of vulnerability in this pandemic is that COVID-19 has more serious impacts for men than for women (a difference that seems to be biological, not social). Apoorva Mandavilli, *Why Does the Coronavirus Hit Men Harder? A New Clue*, N.Y. TIMES, https://www.nytimes.com/2020/08/26/health/coronavirus-men-immune.html [https://perma.cc/SNR9-4A25] (Aug. 27, 2020).

[4] *See* FARBER ET AL., *supra* note 3, at 228 (observing that although natural disasters are "sometimes viewed as 'great social equalizers,'" in fact "[d]isaster does not so much erase as expose social vulnerability"); *see also id.* at 239 (noting that Hurricane Katrina "exposed longstanding racial, social, and economic inequities"). "[D]isaster scholar Steve Matthewman" has argued that disaster "events are merely processes made visible." KATHLEEN TIERNEY, DISASTERS: A SOCIOLOGICAL APPROACH 29 (2019) (citation omitted).

[5] *See infra* notes 43–59 and accompanying text.

public education campaigns, and where school or voter accommodations for vulnerable citizens are most needed.

To expand our understanding of geographic vulnerability, this Article considers new empirical evidence, in tandem with the lessons of past disasters, to explore how a sustained, data-driven, systemic approach to vulnerability can improve disaster decision-making. By developing a county-by-county COVID-19 vulnerability index, our team of legal, public health, and statistics experts answer the call of disaster scholars to provide policy-makers with the "maps and numbers" they need to understand and address vulnerability.[6] We then apply this index to some of the most important COVID-19 policy decisions.

As we developed and applied this unique empirical tool, we recognized that truly understanding disaster vulnerability requires more than seeing spatial vulnerability. Indeed, a single-minded focus on geographic vulnerability can obscure two other important, and interrelated, aspects of vulnerability: conflicting or competing vulnerability and political vulnerability. Conflicting or competing vulnerability considers more carefully and holistically the trade-offs between different aspects of a particular group's vulnerability as well as the trade-offs between different vulnerable groups. Political vulnerability encompasses the various ways that disasters make already-vulnerable groups even more vulnerable to certain kinds of harms, such as political neglect, stigmatization, disenfranchisement, displacement, and other forms of exploitation. Applying the lessons of past disasters and drawing on a second original data set—a two thousand-person national survey—we explore these two additional dimensions of vulnerability. We also contemplate the limits and potential impact of geographic vulnerability indices, like the one presented in this Article, for addressing and mitigating other types of vulnerability.

This Article focuses on these three aspects of disaster vulnerability. Part I begins with a brief background on disaster vulnerability and a review of the relevant literature. In doing so, Part I discusses three aspects of disaster vulnerability: (1) exposure vulnerability; (2) social vulnerability; and (3) individual health and physical vulnerability. We then provide ethical and practical rationales for focusing on vulnerability when responding to and preparing for disasters.

Part II analyzes geographic vulnerability. To understand and visualize the geography of vulnerability to the pandemic, we introduce our COVID-19 vulnerability index. This Part then explores how scholars and policy-makers might use the index and similar data tools to improve disaster management.

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[6] Robert R.M. Verchick, *Disaster Justice: The Geography of Human Capability*, 23 DUKE ENV'T L. & POL'Y F. 23, 25 (2012), https://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1238&context=delpf [https://perma.cc/88BC-MSPM].

Although other indices are available to policy-makers, the vulnerability index leverages several rich data sets and incorporates modeling of case fatality rates. This framework helps to accurately map COVID-19 vulnerability and identify the most important vulnerability drivers of COVID-19 mortality in each U.S. county. We then demonstrate how policy-makers could have used the index to make better decisions about two critical and contentious issues that occupied decision-makers from the onset of the pandemic: mask mandates and voter accommodations in the 2020 primary and general elections. These examples demonstrate how vulnerability data, such as that reflected in the index, can clarify complex issues and introduce some much-needed nuance and direction to our pandemic responses. At the same time, we acknowledge the shortcomings, implicit judgment calls, and limitations of such an index and how factors such as uncertainty and incomplete data challenge even the most informed decision-maker.

Part III explores competing or conflicting vulnerabilities. This Part first examines school reopening decisions as a case study to consider the conflicts between different vulnerabilities within a specific group. Then, we consider the competing vulnerabilities between different groups, primarily through the lens of vaccine-distribution priorities.

Part IV highlights political vulnerability. Examining a wide range of examples from the COVID-19 pandemic and other disasters, we discuss the ways that addressing vulnerability might incidentally or even intentionally lead to political neglect, stigmatization, disenfranchisement, displacement, and other similar patterns of exploitation. Along the way, we weigh the potential dual function of vulnerability data as both an unintended blueprint for exploitation and an important check on disaster inequity.

Finally, this Article concludes by emphasizing the pandemic's lessons for how to best ameliorate and address vulnerability in future disasters, as well as build resilience in historically disadvantaged communities.

I. Background on Disaster Vulnerability

To understand the contribution of this Article, we provide a brief overview of disaster vulnerability. We begin with a background on how the disaster law literature and other disaster scholarship have treated the subject of vulnerability.[7] We then briefly argue that justice requires us to pay particular attention to vulnerable people and that, from a practical perspective, effective disaster management does too.[8]

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[7] *See infra* Section I.A.

[8] *See infra* Section I.B.

A. Understanding Disaster Vulnerability Scholarship

While the literature is challenging to characterize, broadly speaking, disaster vulnerability can be understood as the cumulative effect of three factors: (1) exposure vulnerability; (2) social vulnerability; and (3) individual health and physical vulnerability. These three forms of vulnerability manifest geographically and vary across space—from street to street, neighborhood to neighborhood, county to county, state to state, and country to country.

First, individuals and communities may be particularly vulnerable to disaster because they have increased *exposure* to hazards.[9] Exposure increases the likelihood that particular individuals or communities will experience a disaster event. Exposure vulnerability contains an important spatial component because most natural hazards, such as wildfires, earthquakes, and floods, also have a strong spatial element.[10] The spatial element of exposure vulnerability has taken a unique form during the COVID-19 pandemic. For example, risk of exposure to the virus increases for people with jobs that do not easily permit social distancing or allow working from home. Reliance on public transit that puts people in close proximity and crowded intergenerational housing also increase risk of infection. Because many of these exposure factors are, in turn, correlated with race and class, and most U.S. cities continue to be segregated residentially, the most exposed individuals will often be concentrated in particular neighborhoods and communities.[11] Additionally, homeless people, incarcerated individuals, and those living in other group settings, such as nursing homes, care centers, and mental health facilities, also have heightened exposure because they tend to be confined to spatially-limited living conditions.

Second, individuals and communities may be particularly susceptible to disaster because of *social* or socioeconomic circumstances that limit their capacity or resources (including money and social capital) to respond and adapt when disaster strikes.[12] Disaster literature typically uses the term "social vul-

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[9] Verchick, *supra* note 6, at 38 (describing this exposure vulnerability as "physical vulnerability" when it results from "a community's physical exposure to a place-based risk").

[10] *See id.*; TIERNEY, *supra* note 4, at 121 (describing how exposure to hazards differs across place because "particular geographic areas are simply more prone than others to events that arise from hazards").

[11] *See, e.g.*, Kathleen Dooling et al., *The Advisory Committee on Immunization Practices' Updated Interim Recommendation for Allocation of COVID-19 Vaccine—United States, December 2020*, 69 MORBIDITY & MORTALITY WKLY. REP. 1657, 1658 (2021), https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm695152e2-H.pdf [https://perma.cc/LK36-7C7M] ("The overall proportion of persons aged ≥75 years who live in a multigenerational household is 6%; the proportion among non-Hispanic White persons is 4%, and the proportion among racial or ethnic minority groups is higher (non-Hispanic Black persons, 10%; Hispanic or Latino persons, 18%; non-Hispanic persons of other races, 20%).").

[12] *See, e.g.*, Cutter, *supra* note 3 ("Social vulnerability is partially a product of social inequalities—those social factors and forces that create the susceptibility of various groups to harm, and in turn affect their ability to respond, and bounce back (resilience) after the disaster.").

nerability" to capture these socioeconomic forces that frustrate individual and community capacity to absorb and adapt to disaster shocks.[13] So understood, social vulnerability implies the absence of resilience.[14] In many respects, social vulnerability and resilience are two sides of the same coin. Like exposure vulnerability, social vulnerability can be mapped. Data tools like the Centers for Disease Control and Prevention's (CDC) Social Vulnerability Index (SVI) illustrate how these socioeconomic factors vary across space.[15]

Third, pandemics illuminate *individual health and physical conditions*—vulnerabilities that tend to receive less public attention during other disasters—that make people vulnerable to certain kinds of harm.[16] Although it is always the case during disasters that certain physical conditions predispose people to certain harms, these physical factors play an obvious and important role in determining COVID-19 vulnerability.[17] Research demonstrates that advanced age is the strongest predictor of COVID-19 mortality risk.[18] Additionally, the CDC has identified a number of medical conditions that increase the risk of severe COVID-19 illness or death, including cancer, chronic obstructive pulmonary

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[13] Some definitions of social vulnerability also include exposure vulnerability in the "social vulnerability" umbrella, rather than treating exposure as a separate dimension of vulnerability. Indeed, there is considerable inconsistency, variation, and even contradiction in the way the terms "social vulnerability" and "resilience" are used in the social sciences literature and about how to conceptualize the relationship between the two. *See* Susan L. Cutter et al., *A Place-Based Model for Understanding Community Resilience to Natural Disasters*, 18 GLOB. ENV'T CHANGE 598, 599–600 (2008) (describing various, conflicting scholarly conceptions of resilience, vulnerability, and the relationship between the two); *see also* Verchick, *supra* note 6, at 38 n.71, 39 nn.74, 76 (citing Cutter's research and noting the different ways that scholars define resilience and vulnerability).

[14] *See, e.g.*, Verchick, *supra* note 6, at 39 (describing social vulnerability as the capacity to absorb, respond, and adapt to shocks in the aftermath of disaster events).

[15] *See CDC's Social Vulnerability Index (SVI): SVI Interactive Map*, AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY, https://svi.cdc.gov/map.html [https://perma.cc/P4AD-J9GS] (Oct. 9, 2018) (displaying social vulnerability in the United States by county and census tract).

[16] Other disaster scholars sometimes speak of "physical vulnerability" in terms of the "geophysical characteristics" (including "geology, hydrology, [and] climate") that heighten place-based risks. Verchick, *supra* note 6, at 38. For the purposes of our typology, here, we consider that a form of exposure vulnerability.

[17] For example, evacuation may be more difficult for people who have limited mobility or need supplemental oxygen. During heat waves, individual health and physical vulnerability also play a central role in mortality risk: the people at highest risk of death are the very old or very young, as well as people with certain underlying health conditions like heart disease or Parkinson's disease. *See* NAT'L WEATHER SERV., WHO IS MOST VULNERABLE DURING A HEAT WAVE? 1, https://www.weather.gov/media/lsx/wcm/Heat/MostVulnerableHeatIndex.pdf [https://perma.cc/8P4J-4NA6].

[18] Ray Hill, *Yale Researchers Develop Model to Estimate COVID-19 Mortality Risk in Veterans*, YALE SCH. OF MED. (Dec. 2, 2020), https://medicine.yale.edu/news-article/28980/ [https://perma.cc/U29D-GYB8] ("[R]esearchers discovered that age is the strongest predictor of mortality, with risk climbing after age 55. Patients under the age of 50 with COVID-19 have only a 1 percent chance of dying. Those 85 and older have at least a 34 percent chance of dying if they get COVID-19.").

disease, pregnancy, heart disease, obesity, and type 2 diabetes.[19] Smoking likewise increases a person's risk.[20] Other conditions, such as asthma and liver disease, may increase the risk of poor COVID-19 outcomes.[21]

All of these forms of vulnerability overlap and mutually reinforce one another. For example, social vulnerability influences health and physical vulnerability in critical ways. Health is a product not just of genetics and lifestyle choices but also of a wide array of social determinants such as healthcare access, health insurance coverage, educational access, workplace conditions, community cohesion, poverty, food security, housing stability, neighborhood crime levels, and access to healthy food, air, and water.[22] Historical and current income inequality, structural racism, discrimination, and racial and class segregation mean that many of the medical conditions that increase COVID-19 risk are more common, and less well-treated, among lower-income and BIPOC individuals, and that there are definite geographic patterns to these disparities.[23]

Similarly, social vulnerability and exposure vulnerability to disasters often overlap, coincide, and compound: the most socially vulnerable are often the most exposed to disaster risk.[24] In many areas, poor and minority residents occupy the most marginal, disaster-prone land.[25] In New Orleans, for example, neighborhoods in the lowest-lying areas most subject to flooding are predominantly Black and lower-income.[26] The consequences of this intersection of vul-

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[19] *People with Certain Medical Conditions*, CDC, https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html [https://perma.cc/86H8-E6YH] (Dec. 14, 2021).

[20] *Id.*

[21] *Id.*

[22] *See About Social Determinants of Health (SDOH)*, CDC, https://www.cdc.gov/socialdeterminants/about.html [https://perma.cc/K3Q7-GB3J] (Mar. 10, 2021). Our forthcoming paper explores more fully the relationship between health inequity and structural racism. *See* Douglas M. Spencer, Lisa Grow, Brigham Daniels, Chantel Sloan & Natalie Blades, *Survival Voting and Minority Political Rights*, 71 AM. U. L. REV. (forthcoming 2022).

[23] *See id.*

[24] *See, e.g.*, Verchick, *supra* note 6, at 23 (noting that communities with the least social and economic capital bear "the heaviest burdens of disaster"); ERIC KLINENBERG, HEAT WAVE: A SOCIAL AUTOPSY OF DISASTER IN CHICAGO 20 (2d ed. 2015) (observing that "the geography of vulnerability during the [1995 Chicago] heat wave was hauntingly similar to the everyday ecology of inequality," with deaths "concentrated in the low-income, elderly, African-American, and violent regions of the metropolis").

[25] *See, e.g.*, Debra Lyn Bassett, *The Overlooked Significance of Place in Law and Policy: Lessons from Hurricane Katrina*, *in* RACE, PLACE, AND ENVIRONMENTAL JUSTICE AFTER HURRICANE KATRINA 49, 50 (Robert D. Bullard & Beverly Wright eds., 2009) ("The people who are more economically and socially vulnerable are the ones shunted into the places that are more geographically vulnerable—including those who are less educated, who are low income, who are elderly, or who are minorities.").

[26] *Id.*

nerability became tragically clear when these neighborhoods were inundated during Hurricane Katrina. Many who lacked the transportation and resources necessary to evacuate perished during the storm.

The socially vulnerable also experience higher rates of exposure to COVID-19. Socially vulnerable individuals are overrepresented among front-line essential workers who cannot socially distance, whose workplaces are more likely to lack adequate personal protective equipment (PPE), and who cannot afford to quit their jobs.[27] This dynamic plays out at the neighborhood level as well. Research using cell-phone mobility data from May 2020 demonstrated that residents of lower-income, Black neighborhoods were engaging in less social distancing than richer, white neighborhoods, presumably because their jobs and living conditions often did not allow for it.[28] The overlap between social vulnerability and heightened exposure to disaster risk is not surprising. Indeed, we would expect that those who are socially vulnerable would also lack the financial resources and political power to minimize their exposure to hazards of various kinds.

Because many of the same forces—structural racism, wealth inequality, ageism, and ableism—drive exposure, health, and social vulnerability, the same geographic areas tend to experience heightened levels of all three vulnerability indicators. This intersection of vulnerability raises particularly pressing questions of "disaster justice,"[29] just as the disproportionate exposure of the socially vulnerable to environmental risk raises issues of environmental justice.[30] The patterns of COVID-19 vulnerability, in particular, clearly raise questions of disaster justice because the same individuals and communities often suffer from the most exposure, the greatest health risk, and the highest levels of social vulnerability to COVID-19's effects.

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[27] *See* Kashyap, *supra* note 2, at 527–28.

[28] *See, e.g.*, Makada Henry-Nickie & John Hudak, *Social Distancing in Black and White Neighborhoods in Detroit: A Data-Driven Look at Vulnerable Communities*, BROOKINGS (May 19, 2020), https://www.brookings.edu/blog/fixgov/2020/05/19/social-distancing-in-black-and-white-neighborhoods-in-detroit-a-data-driven-look-at-vulnerable-communities/ [https://perma.cc/29GR-3TNH] (finding that, "as the pandemic wore on," "non-Black and high-income communities began practicing social distancing at a statistically significantly higher rate than their Black and low-income neighborhood peers" and that these "[s]ocial distancing gaps between neighborhoods widened, even as the number of infections soared").

[29] *See* Verchick, *supra* note 6, at 25.

[30] *See, e.g.*, Vicki Been, *What's Fairness Got to Do with It? Environmental Justice and the Siting of Locally Undesirable Land Uses*, 78 CORNELL L. REV. 1001, 1068–84 (1993) (discussing distributive justice in the context of locally undesirable land uses); Robert R. Kuehn, *A Taxonomy of Environmental Justice*, 30 ENV'T L. REP. 10,681, 10,683–702 (2000) (analyzing environmental justice through the lens of distributive justice, corrective justice, procedural justice, and social justice). Some scholars have conceptualized disaster justice—particularly questions of disaster vulnerability and "differential effects of disasters"—as a form or subset of environmental justice. TIERNEY, *supra* note 4, at 74, 74–75.

B. The Ethical and Practical Case for Focusing on Vulnerability

As the prior Section notes, the intersection of various forms of disaster vulnerability raises important questions of justice for both policy-makers and disaster scholars.[31] Although a full exploration of the moral and ethical case for prioritizing the welfare of vulnerable groups and individuals is beyond the scope of this Article, this Section makes a brief case for doing so, both during and after disasters.[32]

Many theories of justice converge around the idea that "justice increases when the benefits and burdens of social cooperation are born more equally, except when moral considerations or other values justify greater inequality."[33] This common ground, or "overlapping consensus,"[34] suggests that justice is disserved when disaster impacts are disproportionately borne by certain groups, particularly those that are already disadvantaged.[35]

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[31] *See* Verchick, *supra* note 6, at 24 (noting that social vulnerability commands significant attention in the field of disaster research in the United States); *see also* Daniel Farber, *Symposium Introduction: Navigating the Intersection of Environmental Law and Disaster Law*, 2011 BYU L. REV. 1783, 1785 (noting disaster law's emphasis on "issues of unequal risk exposure").

[32] The brief case this Article makes here for ensuring that disaster impacts are not disproportionately borne by already disadvantaged groups parallels the case that some of the Article's authors have previously made for environmental justice. *See* Brigham Daniels, Michalyn Steele & Lisa Grow Sun, *Just Environmentalism*, 37 YALE L. & POL'Y REV. 1, 43–45 (2018).

[33] Peter Wenz, *Does Environmentalism Promote Injustice for the Poor?*, *in* ENVIRONMENTAL JUSTICE AND ENVIRONMENTALISM: THE SOCIAL JUSTICE CHALLENGE TO THE ENVIRONMENTAL MOVEMENT 57, 58 (Ronald Sandler & Phaedra C. Pezzullo eds., 2007); *see also* Jouni Paavola, *Justice in Adaptation to Climate Change in Tanzania*, *in* FAIRNESS IN ADAPTATION TO CLIMATE CHANGE 201, 204–05 (W. Neil Adger, Jouni Paavola, Saleemul Huq & M.J. Mace eds., 2006) (arguing that "equality is the best starting point" for considering justice, but that "[n]eed and capability"—both implicated by vulnerability—are persuasive reasons for favoring vulnerable groups in climate change adaptation policy).

[34] *See* John Rawls, *The Domain of the Political and Overlapping Consensus*, 64 N.Y.U. L. REV. 233, 233 n.1 (1989) (explaining that "overlapping consensus exists in a society when the political conception of justice that regulates its basic institutions is endorsed by each of the main religious, philosophical, and moral doctrines likely to endure" for generations).

[35] *See, e.g.*, Kirstin Dow, Roger E. Kasperson & Maria Bohn, *Exploring the Social Justice Implications of Adaptation and Vulnerability*, *in* FAIRNESS IN ADAPTATION TO CLIMATE CHANGE, *supra* note 33, at 79, 81 ("[A] society is just only if it is arranged in such a way that the position of the least advantaged is optimized."). Many different approaches to justice support this conclusion. *See id.* at 80 ("Despite the differences and disagreements among different conceptions of justice, many can be used to generate reasons why the most vulnerable to climate change ought to be given special attention."). For example, Professor Robert Verchick makes the case for prioritizing the vulnerable by building on Amartya Sen's capability approach. *See* Verchick, *supra* note 6, at 57–58 (advocating for "equality of *capability*—the real-world means to lead a life that you have a reason to value, free of extreme deprivations"). Other scholars have arrived at an ethical imperative to prioritize vulnerable populations through relational ethical approaches. *See, e.g.*, David Ian Jeffrey, *Relational Ethical Approaches to the COVID-19 Pandemic*, 46 J. MED. ETHICS 495, 495 (2020).

One might question whether disaster impacts are, in fact, "burdens of social cooperation" that must be distributed equitably.[36] To take up an example discussed in the next Section, one might argue that policy-makers have no obligation to consider vulnerability when designing disaster-time voting rules. Arguably, the barriers posed to vulnerable people voting during a disaster are caused by the disaster itself—whether it be a virus, hurricane, earthquake, or some other natural event—not by any forces within human control.[37] Consequently, policy-makers powerless to prevent these natural hazards might reasonably be absolved from responsibility for addressing these barriers, even though they disproportionately affect the vulnerable.

The rejoinder from this Article, and many other disaster scholars, would reference one of the field's fundamental maxims: no disaster is truly natural.[38] From failure to address climate change that is accelerating the emergence of new zoonotic diseases to a lack of pandemic preparedness and dysfunctional government responses to the crisis, the COVID-19 pandemic—particularly in the United States—confirms the validity of this basic maxim.[39] Governments play an important role in creating disaster impacts and thus bear some obligation to address them, at least from an ethical perspective. For example, governments have a responsibility to tackle disaster-related barriers to voting, particularly for the already-vulnerable who typically experience the greatest disaster impacts and, consequently, the highest voting costs. The objection to governments taking responsibility to accommodate vulnerable voters ignores the role of government and public policy in making certain hazard events more likely, neglecting to mitigate disaster risks, and failing to respond effectively to disasters when they occur.[40]

Much the same can be said of the voting barriers created by underlying, preexisting vulnerability. Indeed, the examples in the prior Section and the lessons of past disasters make clear that "disaster-specific" vulnerability is difficult to disentangle from preexisting, day-to-day vulnerability. Much of this

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[36] *See* Wenz, *supra* note 33, at 58.

[37] Although responsibility (or causal link) is not the only touchstone for evaluating moral and ethical duties, commonly held notions about moral and ethical obligations to mitigate harm to others are often grounded in a sense of collective responsibility for that harm.

[38] *See* FARBER ET AL., *supra* note 3, at 228 ("Disasters are never strictly 'natural' . . . .").

[39] *See* Jitendra Mishra, Priya Mishra & Naveen Kumar Arora, Review, *Linkages Between Environmental Issues and Zoonotic Diseases: With Reference to COVID-19 Pandemic*, 4 ENV'T SUSTAINABILITY 455, 458 (2021) ("Climatic and environmental changes have accelerated the rate of emergence of zoonotic diseases across the globe . . . ."); *Zoonotic Diseases*, CDC, https://www.cdc.gov/onehealth/basics/zoonotic-diseases.html [https://perma.cc/P4JF-T7BF] (July 1, 2021) (defining zoonotic diseases as diseases "caused by germs that spread between animals and people").

[40] *See, e.g.*, Verchick, *supra* note 6, at 54 ("It is not the origin of the injury, but the possibility of preventing and reducing costs, that allows us to judge whether there was or was not unjustified passivity in the face of disaster." (quoting JUDITH N. SHKLAR, THE FACES OF INJUSTICE 81 (1990))).

vulnerability is driven by broader societal forces—such as structural racism, limited access to health care, ageism, ableism, and growing wealth inequality—that are magnified by and embedded in government policies.[41]

In short, disasters and vulnerability are, in substantial part, socially constructed, and we bear collective responsibility for both. Justice thus requires that we act to alleviate the disproportionate burden of disaster impacts on the vulnerable. Moreover, procedural justice also requires that we endeavor to give vulnerable individuals and communities greater voice in disaster policy.[42]

Justice also requires affirmative efforts to prioritize vulnerable people in all aspects of disaster law and policy—and in all stages of disaster management—because the failure to do so inexorably widens the gap between the disadvantaged and the advantaged.[43] The history of disaster policy in the United States and internationally, as well as the more recent COVID-19 response, make clear that "neutral" disaster policies—designed and implemented without particular attention to vulnerability—almost always exacerbate rather than alleviate existing societal inequities.

Research confirms that across every phase of the disaster management cycle—from preparedness and mitigation to response, compensation, and recovery—our current system of government disaster aid disproportionately benefits wealthier, whiter communities and individuals. This vicious cycle deepens existing disparities rather than mitigating racial and class inequality and inequity. A jarring 2018 study found that the higher the disaster costs in a particular county, "the more wealth white residents tend to accumulate, all else equal," whereas Black residents, "on the other hand, tend to lose wealth as local hazard damages increase."[44] This disparity resulted not just from the disaster itself, but from the government response. The researchers found that "the more Federal Emergency Management Agency money a county receives, the more whites' wealth tends to grow and the more blacks' wealth tends to decline, all else equal."[45] They concluded that federal aid was deepening eco-

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[41] Cutter, *supra* note 3 (enumerating the various, less quantifiable social vulnerabilities, such as "the basic provision of health care, the livability of places, overall indicators of quality of life, and accessibility to lifelines (goods, services, emergency response personnel), capital, and political representation").

[42] *See* Daniels et al., *supra* note 32 (discussing procedural justice in the context of environmental justice).

[43] Disaster law, which "encompasses a wide-ranging, interdisciplinary body of research that seeks to inform and improve disaster-related decision-making," often focuses on the role of law in the disaster or "circle of risk management": mitigation, preparedness, compensation, emergency response, and recovery/rebuilding. Farber, *supra* note 31, at 1787, 1788 (citing FARBER ET AL., *supra* note 3, at 3).

[44] Junia Howell & James R. Elliott, *As Disaster Costs Rise, So Does Inequality*, SOCIUS, Jan.–Dec. 2018, at 1, 1.

[45] *Id.*

nomic inequalities in the wake of natural disasters.[46] A recent National Public Radio investigation summed it up even more bluntly: "[A]fter a disaster, rich people get richer and poor people get poorer. And federal disaster spending appears to exacerbate that wealth inequality."[47] This entrenchment of inequity happens at both the individual and community level.[48]

There are several reasons why our current system of disaster aid entrenches inequity. Richer, whiter people and communities tend to receive more federal aid because Congress often allocates such funding "according to cost-benefit calculations meant to minimize taxpayer risk."[49] Much of federal disaster recovery aid takes the form of income tax deductions, available only to higher-income taxpayers, and loans that are available only to those with preexisting banking relationships, good credit scores, and established borrowing history.[50]

Additionally, because wealthier people can demonstrate higher value disaster losses, they typically receive more federal aid, despite greater access to other funds. Individual disaster assistance, distributed by the Federal Emergency Management Agency (FEMA) under the Stafford Act, favors wealthier disaster survivors.[51] FEMA typically provides more assistance to homeowners than renters, to homeowners in upscale neighborhoods than to those in more depressed areas, and to auto-owners with damaged cars than those who ride public transportation. All of these disparities in aid worsen existing wealth gaps.[52] Even when poorer individuals are eligible for the same aid as other survivors, they face more obstacles to accessing that aid, such as lack of time and help to navigate the often labyrinthine application process.[53]

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[46] *Id.*

[47] Rebecca Hersher & Robert Benincasa, *How Federal Disaster Money Favors the Rich*, NPR (Mar. 5, 2019), https://www.npr.org/2019/03/05/688786177 [https://perma.cc/4DRQ-Y7XQ].

[48] TIERNEY, *supra* note 4, at 139 (describing disparate post-disaster aid to individuals and communities, noting that "a hard-hit majority-white community" obtained more aid after a disaster than "a similarly hard-hit majority-African American community").

[49] Hersher & Benincasa, *supra* note 47.

[50] *See* TIERNEY, *supra* note 4, at 138, 138–39 (noting that "the main source of [federal government disaster recovery] assistance" for households and businesses is loans granted based on "good credit history and income" for repayment).

[51] *See* Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. §§ 5170–5174.

[52] *See, e.g.*, TIERNEY, *supra* note 4, at 141 (noting, for example, that, following Hurricane Katrina, "African-American applicants for Road Home grants received smaller compensation awards . . . because they were residents in historically segregated neighborhoods with depressed property values" (quoting Kevin Fox Gotham, *Racialization and Rescaling: Post-Katrina Rebuilding and the Louisiana Road Home Program*, 38 INT'L J. URB. & REG'L RSCH. 773, 783 (2014))). These inequities are also reflected in private insurance payouts for post-disaster costs. *See* Bassett, *supra* note 25, at 57 ("[S]tudies conducted after 1992's Hurricane Andrew in Florida indicated that minorities were receiving inadequate insurance settlements at a rate more than twice that of whites.").

[53] Although the disparity-deepening effect of disaster law and policy is well-studied in the disaster-response context, it also manifests in disaster mitigation efforts that precede and follow disaster

Our experience thus far with the COVID-19 response bears out these patterns. Various forms of government COVID-19 aid have been less accessible to vulnerable individuals and communities. For example, people in low-income, minority neighborhoods have had less access to COVID-19 testing,[54] in part because locating testing facilities at existing medical facilities exacerbates preexisting inequities in health care access.[55] Early vaccination data from some areas suggests that wealthier zip codes have higher vaccination rates than lower-income zip codes,[56] while vaccination rates for Black people are lagging.[57]

Black and other minority business owners have also struggled to access direct COVID-19 financial aid. One study found that "[c]ompared to all other racial or ethnic groups, Black business owners and entrepreneurs were about 30 times less likely to have received government aid for people or businesses

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events. The gap is partly explained by reliance on facially neutral criteria like cost-benefit analyses to determine which hazard mitigation grants to fund. *See Benefit-Cost Analysis*, FEMA, https://www.fema.gov/grants/guidance-tools/benefit-cost-analysis [https://perma.cc/4X3K-8PY8] (Jan. 10, 2022). Poor communities also have difficulty accessing hazard mitigation funds. Research shows that federal money for voluntary buyouts of flood-prone property has disproportionately gone to wealthier, whiter communities, perhaps in part because wealthier counties are more likely to have the administrative infrastructure to apply for and administer complicated buyout grants. Rebecca Hersher, *Sweeping Study Raises Questions About Who Benefits from Buyouts of Flood-Prone Homes*, NPR (Oct. 9, 2019), https://www.npr.org/2019/10/09/767920427 [https://perma.cc/L32F-NUHC]. Additionally, federal hazard mitigation grants—aimed primarily at funding measures that reduce the future disaster risk of public entities like cities and school districts—are contingent on local cost-sharing, meaning that communities cannot even compete for these grants if they lack the resources to fund the mandatory local cost-share. *See Cost Sharing*, FEMA, https://www.fema.gov/hmgp-appeal-categories/cost-sharing [https://perma.cc/C4QD-VADJ].

[54] Soo Rin Kim, Matthew Vann, Laura Bronner & Grace Manthey, *Which Cities Have the Biggest Racial Gaps in COVID-19 Testing Access?*, FIVETHIRTYEIGHT (July 22, 2020), https://fivethirtyeight.com/features/white-neighborhoods-have-more-access-to-covid-19-testing-sites/ [https://perma.cc/Y9E4-MHCM] (finding, based on an "extensive review of testing sites," that "sites in communities of color in many major cities face higher demand than sites in whiter or wealthier areas in those same cities," which means that "Black and Hispanic people are more likely to experience longer wait times and understaffed testing centers").

[55] *See id.* ("Experts say that the disparity [in testing access in San Antonio] can be attributed to a long-standing gap in the health care system and an unequal distribution of health care facilities in the San Antonio area, which is one of the most economically segregated cities in the country.").

[56] *See, e.g.*, Douglas Hanks & Ben Conarck, *Miami-Dade's Wealthiest ZIP Codes Are Also the Most Vaccinated for COVID-19, Data Shows*, MIA. HERALD (Jan. 22, 2021), https://www.miamiherald.com/news/coronavirus/article248697820.html [https://perma.cc/D4HE-6ZKL] ("New state data on vaccinations by ZIP codes map out a familiar pattern for the coronavirus pandemic. Just as low-income neighborhoods tended to get hit harder by COVID-19 spread, wealthier neighborhoods are getting their shots at a faster rate.").

[57] *See id.* (noting that demographic data on vaccinations demonstrates "that just 6% of the 138,000 people who received a COVID vaccine in Miami-Dade are Black in a county with a 17% Black population"). For updated data, see *COVID Data Tracker*, CDC, https://covid.cdc.gov/covid-data-tracker/#vaccination-demographic [https://perma.cc/5R2N-842P] (Feb. 9, 2022).

affected by the pandemic."[58] Although the study did not investigate the causes of the disparity, the authors suggested that structural barriers—including discrimination in lending, lack of information about the stimulus programs, and absence of preexisting connections with mainstream financial institutions—likely made it more difficult for Black business owners to access aid.[59]

In the case of the pandemic, there is a strong practical argument to be made for prioritizing the needs of the vulnerable, aside from the obvious ethical justifications. The virus knows no borders. What happens in vulnerable neighborhoods (and vulnerable countries)[60] ultimately affects everyone. Even if advantaged people, communities, and countries are able to hoard pandemic resources, particularly vaccine doses, failing to address the spread of the pandemic among the vulnerable strains medical resources, such as hospitals beds, ICU beds, and ventilators, on which everyone relies. More pressing still, the uncontrolled spread of the virus through vulnerable areas stimulates its mutation, generating new variants that evade natural immunity from prior infections and immunity from vaccines.[61] There is even some early evidence that COVID-19 infections among the immunocompromised might accelerate virus mutation as the infection persists in the body over long periods of time.[62] Therefore, the rampant, expedited spread of COVID-19 spells potentially catastrophic results for the vulnerable and less vulnerable alike. At least in the case of such serious pandemics, prioritizing the needs of the most vulnerable people keeps essential services, like food supply chains, operating. Ultimately, protecting the most vulnerable among us protects everyone.

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[58] Felix Kabo, Stewart Thornhill & Elizabeth Isele, *Race and Government Aid*, JACKSON HOLE ECON. (Dec. 28, 2020), https://jheconomics.com/race-and-government-aid/ [https://perma.cc/DYN7-NFZC]; *see also Black Business Owners, Entrepreneurs Left Out of Small Business Coronavirus Support*, UNIV. OF MICH. (Jan. 6, 2021), https://news.umich.edu/black-business-owners-entrepreneurs-left-out-of-small-business-coronavirus-support/ [https://perma.cc/723N-6TCU] (reporting that "[i]n May 2020, less than one half of 1% of Black business owners reported receiving government benefits for businesses affected by the coronavirus epidemic compared to about 9% of non-Black business owners").

[59] *See* Kabo et al., *supra* note 58.

[60] Although our vulnerability index is a national one and our focus is therefore on U.S. domestic policy, the international COVID-19 response raises many of the same issues.

[61] *See, e.g.*, Nurith Aizenman, *'Everything Broke': Global Health Leaders on What Went Wrong in the Pandemic*, NPR (Jan. 25, 2021), https://www.npr.org/sections/goatsandsoda/2021/01/25/959692787 [https://perma.cc/63FW-VV5X] (discussing the moral failure of vaccine distributions to wealthier nations and emphasizing that "as long as the coronavirus is raging unchecked somewhere" new variants could emerge).

[62] *See* Bina Choi et al., Correspondence, *Persistence and Evolution of SARS-CoV-2 in an Immunocompromised Host*, 383 NEW ENG. J. MED. 2291, 2291 (2020).

II. GEOGRAPHIC VULNERABILITY AND OUR COVID-19 VULNERABILITY INDEX

Vulnerability data is critical to developing just and effective disaster policies. Frequently, some of the most helpful indicators are spatial data that show the geographic distribution of vulnerable people. Data about individuals' and communities' pre-disaster vulnerability can help policy-makers predict where disaster impacts will hit the hardest and develop proactive strategies to minimize those harms. Gathering data about vulnerable populations during and after disasters allows policy-makers to assess whether strategies tailored to help vulnerable communities and more general disaster response measures were effective. If not, policy-makers then possess the tools to course correct and adopt new strategies to prevent disaster aid from exacerbating preexisting disparities. Geographic vulnerability data exposes suffering that is otherwise invisible to many observers and policy-makers. Indeed, the history of disasters suggests that the suffering and deaths of vulnerable people are often discounted or undercounted,[63] particularly "quiet" deaths from heat waves or disease.[64]

Spatial data about vulnerability is particularly critical in all kinds of disasters. When planning evacuation routes in advance of hurricanes, for instance, spatial vulnerability data helps identify where public buses will be needed to facilitate evacuation for residents who lack private transportation. In the context of COVID-19, spatial vulnerability data can inform decisions such as siting of testing and vaccination facilities, determining vaccination priorities, ascertaining when and where to implement public health measures, assessing the stakes of school reopenings, and structuring aid packages.

Although disaster scholars often advocate for data tools that facilitate a richer understanding of disaster vulnerability, the COVID-19 pandemic offers a rare test case for close, real-time examination of disaster vulnerability. Detailed

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[63] Though the official death count of the Great London Fire of 1666 was only six, some historians believe that thousands or even tens of thousands of poor Londoners may have perished. *See* NEIL HANSON, THE DREADFUL JUDGMENT: THE TRUE STORY OF THE GREAT FIRE OF LONDON 1666, at 326–33 (2001). Almost a century after the 1906 San Francisco earthquake, the city revised the death toll from less than 500 to closer to 3,500, most of whom were likely poor immigrants, including many residents of San Francisco's Chinatown. Bobby Caina Calvan, *San Francisco Revises Death Toll for 1906 Earthquake*, BOS. GLOBE (Feb. 27, 2005), http://archive.boston.com/news/nation/articles/2005/02/27/san_francisco_revises_death_toll_for_1906_earthquake/ [https://perma.cc/HM3D-N3D9].

[64] *See, e.g.*, KLINENBERG, *supra* note 24, at 29–31 (explaining that heat wave-related deaths of older adults or those with chronic health conditions often go uncounted in final toll numbers because of the incorrect assumption "that the people who perished in the heat wave were already about to die"); The COVID Tracking Project, *The Pandemic's Deadly Winter Surge Is Rapidly Easing*, THE ATLANTIC (Feb. 11, 2021), https://www.theatlantic.com/health/archive/2021/02/the-pandemics-deadly-winter-surge-is-rapidly-easing/618005/ [https://perma.cc/UN5W-86DF] (alleging that New York misattributed the number of COVID-19 deaths of nursing home residents during a state audit, estimating that the audit failed to capture 5,620 of these deaths).

information about COVID-19 infections, hospitalizations, and fatalities—almost all of it updated daily and much of it tracked by geography, race, age, health risk, and other important demographic characteristics—has made contemporaneous modeling of vulnerability a real possibility. Moreover, whereas most disasters, such as earthquakes, wildfires, and hurricanes, are sudden and short-lived, the official COVID-19 pandemic, as declared by the World Health Organization on March 11, 2020, has already stretched on for more than two years (and the outbreak was first reported much earlier, in December 2019). The protracted nature of the pandemic, accompanied by carefully tracked and publicly reported data, makes COVID-19 a unique opportunity to build and refine data tools that will help disaster scholars visualize and understand disaster vulnerability.

This Part moves beyond the broader conversation about disaster vulnerability to focus on the spatial dimensions and geographic patterns of vulnerability. In particular, we introduce a vulnerability index to better understand the spatial dimensions of COVID-19 vulnerability.[65] We then provide two examples of how decision-makers could have used such an index to improve COVID-19 disaster management. This Part focuses first on voter accommodations for the 2020 general election[66] and then on mask mandates.[67] We conclude this Part by discussing some of the issues and limitations we confronted in creating the COVID-19 vulnerability index[68] and reflecting on the broader lessons of our experience for disaster management.[69] Specifically, we consider how the innovative approach to disaster vulnerability modeling in this Article could be deployed in other disasters to better anticipate needs and prioritize resources.

A. Constructing Our COVID-19 Vulnerability Index

Our team of public health, statistics, and legal experts set out to create a tool that decision-makers could use to better protect vulnerable communities. We created a county-level COVID-19 vulnerability index to facilitate COVID-19 resource allocation decisions and to evaluate how well past decision-making has accounted for vulnerability. In developing this empirical vulnerability index for COVID-19, we built on the work of public health and disaster scholars who have developed indices to quantify and represent vulnerability to other public health and disaster risks.[70]

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[65] *See infra* Section II.A.

[66] *See infra* Section II.B.

[67] *See infra* Section II.C.

[68] *See infra* Section II.D.

[69] *See infra* Section II.E.

[70] *See, e.g.*, Cutter et al., *supra* note 13, at 602–04 (developing an index of social vulnerability to environmental hazards).

Our index moves beyond prior work in several important ways. The most common pandemic risk indices are case-count indices, like those produced by Johns Hopkins University and the New York Times.[71] These indices help us understand the degree to which COVID-19 is spreading, but because they ignore vulnerability, they tell us much less about the underlying risks than is commonly assumed. A simple example illustrates this point: we would expect much worse outcomes for the same number of COVID-19 cases among residents of an assisted living facility than among high school students. Our index, in contrast, attempts to help communities understand how vulnerable they are to COVID-19 in the first place.

Our approach likewise pushes beyond previous vulnerability indices. The most prominent vulnerability index used by policy-makers is a social vulnerability index created by the CDC.[72] The basic design of the CDC index gives equal weight to several factors that drive vulnerability to disease. Like the CDC index, our index draws on rich datasets about general vulnerability to disease, but it also incorporates specific factors known to influence vulnerability to COVID-19.

Additionally, our model includes an important innovation that prior indices, like the CDC's, do not. Rather than giving equal weight to various risk factors, our index uses case fatality data to model how each factor is contributing to COVID-19 mortality and then weighs each factor accordingly. This modeling innovation allows our vulnerability index to capture vulnerability more accurately and to continuously integrate new data as the pandemic evolves. Furthermore, it performs this modeling at the county (not just the national) level. Evaluating vulnerability at the county level produces a more targeted, accurate picture of which specific factors drive case fatalities in different communities across the United States. Thus, communities can compare their risks to other counties and understand what drives their specific risk profile. This knowledge arms communities with the necessary tools to create tailored strategies that will help their specific vulnerable populations and triage resources most efficiently.

To construct our vulnerability index, our team drew on a reservoir of publicly available data and employed statistical analysis and spatial analysis using a geographic information system (GIS) to help us understand geographic vul-

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[71] *Coronavirus in the U.S.: Latest Map and Case Count*, N.Y. TIMES, https://www.nytimes.com/interactive/2021/us/covid-cases.html [https://perma.cc/734K-2HTA] (Feb. 10, 2022); Ctr. for Sys. Sci. & Eng'g, *COVID-19 Dashboard*, JOHNS HOPKINS UNIV. & MED. CORONAVIRUS RES. CTR., https://coronavirus.jhu.edu/map.html [https://perma.cc/B5EF-MD34] (Feb. 10, 2022).

[72] *See CDC's Social Vulnerability Index (SVI): SVI Interactive Map*, *supra* note 15.

nerability to COVID-19 across the United States.[73] We relied on four types of county-level data from a wide range of publicly-available data sets to build our index. The first type related to the health of Americans: county-level rates of smoking;[74] obesity;[75] diabetes;[76] and deaths due to heart disease, which we include as a proxy measure for hypertension.[77] Second, we incorporated socio-economic risk factors: the percent living below the poverty line;[78] the uninsured;[79] and those employed as essential workers, including in healthcare support, food service and preparation, and other occupations where social presence is necessary.[80] Third, we used data about the racial composition of countries.[81] And fourth, because age plays a key role in determining vulnerability to COVID-19, we used census data on age, specifically the percent of a county that is sixty-five or older.[82]

We then weighed each risk factor and aggregated them into a single "vulnerability index" to identify which counties are particularly vulnerable to a deadly COVID-19 outbreak given their underlying populations. To determine the appropriate weight for each factor, we used a multivariate regression to match up COVID-19 case counts and case-fatality rates across the country with the data on the various risk factors included in the index. Case counts and deaths between May 1, 2020 and November 3, 2020 were aggregated for each county.[83] We used a zero-inflated negative binomial regression of COVID-19

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[73] GIS is an analytic tool that connects data to maps. By doing this, GIS enables place-based analysis that frequently reveals geographic patterns and relationships.

[74] DIV. OF POPULATION HEALTH, CDC, BRFSS SURVEY DATA (2016), https://www.cdc.gov/brfss/annual_data/2016/files/LLCP2016ASC.zip.

[75] *See id*. To access the obesity data, select "all counties" and then from the "indicators" pull down menu, select "risk factors for diabetes" and then "obesity."

[76] *Diagnosed Diabetes*, CDC, https://gis.cdc.gov/grasp/diabetes/diabetesatlas.html [https://perma.cc/W3GW-4J5K].

[77] *Interactive Atlas of Heart Disease and Stroke*, CDC, https://nccd.cdc.gov/DHDSPAtlas/?state=County [https://perma.cc/FJ7W-GZ6U].

[78] *2014–2018 ACS 5-Year Estimates*, U.S. CENSUS BUREAU, https://www.census.gov/programs-surveys/acs/technical-documentation/table-and-geography-changes/2018/5-year.html [https://perma.cc/T4A3-6SL7] (Dec. 8, 2021).

[79] U.S. CENSUS BUREAU, MODEL-BASED SAHIE ESTIMATES FOR COUNTIES AND STATES: 2018 (2019), https://www2.census.gov/programs-surveys/sahie/datasets/time-series/estimates-acs/sahie-2018-csv.zip.

[80] *See 2014–2018 ACS 5-Year Estimates*, *supra* note 78. Manufacturing and transportation are among the other sectors where social presence is deemed necessary. *Id.*

[81] *Id.*

[82] POPULATION DIV., U.S. CENSUS BUREAU, ANNUAL COUNTY RESIDENT POPULATION ESTIMATES BY AGE, SEX, RACE, AND HISPANIC ORIGIN, APRIL 1, 2010 TO JULY 1, 2019 (2019), https://www2.census.gov/programs-surveys/popest/datasets/2010-2019/counties/asrh/cc-est2019-alldata.csv.

[83] *Coronavirus (Covid-19) Data in the United States*, N.Y. TIMES (2021), https://raw.githubusercontent.com/nytimes/covid-19-data/master/us-counties.csv. We initially built the index in the summer of 2020, several months after the coronavirus had been declared a global pandemic and used this early history as a guide for assigning weights to our risk factor variables. We later expanded the data time

deaths with all the risk-factor subcategorization variables plus population density as explanatory variables and case counts as offset. From this, we obtained the posterior predictive distribution[84] for each county's mortality rate from COVID-19. The COVID-19 vulnerability index was then obtained by dividing the counties into risk-deciles based on the posterior predicted mortality rates.

Figure 1 provides a data visualization of the results created by our county-level COVID-19 vulnerability index for the United States. The model provides variables for all 3,142 U.S. counties and, among those, highlights the 308 counties in the highest decile of the vulnerability index. Counties with high vulnerability have, on average, more residents of minority race (53% versus 23.5%), more residents who are uninsured (15.6% versus 10%), higher death rates due to heart disease (48.9 per 1000 versus 34.3 per 1000), and greater population densities (694 people per square mile versus 267.54).[85]

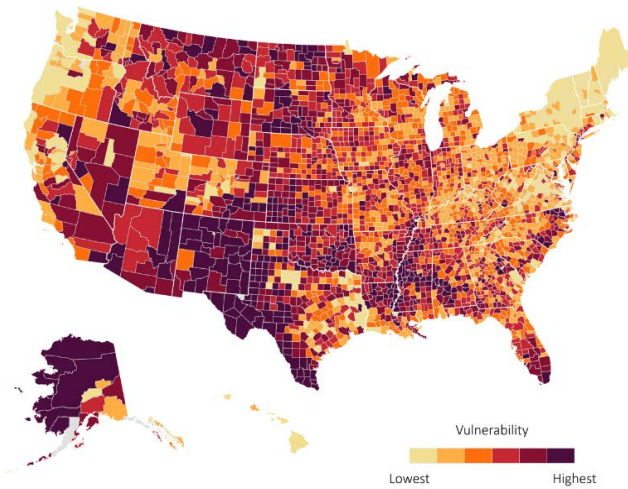

Figure 1. County-level Output of the COVID-19 Vulnerability Index.

Our index provides a useful contrast to the way COVID-19 risk is often quantified and portrayed: raw case counts. The case-count mapping highlights

frame through November 2020. Different iterations of the model using case fatality rates for other time periods yielded substantially similar results, increasing our confidence in our factor weights.

[84] The posterior predictive distribution is a distribution of future observations (here, CFR or mortality rate) that could arise given the model. This takes into account uncertainty in both the parameters and the sampling variability in the observed data. The posterior predictive distribution facilitates inference beyond that which can be made directly from the estimated model parameters. Specifically, it is used here to determine how often a county will fall in the top-decile with respect to either CFR or mortality rate. For a general discussion of inference from posterior predictive distributions see, for example, ANDREW GELMAN, JOHN B. CARLIN, HAL S. STERN, DAVID B. DUNSON, AKI VEHTARI & DONALD B. RUBIN, BAYESIAN DATA ANALYSIS 7 (2014).

[85] For summarized results, see Appendix Table 1.

the prevalence of the current outbreak in different areas, which is a high-level way to think about current exposure vulnerability of a particular area. In contrast, the vulnerability index illustrates latent vulnerability of areas if they were to face a serious outbreak of COVID-19.

Our vulnerability index offers several advantages over other approaches to pandemic response planning. First, systematic analysis of patterns in geographic vulnerability allows policy-makers to be proactive, rather than merely reactive, by anticipating community needs and directing resources (physical and regulatory) to the areas most likely to need them. These proactive steps not only allow policy-makers to respond more quickly to disease spikes in areas where they are likely to be particularly deadly, but also to decrease the risk of such spikes by requiring mitigation measures (such as voter accommodations and masks) and increasing access to testing, contact tracing, and vaccination resources that can help limit COVID-19 surges.

Additionally, although case counts vary substantially over time as COVID-19 hotspots migrate, latent vulnerability is unlikely to change significantly over the course of the pandemic. Thus, the vulnerability index provides valuable information for long-term planning, whereas current case count data may be a very poor predictor of risk over even short time horizons.

To illustrate how knowledge of geographic vulnerability can assist decision-makers, we present two applications of our vulnerability index, the first focusing on 2020 voter accommodations designed to minimize COVID-19 risks and the second focused on mask mandates. These are just two of many ways that our COVID-19 vulnerability index could be deployed to improve pandemic decision-making—and to assess policy choices after-the-fact.

B. Applying Our Vulnerability Risk Index to Voter Accommodations

As the pandemic spread to the United States, the country was in the middle of a presidential primary season. States made a wide range of decisions during the primary season about whether to provide accommodations to keep voters safe from COVID-19. As the primary season ended, it became apparent that voters in the November presidential election would still face risks due to COVID-19.

Just as not every voter would face the same risk from the pandemic, neither would each polling location. To evaluate how voting risk varied across jurisdictions, we overlaid our vulnerability data with voting rules for counties in the top decile of COVID-19 vulnerability. We divided county-voting rules into three categories: the most accommodating (counties with universal mail-in voting and counties that allowed mail-in voting for every voter and mailed ballot applications to every voter); the middle group (counties where mail-in-ballots were available to any voter who requested one but that failed to send

applications to every voter); and the least accommodating (counties where mail-in balloting was unavailable to most voters because fear of contracting COVID-19 was not a valid excuse).

When we compared our county COVID-19 vulnerability index to state voting rules, we found that many of the most vulnerable people in the most vulnerable communities would have to choose between risking their health to vote in-person or not voting at all.

The map below in Figure 2 shows voting rules in counties that ranked in the top ten percent of vulnerable counties based on our data. Green counties have the safest rules, pink the next safest, and orange the least safe.

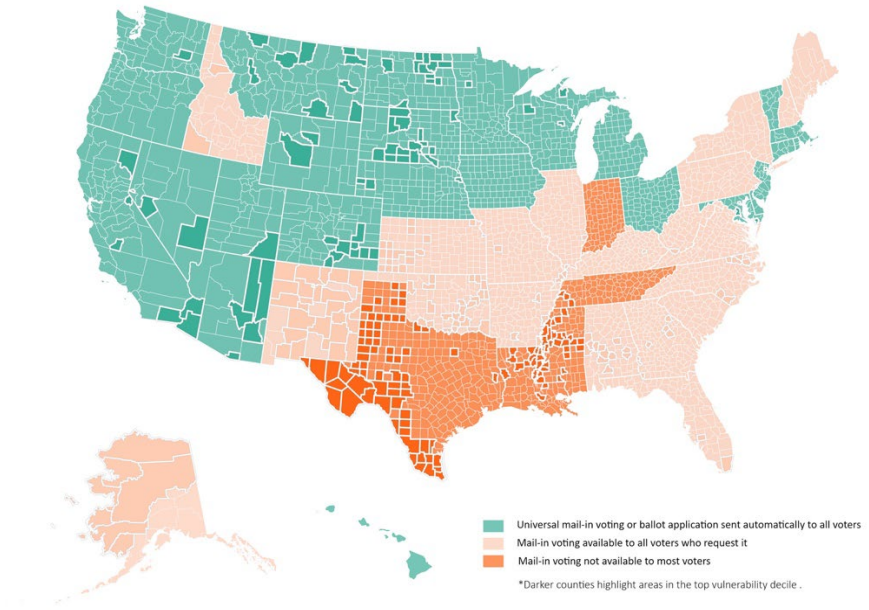

Figure 2. Mail-in Ballot Access for the 2020 General Election Among Those Counties Most Vulnerable to the Risks Posed by COVID-19.

Combining the COVID-19 vulnerability index with the voting rules demonstrates that the overwhelming majority of the most at-risk counties are in states where in-person voting is the default (or only) option for most voters.[86] Forty percent of the highest-risk counties are in states where voting rules allow any voter to request an absentee ballot, either for no reason or based on COVID-19 fears, but where vulnerable voters also had to take the initiative

[86] For summarized results, see Appendix Table 2.

and navigate complex systems to request and submit absentee ballots. Disaster experience has shown time and again that when vulnerable people are required to clear hurdles to access relief, many are simply unable to do so.

Even more concerning, however, was that 113 (or thirty-seven percent) of our most vulnerable counties were in the handful of states that did very little to expand access to mail-in ballots. Nearly five and a half million people in particularly vulnerable counties in Texas, Louisiana, Mississippi, and Tennessee were forced either to risk their health to vote in-person or relinquish their right to vote.

Only twenty-four percent of the most at-risk counties were in the twenty-five states that took major steps to ensure all voters could vote safely, either by adopting (or utilizing existing) universal mail-in-voting or by mailing every voter an absentee-ballot application.

Earlier attention to these patterns of vulnerability might have persuaded some particularly vulnerable jurisdictions to make additional accommodations for vulnerable voters before the November 2020 election. Even once it was too late to make major changes to voting laws, policy-makers and public health officials could still have used this type of data to mitigate in-person voting risk by focusing additional resources on the most vulnerable areas. For example, election officials could have triaged additional poll workers, personal protection equipment, and plexiglass to polling places in the most vulnerable areas. Polling places could have expanded their physical space—by, for example, using individual offices in addition to multi-purpose rooms in public buildings—and worked to improve compliance with CDC guidance about ventilation, line management, and disinfection. Jurisdictions with high levels of vulnerability could also have mandated that poll workers wear masks and provided masks for voters themselves.[87]

C. Applying Our Vulnerability Index to Mask Mandates

Our vulnerability index could also potentially be used to help states decide where and when to mandate public health measures, like mask wearing, closing certain businesses, and limiting gatherings. For illustrative purposes, we consider how our vulnerability data might inform decisions about state and county mask mandates.

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[87] *See Polling Locations and Voters*, CDC, https://www.cdc.gov/coronavirus/2019-ncov/community/election-polling-locations.html [https://perma.cc/C8LT-3E59] (Apr. 20, 2021); ANN BANCHOFF ET AL., MASK RULES FOR IN-PERSON VOTING 2–5 (2020), https://healthyelections.org/sites/default/files/2020-10/Mask_Rules.pdf [https://perma.cc/T7TH-Q7J5] (discussing different states' mask requirements for polling places ahead of the 2020 presidential election).

Because masks are such a low-cost and effective public health measure, every county in the United States should have had a mask mandate in place, if not throughout the pandemic, then at least when case counts were high and before vaccines were widely available.[88] Yet, many state governments declined to issue state-wide mask mandates because mask wearing was, and continues to be, politicized.[89] If jurisdictions in those states imposed mandates at all, the timing, length, and geographic coverage of those mandates were primarily based on COVID-19 case counts.[90] The surge of cases caused by the Delta and Omicron variants renewed the debate over masks.[91]

Although case counts might seem like a straightforward, neutral metric for assessing which areas in a state most need mask mandates at any given time, when analyzed through a vulnerability lens, this metric misses something important. Case counts may reflect some of an area's vulnerability because communities with high vulnerability may have high case counts, but cases may well be undercounted in poor, minority areas because of disparities in access to testing.[92] Moreover, even where case counts capture the full extent of current disease, they can never fully capture a community's vulnerability because they say nothing about the severity of those cases or the likelihood of fatalities. Also, case counts are often tallied with a time lag of at least a few days due to the virus's incubation period. Thus, it is hard to be anything but reactive from a policy standpoint when focusing on case counts alone. Using case counts as the primary metric for action can thus reduce the effectiveness of public health policies (like mask mandates) because the disease spreads too rapidly. Additionally, when a policy is enacted and retracted based on real-time reactions to

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[88] *See* BENJAMIN W. ABBOTT, MITCHELL GREENHALGH, ISAAC ST. CLAIR & JONAS BUSH, MAKING SENSE OF THE RESEARCH ON COVID-19 AND MASKS 4 (2020), https://pws.byu.edu/byu-covid-19-and-masks [https://perma.cc/YAA3-XZ2L] (reporting a meta-study of 112 papers and concluding that "masks could be one of the most powerful and cost-effective tools to stop COVID-19 and accelerate the economic recovery" (emphasis omitted)).

[89] *See* Casey Tolan, *States Grapple with Mask Rules at Polls to Avoid Dangers of Both Superspreaders and Standoffs*, CNN, https://www.cnn.com/2020/10/22/politics/voting-mask-mandate-invs/index.html [https://perma.cc/MAK4-EKL6] (Oct. 22, 2020, 2:30 PM).

[90] Kaia Hubbard, *These States Have COVID-19 Mask Mandates*, U.S. NEWS (Jan. 12, 2022), https://www.usnews.com/news/best-states/articles/these-are-the-states-with-mask-mandates [https://perma.cc/8Z92-ERNZ] (noting many states that have never imposed a statewide mask mandate, including Tennessee, Florida, and Georgia).

[91] *See, e.g.*, Mark Fisher, Christine Spolar & Deborah Lynn Blumberg, *Which Mask? What Test? Covid's Latest Surge Spreads an Epidemic of Confusion.*, WASH. POST (Jan. 11, 2022), https://www.washingtonpost.com/business/economy/covid-confusion-test-vaccine-mask/2022/01/10/1b2a9788-6e48-11ec-b9fc-b394d592a7a6_story.html [https://perma.cc/7JU3-SSS8].

[92] *See, e.g.*, Sean McMinn et al., *In Large Texas Cities, Access to Coronavirus Testing May Depend on Where You Live*, NPR (May 27, 2020), https://www.npr.org/sections/health-shots/2020/05/27/862215848 [https://perma.cc/U7EC-RX8D] (reporting that public testing sites in Texas were "disproportionately located in whiter neighborhoods").

ever-changing case counts, the public may become confused about both the policy's enforcement status and its underlying rationales.

Yet, many states have relied on county case counts to determine which counties should be subject to mask mandates. Some states without state-wide mask mandates require masks in high-transmission counties—as measured, primarily, by case counts[93]—whereas other states with state-wide mandates have opt-out procedures for counties with low case counts.[94] Some state policy-makers have also cited declining case counts as a reason for phasing out state-wide mask mandates.[95]

To demonstrate how vulnerability data could inform mask-mandate decisions, we overlaid our COVID-19 vulnerability index with data from a publicly available county-level mask mandate database,[96] which tracks the date each

[93] Prior to adopting a state-wide mask mandate in November 2020, Utah categorized counties into high, medium, and low transmission counties, with masks mandated only in high-transmission counties. *See* Larry D. Curtis, *Utah's New High, Moderate, Low Transmission Index and Masks: What Does It Mean?*, KUTV (Oct. 13, 2020), https://kutv.com/news/coronavirus/utahs-new-high-moderate-low-transmission-index-what-does-it-mean [https://perma.cc/GXZ6-XFMV]. The categorization was based on three criteria: "seven-day average percent of positive tests," "14-day case rate per 100,000 people," and the level of statewide ICU utilization—none of which account for county-level vulnerability to high case fatality rates. *See id.* In Mississippi, Republican Governor Tate Reeves "first resisted imposing a statewide mask mandate, focusing instead on individual counties with high cases, until cases were spiking throughout the state in early August." Leah Willingham, *After Mandate Repeal, Masks Required Again in Nine Counties*, U.S. NEWS (Oct. 19, 2020), https://www.usnews.com/news/best-states/mississippi/articles/2020-10-19/after-mandate-repeal-masks-required-again-in-nine-counties [https://perma.cc/WJX6-WVNE]. Reeves imposed a statewide mask mandate on August 4, 2020, which he ended on September 30, 2020. *Id.* In mid-October of that year, Reeves began reinstating mask mandates in counties with higher case counts. *Id.*

[94] Texas allowed counties with fewer than 30 new COVID-19 cases during the prior 14 days to opt out of the state-wide mask requirement. *See* Tex. Exec. Order No. GA-29, at 2–3 (July 2, 2020), https://lrl.texas.gov/scanned/govdocs/Greg%20Abbott/2020/GA-29.pdf [https://perma.cc/5HQK-TRDC]; TEX. DIV. OF EMERGENCY MGMT., GA-29 EXEMPTION FORM APPLICATION, https://tdem.texas.gov/wp-content/uploads/2019/08/GA29-Form-4_10-13-2020.pdf [https://perma.cc/3GC6-4Z93]. On March 2, 2021, Governor Greg Abbott removed the statewide mask mandate. Tex. Exec. Order No. GA-34, at 2 (Mar. 2, 2021), https://lrl.texas.gov/scanned/govdocs/Greg%20Abbott/2021/GA-34.pdf [https://perma.cc/6YYC-D8R5]. For a time, Montana exempted counties with three or fewer active COVID-19 cases from its mask mandate. *See* Memorandum from Steve Bullock, Governor, Montana, to Montanans & All Officers & Agencies of the State of Montana 3 (July 15, 2020), https://covid19.mt.gov/_docs/Mask%20Directive%20FINAL.pdf [https://perma.cc/5JY4-WYL5].

[95] North Dakota Governor Doug Burgum, for example, cited declining case counts (and hospitalizations) when he let the state's mask mandate expire on January 18, 2021. *See* Press Release, North Dakota Off. of the Governor, Burgum Urges Vigilance to Keep COVID-19 Numbers Trending Downward as Statewide Mask Requirement Expires Monday (Jan. 15, 2021), https://www.governor.nd.gov/news/burgum-urges-vigilance-keep-covid-19-numbers-trending-downward-statewide-mask-requirement [https://perma.cc/2FB4-TBK8].

[96] *Tracking Mask Mandates: Data Collection*, AUSTIN L. WRIGHT, https://www.austinlwright.com/covid-research [https://perma.cc/H872-DNTU] (Apr. 5, 2021).

county first adopted a mask mandate through August 5, 2020.[97] We grouped the counties into four groups: early mask adopters (counties that imposed mask mandates between March 1 and April 30, 2020), spring/summer adopters (counties that imposed mask mandates between May 1 and June 30, 2020), late adopters (counties that imposed mask mandates between July 1 and August 5, 2020) and very late or non-adopters (counties without a mask mandate before August 5, 2020). This map is displayed below as Figure 3.

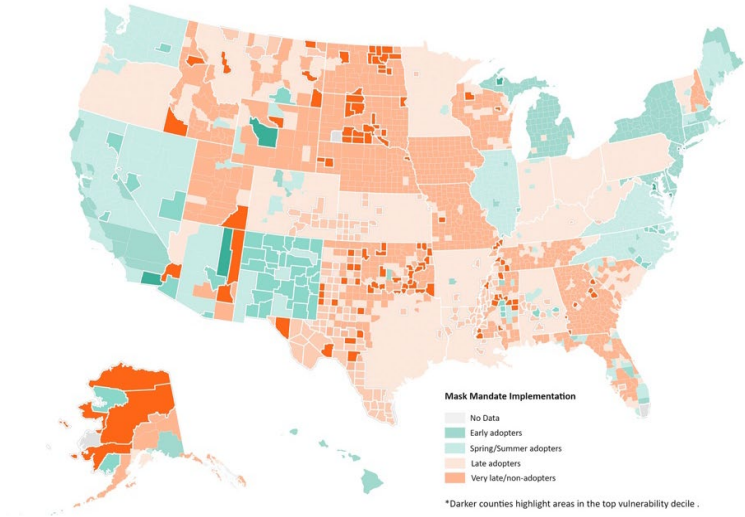

Figure 3. The map above shows the timing of mask mandate implementation in counties across the United States in 2020. Counties in darker shades ranked among the highest vulnerability decile.

Although mask mandates are only one type of preventative measure to protect against COVID-19, their uneven implementation demonstrates how many counties that were highly vulnerable to high fatality rates were left without the protection that a mask mandate could have provided. Our most striking finding is that, of the most vulnerable counties in the country, nearly half

[97] This application of our vulnerability index is imperfect for several reasons. The Wright et al. mask-mandate database is incomplete because it only charts the date each county first adopted a mask mandate and only through August 5, 2020. *See id.* Additionally, the mask database includes only county level data, which may be misleading because some cities, including big cities that cover most of a county, may have mask mandates that are not reflected in the data. *See* Austin L. Wright et al., *Tracking Mask Mandates During the COVID-19 Pandemic* 2 (Univ. of Chi., Becker Friedman Inst. for Econ., Working Paper No. 2020-104, 2020), https://bfi.uchicago.edu/wp-content/uploads/BFI_WP_2020104.pdf [https://perma.cc/G54X-25XY] (acknowledging that the lack of local mandate data can skew analysis). Nonetheless, overlaying our vulnerability data with the mask-mandate data illustrates how similar data sets might have been used to determine where and when mask mandates were most needed.

(47%) were very late or non-adopters, meaning that they had no mask mandate in place before August 5, 2020.[98] Another 36% of our most vulnerable counties were late adopters. Thus, 83% of the most vulnerable counties had no mask mandate in place by July 1, 2020.[99]

As the voting and mask mandate examples demonstrate, a data-driven approach to the geography of risk can help policy-makers make choices that better account for the vulnerability of individuals and communities and thus develop more just and effective disaster law and policy. Similar approaches could shed important light on other pressing COVID-19 policy issues, including school reopenings and vaccination prioritization. These kinds of geographic vulnerability analyses are critical because vulnerability, as well as services and resources, are tied to geography. With the exception of charter and magnet schools, public schools usually serve identifiable neighborhoods whose vulnerability can be mapped and understood. Vaccination clinics, although serving a less geographically bounded population, are more or less accessible to different populations depending on where they are located. And, although people move between geographic areas to work and live, vaccination rates within particularly geographic areas will likely affect COVID-19's spread in those places, particularly in neighborhoods where social distancing is complicated by crowded or intergenerational housing and reliance on public transit.[100]

D. Acknowledging Limitations of Our Data-Driven Approach

Examining vulnerability in this systematic and empirical way also highlights some of the limits and complexities inherent in vulnerability policy in general, and data-driven vulnerability analyses, in particular. These challenges include deciding who "counts" as vulnerable and how much their vulnerability "counts,"[101] determining the appropriate spatial unit for data analysis (data granularity),[102] dealing with missing data,[103] and grappling with uncertainty.[104] We address each of these challenges below.

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[98] *See* Appendix Table 3 (showing the proportion of each vulnerability decile that were early adopters, spring/summer adopters, late adopters or very late/non-adopters).

[99] For summarized results, see Appendix Table 3.

[100] *Science Brief: COVID-19 Vaccines and Vaccination*, CDC, https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/fully-vaccinated-people.html [https://perma.cc/SR76-F94G] (Sept. 15, 2021) (noting that vaccinated people can still spread COVID-19, but "at much lower rates than unvaccinated people").

[101] *See infra* Subsection II.D.1.

[102] *See infra* Subsection II.D.2.

[103] *See infra* Subsection II.D.3.

[104] *See infra* Subsection II.D.4.

1. Deciding Who "Counts" as Vulnerable and How Much Their Vulnerability "Counts"

One of the primary tasks when developing a data-driven vulnerability tool like a vulnerability index is deciding who "counts" as vulnerable and, relatedly, how much weight to give the different factors that make people vulnerable.

In developing our index, we accounted for four primary drivers of vulnerability: age, race, underlying health risk, and socioeconomic factors.[105] We did not include other potential drivers of vulnerability, such as undocumented status and disabilities not captured by the health data, because reliable county-by-county data is lacking. Within each of these drivers, we had to decide which specific data to use to construct our model. For example, when deciding which high-risk health conditions to include, we looked at CDC data about conditions that increase risk. Concerns about endogeneity and collinearity (for example, when multiple factors capture the same underlying condition), and the availability of reliable, county-level data about underlying conditions also informed our decision. Although we settled on rates of smoking, obesity, heart disease, and chronic obstructive pulmonary disease, a different tool, developed at a different time for a different area, might make other choices based on the changing state of knowledge about health risks. For example, how prevalent and correlated certain conditions are in the study area, and what data is widely, publicly, and consistently available at the preferred level of geographic analysis, might inform a different outcome. The same is true for our selection of other risk factors, including socioeconomic risk factors, race, and age.

Equally important are decisions about how to weigh these factors in an index that accounts for many different types of risk. As described above, we weighted the factors in our analysis by modeling how much each factor contributed to observed mortality rates to date.

2. Determining Data Granularity

A related issue for geographic vulnerability indices is deciding on the data granularity—here, which geographic unit to use: neighborhood, voting precinct, zip code, county, or some other level for which data is available. Our COVID-19 vulnerability index is a county-level index because much of the relevant health data is not consistently available for smaller geographic units nationwide.[106] Furthermore, most of the public health measures we initially considered, such as mail-in-voting rules and mask mandates, were being implemented on a county or

[105] Socioeconomic factors that we considered include the percent living below the poverty line, the uninsured, and those employed as essential workers, including in healthcare support, food service and preparation, and other occupations where social presence was necessary.

[106] *See infra* Subsection II.D.3.

state-wide basis. County-level data could be problematic for some purposes, however, because it averages vulnerability over potentially large areas, rendering invisible some pockets of vulnerability within more privileged areas. Thus, the choice about geographic level of analysis determines whose vulnerability is seen and whose vulnerability is overlooked. More granular data would be required for more localized resource targeting, such as deciding where to locate testing and vaccination centers during pandemics, planning transportation for evacuations, and siting cooling centers during heat waves.

3. Dealing with Unavailable Data and Other Data Limitations

As the prior Subsections suggest, the availability of data affects which factors can be included in a vulnerability index. Other than for major cities, data about the prevalence of many health conditions is not available for jurisdictions below the county level. This is particularly true of data about less common conditions, primarily due to potential privacy concerns. Even for the factors we relied on, some data was not available for a handful of rural counties because the population is small enough to allow potential identification of specific individuals. Accordingly, we had to use some state-level data to impute average rates of chronic health conditions in some rural counties, particularly in Alaska. There were also some socioeconomic factors, such as whether there was adequate access to a major hospital, that we ultimately excluded because we felt that county-level data did not capture the full picture of relevant healthcare shortages. In short, there are well-known limitations inherent in using health data at the county level to ascertain vulnerability. If local health departments have access to more detailed data (preferably neighborhood-level data as defined by census tracts), they should use it to estimate vulnerability, while still carefully maintaining and protecting individual privacy.

Additionally, available data always lags behind current conditions, and some sources of data are not updated frequently. Fortunately, data about COVID-19 cases and mortality rates is easily accessible in real-time and continuously updated in our model. Because vulnerability is best understood as dynamic rather than static,[107] fixed health data is a limiting factor in our model. Additionally, static data cannot fully capture many aspects of vulnerability.[108] For example, because "point-in-time" measures, including census information, only provide a snapshot of a single time period, such data "cannot capture the

[107] TIERNEY, *supra* note 4, at 75 (arguing that "for theoretical purposes vulnerability is more appropriately conceptualized as a *process* in which different groups are affected by changes in the broader political and economic environment that either reduce or increase their propensity for loss" rather than "as a *state*").

[108] *Id.*

extent to which undocumented workers in the United States and even legal immigrants [were] made more vulnerable as a result of the 2016 presidential election."[109] To trace such impacts, one would need at least two (and preferably more) different snapshots in time to see how individuals fared before and after the election.

Other aspects of a community's vulnerability can also be difficult to capture in a vulnerability index. Evidence that, in some disasters, neighborhoods with similar demographics and high levels of risk fare very differently complicates the story of vulnerability. For example, during the deadly 1995 Chicago heat wave, "eight of the ten community areas with the highest death rates were virtually all African American, with pockets of concentrated poverty."[110] But, at the same time, "[t]hree of the ten neighborhoods with the *lowest* heat-wave death rates" had similar demographic characteristics.[111]

Some researchers have suggested that the neighborhoods that do better during disasters tend to have higher "social capital," particularly "bonding social capital" that brings neighbors together to check on, help, and advocate for each other.[112] Others have captured similar concepts in different terminology, explaining that the differences are the result of the neighborhood's "social ecology,"[113] "social cohesion," and "social infrastructure," including public spaces and institutions that facilitate neighborly interactions.[114] In neighborhoods with high bonding social capital or social cohesion, residents tend to know one another and engage with each other in faith-based or other community groups.[115] During heat waves, that means that community residents know who to check in on, particularly those who are alone, elderly, or ill.[116] In a pandemic, that means that neighbors grocery shop for each other so that higher-risk individuals can stay home. Additionally, they know about and care for those who are ill, and they help at-risk residents navigate often-complicated systems for voting, COVID-19 testing, and COVID-19 vaccination sign-ups.

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[109] *Id.* at 75.

[110] KLINENBERG, *supra* note 24, at xxiii.

[111] *Id.*

[112] DANIEL P. ALDRICH, BUILDING RESILIENCE: SOCIAL CAPITAL IN POST-DISASTER RECOVERY 15, 31 (2012) (emphasis omitted).

[113] KLINENBERG, *supra* note 24, at 34, 79.

[114] *But see id.* at 230–31 ("[C]ontrary to much folk wisdom, poverty and duress, including physical injury and illness, tend to strain rather than sustain social bonds.").

[115] *See, e.g.*, *id.* at 88 (noting that, generally, Latinx elderly populations tended to withstand the heat wave better than other racial subgroups because "Latino seniors benefit from strong multigenerational and extended family ties that facilitate close contact during normal times as well as crises").

[116] *Id.* at 118 ("Although the high population density and active commercial sector imposes certain strains on local residents . . . they also foster tight social networks among families and neighbors and support a relatively secure public environment.").

Because our index, like other similar tools, does not reflect varying levels of social capital and cohesion across neighborhoods, it may overstate or understate some communities' vulnerability. Subsequent index iterations could attempt to more fully account for this factor by identifying potential proxies for social capital (such as voter turnout), but there will always be important aspects of vulnerability that data cannot fully capture. We explore some of these other aspects in Parts III and IV below.

4. Grappling with Uncertainty

Each of the data and modeling decisions described above, although informed by sound methodology and data limitations, is nonetheless a choice that can alter the vulnerability analysis in important ways. Transparency around these decisions is critical for properly interpreting our results. Although these issues may seem technical, they are important. Complex models, with their sheen of neutrality and even inevitability, may obscure or disguise critical value and policy-laden choices between different vulnerable populations and individuals.[117]

Beyond these difficulties, there are fundamental uncertainties that make any vulnerability index contingent and incomplete. When we began creating the model, there was ongoing debate, for example, about which health conditions most predispose people to poor COVID-19 outcomes. These and other uncertainties made selection of factors for inclusion all the more difficult.

E. Extending Our Data-Driven Approach to Other Disasters

Despite the challenges described in the prior Sections, the COVID-19 pandemic was, in many respects, an ideal case for investigating geographic patterns of vulnerability and for using modeling to identify the primary drivers of the worst outcomes. The pandemic has now raged for over two years and intensive data collection efforts have been underway in most areas for the entire duration. Nonetheless, although briefer, lower-profile disaster events heighten many of the challenges described in the prior Sections, our data-driven vulnerability approach has important implications for disaster planning and response across a wide range of disasters.

Data from any one disaster event may not be available quickly enough to allow modeling and mapping while that disaster is underway. Yet, the recent frequency of disaster events suggests that we could collect ample data across a

[117] *Cf.* Frank Ackerman & Lisa Heinzerling, *Pricing the Priceless: Cost-Benefit Analysis of Environmental Protection*, 150 U. PA. L. REV. 1553, 1562–81 (2002) (leveling a similar critique at the apparent "objectivity" of cost-benefit analysis).

range of disasters to map vulnerability factors that drive poor outcomes. Data from past wildfires in California, for example, could be used to model vulnerability to wildfires there going forward, but it may also yield insights into wildfire vulnerability patterns elsewhere. The same is true for heat waves, flooding, and other disasters. Moreover, some disaster events are now so closely clustered in time and space, occurring in quick sequence, that they become extended, super-disasters. These events generate data that can be used to analyze vulnerability in real-time, even as the disaster unfolds. Indeed, as climate change intensifies, some kinds of disasters now seem to be chronic, at least during certain seasons.[118] Summer wildfires in the western United States, spring and summer flooding in the Midwest, and unbroken strings of hurricanes pummeling the coast throughout the late summer and fall all contribute to an unrelenting new normal.[119]

These terrifying patterns suggest both a real opportunity and a pressing need for better data collection during disasters. Improved data will allow us to better identify, analyze, and understand patterns of vulnerability. That, in turn, will allow for a greater focus on mitigation measures, such as pre-positioning and deploying resources to alleviate a disaster's most severe impacts on the most vulnerable populations. Effective data collection will also require developing consistent approaches for measuring disaster outcomes, including accepted methods for attributing deaths and injuries and for measuring other detrimental impacts, including economic losses and displacement.

Of course, even the best data and modeling alone cannot provide answers to the difficult ethical questions that arise when a proposed disaster response measure may ameliorate one aspect of a community's vulnerability but exacerbate others, when the needs of different vulnerable groups conflict, or when different vulnerable populations or individuals compete for scarce resources. The next Part explores these dilemmas more fully.

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[118] *Cf. 2022 North American Fires*, CTR. FOR DISASTER PHILANTHROPY (Feb. 4, 2022), https://disasterphilanthropy.org/disaster/2022-north-american-wildfires/ [https://perma.cc/64QR-5DNM] (stating that the frequency of wildfires in recent years has nullified the "concept of disaster seasons," creating a constant state of disaster).

[119] *See, e.g.*, Kirk Siegler & Nate Hegyi, *New Wildfires Are at a 10-Year High in the Hot, Dry Western U.S.*, NPR (June 17, 2021), https://www.npr.org/2021/06/17/1007784176 [https://perma.cc/8HD5-DS9M]; Patrick M. O'Connell & Tony Briscoe, *In 2019—the 2nd Wettest Year Ever in the U.S.—Flooding Cost Illinois and the Midwest $6.2 Billion. Scientists Predict More Waterlogged Days Ahead.*, CHI. TRIB. (Jan. 16, 2020), https://www.chicagotribune.com/news/environment/ct-climate-disasters-cost-midwest-20200115-jubchhqe7bfdnolpw3z7cwjwvm-story.html [https://perma.cc/2MYL-MUN4]; *Intense String of Hurricanes Seen from Space*, NASA (Oct. 4, 2017), https://svs.gsfc.nasa.gov/12738 [https://perma.cc/WL5E-NXGT] (describing the 2017 hurricane season, in which four intense hurricanes—Harvey, Irma, Jose, and Maria—came in quick succession, with all but Jose making landfall in the U.S. mainland).

III. Competing or Conflicting Vulnerability

Competing or conflicting vulnerabilities are inherent in every disaster situation. These tensions require us to think more holistically and carefully about trade-offs between different aspects of a particular group's vulnerability, as well as trade-offs between different vulnerable groups. This Part explores these conflicts through various COVID-19 examples in which they are particularly acute. First, we analyze school-reopenings to demonstrate concerns that arise for within-group conflicts.[120] Next, we discuss vaccine prioritization as an example of between-group conflicts.[121]

A. Managing Trade-Offs Between Different Aspects of Vulnerability

Geographic mapping may be very useful in highlighting where vulnerable groups are and where to triage resources. Yet, those who are vulnerable to a particular disaster risk may be socially vulnerable to other risks as well. Tools like our vulnerability index, therefore, can sometimes highlight where help is needed but still leave decision-makers uncertain how to manage competing risks or, worse yet, blind to those competing risks.

Indeed, due to competing risks, well-intended efforts to prioritize care for vulnerable people before, during, and after disasters can nonetheless cause them harm, particularly when those efforts fail to account for the full range of vulnerabilities people face. For example, after the devastating 1995 earthquake in Kobe, Japan, the government prioritized moving elderly and disabled survivors into temporary housing first, often separating them from their families, former neighbors, and communities.[122] Isolated in massive "Soviet-style public housing blocks," where it was difficult to establish new social ties, many survivors suffered from loneliness.[123] At least 120 experienced what the Japanese call "*kodoku shi*" or "lonely deaths,"[124] where no one discovered them for quite some time.[125] Although some deaths may have been inevitable, others may have been prevented had these vulnerable individuals been housed near loved ones or other community members who could have fostered human connection and given them "something [more] to live for."[126] The focus on the immediate housing needs of these individuals was admirable, but it failed to consider how disrupting social connections and isolating older people from

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[120] *See infra* Section III.A.
[121] *See infra* Section III.B.
[122] ALDRICH, *supra* note 112, at 89.
[123] *Id.*
[124] *Id.*
[125] *Id.* at 156.
[126] *Id.*

their families and friends might undermine their resilience in other ways. COVID-19 measures that isolate people in nursing homes, care facilities, and hospitals raise similar concerns.

Other types of vulnerability trade-offs have become apparent in past disasters. For example, strict policing of post-disaster areas to decrease vulnerability to looting, including enforcement of stringent curfews, may advance law enforcement goals but may also disrupt social capital in ways that undercut the community's capacity to recover.[127] One negative side effect of prioritizing law enforcement may be that neighbors cannot come together to support and help one another after a disaster.[128] The same might be true of some COVID-19 lockdown strategies. Completely shutting down churches, schools, and community centers might disrupt social networks in ways that undermine the community's resilience and ability to come together to act for the common good.

In some situations of competing vulnerabilities, decision-makers inadvertently harm vulnerable groups because they did not consider some aspect of vulnerability. When decision-makers account for these overlooked aspects of vulnerability, they can better address or mitigate harms suffered by vulnerable people. In the case of the 1995 earthquake in Kobe, the risk of loneliness among people prioritized for housing could have been mitigated, at least in part, by resettling former neighbors in close proximity, by prioritizing housing for family members of the vulnerable individuals, or by designing housing that facilitated social interaction and connection.

In other cases, the conflict between different aspects of vulnerability is acute, profound, and sometimes seemingly insoluble. The question of school closures and reopenings brings this issue into sharp focus. Although there are some competing vulnerability interests between teachers and students, the most difficult trade-offs are between different facets of students' vulnerability. The tension arises when weighing the students' vulnerability to contracting COVID-19 (or their risk of transmitting the virus to particularly vulnerable family members), and their vulnerability to poor educational outcomes from remote learning.[129]

Unfortunately, and unsurprisingly, the intersection between these two vulnerabilities is vast. Many of the same students who are disproportionately vulnerable to illness or to transmitting illness if they attend in-person school

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[127] *Id.* at 15 (arguing that social capital is the most important driver of effective community disaster recovery).

[128] *See* Lisa Grow Sun, *Disaster Mythology and the Law*, 96 CORNELL L. REV. 1131, 1189 (2011).

[129] We recognize, of course, that students are not a monolithic group and that their vulnerability varies widely across space and circumstances.

are also disproportionately vulnerable to poor educational outcomes,[130] reduced access to nutritious food and other important school services,[131] and mental health challenges if they attend school online.[132] Preliminary data suggests that the pandemic has, indeed, disproportionately impacted the learning outcomes of vulnerable students.[133]

Decisions about whether schools should provide instruction in-person, entirely online, or in some hybrid format thus require nuanced consideration of the multifaceted vulnerability of the impacted communities. This weighing of different vulnerability risks, particularly early in the pandemic, has been further complicated by significant uncertainty about whether and how schools could reopen safely, how best to structure online learning (or hybrid options), and how to compensate for gaps in access and help students who are being left behind.

Obviously, vulnerability data and modeling cannot solve most of the difficult questions that arise in this kind of disaster scenario, especially when the range of possible answers all seem unsatisfactory. Although modeling the spatial components of vulnerability can provide insights into where to focus resources for vulnerable populations, looking at a map does not answer the most critical questions: What risks are worth bearing for a community that is vulnerable to COVID-19? Is it worth it to risk widening educational disparities? What about increasing food insecurity for those receiving free or reduced-cost meals?[134]

As an illustration of the problem, consider the issues that Dr. Janice Jackson, former Chief Executive Officer (CEO) of the Chicago Public Schools, faced

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[130] *See, e.g.*, Michelle Burris, Commentary, *When Closing Schools During COVID-19, Always Remember the Marginalized*, CENTURY FOUND. (Mar. 26, 2020), https://tcf.org/content/commentary/closing-schools-covid-19-always-remember-marginalized [https://perma.cc/7722-HGMV].

[131] *See id.* These services also include after-school programs that supervise students while parents are at work.

[132] *See, e.g.*, Abby Quirk, *Mental Health Support for Students of Color During and After the Coronavirus Pandemic*, CTR. FOR AM. PROGRESS (July 28, 2020), https://www.americanprogress.org/issues/education-k-12/news/2020/07/28/488044 [https://perma.cc/BK8B-EW26] (describing the way that pandemic school closures have cut off the primary source of mental health support for many BIPOC youth).

[133] *See, e.g.*, Emma Dorn, Bryan Hancock, Jimmy Sarakatsannis & Ellen Viruleg, *COVID-19 and Learning Loss—Disparities Grow and Students Need Help*, MCKINSEY & CO. (Dec. 8, 2020), https://www.mckinsey.com/industries/public-and-social-sector/our-insights/covid-19-and-learning-loss-disparities-grow-and-students-need-help# [https://perma.cc/6UG3-QYTK] (finding, for example, that by Fall 2020 "students of color may have lost three to five months of learning in mathematics, while white students lost just one to three months").

[134] Resources in this scenario include personal protective equipment for schools, additional computers, free Internet access, childcare programs for working parents, and mental health services.

as she decided whether to open any of the nearly 650 schools in the district.[135] Because our COVID vulnerability index is only available at the county level and because Chicago Public Schools fall within Cook County, our index does not provide much insight about geographic vulnerability. The CDC's Social Vulnerability Index (SVI) is at the census block level and provides a decent proxy for COVID-19 risk to school-age children. Cook County is shown in Figure 4 below.

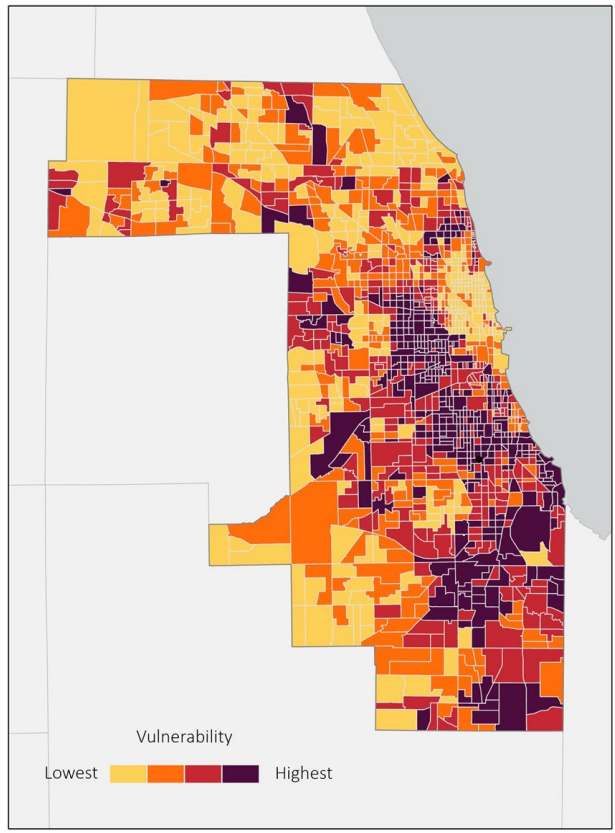

Figure 4. The CDC's Social Vulnerability Index at the Census-block Level for Cook County.[136]

One strategy would be to open schools in waves over the fall and winter. If the CEO focused on COVID-19 risk, she might look at the schools in vul-

[135] *See* Nader Issa, *13 Questions with CPS CEO Janice Jackson a Week After Schools Reopen*, CHI. SUN TIMES (Mar. 5, 2021), https://chicago.suntimes.com/education/2021/3/5/22313937 [https://perma.cc/7NPU-QEEY].

[136] *CDC's Social Vulnerability Index (SVI): SVI Interactive Map*, *supra* note 15.

nerable areas and decide that, due to COVID-19 risk, schools there should not open. On the other hand, she might note that keeping schools closed would also disproportionately burden more vulnerable areas. For example, parents who struggle financially and face challenges with childcare and homeschooling, and students who lack reliable Internet access or adequate technology and who face the highest risk of falling behind, are likely to be most impacted by continued school closures. Based on this latter view of vulnerability, the CEO might decide to prioritize opening schools in the most vulnerable areas as quickly as possible. Because the same communities and students are vulnerable to COVID-19 and other risks, understanding geographic patterns of vulnerability does not provide the CEO with much guidance.

Ultimately, the Chicago Public Schools opted to keep schools closed until the third quarter of the year, when it would open all schools to in-person instruction.[137] To the surprise of many researchers, similar patterns have emerged nationwide among school districts that serve large populations of vulnerable students.[138] Researchers have found that race and income seem to affect reopening plans. Schools "that serve larger proportions of students who are nonwhite and living in higher degrees of poverty seem more likely to open remotely."[139] Additionally, Fall 2020 school closures were "more common in schools with . . . higher shares of students from racial/ethnic minorities, who experience homelessness, have limited English proficiency and are eligible for free/reduced-price school lunches."[140]

The reasons for these patterns are complex, but parent preferences may have played an important role.[141] There is good evidence that, perhaps because of their vulnerability, BIPOC parents are making different risk judgments than white parents about schooling during the pandemic. Although BIPOC students are at disproportionate risk of poor outcomes from remote learning, BIPOC

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[137] *See* Jesse Kirsch, *CPS Reopening: Pre-K, Cluster Students Return to Classroom Thursday*, ABC 7 CHI. (Feb. 11, 2021), https://abc7chicago.com/chicago-public-schools-cps-update-reopening-plan-s-cluster-programs/10329629/ [https://perma.cc/K2TJ-QKRR] (describing how the February 2021 reopening would be staggered by grade-level).

[138] *See, e.g.*, David T. Marshall & Martha Bradley-Dorsey, *Reopening America's Schools: A Descriptive Look at How States and Large School Districts Are Navigating Fall 2020*, 14 J. SCH. CHOICE 534, 542, 544 (2020).

[139] *Id.* at 542. Although the trends weren't statistically significant, "[d]istricts with larger nonwhite student populations and the poorest 25% of districts . . . were more likely to start the 2020–21 school year with remote instruction." *Id.* at 540.

[140] Zachary Parolin & Emma K. Lee, *Large Socio-economic, Geographic and Demographic Disparities Exist in Exposure to School Closures*, 5 NATURE HUM. BEHAV. 522, 522 (2021).

[141] *See* Marshall & Bradley-Dorsey, *supra* note 138, at 544 (noting a number of potential explanations for this pattern, which was the opposite of what the researchers expected initially, including parent preferences and the fact that many of these students live in urban areas that have had large case counts and have powerful teachers unions that may oppose reopening).

parents are less likely to support school reopenings and to send their children to school than white parents.[142] The same is also true of lower-income parents, despite challenges posed by jobs that cannot be performed at home and limited childcare options.[143]

Data from a 2020 survey we fielded through Qualtrics confirmed these trends.[144] When asked if reopening K-12 schools is a risk worth taking, 67% of white and 62% of Asian respondents said "yes." Meanwhile, the proportion of Black, Hispanic, and other/more than one race respondents who felt reopening schools was worth the risk was far lower (49%, 46%, and 44%, respectively). Higher-income respondents were also more likely than lower-income respondents to agree that reopening K-12 schools was worth the risk.[145]

BIPOC parents and low-income parents may prefer online instruction because they are more likely to live in multigenerational housing, meaning that infected students pose risks to older relatives. BIPOC individuals also may conclude that their communities are already at higher COVID-19 risk[146] and may not trust their children's schools, which are often under-resourced already, to keep their children safe from COVID-19.[147]

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[142] *See* Sarah D. Sparks, *Parent Racial, Income Divides Seen on School Reopening Preferences*, EDUC. WK. (July 28, 2020), https://www.edweek.org/leadership/parent-racial-income-divides-seen-on-school-reopening-preferences/2020/07 [https://perma.cc/G635-C3LN].

[143] *Id.* (reporting results of a poll of more than 6,000 families that showed "a majority of families who make less than $50,000 a year wanted schools to avoid in-person instruction entirely for the 2020–21 school year," whereas "only 27 percent of families who make more than $150,000 a year wanted remote-only schooling").

[144] We collected nationwide survey responses between September 23, 2020, and October 2, 2020. For a summary of the demographics of and responses from those who participated, see Appendix Table 5.

[145] Among those making at least four times the federal poverty level (FPL), 76% responded that reopening schools was worth the risk, whereas only 52% of those below the FPL agreed. For these and additional results, see Appendix Table 6.

[146] *See* Christina A. Samuels, *Do Parents Trust Schools? Where the Fault Lines Are During COVID-19*, EDUC. WK. (Sept. 16, 2020), https://www.edweek.org/leadership/do-parents-trust-schools-where-the-fault-lines-are-during-covid-19/2020/09 [https://perma.cc/97DC-8EKQ].

[147] Among vulnerable populations, these trends may be rooted in a deeper distrust of the government's ability to disseminate accurate information about COVID-19, and therefore, its ability to mitigate damage and disruption to their communities. Breaking out the question of school reopening by trust in the accuracy and quality of COVID-19 information delivered by the government, we find 83% of those who trust the government's information "a great deal" also support reopening K-12 schools. This proportion drops to 70% among those who only trust the government's information "a fair amount," 54% among those who trust the government's information "not very much," and 38% among those who do not trust the government's information "at all." *See* Appendix Table 6. Other polling confirms that Black and Latinx parents are substantially less likely to trust their children's schools to keep them safe during the pandemic than white and Asian parents. *See* Samuels, *supra* note 146 (finding only 19% of Asian parents and 26% of white parents had "low to nonexistent" trust in their children's schools, whereas 39% of Black parents and 33% of Latinx parents had "low to nonexistent" trust that schools would keep their children safe from COVID-19).

This experience suggests that, although spatial patterns of vulnerability may not always provide much substantive guidance to decision-makers faced with conflicting intra-group vulnerabilities, those geographic vulnerability patterns may help identify places where local input into decision-making—especially from the most vulnerable stakeholders—is particularly needed. Although procedural justice suggests that vulnerable populations should always have at least some voice in critical decisions that affect them, that interest seems heightened when high-stakes decisions turn on important value judgments about how to make trade-offs between various kinds of vulnerability and consequent harm.

The differing risk calculus made by some vulnerable communities is perhaps most fully evident in decisions by tribes like the Navajo Nation, which has essentially full control over school reopening decisions. Many tribes have kept all reservation schools closed, despite the profound difficulties that remote learning poses for Indigenous students, who often lack computer and Internet access and who had some of the country's highest pre-pandemic dropout rates.[148] The choice to continue online instruction reflects, at least in part, a culturally specific value judgment that sending children to school poses too much risk to grandparents and other older relatives, who often reside with students in multigenerational housing where social distancing is difficult.[149] Navajo leaders pointed to a particularly pressing need to protect Navajo elders "because they are the storytellers . . . they are the heart of the Navajo Nation."[150] High levels of vulnerability on the reservation meant that the risks of school reopening and the costs of continued closures were both high.[151] The Navajo Nation, because of its sovereign status over these decisions, could make its own judgments, consonant with the cultural values of the tribe, about school reopening. Reservation schools run by the federal Bureau of Indian Education, however, appeared less responsive to community needs and preferences.[152]

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[148] *See* Anthony J. Wallace, *Navajo School, Students Fight to Overcome Amid COVID-19*, AP NEWS (Nov. 27, 2020), https://apnews.com/article/technology-arizona-phoenix-coronavirus-pandemic-wi-fi-23a921f457ca55d8abd319e15f781b7d [https://perma.cc/7ZRJ-QLA5] (detailing the obstacles to remote learning for Indigenous students and the great lengths many must go to just to access the Internet).

[149] *See id.*

[150] *Id.* (quoting Darrick Franklin, Educ. Program Manager, Dep't of Diné Educ.) (omission in original).

[151] *Id.*

[152] *See* Rebecca Klein & Neal Morton, *As Coronavirus Ravaged Indian Country, the Federal Government Failed Its Schools*, HECHINGER REP. (June 27, 2020), https://hechingerreport.org/as-coronavirus-ravaged-indian-country-the-federal-government-failed-its-schools/ [https://perma.cc/A3LB-SNUU] (arguing that reservation schools run by the federal Bureau of Indian Education, which educate around 10% of students on reservations, were "slow to shut and to offer distance learning").

Beyond school closures, the Navajo Nation—driven by its understanding of the intense vulnerability of many tribal members and by high case counts—has implemented perhaps the most aggressive COVID-19 lockdowns and curfews of any jurisdiction in the country.[153] In December 2020, when the Nation was in "its sixth week of a strict lockdown and 57-hour weekend curfews," Navajo Nation President Jonathan Nez explicitly noted that these decisions prioritized saving lives over the economy.[154]

Obviously, most vulnerable groups do not have sovereignty over these choices, and, in any event, no vulnerable group is a monolith—disagreements between different group members are to be expected. These experiences, however, do suggest the desirability of making these difficult choices at a more particularized, community level. For decisions that implicate difficult tradeoffs between competing group vulnerabilities, such as school reopening decisions, deciding policy at the lowest possible level (i.e., school by school or district by district) allows for the most community input.[155] Additionally, decision-making must give voice and special accommodation to individuals with cumulative, intersectional vulnerabilities, such as students with disabilities who live in vulnerable areas.

The experience with school closures also suggests the value of giving vulnerable communities and individuals more choices for managing their own

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[153] *See, e.g.*, Kim Powell, *Navajo Nation Continues Strict Curfews Due to "Uncontrolled Spread" of COVID-19*, ARIZONA'S FAM. (Dec. 28, 2020), https://www.azfamily.com/news/continuing_coverage/coronavirus_coverage/navajo-nation-continues-strict-curfews-due-to-uncontrolled-spread-of-covid-19/article_1e78e686-4984-11eb-beaa-67feb635d51f.html [https://perma.cc/GTF2-9JU6]; Simon Romero, *Checkpoints, Curfews, Airlifts: Virus Rips Through Navajo Nation*, N.Y. TIMES, https://www.nytimes.com/2020/04/09/us/coronavirus-navajo-nation.html [https://perma.cc/MZJ6-EWL8] (Apr. 20, 2020) (describing strict measures, including curfews enforced by checkpoints, patrols, and threats of "jail time and hefty fines").

[154] Powell, *supra* note 153 ("Even though the economy here on the Navajo Nation may be hurting because of [the lockdown] . . . saving lives is much more important than the economy here right now." (quoting Jonathan Nez, President, Navajo Nation)). The experience of the Navajo Nation also underscores the difficulty of some place-based decision-making, namely that local public health measures to protect vulnerable populations cannot keep communities safe, despite personal sacrifices, if neighboring communities opt for less protective measures. Although the Navajo Nation has implemented very strict lockdowns, many communities that border the reservation have not; many Diné live in these neighboring towns and the borders are porous. *See* Desi Rodriguez-Lonebear, Nicolás E. Barceló, Randall Akee & Stephanie Russo Carroll, *American Indian Reservations and COVID-19: Correlates of Early Infection Rates in the Pandemic*, 26 J. PUB. HEALTH MGMT. & PRAC. 371, 375 (2020). This limits the effectiveness of President Nez's attempt to create "our little bubble here on the Navajo Nation." Powell, *supra* note 153 (quoting Jonathan Nez, President, Navajo Nation).

[155] This suggests, too, that large teachers unions should be cautious about insisting—as the San Francisco teachers union has—that they will not agree to reopening any schools in an area until all can safely reopen. *See* The Times Editorial Board, *To Get Vaccine Priority, Teachers Should Agree to Return to the Classroom*, L.A. TIMES (Jan. 26, 2021), https://www.latimes.com/opinion/story/2021-01-26/covid-vaccine-teachers-return-school [https://perma.cc/SH7U-6BX9].

risk. Some teachers unions have opposed giving parents more options on the grounds that offering hybrid and in-person learning choices will hurt remote learners because teachers will prioritize teaching the in-person students.[156] Those kinds of risks might be managed in other ways, while still providing vulnerable students and their parents more options, and thus more control, over the vulnerability trade-offs they prefer. For example, schools could help solve this problem by having some classrooms fully remote and some in-person.

One final point perhaps cuts in the opposite direction: in some respects, the trade-off between the safety of vulnerable students and their families versus vulnerable students' education might be a false choice—or at least a much higher-stakes choice than it needed to be. If we had made a large-scale societal choice to prioritize vulnerable students (and, indeed, all students) by opening schools ahead of bars, in-person dining, and other businesses, we might have better controlled community COVID-19 spreading so that vulnerable students could attend in-person school with much less risk to themselves and their families. Alternatively, if schools needed to remain remote, federal or state governments could have directed a large influx of resources to improve online learning for students in the most disadvantaged areas. In many instances, local choice cannot be truly meaningful for vulnerable communities without the necessary infusion of federal or state resources to effectively manage competing risks. Although vulnerability indices like ours cannot dictate what our overarching societal priorities should be, they can clarify and inform the trade-offs those priorities will require and how some of those trade-offs could be minimized.

B. Managing Trade-Offs Between Vulnerable Groups

Another important aspect of competing or conflicting disaster vulnerability is conflicts between the needs of different vulnerable communities or groups. Although it may prove helpful to think about where vulnerable groups are located—such as those vulnerable to the pandemic because of their age, race, or both—knowing where such communities are located does not necessarily tell decision-makers how to manage trade-offs between different vulnerable groups.

Some of the conflicts that have emerged between vulnerable groups during the pandemic have played out without much public attention. For example, although mail-in ballot options benefit most COVID-19 vulnerable voters (in-

[156] *See, e.g.*, Kate Taylor, *Chicago Students Return to School on Monday. Will Their Teachers?*, N.Y. TIMES (Jan. 9, 2021), https://www.nytimes.com/2021/01/09/us/chicago-schools-covid-reopening.html [https://perma.cc/R898-XF89] (reporting the Chicago Teachers Union's argument that reopening schools hurts vulnerable students because requiring teachers "to simultaneously teach both in-person and remote students" will further disadvantage Black and Latinx students, whose parents are more likely to choose to keep their children at home).

cluding older voters and many with chronic health conditions or other disabilities), this move also dramatically decreases the number of in-person polling places. Voters with certain disabilities or limited English-language proficiency rely on such polling sites to provide accessibility services that help them to vote safely and privately.[157]

Additional conflicts between different vulnerable groups are at the heart of some of the most visible and thorny COVID-19 policy issues. For example, in some areas, such as the Chicago Public School District, school reopening decisions were framed as vulnerable teachers versus vulnerable students.[158] Perhaps most prominent was the debate over vaccine priorities, which pitted vulnerable essential workers against vulnerable older adults, vulnerable people who are incarcerated against vulnerable people who are homeless, and vulnerable people with a history of smoking against vulnerable people with diabetes. As discussed below, our vulnerability index's representation of geographic vulnerability can yield some important insights about how to manage these conflicts, but difficult ethical and implementation questions will also require policymakers to consider factors that spatial data cannot fully capture.

From the beginning of the pandemic, there has been a general consensus among experts that ensuring equity for vulnerable populations should play an important role in determining vaccine priorities. All the early vaccine frameworks proposed by the World Health Organization (WHO), Johns Hopkins, and the National Academy of Sciences, Engineering & Medicine (NASEM) included this focus on vulnerability.[159] But two of the most challenging ques-

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[157] Sabrina Gonzalez, *Vote by Mail Is One of Many Ways to Ensure the Disability Community Is Included in the Next Election*, CTR. FOR AM. PROGRESS (May 19, 2020), https://www.americanprogress.org/issues/disability/news/2020/05/19/485218 [https://perma.cc/6KTU-HUSV]. In Oregon, an early adopter of vote-by-mail, there is no in-person voting, and voters with disabilities who need official assistance that cannot be handled via telephone must travel to the county clerk's office. *See Services for Voters with Disabilities*, OR. SEC'Y OF STATE, https://sos.oregon.gov/voting/pages/disabilities.aspx [https://perma.cc/UEK5-NFZ5]. This example also problematizes the definition of a "vulnerable group"; although people with disabilities may have many common disaster needs, different types of disabilities also create divergent needs.

[158] See Moriah Balingit, *Chicago Reaches Deal with Teachers to Reopen School Buildings*, WASH. POST (Feb. 10, 2021), https://www.washingtonpost.com/education/2021/02/10/chicago-teachers-pandemic/ [https://perma.cc/P7BG-CGUZ] (describing how the protracted "impasse" over Chicago school reopening had pitted teachers who felt unsafe entering classrooms against students who would benefit from in-person learning).

[159] World Health Organization [WHO], *Interim Guidance: Framework for Decision-Making: Implementation of Mass Vaccination Campaigns in the Context of COVID-19*, at 4 (May 22, 2020), https://apps.who.int/iris/bitstream/handle/10665/332159/WHO-2019-nCoV-Framework_Mass_Vaccination-2020.1-eng.pdf?sequence=1&isAllowed=y [https://perma.cc/J7L7-TE8V] ("Wherever possible, provision of immunization to vulnerable populations at increased risk of morbidity and mortality . . . should be prioritized."); ERIC TONER ET AL., JOHNS HOPKINS BLOOMBERG SCH. OF PUB. HEALTH, INTERIM FRAMEWORK FOR COVID-19 VACCINE ALLOCATION AND DISTRIBUTION IN THE UNITED STATES 18 tbl.1, 22 tbl.2 (2020), https://www.centerforhealthsecurity.org/our-work/pubs_

tions remained: (1) how to ensure equity for vulnerable racial groups, and (2) how to prioritize different vulnerable groups, particularly the large groups of older Americans versus vulnerable racial minorities.

A major question for prioritizing vulnerable racial groups has been how explicitly to prioritize race. For a variety of reasons—including the potential for increasing vaccine hesitancy among racial minorities who reasonably fear being used as "guinea pigs"[160]—the early frameworks and the guidance ultimately adopted by the CDC rejected an explicit preference based on race or ethnicity. The NASEM framework suggested a place-based proxy for race. It proposed using geographic measures of social vulnerability, such as the CDC's Social Vulnerability Index (SVI) (or something like our index), to identify the most vulnerable areas in each state and to coordinate "special efforts" to vaccinate people in those areas during each phase of vaccine distribution.[161] The Johns Hopkins framework appeared to favor an occupation-based proxy for race. It recommended prioritizing "essential workers," which would "indirectly help address the disproportionate burden" of COVID-19 on minority communities.[162]

Ultimately, the CDC's Advisory Committee on Immunization Practices (ACIP) took the occupation-as-proxy approach to vulnerability, with the first phase covering health care workers and "residents of long-term care facilities"; the second phase covering people seventy-five or older and "frontline essential workers"; and the third phase covering people ages sixty-five to seventy-four years, ages sixteen to sixty-four years old "with high-risk medical conditions" and "essential workers" not previously covered.[163] This approach, on its face,

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archive/pubs-pdfs/2020/200819-vaccine-allocation.pdf [https://perma.cc/CGR3-A9HQ] (discussing the goal of "reduc[ing] higher rates of severe COVID-19 illness and mortality being experienced by systematically disadvantaged social groups and marginalized populations"); NAT'L ACADS. OF SCIS., ENG'G, & MED., FRAMEWORK FOR EQUITABLE ALLOCATION OF COVID-19 VACCINE 8–9 (Helene Gayle, William Foege, Lisa Brown & Benjamin Kahn eds., 2020) (noting that "[f]or each population group, the committee recommends prioritizing for areas identified as vulnerable through CDC's Social Vulnerability Index (SVI) or another more specific index").

[160] NAT'L ACADS. OF SCIS., ENG'G, & MED., *supra* note 159, at 133 (rejecting an explicit preference because it "may omit other important social determinants of health," "could be legally challenged," and "is likely to increase mistrust in communities of color" who might be suspicious of vaccine safety "given a long history of mistreatment"). The WHO guidance did not specifically address race. *See* World Health Organization [WHO], *supra* note 159.

[161] NAT'L ACADS. OF SCIS., ENG'G, & MED., *supra* note 159, at 9, 133 (explaining how the occupation-based strategy would address vulnerability without explicitly allocating doses based on race).

[162] TONER ET AL., *supra* note 159, at 12.

[163] Dooling et al., *supra* note 11, at 1659. The only mention of race in the guidance is in the context of the disproportionate number of racial and ethnic minorities among COVID-19-infected essential workers. *See id.* at 1658.

gives relatively equal priority to older Americans and the essential-worker proxy for race and social vulnerability.[164]

What does our COVID-19 vulnerability index data tell us about these choices? Figure 5 shows the primary driver of vulnerability—race, age, essential worker, or other—in every county in the United States, with the most vulnerable counties (those in the top decile) shaded darker.[165]

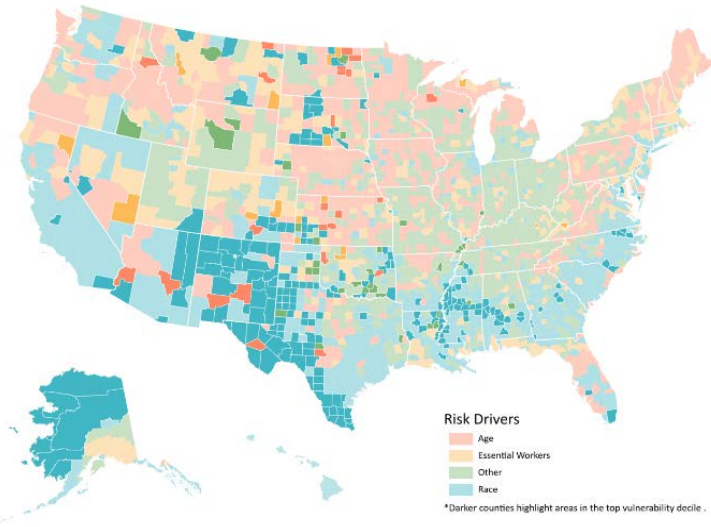

Figure 5. Primary Risk Drivers of COVID-19 Vulnerability at the County Level.

This map suggests two important considerations for policy-makers charged with vaccine distribution: (1) that the primary driver of COVID-19 vulnerability differs from county to county, and (2) that the predominant driver of vulnerability in an overwhelming number of the most vulnerable counties is race. The first consideration suggests that there may be wisdom in allowing states flexibility to adjust vaccination-phase priorities to best address the primary drivers of vulnerability and COVID-19 mortality in their own jurisdic-

[164] Each state is responsible for developing its own phased prioritization plan informed by the CDC's guidance. *State Plans for Vaccinating Their Populations Against COVID-19*, NAT'L ACAD. FOR STATE HEALTH POL'Y, https://www.nashp.org/each-states-plan-for-vaccinating-its-populations-against-covid-19/ [https://perma.cc/8RBE-HAWV] (Apr. 19, 2021).

[165] Note that this top decile of counties is somewhat different from that displayed in our voter maps in Section III.B because that data was through fall 2020, whereas the data for this map goes through February 2021.

tions. States could also use this vulnerability data, and related finer-grain data, to send extra vaccine doses to the most vulnerable geographic areas. Although states were given some flexibility to determine their own vaccination plans, informed by CDC guidance, it is not yet clear the extent to which states actually used vulnerability data to determine vaccine priorities and distribution.[166]

The second consideration suggests that to address the vulnerability of the most vulnerable counties, it is imperative that vaccine distributions ensure equitable access for members of vulnerable racial groups and effectively prioritize such access, consistent with any constraints imposed by the Fourteenth Amendment. Unfortunately, early data on COVID-19 vaccinations suggested that the opposite was happening. Vaccination rates for Black people and other minorities lagged in many areas in the early days of distribution, and wealthier zip codes tended to have higher vaccination rates than lower-income zip codes.[167]

The reasons for these early patterns are myriad. First, despite the CDC's recommendations, many states—including Texas and Florida—decided to prioritize older people over essential workers.[168] Second, on January 12, 2021, the Trump Administration urged states to speed vaccination by opening up eligibility immediately to everyone over the age of sixty-five, rather than to essential workers, such as "grocery, agricultural and transportation workers," and those

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[166] Many states announced plans to use the CDC's SVI in some way. *See* Maria Eloisa Capurro, *States Count on an Index for Vaccinating Those Most in Need*, BLOOMBERG (Dec. 14, 2020), https://www.bloomberg.com/news/articles/2020-12-14/who-gets-covid-vaccine-first-tool-will-help-ensure-equitable-shot-distribution [https://perma.cc/6F3Q-3C7J] (reporting that "at least 26 states and Washington, D.C." plan to rely on the CDC's SVI to help determine vaccine prioritization, with Tennessee having the "clearest plan" to follow NASEM's proposal "to reserve and distribute 10% of the vaccines it receives in the most vulnerable geographic areas"). It is less clear, however, how many states have actually done so.

[167] *See, e.g.*, Hanks & Conarck, *supra* note 56 (noting that demographic data on vaccinations demonstrate "that just 6% of the 138,000 people who received a COVID vaccine in Miami-Dade are Black in a county with a 17% Black population"); *id.* ("New state data on vaccinations by ZIP codes map out a familiar pattern for the coronavirus pandemic. Just as low-income neighborhoods tended to get hit harder by COVID-19 spread, wealthier neighborhoods are getting their shots at a faster rate."). Over time, the story of vaccination in the United States has become more complicated—vaccination rates of Latinx and Asian people have outpaced both Black and white people; however, Latinx people have trailed almost every racial group in the percentage of eligible people opting to receive booster shots. *COVID Data Tracker: COVID-19 Vaccination Equity*, CDC, https://covid.cdc.gov/covid-data-tracker/#vaccination-equity [https://perma.cc/TWY6-Q8Z5].

[168] Isaac Stanley-Becker, *Some States Buck Federal Vaccine Recommendations and Prioritize the Elderly Over Essential Workers*, WASH. POST (Dec. 29, 2020), https://www.washingtonpost.com/health/2020/12/29/covid-vaccine-priority-group-elderly/ [https://perma.cc/MBJ5-AMP8] (reporting that "Texas, Florida, and some other Republican-led states are bucking federal advice to provide early doses of the new coronavirus vaccines to front-line workers, choosing instead to prioritize the elderly").

seventy-five and older.[169] These decisions undermined the occupation-as-proxy for race approach.[170]

Third, even in states that prioritized essential workers on par with older individuals, the vaccination gap between white people and other racial groups was likely exacerbated by the online vaccine sign-up process in many states. The online process favors those who can easily access the Internet at any time of the day, who can expend significant time checking health department websites or social media for information about appointment availability, and who have friends and family who have the time and resources to help them navigate the system.[171] As John Hopkins Professor Alexandre White explains, "If you focus on speed, those who are most easily accessible will be the ones who receive the most care, and those who have been historically isolated from healthcare access . . . will be the ones most likely to suffer without vaccine coverage."[172] Vaccination efforts thus fell well short of the concerted effort required to reach traditionally underserved populations who also exhibit high levels of distrust in government and vaccine hesitancy.

Would using a vulnerability index like ours, that uses a place-based proxy for race, to guide vaccine prioritization have been a more effective approach for achieving vaccine equity? The answer probably depends on the details of distribution logistics and the extent of outreach to vulnerable communities. Even data-driven attempts to equalize resources between areas or to promote more equitable outcomes by targeting disadvantaged areas for resource infusions may be thwarted when richer, white citizens can easily avail themselves of the resources allocated to vulnerable neighborhoods. When vaccine rollout began, there were widespread reports of white, wealthier residents with easy computer access, more flexible work schedules, and time to navigate complex online distribution regimes appropriating appointment slots in many low-income, minority neighborhoods.[173] Some of these people even crossed state

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[169] *See* Selena Simmons-Duffin & Pien Huang, *Trump Administration Urges States to Open COVID-19 Vaccination to Everyone Over 65*, NPR (Jan. 12, 2021), https://www.npr.org/sections/health-shots/2021/01/12/956017635 [https://perma.cc/YGC9-FBYU].

[170] Hanks & Conarck, *supra* note 56 (explaining that "[i]nequities have been worsened in part" by vaccination plans that "skipped over essential workers, who often are low-income and disproportionately people of color, in favor of senior citizens").

[171] *See id.*

[172] *Id.* (quoting Alexandre White, Assistant Professor, Johns Hopkins Univ.) (omission in the original).

[173] *See, e.g.*, Sean McMinn et al., *Across the South COVID-19 Vaccine Sites Missing from Black and Hispanic Neighborhoods*, NPR (Feb. 5, 2021), https://www.npr.org/2021/02/05/962946721 [https://perma.cc/9DN7-WFRK]. The same phenomenon was observed when San Antonio tried to address disparities in COVID-19 testing access by using its geographic equity matrix. *See Equity Matrix & Demographic Indicator Maps*, CITY OF SAN ANTONIO OFF. OF EQUITY, https://cosagis.maps.arcgis.com/apps/MapSeries/index.html?appid=184271d3b89748e5b6ba183463da804a [https://perma.cc/

borders to do so.[174] Moreover, targeted outreach and careful messaging to racial minorities and lower-income people will be required to mitigate distrust and vaccine hesitancy among these groups.

These examples demonstrate the limitations of a place-based approach to addressing vulnerability. One might try to compensate for some of these failings by imposing stricter limitations on who can obtain vaccinations at a particular location, but enforcement would likely necessitate that people show identification or address verification. This, in turn, would create additional access hurdles for vulnerable populations, in general, and undocumented residents, in particular. It might be more effective to use spatial vulnerability data to determine where more targeted distribution mechanisms are needed, such as providing vaccinations through employers like grocery stores and agricultural companies, and where developing targeted messaging to vulnerable groups is critical.

The next Part continues the vaccination discussion, as we address another aspect of vulnerability.

IV. POLITICAL VULNERABILITY

Political vulnerability represents another critical facet of disaster vulnerability. We use this term to encompass a variety of ways that disasters make already-vulnerable groups even more vulnerable to certain kinds of harm. Like the other forms of vulnerability that we have discussed, political vulnerability overlaps with, reinforces, and is reinforced by other types of vulnerability. Nonetheless, because disasters often provide opportunities for political elites and special interests to weaponize communities' vulnerability against them—and because vulnerability data can sometimes provide a blueprint for exploitation—it is critical to identify and explore these additional aspects of disaster vulnerability. This Part discusses several dimensions of political vulnerability, including political neglect,[175] stigmatization,[176] disenfranchisement,[177] displacement,[178] and other forms of exploitation.[179]

77QD-DEST]. The city used the matrix to map locations for "three cost-free pop-up sites that rotate[d] around different parts of the city each week." Kim et al., *supra* note 54. Unfortunately, these testing centers quickly became overwhelmed as residents from across the city flocked to the sites to take advantage of testing that was easily accessible for free and without a doctor's referral. The government testing sites thus became "part of the disparity by concentrating demand even as they seek to address it in underserved neighborhoods." *Id.*

[174] *E.g.*, Simon Romero, Amy Harmon, Lucy Tompkins & Giulia McDonnell Nieto del Rio, *Can't Get a Shot? Thousands of 'Vaccine Hunters' Are Crossing State Borders to Get Theirs*, N.Y. TIMES, https://www.nytimes.com/2021/02/04/us/covid-vaccines-crossing-states.html [https://perma.cc/J6JN-JU9K] (Feb. 11, 2021).

[175] *See infra* Section IV.A.

[176] *See infra* Section IV.B.

[177] *See infra* Section IV.C.

A. Political Neglect

One important aspect of political vulnerability is political neglect, which might occur inadvertently or intentionally. Neglect manifests itself in two main ways. First, we might see a lack of political will to address harms to some vulnerable populations but not others. Alternatively, neglect might take a more extreme form and undermine efforts to address vulnerability to a disaster more broadly. For example, a disaster's disproportionate impact on vulnerable populations might undermine the political will to mobilize disaster aid and adopt mitigation measures or undermine the public's willingness to comply with those measures.

As to neglect that falls unevenly among vulnerable populations, this may be complicated by the already challenging dynamics of competing vulnerable populations jockeying for resources, such as vaccinations. Figure 6 illustrates how this competition for resources can deepen disparities and disadvantage the most vulnerable. Comparing vaccination data to mortality data and even case count data in Chicago demonstrates that, as vaccines first became available, the most vaccinated zip codes were those that faced the least risk from COVID-19.

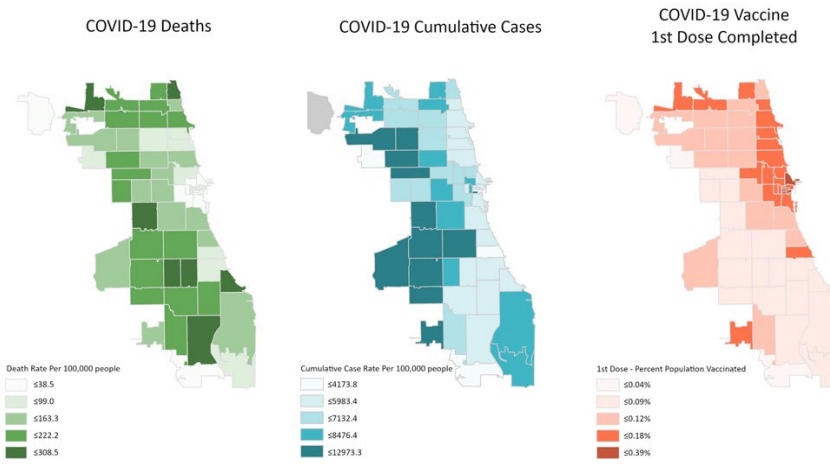

Figure 6. COVID-19 Deaths and Cumulative Cases (Case Counts) Compared to Vaccines at the Zip Code Level in February 2021.

Although these maps underscore the depth of the vaccination disparity and the importance of public data more generally, the availability of both of these maps and the detailed data necessary to make them were not enough to

[178] *See infra* Section IV.D.
[179] *See infra* Section IV.E.

prevent the problem. This result indicates a disturbing level of neglect toward vulnerable populations. Further, this striking result only surfaced because the city of Chicago regularly updates its publicly available vaccination database by zip code.[180] In contrast, some states report little to no data about vaccination rates by geographic area or by race.[181] Although most counties do not report such meticulous data, for the counties that do, San Diego,[182] New York,[183] and Maricopa County in Phoenix note similar trends.[184]

Research conducted in the aftermath of Hurricane Katrina revealed a second manifestation of neglect: lower willingness to support disaster aid for people of color. One study that varied the apparent race or ethnicity of Hurricane Katrina victims featured in news coverage found that respondents supported significantly less generous government disaster assistance for Black victims than for white victims.[185] The authors concluded that their "results suggest that public support for large-scale governmental relief efforts is weakened when hurricane victims are disproportionately African American."[186] Perhaps cognizant of these dynamics, government officials and reporters sometimes attempt to make deaths more relatable by arguing that the vulnerable people who are dying are, in fact, just like everyone else—even when they are not.[187]

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[180] *See COVID-19 Vaccinations by Zip Code*, CHI. DATA PORTAL, https://data.cityofchicago.org/Health-Human-Services/COVID-19-Vaccinations-by-ZIP-Code/553k-3xzc [https://perma.cc/BTB6-D3WD] (Feb. 10, 2022).

[181] *See* Emily Zylla, Sydney Bernard & Elizabeth Lukanen, SHADAC, *Ensuring Equity: State Strategies for Monitoring COVID-19 Vaccination Rates by Race and Other Priority Populations*, PRINCETON UNIV. (June 3, 2021), https://www.shvs.org/ensuring-equity-state-strategies-for-monitoring-covid-19-vaccination-rates-by-race-and-other-priority-populations [https://perma.cc/JPU6-DRGN].

[182] *See* Jared Aarons, *In Depth: San Diego's 'Vaccine Gap' Concerns Minority Leaders*, ABC 10NEWS SAN DIEGO, https://www.10news.com/news/coronavirus/in-depth-san-diegos-vaccine-gap-concerns-minority-leaders [https://perma.cc/D39Q-MYUG] (Apr. 18, 2021).

[183] *See* Troy Closson, *Stark Disparities in Vaccine Rollout by ZIP Code*, N.Y. TIMES (Feb. 17, 2021), https://www.nytimes.com/2021/02/17/nyregion/vaccine-rollout-neighborhood-numbers.html [https://perma.cc/U8JW-L7DG].

[184] *See Data Shows Large Differences in Vaccination Rates Between Maricopa County's ZIP Codes*, ARIZONA'S FAM. (Feb. 12, 2021), https://www.azfamily.com/news/continuing_coverage/coronavirus_coverage/data-shows-large-differences-in-vaccination-rates-between-maricopa-countys-zip-codes/article_153eef32-6d99-11eb-b1c8-9f2fbc3fbcd5.html [https://perma.cc/48MV-U67G].

[185] Shanto Iyengar & Kyu S. Hahn, Natural Disasters in Black and White: How Racial Cues Influenced Public Response to Hurricane Katrina 12 (June 10, 2007) (unpublished manuscript), http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.172.1342&rep=rep1&type=pdf [https://perma.cc/W744-W7N5].

[186] *Id.*; *see* ROBERT R.M. VERCHICK, FACING CATASTROPHE: ENVIRONMENTAL ACTION FOR A POST-KATRINA WORLD 160–64 (2010) (discussing studies suggesting that "unconscious bias" might affect how much disaster aid minority individuals and communities receive).

[187] KLINENBERG, *supra* note 24, at 213 (describing how journalists tried to draw readers into stories about the Chicago heat wave with headlines that portrayed the victims as "just like" the average reader, even though, in fact, most victims were poor, older, and ill).

One might expect these dynamics to play out somewhat differently in a pandemic because everyone is experiencing it—everyone is at some level of risk—and experiencing it for a long time. We might well expect that political will and individual commitment to implementing public health measures would wane, as COVID-19 exhaustion sets in. Whether or not the universal risk makes people more or less sympathetic to public-health calls to protect the vulnerable seems a more complicated question. In some respects, the pandemic might underscore our interconnectedness because our health and well-being during the pandemic is, to some extent, intertwined with everyone else's. Failure to protect the vulnerable from COVID-19 might interrupt food and other supply chains, deepen economic damage, and allow more deadly, contagious, and resistant strains of the virus to emerge.[188] At the same time, the fact that everyone is at some risk means that everyone's self-interest is more directly in play than when choosing, for example, whether to donate to a particular disaster cause or to support federal relief for a disaster in another state. Some people might feel differently about prioritizing vaccines for vulnerable populations if it means they must wait longer themselves.

Additionally, the widespread risk might lead less vulnerable people to manage their COVID-19 anxiety by creating psychological distance between themselves and vulnerable victims, by treating the victims as "other." The public focus on vulnerability—the familiar reciting of the ages, preexisting conditions, and other demographic characteristics of COVID-19 victims that made them vulnerable to the worst outcomes—often seems more a way of separating the majority from the victims (reinforcing an aura of relative safety and perhaps justifying more personal risk-taking) than an expression of empathy or concern for addressing either the underlying vulnerabilities or the public health measures that could mitigate risk to the most vulnerable.

Research of such "othering," in different contexts shows decreased empathy.[189] As one commentator observed, "Part of the reason this majority-white, majority-non-elderly country has been so blasé about COVID-19 deaths is that mostly Black people and old people are dying."[190] That creation of psychologi-

[188] *See supra* note 61 and accompanying text.

[189] *See* Olga Khazan, *A Failure of Empathy Led to 200,000 Deaths. It Has Deep Roots.*, THE ATLANTIC (Sept. 22, 2020), https://www.theatlantic.com/politics/archive/2020/09/covid-death-toll-us-empathy-elderly/616379/ [https://perma.cc/D5RN-X85J].

[190] *See id.* (arguing that "[w]hite people's brains psychologically sort minorities as 'out-groups' that stir less empathy").

cal distance is likely aided by geographic distance—rooted in segregation and reflected in our maps—between the more privileged and the most vulnerable.[191]

Our two thousand-person survey, fielded between September 23 and October 2, 2020,[192] may suggest that people are more willing—or at least say they are more willing—to sacrifice for the vulnerable than the discussion thus far suggests. Participants were asked two questions about vaccine prioritization: one about prioritizing "high-risk groups" and the other about prioritizing "essential workers."[193]

For the first question, participants were asked: Should "high-risk groups" be given priority to receive the vaccine before other people? Half of our sample was randomly given a version of this prompt that asked about "high risk groups like the elderly and people with preexisting conditions," whereas the others saw a version that said, "high risk groups like racial minorities and low-income people."[194] Around eighty-three percent of participants supported vaccine prioritization for high-risk groups like the elderly and those with preexisting conditions; support dropped to seventy percent for prioritization of racial minorities and those experiencing poverty. All racial and ethnic groups and all income levels expressed less support for prioritizing racial minorities and poor people than for prioritizing the elderly and those with preexisting conditions, with Black participants exhibiting the largest drop in support for prioritizing minorities and low-income people[195] and the lowest-income groups exhibiting the smallest drop in support.[196] For both prompts, racial minorities and low-income people were significantly less supportive of giving vaccine priorities to high-risk groups. The lower support for high-risk-group prioritization among minorities is somewhat puzzling. It could reflect vaccine hesitancy rather than unwillingness to prioritize vulnerable groups.[197] It could also suggest the desire

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[191] *See id.* ("Segregated neighborhoods have also helped insulate white Americans from the horror Black Americans face, because the ambulance sirens and the packed hospital wards are typically far from their own zip codes.").

[192] For a summary of the demographics of and responses from those who participated in our nationwide survey, see Appendix Table 5.

[193] For summarized results, see Appendix Table 7.

[194] *Id.*

[195] *Id.* The average drop in support from framing high-risk individuals as the elderly and those with preexisting conditions to racial minorities and those experiencing poverty was 11.6 points. *Id.* Among Black respondents the drop was 15.0 points. *Id.* The next largest drop was a 12.1-point decrease in support among white respondents. *Id.*

[196] Comparing support of prioritization between "the elderly and people with preexisting conditions" and "racial minorities and low-income people," those at the lowest income levels had the lowest drops in percentage of support (with <100% FPL and 100–150% FPL dropping only 7 and 9 points, respectively). For summarized results, see Appendix Table 7.

[197] *See infra* Part IV.E.

not to feel somehow stigmatized by being given a place in the front of the line or the fear of potential backlash that such prioritization might provoke.[198]

We also asked survey participants how willing they were to support aggressive public health measures to protect high-risk groups and essential workers by limiting the spread of COVID-19. Across the board, respondents indicated high levels of support for aggressive public health measures, with 88% strongly or somewhat supportive of taking those measures. These numbers were high across all race and ethnic groups. Respondents below 100% of the FPL and those without a college degree were the only groups that exhibited a statistically significant lower level of support, although those numbers were still above 80%.[199]

These numbers suggest strong support for taking steps to protect vulnerable populations, yet we recognize that expressed support may be more aspirational than real. Moreover, the data shows that people were more willing to prioritize the elderly and those with preexisting conditions for vaccine distribution than racial minorities and those experiencing poverty. This was even (and sometimes especially) true for the very groups such a priority would ostensibly benefit, perhaps because of vaccine-hesitancy or fear of being stigmatized. These survey results suggest both the need for sensitive outreach to these groups and the difficulty of addressing long-standing, deep vulnerabilities—and the distrust that disparities breed—under the time pressure disasters create. Addressing vulnerability during disasters will not be enough without addressing underlying vulnerability and distrust outside moments of crisis.

The potential lack of political will to take adequate measures to protect the most vulnerable also underscores the inherent flaw in state policies that block local jurisdictions from implementing independent public health directives, like mask mandates and localized lockdowns. These state restrictions silence vulnerable groups whose voices are often louder in local community

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[198] When asked whether "essential workers" should be prioritized for vaccination, people, across the board, expressed even higher levels of support. In one randomized prompt, "essential workers" was modified with "like doctors and nurses" and in the other it was modified with "like hospital janitors." There was no statistically significant difference between the support levels associated with the two prompts (87% for doctors and nurses, 89% for hospital janitors). For summarized results, see Appendix Table 7.

[199] Among respondents below the FPL, 80.4% supported aggressive public health measures to protect high-risk groups and 82.1% to protect essential workers. Among respondents with a high school education or less, the numbers were 82.0% and 83.6%, respectively, and among respondents with some college (but no degree), the numbers were 83.9% and 84.84%, respectively. These respondents may feel the economic pinch of aggressive public health measures like lockdowns more acutely than other groups. For summarized results, see Appendix Table 7.

settings. As such, these state-wide decrees, such as bans on local mask mandates, frustrate the capacity for vulnerable communities to protect themselves.[200]

B. Stigmatization

Vulnerability-informed disaster-response measures must also consider the potential stigmatization that vulnerable communities might endure as a by-product of receiving specially targeted resources or public health measures.[201] Stigmatization might be inadvertent. It could also be part of a concerted government effort to shift blame for the disaster, justify withholding information, or implement harsh crackdowns in certain areas.[202] During the COVID-19 pandemic, the possibility of stigma is perhaps most acute in the localized implementation of public health measures that suggest (directly or indirectly) that a particular community is a hotspot for disease.[203]

Thus, the possibility of stigma might be particularly relevant to mask mandates, one of our modeling examples. If, for example, vulnerability data suggests that mask mandates are most needed in predominantly poor, minority neighborhoods, authorities might choose to implement mask mandates only in those communities. Communities requiring masks might then be stigmatized as particularly dangerous or infectious places—as epicenters of disease—that should be avoided. That association between poorer, nonwhite communities and disease might damage those communities' businesses and even fuel narratives of blame that could increase prejudice and hate crimes.

Consider, for example, what might happen if policy-makers in Manhattan were to use census-block-level vulnerability data to determine where to mandate masks: Chinatown and the adjacent Lower East Side—considered "the only remaining working-class neighborhoods in Manhattan south of Central

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[200] *Cf.* Romer v. Evans, 517 U.S. 620, 631–33 (1996) (invalidating, as a violation of equal protection, a Colorado constitutional amendment that forbade localities from adopting anti-discrimination laws to protect gay, lesbian, or bisexual individuals).

[201] Some have suggested, for example, that prioritizing BIPOC people for early vaccination might inadvertently stigmatize BIPOC individuals and communities as victims or spreaders/carriers of disease. *See, e.g.*, Sigal Samuel, *Should People of Color Get Access to the Covid-19 Vaccine Before Others?*, VOX (Oct. 28, 2020), https://www.vox.com/future-perfect/2020/10/2/21493933/covid-19-vaccine-black-latino-priority-access [https://perma.cc/KRP3-NND4].

[202] *See* Lisa Grow Sun & RonNell Andersen Jones, *Disaggregating Disasters*, 60 UCLA L. REV. 884, 886–87 (2013).

[203] *Cf. Reducing Stigma*, CDC, https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/reducing-stigma.html [https://perma.cc/6TY6-4XKF] (July 22, 2021) (observing that "[f]ear and anxiety about a disease can lead to social stigma" and that "stigma and discrimination can occur when people link a disease, such as COVID-19, with a population, community, or nationality").

Park"[204]—would be obvious candidates for a mask mandate. As illustrated in Figure 7, their relative vulnerability jumps out on this vulnerability map based on the CDC's block-level Social Vulnerability Index (SVI).

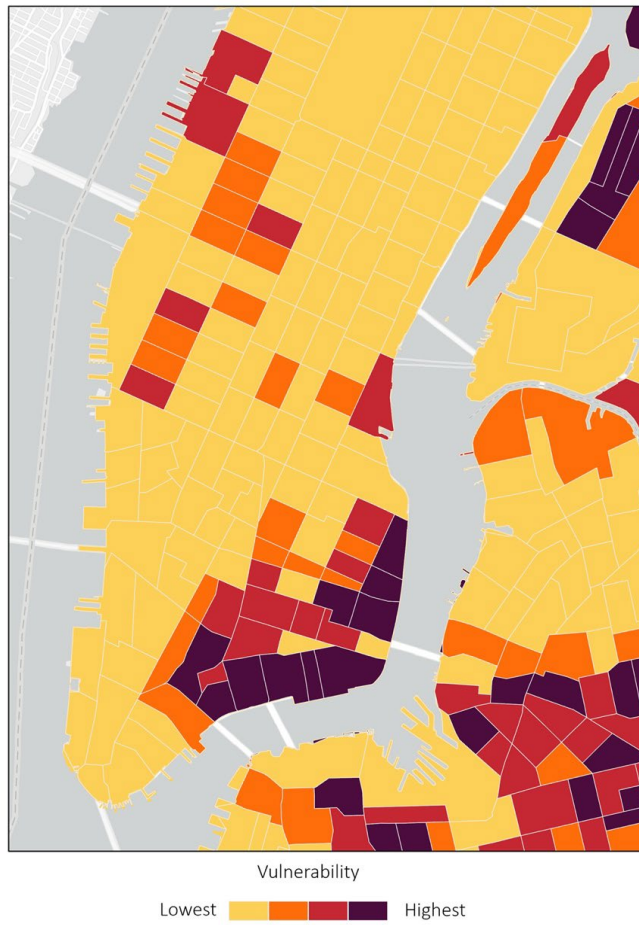

Figure 7. The CDC's Social Vulnerability Index at the Census-block Level for Manhattan.

These neighborhoods are pockets of "high" and "extreme" vulnerability in a sea of "low" and "moderate" vulnerability areas. If policy-makers chose to implement mask mandates in Lower Manhattan only in the Lower East Side

[204] Sarah Ngu, *Will Luxury Towers Edge Out the Last of the Working-Class Chinese in New York's Iconic Chinatown?*, VOX, https://www.vox.com/the-highlight/2019/9/18/20861446/new-york-city-chinatown-gentrification-lower-east-side [https://perma.cc/92A3-R9VL] (Sept. 25, 2019).

and Chinatown neighborhoods, this area—which is lower-income, more heavily Asian-American, and much more racially diverse generally than most of Manhattan—might be stigmatized as a COVID-19 hotspot.[205]

This possibility is especially concerning given the long history of stigmatizing and blaming predominantly minority or low-income neighborhoods during disease outbreaks.[206] There is particular reason to be sensitive to this in the context of COVID-19 because Chinatowns across the country have already been a target of prejudice. Bias against Chinese Americans and Chinese-American businesses has also increased during the pandemic, fueled at least in part by the "China virus" rhetoric of President Donald Trump and others.[207]

Although Chinatowns may present a worst-case scenario for COVID-19 stigmatization, this pattern holds more generally as well. Neighborhoods with high levels of COVID-19 vulnerability are also highly vulnerable to stigmatization. Research has demonstrated, for example, that white people are even more likely to hold negative racially stereotyped views of Black neighborhoods than of Black people, with Black neighborhoods perceived as "impoverished and undesirable,"[208] "crime-ridden," "rundown," "dangerous," and "dirty."[209] More

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[205] *See Lower East Side/Chinatown MN03*, NYU FURMAN CTR., https://furmancenter.org/neighborhoods/view/lower-east-side-chinatown [https://perma.cc/NF6J-LUYH]. In 2019, "32.8% of the [Lower East Side/Chinatown] population identified as Asian, 7.6% identified as Black, 25.4% identified as Hispanic, and 30.3% identified as white." *Id.* The poverty rate was 24% (versus 16% citywide), and the median household income "was $42,010, about 40% less than citywide median household income ($70,590)." *Id.*

[206] *See generally* ADAM KUCHARSKI, THE RULES OF CONTAGION: WHY THINGS SPREAD—AND WHY THEY STOP (2020). For more about the history of the outsized blame placed on minority communities during pandemic or disease, see also Marian Chia-Ming Liu, *The Coronavirus and the Long History of Using Diseases to Justify Xenophobia*, WASH. POST (Feb. 14, 2020), https://www.washingtonpost.com/nation/2020/02/14/coronavirus-long-history-blaming-the-other-public-health-crises/ [https://perma.cc/S35W-3VFE] (explaining that "[w]hat you have over history and throughout modern-day outbreaks is people fixing blame on a contagious disease on outsiders" (quoting Monica Schoch-Spana, Med. Anthropologist, Johns Hopkins Ctr. for Health Sec.)); Robert Klemko, *Coronavirus Has Been Devastating to the Navajo Nation and Help for a Complex Fight Has Been Slow*, WASH. POST. (May 16, 2020), https://www.washingtonpost.com/national/coronavirus-navajo-nation-crisis/2020/05/11/b2a35c4e-91fe-11ea-a0bc-4e9ad4866d21_story.html [https://perma.cc/4F7D-U6NC] (noting that some "community leaders" in towns adjacent to the Navajo Nation have blamed outbreaks on tribal members).

[207] Editorial, *Stop the Coronavirus Stigma Now*, 580 NATURE 165, 165 (2020); Lin Taylor, *As Lunar New Year Arrives, COVID-19 Pushes Chinatown Businesses to the Brink*, JAPAN TIMES (Feb. 12, 2021), https://www.japantimes.co.jp/news/2021/02/12/world/chinatowns-coronavirus-impact/ [https://perma.cc/K7G2-ZDWW] (recounting how "Chinatowns, in particular, have been hit harder and for longer [by COVID-19's economic impacts], partly due to xenophobia related to the origins of COVID-19, which led to an avoidance of the area").

[208] Courtney Bonam, Caitlyn Yantis & Valerie Jones Taylor, *Invisible Middle-Class Black Space: Asymmetrical Person and Space Stereotyping at the Race-Class Nexus*, 23 GRP. PROCESSES & INTERGROUP RELS. 24, 24 (2018).

[209] Courtney M. Bonam, Hilary B. Bergsieker & Jennifer L. Eberhardt, *Polluting Black Space*, 145 J. EXPERIMENTAL PSYCH. 1561, 1566 & fig.2 (finding that people hold a "negative and prevalent

generally, research has found that "[a]s the concentration of minority groups and poverty [in a neighborhood] increases, residents of all races perceive heightened disorder" and decay and have a more negative mental picture of the area.[210] Vulnerability-driven mask mandates might compound and reinforce these preexisting associations.

Other targeted COVID-19 response measures—such as imposing more aggressive lockdowns, prioritizing certain neighborhoods for vaccination, or enforcing stricter school closures—might likewise risk stigmatization.[211] Even more troubling, vulnerability data might serve as convenient political or legal cover for imposing harsher disease-control measures motivated, at least in part, by racism or other prejudice. In Hong Kong, for example, the government has imposed "'pop-up' lockdowns" in impoverished areas with larger South Asian minority populations[212] who have been long-standing targets for discrimination in Hong Kong and who have frequently been blamed for COVID-19 outbreaks.[213] In such instances, targeted measures may reflect and deepen discrimination and stigma.

At least in those cases in which stigma is an unintended byproduct of well-intentioned policy, the risk of stigmatization can sometimes be ameliorated by choosing a different geographic unit as the locus for decision-making. In our mask mandate modeling, for instance, our vulnerability data is county-level data and, although it is certainly possible that a whole county could be stigmatized as a COVID-19 hotspot, that seems much less likely than stigmatizing a particular neighborhood.[214] Similarly, county-wide lockdowns may be

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picture of Black space as failing: physically degraded, unpleasant, unsafe, and lacking resources," which "suggests lay people (likely irrespective of race) are aware of a generalized image of Black areas that echoes the U.S. historical legacy of confining Black Americans to impoverished, blighted spaces").

[210] Robert J. Sampson & Stephen W. Raudenbush, *Seeing Disorder: Neighborhood Stigma and the Social Construction of "Broken Windows,"* 67 SOC. PSYCH. Q. 319, 319 (2004); *see also id.* at 320 (arguing that "[r]esearch on implicit bias and cultural stereotyping suggests that Americans hold persistent beliefs linking blacks and disadvantaged minority groups to many social images, including but not limited to crime, violence, disorder, welfare, and undesirability as neighbors" and that these beliefs "are reinforced by the historical association of nonvoluntary racial segregation with concentrated poverty, which in turn is linked to institutional disinvestments and neighborhood decline").

[211] *See* Samuel, *supra* note 201 (discussing potential vaccine-prioritization stigma). On the flip side, a decision to prioritize in-person school instruction for certain neighborhoods or students—because of high social vulnerability, limited access to online learning, or other related factors—might stigmatize those school communities, or the particular students singled out, as underperforming, underachieving, or substandard.

[212] Theodora Yu & Shibani Mahtani, *Wave of Coronavirus Cases Brings a Tide of Racism in Hong Kong*, WASH. POST (Feb. 11, 2021), https://www.washingtonpost.com/world/asia_pacific/hong-kong-coronavirus-racism-lockdown/2021/02/11/80ce8aee-6765-11eb-bab8-707f8769d785_story.html [https://perma.cc/D37E-5YCW].

[213] *See id.*

[214] This argument may be less persuasive in states where counties are relatively small.

less stigmatizing than neighborhood lockdowns. State-wide mask mandates or lockdowns seem unlikely to generate any stigma at all. This suggests that minimizing the risk of stigma should be one factor in deciding the geographic unit at which data will be analyzed and in determining which jurisdictional level should impose public health measures.

Some researchers have suggested that the very notion of "vulnerability" is itself stigmatizing and can be used to undermine the competence and humanity of disaster survivors and thus justify denying them a voice in their own recovery. On this view, vulnerability discourse can be an "instrument of marginalization and pretext for intervention."[215] At the international scale, for example, researchers have argued that the vulnerability construct was used in the aftermath of Haiti's devastating 2010 earthquake to sideline the Haitian government in recovery efforts, which "naturalized foreign control and reduced the Haitian people to objects of aid in a 'top-down, militarized, foreign-led response.'"[216] This example suggests the need for continuing reflection on the language and impacts of vulnerability discourse and the possibility of reconceptualizing or reframing vulnerability in ways that minimize these risks.[217]

C. Disenfranchisement

As our discussion on accommodations provided to voters in Section III.C suggests, the failure by some states and counties to prioritize protecting vulnerable voters during the COVID-19 pandemic threatened to, and likely did, suppress the vote among vulnerable populations. It is, of course, hard to prove a counterfactual: What would turnout have been among lower-income, older, minority voters if every county had opted for automatic mail-in ballots, the safest voting process, for every citizen? But, there is good reason to believe that some of these voters, faced with the choice of risking their health (or even their lives) to vote, forfeited their right to vote because they could not cast their ballot

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[215] Lei Sun & A.J. Faas, *Social Production of Disasters and Disaster Social Constructs: An Exercise in Disambiguation and Reframing*, 27 DISASTER PREVENTION & MGMT. 623, 629 (2018) (emphasis omitted).

[216] *Id.* (quoting Mark Schuller, *"The Tremors Felt Round the World": Haiti's Earthquake as Global Imagined Community*, *in* CONTEXTUALIZING DISASTER 66, 80 (Gregory V. Button & Mark Schuller eds., 2016)).

[217] One might even consider abandoning the vulnerability construct itself, in favor of other terminology or concepts, but it is unclear whether other proposed terminology (like "low resilience") is better at treating disaster survivors more as actors than objects. At least one legal scholar has pushed in the opposite direction, suggesting a more expansive view of vulnerability that recognizes our "common vulnerabilities." Martha Albertson Fineman, *The Vulnerable Subject: Anchoring Equality in the Human Condition*, 20 YALE J.L. & FEMINISM 1, 1–2 (2008) (arguing that "the 'vulnerable subject' must replace the autonomous and independent subject asserted in the liberal tradition" and would lead to a richer understanding of equality than "our current legal doctrine").

safely. Our data shows that millions of voters had to make that choice in places like New Orleans, Louisiana; Jackson, Mississippi; and Houston, Texas.[218]

In some counties, this voter suppression may have been the unintended consequence of political paralysis or a misguided attempt to protect election integrity, but in others, it may well have been intentional.[219] The history of overt voter suppression in the states that have been most resistant to COVID-19 voting changes makes this latter possibility all the more plausible. The worst offenders—including Texas, Louisiana, Mississippi and Tennessee—are states with long, ugly histories of voter suppression.[220] It is hard to view Texas Governor Greg Abbott's decision to limit all of Harris County to one absentee-ballot drop box location, for example, as anything other than a transparent ploy to make absentee voting even more difficult for the limited number of vulnerable Harris County residents who were able to qualify for an absentee ballot.[221] As we show in other work, Texas election officials' choice to limit absentee ballots only to those over age sixty-five left the most vulnerable counties completely exposed.[222]

Once we had constructed our vulnerability index and identified the most at-risk counties, our team of researchers worried that our data could be used as a blueprint during the 2020 presidential election to suppress the vote among vulnerable voters by making clear how little some state and local officials had done to allow people to vote safely. If the data had been available even earlier in the process, election officials intent on suppressing the vote might have used it to deter vulnerable voters by making polling places in the most vulnerable counties feel even more unsafe by lifting mask mandates or limiting polling places to ensure longer lines. In fact, as we shared earlier drafts of our work that focused on voter risks prior to the election, reviewers worried that political

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[218] For summarized results, see Appendix Table 2.

[219] *See, e.g.*, Emily Bazelon, *Will Americans Lose Their Right to Vote in the Pandemic?*, N.Y. TIMES MAG., https://www.nytimes.com/2020/05/05/magazine/voting-by-mail-2020-covid.html [https://perma.cc/BJ6B-DUL4] (July 18, 2021) (reporting that some state officials cited potential fraud as a reason not to expand mail-in voting).

[220] Each of these states was a covered jurisdiction under section 5 of the Voting Rights Act. *Jurisdictions Previously Covered by Section 5*, DEP'T OF JUST., https://www.justice.gov/crt/jurisdictions-previously-covered-section-5 [https://perma.cc/RNA2-5ZD2] (Nov. 29, 2021).

[221] Harris County, "a Democratic stronghold" that includes Houston, spans some 1,700 square miles. Emma Platoff, *Voters, Voting Rights Groups Sue Gov. Greg Abbott Over Order to Close Ballot Drop-Off Locations*, TEX. TRIB., https://www.texastribune.org/2020/10/02/texas-greg-abbott-ballot-drop-lawsuit/ [https://perma.cc/3R4P-8NFA] (Oct. 3, 2020). It is approximately 41% Hispanic, 18% Black, 6% Asian, and 31% white. John D. Harden, *Five Maps Illustrate Houston's Racial-Ethnic Breakdown by Neighborhood*, HOUS. CHRON., https://www.chron.com/houston/article/Five-maps-illustrating-Houston-s-racial-breakdown-12711221.php [https://perma.cc/N6W5-3XNE] (Feb. 27, 2018). County officials had arranged for multiple drop boxes throughout the county until the Republican governor ordered them closed. Platoff, *supra*.

[222] *See* our forthcoming paper, Spencer et al., *supra* note 22.

opportunists might use it to strategically scare off voters. This potential for exploitation is always present with vulnerability data, although officials likely already have some sense of the demographics of different neighborhoods in their jurisdiction. More detailed data may simply allow them to refine their exploitative strategies.

Disasters like the pandemic force us to confront how holding typical in-person elections, without modification, in disaster's wake may systematically disenfranchise vulnerable voters.[223] After a major disaster like a hurricane or flood, many residents will be displaced from their homes—sometimes at quite long distances and across state lines. After Hurricane Katrina struck in August 2005, many New Orleans residents were displaced to nearby Baton Rouge, but many others temporarily settled across state lines in Atlanta, Memphis, Jackson, and Houston.[224] When New Orleans's mayoral elections were held the following spring, approximately "two-thirds of the city's population" was gone.[225] Wealthier evacuees might have had the means to travel back to New Orleans to vote, whereas poorer voters "in exile,"[226] particularly those out-of-state, would almost certainly have been disenfranchised without significant expansion of absentee voting.[227]

Although the most vulnerable to COVID-19 have generally been confined to, rather than displaced from, their homes, they were nonetheless voters "in exile" from traditional in-person elections in 2020. Their predicament, captured and clarified by our index and maps, demonstrates the need to be attentive to individual and community vulnerability when shaping voting laws and policies. That means recognizing that voting law reforms that have traditionally been characterized as "convenience voting"—including vote-by-mail, online

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[223] *See* WILLIAM WILDER, BRENNAN CTR. FOR JUST., VOTER SUPPRESSION IN 2020, at 3 (2021), https://www.brennancenter.org/sites/default/files/2021-08/2021_08_Racial_Voter_Suppression_2020.pdf [https://perma.cc/SGU6-KVTF] (elucidating on the insidious racially discriminatory practices that permeated the 2020 elections, "including new restrictive legislation, discriminatory voter roll purges, long lines and closed polling places, voter intimidation and misinformation, and efforts to overthrow . . . or invalidat[e]" the results).

[224] Brian Brox, *Elections and Voting in Post-Katrina New Orleans*, S. STUD., Fall/Winter 2009, at 1, 3; Laura Bliss, *10 Years Later, There's So Much We Don't Know About Where Katrina Survivors Ended Up*, BLOOMBERG CITYLAB (Aug. 25, 2015), https://www.bloomberg.com/news/articles/2015-08-25/8-maps-of-displacement-and-return-in-new-orleans-after-katrina [https://perma.cc/LC88-KP74].

[225] Brox, *supra* note 224, at 2–3.

[226] *Cf.* NAOMI KLEIN, THE SHOCK DOCTRINE: THE RISE OF DISASTER CAPITALISM 5 (2007) ("Within nineteen months [of Hurricane Katrina], with most of the city's poor residents still in exile, New Orleans' public school system had been almost completely replaced by privately run charter schools.").

[227] Even with these accommodations, voter turnout was lower than in the prior mayoral election. *See* Brox, *supra* note 224, at 13.

voter registration, and early voting—may actually be "survival voting" for vulnerable voters.[228]

Disenfranchisement post-disaster may also take forms other than voter suppression. Disasters also present an opportunity for decision-makers to exploit a community's heightened vulnerability during and after the disaster to make decisions without community input that undermine the community's well-being, or that a majority of the community opposed pre-disaster. For example, immediately post-Katrina, the state took control of New Orleans's already struggling public schools and then closed neighborhood schools, outsourcing the city's education system to privately run charter schools in the nation's most aggressive experiment with market-based school reform.[229]

Post-disaster displacement and damage made organizing against these efforts all but impossible. That decision remains immensely controversial today, with some metrics suggesting improvements in student learning, but others suggesting a system that has failed its most vulnerable students.[230] What is clear is that many of New Orleans's low-income Black residents continue to lament the loss of long-established neighborhood schools that brought communities together, and to decry the strict, "no-excuses" charter schools they say discriminate against and demoralize disadvantaged children.[231] Their experience stands as a stark reminder that vulnerable populations are at-risk post-disaster of being politically steamrolled. In such situations, powerful elites have greater leverage to enact unpopular reforms with minimal, if any, consultation with the most affected populations.

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[228] *See generally* CALTECH/MIT VOTING TECH. PROJECT, VOTING: WHAT IS, *WHAT COULD BE* (2001), https://vote.caltech.edu/reports/1 [https://perma.cc/8VE4-9SPN] (discussing the U.S. voting system and potential reforms). The pandemic has placed some vulnerable voters in the unenviable situation of having to choose between casting a ballot and risking exposure to a disease that they have good reason to believe would be life-threatening. Thus, for those voters, voting accommodations are not about mere convenience but rather about avoiding a non-trivial risk of exposure to a deadly disease.

[229] KLEIN, *supra* note 226, at 5–6; *see* Kenneth J. Saltman, *Schooling in Disaster Capitalism: How the Political Right Is Using Disaster to Privatize Public Schooling*, TCHR. EDUC. Q., Spring 2007, at 131, 131 (critiquing the "grotesque pattern" of corporate takeover and capitalization in communities devastated by disasters); Naomi Klein, *How Power Profits from Disaster*, THE GUARDIAN (July 6, 2017), https://www.theguardian.com/us-news/2017/jul/06/naomi-klein-how-power-profits-from-disaster [https://perma.cc/K8JA-Q38C] (recounting how Milton Friedman, "famed free-market economist," framed Katrina's destruction of schools and displacement of students as a "tragedy" but "also an opportunity to radically reform the educational system").

[230] Colleen Kimmett, *10 Years After Katrina, New Orleans' All-Charter School System Has Proven a Failure*, IN THESE TIMES (Aug. 28, 2015), https://inthesetimes.com/article/10-years-after-katrina-new-orleans-all-charter-district-has-proven-a-failur [https://perma.cc/49DB-VQXS].

[231] *See id.*

D. Displacement

Communities' heightened post-disaster vulnerability has also been weaponized against them to facilitate forced relocation of vulnerable residents. For example, after the 1906 San Francisco earthquake, city elders moved quickly to relocate the city's Chinatown, which—although devastated by the earthquake and subsequent fire—occupied some of San Francisco's most valuable and sought-after real estate.[232] Only the intervention of China's Empress and the threat of losing lucrative Chinese trade dissuaded city officials from permanently exiling Chinatown's displaced residents from their homes.[233]

Similarly, after the 2004 Indian Ocean tsunami, government-mandated "coastal buffer zones" displaced tsunami-ravaged fishing villages from their traditional coastal lands, ostensibly to protect vulnerable residents from future disasters, but also to clear the path for new beachfront luxury resorts.[234]

After Hurricane Katrina in 2005, public housing residents faced a similar threat of displacement (and replacement). Indeed, some politicians seemed to revel in the opportunity that Katrina presented to push poor Black residents out of New Orleans. Soon after Katrina hit, Republican U.S. Congressman Richard Baker of Louisiana said: "We finally cleaned up public housing in New Orleans. We couldn't do it. But God did."[235] Not surprisingly, many public housing residents "suspected that landlords and city decision-makers were deliberately trying to make it as difficult as possible for people like them to return to New Orleans—suspicions that have been largely borne out."[236]

After Katrina, the New Orleans Housing Authority demolished its four largest public housing complexes even though they were located on relatively high ground and many units did not suffer major damage during the storm.[237] The last of the complexes to be demolished was the Iberville Housing Devel-

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[232] *See* Richard Gonzales, *Rebuilding Chinatown After the 1906 Quake*, NPR (Apr. 12, 2006), https://www.npr.org/templates/story/story.php?storyId=5337215 [https://perma.cc/2PWB-P2PT].

[233] *See id.*

[234] *See, e.g.*, ACTIONAID, FISHERIES-BASED LIVELIHOODS IN THE POST-TSUNAMI CONTEXT: PEOPLE'S REPORT, INDIA, THE MALDIVES, SRI LANKA & THAILAND 33 (2007), https://actionaid.org/sites/default/files/fisheries_based_livelihoods_in_the_post-tsunami_context.pdf [https://perma.cc/ZW3E-GB45] (recounting fishers' fears in Sri Lanka, Thailand, and India that their governments were displacing them to make way for resort hotels).

[235] Susan Saulny, *Clamoring to Come Home to New Orleans Projects*, N.Y. TIMES (June 6, 2006), https://www.nytimes.com/2006/06/06/us/nationalspecial/06housing.html [https://perma.cc/CVB6-98GS] (quoting Richard H. Baker, U.S. Representative).

[236] TIERNEY, *supra* note 4, at 140.

[237] *See* Robert D. Bullard & Beverly Wright, *Race, Place, and the Environment in Post-Katrina New Orleans*, *in* RACE, PLACE, AND ENVIRONMENTAL JUSTICE AFTER HURRICANE KATRINA, *supra* note 25, at 19, 28–30.

opment, which had 821 public housing units.[238] Although many of these units were in disrepair and unoccupied,[239] Iberville was still considered the "crown jewel of the projects" and a "gem of Depression-era buildings," occupying a "coveted location next to the French Quarter."[240] By the end of 2019, the government-funded (and still incomplete) mixed-income development on the Iberville site had 300 public housing units, 227 market rate units, and 151 moderately priced units.[241] The other redeveloped complexes lost a much higher percentage of public housing units, with an overall loss of thousands of units.[242] Consequently, although some former public housing residents now have much nicer units, most were left with section 8 vouchers to compete (often unsuccessfully) for private units in a very tight post-storm rental market and many never returned to New Orleans from the cities to which they evacuated.[243]

Some politicians expressed the arguably paternalistic view that New Orleans's poorest residents would be better off staying in the communities where they relocated, despite most residents' expressed desire to return to their former homes. For the most part, however, research does not show that Katrina's survivors were better off in the cities where they were relocated in the storm's immediate aftermath.[244] Nonetheless, this remains a common tactic: casting post-disaster measures that target and harm vulnerable populations as efforts to protect those groups.

Although COVID-19 has not directly damaged property in ways that promote turnover and gentrification, the pandemic nonetheless threatens disaster gentrification analogous to that observed in past disasters.[245] Evictions in vulnerable neighborhoods are on the rise since the eviction ban expired,[246]

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[238] Jessica Williams, *Former Iberville Housing Complex Reimagined as New Community: 'It Changed for the Better,'* NOLA.COM, https://www.nola.com/news/politics/article_23e7220a-057d-11ea-a319-5314db00d55d.html [https://perma.cc/H2PS-MUH2] (Nov. 13, 2019).

[239] *See id.*

[240] Saulny, *supra* note 235.

[241] Williams, *supra* note 238.

[242] *See* Richard A. Webster, *New Orleans Public Housing Remade After Katrina. Is It Working?*, NOLA.COM, https://www.nola.com/news/article_833cc3f5-2d6d-5edc-bc0f-ecd55ead7026.html [https://perma.cc/ZV9M-5WAM] (July 18, 2019). For example, St. Bernard went from 1,464 public housing units to 221 in the redeveloped mixed income complex, and C.J. Peet went from 1,403 to 193. *See id.*

[243] *Id.*

[244] *See* TIERNEY, *supra* note 4, at 142 (arguing that "far from confirming this hypothesis [that poor Black residents displaced by Katrina were better of elsewhere], members of those populations did not benefit from moving" and "were not necessarily better off" when evaluated by a number of metrics, including "employment, housing quality, neighborhood quality, health, and mental health").

[245] Richard Florida, *Will Coronavirus Be the Death of Cities? Not So Fast*, WALL ST. J. (Dec. 10, 2020), https://www.wsj.com/articles/will-coronavirus-be-the-death-of-cities-not-so-fast-11607612400 [https://perma.cc/YSC4-HRGQ] ("It will take conscious and intentional action to avert a new wave of gentrification in cities, suburbs and rural areas.").

[246] *See* Will Parker, *U.S. Poised for Wave of Evictions in January as Federal Ban Expires*, WALL. ST. J., https://www.wsj.com/articles/u-s-poised-for-wave-of-evictions-in-january-as-federal-ban-expires-

clearing the path for future redevelopment.[247] Anecdotal evidence suggests that some landlords have used COVID-19 infections as a justification for evicting tenants "for cause" to free up units for remodeling or replacement by more high-end housing.[248] Additionally, many rural areas are experiencing serious pressure on housing and rental markets as city-dwellers, freed from geographic restrictions by work-at-home policies that may become permanent, buy or rent homes in rural communities.[249]

E. Exploitation of the Vulnerable to Protect the Privileged

Putting the vulnerable in harm's way to protect the privileged is a common theme in the history of disasters. During the Great Mississippi Flood of 1927, as floodwaters threatened New Orleans and levees protecting the city faltered, city elders met to devise a plan to save New Orleans.[250] At their urging, Louisiana's Governor ordered levees downstream of New Orleans dynamited, sparing the city by diverting flooding into the predominantly poor, Black communities to the south.[251]

This history makes clear that Black Americans and other vulnerable groups have good reason to distrust that disaster decision-makers will act in their best interest. Likewise, the infamous Tuskegee Experiment exemplifies the ways that, outside of the disaster context, Black Americans have also been exploited by health care providers and researchers.[252] It is, unsurprising then, that many Black Americans expressed fears that the government and pharmaceutical companies wanted to prioritize racial minorities for vaccine distribu-

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11607855401 [https://perma.cc/VV6S-3GDP] (Dec. 13, 2020); Michael Casey, *Evictions on the Rise Months After Federal Moratorium Ends*, AP NEWS (Dec. 15, 2021), https://apnews.com/article/coronavirus-pandemic-business-health-bd61b8a59126081bb09ef9515d09866f [https://perma.cc/JYS8-6DZL].

[247] *See* Florida, *supra* note 245.

[248] Leticia Miranda, *Landlords Could Exploit COVID-19 Victims to Fast-Track Evictions, Housing Advocates Say*, NBC NEWS (Aug. 13, 2020), https://www.nbcnews.com/business/business-news/landlords-could-exploit-covid-19-victims-fast-track-evictions-housing-n1234220 [https://perma.cc/KDE6-73FW] (recounting attempted evictions of renters who had tested positive for COVID-19 as a "nuisance" and reporting that COVID "has emerged as a convenient way to facilitate" pushing out current tenants to allow for gentrification).

[249] *See* Florida, *supra* note 245 (observing, on the subject of the pandemic-induced migration to rural areas, that "pandemics through all of human history, [are] not . . . fundamental disrupter[s] but . . . accelerator[s] of trends already under way").

[250] *See* JOHN M. BARRY, RISING TIDE: THE GREAT MISSISSIPPI FLOOD OF 1927 AND HOW IT CHANGED AMERICA 222–58 (1997).

[251] *See id.*

[252] *See* Ruqaiijah Yearby, *Exploitation in Medical Research: The Enduring Legacy of the Tuskegee Syphilis Study*, 67 CASE W. RSRV. L. REV. 1171, 1772–73 (2017).

tion to use them as "guinea pigs" to test the vaccine's effects before distributing it to the wider population.[253]

Similarly, Indigenous people have good reason to distrust the government and the medical establishment.[254] Because of a long litany of past abuses, well-intentioned efforts to foster Indigenous inclusion in vaccine research and to prioritize Indigenous peoples in vaccine distribution are likely to generate suspicion and resistance. For example, when the Navajo Nation review board charged with approving medical research gave accelerated approval to enrolling interested Navajo members in the Pfizer vaccine trial to improve the trial's diversity and representativeness, "tribal members [immediately] accused their government of allowing them to be guinea pigs, pointing to painful times in the past when Native Americans didn't consent to medical testing or weren't fully informed about procedures."[255] Rumors spread that Navajo people were going to be intentionally infected with COVID-19 so that protective antibodies could be harvested from their blood to treat others.[256] Community outreach and longstanding relationships between the Johns Hopkins Center for American Indian Health and the tribe helped temper concerns sufficiently to enroll enough tribal members to allow comparison of immune responses in Indigenous participants to those of other demographics.[257]

This historically-informed fear of exploitation and distrust of government and the medical profession is reflected in much higher levels of vaccine hesitancy among racial minorities. Our two thousand-person survey from 2020 confirms the trends observed in other research: the proportion of people unwilling to be vaccinated was lowest for white and Asian respondents (19% and 22% respectively), jumped to 36% for those who self-categorized as being "other race or more than one race," 41% for Hispanic respondents, and was highest among Black respondents with nearly 47% reporting that they were "not willing" to receive an FDA-approved vaccine in 2021.[258] We also observed a directional trend in vaccine hesitancy across income groups. Nearly 41% of those below the federal poverty line were vaccine hesitant. Vaccine

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[253] *See* Samuel, *supra* note 201.

[254] Melissa Sevigny, *For Native People, Coronavirus Vaccine Trial Raises Specter of Past Traumas*, KNAU (Dec. 14, 2020), https://www.knau.org/post/native-people-coronavirus-vaccine-trial-raises-specter-past-traumas [https://perma.cc/Q7V3-XMKC] (detailing past abuses inflicted on Indigenous people by "doctors and scientists," including forced sterilization of Indigenous women and "misused blood samples" collected from Havasupai tribal members for unauthorized purposes).

[255] Felicia Fonseca, *Fast Rollout of Virus Vaccine Trials Reveals Tribal Distrust*, AP NEWS (Jan. 4, 2021), https://apnews.com/article/us-news-flagstaff-arizona-clinical-trials-coronavirus-pandemic-712d482a83cb49464745fca7f8b93692 [https://perma.cc/5LVJ-43HJ].

[256] *Id.*

[257] *Id.*

[258] For summarized results, see Appendix Table 8.

hesitancy decreased in each subsequently wealthier subgroup, until the number of vaccine hesitant individuals was only 12% among those living at or above four-times the federal poverty line. Logistic regression modeling of our results also showed that those who do not trust the government or the mass media to deliver accurate information about COVID-19 are more likely to be vaccine hesitant.[259] Although using tools like our vulnerability index to target vulnerable *neighborhoods* for vaccine distribution, rather than vulnerable *individuals*, may mitigate some of this concern, it cannot eliminate it entirely.

The ways that the vulnerable are sacrificed to protect the privileged post-disaster may sometimes be less dramatic, but they can be equally damaging. Because they typically have less political voice, vulnerable neighborhoods are often targeted for disaster-related, undesirable land uses, such as new landfills necessitated by debris clean-up,[260] which aggravate existing environmental justice issues, or temporary post-disaster housing, which taxes already strained infrastructure.[261] Politicians and corporations can misuse systematic data about neighborhood vulnerability, like that in our vulnerability index, to identify neighborhoods to exploit and burden.[262]

Indeed, vulnerability data, like that generated by our index, is Janus-faced: it can be a map for targeting and exploitation, helping actors know where to locate disaster "bads," like landfills or where to make voting most risky; it can also help us monitor, identify, and hopefully check these kinds of abuses. Without indices like ours, for example, it would be harder to detect—and even harder to prove—patterns of voter suppression during the 2020 elections. Although there is always risk that unsavory decision-makers will take vulnerability data as an instruction manual for exploiting vulnerable populations, most politicians already have at least a crude sense of which neighborhoods are politically vulnerable.[263] Such data may primarily allow them to re-

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[259] *Id.*

[260] REILLY MORSE, JOINT CTR. FOR POL. & ECON. STUD., HEALTH POL'Y INST., ENVIRONMENTAL JUSTICE THROUGH THE EYE OF HURRICANE KATRINA 12–13 (2008), https://inequality.stanford.edu/sites/default/files/media/_media/pdf/key_issues/Environment_policy.pdf [https://perma.cc/79X7-MTJR]; Bullard & Wright, *supra* note 237, at 25–27.

[261] Although there was a tremendous need for temporary housing after Hurricane Katrina, many New Orleans residents nonetheless "viewed [FEMA] trailer parks as an additional blight rather than the solution to the housing problem," and many neighborhoods rejected proposals to site the trailer parks in their communities. ALDRICH, *supra* note 112, at 135.

[262] *Cf. id.* at 138 (reporting that "researchers have found that many companies conduct a 'windshield survey' by driving through potential host communities [for undesirable land uses] and noting signs of disconnectedness, low capital, and poverty").

[263] *See id.* (including an account of one land surveyor who designated a town as a potential location for future "low-level radioactive waste" plants because there were "trailers everywhere" (citation omitted)).

fine, rather than discover, ways they can harm vulnerable populations during and after disasters.

Conclusion

This Article leverages the unique COVID-19 window into disaster vulnerability to answer the long-standing call of disaster scholars to use data-driven approaches to explore the geographic dimensions of vulnerability. Our COVID-19 vulnerability index illuminates how sustained attention to geographic vulnerability can help policy-makers triage scarce resources—such as testing centers, contact tracers, and vaccines—to particularly vulnerable areas and help policy-makers understand where aggressive public health measures or COVID-19 voter accommodations may do the most good.

At the same time, our experience has clarified that really addressing disaster vulnerability requires attention to two additional dimensions of vulnerability that spatial data do not fully capture: conflicting and competing vulnerability, both among and between vulnerable groups, as well as political vulnerability. Without attention to conflicting and competing vulnerabilities, we may insufficiently attend to the ways that school reopenings implicate many different aspects of students' vulnerability, or how speeding vaccine delivery by expanding age priorities may deepen racial inequity in COVID-19's impacts. Furthermore, without attention to political vulnerability, we may fail to see how localized mask mandates might stigmatize vulnerable communities or how vulnerability data might be used to suppress the vote. These examples make clear that vulnerability data can be used both as a blueprint for and a check on weaponizing or exploiting a community's vulnerability.

Consideration of all three of these critical dimensions of disaster vulnerability—geospatial, competing and conflicting, and political—makes clear how much research and policy work lies ahead. The same patterns and dimensions of vulnerability that we have identified must also be addressed internationally. We must also find better tools for identifying and addressing intersectional, cumulative vulnerabilities of individuals and groups. And, most fundamentally, we must work at home and abroad, not only to ensure that disasters do not replicate and deepen existing patterns of vulnerability, but also to address and mitigate the underlying vulnerabilities of "normal times." Sustained attention to vulnerability during disasters will not be enough without a similar resolve to address vulnerability outside moments of crisis.

APPENDIX

Table 1. Model variables for all 3142 counties and for counties in the top decile according to the COVID-19 Vulnerability Index. Table entries are mean (SD).

	Top Decile Counties (N=308)	All Counties (N=3142)
Minority Race	52.99 (23.6)	23.50 (20.2)
Uninsured	15.62 (7.0)	10.08 (5.1)
Essential Workers	9.52 (2.6)	11.34 (2.9)
Over 65 Years	17.27 (5.1)	18.37 (4.6)
Current Smokers	19.71 (5.3)	17.87 (3.7)
Obese	35.37 (7.6)	33.43 (5.9)
Diabetes	12.54 (4.7)	10.49 (3.5)
Heart Disease (Deaths/1000)	48.87 (57.0)	34.25 (111.9)
COPD (Deaths/1000)	39.74 (16.1)	38.22 (13.0)
Pop Density (per sq mile)	694.18 (5164.5)	267.54 (1782.4)

Table 2. Demographic variables for all 3142 counties and for counties stratified by mail-in ballot access for 2020 general election. Table entries are mean (SD).

	Mail-in Ballots			
	Available on Request (N=91)	Not Available to Most (N=633)	Universal (N=2418)	All Counties (N=3142)
Minority Race	34.28 (20.7)	33.99 (22.6)	20.36 (18.4)	23.50 (20.2)
Uninsured	9.19 (2.9)	13.53 (5.0)	9.21 (4.8)	10.08 (5.1)
Essential Workers	10.94 (2.2)	11.36 (2.8)	11.35 (2.9)	11.34 (2.9)
Over 65 Years	17.53 (3.1)	17.27 (4.1)	18.68 (4.7)	18.37 (4.6)
Current Smokers	19.14 (3.4)	18.65 (3.3)	17.62 (3.7)	17.87 (3.7)
Obese	36.98 (5.3)	34.55 (6.4)	33.00 (5.7)	33.43 (5.9)
Diabetes	13.70 (3.8)	11.73 (3.7)	10.04 (3.3)	10.49 (3.5)
Heart Disease (Deaths/1000)	14.50 (14.0)	41.52 (185.5)	33.09 (85.0)	34.25 (111.9)
COPD (Deaths/1000)	42.41 (15.8)	41.02 (12.1)	37.31 (12.9)	38.22 (13.0)
Pop Density (per sq mile)	281.83 (848.5)	128.94 (285.0)	303.28 (2018.5)	267.54 (1782.4)

Table 3. Proportion of Each Vulnerability Decile that Were Early Adopters, Spring/Summer Adopters, Late Adopters or Very Late/Non-adopters of Mask Mandates. (10th decile is the most vulnerable decile and 1st decile is the least vulnerable.)

Mortality Rate Decile Ranking	Early Adopters	Spring/Summer Adopters	Late Adopters	Very Late/Non-Adopters
1st	0.28	0.18	0.44	0.10
2nd	0.14	0.20	0.52	0.14
3rd	0.08	0.18	0.52	0.22
4th	0.06	0.19	0.45	0.30
5th	0.05	0.21	0.42	0.32
6th	0.04	0.17	0.37	0.42
7th	0.04	0.23	0.32	0.41
8th	0.05	0.14	0.36	0.46
9th	0.03	0.15	0.33	0.50
10th	0.03	0.14	0.36	0.47

Table 4. Demographic variables for all 3142 counties and for counties stratified by timing of mask mandate adoption. Table entries are mean (SD).

	Mask Mandate Adoption				
	Early (N=248)	Late (N=1281)	Spring/ Summer (N=563)	Very Late (N=1041)	All Counties (N=3142)
Minority Race	24.90 (21.2)	22.85 (20.4)	28.83 (20.2)	20.83 (18.7)	23.50 (20.2)
Uninsured	6.76 (3.0)	9.91 (5.0)	9.25 (4.0)	11.45 (5.5)	10.08 (5.1)
Essential Workers	10.86 (2.9)	11.57 (2.8)	10.81 (2.6)	11.49 (3.0)	11.34 (2.9)
Over 65 Years	18.08 (4.6)	17.92 (4.1)	18.68 (5.3)	18.85 (4.6)	18.37 (4.6)
Current Smokers	16.67 (3.2)	18.45 (3.5)	16.69 (3.0)	18.04 (3.9)	17.87 (3.7)
Obese	31.22 (5.8)	34.26 (5.7)	31.60 (6.3)	33.96 (5.6)	33.43 (5.9)
Diabetes	9.42 (2.3)	10.94 (3.5)	10.10 (3.5)	10.40 (3.7)	10.49 (3.5)
Heart Disease (Deaths/1000)	19.60 (183.6)	28.22 (122.1)	18.97 (42.3)	53.12 (99.2)	34.25 (111.9)
COPD (Deaths/1000)	30.57 (10.1)	40.51 (13.5)	34.25 (11.0)	39.66 (12.7)	38.22 (13.0)
Pop Density (per sq mile)	1320.45 (5845.0)	154.84 (460.0)	431.23 (1256.9)	65.89 (165.2)	267.54 (1782.4)

Table 5: Survey Sample Demographics

Responses collected between 09/23/20 and 10/02/20	Total Sample
	n = 2,037
	n (%)
DEMOGRAPHIC INFORMATION	
Age in years (Mean, SD)	45.95 (17.74)
Gender	
Woman	1043 (51.20)
Man	974 (47.82)
Other	20 (0.98)
Race/Ethnicity	
White only	1422 (69.81)
Black only	285 (13.99)
Asian only	187 (9.18)
Hispanic (any race)	70 (3.43)
Other or more than one race	73 (3.58)
Income by Poverty %	
0-99% of the FPL	229 (11.24)
100 - 149% of the FPL	259 (12.71)
150 - 199% of the FPL	224 (11.00)
200 - 299% of the FPL	375 (18.41)
300 - 399% of the FPL	362 (17.77)
400+ % of the FPL	588 (28.87)
Education	
Less than high school degree	39 (1.91)
High school degree or equivalent	395 (19.39)
Some college but no degree	334 (16.40)
Associates degree	193 (9.47)
Bachelor's degree	489 (24.01)
Masters degree	443 (21.75)
Advanced degree	114 (7.07)
Marital Status	
Married	1144 (56.16)
Never Married	547 (26.85)
Divorced	196 (9.62)
Widowed	124 (6.09)
Separated	26 (1.28)

Child under 18 living at home	
Yes	895 (43.94)
Political viewpoint	
Liberal	716 (35.15)
Moderate	710 (34.86)
Conservative	611 (30.00)
Describe the area you live	
Urban	971 (47.67)
Rural	757 (37.16)
Suburban	309 (15.17)
MEASURES OF FINANCIAL STABILITY	
In the past 6 months, received...	
govt. food assistance (SNAP, food stamps, WIC, etc.)	718 (35.25)
govt. unemployment benefits	612 (30.04)
Are you currently caught up on rent/house payments?	
Yes	1185 (58.17)
No	429 (21.06)
I'm not currently renting or making payments on a house	408 (20.03)
I don't know	15 (0.74)
HEALTH	
Self described as high risk for COVID-19	
Yes	796 (39.08)
Knows someone personally who has been	
Diagnosed with COVID-19	916 (44.97)
Died or been seriously ill due to COVID-19	589 (28.93)
Frequency of getting flu shot over the last 5 years	
Every year	806 (39.57)
Almost every year	382 (18.75)
About every other year	166 (8.15)
Only once	182 (8.93)
Never	501 (24.59)
Considers MMR vaccine to be safe	
Yes	1415 (69.46)
No	261 (12.81)
I'm not sure	361 (17.72)

Table 6: Demographic Influences on Attitudes About Reopening K-12 Schools

	Do you think reopening K-12 schools is a risk worth taking? (Yes/No/I don't know)	
	Yes n (row %)	
Race		*p-val < 0.0001
White	951 (66.88)	
Hispanic	32 (45.71)	
Black	139 (48.77)	
Asian	116 (62.03)	
Other/2+	32 (43.84)	
FPL		p-val < 0.0001
<100%	119 (51.97)	
100-149%	121 (46.72)	
150-199%	124 (55.36)	
200-299%	213 (56.80)	
300-399%	246 (67.96)	
400+%	447 (76.02)	
Trust in the government to provide full and honest information about COVID-19		p-val < 0.0001
A great deal	387 (82.87)	
A fair amount	474 (69.30)	
Not very much	252 (54.19)	
Not at all	146 (37.82)	
No opinion	11 (31.43)	

*Note: All p-values derived from Chi-square test for difference in proportions

Table 7: Demographic Influences on Willingness to Allow Vaccine Prioritization for Vulnerable Populations and Support of Aggressive Public Health Measures to Limit the Spread of COVID-19

	...should **high risk groups** like **the elderly and people with preexisting conditions** be given priority to receive that vaccine before other people? (Yes/No)	...should **high risk groups** like **racial minorities and low-income people** be given priority to receive that vaccine before other people? (Yes/No)	How much do you support aggressive public health measures **to protect high risk groups** by limiting the spread of COVID-19? (Strongly, Somewhat, Not really, Not at all)	...should **essential workers** like **doctors and nurses** be given priority to receive that vaccine before other people? (Yes/No)*	...should **essential workers** like **hospital janitors** be given priority to receive that vaccine before other people? (Yes/No)*	How much do you support aggressive public health measures **to protect essential workers** by limiting the spread of COVID-19? (Strongly, Somewhat, Not really, Not at all)
	Yes	Yes	Strongly/Somewhat	Yes	Yes	Strongly/Somewhat
	n (row %)	n (row %)	n (row %)	n (row %)	n (row %)	n (row %)
Age	**p-val = 0.0717	p-val = 0.1582	p-val = 0.5184	p-val <0.0001	p-val = 0.0024	p-val = 0.4174
Under 65	651 (81.48)	563 (71.63)	1386 (87.44)	677 (85.05)	686 (86.95)	1396 (88.08)
65 or older	193 (86.94)	153 (66.52)	401 (88.72)	221 (95.67)	209 (94.57)	405 (89.60)
Race	p-val <0.0001	p-val = 0.0001	p-val = 0.4753	p-val = 0.0007	p-val = 0.3510	p-val = 0.5915
White	612 (86.44)	531 (74.37)	1250 (87.90)	640 (89.76)	634 (89.42)	1258 (88.47)
Hispanic	21 (70.00)	24 (60.00)	61 (87.14)	26 (81.25)	33 (86.84)	58 (82.86)
Black	101 (70.63)	79 (55.63)	251 (88.07)	112 (77.24)	117 (83.57)	251 (88.07)
Asian	80 (80.00)	61 (70.11)	166 (88.77)	85 (89.47)	83 (90.22)	168 (89.84)
Other/2+	30 (75.00)	21 (63.64)	59 (80.82)	35 (83.33)	28 (90.32)	66 (90.41)
FPL	p-val <0.0001	p-val = 0.0013	p-val = 0.0008	p-val = 0.0015	p-val <0.0001	p-val = 0.0185
<100%	73 (68.22)	75 (61.48)	184 (80.35)	97 (78.23)	83 (79.05)	188 (82.10)

100-149%	95 (72.52)	81 (63.28)	225 (86.87)	96 (80.67)	114 (81.43)	228 (88.03)
150-199%	107 (83.59)	59 (61.46)	193 (86.16)	97 (88.18)	94 (82.46)	199 (88.84)
200-299%	147 (84.48)	144 (71.64)	323 (86.13)	165 (89.67)	169 (88.48)	327 (87.20)
300-399%	164 (86.77)	127 (73.41)	329 (90.88)	173 (89.64)	164 (97.04)	330 (91.16)
400+%	258 (88.36)	230 (77.70)	533 (90.65)	270 (90.91)	271 (93.13)	529 (89.97)
Education	p-val <0.0001	p-val <0.0001	p-val <0.0001	p-val = 0.0001	p-val <0.0001	p-val <0.0001
HS or less	161 (77.03)	133 (59.11)	356 (82.03)	171 (80.28)	180 (81.45)	363 (83.64)
Some college/Assoc.	207 (77.53)	174 (66.92)	442 (83.87)	227 (84.70)	225 (86.87)	447 (84.82)
Bachelor	219 (83.59)	160 (70.48)	436 (89.16)	238 (90.49)	204 (90.27)	437 (89.37)
Master or Adv.	257 (90.81)	249 (81.91)	553 (94.21)	262 (92.58)	286 (94.08)	554 (94.38)

*Note: Over the entire sample (n = 2,037) differences between responses to vaccine prioritization questions between "doctors and nurses" framing and "hospital janitors" framing was not statistically significant (Chi-square p-value = 0.4544).

Table 8: Influences on Vaccine Hesitancy

Defining "Vaccine Hesitant"	**total sample = 2,037**
How willing would you be to receive an FDA-approved COVID-19 vaccine next year? (Very willing/Somewhat willing/Not willing)	
Willing (Very or somewhat willing)	n = 1534 (75.31%)
Vaccine Hesitant (Not willing)	n = 503 (24.69%)

Vaccine Hesitancy by Demographic Information	Vaccine Hesitant (n = 503) n (row %)	*p-value
Age		0.002
Under 65 years old	366 (23.09)	
65 years old or older	137 (30.31)	
Gender		0.0005
Woman	372 (35.67)	
Man	126 (12.94)	
Other	5 (25.00)	
Race/Ethnicity		0.0005
White only	274 (19.27)	
Black only	133 (46.67)	
Asian only	41 (21.93)	
Hispanic (any race)	29 (41.43)	
Other or more than one race	26 (35.62)	
Income by Poverty %		0.0005
0-99% of the FPL	93 (40.61)	
100 - 149% of the FPL	100 (38.61)	
150 - 199% of the FPL	70 (31.25)	
200 - 299% of the FPL	101 (26.93)	
300 - 399% of the FPL	67 (18.51)	
400+ % of the FPL	72 (12.24)	
Education		0.0005
High School or Less	155 (35.71)	
Some College/Assoc.	196 (37.19)	
Bachelor's Degree	96 (19.63)	
Masters or Advanced Degree	56 (9.54)	
Marital Status		0.0005
Married	191 (16.70)	
Never Married	189 (34.55)	
Widowed/Divorced/Separated	123 (35.55)	
Child under 18 living at home		<0.0001

Yes	144 (16.09)	
No	359 (31.44)	
Political viewpoint		0.0005
Liberal	129 (18.02)	
Moderate	210 (29.58)	
Conservative	164 (26.84)	
Describe the area you live		0.0005
Urban	167 (17.20)	
Rural	229 (30.25)	
Suburban	107 (34.63)	
by Financial Stability		
In the past 6 months, received...		
govt. food assistance		<0.0001
Yes	131 (18.25)	
No/I don't know	372 (28.20)	
govt. unemployment benefits		<0.0001
Yes	96 (15.69)	
No/I don't know	407 (28.56)	
Caught up on rent/house payments		0.0005
Yes	341 (28.78)	
Not currently renting or making payments	93 (22.79)	
No/I don't know	69 (15.54)	
by Health Information		
Self-describe as high risk for COVID-19		<0.0001
Yes	141 (17.71)	
No	356 (29.16)	
Is a health care worker		0.0001
Yes	40 (15.38)	
No	463 (26.06)	
Knows someone personally who has been...		
Diagnosed with COVID-19		0.0390
Yes	206 (22.49)	
No	297 (26.49)	
Died or been seriously ill due to COVID-19		<0.0001
Yes	98 (16.64)	
No	405 (27.97)	
Frequency of getting flu shot over the last 5 years		0.0005
Every year	114 (14.14)	
Almost every year	40 (10.47)	
About every other year	34 (20.48)	

Only once	47 (25.82)	
Never	268 (53.49)	
Considers MMR vaccine to be safe		0.0005
Yes	240 (16.96)	
No	98 (37.55)	
I'm not sure	165 (45.71)	
by Trust in Government		
How much do you trust _____ to provide full and honest information about COVID-19?		
the government		0.0005
A great deal	31 (6.64)	
A fair amount	120 (17.54)	
Not very much	144 (30.97)	
Not at all	189 (48.96)	
No opinion	19 (54.29)	
President Trump		0.0005
A great deal	68 (14.98)	
A fair amount	76 (17.67)	
Not very much	66 (23.16)	
Not at all	254 (31.95)	
No opinion	39 (53.42)	
the CDC		0.0005
A great deal	83 (11.35)	
A fair amount	179 (23.25)	
Not very much	122 (35.99)	
Not at all	84 (61.31)	
No opinion	35 (58.33)	
your state government		0.0005
A great deal	71 (12.43)	
A fair amount	143 (18.01)	
Not very much	141 (35.25)	
Not at all	108 (51.92)	
No opinion	40 (62.50)	
your local government		0.0005
A great deal	50 (10.55)	
A fair amount	178 (20.14)	
Not very much	134 (31.60)	
Not at all	100 (54.05)	
No opinion	41 (58.57)	
medical professionals like your doctor(s)		0.0005

A great deal	168 (16.12)	
A fair amount	204 (28.49)	
Not very much	65 (38.01)	
Not at all	33 (58.93)	
No opinion	33 (63.43)	
public health professionals like Dr. Fauci		0.0005
A great deal	127 (14.42)	
A fair amount	153 (22.27)	
Not very much	113 (40.79)	
Not at all	66 (60.55)	
No opinion	44 (53.01)	
by Trust in Media		
How much do you trust _____ to provide full and honest information about COVID-19?		
mass media (such as newspapers, TV, or radio)		0.0005
A great deal	30 (7.56)	
A fair amount	123 (16.58)	
Not very much	144 (29.88)	
Not at all	164 (48.09)	
No opinion	42 (56.00)	
Fox News		0.0005
A great deal	30 (6.62)	
A fair amount	130 (21.21)	
Not very much	110 (28.50)	
Not at all	181 (38.92)	
No opinion	52 (43.33)	
The Wall Street Journal		0.0005
A great deal	34 (8.95)	
A fair amount	110 (15.76)	
Not very much	101 (25.90)	
Not at all	154 (50.83)	
No opinion	104 (39.10)	
NPR (National Public Radio)		0.0005
A great deal	44 (10.38)	
A fair amount	107 (15.53)	
Not very much	111 (29.29)	
Not at all	135 (49.82)	
No opinion	106 (38.69)	
CNN		0.0005
A great deal	71 (12.22)	

A fair amount	120 (19.05)	
Not very much	86 (25.44)	
Not at all	176 (48.62)	
No opinion	50 (39.68)	
What is your primary source of trusted, useful information about COVID-19?		0.0005
Friends and family	80 (40.82)	
President Trump	47 (25.27)	
State and local officials	57 (24.57)	
Public health professionals like Dr. Fauci	177 (23.17)	
Social media	37 (19.27)	
Commentators who share my political views	27 (47.37)	
Mass media (newspapers, TV, radio, etc.)	78 (19.02)	
To your knowledge, where did COVID-19 come from?		0.0005
China, by spreading from animals to people	192 (19.26)	
China, engineered in Chinese labs	207 (28.43)	
Russia, engineered in Russian labs	5 (25.00)	
Bill Gates and other elites	12 (18.18)	
Big pharmaceutical companies	9 (23.68)	
COVID-19 is not real	11 (45.83)	
Other	67 (40.85)	

*p-values derived from Fisher's exact test for count data