The blueprint of disaster: COVID-19, the Flint water crisis, and unequal ecological impacts

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COVID-19 is unique in the scope of its effects on morbidity and mortality. However, the factors contributing to its disparate racial, ethnic, and socioeconomic effects are part of an expansive and continuous history of oppressive social policy and marginalising geopolitics. This history is characterised by institutionally generated spatial inequalities forged through processes of residential segregation and neglectful urban planning. In the USA, aspects of COVID-19's manifestation closely mirror elements of the build-up and response to the Flint crisis, Michigan's racially and class-contoured water crisis that began in 2014, and to other prominent environmental injustice cases, such as the 1995 Chicago (IL, USA) heatwave that severely affected the city's south and west sides, predominantly inhabited by Black people. Each case shares common macrosocial and spatial characteristics and is instructive in showing how civic trust suffers in the aftermath of public health disasters, becoming especially degenerative among historically and spatially marginalised populations. Offering a commentary on the sociogeographical dynamics that gave rise to these crises and this institutional distrust, we discuss how COVID-19 has both inherited and augmented patterns of spatial inequality. We conclude by outlining particular steps that can be taken to prevent and reduce spatial inequalities generated by COVID-19, and by discussing the preliminary steps to restore trust between historically disenfranchised communities and the public officials and institutions tasked with responding to COVID-19.

The blueprint of disaster: unequal ecological effects

Information slowly trickled in: data passively hinting at an emergent public health crisis and at a rupture in civic governance. Government and health officials were furtive as they became increasingly assured of the scope of the crisis. However, in public they remained silent and demurring. The signals then became undeniable: various facets of the population's morbidity were growing well beyond conventional epidemiological surveillance estimates. What was forthcoming was an unavoidable surge in adverse health outcomes, far beyond what the average US citizen would reasonably imagine, or accept, in their country. This event took place in Flint, Michigan, in 2015, less than 1 year after the city's water source was switched, from Lake Huron to the Flint River. This fateful transition was part of a broad austerity movement spearheaded by an unelected emergency manager, installed by Michigan's then-governor to manage finances in the segregated, socioeconomically disadvantaged city.

More than 1 year since the emergence of COVID-19, an uncanny geopolitical enlargement of the racial, ethnic, economic, and spatial inequities seen in the Flint water crisis is taking place because public health disasters that wield disproportionate effects on historically disadvantaged populations share the same macrosocial and ecological blueprint. In this context, the enormity of the current global health catastrophe is impossible to ignore, even for those most insulated from the effects of the pandemic.[1,2] In addition to a more generalised recognition of the gravity of COVID-19, as a seminal cross-cultural event, there is an increasingly broad awareness of the striking racial, ethnic, and spatial inequities that the pandemic acts upon and exacerbates.[3] For marginalised communities that have long endured dysfunction both in the health-care system and in their built environment,[4] the ongoing pandemic is another situation where a seemingly natural calamity is exacerbated by historically embedded systems of sociospatial inequity. In this Viewpoint, we present the Flint water crisis as a salient and instructive case study and forewarning of how COVID-19 further entrenches existing social inequalities but is lived as bodily and ecological erasure as a result of politicised, unsystematic institutional responses to its broader causes and consequences.

In the immediate aftermath of the city's water source switch to the Flint River, lead, an invisible, odourless, and tasteless neurotoxin, was released from the city's antiquated and undertreated water delivery infrastructure into the water supply.[5] The surge in the concentration of lead occurred alongside increases in the concentrations of other heavy metals, carcinogenic trihalomethane compounds, and pneumonia-inducing legionella bacteria.[6] Well before the contamination was publicly acknowledged by government officials, the broader Flint public, roused by a nascent citizen science movement, discovered that the water supply was contaminated.[7] Still, officials and clinicians in the city deflected and neglected their responsibilities, presenting the water quality woes as transient consequences of the water source switch, and residents' emergent health issues as aberrations or casually indeterminate.[8]

Mona Hanna-Attisha, a paediatrician in Flint, provides a telling account in her book, *What the Eyes Don't See*,[9] describing an epidemic of clinical neglect as resident reports of water contamination-related symptomatology began to pour in: "I don't know if I'd ever felt so stunned and disillusioned and sad all at once. What had I done? Where had I been? Baby after baby had come into our clinic. We gave the same advice. 'It's fine. Yes, it's fine. Drink the water. Of course it's okay.' Flint had low breastfeeding rates for a number of reasons. Powdered

formula is the norm. To make formula from the powder, you have to mix it with tap water. Meanwhile, for older kids, because of our emphasis on healthy living and lowering sugar in their diets, we are always recommending fewer juices and soda. And more water."

Abundant media and academic comments on the Flint water crisis have acknowledged the structural and strategic racism and associated environmental injustice in action in the crisis.[8,10–13] Similarly, as the COVID-19 pandemic continues, data are quickly emerging about the gross disparities between historically marginalised populations and their neighbourhoods: people from racial and minority ethnic groups face a heightened risk of exposure to COVID-19 because of social factors rooted in structural inequality and overt discrimination that feed directly into social determinants of health. This reality is illustrated by the fact that a disproportionate number of people from racial and minority ethnic groups have been infected and killed by COVID-19.[14,15]

Specific factors that contribute to this morbidity and mortality trend include the higher likelihood that people from racial and minority ethnic groups have inadequate access to housing,[16,17] predisposing health conditions, make up a higher relative proportion of essential workers, or have jobs that cannot be done remotely.[18] Moreover, and directly related to the points we stress here, long-standing distrust in both the government and public health institutions further limits their engagement with health-care deployment strategies.[19] We describe these factors as a process of reproducing marginalisation, as illustrated by the connections between the distrust that resulted from the Flint water crisis and the scepticism around COVID-19 mitigation measures and vaccination. The prospective consequences of these factors are shown by the outsized devastation of COVID-19 in Black communities; a study in selected US states and cities found that 34% of COVID-19 deaths were among non-Hispanic Black people, although they compose only 12% of the total population of the USA.[20] Spatial epidemiology shows how a common genealogy of oppression and distrust consistently reproduces these inequities.

Overlapping and embedded crises

The blueprint of disaster is fundamentally mediated by fluid and historical processes of social and economic stratification, which are connected to, and frequently motivated by, attitudes to race.[21] For the past 4 years, we have conducted community-based, mixed-methods research with lifelong residents and local professional stakeholders in Flint, including government officials and clinicians, to understand the causes, consequences, and recovery needs of the crisis. This research, part of the Flint Engagement Community Project, has focused on identifying and contextualising the attitudes, beliefs, and health outcomes of Flint residents living in the city during, and in the years after, the water crisis. Lessons on national, state, and local government ineptitude derived

from the Flint Engagement Community Project foretell many of the public health weaknesses that typify the COVID-19 response. That Flint was unprepared to deal with its water crisis and bore the consequences in population morbidity is obvious. That the city could have been prepared to address what lay ahead, however, is a more fertile debate, pertinent also to COVID-19 as social and health sciences researchers look for so-called best practices from the communities and countries that were more successful in protecting their citizens from the dire extremes of the pandemic.

COVID-19's most vivid parallel with the Flint water crisis is its accentuation of exceptional inadequacy of morbidity prevention and management in the US health-care system—especially when compared with countries with similar financial means—which ignored warning signs, was underprepared in terms of resources and public communication (ie, across and between federal, state, and local government, and to the communities), and buckled under the pressure of multiple infection surges. Shortcomings in epidemiological oversight and public health reporting will invariably lead to population health crises, which will almost always exact their most serious effects on the most socioeconomically vulnerable individuals in the population, who are unable to access health promotion resources. What is most deplorable is that this chasm is not natural, but the result of a specific form of moral and technical disinvestment in public health for racially minoritised communities. As COVID-19 spread, WHO issued clear directives to countries on how to confront the pandemic.[22] These measures, such as closing schools and workplaces, were easier to implement in wealthier nations, but were also based on an assumption that the areas that heeded this advice would ultimately be able to deploy a functioning health-care system to manage the reduced number of cases—namely, one in which the entire population had adequate access to screening and health care. Although the specific structures of health-care systems worldwide vary, the general lesson of COVID-19 is that mitigation of the crisis will be more effective in areas where public instead of private provisioning is the norm.[23,24] The recurrent failure of the USA to provide such a system limits the remedial capacity of any present or near-future turn towards purposeful investment in approaches to reducing health disparities. This limitation exists, in part, because trust in the US health-care system has been vigorously eroded,[25–27] in racial and minority ethnic groups more than in any other populations.[28,29]

The pandemic has shown that there are not only material barriers to care, but also racial, ethnic, and political difficulties in the uptake of mitigation protocols, associated with factors ranging from structural racism to health efficacy, or confidence in one's ability to pursue a healthy life, and health literacy.[28,30] COVID-19 will stand as a particular flash point, as the ruptures of trust happen not just between the public and the government and health-care institutions (eg, local hospitals, public health officials,

the US National Institutes of Health, and the Centers for Disease Control and Prevention) but, crucially, within communities, as neighbours engage in fractious debates on the nature of the COVID-19 threat in public spaces and online.[31,32] The ubiquity of this discord suggests that mixed adoption of COVID-19 mitigation strategies is reflective of other forms of social and bodily resistance related to political philosophy and stigma and blame. This observation builds on research emphasising the spatial dynamics of differentiation in this erosion of trust.[33,34]

Such a situation has, of course, happened before. Over 20 years ago, much of the hypersegregated metropolitan Chicago (IL, USA) area was affected by a heatwave; roughly 750 people died, most of whom were individuals of low income and older than 65 years, living in under-resourced communities in the city's economically des-pondent south and west sides, affected by commercial decline and neighbourhood disinvestment.[35,36] During this time, public officials clashed with these community members on their neighbourhoods' poor resilience and dereliction in looking out for one another.[37,38] COVID-19 has wielded similarly stark, disproportionate effects in these same Chicago communities[39,40] while state and local politicians hesitated on shutdown restrictions and, at times, seemingly pivoted towards a focus on a con-comitant increase in crime in the city.[41–43]

Historically produced intersections of race, sustain-ability, and urban planning matter. In Chicago's sobering case of environmental health inequity during its mid-1990s heatwave, this intersection was that of the so-called heat islands, scarce tree shading, and commercial exodus (businesses had begun leaving the city's south and west sides in droves in the 1980s);[35] in New Orleans (LA, USA), it was a porous and overextended patchwork of levees that bore the brunt of Hurricane Katrina;[44] and in Flint, it was a flagging, undertreated water infrastructure system and a dilapidated housing stock.[6] With the COVID-19 pandemic, the amalgamation of such lapses in municipal and city planning and design have left parts of the global population to endure a range of unmitigated vulnerabilities produced through the built environment, thus exponentially more exposed to environmental health and infectious disease threats than others.[45,46]

Many of the comorbidities directly linked to increased hospitalisation and mortality due to COVID-19 (eg, asthma or chronic obstructive pulmonary disease, diabetes, obesity, cardiac disease, and cancer) are closely associated with built environment factors such as air, water, and soil pollution, unavailability of green spaces and of walkable places, and diminished access to healthy food (so-called food deserts), all of which are traits found far more frequently in low-income, non-White neighbourhoods.[47–49] This mosaic of environmental injustice is attributable to a history of racially motivated community disinvestment and residential segregation and redlining (discriminatory real estate practices engineered to preclude racially

minoritised and minority ethnic communities from living in neighbourhoods predominantly inhabited by White people),[50] factors that the Flint residents we interviewed were implicitly familiar with. Other inherently unhealthy urban spaces are the shameful legacy of urban renewal, which disproportionately targeted and fragmented low-income, minority ethnic neighbourhoods and that, ironically, replaced dense walkable districts and civic centres with features such as freeways, in the name of public health and economic progress.[51–53]

According to the fundamental causes theory, the privilege of accumulated resources leads to the ability to avoid some harms.[54] As COVID-19 has shown, "key resources such as knowledge, money, power, prestige, and beneficial social connections can be used no matter what the risk and protective factors are in a given circumstance".[55] Much of this enactment of social and political capital is relational in nature—for example, the influx of tourists from high-income countries led to pronounced surges in COVID-19 cases in minority ethnic enclaves in Asia, Africa, and South America.[56–58]

Arline Geronimus' work on the weathering hypothesis[59] provides a similar call to action, signalling the potential for COVID-19-related chronic mental illness and trauma for doubly disenfranchised groups, such as Black women and mothers who bear an unequal burden in domestic duties.[59,60] When considering the effects on children, long-term reciprocal disadvantages emerging from COVID-19's sprawling effects on education (eg, remote learning requiring child care and technology that might be difficult to purchase or access) are also a cause for concern.[61,62]

Preparing for future outbreaks in marginalised spaces

We now turn to observations from our work in Flint to provide some recommendations on how to prepare for further COVID-19-related disparities. Importantly, although access to screening was touted as a panacea for the mitigation for water contamination-related morbidity in Flint and is being prioritised globally for COVID-19 mitigation, screening does not fundamentally address built-in risks that racially minoritised communities frequently face. Although focusing on the reduction of individual-level barriers to screening is important—including by addressing poor health literacy and restricted access to transportation—a fully realised assessment of disasters such as COVID-19, the Flint water crisis, and other similar potential public health calamities requires continuous attention to macrosocial forces.

Beyond the failure to consistently and clearly articulate and implement physical distancing guidelines and maintain medical equipment reserves during the incipient stages of the spread of COVID-19 in China,[63,64] many other miscommunications took place during the virus' initial spread in the USA. The variety of misstatements and semantic lapses from governmental and public health leaders were most centrally around how severe COVID-19

was, or could be, and around who should access screening and whether insurance was needed to do so. As we learned in Flint, because of issues caused by little access to information, low health literacy, and low general literacy, many residents were unsure of the health risks posed by consumption of contaminated water, and whether and how to find out if their water was contaminated. Furthermore, residents were confused about the utility of blood lead screenings and whether they were free (which they were, at least for a certain period and at certain clinical outposts in the city), which deterred residents from getting medical screenings. Other residents whom we have engaged held deeply fatalistic perspectives about their health, believing that a positive blood lead screening was a deleterious and irreversible outcome, or were unsure of what to do because of contradictory information that suggested that continued water consumption was safe, but that it may need to be boiled or filtered first. Confusion and disinformation in Flint, like that regarding the origins and severity of COVID-19,[65] require ongoing contestation, particularly from local trusted stakeholders—such as faith-based institutions, schools, and small businesses—to generate and sustain the community trust and adherence needed to implement effective mitigation strategies.

In Flint, we frequently observed inconsistencies in how the government and health-care providers described both risk and risk mitigation, as officials misrepresented and hesitated in disclosing the potential consequences of exposure to contaminated water, on who needed to get tested for blood lead concentrations and for contaminant sequelae, and on who needed to have their water infrastructure replaced by the city, the centrepiece of the government's response effort.[7,66] Officials also commonly shifted and closed bottled water distribution sites, and altered their positions on issues such as whether or when it was necessary to boil tap water or to use tap water filters to remove contaminants. Therefore, unsurprisingly, many of the measures taken by the government in response to the Flint water crisis were rejected by residents, who were either consummately dubious about or unfamiliar with the potential benefits of these resources, unaware these resources existed, or simply did not have the means to access them.

The fact that this reality contributed to increased distrust of local government and of public health-care institutions among Flint residents relates to reproducing marginalisation. Even the most substantial and visible solution implemented by the government in response to Flint's crisis—replacing lead water lines throughout the city—has done little to assuage the internalised suspicions of Flint residents, as had the switch-back to Flint's precrisis water source and the citywide provisioning of tap water filters. Evidence suggests that residents continue to avoid consuming the city's tap water in favour of bottled water,[67] although by even the most rigorous accounts and those published by the US Environmental Protection Agency, Flint's water has been consistently safe to consume since

at least late 2017.[68] The residents' persistent avoidance of the city's tap water highlights how, in addition to the common social determinants of health, there is an additional psychological barrier of eroded trust that must be remediated in communities who have felt chronic and historic neglect from public health institutions, even if future investments are made at the level of services and resource provisioning.

This nuanced form of social vulnerability has clear historical antecedents. Little investment in public health infrastructures (in terms of services, resources, and the establishment of transparent, culturally sensitive public communication standards) reproduces racial and social inequities, contributing to the inability of these institutions to effectively mitigate bodily and psychological risk for individuals, or invest in the necessary work of cultivating community trust. In the case of COVID-19, existing social vulnerability and distrust is heightened by previous experiences of institutional and health-care disenfranchisement. For example, questions about the effectiveness of face masks and vaccines further contribute to an insufficient use of mitigation strategies, and to a general sense that political and public health officials are misguided or dubious about their own proposed strategies (eg, consider the high-profile cases of politicians not wearing masks or attending gatherings that are not physically distanced).[69,70] As the Tuskegee syphilis study[71] and the broader legacy of racialised medical experimentation in high-income countries poignantly affirm,[71,72] breaches such as these have both short-term and long-term consequences.

In conclusion, the interchangeability of the very notion of crisis should be recognised; scale and impact are relative and, thus, subjective. Now, more than 7 years after the start of the Flint water crisis, the episode has largely faded from the public's, and from scholars', gaze. Nevertheless, with the benefit of hindsight, there are many lessons to be taken from the situation. Rectifying the wrongs of institutionally generated environmental trauma, to the extent that can be done, requires a reorganisation of systems and structures that have helped to generate and sustain frequent racial and other forms of social inequity in the USA. A complete description of acts necessary to do so is beyond the scope of this Viewpoint. However, a focus on where this effort can begin might be instructive. First and foremost, public health officials should make dense and spatially vulnerable communities—often racially minoritised communities—explicit priorities in terms of allocation of mitigation resources, including masks, screenings, treatment, and other forms of material and social support. Recognising that the effects of COVID-19 have followed classic lines of social and economic stratification, the most intuitive approach to prevent, disrupt, and ultimately undo the pattern of disaster is concentrating resources in communities where stratification is most pronounced. Simultaneously, public health officials should strive for consistency in communicating the utility and means of

accessing these resources, insofar as scientific predict-ability allows, and enrol trusted community stakeholders as the primary messengers.

Although much attention has been paid to the physical consequences of COVID-19, commensurate attention must be paid also to the potential impact of COVID-19 on mental health and trauma. Evidence has consistently shown that, after large-scale crises, survivors are prone to have severe depression, anxiety, and trauma.[73,74] Because socioenvironmental distress is already pronounced in many racially minoritised and minority ethnic populations,[75] COVID-19 will probably intensify embedded existing mental health disparities. As we found by speaking with Flint residents, the effect of COVID-19 will not just be on the surface, manifesting on the body of individuals, but will come to reshape their mental health profiles.[76] Indeed, the effects will remain fixed in the psyches of many of those who were directly affected and felt that they were targeted or preyed upon, through symptomatology that they observe in themselves and their loved ones; and for those who are more indirectly affected through ongoing social isolation, job and education loss, and other factors. In addition to buffering local economic and educational opportunities (an upstream approach), officials should work to ensure that mental health resources are broadly accessible in these communities as part of the recovery efforts.

Furthermore, there is also a pivotal and perhaps time-limited opportunity to tend to previous environmental injustices and show concern for the overall wellness of specific populations and the health of their environments. Engaging racially minoritised and minority ethnic communities in the environmental remediation process, greening, and other measures to improve local eco-system services and neighbourhood liveability—without immediately triggering gentrification and displacement—will be crucial to promote a public health preparedness ethos, to rebuild trust, and to combat the underlying health factors that predispose many people in these communities to deleterious contacts with infectious diseases and with public and environmental health crises more broadly. A reckoning with the low uptake of preventive public health measures and sentiments of social and bodily vulnerability is likely to be most effectively achieved through efforts that empower individuals and restore a sense and possibility of individual agency, community ownership and capacity, and institutional earnestness and goodwill.

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