JFSS Journal of the FoodService Safety www.fssanitation.com

급식 외식위생학회지 3(2): 45-48, 2022 eISSN 2765-2025
https://doi.org/10.22960/JFSS.2022.3.45

Review

A Hyperlocal Approach to Foodborne Illness Outbreaks?: Exploring a New Application of NYC's Community Assessment to Inform Rapid Response

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I. The Geography of Disaster

Disasters are inherently geographic. Some have boundaries, such as flood zones in a cyclone, while "man-made" disasters are often defined by the sites where they occur, be it a mass transit collision or an armed conflict over disputed territory. Even infectious diseases have geographic attributes, such as the distance over which microbes transmit or the ambient environmental conditions that promote their transmission. However, especially in an age of climate change and globalization, it has become clear that the role of geography is disaster begins long before the time of impact (Gruskin & Ray 2014).

What is a disaster? The World Health Organization defines disaster as "an occurrence disrupting the normal conditions of existence and causing a level of suffering that exceeds the capacity of adjustment of the affected community" (Environmental Health Agency & World Health Organization 2002). If a shock is to rise to the level of a disaster, it must pass the maximum threshold that those impacted can absorb. That threshold can be described as a community's level of resilience (Chou & Wu 2014). Thus while the inherent geographies of disaster often determine the severity of a disaster, the ability to withstand that disaster is often determined by long-standing, intersecting features that often vary geographically (Quarantelli 1998).

In NYC and other cities in the United States, the ongoing consequences of explicitly racist policies have shaped urban geography in fundamental ways. In particular, a practice called redliningin the 1930s identified areas with a high number of Black and Latino residents as "hazardous" and "undesirable", blocking residents from those neighborhoods from home ownership through restriction of home loans. Although redliningwas abolished in the 1960s, it spawned reinforcing inequitable systems, in which disinvestment in Black and Latino neighborhoods led to, among other effects, lower socioeconomic status of neighborhood residents. As a result, further disinvestment relative to predominantly White neighborhoods simultaneously occurred. Krieger, et al. explore the complex, intersecting mechanisms by which redliningcreated structurally-embedded, neighborhood-level inequities in the built environment, financial well-being, air pollution, healthcare access, housing stability, and other determinants of disaster resilience between "Black neighborhoods" and "White neighborhoods" that persist to this day (Bailey et al. 2017; Krieger et al. 2020).

Neighborhood differences can be beneficial even in a larger context of inequity. For example, a high-poverty neighborhood with strong community-based organizations may be able to transmit information more efficiently, share resources to promote preparedness, and care for individuals with greater vulnerability in disaster relative to neighborhoods where residents do not have strong connections with each other before a disaster strikes (Quarantelli 1998).

Disaster response operations generally account for inherent geographic differences between neighborhoods. It is hard to imagine, for example, a relief operation that doesn't consider the extent of a power outage in one neighborhood versus another when sending emergency supplies and aid. However, truly effective operations in a power outage might leverage locally trusted organizations to deliver supplies to neighbors or account for personnel hazards created by poorly maintained buildings in an area with dilapidated housing. To best serve those impacted by a disaster, a response must be

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2021년 9월 20일 접수, 2022년 11월 25일 채택

tailored not only to inherent geographical attributes of the event, but also the background strengths and vulnerabilities that shape resilience.

II. The Community Assessment to Inform Rapid Response (CAIRR)

In early 2020, NYC became the global epicenter of COVID-19 pandemic. Since response to disasters, especially infectious disease outbreaks, is a core function of NYC's Department of Health and Mental Hygiene (the Health Department), the agency rapidly focused its activities to lead the Citywide response. However, one of the NYC Health Department's most critical roles in any disaster is the creation of a public health risk assessment to inform situational awareness, (New York City Emergency Management, 2005) facilitated by one of the United States' most sophisticated surveillance and epidemiology teams and a dedicated team for the integration of operational data. Early analyses of the COVID-19 response quickly revealed that while Citywide operations were achieving success in SARS-CoV-2 transmission, NYC was experiencing stark geographical inequities in disease transmission, testing uptake, severe morbidity, and mortality. Unsurprisingly, COVID-19 impact was worse in many of the neighborhoods marked as "undesirable" by redliningdecades before and which suffer very high chronic disease prevalence to this day (Chan et al. 2021).

What was needed was not to replace the Citywide operations that were bringing transmission down in the aggregate, but to enhance them so that they worked at maximum effectiveness for those neighborhoods most impacted. While epidemiological, quantitative, and other data could help pinpoint where disparities existed and could even hint at why, what they could not reveal was how to fix them. Addressing these inequities was urgent, foremost because New Yorkers were getting sick and dying, but also because of the reinforcing nature of inequities; the long-term health, financial, mental health outcomes of COVID-19 in a neighborhood can all exacerbate the downstream consequences of disinvestment and foster further distrust in government and healthcare.

To complement the Citywide disaster response, the NYC Health Department designed a novel hyperlocal approach using a process called the Community Assessment to Inform Rapid Response (CAIRR) began. At a high-level, the CAIRR is a 5-day process for the rapid collection and translation of qualitative, neighborhood-level data into tailored, neighborhood-level operations, running for a period of about 3 weeks per neighborhood. By using the CAIRR, the NYC Health Department was able to meet the needs of communities as defined by the communities themselves. This was largely successful; for example, the NYC Health Department was able to increase testing rates in one neighborhood to the average Citywide number, while an emerging transmission cluster in one neighborhood was contained before it became widespread. Additionally, use of this process deepened relationships between the Health Department and community partners, who appreciated that the concerns and feedback they expressed were translated into operations in a short period of time. In our 2022 paper introducing the CAIRR, we describe its development and implementation in detail as well as considerations for adaptation of the process (Ray et al. 2022). <Table 1> provides a quick summary of the steps involved in applying the CAIRR to different emergencies and jurisdictions.

III. Social and Geographic Determinants of Foodborne Illness Outbreak Response

Disasters can take many shapes and forms, but some features remain constant. Foodborne illness outbreaks have clear inherent geographic aspects, such as distribution routes of contaminated food supplies or the location of an inciting human contamination event. Although subtle, resilience in food safety also has geographic elements, often rooted in neighborhood-level disparities in social determinants of disaster.

These disparities can be linked to food safety indirectly. The World Health Organization posits that food security is linked to food safety exposure and vulnerability, although mechanisms are unclear and analyses are mixed in supporting this conclusion (Newman et al. 2015; World Health Organization 2010). Food security, of course, has a clear association with poverty, education, and other social determinants that can vary by neighborhood, and is also affected by the geographic proximity of accessible food sources, the lack of which creates food deserts. Extreme heat has a stronger link to food safety (Sonnino 2016). Many cities, including NYC, have described a positive association between food safety violations and ambient external temperatures, (Dominianni et al. 2018)and the relationship between heat vulnerability and factors that vary across neighborhoods such as built environment, race and age demographics, and poverty is well documented

Table 1. Steps to Implementing the CAIRR

1. Define an inventory of possible neighborhood-level field operations (including remote informational sessions.)
2. Develop an objective-based, *operational framework* to encompass all the operations.
3. Design an *interview tool* using the structure of the *operational framework* for qualitative data collection
4. Collect neighborhood-level qualitative data from *strategically selected community partners* who interact regularly with neighborhood residents.
5. Rapidly analyze qualitative data using a matrix analysis method, producing themes structured according to the *operational framework.*
6. Use themes to *tailor neighborhood operations* to the corresponding parts of the *operational framework.*

(Madrigano et al. 2015; Reid et al. 2008).

While theoretical linkages between foodborne illness and neighborhood-level disparity may be opaque, the value of timely, neighborhood-level data to outbreak investigations are more clear. Indeed, the CAIRR was developed specifically to obtain local, community-based information within an operational framework. For example, many municipalities, including NYC, have successfully used social media and other online platforms to assist in surveillance and investigate outbreaks of foodborne illness (Chapman et al., 2014; Effland et al., 2018). The CAIRR can facilitate capture of the "wisdom of the crowd" even in areas where residents have low digital literacy. Furthermore, if a particular geographic area is of interest, the CAIRR can generate rich contextual information on residents' food handling practices, common food sources, and knowledge of the outbreak, all of which can rapidly be translated into tailored, culturally appropriate messaging.

NYC's use of the CAIRR in COVID-19 is directly generalizable to foodborne illness outbreak investigation in many ways. The NYC Health Department engaged local businesses as part of neighborhood-level data collection and tailored operations, with a special focus on food purveyors (bars, smalls stores, grocery stores, corner stores or "bodegas", and food pantries). These sites were critical given both the social and cultural importance of food establishments and the potential for increased transmission in areas where individuals removed masks.

Business owners almost universally expressed a desire to promote disease prevention among customers and staff, but often did not know what information to share or how. As part of hyperlocal response operations and driven by the concerns of local business owners, the NYC Health Department provided floor decals for social distancing, posters on handwashing and other preventative measures, demonstration of proper donning and doffing of protective equipment, and supply of vinyl gloves and surgical masks for both customers and staff. Additionally, many business owners were unaware of financial support for business and staff to support emergency paid sick leave. Analyses have shown that financial support for small businesses and paid sick leave resulted in significant prevention of SARS-CoV-2 transmission.

Food safety inspectors often already have long-standing relationships with food establishments; in the context of an outbreak, the relationships could rapidly and easily be leveraged using the CAIRR in order to share information, assess understanding of food handling guidelines, facilitate proper food storage, and identify supply or resource needs for compliance with food safety guidelines.

IV. International Perspectives on Inequity in Disaster

Given a wide diversity in policies, practices, and history, structural inequities look different in different countries. In the United States, many structural inequities were built into systems designed in an era of human slavery; many other nations struggle to purge inequities stemming from deeply embedded divide-and-conquer colonial structures. South Korea's landscape is different from both of these; strict immigration requirements have created a largely homogeneous population. Prosperity has been widespread, giving South Korea the lowest Gini coefficient, a measure of income inequality, in the world (Kim 2021).

However, this does not mean that geographic disparities do not exist, just that they are harder to find in "blue skies" situations. When disaster strikes, subtle inequalities can create massive consequences; it is imperative to anticipate such consequences before the disaster and build resilience over the long-term. A few provocative studies suggest avenues to explore and identify urban inequalities in Seoul, where rapid urbanization may have concealed some disparities.

Ikhan Kim of the Kosin University College of Medicine hypothesized that although South Korea boasts great income equality, spatial disparities in wealth across Seoul are possible determinants of spatially determined health inequities

as measured by all-cause mortality (Kim 2021). Other authors have asserted that income inequality is increasing and disparities in social mobility are escalating (Chang 2018; Yim & Lee 2002). Oh, et al. describe spatial disparities in extreme heat and urban area heat islands in Seoul, which in other areas of the world are closely associated with socioeconomic and other inequities (Oh et al. 2020).

Food safety professionals working in South Korean cities should use their experiences to determine what makes up the uniquely Korean determinants of food safety, not only with regard to potentially deleterious impacts, such as spatial disparities in wealth or ambient heat, but also for advantageous examples of neighborhood cohesion, food establishment engagement, or commitment to safe food handling. A good place to start is the collection of hyperlocal, qualitative data from neighborhoods impacted by foodborne illness outbreaks.

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