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Hurricane Ida's impact on Louisiana and Mississippi during the COVID-19 Delta surge: Complex and compounding threats to population health

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Introduction

On August 29, 2021, sixteen years to the day since Hurricane Katrina savaged the U.S. Gulf Coast, Hurricane Ida made landfall in Louisiana and Mississippi (Figure 1). Hurricane Ida brought into stark relief the complex and cascading risks to population health posed by combined climate and pandemic hazards.[1] Ida produced crippling destruction throughout Louisiana and widespread flooding throughout Mississippi, two states with the lowest COVID-19 vaccination rates in the country.

A public health emergency was declared for both states one day prior to landfall. At the moment of impact, medical centres in both states were filled with pandemic cases, many of whom were in intensive care units (ICUs). Louisiana had 2,266 hospitalized COVID-19 patients and Mississippi had 1673. Medical wards had been converted to COVID-19 units to accommodate the surge and there were essentially no available ICU beds at any hospitals. Hurricane Ida's devastation added to these strained healthcare systems.

Hurricane damage and power outages forced healthcare facilities to evacuate patients, shift to generator power, or both. The situation was most precarious for COVID-19 patients requiring mechanical ventilation or oxygen. Evacuation of COVID-19 inpatients had to be performed swiftly while ensuring that infection control measures were taken to prevent spread of the highly transmissible SARS-CoV-2 Delta variant that was predominant nationwide. Two days after impact, as power outages affected 990,000 Louisiana residents and 46,000 Mississippi residents, 1755 patients had been evacuated from 12 hospitals in the two states. In Louisiana, 15 hospitals were fully evacuated and 18 operated on generator power. For nursing homes, corresponding tallies were 21 and 35; and for assisted living facilities, 47 and 21.

Climate change is exacerbating hurricane hazards

Climate is changing at an alarming pace, making it harder for communities to prepare and respond to increasingly unpredictable extreme weather events.[2] Human actions, particularly the burning of fossil fuels, potentiate climate change, causing Earth to retain more heat energy than it emits.[3] Planetary heat retention produces "climate drivers" such as anomalously warm tropical oceans, the primary energy source for hurricanes.[4] Climate drivers transform hurricane hazards, increasing hurricane activity over the past decades[5] and contributing to higher peak wind speeds, rapid intensification, and increased rainfall.[5–8] Climate drivers change the way these tropical systems move.[9–11] Over the past half-century, Atlantic hurricanes are becoming progressively stronger and wetter, with a tendency for decreasing forward speed as they move over land.[5–11] Climate-related sea level rise increases damage from hurricane storm surge and coastal wave action.

On path toward the Gulf Coast, Hurricane Ida displayed the attributes of a climate-driven storm. Ida underwent multiple phases of rapid intensification. Moving over the superheated Gulf Loop Current, Ida increased windspeed up to the point of landfall. At 150 mph, Ida tied 2020 Hurricane Laura and the 1856 Last Island Hurricane as the strongest landfalling tropical cyclones in Louisiana history.[12] In the New Orleans area, the $14.5 billion fortress of levees constructed

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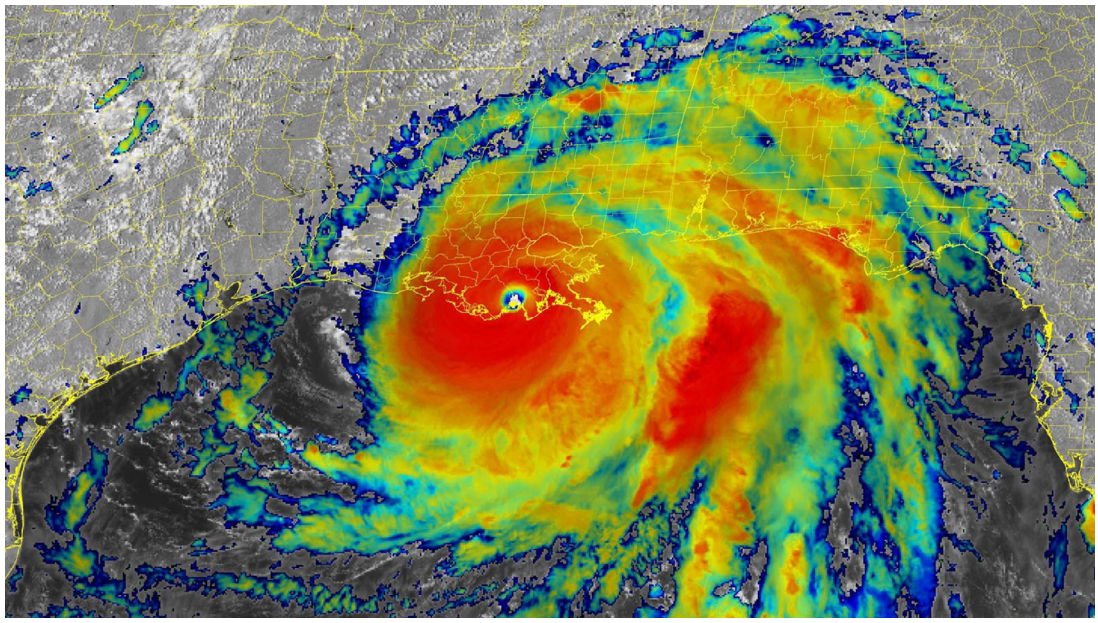

Figure 1. Infrared satellite image of Hurricane Ida making landfall in Louisiana on August 29, 2021 with maximum sustained winds of 150 mph (Image credit: NOAA).

post-Katrina withstood Ida's onslaught. Impact phase mortality was limited to 34 deaths in Louisiana and 3 in Mississippi. However, the city's frail power grid collapsed, leaving 1.1 million Ida survivors without power, sweltering in post-storm heat and humidity.

Intersecting hurricane and pandemic risks in 2020 and 2021

In 2020, one year prior to Hurricane Ida, the global emergence of COVID-19 coincided with a record-setting, 30-storm Atlantic hurricane season. Safeguarding the public's health when climate-driven storms approach coastal populations where COVID-19 is actively circulating is complicated because approaches to hurricane and pandemic mitigation involve potentially conflicting strategies.

Hurricane population protection rests on gathering people together.[13] Warning, evacuation, and sheltering strategies save lives by moving residents away from coastlines and into shared homes or fortified community shelters able to withstand the force of the storm.[13,14]

In contrast, COVID-19 population protection rests on keeping people apart. As examples, during the 2020 pre-vaccine era, communities initially invoked anti-contagion policies including lockdowns and movement restrictions to slow pandemic spread. Although these stringent measures were quickly rescinded, social distancing, wearing face masks, and conscientious hand washing were broadly practiced throughout 2020.

Apparently contradictory strategies—separating people for pandemic safety versus congregating people for hurricane safety—triggered concerns that one or both of two life-threatening scenarios could play out.[13–17] First, citizens might not heed hurricane evacuation orders due to fear of contagion. Second, citizens who evacuate might spread COVID-19 while sheltering together. In response, emergency management protocols from FEMA and the Centers for Disease Control and Prevention (CDC) were reconfigured, attempting to reduce COVID-19 transmission risks associated with hurricane evacuation and sheltering.[14] Modified guidelines portrayed large congregate shelters as options of last resort, promoting instead the use of smaller shelters with separate quarters (e.g. hotel rooms and dormitories). Updates for shelter operations emphasized increased ventilation; maximizing physical space and separation for each resident; continuous symptom monitoring; isolating symptomatic residents; wearing masks, hand hygiene, cleaning, and disinfection; rapid demobilization of shelters after the storm; and self-quarantine after leaving the shelter.[14]

The year 2021 looked to be different. Highly efficacious COVID-19 vaccines were widely available nationwide with adequate supply for all citizens over the age of 12 to be fully vaccinated prior to the peak of hurricane season. Achieving broad vaccine coverage would have reduced COVID-19 transmission risks during hurricane evacuation and sheltering operations to near pre-pandemic levels. Yet, this best-case scenario was not the reality when Ida made landfall on August 29, 2021.

Instead, the Gulf's summer COVID-19 surge was generating high rates of cases and hospitalizations—for several reasons. First, hurricane coast states were easing

restrictions as they promoted their open-for-business, tourism-based economies. Second, the predominant highly-transmissible SARS-CoV-2 Delta variant was propelling a surge of severe disease cases.

Third, Louisiana and Mississippi, the two poorest states in the US, had the lowest vaccination rates in the nation on the day Ida came ashore. Achieving vaccine uptake was impeded by a widespread lack of affordable, quality healthcare; low rates of access to a trusted primary care provider and preventive services; and low levels of confidence in governmental health recommendations coupled with ample medical misinformation. A history of unethical medical practice contributed to lower vaccination rates among individuals from communities targeted for marginalisation. Yet, counterintuitively, given the extremely low vaccination rates in rural areas statewide, a higher proportion of Louisiana's African Americans had received the vaccine than Whites.

Health outcomes from hurricane strikes during COVID-19 surges

Fortunately, 2020 and 2021 saw neither large numbers of impact-phase hurricane deaths from landfalling Atlantic storms, nor detectable COVID-19 spikes among storm survivors. New Orleans maintained continuous COVID-19 surveillance, showing no rise in COVID-19 cases among survivors of 2020 Hurricane Laura who were relocated to New Orleans from Lake Charles, nor following 2021 Hurricane Ida's direct impact on the city.

Several factors may account for these observations. First, COVID-19 testing routinely declines in hurricane-affected areas, so the completeness of detection of incident cases likewise declines. Second, both 2020 Hurricane Laura and 2021 Hurricane Ida made landfall at a moment when Louisiana cases were decreasing rapidly from an earlier peak; the ongoing steep drop in cases may have masked any local uptick among persons who were directly exposed to storm hazards and power outages. Third, in terms of what worked, both storms occurred while behavioural mitigation measures—wearing masks, vaccine checks, and social distancing—were in place. Shifting to smaller shelters, some with separate quarters, avoided a COVID-19, or other respiratory disease, outbreak as happened in a Houston mega shelter after 2017 Hurricane Harvey.

Mental health considerations

Too often overlooked, the mental health consequences of COVID-19 are pervasive, producing substantial and persistent increases in underlying rates of common mental disorders (CMDs), particularly depression.[21] For communities recovering from Ida, storm-associated new-onset psychopathology was overlaid on this COVID-19-elevated baseline rate of CMDs. Although documenting rises in CMDs specific to Ida is challenging until targeted studies are conducted, Gulf Coast communities were already experiencing poorer physical and mental health before and during the COVID-19 pandemic. These detrimental patterns, related to cumulative disaster exposure, were likely exacerbated by the devastating shock of Hurricane Ida.[22] Furthermore, the combination of high rates of CMDs, severe COVID-19 illness, and life-changing hurricane impacts tend to disproportionately affect communities targeted for marginalization. As a clear acknowledgement of the salience of mental health sequelae, the Louisiana Spirit Crisis Counselling Program, operating under the auspices of the Louisiana Department of Health's Office of Behavioural Health, received $9.2 million in March 2022 to support Hurricane Ida survivors.

Lessons learned and future directions

Each tropical cyclone impact provides lessons to carry forward. The Ida experience presented new perspectives on protecting populations from climate-driven hurricanes, adapting to ever-changing pandemic dynamics, and confronting barriers to adopting life-saving public health measures such as vaccination. We comment on strengthening infrastructure, flexibly adapting shelter protocols, nimbly adjusting health risk communications, and integrating an environment-focused global social medicine perspective.

First, climate change mitigation and adaptation efforts must strengthen infrastructure. In response to Katrina's catastrophic flooding and preventable loss of life, the federal government invested $14.5 billion to rebuild New Orleans' levee system. When tested by Hurricane Ida's Category 4 winds and deluging rains, the network of levees performed well to protect lives and property. Nevertheless, flooding did occur in poor neighbourhoods outside the perimeter of the levee system, so the work is not done.[18]

However, during Ida, the power grid collapsed, leaving New Orleans powerless, in the dark, and suffocating in post-storm heat and humidity. Loss of power complicated the treatment of patients hospitalized for COVID-19, especially those who were dependent on oxygen or mechanical ventilation. Preventable and prolonged power outages jeopardized health for persons living with disabilities, older adults, persons living with chronic health conditions or limited mobility, and individuals undergoing medical treatments for cancers and other diseases.[19,20] Ongoing cancer therapies were disrupted, and cancer patients displaced by Ida needed to restart their treatments in distant places. Forty dialysis centres were inoperable in the immediate aftermath due to power loss and staff ill with COVID-19. Hardening infrastructure and upgrading the power grid are imperative prior to future encounters with climate-driven extreme weather impacts.

Second, hurricane sheltering protocols must be regularly revised to adapt to ever-changing infectious disease threats. As described previously, major modifications to CDC and FEMA shelter protocols were implemented in 2020 to address COVID-19 risks. Protocols were further revised in 2021 to better control the accumulation of respiratory aerosols containing more transmissible COVID-19 variants, like Delta and later, Omicron. Revised protocols recommend symptom monitoring, wearing masks, and access to more, smaller shelters that allow for better social distancing.

Third, in times of complex, layered threats as witnessed when Ida made landfall during a pandemic surge, emergency and health communications must become increasingly sophisticated and nuanced. Accurately portraying the compounding threats to population health in a trustworthy, believable, and compelling manner is critical. Motivating protective actions that will save lives—COVID-19 and influenza vaccination, maintaining a family emergency plan, heeding evacuation warnings, and planning for the needs of disabled or medically vulnerable family members—relies upon well-constructed crisis and emergency risk communication messaging. Crafting effective communications has never been more challenging, given the ubiquitous nature of social media and the frequently changing COVID-19 recommendations. Communications grounded on emergency management principles and population health science hold the greatest promise for safeguarding communities during disasters and extreme events.

Fourth, an important limitation is the persistent tendency to bring an acute-phase focus on sudden-onset, short duration disaster impacts, including landfalling hurricanes. Risks to population health from events like Hurricane Ida occur in the context of other ongoing hazards operating across varying time scales. Ida came ashore at full force and moved on quickly to the US Northeast, striking Gulf Coast communities that had been grappling with COVID-19 for 18 months yet were still reeling from the aftermath of Katrina 16 years earlier and the BP oil spill a decade ago. Climate change influences have been progressively evident over recent decades. Yet, as described by Adams et al. (2021), in the complexity of these overlapping and intersecting contexts, health and social inequities are extremely powerful determinants of community vulnerability and community survival.[23]

Concluding comment

Hurricane Ida is an illustration of the complexities of multiple intersecting hazards, with human actions playing leading roles. Anthropogenic climate change likely worsened the hazard properties of Hurricane Ida and exacerbated exposure to extreme heat in the aftermath. The superimposed hazard of the COVID-19 pandemic filled area hospitals to capacity, complicated evacuation and sheltering operations, and increased pre-storm population prevalence rates of mental disorders. Collectively, these compounding features of the risk landscape came together to amplify risks to population health during Hurricane Ida's passage through Louisiana and Mississippi.

Contributors

James M. Shultz conceptualized the paper, selected the co-authors, led the writing, and serves as corresponding author. Edward J. Trapido provided population health and special medical needs information from having experienced Hurricane Ida first-hand in New Orleans (LSU-HSC and Stanley S. Scott Cancer Center). James P. Kossin provided expert atmospheric science perspectives on climate change effects on hurricane behavior specific to Hurricane Ida. Craig Fugate provided the emergency management expertise as former FEMA administrator. Leticia Nogueira added health equity and special populations perspectives to the narrative and detailed edits. Ashley Apro and Mayuri Patel assisted with the literature review and compiling the references. Vincent J. Torres provided the key source materials on the impacts of Hurricane Ida on health systems. Catherine K. Ettman provided insights related to the COVID-19 pandemic's pervasive mental health effects. Zelde Espinel provided input on mental health and psychosocial support. Sandro Galea guided the overall structure of the paper and provided edits throughout the manuscript.

Declaration of interests

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