# Serial Hurricanes The 2017 Hurricane Public Health Responses: Case Studies Illustrating the Role of Centers for Disease Control and Prevention's Public Health Emergency Preparedness Program

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## ABSTRACT

The Centers for Disease Control and Prevention (CDC), Division of State and Local Readiness (DSLR), Public Health Emergency Preparedness(PHEP) program funds 62 recipients to strengthen capability standards to prepare for and respond to public health emergencies. Recipients use these PHEP resources in addition to CDC's administrative and scientific guidance to support preparedness and response program planning and requirements. It is expected that public health agencies develop and maintain comprehensive emergency preparedness and response plans in preparation for disasters such as hurricanes. The 2017 historic hurricane season highlighted how emergency planning and collaborative operational execution is important for public health agencies to effectively prepare for and respond to both the immediate and long-term population health consequences of these disasters. In 2017, the southeastern United States (US) and US Caribbean territories experienced 3 Category 4 or higher Atlantic hurricanes (Harvey, Irma, and Maria) within a 5-week period. This paper highlights selected case studies that illustrate the contributions and impact of jurisdictional emergency management planning and operational capacity supported by capability standards during the 2017 hurricane season. Although the magnitude of the 2017 hurricanes required public health officials to seek additional assistance, the following case studies describe the use of public health preparedness systems and recovery resources supported by the PHEP program.

The 2017 Atlantic hurricane season was one of the most active and destructive hurricane seasons on record in the United States (US).[1,2] Hurricanes Harvey, Irma, and Maria collectively produced record-setting devastation with more than a quarter trillion dollars in damage.[2] These 3 hurricanes caused deaths, injuries, and catastrophic damage for people in Florida, Georgia, Puerto Rico, Texas, and the US Virgin Islands (USVI).[3] In anticipation of the hurricanes, local, state, territorial, and federal government agencies activated emergency operation centers and response teams before landfall.

Building and advancing public health emergency response systems' capacity and capabilities is a priority at the US Centers for Disease Control and Prevention (CDC).[4] The devastation from the 2017 hurricanes varied in affected jurisdictions causing a wide range of damage to infrastructure systems. Therefore, CDC was requested to provide supplementary assistance (eg, hurricane funding, public health staffing support) for the response. CDC's Emergency Operations Center (EOC) supported the responses in the southeastern United States and US Caribbean territories by fulfilling 370 requests for public health responders to help communities affected by the aftermath of the hurricanes.[5] CDC Career Epidemiology Field Officers (CEFOs), Public Health Advisors (PHAs), and other essential staff members were assigned to help build and strengthen the capability and capacity in state, territorial, and local public health preparedness programs.[6-8]

In addition to emergency response operations, the CDC's Public Health Emergency Preparedness (PHEP) cooperative agreement program supported development of jurisdictional preparedness activities that were implemented during the 2017 hurricane season. Since 2002, the PHEP program has funded 62 recipients (50 states, 4 large metropolitan areas, and 8 US territories or freely associated states) to advance 15 capability standards.[7,8] The capability standards offer a flexible and adaptable framework that jurisdictions can apply to any disaster. The capability





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standards are organized into 6 domains: Incident Management, Community Resilience, Bio-Surveillance, Information Management, Countermeasures and Mitigation, and Surge Management. PHEP recipients use these capability standards as a framework to develop and guide preparedness and response strategies and prioritize program activities needed to define public health roles, common terminology, and collaborate with stakeholders during hurricanes and floods.[7,8]

The impacts of Hurricanes Harvey, Irma, and Maria required public health agencies to assure medical treatment for those with pre-existing and/or new conditions brought about by the storms. Hurricane preparedness planning enabled by PHEP program funding and use of the capability standards helped prepare public health agencies to respond to critical public health service needs of their communities. These needs included, but were not limited to, developing capacity to support medical needs in shelters and vaccination sites, deploying and staffing mobile hospitals, and obtaining additional resources required to assist impacted populations. This article discusses 3 hurricane case studies that demonstrate the impact of prehurricane planning enabled by the PHEP program funding and the capability standards during the 2017 hurricane season.

## CASE STUDIES

The 3 case studies summarized in Table 1 illustrate the use of PHEP resources and the public health preparedness capability standards framework during the 2017 hurricanes impacting the Southeastern United States and Caribbean territories. These case studies are examples of organizing efforts to stabilize public health services delivery that were disrupted by the hurricanes. In alignment with Federal Emergency Management Agency's guidelines, they represent use of core capability elements of the Emergency Support Function-#8 (public health and medical services) and responsibilities described within the National Response Framework[9] and Response Federal Interagency Operational Plans.[10]

### *Case 1: Texas - Hurricane Harvey*

Hurricane Harvey's record-breaking rainfall in August 2017 flooded more than 150,000[11] homes and 300,000 to 500,000[12] cars in Houston and Harris County, the nation's third most populated county. CDC's PHEP program and capability standard framework supported the city of Houston and Harris County with hurricane preparedness planning before landfall and with response operations after landfall. For example, hurricane preparedness planning prepared Harris County Public Health (HCPH) department to respond to Hurricane Harvey and help meet the public health consequences of a subset of higher risk victims. The Executive Director of the department used a brand-new response capability to help meet those critical needs: a fleet of 7 mobile units. Just days after Harvey made landfall, the units were dispatched to 32 low-income, badly damaged neighborhoods for 32 days. HCPH staff members provided tetanus and influenza vaccines and distributed food, water, pet food, and cleaning supplies to residents. More than 2000 families received food, 900 people received vaccines, and more than 1400 pets received vaccinations, animal identification microchipping, and/or food.

### *Case 2: Puerto Rico - Hurricane Maria*

On September 20, 2017, Hurricane Maria made landfall in Puerto Rico as a strong Category 4 hurricane causing unprecedented damage to structures, roads, electricity, water, and healthcare facilities. The PHEP resources and capability standards supported prehurricane response planning. Due to the magnitude of the hurricane, Puerto Rico needed support with implementing response plans and requested assistance from CDC after landfall. For example, the loss of power compromised cold chain storage for vaccines, leaving residents without immunizations needed to control endemic communicable diseases. A CDC CEFO medical officer with expertise in public health surveillance and epidemiological investigation, medical material management and distribution, responding to outbreaks, operationalizing disaster plans, and conducting epidemiologic investigations, responded to the request post-Hurricane Maria. The CDC CEFO, alongside local public health department staff, conducted surveillance to identify potential infectious disease outbreaks, exacerbations of chronic disease, and mental health needs, coordinated the inspections of potential vaccination sites, assessed the power needs of the sites, and worked with local officials to make them operational. As a result, more than 25 additional vaccination sites were able to provide immunization services to residents, including at-risk populations, such as children and senior adults. The team also coordinated with mental health providers to provide services to the community.

### *Case 3: USVI - Hurricanes Irma and Maria*

Two category 5 hurricanes struck the USVI within a 2-wk period, severely damaging the territory's infrastructure. Hurricanes Irma and Maria caused widespread damage to homes and business, leaving many residents without electricity or potable household water for months. Of the 3 hospitals in USVI, 2 remained marginally operational, while public health operations were limited. The PHEP program and capability standards supported USVI with prehurricane planning. However, the response to a disaster of this magnitude required the implementation of nearly every capability standard and assistance from the CDC to execute response activities. For instance, a senior CDC CEFO assigned to USVI provided public health, medical, and EOC leadership to support the months-long response. Mass care and evacuation of hundreds of patients were the primary EOC emphases during the



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# TABLE 1

## Impact of the PHEP Program and Capability Standards During the 2017 Hurricane Response

| Hurricane | PHEP Support | At-Risk Population | Public Health Impact | Capability Standards Domain | Activity |
|---|---|---|---|---|---|
| Hurricane Harvey | Harris County Health Department Staff, Resources, and Training (Case Study 1) | Vulnerable populations and pets | **Location:** Texas<br>**Hurricane Category**: 4<br>**County Impacted:** Harris County<br>**Public Health Intervention** Public health department utilized a fleet of 7 mobile units. Just days after Harvey hit, the units were dispatched to 32 low-income, badly damaged neighborhoods for 32 days. Also, staff members provided tetanus and flu shots and distributed food, water, pet food, and cleaning supplies to often distraught and emotional residents. More than 2,000 families received food, 900 people received vaccines, and more than 1,400 pets received vaccinations, animal identification microchipping, and/or food.<br>**Population Impacted by Intervention:** 4,092,459 residents | Community Resilience, Incident Management, Information Management, Countermeasures and Mitigation, Surge Management, and Biosurveillance | Setting up mobile units, providing tetanus and flu shots, and distributing food, water, pet food, and cleaning supplies |
| Hurricane Maria | CDC staff CEFO (Case Study 2) | Residents that needed vaccinations | **Location:** Puerto Rico<br>**Hurricane Category**: 4<br>**Counties Impacted:** N/A<br>**Public Health Intervention:** A CDC CEFO physician normally assigned in New York City, conducted surveillance to identify potential infectious disease outbreaks, exacerbations of chronic disease, and mental health needs, coordinated the inspections of potential vaccination sites, assessed their power needs to maintain cold chain, and worked to make them operational in partnership with local Puerto Rico health department staff. As a result, more than 25 additional vaccination sites were able to provide services to residents. The team also coordinated with mental health providers to provide services to the community.<br>**Population Impacted by Intervention:** 3,725,789 residents | Surge Management, Countermeasures and Mitigation, and Biosurveillance | Disease surveillance and re-establishing vaccination sites |
| Irma and Maria | CDC Staff CEFO (Case Study 3) | Residents without shelter and patients needing medical supplies | **Location:** US Virgin Islands<br>**Hurricane Category**:5<br>**Counties Impacted:** N/A<br>**Public Health Intervention:** The CDC CEFO assigned to the USVI Department of Health, alongside local staff, coordinated evacuations, sheltering, and distribution of medical supplies. The CDC CEFO also was involved with multiple rapid needs assessments to determine the health status and basic needs of the community so emergency managers could act quickly.<br>**Population Impacted by Intervention:** 106,405 residents | Incident Management, Community Resilience, Biosurveillance, Information Management, Countermeasures and Mitigation, and Surge Management | Coordinated evacuations, sheltering, and distribution of medical supplies |

early stages of the response, while the distribution of medical supplies, food, and water were coordinated, concurrently.

Teams quickly established general and special-needs shelters for residents on each island, and the CDC CEFO supported a range of response activities associated with the capability standards. The CDC CEFO was a trusted partner and advisor helping to establish disaster public health surveillance and community recovery capability standard activities, which included shelter surveillance and conducting community assessments to characterize disaster impacts and identify community recovery needs. During the response, the USVI Department of Health conducted 2 Community Assessments for Public Health Emergency Response (CASPERs).[13] These were followed by an additional CASPER 3 mo later to better understand community recovery progress and guide prioritization of ongoing community recovery efforts.[13] The information gathered from these assessments enabled territorial leadership to implement a data-driven response and assure public health issues remained at the forefront of recovery planning.13

## DISCUSSION

CDC's PHEP support and capability standard framework provides guidelines to affected jurisdictions to help identify public health systems capacity needs to ensure continuity of operations, reduce community morbidity and mortality, and strengthen health protection activities for impacted populations. The PHEP program and capability standard framework can assist state, tribal, local, and territorial (STLT) agencies with their hurricane preparedness planning for response operations. Regardless of the level of capability developed and prehurricane capacity level of the jurisdiction, communities were not able to predict the level of devastation by these hurricanes. Jurisdictions developed plans based on the capability standards before the 2017 hurricanes, but had challenges implementing the plans due to the massive destruction of infrastructure.

Opportunities for improvement (eg, post-storm health risk communications, vaccinating residents, staffing, etc.) identified during the 2017 hurricane season caused further review of public health preparedness and response policies, science, and practices. As a result, CDC included in the 2018 version of the capability standards lessons learned from the 2017 hurricane season as well as other public health responses since 2011.[8] The PHEP program will continue to evolve as public health agencies continue to learn, share promising practices, and further test methods to further incorporate the capability standards and their application as described in the 2019-2024 PHEP notice of funding opportunity cooperative agreement.

Planning is essential to advance STLT emergency response capacity.[1,14,15] The CDC's PHEP program assists public health agencies build and advance capabilities and capacity before, during, and after public health emergencies,[5-8] such as the 2017 Hurricanes Harvey, Irma, and Maria. The responses to the devastating 2017 hurricane season highlight the value of the CDC PHEP program and demonstrate the utility of applying the capability standards as a framework to plan and respond to public health threats and emergencies. Complementary to the National Response Framework,[9] the capability standards help jurisdictions define and link public health response roles and responsibilities with the larger organized emergency management community's response and recovery functions that will be needed during any all-hazards' population threat or emerging hazard.[8,14]

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