A Modern Approach to Public Health Preparedness

Industry Perspective

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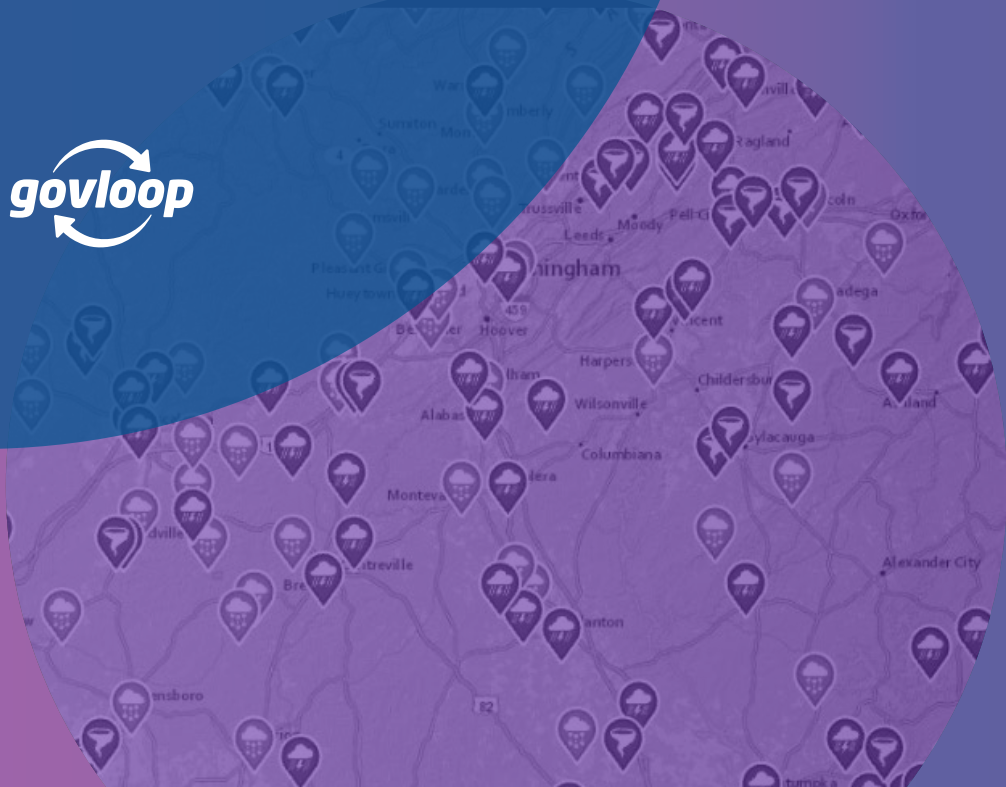
Introduction

No water. No power. No fuel. Limited food and shelter. Homes destroyed, streets flooded, infrastructure faltering, communities cut off.

This was the reality for the residents of Houston in the aftermath of Hurricane Harvey in August and September 2017. At least 82 people were killed as a result of the storm; 30,000 people were displaced, and Harvey tied with Hurricane Katrina as the costliest tropical cyclone on record, inflicting at least $125 billion in damages.

Hurricane Harvey was devastating, but it wasn't an isolated incident. Several more natural disasters and outbreaks have happened in the United States. In fact, in 2017, there were 16 weather and climate disaster, with losses exceeding $1 billion each, across the United States. Making 2017 one of the costliest years for disaster event in nearly a decade.

Being prepared is more important than ever – and geographic information systems can help.
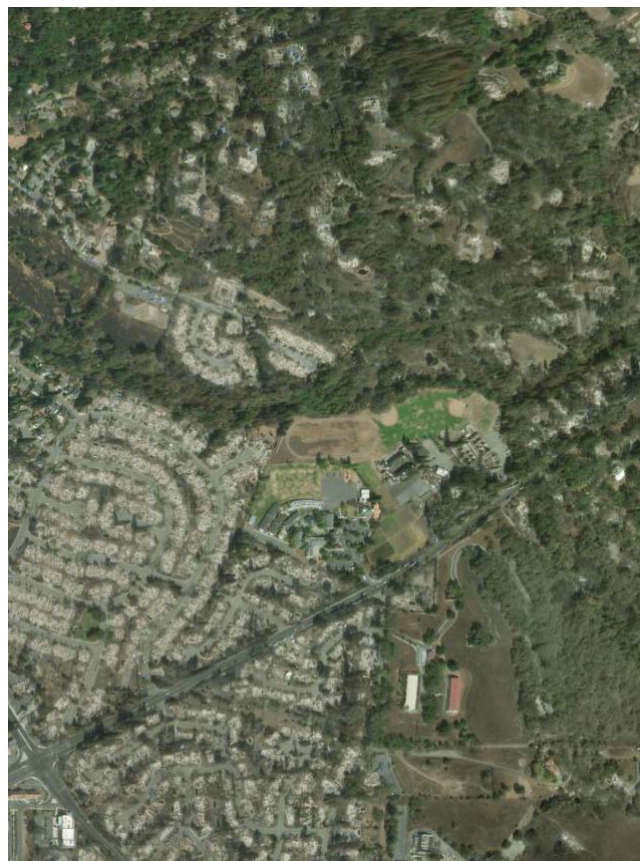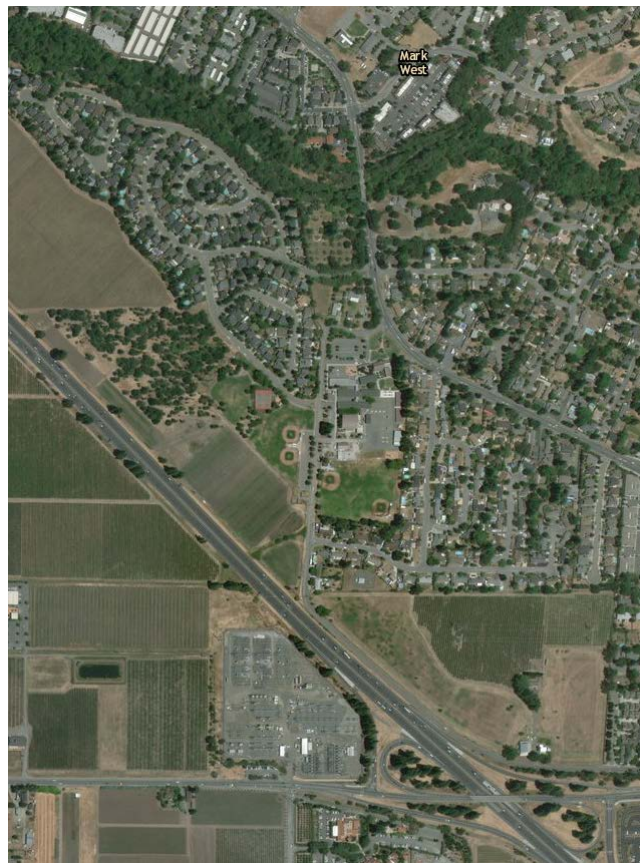
Public health preparedness is more than preparing for disaster response. It involves extensive planning for a wide range of contingencies, including escalating operational support and shifting strategies that focus resources where and when they are needed most. Public health preparedness play different roles depending on how events change. This includes responding quickly and effectively the moment a problem is identified. Deploying the right people and resources to contain or mitigate the incident before it gets out of control.

But preparedness must also include strategies that take the longer view of supporting incidents where the end is unclear and the extent of the after-effects is unknown. This means that the tools they use must accommodate and help them manage ever growing amounts of data, from more sources. They need to turn this data into actionable information on-the-fly to coordinate their efforts with other agencies, partners and build confidence and trust with the public.

While critically important to our nation, public health preparedness faces obstacles in coordination of response, synthesis of data, long-term projections and true situational awareness. The field needs to look to the future – and that's where geographic information systems (GIS) comes in. Today's toughest challenges have one thing in common: location. When disaster strikes, governments need to locate health services, responders and victims to protect lives, resources and critical infrastructure.

To better understand how public health preparedness can robustly move to the future and respond to increasing threats and disasters, GovLoop partnered with Esri for this industry perspective. In the following pages, informed by experts from Esri and government success stories, we'll explore how GIS helps public health preparedness efforts overcome legacy challenges; how governments across the country are implementing GIS in their community public health outreach efforts and how your agency can take advantage of location data, visualization, and analysis to better respond to natural disasters and outbreaks.

Northern California Wildfires Post-Event Imagery

# Responding to the Challenges of Public Health Preparedness With GIS

Preparedness staff face some of the most challenging trials of our time. They must plan for and ensure resilient, healthy, and safe communities in the face of ever-changing and increasing public threats like climate disasters, disease outbreaks, earthquakes or mass shootings. Not only must they prepare communities in the hypothetical event of these disasters, but they must help in the response and aftermath should any of these events take place.

But like many other areas in government, they face a maze of obstacles. Planning and coordinating emergency response and recovery strategies places a tremendous responsibility on agencies to make the best decisions under difficult circumstances.

One massive challenge is the enormous amount of data. Agencies may be overwhelmed and unable to access or process the colossal amount of data they need to prepare and respond to public health catastrophes. There are often multiple sources of data; old data sets or an inability to bring together multiple data sets in a timely manner. Getting true situational awareness to respond in a real-time manner to threats and their aftermath can be nearly impossible.

That's why preparedness staff need a collection of foundational data, supported by GIS, an enterprise platform, that is ready to go when a disaster strikes. They must pull together data from countless systems, into a single framework to make timely and crucial decisions. Geography is often the only consistent element for all of these data. When a GIS platform is created and accessible, agencies will be able to create information products that will help them answer the questions they're facing and the decisions they must make.

Leveraging an enterprise GIS technology platform can help public health preparedness planners meet the six preparedness domains, as defined by the Center for Disease Control's Public Health Emergency Preparedness Program. The six domains are community resilience, incident management, information management, countermeasures and mitigation, surge management and biosurveillance. Here are the challenges presented in preparing for each domain, and how GIS helps:

Community Resilience

Incident Management

Information Management

Public Health Preparedness

Biosurveillance

Countermeasures & Mitigation

Surge Management
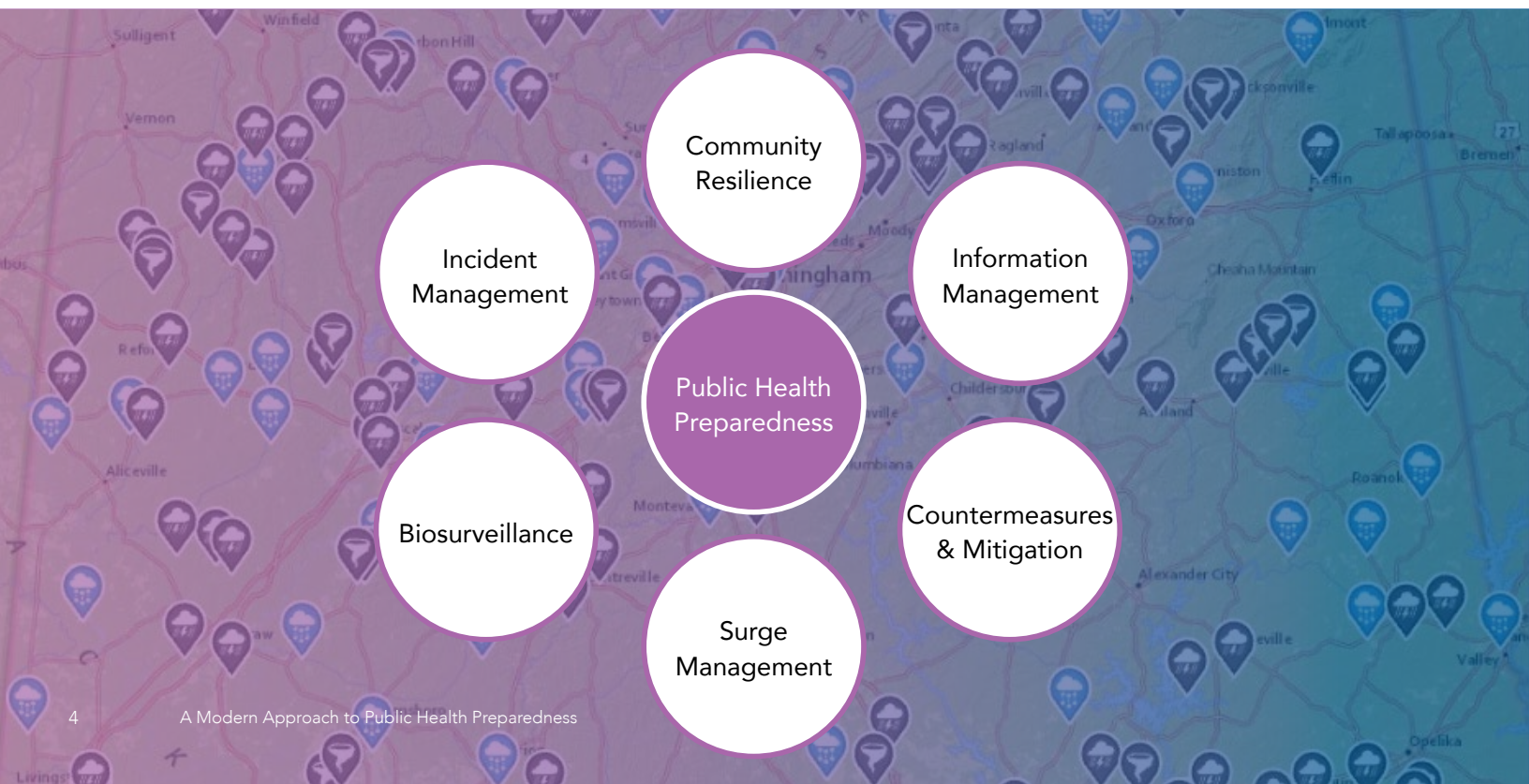
Community Resilience:
## Preparing for and Recovering From Emergencies

The key to quickly recovering from an emergency is adequate preparation. Communities must understand their vulnerabilities and analyze their risk to be fully prepared, but this is a daunting task. GIS can help with tactics like historic risk modeling to understand factors like natural and biological hazards. This helps prioritize mitigation activities, develop comprehensive response plans and predict the impact of different scenarios.

Incident Management:
Coordinating an Effective Response

Organizations have traditionally combined their disparate data together in often cluttered, web-based common operating pictures. An enterprise GIS platform allows smooth internal collaboration across departments as well as external collaboration with citizens, non-profits, and more.

Information Management: Making Sure People Have Information to Take Action

Having the right data is vital in public health preparedness to drive analysis, help inform decision-makers and support warning systems. Because data comes in many forms and from many sources, it can quickly overwhelm. Organizations can use GIS data to leverage location to uncover patterns and communicate so that all stakeholders, including partners and the public, understand.
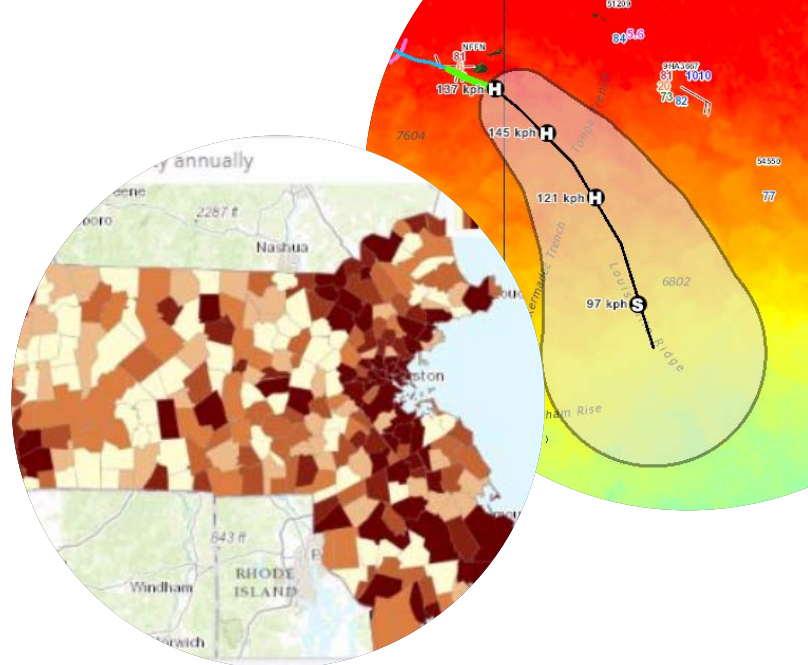
Countermeasures and Mitigation: Getting Medicines and Supplies Where They Are Needed

It's critical to safeguard the community's supply of medicines and other supplies before, during and after an incident. Providing and maintaining services, as well as the health and safety of response staff, often requires real-time data. Being able to quickly assess the geographic extent of an incident and monitor human and material assets lets organizations quickly make data-driven decisions.

Surge Management: Expanding Medical Services to Handle Large Events

Organizations may have to expand the medical services provided within the community during an incident. Location is key to planning and monitoring these services, whether providing seasonal cooling or heating centers, monitoring emergency shelter capacity, reuniting families or planning temporary medical clinics. Using GIS to help both partners and citizens easily locate preparedness resources and potential hazards helps ensure overall health security.

Biosurveillance:
Investigating and Identifying Health Threats

Identifying health threats and taking action requires the ability to recognize patterns in space and time using different analysis tools and methods. An enterprise GIS platform can provide the analytic engine to turn raw data into actionable information by leveraging its location component. Spatial analysis provides the ability to detect an emerging threat or disease outbreak, model its spread and predict where it's likely to happen next.
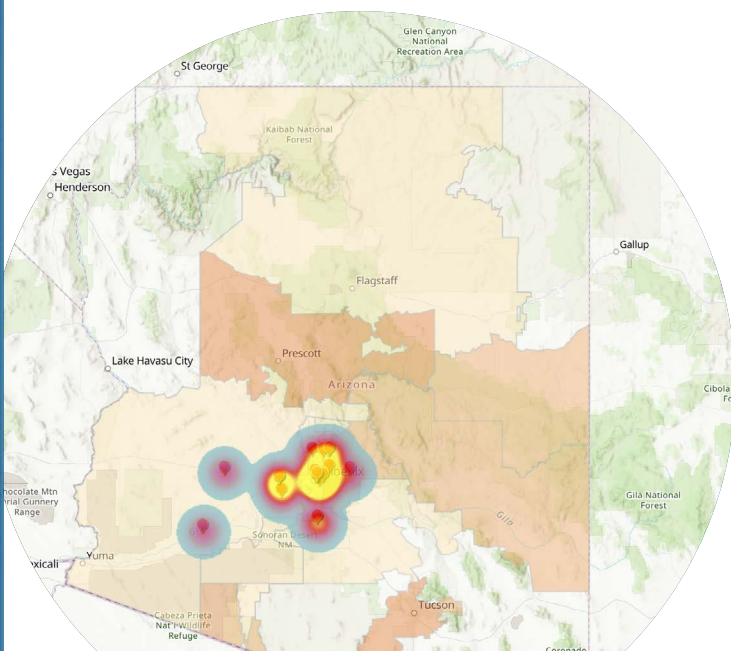
A Location Strategy for Public Health Preparedness

With GIS and a location strategy in place, you can:

Manage location data and imagery and perform advanced visualizations with maps and analytics:

By comparing before and after images of a location after a disaster, such as a flood, crisis managers can quickly assess the level of damage and assign health personnel to locations where they are needed most.

Get accurate data into and out of the field faster:

With mobile devices and easy-to-use apps, staff have the intelligence support they need to complete tasks ranging from simple to complex — anytime and anywhere.

Enrich your data with authoritative demographics, lifestyle and spending data to present powerful population insights:

Demographic statistics in a spreadsheet are cumbersome to use. But if location and time are included in the data, you can use GIS to map it, so it is easy to integrate and understand. For instance, you can see the location and timeline of a flu epidemic and determine where best to place inoculation centers based on the need.
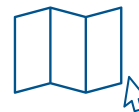
Use interactive maps to communicate better:

Because maps provide a common visual language for all kinds of data, they help you break down barriers to information-sharing, communication and collaboration. This will help you get critical information out to the public in the most efficient and effective manner.
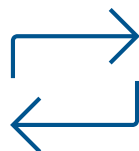
Monitor and respond in real time to changes in daily operations:

Real-time information helps response teams direct action in a crisis. This level of visibility into live events helps improve operational awareness and enables a quicker response to dynamic situations.

Create engaging, interactive map-based stories to inform stakeholders, decision-makers and the public:

During a crisis, two-way communication with the public is critical. Agencies can post web maps and share their current plans, activities and locations of health care facilities.

Case Studies: GIS and Public Health Preparedness in Action

Cities, counties, states and the federal government are already leveraging GIS to help in their public health preparedness efforts. Here are a few of their stories.

West County Health Centers, Sonoma, Calif.

245,000 acres. 250 different wildfires. 44 people dead, and at least 185 injured. $85 billion in damage to the U.S. economy.

These staggering figures were the immediate ramifications of the wildfires that spread across Northern California in October 2017. While the cause of the wildfires is still being investigated, the damage it left was clear – air pollution, ruined property, countless losses.

But what was less clear was the near- and long-term health impacts the wildfires would cause, and how they could be treated.

Health concerns from the wildfires were top of mind the first day of the fires for the West County Health Center, a federally qualified health center that serves patients in western Sonoma County, many of them uninsured. As the fires tore through the area, employees at the center realized they could put their GIS tools to work.

"Well before the fires, we've been trying to think more upstream about public health," said Dr. Jason Cunningham, Chief Medical Officer at the center. "This means thinking about things like location, poverty, social services and more, and how those affect health outcomes. We quickly figured out that we needed data that don't normally reside with our electronic health records. So it's not just the blood pressure; it's where do patients live, and more. And so we needed to own our data, and we turned to GIS."

The health center had already been experimenting with GIS applications to help identify these sorts of far-reaching health problems in its patients well before the wildfires hit. But they quickly realized they could use the base of what they had accomplished in GIS for new causes in treating those affected by the fires.

"We started realizing that staff weren't coming into the centers, and that they might be affected by the fires," said Cunningham. "Then we started thinking about what we could do for the patients affected."

Within the early days of the fire, using ArcGIS, the center was able to identify patients who lived within an area of direct fire exposure of high risk for evacuation and make proactive outreach calls to offer support and treat them.

"It was an incredibly powerful opportunity to offer tangible support and a great example of self-service software empowering real impact," said Cunningham. "We were asked by two other community health centers in Sonoma County to do the same for their patients, and within an hour, were able to provide them with a similar resource that they used for outreach."

Additionally, the center now has a marker for which patients were physically affected by the fire and are using that for ongoing care management support and trending for potential health disparities over time.
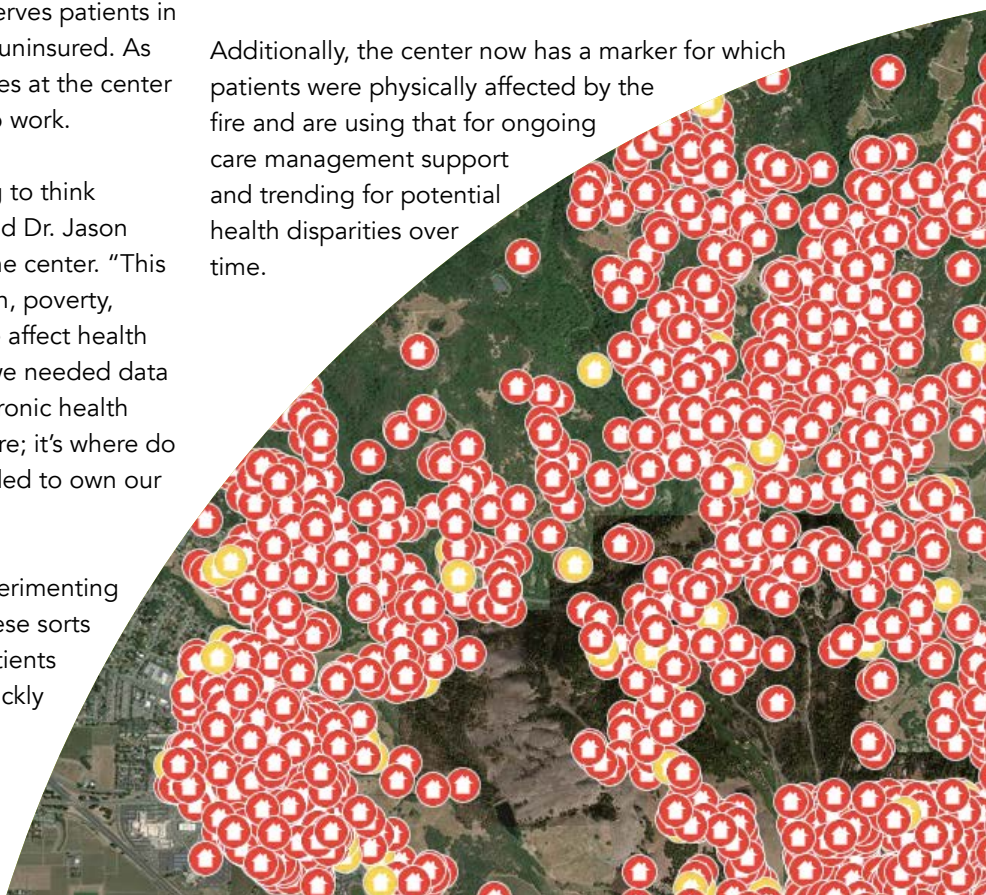
Harris County, Texas, Department of Public Health

Harris County had never seen a storm like Hurricane Harvey. It was, as the National Weather Service tweeted, unprecedented and beyond anything experienced.

In August of 2017, one trillion gallons of water fell across Harris County over a 4-day period, covering the county's 1,800 square miles with an average of 33 inches of water.

When the storm finally abated, Harris County was left with lingering flooding and overflow of reservoirs and other water sources, which ended up contaminating drinking water used by the county's residents. Pumps failed, water companies were unable to quickly repair them, and boil water notices (where residents are instructed to boil their water before any use because of potential contaminates) were issued by the dozen.

In addition to the aftermath of the storm, residents of Harris County faced another challenge: most were not aware what water company serviced their neighborhood, so it was impossible to know if they were affected by the boil water notices that were coming out or not.

That's where GIS technology came in. Elizabeth Perez, Director of Communications for the Harris County Public Health Department, explained.

"There's not really a way for residents to know what water company is providing them water," Perez noted. "So what we ended up doing is putting an ad hoc GIS map so that way we could give people a general idea of where the affected water was."

Perez and the GIS team put together a map that sorted water companies boil water notices by zip code. People could head to the map and check if their water still needed to be boiled.

"We made sure to share the map with the media and on social media so people became aware of its existence," Perez said. The map was updated every 24 hours.

The results? The map received nearly 30,000 views, and kept residents informed about the safety of their drinking water in a timely manner.

"Being adaptable and responsive with GIS was what really helped us," Perez concluded.
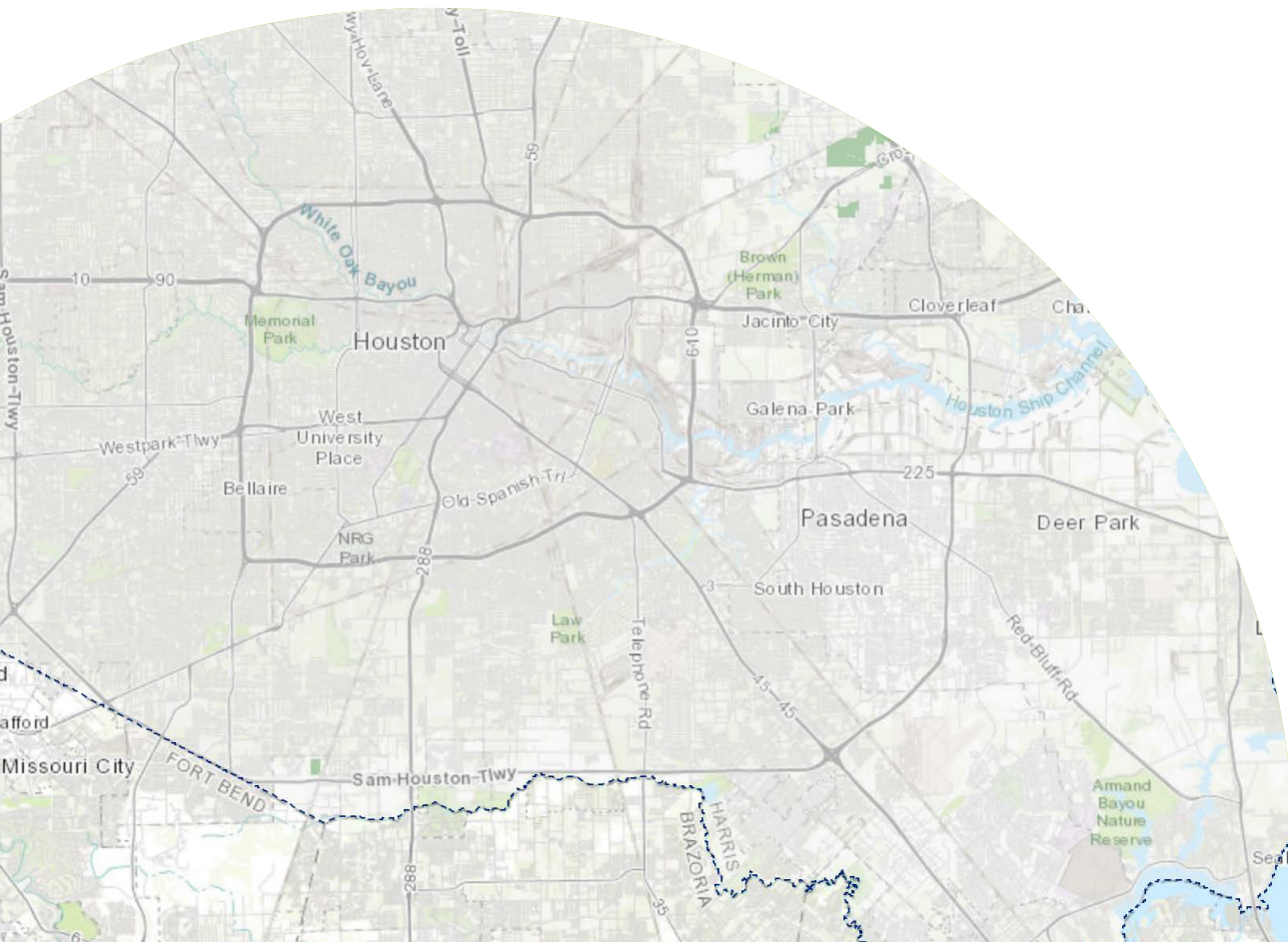
New York City Department of Health and Mental Hygiene

The work of the New York City Department of Health and Mental Hygiene (DOHMH) is broad ranging, from administering inspection grades for dining establishments to mitigating infectious disease outbreaks. With over 7,000 employees serving more than eight million citizens, DOHMH is one of the largest public health agencies in the world. As the threat of Zika virus loomed over the United States, DOHMH used GIS technology to target messaging in potentially at-risk neighborhoods in New York City (NYC).

To ensure messaging was reaching potentially at-risk populations, under Dr. David E. Lucero's (Director, Data Unit) leadership, DOHMH identified at-risk neighborhoods and reached out to these patients via obstetrics and gynecology (OB-GYN) providers. To ensure messaging was getting to patients, DOHMH needed to canvass 178 OB-GYN clinics with limited resources.

With ArcGIS, they developed a risk index using the following data layers:

• Population density of first-generation immigrants in NYC from Latin American countries where there is local Zika virus transmission

• Water and tree canopy density in NYC

• Density of arboviral (infections caused by viruses spread by infected insects) cases for the past three years in NYC

Next, using spatial analyses, clinics were optimally assigned to canvassing teams. The analysis, a K-means clustering algorithm assigned clinics to a team by minimizing travel distance to public transit stations, public transit routes, and at-risk neighborhoods.

The department was able to identify which neighborhoods were most at risk of local Zika transmission and develop optimal routes to reach clinic locations likely to service this population. In one business day, 11 teams used public transportation to visit a total of 178 OB-GYN facilities across 10 neighborhoods.
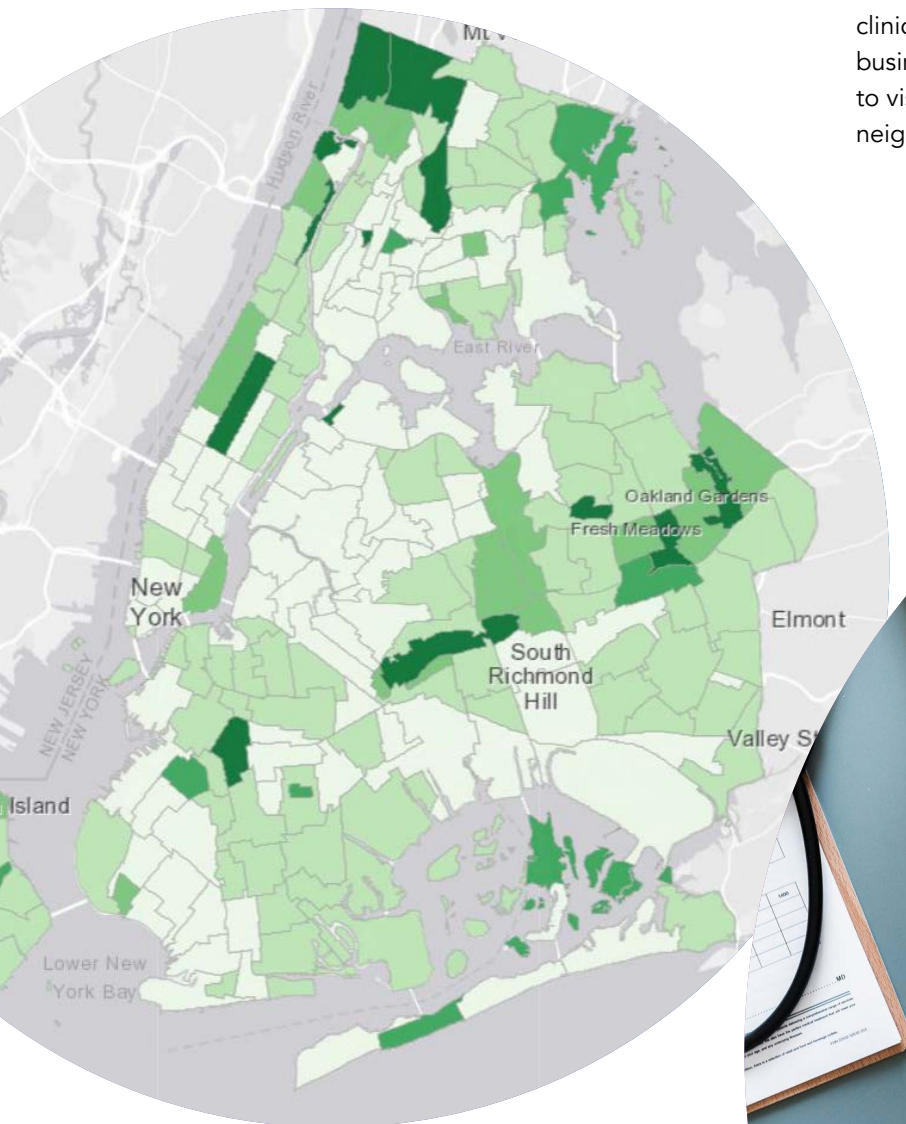
How Esri Can Help

Esri uniquely supports public health preparedness through its software, services and expertise, and provides capabilities that help health departments build, promote and sustain healthy communities:

- **Real-time GIS platforms:** Analyzing your data and author geographic knowledge lets you examine relationships, test predictions and ultimately make better decisions, and offers a geographic approach to public health preparedness. Sound analysis and data-sharing capabilities will allow you to reach across disciplines, jurisdictions and more. A common operating picture for decision-makers and people on the ground is necessary in public health preparedness. Using digital maps and infographics can give officials the power to visualize an emergency situation in real time, and ensure that resources are deployed quickly and effectively.

- **Community intelligence:** Governments need to better understand their community and potential vulnerable populations and ways to engage. By analyzing variables of your population, you can prioritize community projects, allocate resources for greatest impact and understand the types of people impacted by a policy decision.

- **Focused GIS maps and apps:** Ready-to-use maps and apps designed to support mission-critical activities, such as conducting surveys, assessing damage, and sharing real-time status with decision-makers and citizens. Public health preparedness planners, responders, and analysts can work from the same information for faster response and recovery.
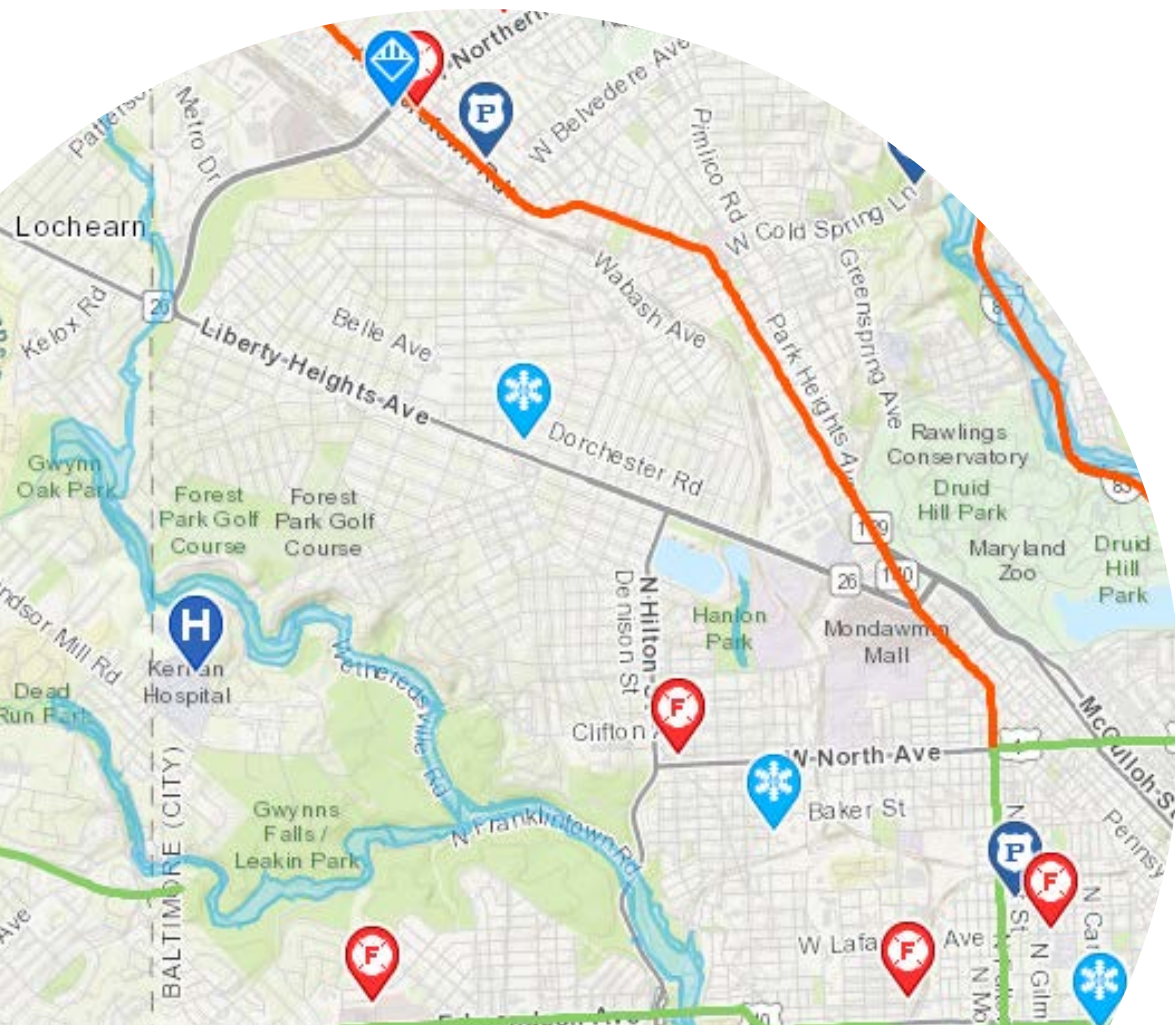
Conclusion

Being prepared is the backbone of any safe, healthy and resilient community. But as threats, natural disasters and pandemics shift and evolve, so must the capabilities of officials to meet the ever-changing threats facing communities today. Given all of the pieces they must organize, having a location strategy and one platform to bring it all together is the key to communication and organization during a crisis. By using GIS technology, governments can better manage pandemics, prevent chronic disease and monitor environmental quality to transform community health and safety, today and in the future.

About Esri

When Esri was founded in 1969, we realized even then that geographic information system (GIS) technology could make a difference in society. Working with others who shared this passion, we were encouraged by the vast possibilities of GIS.

Today our confidence in GIS is built on the belief that geography matters - it connects our many cultures and societies and influences our way of life. GIS leverage geographic insight to ensure better communication and collaboration.

Explore our website to discover how our customers have obtained the geographic advantage by using Esri software to address social, economic, business, and environmental concerns at local, regional, national, and global scales. We hope you will be inspired to join the Esri community in using GIS to create a better world.

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About GovLoop

GovLoop's mission is to inspire public sector professionals by serving as the knowledge network for government. GovLoop connects more than 270,000 members, fostering cross-government collaboration, solving common problems and advancing government careers. GovLoop is headquartered in Washington, D.C., with a team of dedicated professionals who share a commitment to the public sector.

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