Case 2 : Hurricanes and Health: A Systems Thinking Approach to Understanding Complexity and Context

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CASE 2

Hurricanes and Health: A Systems Thinking Approach to Understanding Complexity and Context[1]

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To Leona Hernandez it looked like a giant gash had been torn from the very fabric that made up life in Roseau, Dominica. Colourful houses looked empty with their roofs torn clear off and the everyday items that make up families' lives were scattered in the street. Telephone poles and palm trees toppled across roads that ended abruptly as landslides and flooding got the better of modern infrastructure (Exhibit 1). It was Monday October 2, 2017, which officially marked two weeks since Hurricane Maria had made landfall on the island of Dominica and forever changed the lives of its residents.

Leona had arrived the previous night in Roseau, the capital of Dominica, and she was tired after eight hours of travelling from Washington, D.C. As a water and sanitation engineer, she had been sent from her corner office in the Emergency Operations Center (EOC) at the Pan American Health Organization (PAHO) headquarters to assist with relief efforts on the ground. Being in the field was one of the things Leona loved most about her job, and she knew her skill set was needed.

The main priority for Leona was to lead the water, sanitation, and hygiene (WASH) coordination group meetings. As in any relief effort post disaster, there was a significant number of partner organizations involved: Dominica Water and Sewage Company Limited (DOWASCO), Caribbean Disaster Emergency Management Agency (CDEMA), United States Agency for International Development (USAID), International Federation of Red Cross (IFRC), Caribbean Electric Utility Services Corporation (CARILEC), and the United Nations Children's Fund (UNICEF), to name a few. Leona was in charge of making sure the organizations were able to fill the necessary response gaps, avoid duplication of effort, and coordinate an effective WASH response. She was also in charge of ensuring that the help each organization provided was in

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line with the needs of the people of Dominica. The only way Leona would be able to understand, and advocate for, the needs of different communities would be to visit the people, even in the most remote towns and villages.

BACKGROUND

Small Island Developing States: Defining Vulnerability

Small Island Developing States (SIDS) are a unique group of nations, including Dominica, recognized by the United Nations as countries confronting distinct environmental and developmental challenges (United Nations, 2015). One of these challenges is the high vulnerability to climate change impacts these nations face despite contributing very little to climate change themselves. With a total population of fewer than 65 million inhabitants, the combined climate change contribution of these SIDS nations is less than 1% of overall global greenhouse gas emissions (United Nations, 2015). However, it is projected that SIDS will experience significant changes to their average temperature, rainfall levels, and sea levels in the coming decade (United Nations, 2015). Most communities, infrastructure, and economic activities are found in the low-lying coastal regions, leaving them especially vulnerable to rising sea levels. Increased risk of tropical storms is another projected impact to SIDS under current climate change predictions (Shultz et al., 2018). Climate change impacts will reach other sectors, devastating both natural environments and social systems. Freshwater security and biodiversity are at risk, and natural environments such as coral reefs are at risk as well. Social systems may also face disruption, particularly with respect to public health, food security, and sustainable development (United Nations, 2015).

Dominica: The Nature Island

A mountainous island in the Caribbean, Dominica is 750 km^2 and home to 73,162 people (PAHO, 2017). The rugged landscape of the interior has created a narrow band of concentrated development along the coastline where 90% of the residents live, leaving citizens and the infrastructure exposed to the impacts of natural disasters (Global Facility for Disaster Reduction and Recovery, n.d.). Economic development is also vulnerable to natural disasters with the primary drivers of development being agriculture and tourism (Global Facility for Disaster Reduction and Recovery, n.d.).

Hurricane Maria: A Perfect Storm

During the 2017 hurricane season, the island of Dominica experienced one of the most devastating storms to date. The following is a condensed timeline of events during Hurricane Maria in Dominica (CDEMA, 2017):

Day 1: September 16, 2017, 6:00 p.m. AST
- CDEMA issued a report regarding the formation of Tropical Storm Maria over the Atlantic
- For Dominica, a tropical storm warning was put into effect
- The public was advised to monitor radio or television for progress reports

Day 3: September 18, 2017, 7:00 p.m. AST
- CDEMA updated Hurricane Maria to a category 4 hurricane as it tracked toward the island nation

Day 3: September 18, 2017, 9:35 p.m. AST
- Hurricane Maria made landfall on Dominica with wind speeds of 250 km/h (155 mph), making it a category 5 hurricane

- Initial reports indicated 100% of the country had been impacted, significant damage had occurred to the housing stock, and there was a need to reestablish communication networks and provide water
- PAHO deployed humanitarian advisors to assist with relief efforts

Day 7: September 22, 2017, 9:00 p.m. AST

- Power and water supplies were disrupted
- Road access was extremely limited due to landslides
- 98% of housing had roof damage and 50% had frame damage, leaving an estimated 17,000 people in need of shelter
- Communications were partially restored
- Daily curfew established from 4:00 p.m. to 8:00 a.m. to ensure people remained indoors

Day 16: October 2, 2017, 9:00 p.m. AST

- 88 shelters remained open—many without power, running water, or proper sanitation, and many faced issues of overcrowding
- Some shelters relied on river water as the primary source of drinking water
- PAHO led the WASH coordination group meetings

Providing Technical Cooperation

The EOC is the heart of the Health Emergencies Department and the touch point for all emergency response operations within the organization (PAHO, n.d.). To ensure PAHO is ready to respond in a timely and effective manner, the EOC is responsible for:

- supporting member countries in assessing the health situation postdisaster
- supporting the coordination of international health assistance
- providing technical cooperation in health-related emergency response activities
- activating and mobilizing institutional response mechanisms (PAHO, n.d.)

Providing technical cooperation includes information management, resource mobilization, and the deployment of experts to the field. Hearing the news of Hurricane Maria, the EOC manager knew it would be important to deploy his best and brightest experts. Having previous experience coordinating a WASH response, Leona was the natural choice to send to Dominica to assist national authorities. Since the start of her career, Leona had been fueled by a mission to create an environment in which all people can be healthy. When she heard the news that she would be deployed, Leona felt ready to tackle the many challenges of providing clean water in Dominica posthurricane.

PUBLIC HEALTH IMPACTS OF A HURRICANE

Temporary Shelter from the Storm

After leaving Roseau on Tuesday and travelling to the very southern edge of Dominica, Leona arrived in Scotts Head—a small fishing village of 800 residents. The single road leading to Scotts Head had been severely damaged by Hurricane Maria, which made the trip difficult. Leona was travelling with a few other members of the WASH team—Marco of the International Federation of Red Cross and Red Crescent Societies and Dana of the CDEMA. They were there to visit the temporary shelter site and assess the WASH needs.

Parking the truck and making their way through the village to the shelter at the top of the hill, the team had a view of the whole village—or rather, what had been the village. Not a single tree was left standing, turning the once lush green hills to the colour of dirt, interrupted only by the ruins of houses. Even the ocean looked different, suddenly ominous and unfriendly. Talking to

residents along the way it was clear that Hurricane Maria had changed the lives of the old and young alike:

> "*I can't believe the village I have been in my whole life looks like this. It's unrecognizable," said Charles, who sat on a splintered rocking chair on what used to be his front porch.*
>
> *"I have lived here for 27 years. I never thought a storm could do this." Emilio scanned his surroundings as he spoke as if he still could not believe this new reality.*
>
> *"My four-year-old daughter sticks her fingers in her ears every time it rains." Ann remarked as she hugged her daughter Isla closer to her chest. Leona could see the fatigue in Ann's eyes, but she could also see her incredible strength as she comforted and protected her daughter.*

Impacted by the stories of the residents, the WASH team trio paused outside the elementary school-turned-shelter. There was a river running next to the building and it would have almost been peaceful if Leona could have seen past the devastated landscape. Buckets, empty jerry cans, and other containers had been left alongside the riverbed. When she asked about it, the residents confirmed for Leona that they had no access to running water so they had all been drinking, bathing, and washing their clothing in the river. *This is not good,* Leona thought, *not good at all...with all the people drinking the same water…and the likely chance of water contamination poststorm…*

Linking Environment and Health: Leptospirosis

Leptospirosis is a zoonotic disease that has the potential to become an epidemic, especially after heavy rainfall conditions (Mwachui, Crump, Hartskeerl, Zinsstag & Hattendorf, 2015). A broad range of animals including livestock, pets, and rodents can act as vectors for transmitting leptospirosis to humans—either by direct contact through infected urine or by indirect contact through the environment (Mwachui et al., 2015).

Leona can't help but think about the potential for an outbreak of leptospirosis in the shelter after seeing the residents' heavy reliance on river water and knowing the disease is endemic to the island. She saw people engage in many high-risk activities, such as drinking water from untreated sources, bathing in potentially contaminated water, and eating food that had been exposed to the same water (Centers for Disease Control and Prevention, 2017).

The most common symptoms of leptospirosis mimic influenza and include fever, muscle aches, and headaches. There is a chance that those infected can progress to more severe disease states and can suffer jaundice, respiratory problems, organ failure, meningitis and, in rare instances, death (Centers for Disease Control and Prevention, 2018).

Leptospirosis is rarely spread through person-to-person contact; however, an outbreak risk is present when a large number of people use the same drinking water source (Centers for Disease Control and Prevention, 2018). The best way to prevent an outbreak of leptospirosis is to avoid contaminated water sources. Thinking of different ways the WASH team can address the environmental health risk, Leona started to brainstorm solutions, keeping the WASH gold standards in mind (The Sphere Handbook, 2018).

Water and Sanitation
The current gold standard for water supply, sanitation, and hygiene promotion is set by the Sphere Project. *The Sphere Handbook* (2018) lists several key activities for WASH programs including promoting good hygiene practices, providing safe drinking water, and reducing environmental health risks. According to the guidelines, the key indicators for access and water quality include:

- Average water use for drinking, cooking, and personal hygiene for each person in any household is at least 15 L/day
- The maximum distance from any household to the nearest water point is 500 m or less (Sphere, 2018)

In addition, general guidelines are provided for the amount of water needed per person per day (adapted from *The Sphere Handbook*, 2018):

Survival needs: water intake (drinking and food)	2.5 L/day to 3 L/day	Depends on the climate and individual physiology
Basic hygiene practices	2 L/day to 6 L/day	Depends on social and cultural norms
Basic cooking needs	3 L/day to 6 L/day	Depends on food type and social and cultural norms
Total basic water needs	**7.5 L/day to 15 L/day**	

The Sphere guidelines also note that WASH responses should minimize damaging environmental impacts and enhance the long-term goals of the community (Sphere, 2018).

Had the damaging environmental impacts been minimized here? Leona wasn't sure and, while she knew there wasn't a simple solution, she was committed to working with the Scotts Head residents to get them clean water. Leona, Marco, and Dana were quiet as they made their way back down the hill to the truck, each thinking of what they had seen and scribbling field notes to help fill out the official report later.

Dana broke the silence, "I'm really worried about the conditions in the shelter…"

Leona jumped in immediately, "I agree, the conditions are not good."
Finishing her sentence Dana continued, "mental health has to be our number one priority."

"Mental health?" Leona and Marco exchanged a look of surprise. Unsure of what to say next, Leona proceeded cautiously. "Okay, I'm interested to hear your thoughts on this Dana. What does mental health have to do with water security?"

Physical Health and Mental Health
"Ever heard of solastalgia?" Dana asked the other two. Both shook their head, wondering what on earth she was talking about. "It boils down to a feeling of being homesick while you're still at home."

"Imagine this, you wake up one day in the same place you have woken up every morning for the past 20 years. Except it's not the same place at all. The trees that used to catch the sunlight, the river that used to bubble along on your walk to town, and your neighbour's sky blue house that stood across the way…all gone overnight. Important places like the rocks by the sea where you

sat with your grandma, they were swept out by the storm. All you want is for things to go back to the way they were but knowing that's impossible. How would you feel?"

Leona nodded "It's hard to imagine your whole world changing overnight. Then, on top of that, having to live in a shelter environment that doesn't even have running water."

"Exactly," Dana continued, "we cannot ignore the mental health concerns of the residents."

"I agree with you that mental health is important," Marco began, "but I don't think it is more important than providing water in the shelter."

Leona turned her thoughts to trying to balance both concerns. "Maybe by working with the Scotts Head residents we can find a solution that will give them clean water and a way to positively interact with their environment again," she said, thinking out loud.

"But they need water now!" Marco exclaimed, "we don't have time to sit down and come up with different solutions. The only solution is giving them chlorine tablets to purify the river water and remove bacteria. End of story."

Leona looked from Marco to Dana, wondering how the three of them had seen the same shelter, had the same end goal, and yet had such different ideas of what the next step was.

Sensing the group was divided, Marco kept trying to persuade the others. "Our job is to provide families with a way to drink clean water" Marco stated, "So long as they are not drinking river water, their health is not at risk and the job of our organizations is done." Leona thought about Marco's statement…*would their job really be done?*

SPECIFIC PROBLEM OF DECISION

On one hand Leona knew it was important to provide a short-term solution and a way for Dominicans to drink clean water. Marco's chlorine tablets would also reduce the immediate risk of a leptospirosis outbreak. On the other hand, Leona was compelled to explore the more long-term solution that Dana was proposing. A solution that could address mental health concerns and help the residents feel at home once again. But how? It would be more resource intensive, and some organizations were already burned out from responding to the double header of Hurricane Maria after already responding to Hurricane Irma, which had battered the island in 2016.

Questions kept tumbling around Leona's mind. How would she set priorities when responding to the health concerns of a shelter? How should she balance all the competing demands and needs? Which risks are most important to address first: environmental, social, or mental health?

CONCLUSION

As the truck neared the outskirts of Roseau, the three WASH team members had settled into an uncomfortable silence. Leona knew the meeting of the entire WASH team tomorrow would be very important in setting the strategic direction of the response. It needed to happen quickly so the logistics team could begin organizing final details—getting the right materials and expertise to the right place at the right time. In an environment where communication and transportation networks were suboptimal, time was of the essence.

Switching on her phone to see if there was any service, Leona heard two small beeps signalling a new message. Looking at the screen she saw the words:

STORM ALERT: POTENTIAL HURRICANE DEVELOPING OFF THE COAST OF DOMINICA

Speechless, Leona passed the phone to Marco and Dana. What did this mean for the WASH team response? With a new storm approaching, would priorities need to shift or change altogether? Could the small island nation survive another storm?

EXHIBIT 1

Roseau, Dominica after Hurricane Maria in October 2017

Source: Pan American Health Organization, 2017.

EXHIBIT 2
Acronyms used in the Case

EOC—Emergency Operations Center
PAHO—Pan American Health Organization
WASH—water, sanitation and hygiene
DOWASCO—Dominican Water and Sewage Company Limited
CDEMA—Caribbean Disaster Emergency Management Agency
USAID—United States Agency for International Development
IFRC—International Federation of Red Cross and Red Crescent Societies
CARILEC—Caribbean Electric Utility Services Corporation
UNICEF—United Nations Children's Fund

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INSTRUCTOR GUIDANCE

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BACKGROUND

This case examines the complexity of responding to a natural disaster. Leona Hernandez, a water and sanitation engineer from the Pan American Health Organization, is in charge of coordinating the water and sanitation response on the island of Dominica following Hurricane Maria in October of 2017. Upon visiting one of the shelters in the remote fishing village of Scotts Head, she becomes aware of the precarious environmental conditions in the community. Many of the residents are distressed by the complete destruction of their surroundings, and a lack of running water has led to a reliance on drinking from the river. Of immediate concern is the potential for an outbreak of leptospirosis; however, issues of the disaster's impacts on mental health are also emphasized. The Water, Sanitation and Hygiene team members each have a different idea about how to act and which response actions to prioritize. Leona must unite the team and coordinate an effective response, which becomes more complex with another storm system threatening to develop near the island.

OBJECTIVES

1. Apply systems thinking to determine the relationship between climate change, natural disasters, human health, and Small Island Developing States.
2. Explore strategies to set priorities and balance competing needs around environmental health and mental health issues following a natural disaster.
3. Use a framework approach to water and sanitation concerns after a disaster and discuss the public health implications.
4. Discuss broader implications of natural disasters and sustainability.

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DISCUSSION QUESTIONS

1. How important is the role of the environment in determining health? Is it sensitive to change?
2. How do you determine the mental health needs of a community? Who is responsible?
3. How important is the context of a Small Island Developing State? How would the influence diagrams (from the instructor guidance) stay the same and how would they change if we were talking about the response to a hurricane in North America (e.g., Hurricane Harvey in Texas, August 2017)
4. How do you prioritize the response to a disaster? What helps to inform the decision?
5. What does sustainable development mean? Is it about the resilience of the people? The environment? The climate?

KEYWORDS

Environmental health; mental health; sustainable development; systems thinking