A Storm’s A-Comin’!
Implementing Innovative Hurricane Disaster Preparedness Strategies in a Changing Global Climate

Emory Global Health Institute

2019 International Emory Global Health Case Competition Case Writing Team:
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Special thanks to Rebecca Baggett, Robert Breiman, Jeffrey Koplan, Lara Martin, and Rebecca Philipsborn for the Review of the Case

The characters and scenarios described in this case are fictional. The hypothetical case scenarios are complex and do not necessarily have a correct or perfect solution, and thus encourage a judicious balance of creative yet perceptive approaches. The authors have provided informative facts and figures within the case and appendices to help teams. The data provided are derived from independent sources, may have been adapted for use in this case, and are clearly cited such that teams can verify or contest the findings within their recommendations, if it is pertinent to do so. Teams are responsible for justifying the accuracy and validity of all data and calculations that they use in their presentations, as well as defending their assertions in front of a panel of judges.
Introduction

In the year 2030, climate change is producing a proliferation of natural disasters across the globe at an astounding rate. Previous disaster preparedness plans are not able to meet the intensifying environmental challenges and provide populations expedient public health support during the frequent crises. To help combat this problem, a group of benefactors has founded the Climate Impact Institute (CII) to research, create, and implement solutions for climate-related environmental impacts on global health. One of CII’s objectives is for nations to learn from prior examples of insufficient preparation and inadequate responses to major disasters and to use those lessons learned to revolutionize their own disaster preparedness plans.

While climate change produces a broad range of natural disasters, the frequency of hurricanes has been increasing more rapidly. Additionally, CII has noted that prior to a storm, officials have sometimes made assumptions and misjudged the potential impact of the disaster. As a result, in some cases, fewer preparations were made than were needed (Reference Appendix A). Because the frequency of hurricanes is increasing internationally, CII created an initiative to challenge five nations that are disproportionately experiencing destructive storms. CII challenges these five nations to develop new, innovative plans to improve their country’s resilience to, preparedness for, and responses to hurricanes, focusing specifically on those innovations that will protect human health.

Prompt

CII invites representatives from the Dominican Republic, Japan, Madagascar, Mexico, and the Philippines to learn from the successes and challenges that the United States encountered when managing Hurricanes Harvey, Irma, and Maria. Teams should read the Federal Emergency Management Agency’s (FEMA) 2017 Hurricane Season FEMA After-Action Report regarding the United States’ responses to the multiple hurricanes that occurred within a three-week period in 2017 (Reference Appendix B). Where the United States (US) utilizes a federal program, FEMA, to meet hurricane crises, many other countries coordinate with United Nations (UN) agencies. Teams should consider the conclusions from FEMA’s report regarding the US’s gaps in response to the three contiguous hurricanes. Then, CII requests that teams analyze their own country’s responses to catastrophic hurricanes, and identify lessons learned when responding to their own nation’s disaster-related human health crises. Teams should then develop innovative, efficient, creative solutions to the identified vulnerabilities within their selected country’s hurricane preparedness plans (country selection process explained below).
In addition, teams should design unique and inventive strategies to solve their nation’s greatest post-hurricane health challenge. Teams should address socioeconomic vulnerabilities that relate to human health outcomes in their proposals and integrate climate change mitigation as part of their strategies. Teams should consider health at all the stages of the disaster preparedness cycle: preparation, response, recovery, and mitigation. Representatives from the UN, World Health Organization (WHO), and CII will judge and determine which plan is the most effective, innovative, and original.

The winning team will be rewarded $50 million (USD) to fund the implementation of its country’s proposal, including resources, services, and provisions. However, the funders recognize that each country’s needs are different. As such, teams can outline and justify how they would use additional funds, while focusing the $50 million budget on the most vulnerable areas and populations in their country.

### Case Country Selection and Case Presentation Logistics

The 30 student teams participating in this competition will sign up to represent one of the following five countries: the Dominican Republic, Japan, Madagascar, Mexico, or the Philippines. Teams will select a country via a sign-up form provided via email by the Case Competition Planning Team. This form is also available on the [Case Competition website](#). Only six teams can sign up for the same country, and teams will select a country on a first-come, first-serve basis. The Case Competition Planning Team suggests teams select their country as soon as possible after receiving the case so that they can start focusing their research and analysis. The deadline for selecting a country is 6:00 pm eastern time, Sunday, March 10.

During the first round of the competition, teams that selected the same country will be placed in the same competition stream and will compete against each other by presenting their best state-of-the-art proposal for that country. Judges in the first round of the competition will represent governmental representatives of the selected country. The top team from each stream will participate in the final round of the competition.

The five finalist teams, representing the Dominican Republic, Japan, Madagascar, Mexico, and the Philippines, will present their presentations to a different group of judges who will represent the UN, the WHO, and the CII. Teams will have 15 minutes to present their case solutions and the 10 minutes of Q&A with the judges in both the first-round and final-round of the competition.
Below are hypothetical scenarios that personalize the issues faced by residents of each of the five countries. Teams may use these vignettes to personalize their case solutions if they think it strengthens them, however, this is not required.

Dominican Republic

*Santo Domingo, Dominican Republic Volunteer Site:* Everything is completely black except for the stars and the occasional flicker of flashlights and vehicle lights illuminating the volunteer staging area. After traveling on a 12-hour journey that should have taken two, young college students, Isamar and Jeshurun, are on a mission to deliver clothes and water. Upon arrival, they realize that the site has received more supplies than it can handle. Because it is too early in the rescue operation, people are not ready to receive provisions. The authorities inform the students that the area is not safe because of downed power lines and advises them to turn back. The students realize that they are low on fuel but begin their journey back hoping to find gasoline along the way.

Japan

*Shikoku, Japan Hospital:* Nurse Yuka has not slept in two days, and her feet are throbbing. The electricity in the hospital continues to fail, and the rumor is that the generators may not run for much longer. Medicine is dwindling, the water system is polluted, and patients are lining the halls. The hospital administration is concerned with the building's structural integrity and is considering evacuating it. Yuka's thoughts are with her two-year-old, as she wonders how her child is faring without her at her grandmother's house.

Madagascar

*Morondava, Madagascar Disaster Relief Site:* As part of the hurricane rescue team, Yandee assists a boat crew. The group is instructed to go to a certain neighborhood; however, other squads have been dispatched to the same location. They return to the camp and discover they are covered in mosquito bites. The group launches, again, to search for people in a new district. They find an older man with a young boy on a roof. The boy shouts that he is feeling very sick and that the man is deaf. Because the survivors are difficult to reach, Yandee reassures the boy that the rescue team will come back with help to relocate them. The workers quickly leave the area to return to camp.

Mexico

*Manzanillo, Mexico Governmental Office:* Mayor Rosa manages the city's disaster responses and its communications to the public. She is concerned about her office's ability to handle the catastrophe of multiple hurricanes. The Mayor hopes for outside resources, because funds have quickly depleted due to the repetitive storms. Feeling overwhelmed, Mayor Rosa worries about how to communicate information to her district concerning a leptospirosis outbreak. Shortly, she receives
an update that the weather service detects more hurricanes forming with a possible arrival in two weeks.

**Philippines**

*Baguio, Philippines Neighborhood:* Mahalia never knew the hurricane was coming. She lost her family in the flooding aftermath, and after two weeks, no one has come to help. Surrounded by water, she lives on the top floor of her house and watches dead bodies float past her window. Mahalia’s arm is broken from falling, and she is dehydrated. She resorts to drinking polluted water. Because there is no communication, the young woman has no idea what is happening in her city. Mahalia worries about her safety and believes she will die.

### Additional Required Considerations

- CII has determined that all teams have a budget of $50 million (USD) to implement its plan and can justify how additional funds requested would be used in their case solutions. Include a budget allocation breakdown, and be prepared to justify budgetary choices. Present all budgets in US Dollars.
- While considering the whole nation, choose a city or region in your prospective country and present how your solutions and innovations could be implemented. Explain why you chose this location considering the following: the feasibility, the relationship to population centers, the political will and context, protecting key infrastructures, and the climate-related vulnerabilities (e.g., broad areas near sea level along the coast at risk for flooding).
- Identify the weaknesses in your country’s preparation for and management of human health crises during hurricanes, and develop new approaches to programs, services, and/or technologies to ensure public health.
- Consider the illnesses and injuries that accompany hurricanes and how a revised plan would best address the prevention and treatment of diseases in the aftermath. Address potential outbreaks and epidemics.
- Identify weaknesses within your country’s infrastructure (communication, transportation, housing, energy, security, health care system, etc.), and create solutions to ensure the best delivery of health care during a catastrophic hurricane.
- Address how a hurricane’s effect upon the environment impacts the population’s health outcomes. What are ways to mitigate these environmental impacts and health risks? For example, think about appropriate land use, barrier island health, preserving marsh-lands, and ecosystem services. Consider concepts like resilience and climate adaptation, and include them into your preparedness plans.
- Propose plans that are acceptable to the local population and stakeholders, readily executable, and adaptable to other sites within your nation.
Think of socioeconomic factors that include education, income, demographics, and exposure to hazards. For example, 85% of people who died in Hurricane Katrina in the US were over 51. Half of the deaths were aged 75 or older.\(^1\)

Focus on the entire disaster preparedness cycle.

**Other Possible Considerations**

CII recognizes that all of these considerations cannot be addressed in the time frame allotted; therefore, discern which information is most pertinent to your country and plan of action.

- What governmental policies, if any, would need to change to implement your recommendations?
- How would your proposal strengthen the coordination of your nation’s government, local officials, emergency and medical personnel, volunteers, and security forces?
- Are there established organizations with which your nation has not yet coordinated that could aid in delivering better health services to survivors after a hurricane? (e.g., CARE, Catholic Relief Services, The Red Cross, etc.) What are the benefits?
- How would your proposal benefit local health care facilities and health professionals before, during, and after a catastrophic storm?
- What are the main services and resources that a refined hurricane response strategy could offer to improve public health in between storms?
- Review India’s disaster preparedness plan as an example of an international plan (Reference Appendix B).
- Review WHO’s Health System Building Blocks (Reference Appendix B).

**How Climate Change Effects Severe Weather**

Scientists generally concede that the Earth’s climate is changing, including warming ocean temperatures and rising sea levels. While these developments have important impacts on their own, they also contribute to the growth of severe tropical storms such as hurricanes. Whether or not the number of hurricanes per year is increasing is widely debated. While data is gathered every year, trendlines are not indicative of annual occurrences.\(^2,3\)

On the other hand, evidence more reliably suggests that the intensity of storms will multiply in the coming century. Over the past 30 years, on average, the strength of hurricanes has escalated due to warming ocean temperatures.\(^2\) Because warmer ocean temperatures translate into increased storm wind speeds and rainfall, hurricanes can grow more intensely. Additionally, in the next century the sea level is expected to rise by 1-4 feet, which would place more inhabitants in coastal...
areas at risk for the possibilities of flooding and storm surges. Lastly, one model suggest that Category 4 and 5 hurricanes (the most severe categories) will increase by 45-87% in the continental United States.

As climate change warms the atmosphere, the warmer air dries out the soil causing it to break down allowing for more water to penetrate. Then, when hurricane rain and winds make landfall, the soil washes away, often in dangerous landslides and mudslides. As climate change warms the oceans, more flooding will occur when strong winds force water onto shore forming powerful storm surges. Coastline environmental barriers will continue to erode as a result allowing more flooding in the future (Reference Appendix D).

### How Hurricanes Impact Human Health

Hurricanes result in devastating impacts on human health. Ninety-percent of hurricane deaths are water related and a portion of this percentage, 49%, are often from storm surges. Storm surges are an unusual rise of water generated by hurricane winds. Storm surges can measure above 20 feet or more and stretch along coastlines for hundreds of miles. Strong winds and tornadoes from hurricanes blow wreckage causing bodily harm and death.

Survivors are impacted by the loss of their basic necessities to sustain a stable, healthy life: shelter, food, water, and transportation accessibility. In particular, clean drinking water is highly challenging to obtain following a hurricane, because sewage systems often burst and contaminate any nearby drinking water sources. Often, hospitals experience structural damage and struggle to serve the excessive demands to treat victims of waterborne illnesses.

Hurricanes introduce disease and physical and environmental dangers threatening human health. Flood waters, especially surges, pose the risk for drowning for all ages, no matter their swimming abilities. Floating debris, chemicals, and human and animal waste can be harmful to people immersed in the contaminated water. Open wounds are susceptible to rashes and infections developing, especially tetanus. Because good hygiene is difficult due to polluted water, respiratory diseases and diarrheal illnesses are prevalent. Cholera, Typhoid fever, leptospirosis, and hepatitis A are a few water-borne diseases that can develop in the aftermath of hurricanes.

Infrastructure damage creates great health risks. Downed power lines pose a danger for electrocution on the ground and in the water. Due to electrical outages, people are at risk of food poisoning from unrefrigerated items. People who have access to generators are susceptible to carbon monoxide poisoning. Landslides from the disturbance of earth, debris, and rocks are a common cause for death and injury. Air quality can be compromised by air-borne chemicals and burning debris. After hurricanes, mold growth perpetuates respiratory illnesses and allergic reactions.
After a hurricane, coming into contact with diseased animals, insects, and humans threatens human health. Animals, domesticated and wild, can threaten the population with physical harm and diseases, especially dead animals. Because of standing water, mosquito populations grow and spread diseases from two weeks to two months after a hurricane. West Nile virus, Zika, chikungunya, yellow fever or dengue are mosquito related illnesses. Severe long-lasting health effects or death can occur if patients do not receive immediate treatment for these diseases.¹⁰ People who come into contact with corpses are at risk to contract tuberculosis, E. Coli, typhoid, paratyphoid fevers, rotavirus diarrhea, hepatitis A, cholera, shigellosis, Hepatitis B/C, or HIV.¹² A common illness like influenza, scabies, and lice can spread quickly in the close confines of overcrowded rescue shelters.¹¹ In cases where there is low vaccination coverage, overcrowded shelters can allow the spread of measles and tuberculosis.¹⁴ Outbreaks and plagues often follow catastrophic hurricanes when health services and medicines are limited.¹⁰

Additionally, the influx of water resulting from hurricanes can severely, ecologically impact human health. Rapid changes to aquatic ecosystems can lead to toxic environments for fish, thereby, damaging an important food source for many coastal areas. Flooding and landslides can severely damage agricultural communities, resulting in food shortages and economic burdens on farmers. Cities often are economically impacted for years from the widespread job loss and damage to the tourism industries.⁸,⁹

Lastly, the victims’ psychological health is at great risk after damaging hurricanes. Having injuries and diseases when treatment has been delayed or not readily available can impact their emotional well-being. Survivors may have lost friends or family, become newly distanced from neighborhood support and relationships, or even become homeless.⁶ As a result of these crises, the undeniable trauma can negatively affect the mental health of any survivors.⁸,⁹

**Chronological Public Health Effects on Injured People and Survivors**

Natural disaster survivors may progress through three health cycles. Within the first four days the injured are removed from their location and initial treatment is given. Between four days and four weeks infectious diseases, air-borne, food-borne, and waterborne, begin to present. After four weeks, latent infections become apparent and other injury-related complications arise. Diseases that were present before the hurricane can spread resulting in epidemics.¹⁴
Dominican Republic
Hurricane George
Hurricane George directly struck the Dominican Republic in 1998 causing upwards of 500 fatalities and over 90 missing persons. The local government reported that at least 150,000 people were displaced from their homes as a result of flash flooding.\textsuperscript{15} Most shelters became overcrowded, did not have clean water, and lacked proper sanitation. Therefore, cholera, diarrhea, conjunctivitis, malaria, dengue, and acute respiratory infections became prevalent.\textsuperscript{16} Damage to 100\% of roads and 60\% of bridges left much of the island isolated from any relief efforts, causing a shortage of food and water to those areas. In Santo Domingo, the country’s capital, electricity was not restored for at least a month and not to full capacity across the island for several months. The Dominican government estimates that the damages amounted to at least $1.2 billion in the power sector and at least $260 million in the agriculture sector.\textsuperscript{15}

Hurricane David
In 1979, Category 5 Hurricane David’s eye passed over Santo Domingo in the Dominican Republic killing 2,000 people. Most of the fatalities were caused by mudslides and landslides.\textsuperscript{17} Extreme river flooding swept away entire villages causing over 200,000 survivors to be left homeless. About 70\% of the nation’s crops were damaged from the flooding. Agricultural and industrial properties experienced over $2.8 billion (USD) of damage.\textsuperscript{18} Five months after the hurricane impacted the Dominican Republic, deadly measles and typhoid outbreaks emerged.\textsuperscript{6}

Japan
Typhoon Jebi
Typhoon Jebi struck Japan near Kyoto in 2018, the strongest storm to hit the country in 25 years. At least eleven people were left dead and 600 injured.\textsuperscript{19} Many of the dead were older people who were killed by flying objects blown by hurricane force winds. Over 1.6 million homes were without power.\textsuperscript{20} Eight thousand residents left their homes and occupied 1,667 evacuation shelters.\textsuperscript{21} The region’s transportation was severely affected; the international airport was flooded, and a main bridge was knocked out.\textsuperscript{19} Approximately 3,000 passengers were stranded in the airport and spent the night.\textsuperscript{21} Cars were blown off the road by strong winds, and part of the a train station collapsed on people. Over 700 domestic and international flights were cancelled.\textsuperscript{19} Japan’s oil industry had to shut down refining units and some were damaged severely. Vegetables and fruits ready to be harvested were destroyed.\textsuperscript{22}

Typhoon Vera
Super Typhoon Vera struck in the Kushimoto region in the Wakayama Prefecture in 1959. The typhoon was the most destructive storm to hit Japan in modern history. Five thousand people
died, and there were 39,000 injured survivors. Some wind gusts peaked up to 160 mph. Most deaths occurred due to storm surges that reached 13 feet (4 m) leading to heavy flooding. Areas did not drain easily; therefore, dysentery infections and unsanitary conditions were prevalent. Winds and flooding damaged 160,000 homes leaving thousands displaced. Overall, 834,000 buildings were damaged or destroyed in Japan.\(^{23}\)

**Madagascar**

**Cyclone Ava**

In 2018, Cyclone Ava made landfall in Madagascar, resulting in at least 50 casualties, and more than 50,000 displaced people.\(^{24}\) The cyclone damaged 141 schools, including 77 that were used as shelters, leaving approximately 34,640 children without schools.\(^{25}\) While this storm was not necessarily the strongest Madagascar has experienced recently, it had a devastating impact on the economy because of the destruction of agriculture and fishing. One study estimated that damage from Cyclone Ava cost 2.9% of the country’s GDP. More than 90% of the city of Toamasina’s electricity infrastructure was destroyed. Additionally, the cyclone had a major impact on underdeveloped transportation and infrastructure. Houses were mostly destroyed due to the use of non-permanent building materials. Open water sources quickly became contaminated with illnesses.\(^{24}\)

**Cyclone Gafilo**

Cyclone Gafilo made landfall in 2004 killing 237 and injuring 879 people. The missing amounted to 181, and 304,000 people became homeless. More than 20,000 homes were destroyed and 3,400 schools were damaged. Malaria, diarrhea, and cholera impacted the survivors weeks after the storm. Flooding caused great destruction to vanilla, banana, and rice crops. The shrimp industry was ecologically and economically damaged, as well.\(^{26}\)

**Mexico**

**1959 Hurricane**

Mexico is threatened by both Atlantic and Pacific Hurricanes. The most deadly eastern Pacific hurricane on record, an unnamed Category 5 storm, hit Mexico on its Pacific Coast in October 1959. Nearly 1,800 fatalities occurred, with 800 of those caused by a landslide in Colima. Trash, debris and dead bodies polluted water sources. Typhoid spread and tetanus was common, so mass vaccinations were implemented. Flash flooding stranded thousands of residents, and all emergency aid transportation was hindered. Also, the rain destroyed many coconut plantations that fueled the regional economy. Widespread panic ensued because the financial security for thousands of citizens was threatened. Following the tragedy, the changing landscape provoked multitudes of venomous snakes and scorpions to come out of hiding causing even more fatalities. The cost of the damage accumulated to at least $280 million.\(^{27,28}\)
Hurricanes Ingrid and Manuel
Two hurricanes, Ingrid and Manuel, landed at the same time and impacted two-thirds of Mexico in September of 2013. For eight days near Acapulco, the rainfall reached 43.6 inches. The death toll from the two hurricanes totaled 155 people. Manuel was responsible for 123 deaths primarily resulting from mudslides and flooding. About 39,000 people evacuated to shelters. Survivors numbering 10,000 were evacuated by plane to Mexico City, which was difficult because radars were not working. Banana crops stretching across 58 square miles were destroyed. The total cost was approximately 4.2 billion (USD).

Philippines
Typhoon Haiyan
Typhoon Haiyan hit the Philippines on November 7, 2013, leaving massive destruction in its wake. Over 6,000 people were killed and more than 27,000 injured in what is considered one of the strongest storms to ever make landfall. Some estimate that the death toll was over 10,000 in the city of Tacloban alone, with most of these deaths thought to be due to drowning or crushing by collapsing buildings. In Tacloban, the storm surge reached as high as 15 feet. An estimated 550,000 houses were destroyed and an additional 580,000 were severely damaged. Initially, an estimated 3.9 million people were displaced from their homes. Widespread power outages and food and water shortages contributed to the crisis. In Tacloban City, where the center of the storm made landfall, most houses were destroyed causing debris to block the city streets. As a result, problems with communication and impassable roads delayed the delivery of humanitarian aid such as food, medicines, and other supplies. Additionally, due to the destruction of fishing equipment and crops, many survivors struggled to return to normal livelihoods following the storm.

Typhoon Pepeng
In 2009, Typhoon Pepeng damaged 61,869 houses, which displaced thousands of people within the Northern Luzon, Cordillera Region. Most mortalities were due to drowning, and some other reported deaths resulted from electrocution and heart attacks. In total 492 deaths were recorded. Wounds and infections numbered up to 6,587. A leptospirosis outbreak was documented to affect 1,090 people. The following diseases were treated after the hurricane: 19,294 acute respiratory tract infections, 2,064 influenza-like illnesses, 5,188 acute gastroenteritis/diarrhea, and 2,064 febrile illnesses.

Disclosures
The case writers understand that your nation’s complete disaster preparedness plan may not be easily available and too exhaustive to read; therefore, draw conclusions about your country’s
hurricane history from research and statistics. An example of an international disaster preparedness plan is included under Possible Considerations.

The term “hurricane” is most often used throughout the case, and the case writers are aware that there are different terms for these storms depending on the country’s global location. However, please address the problem by using the term appropriate for your region of the world. (Reference Appendix C)
Appendices:

Appendix A: Planning Assumption vs. Hurricane Impact in Puerto Rico

Figure 8: Planning assumptions underestimated impacts of 2017 hurricanes in Puerto Rico.

Source: https://www.fema.gov/media-library-data/1531743865541-d16794d43d3082544435e1471da07880/2017FEMAHurricaneAAR.pdf
## Appendix B: Reference Documents

<table>
<thead>
<tr>
<th>Reference</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO’s Health System Building Blocks</td>
<td><a href="https://www.who.int/healthinfo/systems/WHO_MBHSS_2010_full_web.pdf">https://www.who.int/healthinfo/systems/WHO_MBHSS_2010_full_web.pdf</a></td>
</tr>
</tbody>
</table>
Appendix C: Storm Defined By Global Location


Differences in Hurricanes, Cyclones, and Typhoons and How They Work
https://ocean.si.edu/planet-ocean/waves-storms-tsunamis/hurricanes-typhoons-and-cyclones

National Geographic: Hurricanes 101 Informational Video
Appendix D: Climate Change Documents

<table>
<thead>
<tr>
<th>Protecting Health from Climate Change</th>
<th><a href="https://www.who.int/globalchange/publications/Final_Climate_Change.pdf">https://www.who.int/globalchange/publications/Final_Climate_Change.pdf</a></th>
</tr>
</thead>
</table>
Appendix E: Map of Dominican Republic

Source: https://www.cia.gov/library/publications/the-world-factbook/attachments/maps/DR-map.gif
Appendix F: Map of Japan

Appendix G: Map of Madagascar

Appendix H: Map of Mexico

Source: https://www.cia.gov/library/publications/the-world-factbook/attachments/maps/MX-map.gif
Appendix I: Map of Philippines

Appendix J: General Country Information

<table>
<thead>
<tr>
<th></th>
<th>Dominican Republic</th>
<th>Japan</th>
<th>Madagascar</th>
<th>Mexico</th>
<th>Philippines</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP</td>
<td>75.932 billion</td>
<td>4.872 trillion</td>
<td>11.5 billion</td>
<td>1.151 trillion</td>
<td>313.595 billion</td>
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<tr>
<td></td>
<td>44</td>
<td>41</td>
<td>37</td>
<td>46</td>
<td>38</td>
</tr>
<tr>
<td>Total population</td>
<td>10,766,998</td>
<td>126,785,797</td>
<td>25,570,895</td>
<td>129,163,276</td>
<td>104,918,090</td>
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<td></td>
<td>44</td>
<td>41</td>
<td>37</td>
<td>46</td>
<td>38</td>
</tr>
<tr>
<td>Length of coastline</td>
<td>1,288 km</td>
<td>29,751 km</td>
<td>4,828 km</td>
<td>9,330 km</td>
<td>36,289</td>
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<td></td>
<td>45</td>
<td>42</td>
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<td>43</td>
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</tr>
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</table>
Appendix K: Common Diseases Caused by Hurricanes

<table>
<thead>
<tr>
<th>Water-Borne Diseases</th>
<th>Typhoid Fever, Cholera, Leptospirosis, Hepatitis A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vector-Borne Diseases</td>
<td>Malaria, Dengue and Dengue Hemorrhagic Fever, Yellow Fever, West Nile Fever, Zika,</td>
</tr>
</tbody>
</table>

Sources:
https://www.who.int/hac/techguidance/ems/flood_cds/en/

https://www.cdc.gov/cpr/readiness/00_docs/CDC_Hurricanes_PreparednessSafetyMessaging_June2018_508.pdf
Appendix L: Infectious Diseases Following Natural Disasters Charts

Table 2. Risk factors and onset of communicable diseases following natural disasters.

<table>
<thead>
<tr>
<th>Major risk factors following natural disasters</th>
<th>Water-borne diseases</th>
<th>Air-borne/droplet diseases</th>
<th>Vector-borne diseases</th>
<th>Contamination from wounded injuries</th>
<th>Clinical phase of natural disasters</th>
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</thead>
<tbody>
<tr>
<td>Population displacement from nonendemic to endemic areas</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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</tr>
<tr>
<td>Overcrowding (close and multiple contacts)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Stagnant water after flood and heavy rains</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Insufficient/contaminated water and poor sanitation conditions</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>High exposure and proliferation to disease vectors</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Insufficient nutrient intake/ malnutrition</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Low vaccination coverage</td>
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<td>✓</td>
<td>✓</td>
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<tr>
<td>Injuries</td>
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<td>✓</td>
<td>✓</td>
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</tr>
</tbody>
</table>

Disasters do not carry diseases/epidemics. Disease risk factors need to be in place and exacerbated as a result of the after effects of the disaster. ARI: Acute respiratory infection.

Table 3. Prevention and control checklist of recorded infectious diseases following natural disasters.

<table>
<thead>
<tr>
<th>Prevention and control of infectious diseases following natural disasters</th>
<th>Water-borne diseases</th>
<th>Air-borne/droplet diseases</th>
<th>Vector-borne diseases</th>
<th>Contamination from injury/wound</th>
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<tr>
<td>Site planning</td>
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<tr>
<td>Clean water</td>
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<tr>
<td>Good sanitation (e.g. excreta disposal)</td>
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<tr>
<td>Solid waste management</td>
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<tr>
<td>Water and food hygiene</td>
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<tr>
<td>Nutrition and supplements</td>
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<tr>
<td>Vaccination</td>
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<td>Vector control</td>
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<tr>
<td>Personal hygiene (e.g., hand washing)</td>
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<tr>
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<tr>
<td>Wound/injury care</td>
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<tr>
<td>Health education</td>
<td>✓</td>
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<tr>
<td>Disease management/treatment and supportive care (follow national guidelines)</td>
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</tbody>
</table>

Specific communicable diseases applicable to the preventive and control measure given. ARI: Acute respiratory infection.

Source:
References:


