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Three Sets of Simulation Exercises Teaching Clinical Skills and Knowledge of
the Health Effects of Climate Change

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Clinical Simulations Set #1

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Four clinical simulations used with second year medical students at the American University of Antigua School of Medicine

Medical student patient simulation 1: Hurricane Migrant

You are a resident in internal medicine at a hospital in New York City. A medical student on your team requests your advice while taking a history and conducting a physical exam for a patient in the emergency department.

So far, the medical student learned that the patient migrated from Puerto Rico to New York City following Hurricane Maria. She is a 29-year old single mother of three small children. She lived in a rural community in Puerto Rico, speaks limited English, and has a high school education. Her home was flooded during the hurricane. While she and her children continued to live there for three weeks, they lacked electricity and drinking water, and some carpets, furniture and wallboards remained wet. The storm destroyed her place of employment, and she was not able to find other work. She and her children migrated last week to New York City to stay with a cousin in a small apartment.

The patient complains of wheezing, coughing, a rash, and a runny nose. Also, she states that she is experiencing anxiety and difficulty sleeping.

What specific guidance will you give the medical student for further steps in conducting this patient's history and physical examination? What advice do you have on cultural aspects of dealing with this patient?

A few days later, your team is asked to present this case at a conference. In preparation for this presentation, what research do you want the medical student to do related to the health impacts of climate change?

Medical student patient simulation 2: Juvenile Respiratory Health

During your pediatrics rotation in Chicago, you are seeing clinic patients in the last week of March. Your patient today is a 9-year old boy complaining of coughing and shortness of breath during outdoor

physical activity. His chart reveals his sensitivity to pollen and past asthmatic symptoms. Additionally, the patient's mother states that they live near a major highway. The patient reports seeing and hearing heavy traffic in the afternoons while playing in his yard.

What research would you want to do in order to develop a diagnosis and course of treatment for this patient? What are the primary causes of the patient's respiratory illness? What would you advise the patient and his mother to do to reduce the risk of further illness for this boy?

How is climate change related to this boy's symptoms?

In a discussion with the boy and his mother, you communicate the relationship between the boy's symptoms and climate change. What do you explain to them? When the mother asks what she can do to address the causes of her child's illness, what do you suggest?

What cultural aspects of this boy and his mother should you consider in your treatment and communication?

Medical student community involvement simulation 3: Community Health Care Planning

As a medical student, you found an opportunity to earn some money as a research assistant. You are working with the staff of a committee in Antigua to plan health care services and facilities.

Part of the committee's task is to consider the risks related to climate change to health and health care services. You are asked to research and analyze relevant demographic and geographic characteristics of Antigua. In your early efforts, you found the following information:

- Antigua is a low-lying tropical island, 170 square miles in size including 54 miles of coastline.
- According to 2011 Census Data¹, Antigua is home to about 85,000 residents.
 - About 35% of the island's population (about 30,000 residents) is rural; 70% of rural households do not have a computer in the home.
 - Approximately half of the island's population does not have health insurance.
 - The unemployment rate was 10.2%
 - About 10,000 residents are aged 65 or older, and 13,000 are less than 10 years old.
 - Most residents have at least high-school education. However, only 40% of the population has received, attempted, or completed skills training.
- Tourism is the island's primary source of income, with many hotels located in coastal areas
- Antigua has two main hospitals, Mount St. John's Medical Center and Adelin Medical Centre, both located in St. John's. Pharmacies are located around the island but are concentrated in St. John's.
- In September 2017, Hurricane Irma destroyed 90% of the buildings on neighboring island Barbuda and many residents were evacuated to Antigua.
- The Centers for Disease Control and Prevention (CDC) notes the threats of Hepatitis A and B, Dengue, Typhoid, Rabies, and Zika in Antigua.²

¹ Government of Antigua and Barbuda, 2011 Population Housing Census Book of Statistical Tables I. Statistics Division, Ministry of Finance, the Economy Public Administration, Public Broadcasting and Information. April 2014.

² "Travelers' Health." Centers for Disease Control and Prevention, 5 Dec. 2017, wwwnc.cdc.gov/travel/destinations/clinician/none/antigua-and-barbuda.

In light of the information you found, what are the greatest health threats related to climate change in Antigua? What additional research would you want to do for your report?

What plans would help Antigua's healthcare sector improve its resilience to climate effects, including disasters and disease?

What other programs should Antigua consider to reduce the residents' risks from climate change?

Medical student community involvement simulation 4: Climate Action Plan

The Government of Antigua and Barbuda developed a draft plan to reduce the nation's contribution to climate change and mitigate the impacts of climate change on its residents. The government released the draft Climate Action Plan for public comments and scheduled a public hearing. As medical students concerned about community health and sustainability, you and some of your colleagues decide to review the draft.

The Climate Action Plan includes short, medium, and long-term goals for energy consumption, clean energy production, recycling, water usage, protecting natural resources, mass transportation, building codes, and community education.

However, you and the other medical students find several disturbing shortcomings. The draft does not discuss health impacts that have occurred or are predicted. Additionally, your team is concerned that the strategies do not include actions by healthcare providers or facilities. Next, the plans for education fail to address curriculum for schools and appear to be concentrated within the islands' cities. Furthermore, the draft plan does not present the health benefits of some activities that reduce greenhouse gasses, such as walking, biking, and planting trees in urban areas.

You and your colleagues want to help improve the Climate Action Plan and decide to testify at the public hearing.

What research would you want to do before writing your testimony?

In the introduction to your testimony, describe why as medical students you are interested in the Climate Action Plan.

Develop the key points in your testimony on the Climate Action Plan (consider facts presented, recommendations, and benefits).

In seeking support for your points, what stakeholders in the community should you contact about collaboration? How will you advocate for your positions with these stakeholders? Which groups in the community would likely oppose your recommendations? How will you try to convince them to support your positions?

Clinical Simulations Set #2

April 2018

Four clinical simulations used with graduate students at the University of Illinois School of Public Health in Chicago

Public health student simulation 1 – Climate Health Effects in Community Health Needs Assessments

You are a graduate student in a community health program. You see in a newsletter that a local hospital is developing a new community health needs assessment (CHNA) and is seeking input from local residents. Looks like an interesting experience, so you decide to participate.

In preparing for your interview, you look at the hospital's current CHNA. The report shows various health indicators including:

- **Mortality:** deaths by cause, average age at death
- **Morbidity:** infectious diseases, diabetes, respiratory illnesses
- **Access to healthcare:** uninsured population, number of primary care physicians, number of dentists, mammography screening
- **Demographics:** household income, age distribution
- **Behaviors:** adult smoking, adult obesity, adult use of alcohol, teen birth rate
- **Community Resources:** affordable housing, mental health services, access to sidewalks, access to public transportation

The last community survey identified these priority health concerns:

- Mental health
- Alcohol/drug abuse
- Gun violence
- Obesity
- Domestic violence
- Child abuse and neglect
- Senior/aging challenges
- Heart disease and stroke
- Cancers
- Suicide

You think about the health effects of climate change, and your responsibilities as a public health professional in climate change mitigation, adaptation and communication. You become concerned that this hospital's CHNA does not reflect these health risks to the community and actions that the hospital could be taking to address climate related community health needs.

To address climate related issues in this CHNA, develop additional suggestions for

- Community health indicators
- Priority health concerns
- Long-term health goals
- Strategies for the hospital
- Measures of progress in implementing the strategies

Public health student simulation 2 – Mainstreaming Climate Health Effects in Government Decisions

You are a new staff person in the U.S. Department of Transportation under an administration that promotes public health as well as climate change mitigation and adaptation.

The Secretary of Transportation wants to integrate health impacts and climate change analyses into all major decisions on transportation issues. The senior staff recommends weighing these issues by expanding the scope of environmental impact statements (EIS). The traditional focus of EIS has been on harms to natural resources (wildlife, water bodies, forests, and other habitats) and emissions from construction and operations. The strategy would be to consider the human health impacts of the proposed action and alternative options, including contributions to climate change and the associated human health effects.

You are asked to analyze the human health impacts and climate change aspects of the following types of transportation projects:

- highway construction
- mass transportation
- vehicle fuel efficiency
- autonomous vehicles
- bicycle lanes and trails

Describe the impacts you would highlight and whether they are of high, medium or low importance for this type of project.

Public health student simulation 3 – Caring for Migrants from Areas Struck by Natural Disasters

You are a new staff member in a county public health department. While the county you are in is enjoying mild weather, people in areas within a few hundred miles are suffering from several natural disasters:

- Heavy rains causing river flooding
- Drought with widespread wild fires
- Heat waves with power outages

With the outpouring of public sympathy for people who are losing their homes or threatened by these conditions, your county's government, religious congregations, and social services organizations would like to offer temporary housing for hundreds of families affected by these conditions.

The families are expected to start arriving in your county in a few days, and may stay for up to three months. You are in charge of making sure that the migrants receive adequate healthcare services and live in healthy conditions.

Your first step is to call a meeting of the stakeholders in your community. Who do you invite?

What risks should you highlight for the attendees regarding the migrants' health? What community capabilities do you need to have available as the migrants arrive to address their health needs?

What are the key issues in providing healthy living conditions for the migrants?

What metrics and data do you want to have to evaluate your challenges and progress?

Public health student simulation 4 – Multinational Corporation's Sustainability Program

You are a public health advisor to the Chief Sustainability Officer at a multinational corporation that is in the fast food industry.

For many years, the corporation has been pressured by government regulators and health advocacy organizations to address issues related to the nutritional content of its foods, fats used in cooking, labeling menus with calories, sugary sodas, and offering healthy alternatives such as salads. Recently, the corporation has tried to raise its public image as health conscious by changing its food practices and by supporting foodbanks and community gardens.

The corporation has also been pressured by large investment funds to reduce its environmental footprint. It has been monitoring and making publicly available information on its greenhouse gas emissions, consumption of electricity and petroleum, and use of water, wood, and other natural resources. To help win endorsements from green investment advisors, the corporation adopted targets to make its operations more energy efficient, use electricity generated by wind and solar power, purchase electric vehicles, and use recycled content materials in packaging.

The new Chief Sustainability Officer for this corporation is thinking of an initiative to tie together the health conscious image and the environmental sustainability programs. She asks you to develop presentations and actions on the health benefits of the corporation's environmental sustainability improvements.

What are the key points for your presentation to the corporation's strategy group? What are the key points for your presentation to the health and environmental advocacy organizations?

How does the perspective of climate health effects change the strategies and targets for the corporation's efforts to promote images of health conscious and environmental sustainability?

What metrics and data should the corporation develop to support your program of actions?

Clinical Simulations Set #3

July and August 2018

Three Clinical Simulations Used with First and Second Year Medical Students at the American University of Antigua School of Medicine and the University of Illinois College of Medicine in Peoria

Developing Standardized Case Scenarios for Patients Affected by Climate Change

Three patients present for clinical examination by medical students – one child, one elderly person, and one young adult. You will choose one patient and work with a few other students to develop a case scenario for portrayal by a standardized patient.

Each patient has been affected by a climate-related natural disaster (such as hurricane, flooding, or wildfire) or by another environmental condition related to climate change (such as heatwave, drought, elevated pollen, intensified air pollution, or contaminated water).

Your group will:

- 1. Consider several types of climate-related health threats for your patient*
- 2. Select one of the threats you identified for your case*
- 3. Create a case scenario for portrayal by a standardized patient. Include:*
 - a. Patient's age, gender and geographic location*
 - b. Patient's description of chief complaint/symptoms*
 - c. History, including*
 - i. exposure to climate-related conditions*
 - ii. vulnerabilities to climate-related conditions, including patient's medical and socio-economic conditions as well as community characteristics*
 - d. Physical exam, including vital signs and other key points*
- 4. Consider how a student will approach the clinical exam of this patient*
 - a. What additional sources of information would you consult on the patient's climate-related health effects?*
 - b. Possible recommendations for the patient to reduce the climate-related risks*



The following excerpts provide background information on the climate-related health effects for children and elderly people, as well as climate-related mental stresses.

You can also do Internet research.

1. Child Patient Affected by Climate Change



https://www.apha.org/-/media/files/pdf/topics/climate/childrens_health.ashx?la=en&hash=02D821C65EDCAB093A48AD7B101EC73080A216BF

EXTREME WEATHER: Climate change increases the amount and severity of storms. Extreme weather can impact sanitation and sewer systems. This increases the risk of **water-related and gastrointestinal illnesses**. Children are especially susceptible to such conditions due to their developing immune systems. Injury and mental health impacts are also common among children exposed to extreme weather.

EXTREME HEAT: Climate change is increasing the frequency and intensity of extreme heat events. Children are less able than adults to regulate their body temperature. Thus, they are more vulnerable to changes in temperature. Compared to adults, extreme temperatures have led to more **heat-related illnesses** and deaths among children, especially infants.

VECTOR-BORNE DISEASE: Insects and rodents that carry viruses respond quickly to changes in temperature and moisture, which can increase their growth and duration. Children are at risk for vector-borne illnesses due to their increased outdoor activity. They are also susceptible due to their developing immune systems. **Lyme disease, hantavirus, dengue fever, and Zika virus** are among the climate-related vector-borne diseases that pose a heavy health burden on children.

POOR AIR QUALITY: Climate change extends the warm season and lengthens pollen season. It also increases the amount of airborne pollutants in the environment. Pollutants and pollen can have chronic impacts on children's respiratory health, triggering **allergies and asthma**.

FOOD INSECURITY: Given changes in the weather due to climate change, crops will be affected by droughts and flooding. Climate change also alters the nutrient quality of food. Together, these impacts could reduce access to food and nutrients. **Poor nutrition** can result in developmental delays and adverse health outcomes for infants and children.

CASE STUDY: HEAT STROKE HITS YOUTH It was early August, and Logan attended his junior high school basketball practice. The intensity of the drills was matched only by the temperature of over 100°F inside the unairconditioned gym. As practice progressed, Logan became dizzy and eventually collapsed. He suffered heat stroke and developed life-threatening complications. After a week in the hospital, Logan returned home. Unfortunately, heat stroke is becoming more common among young athletes. Heat illness is now the top cause of death and disability in high school athletes.

American Academy of Pediatrics Policy Statement, "Global Climate Change and Children's Health" Pediatrics November 2015, VOL. 136 / ISSUE 5 [excerpts]
<http://pediatrics.aappublications.org/content/pediatrics/early/2015/10/21/peds.2015-3232.full.pdf>

Although uncertainties remain regarding risks and appropriate policy response, failure to take prompt, substantive action—given our current knowledge—would be an act of injustice to all children. Pediatric health care professionals should increase their understanding of the health threats associated with climate change, thus enabling them to recognize and anticipate climate-associated effects and become engaged in the development and implementation of effective mitigation and adaptation strategies to address this global challenge.

Effects of Climate Change on Children’s Health

The changing climate is causing physical, chemical, and ecological changes that are fundamentally altering the planet. These changes pose significant threats to human health, with children representing a uniquely vulnerable group. According to the World Health Organization, **more than 88% of the existing burden of disease attributable to climate change occurs in children younger than 5 years.** The diverse health effects of climate change have been categorized as primary, secondary, and tertiary....

Primary Effects

Extreme weather events, including severe storms, floods, and wildfires, directly threaten children with injury and death. The frequency of reported natural disasters has increased over the past 40 years. Three times as many extreme weather events occurred between 2000 and 2009 as occurred between 1980 and 1989. The scale of natural disasters has also increased because of deforestation, environmental degradation, urbanization, and intensified climate variables. The distinctive health, behavioral, and psychosocial needs of children subject them to unique risks from these events. **Extreme weather events place children at risk for injury, loss of or separation from caregivers, exposure to infectious diseases, and a uniquely high risk of mental health consequences, including posttraumatic stress disorder, depression, and adjustment disorder.** Disasters can cause irrevocable harm to children through devastation of their homes, schools, and neighborhoods, all of which contribute to their physiologic and cognitive development.

Children suffer directly from the increased severity and duration of heat waves. Studies performed in multiple countries have shown an **increase in child morbidity and mortality during extreme heat events.** Infants younger than 1 year and high school athletes seem to be at particularly increased risk of heat-related illness and death....

Secondary Effects

Climate change is altering the environmental systems on which we rely and causing shifts in ecosystems and diseases of humans, crops, and natural systems. Air quality can be reduced through temperature-associated elevations in ground-level ozone concentration, increased pollen counts and allergy season duration, and wildfire smoke; all of these factors exacerbate **respiratory disease and asthma** in children. Climate influences the behavior, development, and mortality of a wide range of living organisms, some of which have the potential to cause pediatric infection. Determining the effects of climate change on infectious diseases is complex because of confounding contributions of economic development and land use, changing ecosystems, international travel, and commerce. Currently, climate warming has been identified as contributing to the northern expansion of **Lyme disease** in North America and has been projected to increase the burden of child **diarrheal illness**, particularly in Asia and sub-Saharan Africa. Concern has also been raised for climate links to **emerging infections, including coccidioidomycosis and amoebic meningoencephalitis**.... Altered agricultural conditions, including extreme heat, expanded water demands, and increased severe weather events, will affect food

availability and cost, particularly in vulnerable regions in which child **undernutrition** is already a major threat. The decreased protein, iron, and zinc content of certain major crops has been demonstrated for plants grown under increased CO2 conditions, carrying significant implications for child nutrition.

Tertiary Effects

Children's biological and cognitive development occurs within the context of stable families, schools, neighborhoods, and communities. Unchecked climate change threatens the safety and well-being of children via its effects on this broader social context.... These effects will likely be greatest for communities already experiencing socioeconomic disadvantage.



<https://www.cmu.edu/steinbrenner/EPA%20Factsheets/older-adults-health-climate-change.pdf>

Older adults are vulnerable to climate change-related health impacts for a number of reasons. One reason is that normal changes in the body associated with aging, such as muscle and bone loss, can limit mobility. Older adults are also more likely to have a chronic health condition, such as diabetes, that requires medications for treatment. Some older adults, especially those with disabilities, may also need assistance with daily activities. In 2010, nearly half of people over age 65 were reported to have a disability, compared to about 17% of people aged 21–64. This includes disabilities in one or more areas related to communication (seeing, hearing, or speaking), mental functioning (such as Alzheimer's disease, senility, or dementia), and physical functioning....

Extreme Heat Extreme heat exposure can increase the risk of illness and death among older adults, **especially people with congestive heart failure, diabetes, and other chronic health conditions that increase sensitivity to heat.** Higher temperatures have also been linked to increased hospital admissions for older people with **heart and lung conditions.** Older adults with limited incomes who own air conditioning units may not use them during heat waves due to the high cost to operate them.

Extreme Events Older adults are more likely to suffer storm and flood-related fatalities. For example, almost half of deaths from Hurricane Katrina were people over age 75, while for Superstorm Sandy almost half were over age 65. If an extreme event requires evacuation, older adults have high risk of both physical and mental health impacts. Some of the most vulnerable are people with disabilities, with chronic medical conditions, or living in nursing homes or assisted-living facilities. Health impacts could be made worse by **interruptions in medical care and challenges associated with transporting patients** with their necessary medication, medical records, and any equipment like oxygen. Extreme events can also cause power outages that can affect electrically-powered medical equipment and elevators, leaving some people without treatment or the ability to evacuate.

Poor Air Quality Climate change worsens air quality because warming temperatures make it easier for ground-level ozone to form and can lengthen the season of aeroallergens like ragweed pollen. Changing weather patterns and more intense and frequent wildfires also raise the amount of pollution, dust, and

smoke in the air. These changes will increase the number of emergency department visits and hospital admissions, even for healthy older adults. Poor air quality worsens respiratory conditions common in older adults such as **asthma and chronic obstructive pulmonary disorder (COPD)**. Air pollution can also increase the **risk of heart attack** in older adults, especially those who are diabetic or obese.

Illnesses Spread by Ticks or Mosquitoes Climate change and increased temperatures will lead to ticks and mosquitoes expanding their ranges and being present for longer seasons. This means an increased risk of being bitten by disease-carrying ticks and mosquitoes. **Lyme disease**, which is spread by ticks, is frequently reported in older adults. The **West Nile and St. Louis encephalitis** viruses, which are spread by mosquitoes, pose a greater health risk among older adults with already weakened immune systems.

Illnesses Caused by Contaminated Water Climate change increases the contamination risk for sources of drinking water and recreational water. Older adults are at high risk of contracting **gastrointestinal illnesses** from contaminated water. Those already in poor health are more likely to suffer severe health consequences including death. In 2013, almost 28% of adults age 75 and older were described as in fair or poor health, compared to 6% for adults age 18 to 44.

Climate Change and Older Americans: State of the Science Janet L. Gamble, Bradford J. Hurley, Peter A. Schultz, Wendy S. Jaglom, Nisha Krishnan, and Melinda Harris Environmental Health Perspectives • vol. 121 | no. 1 | Jan. 2013 pages 15-22 [excerpts]
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3553435/>

Climate Stressors and the Vulnerability of Older Adults

Extreme heat. Extreme heat events are a major source of climate-related risk for older adults, with older Americans experiencing disproportionate risks of heat-related mortality. Other health outcomes from extreme heat events include **heat exhaustion, heat stroke, dehydration, acute renal failure and nephritis, exacerbation of cardiopulmonary diseases, and potential aggravation of side effects of some medications such as beta blockers used to control blood pressure, some psychotropic medications, and certain drugs used to treat chronic obstructive pulmonary disease.** Heat stroke occurs at rates that are 12–23 times higher in persons ≥ 65 years of age compared with other age groups. But climate change may also decrease the frequency of extremely cold periods. Older Americans may benefit from warmer winters, both in terms of reduced heating costs as well as reductions in health and safety risks associated with cold weather.

Hurricanes, floods, droughts, and other extreme weather events. Nearly 60% of the flooding-related fatalities following Hurricane Katrina were among persons ≥ 65 years of age. A rapid needs assessment of older adults in Florida found that Hurricane Charley, a category 4 storm that struck in 2004, aggravated preexisting, physician-diagnosed medical conditions in 24–32% of elderly households. Analyses of pre- and post-disaster cognitive status showed **decreases in working memory** for middle-aged and older adults. Nursing home residents and staff have been found to have mental health needs even 5 months after a hurricane. Flooding can result in **contamination of drinking-water supplies, increased incidence of indoor mold and associated respiratory illnesses**, and long-term relocation and property loss among affected populations. Extreme events can also compromise health care services and social support systems. Finally, the **need to evacuate a region ahead of approaching severe weather can also pose health and safety risks** for older adults.

Climate impacts on air quality. Climate change can affect air quality by increasing the formation of ground-level ozone and by leading to higher atmospheric concentrations of fine particulates, allergens, and dust in drought-prone areas. These effects, though not restricted to older adults, are typically more severe due to preexisting medical conditions. Higher levels of ground-level ozone can exacerbate **cardiopulmonary illnesses, especially asthma and COPD** and premature mortality from these diseases. Ozone injures lung tissue and promotes airway inflammation, and may have a stronger effect on **respiratory disorders** than on cardiovascular disease. Higher temperatures are associated with longer ragweed pollen seasons across a broad swath of midwestern states from Texas to the Canadian border. Older adults living in areas where drought has increased in frequency and/or severity may also be at greater risk because exposure to dust can exacerbate existing respiratory illnesses.

Impacts on infectious diseases. The abundance and distribution of some infectious disease vectors (e.g., fleas, mosquitoes, and ticks) may be affected by climate change. To the extent that older adults are more likely to have compromised immune systems, **vector-borne diseases** may pose a greater risk. The incidence of **water- and food-borne illnesses** can be affected by increased flooding (e.g., through contamination of food crops by flood waters and contamination of drinking water from combined sewer overflow and agricultural runoff) and other stressors associated with climate change (e.g., warmer temperatures, which may enhance bacterial growth). Although the outcome of many **gastrointestinal diseases** is mild and self-limiting, these diseases can be severe and even fatal among vulnerable populations, including young children, those with compromised immune systems, and older adults.

3. Young Adult Affected by Climate Change – Mental Health



https://www.apha.org/-/media/files/pdf/topics/climate/climate_changes_mental_health.ashx?la=en&hash=AFF50C8C183A2846372355AB2B438A1157E1B3AE

FAST FACTS

- More than 40 million adults in the U.S. suffer from a mental illness.
- Victims of natural disasters are at an increased risk of anxiety, depression, PTSD, and suicide.
- 25-50% of people exposed to an extreme weather disaster are at risk of adverse mental health effects.
- Up to 54% of adults and 45% of children suffer depression after a natural disaster.
- Forty-nine percent of the survivors of Hurricane Katrina developed an anxiety or mood disorder, and 1 in 6 developed PTSD. Suicide and suicidal ideation more than doubled.
- After a record drought in the 1980s, the suicide rate doubled, including more than 900 farmers in the Upper Midwest.

IMMEDIATE IMPACTS Natural disasters may cause **posttraumatic stress disorder (PTSD), anxiety, depression, and stress**. Self-harm, including **substance abuse and suicidal ideation**, may also occur.

READINESS: Seek education about what to expect and how to prepare for future climate events.

GRADUAL IMPACTS **Chronic stress** can result from the gradual impacts of climate change. For example infectious diseases, chronic diseases (asthma and allergies), nutritional deficiencies, and injuries can contribute to stress.

MONITORING: Know your health, and determine whether you are stressed (signs include low energy, tension, and headaches). Seek treatment and/or support if needed.

INDIRECT IMPACTS After a climate event or resulting displacement, people may experience a **diminished sense of self, difficulty relating to others, diminished social interaction, and solastalgia** (the loss of a sense of place, solace, and security tied to one's physical environment). Community impacts include **domestic abuse, child abuse, and violence** (e.g., assault and civil conflict).

COOPERATION: Establish social ties and connections with community members. This will help to withstand changes and encourage adaptation.

CASE STUDY: THE MENTAL WEIGHT OF BROKEN LEVEES The severity of Hurricane Katrina was far exceeded by the considerable destruction, devastation, displacement, and death left in its aftermath. Some residents trapped in their homes escaped to their roofs to await rescue. From there, they watched as the remains of their neighbors and loved ones floated through the flooded streets. Some families were separated into different places of refuge. Over a million people were displaced and nearly 2,000 died. Thousands were left traumatized. Those who remained were unable to access basic resources such as schools, shelters, and emergency services. The heavy mental toll extended to those who evacuated as well. Indeed, Katrina's overwhelming burden produced many stressors. Survivors had to cope with profound loss, disrupted social ties, and resulting surges in violence. Mental health services were not widely available. Thus, years later, the psychological scars caused by Katrina continue to linger.

The case for systems thinking about climate change and mental health

Helen L. Berry, Thomas D. Waite, Keith B. G. Dear, Anthony G. Capon & Virginia Murray

Nature Climate Change vol. 8, pages 282–290 (2018)

<https://www.researchgate.net/publication/324146598> The case for systems thinking about climate change and mental health

A common observation is that climate change is unlikely to generate new classifications of psychiatric disorder, instead aggravating well-known risk factors for already-existing disorders. For example, climate-change-related increases in extreme events mean that more people will be exposed to circumstances known to exacerbate existing mental disorders or to provoke first onset.

Hot days and heatwaves are particularly concerning because of their prevalence and danger, and the statistical effect size of hot days on population mental health approximates that of unemployment. Night-time heat, projected to increase with climate change, is associated with poorer sleep, a cause and consequence of poor mental health, and some psychoactive medicines become ineffective during heatwaves. Just as heat best predicts mortality in conditions of high humidity, so hot days are particularly strongly associated with deterioration in population mental health and well-being in humid weather (these associations vary seasonally). **Heatwaves aggravate various mental disorders**, especially (though not exclusively) affecting people in lower-income and middle-income countries. Heatwaves in Adelaide, South Australia, for example, caused excess hospital admissions for psychiatric presentations,

while hot days predicted hospitalization for self-harm and even suicide. A link has also been found among Indian farmers between extreme heat, reduced agricultural yields and sharp increases in suicides.

Extreme weather events attributable to climate change can also lead to mental health risks if they provoke **migration**, whether people are forcibly displaced, resettled or choose to leave. These risks are related to an array of factors connected with pre-migration vulnerability and post-migration adjustment. The features of and impacts on recipient communities, and the processes of interaction between migrants and their new communities, are also important: planned migration delivers superior outcomes. Those forced to migrate often come from regions where rates of psychiatric morbidity and underlying mental health risk factors, such as violence and starvation, are high. A useful related literature therefore considers the severe mental health effects of climate change on sub-populations likely to be disproportionately vulnerable, such as migrants, women, youth and people living with disadvantage, minority or ethnic status, poor family or social support and a history of mental illness. Additionally, vital medicines and medical aids can be lost fleeing extreme weather events, interrupting continuity of care for people with pre-existing morbidity (especially among older adults).

Climate change will increase the numbers of individuals exposed to extreme events and, therefore, to subsequent psychological problems such as **worry, anxiety, depression, distress, loss, grief, trauma and even suicide.**