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Climate Change Changes Health

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Climate Change and Allied Health Professionals

- It is going to affect the health of the people we care for.
- It is a social justice issue: the negative effects are felt most acutely by those who contribute to it the least and lack the resources to adapt.
- Our students will need the skills to make an impact in supporting people as they adapt to their changing climate.
- ASAHP is well placed to support policy/efforts to reduce GHG emissions.
- We need to conduct the research to advance our understanding of and deal with the health outcomes associated with climate change.
- Social responsibility should be a core element of a 21st century allied health education.

Climate Change

- The fact that the earth has warmed over the last century is unequivocal. Multiple observations of air and ocean temperatures, sea level, snow and ice have shown these changes to be unprecedented over decades to millennia. Human influence has been the dominant cause of this observed warming.
- Rising temperatures, the resulting increases in the frequency or intensity of some extreme weather events and rising sea levels are already disrupting people's lives and damaging some sectors of the U.S. economy.

Climate change affects the social and environmental determinants of health – clean air, safe drinking water, sufficient food and secure shelter.

“Climate change is a significant threat to the health of the American people.”

U.S. Global Change Research Program (USGCRP)
Health2016.globalchange.gov

A team of 100 scientist from 14 U.S. Federal agencies: HHS, NIH, CDC, NIOSH, ASPR, FDA, SAMHSA, NOAA, EPA, USDA, NASA, USGS, DOD, VA.



Consequences

- Between 2030 and 2050, climate change is expected to cause approximately **250,000 additional deaths per year**, in the U.S. from malnutrition, malaria, diarrhea, heat stress and exacerbation of chronic disease.
- The direct damage costs to health (excluding costs in health-determining sectors such as agriculture and water and sanitation), is estimated to be between **\$2-4 billion/year by 2030**.

Reducing emissions of GHG through better transport, food and energy-use choices can result in improved health, particularly through reduced air pollution.

U.S. Global Change Research Program

Climate Change Affects Health in Two Ways:

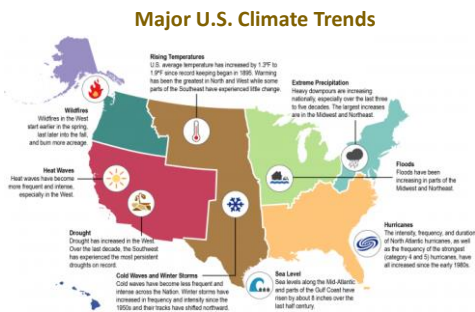
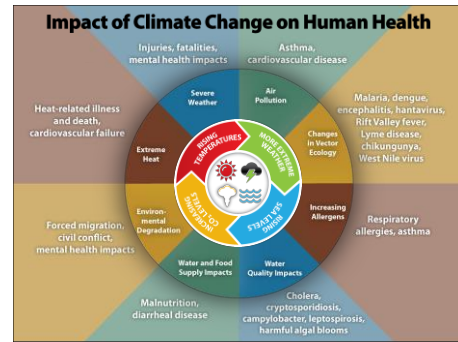
- By changing the severity or frequency of health problems that are already affected by climate or weather factors.

- Example:
Summer 2018 *karenia brevis* (red tide) Florida coast.



- By creating unprecedented or unanticipated health problems or health threats in places where they have not previously occurred.

- Example:
Ticks that carry Lyme disease have now crept northward all the way up into Canada, whereas a decade ago the disease didn't exist there.



Vulnerability

The tendency or predisposition to be adversely affected by climate-related health effects, and encompasses three elements:

- **Exposure** is contact between a person and one or more biological, psychosocial, chemical or physical stressors.
- **Sensitivity** is the degree to which people or communities are affected.
- **Adaptive Capacity** is the ability to adjust to potential hazards, to take advantage of opportunities or to respond to consequences.
- **Resilience** is the ability to prepare and plan for, absorb, recover from and more successfully adapt to adverse events.

Vulnerability

While all Americans are affected by climate change, some groups are disproportionately vulnerable to climate health impacts. These disparities are often dependent on the social determinates of health.

What Makes Children Vulnerable?

Children are especially vulnerable to the impacts of climate change because of their:

- **Growing bodies** are biologically *sensitive* to climate change threats.
- **Unique behaviors and interactions with the world around them** can increase their *exposure* to climate change threats.
- **Dependency on caregivers** reduced their *ability to adapt* to climate impacts because they rely on caregivers to provide for basic needs. Separation during a weather event increases children's risk of negative health impacts.

Overview Of Presentation

Exposures

- Temperature
- Air Quality
- Extreme Events
- Vectors Borne Disease

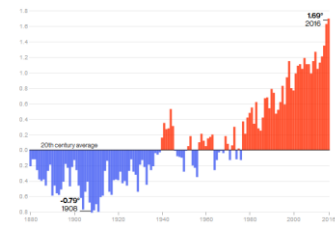
Consequences

- Health Outcomes
- Food & Nutrition Impacts
- Adaptive Capacity
- Populations of Concerns

Allied Health Response

- Prevention
- Treatment
- Research
- Policy

GLOBAL AVERAGE SURFACE TEMPERATURE, DIFFERENCE FROM 20TH CENTURY AVERAGE (IN DEGREES FAHRENHEIT)



SOURCE: NOAA

Temperature: Health Outcomes

- An increase of thousands to tens of thousands of premature heat-related deaths in the summer and a decrease of premature cold-related deaths in the winter are projected.
- The reduction in cold-related deaths is projected to be smaller than the increase in heat-related deaths in most regions.
- Future adaptation will very likely reduce these impacts.

Example: The European heat wave of 2003 was estimated to have been responsible for between 30,000 and 70,000 premature deaths.

Temperature: Health Outcomes

Temperature extremes compromises the body's ability to regulate its internal temperature resulting in a cascade of illnesses including:

- heat cramps
- heat exhaustion
- heatstroke
- mental health issues
- preterm births
- hyperthermia/hypothermia
- frostbite

Temperature extremes can also worsen or trigger chronic conditions such as:

- cardiovascular disease
- respiratory disease
- cerebrovascular disease
- diabetes related conditions
- kidney disease
- malnutrition

Temperature: Food & Nutrition

- Food will go bad quicker.
- Fish will be higher in mercury.
- Harmful algae blooms (HAB) contaminate seafood.
- Crop yields will be diminished.



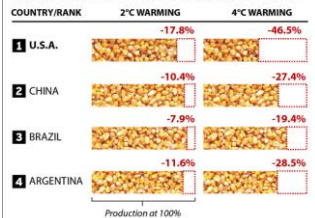
Example: An infections from eating raw oysters is caused by *Vibrio*. Between 1996 and 2005, the incidence of vibriosis in the southeastern U.S. increased by more than 80%, likely due to increase in sea temperature. *Vibriosis* kills about 1 in 4 people who contract it, sometimes within only one or two days.

Climate Change Raises Risks to Corn

New research projects that rising global temperatures will reduce yields in the world's largest corn-producing regions and could lead to food shortages.

MAIZE PRODUCTION PROJECTIONS

Projections under different warming scenarios, top producers, mean figures



Some Good News (for now)

- It's not gloom for everyone, with mostly colder northern areas benefiting so far.
- The U.S. corn belt is edging toward the border with Canada, which is already growing more crops than it used to.
- Russia is enjoying bumper harvests of wheat, partly as record temperatures boost yields.
- California farmers are planting coffee.
- Maine lobstermen have been catching more of the delicacy than ever before. While further temperature increases may go too far and erode lobster populations in coming decades, for now crustaceans are still breeding in great profundity.

Temperature: Populations of Concern

- Children and older adults have reduced ability to regulate their internal temperature and have limited acclimatization capacities, thus; they have higher M/M due to extreme heat.
- Traditional tribal consumption of seafood in the NW and Alaska can be up to 20 times higher than other Americans. They may face increased health risks from contamination. Replacing these traditional foods with less nutritious processed foods and the loss of cultural practices tied to fish and shellfish harvest.
- People working outdoors, the socially isolated and economically disadvantaged, those with chronic illnesses, as well as some communities of color, are especially vulnerable to death or illness for extreme temperatures.
- City dwellers.

Adaptation to Temperature Extremes

Less mortality/morbidity in response to extreme heat in typically hotter cities suggests that people can adapt.

- This may be due to infrastructure such as the SE has greater prevalence and use of air conditioning.
- There is evidence of a physiological acclimatization such as: changes in sweat volume and timing, blood flow and heat transfer to the skin, kidney function and water conservation occurring over the course of weeks to months of exposure to a heat wave.

Temperature: Minimizing Impact

- Heat wave early warning systems can protect people by communicating risks and are much less costly than treating/coping with heat illnesses. They serve as triggers to take preventive action, like opening cooling centers, staying hydrated and avoiding strenuous outdoor exercise.
- Research the associations between exposure to a range of temperatures and exacerbation of illnesses across locations and healthcare settings.
- Improve understanding of how genetic factors & determinants contribute to vulnerability to illness and death from extreme temperature exposures.



Temperature: Minimizing Impact

- Longer growing seasons in some places won't be large enough to make up for the loss of food production in others; alternative foods and GMO crops may be required.
- Updating building codes and landscaping laws can increase energy efficiency. It also improves the ability of buildings to provide protection against extreme heat.

Example: green roofs (roofs with plant cover) and strategically located shade trees can reduce indoor temperatures and improve buildings' energy efficiency. Urban forests, including street trees and wooded areas, can mitigate urban heat islands, reducing local air temperatures by up to 9°F.

Air Quality: Health Outcomes

Changes in the climate affect air quality through three pathways:

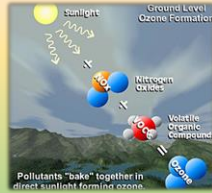
- Outdoor Air Pollution
- Aeroallergens
- Indoor Air Pollution



Poor air quality, whether outdoors or indoors, can negatively affect the human respiratory and CV systems.

Air Quality: Exacerbated Ozone (O₃) Levels

- O₃ is a compound that occurs naturally in Earth's atmosphere but is also formed by human activities.
- O₃ prevents harmful solar ultraviolet radiation from reaching the Earth's surface.
- Surface O₃ is a respiratory irritant and contributes to other adverse outcomes.
- Ground-level O₃ have been estimated to be responsible for tens of thousands of hospital and ED visits, millions of cases of acute respiratory distress, school absences and thousands of premature deaths each year in the U.S.



Air Quality: Wildfires

- Climate change has already led to an increased frequency of larger and longer wildfires in the western U.S. and has increased particulate matter (PM).
- PM smaller than 2.5 microns in diameter (PM_{2.5}) is associated with serious chronic and acute health effects, including lung cancer, COPD, CVD and the development and exacerbation of asthma and other RD.
- PM from wildfires increases the risk of premature death, hospital and ED visits.

Air Quality: Aeroallergens

- Ragweed is the most common aeroallergen in the U.S.
- Ragweed pollen season length has increased between 1995-2011 by as much as 11-27 days in parts of the U.S. and Canada.
- Aeroallergen exposure contributes to the occurrence of asthma episodes, allergic rhinitis (hay fever), sinusitis, conjunctivitis, hives, eczema and anaphylaxis.
- These diseases have increased in the U.S. over the past 30 years. The prevalence of hay fever has increased from 10% of the population in 1970 to 30% in 2000.
- Asthma rates have increased from approximately 8 to 55 cases per 1,000 persons to approximately 55 to 90 cases per 1,000 persons over that same time period.

Air Quality: Indoor Pollution

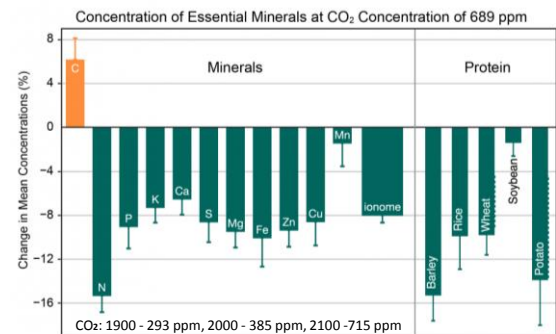
- Increased indoor dampness and humidity will in turn increase indoor mold, dust mites, bacteria and other bio-contamination indoors, as well as increase levels of volatile organic compounds (VOCs) and other chemicals resulting from the off-gassing of damp or wet building materials.
- Dampness and mold in U.S. homes are linked to approximately 4.6 million cases of worsened asthma and between 8% and 20% of several common respiratory infections, such as acute bronchitis.



Air Quality: Food & Nutrition

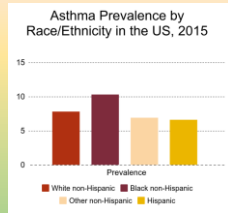
Research shows that when certain foods are grown at high levels of atmospheric CO₂, they lose some of their nutrients.

Nutrients of Concern:	Crops of Concern:
Protein	Rice
Iron	Corn
Zinc	Wheat
Calcium	Barley
Magnesium	Potatoes
Phosphorous	
Potassium	
B Vitamins	



Air Quality: Populations of Concern

- Blacks, women and the elderly experience the greatest baseline risk from air pollution.
- Lower SES and housing disrepair have been associated with higher indoor allergen exposures.
- The onset of asthma in children is linked to early allergen exposure, which acts in concert with genetic susceptibility.
- The elderly are particularly sensitive to short-term PM exposure, with a higher risk of hospitalization & death.



Air Quality: Populations of Concern

- Vegans
- Those with Limited Food Budgets
- Starch Based Diet Populations

Rice is the staple food of more than half of the world's population – more than 3.5 billion people depend on rice for more than 20% of their daily calories. Rice provided 19% of global human per capita energy and 13% of per capita protein in 2009.

Adaptation To Poor Air Quality

- Avoid exercising outdoors when pollution levels are high. Limit the amount of time children spend playing outdoors if the air quality is unhealthy.
- Always avoid exercising near high-traffic areas.
- Use less energy in your home. Generating electricity and other sources of energy creates air pollution.
- Many school systems are using the U.S. EPA's Clean School Bus Campaign to clean up these dirty emissions.
- Don't burn wood or trash. Burning firewood and trash are among the major sources of PM in many parts of the country.
- Prohibit indoor smoking and support measures to make all public places tobacco-free.

Air Quality: Minimizing Impact

- Inform your patients about the health effects associated with air pollution exposure.
- EPA's Air Quality Index (Airnow.gov) and local hazard warnings.
- Enhance understanding of how interactions among climate-related factors, such as temperature or relative humidity, aeroallergens and air pollution, affect human health and how to attribute health impacts to changes in these different risk factors.
- Identify the impacts of changes in indoor dampness, such as mold, other biological contaminants, VOCs and indoor air chemistry on indoor air pollutants and health.

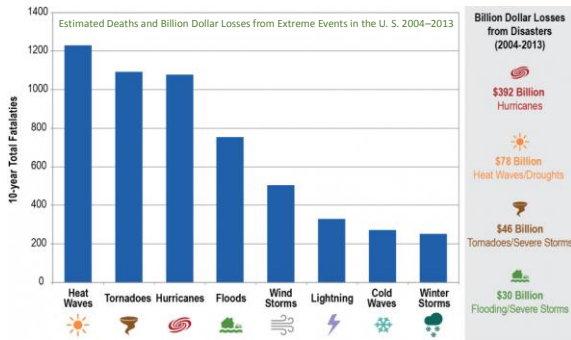
Air Quality Index Levels of Health Concern	Numerical Value	Meaning
Good	0 to 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health alert: everyone may experience more serious health effects.
Hazardous	301 to 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

Extreme Events

- Flooding Related to Extreme Precipitation, Hurricanes & Coastal Storms
- Droughts
- Wildfires
- Winter storms and severe thunderstorms

While it is intuitive that extreme events can have health impacts such as death or injury during an event, health impacts can also occur before/after an event as individuals may be involved in high risk activities, such as disaster preparation and cleanup. Health risks may also arise long after the event or in places outside the area where the event took place, as a result of damage to property, destruction of assets, loss of infrastructure and public services, social and economic impacts, environmental degradation and other factors.

Example: 2,975 people lost their lives in Puerto Rico during and after Hurricane Maria in 2017



Extreme Events: Flooding Related to Extreme Precipitation, Hurricanes & Coastal Storms

- Traumatic injury and death (drowning)
- Mental health impacts
- Preterm birth and low birth weight
- Infrastructure disruptions and post-event disease spread
- CO₂ poisoning related to power outages

Extreme Events: Droughts

- Reduced water quality and quantity
- Respiratory impacts related to reduced air quality
- Mental health impact
- Food Insecurity
- West Nile

Extreme Events: Wildfires

- Smoke inhalation
- Burns and other traumatic injury
- Asthma exacerbations
- Mental health impact
- GI problems

Extreme Events: Winter Storms & Severe Thunderstorms

- Traumatic injury and death
- CO₂ poisoning related to power outages
- Hypothermia and frostbite
- Mental health impacts

Extreme Events: Food & Nutrition

Climate change's effects on global food supply could lead to more than 500,000 deaths by 2050 as people around the world lose access to good nutrition:

- Too much water — or not enough of it — can severely cut down on crops.
- Transport of food could be seriously limited during extreme weather. Grains, which are mostly shipped by water, could experience difficulties.
- If food can't get from place to place, there's a bigger chance it will go bad in higher temperatures, especially if power outages are involved.
- Livestock deaths.

Example: In 2003, a power outage affected the northeastern U.S. and Canada. NYCDOHMH detected a statistically significant citywide increase in diarrheal illness resulting from consumption of spoiled foods.

Hurricane Florence North Carolina 2018

Losses:

- Row crop \$986.6 million
- Vegetable crop \$26.8 million
- Livestock & aquaculture \$23.1 million
- Livestock deaths: 4.1 million poultry & 5,500 hogs



We won't be able to rely on stable sources of food.

Extreme Events: Populations of Concern

- Storms/floods compromise drinking water and in water bodies where children play and they are more likely than adults to develop GI and diarrheal illnesses.
- The Black adult mortality rate from Hurricane Katrina was 1.7 - 4 times higher than that of whites.
- Pregnant women/newborns are uniquely vulnerable to flood health hazards; exposure was associated with adverse birth outcomes (preterm birth, low birth weight) after Katrina and the 1997 floods in North Dakota.
- Half of deaths from Katrina were people over age 75; for SS Sandy almost 1/2 were over age 65.
- Low-income populations have increased exposure risk to severe winter conditions as they are more likely to live in low-quality, poorly insulated housing; be unable to afford sufficient heating; or need to make tradeoffs between food and heating.

Extreme Events: Minimizing Impacts

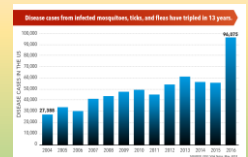
Needed Research

- Patterns of extreme weather have the potential to strain the capacity of public health systems. Few studies have examined the human health impacts of such health-system strain.
- The impacts on health systems from short- and long-term population displacement are not fully understood or well quantified.
- The role of future population migration and demographic changes is just beginning to be elucidated in assessments of local adaptive capacity or resilience to the effects of future extreme events.
- Methodological challenges remain for accurately quantifying and attributing delayed mortality associated with, but not caused directly by, extreme event exposure.



Vector Bourne Disease (VBD)

- Illnesses that are transmitted by mosquitoes, ticks and fleas.
- Nine new vector pathogens since 2004.
- There are currently 16 VBD that are of national public health concern.
- These diseases account for a significant number of human illnesses and deaths each year and are required to be reported to the National Notifiable Diseases Surveillance System at the CDC.



VBD: Health Outcomes

- Longer seasonal activity, increased abundance and expanding geographic range of ticks and mosquitoes and other vectors will increase the risk of human exposure.



Diffuse maculopapular rash associated with West Nile virus infection.

VBD: Populations of Concern

- Children spend more time outdoors than adults, increasing their exposure to bites; diseases that are diagnosed more often in children, include encephalitis and Lyme disease.
- Outdoor workers.
- Some evidence that being male contributes to a higher risk for severe WNV infections.



