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PH-460-003: Concepts in Climate Change & Public Health Preparedness

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A problem that is the result of climate change is heat waves. Heat waves refers to temperatures that are abnormally high and last for several days, weeks, and even months. Hassan explains what causes a heat wave in his article “What to Know About the Heat Waves.” He says that “Heat waves begin when high pressure in the atmosphere moves in and pushes warm air toward the ground. That air warms up further as it is compressed, and we begin to feel a lot hotter” (2021). Greenhouse gasses are a good thing to an extent; they keep the planet warm through the greenhouse effect. The greenhouse effect occurs when greenhouse gasses in the atmosphere like carbon dioxide, methane, and nitrous oxide trap heat just like the glass walls of a greenhouse do. According to Means (2021), before the Industrial Revolution, carbon dioxide fluctuated between 180 and 280 parts per million (ppm). Since the beginning of the Industrial Revolution, carbon dioxide in the atmosphere has risen nearly 50%, and today it’s at over 410 ppm. Solar energy passes through the atmosphere and to the surface of the earth. This energy is then absorbed by the land, oceans, and atmosphere, heating the planet. Heat radiates back in the form of infrared light, which is absorbed by greenhouse gasses and redirected back toward the earth, warming it even more. There are activities that are impacting the greenhouse effect, and these are burning fossil fuels, cutting down forests, and farming livestock. These activities cause more greenhouse gasses to add to the naturally occurring greenhouse gasses that are already in the atmosphere, resulting in higher concentrations of greenhouse gases, especially carbon dioxide. This then results in Earth’s atmosphere trapping more heat and global temperatures rising, which is known as global warming.

North American and Europe are accountable for about half the total of greenhouse gas emissions. The region of focus for this paper is the United States. In North America, heat waves

occur in the summer months, between July and August. From the 1960s to the 2010s, there has been a steady increase in frequency, duration, intensity, and the length of heat wave season in the United States. According to the United States Environmental Protection Agency, the occurrence of heat waves has increased from an average of two heat waves per year during the 1960s to six heat waves per year during the 2010s. The duration of heat waves has increased from three in the 1960s to four days long in the 2010s. The intensity has increased from 2.0°F above the local 85th percentile threshold to 2.5°F above the local threshold. The length of heat wave season has increased by 47 days from the 1960s to the 2010s (2021). Heat waves can have serious consequences for health and life. They can affect vulnerable populations such as older adults, children, among others. Other consequences of heat waves include forest fires, increase in mortality, health problems, agriculture damages, increase in energy consumption, and increase in power outages. If no significant changes are made, such as replacing fossil fuels for renewable resources, in the following years, temperatures will continue to rise. It is predicted that if temperatures continue to rise at the current rate, there will be more frequent heat waves and the time between them will be shorter. In "Greenhouse Effect 101," Denchak states that global warming will reach 2.7°F above preindustrial levels between 2030 and 2052. By 2100, the world temperature could increase by more than 4°F (2019).

Heat waves in the United States can affect people with respiratory diseases. The reason for this is because heat waves impact air quality through events such as wildfires; the amount of pollution in the air determines the quality of the air. An example of a respiratory disease is asthma. Asthma is a chronic disease that affects the airways of the lungs; although asthma is not curable, it is treatable. Heat waves lead to a chain of events that result in people with

asthma being affected. Heat waves can exacerbate drought, creating hot and dry conditions which can in turn create wildfire conditions. Smoke from fires is a source of air pollution along with gases, volcanic ash, and dust particles. Smoke from fires release substantial amounts of volatile and semi-volatile organic materials and nitrogen oxides that form ozone and organic particulate matter. These toxic pollutants can directly affect first responders and local residents, as well as people from regions far away from the wildfires because air transports these and other pollutants. One of these air pollutants is ozone, which is a highly reactive gas. The website "Asthma and Allergy Foundation of America" (2015) explains that "Ozone triggers asthma because it is very irritating to the lungs and airways. It is well known that ozone concentration is directly related to asthma attacks. It has also caused the need for more doses of asthma drugs and emergency treatment for asthma." In another article, they explain the harmful effects of ozone by stating that "When inhaled, ozone can damage the lungs. Relatively low amounts can cause chest pain, coughing, shortness of breath and throat irritation. Ozone may also worsen chronic respiratory diseases such as asthma and compromise the ability of the body to fight respiratory infections" (Ozone Generators, 2021). Therefore, air pollution, commonly the pollutant ozone among other airborne particles, is detrimental for people with asthma who already have difficulty breathing due to airways that become inflamed and narrow. The article "Weather Can Trigger Asthma" (2017) states that "Hot, humid air can cause asthma symptoms as well. Humidity helps common allergens like dust mites and mold thrive, aggravating allergic asthma. Air pollution, ozone and pollen also go up when the weather is hot and humid. Particles in the air irritate sensitive airways." The article also talks about research showing that air pollution can worsen asthma symptoms. Research found that young campers

with moderate to severe asthma were 40% more likely to have acute asthma episodes on summer days with high pollution than on other days. Also, another study involving older adults found that during summer, when air pollution is high, they were more likely to visit the ER for breathing problems. The health effects resulting from wildfires smoke depend on the level of exposure; for people who were exposed for a longer period, the health effects can be more serious, making recovery less certain. In "How Heat Can Trigger Asthma Symptoms," Echague (2017) states that a study of thousands of cases in Maryland, found that the risk of hospitalization due to asthma increased 23% during extreme heat and heavy rainfall; the risk was highest for people between 5 and 17 years old. This is a significant problem in this country since millions of people suffer from this condition. The CDC estimates that about 25 million of people in the United States have asthma; that is about 1 in 12 people, with the number increasing every year (Asthma in, 2011).

The principle of prevention from the concepts of the article "Climate Change: The Public Health Response" (2008) serves as the foundation to approach climate change. The concept of prevention applies to diseases and consists of three different types of prevention: primary prevention focuses on preventing the onset of injury, illness, or disease; secondary prevention focuses on diagnosing disease early in order to control it and reduce its health burden; tertiary prevention focuses on reducing morbidity, avoiding complications, and restoring function once a disease is diagnosed. In the case of climate change, the concept of mitigation, which is analogous to primary prevention, can be used to address the problem of heat waves as a result of climate change. Mitigation focuses on slowing, stabilizing, or reversing climate change by reducing greenhouse gas emissions. According to the Council on Foreign Relations (n.d.), the

energy industry produces the most greenhouse gases; these emissions are tied to various sources including electricity and heat that power households, manufacturing, construction, and transportation. The energy industry contributes almost 75% of greenhouse gas emissions globally. Therefore, this industry should be the focus of attention to mitigate the adverse consequences of heat waves. The strategies to reduce emissions in the energy industry and achieve a future with clean energy and clean transportation, as stated by the Center for Climate and Energy Solutions, include switching to renewable energy by using resources such as rooftop solar panels, solar water heating, small-scale wind generation, fuel cells powered by natural gas or renewable hydrogen, and geothermal energy; switching to nuclear power; using carbon capture and storage; installing more efficient lighting; improving fuel efficiency; investing to electric cars; and blending biofuels with gasoline (2020).

Educating communities is also part of the concept of mitigation. Education can include strategies to deal with extreme heat, such as recognizing the signs of heat-related illness and ways to mitigate it; how to stay safe and minimize outdoor activity during extremely high temperatures; the importance of maintaining hydration; and how to keep their home cool or find an open public cooling center. Through education, communities can be better prepared to be resilient and best cope with the adverse impacts of heat waves, thereby reducing the adverse consequences of heat waves and associated health burden. Then, through adaptation, which is analogous to secondary and tertiary prevention, efforts can be made to anticipate and prepare for the actual or expected effects of climate change, and by that means reduce the associated health burden. To adapt to heat waves, the United States Environmental Protection Agency (2021) suggests that “to safeguard against the acute effects of extreme heat on

people's health in the short term, local officials can establish early warning systems and urban cooling centers and raise awareness about risk factors, symptoms of heat-related illness, and when and how to seek treatment." It also suggests that local officials can "protect or modify roads, train tracks, and other infrastructure by using more resilient materials, as well as implement energy efficient measures to reduce disruptions of city services and stress on electricity systems during heat waves" (United States, 2021). Another recommendation to improve resilience is to incorporate heat island reduction strategies. These strategies include green or cool roofs, cool pavements, and increased vegetation and trees; these measures help lessen the impacts of heat waves on public health. Besides addressing the effects of climate change, economic, gender, and racial justice needs to be addressed as well. People in low-income communities, people of color, and other vulnerable populations face the impacts of climate change while having fewer or no resources to respond and adapt to the changes. Therefore, especial consideration must be placed in these populations to ensure that they obtain the resources needed for prevention, preparedness, and adaptation, thus reduce inequities.

As read throughout this essay, heat waves are another critical issue of climate change. Since the industrial revolution, carbon dioxide in the atmosphere has increased due to human activities. The increased in carbon dioxide levels has caused an increase in temperatures, which in turn, has increased the frequency, duration, intensity, and length of heat wave season in the United States. Heat waves are expected to continue impacting the country if no significant changes are made. People with asthma are particularly affected by the occurrence of heat waves; their risk for exacerbations, ER visits, and hospitalizations increases during these events.

To counteract the effects of heat waves, the concepts of mitigation, adaptation, and ethical principles need to be part of the approach. Educating communities, switching to renewable energy and nuclear power, using carbon capture and storage, installing efficient lighting, improving fuel efficiency, investing in electric cars, and blending biofuels with gasoline are part of mitigation. Adaptation consists of protecting or modifying infrastructure, implementing energy efficient measures, incorporate heat island reduction strategies, among others. This will require collaboration from federal, state, and local government; scientists and experts; businesses; and local community members. And finally, environmental justice is an essential principle to consider to ensure that inequities are addressed as well.

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