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Rising Heat: Health Impacts, Preparation, Mitigation, and Recovery

Matea Hoover

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University of New Mexico: College of Nursing

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Part I

Increasing temperatures are an ever-rising problem in New Mexico. With the average annual temperature rising by 2.7°F since 1970, New Mexico is the sixth-fastest warming state in the nation. Extreme heat in the summers creates several problems in New Mexico that are occurring currently and set on the course to only increase in the decades to come. The extreme heat in of New Mexico summers directly impacts the health of individuals by contributing to pre-existing health problems and creating new health problems for previously healthy individuals. Heat contributes to dehydration, and many heat related illnesses. Rising temperatures also impact the water resources within New Mexico and increase the risk of wildfires.

Extreme heat is considered the deadliest form of weather. It leads to heat stress, heat stroke, increased prevalence of cardiovascular and respiratory disorders, and potentially devastating mental health conditions. Dangerous heat days are those with a heat index of 95°F or higher. Currently, Albuquerque averages 17 dangerous heat days per year and is predicted to have twice as many by the year 2050. Heat is rising for a variety of reasons, including the human contributions of greenhouse gas emissions from ever expanding infrastructure. Due to increased human activity and increased modification to land surfaces, urban heat islands are being created all over the nation. An urban heat island is an urban area that has considerably higher temperatures than the surrounding rural area. The city of Albuquerque is the second most intense urban heat island in the nation. City summers are 5.9°F hotter than in rural areas with city temperatures up to 22°F higher than those in the surrounding rural areas. Additionally, Albuquerque has more than twenty-five days a year that are above 90°F. Temperatures above 90°F are not only contribute to heat stress on people's bodies, but these high temperatures are

also associated with increased ozone production. The impact of breathing in ozone can lead to lasting health conditions. Breathing in ozone can trigger throat irritation and airway inflammation; it can exacerbate pre-existing respiratory health problems such as asthma, bronchitis, and emphysema. It has also been associated with increased occurrence of chest pains and heart attacks. As cities grow, the intensity of urban heat islands increases which places more people at risk for heat related health complications.

Increasingly high temperatures also impact water resources in several ways. Rising temperatures both reduce the creation of snowpack and cause earlier snowmelt in the spring. This creates an overall decrease in water levels in the Rio Grande and other prominent water resources in New Mexico. Furthermore, the abnormal timing of snowpack melting leads to lower levels of available water during the times of highest demand. Another way that increasing temperatures impact water levels is through evaporation. Higher temperatures accelerate the rate of water evaporation into the atmosphere. Increased evaporation may lead to an increase in the atmosphere's ability to hold the extra evaporated water. This can lead to more extensive periods of drought in some areas while creating flooding in other areas. Having periods of drought combined with periods of extreme heat creates the perfect environment for wildfires to thrive. These high heat conditions are increasing the frequency, duration, and intensity of wildfires.

Part II

Extreme heat can be devastating to many people throughout New Mexico. The populations most vulnerable to heat related health issues are those with pre-existing health conditions, the elderly, children and infants, and homeless. Why are these populations the most

vulnerable? The old and the young are more vulnerable because they have a decreased ability to regulate their own body temperature. Additionally, the elderly may be even more susceptible if they have other health conditions. Having pre-existing health conditions, especially respiratory, cardiac, or renal conditions, makes a person more vulnerable because these health conditions can be easily aggravated by high temperatures. The homeless and other low-income peoples are more at risk for heat-related illness because they may lack shelter from the heat or air-conditioning to help aid their body in cooling down.

The elderly are more vulnerable to extreme heat because they are less able to thermoregulate, they are more likely to have chronic health issues, and they may be taking medications that impact body temperature. There are several ways that heat impacts health. The most common and more mild impacts heat can have on health include dehydration, heat cramps, heat exhaustion, and heat syncope. When exposed to hot temperatures in the environment, the body begins to heat and uses sweat as a cooling mechanism. Sweating cools the body, but also eliminated fluids from the body and causes a person to become dehydrated more quickly. Heat cramps are usually brief but painful muscle spasms. These cramps most often occur in the stomach, arms, or legs and may be accompanied by sweating and nausea. Heat syncope occurs when the body begins to overheat, causing dizziness and a potential brief loss of consciousness. Heat syncope happens due to the process that occurs within blood vessels when the human body is trying to cool itself off. The blood vessels dilate which decreases blood flow to the brain and can cause loss of consciousness. A more serious heat related health issue is heat stroke; this occurs when the body is overheated and cannot cool itself down, temperature rises rapidly and sweating fails. Heat stroke is a very serious condition that must be treated quickly. Without

treatment heat stroke can result in death or permanent damage to the brain, heart, kidneys, and muscles.

Higher temperatures can also impact pre-existing respiratory and cardiovascular conditions that many elderly individuals may already have. It can also be detrimental to the kidneys. Increased heat contributes to an increase in air pollutants. Ground level ozone can cause chest pain, throat irritation, coughing, and diminished lung function. Additionally, studies have shown that simply breathing in hot air can cause respiratory irritation regardless of the pollutant level of the air. Cardiovascular diseases are already the leading cause of death in the United States and they can be exacerbated by extreme heat conditions. As mentioned, heat increases ozone and other air pollutants which puts extra stress on the respiratory system. More stress on the respiratory system leads to impaired gas exchange which puts more stress on the heart. Additionally, mental stress and anxiety related to extreme temperatures is correlated with an increase in heart attacks. Heat illness also causes dehydration, which on its own can be harmful to the kidneys. Dehydration can also lead to dangerously low blood pressure and imbalanced electrolyte levels. This combination can cause lack of blood flow or clotting that can cause irreversible damage to the kidneys or other organs. Exposure to extreme heat conditions puts added stress on all body systems. This can be very dangerous for the likely already compromised elderly population.

Part III

As temperatures are rising, there are several ways to prepare and combat the impacts of heat. In order to prepare for extreme heat, there are several actions to be taken. Many preventative actions also provide mitigation of the adverse impacts heat has. On the system's level, warnings and alerts can be provided, policies about shade and work hours can be made,

and cooler building styles can be implemented. Having a warning system for when extreme heat days are forecasted can help prepare a community for the coming events. Warnings allow for people to plan to stay indoors more ahead of time and help provide access to resources that may be needed. Policies can be put in place for businesses that operate outdoors during hot weather conditions to provide adequate break time, proper shade structures, and water to employees. Additionally, cooler building styles can be implemented; this will not only act as a preventative measure to protect from heat but also as mitigation to reduce the impacts of the heat. Evidence shows that adobe buildings are the best in extreme heat and provide the most heat moderation. Another element of construction that can be implemented is using cool pavement instead of the traditional dark pavements. Cool pavements have additives that help to reflect the heat from the sun instead of absorbing it. Using a cool pavement can be done as preparation in cities that expect hot temperatures because it helps to reduce the heat transferred to the surrounding people, buildings, and air. This lowers the intensity of urban heat islands. Another method for reducing urban heat island intensity is tree planting. Trees provide shade as well as helping to clear out greenhouse gases being produced by a city. On a more individual level, people can use heat protective shields in windows and use air conditioners to keep their homes cool. Individuals can also practice safety during hot conditions by staying hydrated, wearing lightweight clothing, applying sunscreen, and staying indoors when possible. Taking these simple actions to prepare for heat before and protect during extreme heat helps to preserve the community's health and wellbeing.

The response a community takes to the issues that arise from extreme heat is also an important aspect in preserving health. The response to extreme heat events should be to provide relief to those in need and increase preventative measures. Response is tied heavily to

preparation, because a good response is supported by resources obtained in advance. Hospitals should be prepared for a potential influx of patients during times of extreme heat. The warning systems provided by a community not only help to protect individuals, but they also help give hospitals a chance to prepare resources that they may need to help people impacted by heat. One of the most important aspects of response during an extreme heat event is adequate medical care. Additionally, responses to extreme heat should include the further implementation of preventative measures. If people in a community are suffering from health issues related to extreme heat, then the community should strive to lower the impacts of heat through the methods previously mentioned. Overall, the goal of the response should be to provide immediate care and safety to people followed up by a sustainable response to provide extended safety to the community. The responsibility to protect a community from extreme heat and other climate change related events is shared by each individual and organization.

Part IV

When looking at the concept of recovery as it relates to extreme heat there are several changes of actions and mindset that could occur. Actions should apply to individuals and the community as a whole. In order to move to a place of recovery, the Jem Bendell, Deep Adaptation model could be followed. For resilience, the community should identify their individual and collective priorities. These could relate to any aspect of life, but one high priority could be simply quality of life throughout aging under extreme heat conditions. Finding the most valued aspects of life is the first step towards recovery. The next area of recovery is looking at relinquishment. The community has to identify what parts of life they can let go of to create a better future. When relating this to extreme heat, some things to consider letting of could be outdoor summer activities or work. On the broader approach, things to let go of could be

anything that is increasing climate change effects and especially those increasing urban heat islands. The community could let go of individual travel and transportation, meat production plants or other production plants with high emissions, or the continuation of unnecessary construction. The next area to look at in the community is restoration. What areas of the community or of individual life could be brought back to create a better future? This could mean bringing back the traditional adobe building style which provides better temperature moderation. The community could also restore values or beliefs from other cultures such as the high value or nature that is seen indigenous communities. The last aspect of recovery that the community should address is reconciliation. The individuals in the community should look to make peace with those around them and to reconcile with nature itself. Looking at the mutual mortality of the community, reconciliation will create the space for full recovery to occur.

The impacts of extreme heat and rising temperatures can be catastrophic. However, there are many ways to prepare, protect, combat, and recover from these devastating events. Every action by every person makes an impact on climate change. Ultimately, all aspects of climate change reduction and recovery rely on the combined actions of every individual within a community.

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