Beyond Environmental Change: How Climate Change Affects Public Health

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Introduction

The environmental effects of climate change are well documented. The public is increasingly aware of physical changes – sea level rise, droughts and heat waves, changes in precipitation, and so on – but what about the impacts on human health? We know we can expect to see more heat waves, but the consequences go beyond mere discomfort of summer months.

Beyond heat waves, changing temperatures can have serious and numerous downstream effects that will impact public health. Some health impacts have already started to manifest, while others may be unexpected. Developing an understanding of how climate change impacts public health, coupled with strong climate policy and public health readiness can help counteract many of the serious effects we can expect to see in the years to come.

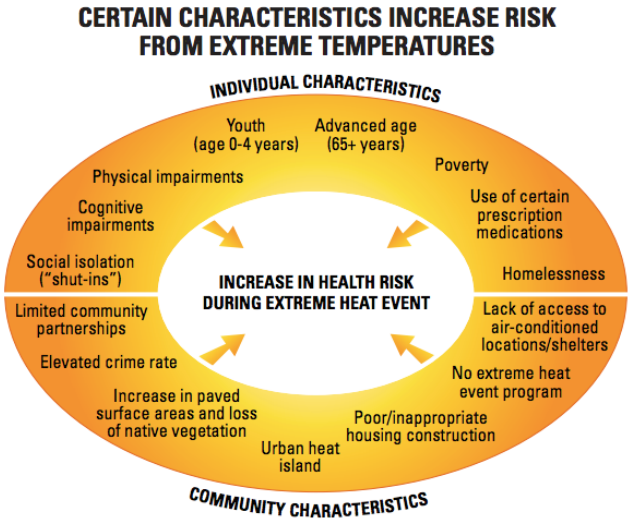
How does changing climate affect public health?

Climate change's impacts on public health are numerous. It is important to begin to recognize many of these effects in order to better inform health policy, strategize to prevent extensive damage, and to improve climate readiness. The following are expected ways in which climate change will likely affect human health.

1. **Heatwaves**

   Increasing temperatures will be the most obvious and immediate impact of climate change on human health. Extreme heat waves can be deadly – as the world has seen in the 2003 European heat waves, or the 2010 Russian heatwave, each causing tens of thousands of deaths. While individual heat wave events may not be directly attributable to climate change, we can expect to see more of these in years to come. In general, we will continue to see higher temperatures in summer months.

Depending on the region, higher temperatures – especially when tied with high humidity and warmer nighttime temperatures – can be a threat to public health, especially vulnerable populations include the very young and elderly, low-income communities, and those with chronic diseases. The United States Centers for Disease Control and Prevention illustrated some of the most vulnerable groups in the graphic below, considering both individual and community characteristics that lead to increased risk[1]:



Researchers predict that climate change will increase the threat of heat waves. In 2017, *Nature* published a study analyzing hundreds of papers documenting lethal heat events from 1980 to 2014. The authors found that around 30% of the world's population is exposed to more than 20 days per year during which the human body cannot effectively regulate its core temperature of 37 degrees Celsius due to high heat and humidity. The percent of the world population exposed to these deadly heat conditions is projected to nearly double by 2100, even under a scenario in which global greenhouse gases are reduced. In a projection where global greenhouse gases remain high, the affected population would increase by nearly 75%.[2]

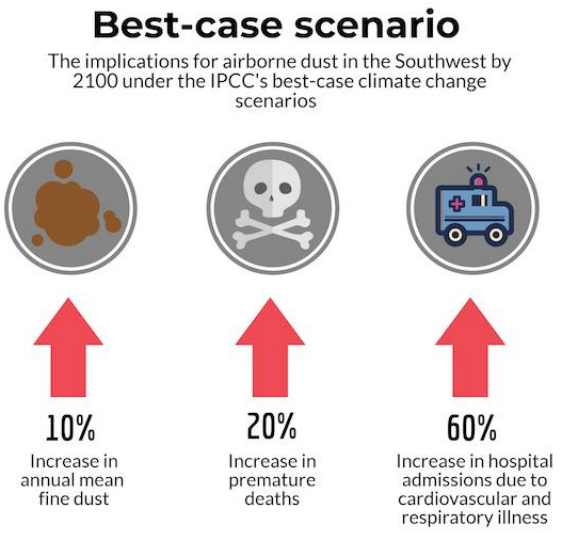
2. Air Quality

Increasing temperatures and irregular seasons driven by climate change are also closely tied with worse air quality. Anyone who experiences pollen allergies may be discomforted to know that

longer warm seasons, especially when paired with drought, can cause plants to pollinate for longer periods of time and with more intensity. Warmer winters might also mean that pollens become less dormant, contributing to longer allergy seasons.[3]

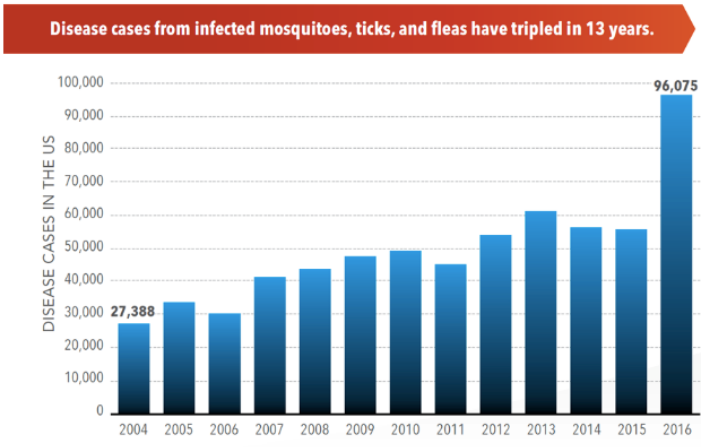
Outdoor air pollution, which already causes an estimated 4.2 million deaths per year according to the World Health Organization[4] Pollutants like ozone and small particulates cause and exacerbate a range of health conditions, including heart disease, stroke, respiratory infections, lung cancer, and more. The progression of climate change is expected to increase the number of deaths and hospitalizations caused by air pollution. Ozone, for example, is a hazardous pollutant formed from the reactions of sunlight and nitrous oxides and other emissions. We can expect an increase in warm, sunny days as climate change progresses, leading to an increase in ozone pollution and subsequent health challenges.

Increased dust levels could be another cause of concern. The southwestern United States, for example, could be at particularly high risk. Researchers from Harvard and the George Washington University found that fine mineral dusk, which is considered a fine particulate matter air pollutant, is likely to increase in this region, due to increasingly severe and prolonged droughts in this region. They note that soil-derived small particulate matter has been clearly documented to have detrimental effects and has been linked to increased hospitalizations for respiratory and cardiovascular diseases. Silica which often makes up about half of windblown dusk in desert regions has been linked to lung inflammation and fibrosis, lung cancer, and systemic autoimmune diseases.[5] Other arid regions might face similar concerns. A summary of dust impacts as reported in this study is visualized below[6]:



3. Vector-Borne Diseases

In May 2018, the US Center for Disease Control (CDC) published a report noting a rise in vector-borne diseases. From 2006 to 2014, disease cases from mosquito, tick, and flea bites tripled in the US, and since 2004, nine new germs spread by mosquitoes and ticks have been discovered or introduced.[7] In the last decade, unexpected vector-borne pathogens, including the chikungunya and zika viruses, have either been discovered for the first time or reintroduced in the United States. The spread of vector-borne diseases should come as no surprise. As global temperatures increase, so too does the geographic range for many disease-carrying pests. Certain regions may see an increase in precipitation, which could create more viable breeding grounds for mosquitoes and other insects.[8] The chart below shows the rise in reported disease cases in the United States since 2004:



SOURCE: CDC Vital Signs, May, 2018

We can expect to see vector-borne disease outbreaks to increase around the world. A recent report noted that climate change would likely amplify the transmission of dengue, especially in Latin America. Dengue is a vector-borne disease found in over 100 countries, estimated to cause around 390 million cases per year.[9] Through increased temperatures, climate change is expected to alter the length of dengue transmission season. Additionally, regions that were not previously exposed to dengue might be more susceptible to the disease, contributing to new outbreak cases in a changing climate. Under a 3.7ºC warming scenario, dengue cases are projected to increase by approximately 7.5 million per year by 2050. Mitigating emissions to achieve a 2.0ºC warming scenario would decrease this to 6.7 million additional cases per year.[10]

Globalization and other complex factors also contribute to the spread of vector-borne diseases. CDC director of vector-borne diseases Dr. Lyle R. Petersen noted that beyond weather, increased travel and a decrease in vaccine availability contribute to this public health challenge.[11] The US Global Change Research Program notes that these interactions can actually make it difficult to find patterns in vector-borne disease pathways, especially as it relates to climate change. For example, it will be difficult to predict how pathogens may adapt, or how changes in land use and human behaviors will impact the spread of diseases. Even with the unpredictable nature of vector-borne diseases, climate change is an added complexity in these interactions. With the rising counts of disease cases in recent years, public health programs should certainly be ready to mobilize in response to likely future outbreaks.

4. Water Quality

Irregular weather patterns brought around by climate change – from increased precipitation, droughts, flooding, and warmer temperatures – is also expected to impact water quality. In some regions, climate change may introduce alternating patterns of floods and droughts. These droughts decrease the soil's ability to absorb water, meaning heavier rains are more likely to cause heavy runoff. Increases in excessive precipitation can lead to contamination from overwhelmed sewer systems, leaking septic tanks or agricultural runoff, leading to greater exposure and new outbreaks in gastrointestinal diseases like cholera or campylobacteriosis.[12]

The link between public health and excessive precipitation is well known. A 2001 Johns Hopkins University report analyzed the association between extreme precipitation and waterborne disease outbreaks in the United States in the mid-1900s. Reviewing the 548 reported outbreaks in the US Environmental Protection Agency's records, researchers found that 51% of these were preceded by precipitation events.[13] The report noted the risk of bacterial and protozoan contaminations from livestock farm runoff. Another health risk was linked to failing infrastructure, and the likelihood of excessive rainfall exceeding the capacity of municipal water systems, causing excess waste water to discharge into bodies of water. Climate change is certain to increase these pressures, and we must be prepared to address forthcoming changes.

The climate change impact on public health is not limited to those four areas. The interaction of weather, demographics, land use change, are complex and so we may not be able to predict every type of health challenge that lies ahead. As our understanding of climate change develops, new complications may emerge. For example, a recent study published in *Science* suggested that carbon emissions may decrease the protein and nutrient levels in rice, which may have negative implications for impoverished countries relying on rice as their primary food source.[14] Another research study suggested that rising temperatures could lead to a rise in antibiotic resistance.[15] While these public health concerns may be numerous and unpredictable, there are many opportunities to reduce both public health and climate pressures.

How do we combat these public health challenges?

The public health implications of climate change are numerous and complex. It will be essential for local and national public health programs to respond to these challenges quickly and efficiently. For example, public health agencies should regularly monitor and test water quality, issue alerts and safety guidelines during heatwaves, and improve funding to detect and respond to outbreaks.

We cannot simply adapt to many of these changes. In cases of heatwaves, many people might be fortunate enough to rely on air conditioning, but this is not a universally available luxury. In fact, dependence on air conditioning could create other downstream effects such as overburdening the electric grid or contributing to greenhouse gas emissions.[16] For vector-borne diseases, the CDC may recommend wearing insect repellent and long sleeves, but that does not eliminate the source or cause of new outbreaks.

The public health implications of climate change are clear and widespread. Adapting to projected health challenges will be important, but we must also address the underlying cause through climate change mitigation. Cities, states, and nations must adopt and continue to develop cross-cutting policies that reduce greenhouse gas emissions while also keeping human health and safety a priority. For example, creating more green spaces in cities could combat urban heat island effects, reducing extreme heat at the local level. Such efforts might have the co-benefit of serving as small carbon sinks, helping to pull carbon out of the atmosphere while relieving the impact of high temperatures.

Another multipurpose strategy for reducing climate change and public health pressures would be to reduce transportation emissions. City and local-level approaches would again be important to this effort, where local governments could improve and promote public transportation, reducing the number of vehicles on the road. For areas relying on bus systems, transportation offices could invest in a zero-emission fleet. At a national level, the government could incentivize electric vehicles, and private companies could collaborate with utilities and local governments to expand charging infrastructure. With such strategies, countries could reduce harmful pollution and emissions, thereby combatting both poor air quality and climate change.

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Notes

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