Impacts of Climate Change on Health Care

In October 2019, in a proactive attempt to forestall sparking from its equipment during intense Santa Ana winds, Pacific Gas & Electric (PG&E) induced a widespread power outage in Northern California, cutting off power to more than 2 million residential and commercial customers. California’s fire season has increased an estimated 75 days in the past decade, making the Santa Anas even more dangerous.¹ Health systems that include urgent care clinics, outpatient facilities and small doctors’ offices — which typically lack backup generators — had to mobilize quickly to address complications that might arise with no access to power. Those complications included moving medications that need refrigeration — including flu, shingles and MMR vaccines and osteoarthritis medicine — to locations not affected by the outage. It also included implementing an outreach to patients who use electricity-powered medical devices at home to advise them on how to protect their health during an outage.²

This was, in essence, a fire drill for climate change events that are an increasing and costly reality for public health systems around the world.³ These incidents can also heighten a wide range of potential health system vulnerabilities, including inaccessibility to medical records, staff shortages, imperiled communication systems, disrupted transportation, insufficient water supplies, facility loss or damage, and supply chain interruptions. When Hurricane Maria decimated Puerto Rico where IV bags are manufactured, the critical shortage of this integral component of health care reached crisis proportions and imperiled patient health.⁴ For vulnerable populations whose lives depend on local health care systems, disruptions like these can be life threatening.⁵

Health Costs Caused by Climate Change

The five warmest years on record in the world to date occurred from 2014 to 2018.⁶ Rising atmospheric temperatures multiply the likelihood, frequency, intensity, duration, and geographic extent of heat waves, air pollution, wildfires, activity of infectious disease vectors, rising sea levels, storms, extreme rainfall, and flooding.⁷ As global warming intensifies, health, social, and financial effects will continue to

compound—exacerbating a population health crisis at a global scale, particularly in low and middle income countries/populations and will disproportionately affect vulnerable groups within each country, including the poor, children, the elderly and those with pre-existing medical conditions.\(^8\)

Climate related health risks occur across varying timescales, from short-term climate variability (e.g., heat waves that can trigger health emergencies over timescales ranging from days to weeks), to long-term climate change (e.g., season onset variability and average temperatures occurring over decades).\(^9\)

The exact costs of climate change on health are difficult to calculate because of the interrelated nature of environmental and social determinants of health. However, costs will continue to increase for payers covering health conditions that will become more common with climate disruption, and for hospitals and other health care facilities managing the consequences of extreme weather events.\(^10\)

A 2011 study published in *Health Affairs* was the first to attempt to assess the scale of climate change-related health costs by studying six climate change–related events in the United States between 2000 and 2009.\(^11\) The researchers determined that health costs exceeded $14 billion, 95% of which was attributed to premature loss of life. In addition, there were associated health care costs that totaled an estimated $740 million, with a staggering 760,000 encounters with the health care system. The report concluded that, with warming global temperatures, climate-related extreme events affecting health would become more frequent, more intense, and consequently more detrimental, in years to come.\(^12\)

A subsequent study published in *GeoHealth* in September 2019 details ten different climate-sensitive events across the United States that occurred in 2012, a year of record-breaking temperatures, in an attempt to identify the range of climate-sensitive health problems, i.e. those expected to worsen in frequency, intensity, duration, and/or areal extent in the future due to climate change. The events evaluated were diverse in type, intensity, and location: wildfires (Washington and Colorado); toxic algal blooms (Florida); Lyme disease (Michigan); Hurricane Sandy (New Jersey and New York); ozone air pollution (Nevada) allergenic oak pollen (North Carolina); extreme weather (Ohio); West Nile Virus outbreak (Texas) and extreme heat (Wisconsin).\(^13\) In total, these events resulted in an estimated 917 deaths, 20,568 hospitalizations, and 17,785 emergency department visits totaling nearly $10 billion (in 2018 dollars) in health-related costs.\(^14\) Medicare and Medicaid were expected to cover roughly 64% of these costs.\(^15\)

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\(^8\) Confronting climate change: Northwest Permanente in the environment of the future. Colin Cave, MD; Medical Director for External Affairs, Government Relations and Community Health.  


\(^12\) Knowlton, Kim, et al., 2011.  


\(^14\) Limaye, 2019.  

\(^15\) Limaye, 2019.
The Effects of Climate Change on Health

*Heat Extremes*

Globally, extreme temperature events are increasing in their frequency, duration, and magnitude and are associated with increased hospital admissions for heart and kidney disease, respiratory issues, dehydration, heat cramps, and heat exhaustion.\(^{16}\) Between 2000 and 2016, the number of people exposed to heat waves increased by around 125 million.\(^{17}\) The Center for Climate Change and Health reports that extreme heat causes more deaths in the U.S. than any other type of natural disaster; between 1999-2010, more than 7,100 deaths — an average of 618 deaths per year. The 2006 California heat wave resulted in 650 deaths, 16,000 emergency room visits and a 10-fold increase in hospital admissions for heat-related illnesses.

Another complicating factor in heat-related illnesses is the effect higher temperatures have on the efficacy and side-effects of prescription medications.\(^{18}\) People taking certain psychoactive drugs are at risk during hot weather because those medications may interfere with temperature regulation and may potentially cause hyperthermia.

While extreme increases in temperatures won’t affect the Pacific Northwest as severely as other parts of the world, Oregon’s population can be expected to continue to increase as a result of temperature increases elsewhere. This will increase Oregon’s vehicle emissions and transportation costs and will lead to a larger carbon footprint for the state.

*Air Pollution*

In 2018, 141 million people in the United States were exposed to unhealthy air, increasing by 7 million from 2017.\(^{19}\) Particulate air pollution from burning fossil fuels, wildfire smoke and increasing ground-level ozone increases asthma prevalence and severity of respiratory diseases. The rate of asthma in the United States has increased 28% from 2001 to 2011, with approximately 25 million children and adults now suffering from the ailment.\(^{20}\) Air pollution has also been linked to heart/lung disease, allergies, neurotoxins, and neonatal development.\(^{21}\)

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17 The Lancet Countdown on health and climate change: from 25 years of inaction to a global transformation for public health, Watts, Nick et al., The Lancet, Volume 391, Issue 10120, 581 - 630
19 American Lung Association, Key Findings, The State of the Air 2019 https://www.lung.org/our-initiatives/healthy-air/sota/key-findings/
20 https://www.aafa.org/asthma-facts/
21 Ebi, K.L., et al 2018
In 2014, the Organization for Economic Co-operation and Development (OECD) determined the cost of the health impact of air pollution in 33 OECD member countries was about USD $1.7 trillion, USD $1.4 trillion in China and USD $0.5 trillion in India.

In Oregon, the direct and indirect public health costs associated with air pollution are estimated by the Environmental Protection Agency to be $3.5 billion per year in Oregon alone. Applying methods from their 2019 GeoHealth report, researchers recently estimated that wildfire smoke in Oregon is caused hundreds of premature deaths and more than $2 billion in health costs in 2012.

**Soil and Waterborne Diseases**

Warming global temperatures increase precipitation, storm surges, and sea temperatures, resulting in flooding and runoff that can spread sewage, chemicals and disease agents, particularly in developing countries. Water-borne pathogens presenting health risks include diarrheal diseases, typhoid, dysentery, leptospirosis, and harmful algal blooms. Diarrheal diseases like cholera and cryptosporidiosis tend to occur more frequently during periods of unusually high and low precipitation, while rapid snowmelt has been correlated to outbreaks of salmonella and campylobacter.

During 2015, the second hottest year on record, the number of soil and waterborne diseases escalated in Oregon: *Cryptococcus gatti*, a fungus found only in the tropics before 1999, caused 76 cases of cryptococcal infection; an outbreak of Shigellosis (a bacterial diarrheal disease) in Portland was associated with the region’s wettest rainy season on record; and one of the largest harmful algal blooms ever observed developed off the West Coast, stretching from California to Alaska.

**Vector-Borne Diseases**

Because insects change where they live based upon temperature and precipitation, the Intergovernmental Panel on Climate Change (IPCC) report identified mosquito-borne diseases (MBDs) such as malaria, dengue, chikungunya, West Nile virus, Zika and Eastern Equine Encephalitis as the infectious diseases most likely to increase due to climate change, with some of the largest increases projected to occur in North America. According to the CDC, Chikungunya and Zika viruses caused outbreaks in the US for the first time in 2015 and 2016. Reported cases of Lyme disease in the United States have tripled since the late 1990s, according to a recent study in the Canadian Journal of Infectious Diseases and Medical Microbiology. In 2017, the CDC reported that, between 2004-2016, the number of

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25 Funari, 2012
reported cases of disease from mosquito, tick, and flea bites has more than tripled, with more than 640,000 cases reported, including 60,000 cases of tick-borne diseases, including Lyme disease and Rocky Mountain spotted fever.

In early 2018, four Oregonians were infected with Colorado tick fever, a rare tick-borne virus; Oregon typically has one case per year, at most.28

**Mental Health Impacts**

Because climate change will expose an increasing number of people to extreme weather events, stressors on coping mechanisms can result in psychological side effects, such as worry, anxiety, depression, distress, loss, grief, trauma and even suicide.29 Increased levels of stress and distress can also impact social relationships and physical health, including memory loss, sleep disorders, gastrointestinal distress and immune suppression.30

Because of the breadth, depth and complexity of the concomitant effects of climate change on both health and mental health, the economic costs are nearly incalculable: to do so, one would have to account for the private, public and mental health care costs stemming from the incidence of death and disease; economic losses due to lower productivity and sick days; the accrued costs of repeated or lingering episodes of malaria, dengue, Lyme disease, diarrhea, or other infectious diseases; the costs associated with food insecurity, lack of access to safe water and sanitation, among other things.31

In Oregon, wildland fires and drought could have significant mental health and financial impacts on those primarily living and working in rural areas. Displacement as a result of drought or wildfire can lead to acute and chronic mental health issues such as anxiety, depression and disruption of social networks.32 A University of Oregon study estimated that up to one third of residents in the West who live near wildland areas lack the income to meet basic needs and are unable to afford the cost of fire protection, increasing the risk of displacement33.

**Carbon Footprint Reduction and Opportunities to Build Resilience**

To date, there is no universal standard for measuring the greenhouse-gas emissions of the health-care sector, although many health-care systems around the world are attempting to measure and reduce their respective greenhouse-gas emissions. Some health-care organizations, facilities, and companies provide self-reported estimates of emissions; however, these estimates are rarely standardized across sites. A 2017 World Bank report, the first-ever comprehensive estimate of global health care emissions,
determined that health care systems generate roughly 5% of world-wide greenhouse gas emissions, or 2.6 billion metric tons of CO$_2$e (carbon dioxide equivalent) in 2011. The report further found that the United States, China, and the European Union are the top three contributors to health care’s climate footprint. They also rank as the top three in the world in overall emissions.

The U.S. health care sector is likely responsible for an estimated 10% of the greenhouse-gas emissions in the United States. The US Department of Energy (DOE) reports that health care facilities are among the country’s most energy-intensive buildings: energy use accounts for 51% of health systems facility spending, totaling around 836 trillion BTUs of energy while emitting more than 30 pounds of CO$_2$ per square foot each year.

The mitigation experiences of the health care sector to date suggest that the costs of implementing carbon-reduction strategies can be offset by recurrent savings. The healthcare facilities listed below have utilized resilience opportunities in an effort to reduce their carbon footprint and save resources in the long term. Notably, Kaiser Permanente and Providence Health have implemented new systems to reduce their carbon footprints.

- **Westmead Hospital, New South Wales in Australia:** In 2012, the hospital implemented a $3.5 million lighting upgrade, reducing electricity consumption by 3,200 MWh and $450,000 a year in energy costs. A subsequent upgrade to Westmead’s heating, ventilation and air conditioning system, a $1.9 million undertaking, will save the hospital an additional $400,000 and 4,200 MWh of electricity annually.

- **The Cleveland Clinic:** To finance its commitment to reducing its energy use by 20% by 2020, the Cleveland Clinic established a $7.5 million “Green Fund” in 2016. As money is used for various projects, the savings from reduced energy consumption and rebates are reinvested in the fund. Initiatives include transition to LEDs, reducing electric consumption by 28.6 million kW per year, saving about $2 million/year, programmed lighting control that automatically shuts off lights in unoccupied areas, and more energy-efficient chillers.

- **Boston Medical Center** is conducting an inventory of its facilities, rooting out duplicative and underused space, successfully minimizing energy use along with square footage while increasing

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38 Bell, 2011

patient capacity by 20%, and eliminating ambulance transportation to distant areas of campus. Its new gas-fired 2-megawatt cogeneration plant supplies 41% of the hospital’s energy needs and is a backup for essential services if the power grid goes down; it also traps and reuses heat, saving money and emissions. Overall, it has cut consumption by 42% from a 2011 baseline.  

- **Kaiser Permanente** has set an internal goal to be “carbon net positive” by 2025 by purchasing enough clean energy and carbon offsets to remove more greenhouse gases from the atmosphere than they emit. The solar system at Kaiser’s Richmond (CA) Medical Center is credited with reducing electric bills by about $140,000 a year. Between 2014 and 2017, Kaiser Permanente achieved a 23% reduction in greenhouse gas emissions associated with its use of anesthetic agents.

- **Providence Health Hospitals** After one of Providence’s anesthesiologists learned that the use of the common anesthesia Desflurane is a potent greenhouse gas that stays in the atmosphere for 14 years, all of the Oregon health system’s eight hospitals made the switch to Sevoflurane which is less harmful to the environment and breaks down in just one year. The costs savings are roughly a half million dollars a year.

Taking systemic steps to reduce emissions and become more energy efficient (1) reduces emissions that contribute to climate change, (2) lowers energy costs, ostensibly enabling providers to reallocate funding to instead meet increasing systemic demands, and (3) contributes to healthier environmental conditions in the community. A key benefit may also be reducing the cost of care while increasing responsiveness.

As the health consequences of climate change compound, the need for training and continuing medical education that addresses health risks associated with climate change will continue to grow. It is critical that health professionals and organizations understand their local vulnerabilities (e.g., health risks posed by increasing wildfires) as well as the environmental impact of health system practices, particularly energy consumption, so as to strengthen system resiliency and sustainability. The global health sector comprising millions of health professionals, professional associations, hospitals, health systems, health NGOs, ministries of health and international organizations play an important role in addressing efforts to address climate change. Such efforts can ensure that health systems will continue to function effectively when their communities are most in need while minimizing their own environmental footprint.

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40 Appleby, 2018
41 Appleby, Julie, 2018.
42 Appleby, 2018.
43 https://about.kaiserpermanente.org/community-health/improving-community-conditions/environmental-stewardship/climate-action