Upper Missouri Basin Drought and Human Health Workshop

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Thank you!

Rachel Lookadoo

Everyone on the planning committee

Britt, Molly, and NIDIS

Keith Hansen

Montana State University

Everyone for their help

Special thanks to COVID and Montana Weather
Goals of the Meeting

• Provide participants with a better understanding of the health impacts of drought in the Upper Missouri River Basin

• Engage participants across academic, healthcare, public health, and other sectors to encourage cross-sector collaboration

• Showcase best practices on how to reduce health impacts from increasing drought conditions

• Discuss strategies for addressing and minimizing the health impacts of drought
Relationship of Climate to Health
Climate is Affecting Your Health

Direct

Affecting Health Directly

- Extreme Heat
- Air Pollution
- Extreme Weather

Indirect

Spreading Disease

- Diseases Spread by Insects, Ticks, and Rodents
- Contaminated Water
- Contaminated Food

Destroying & Disrupting Food Supplies

- Hunger and Malnutrition

Disrupting Well-Being

- Mental Health Problems
- Conflict and Displacement
How Puerto Rico's death toll climbed from 64 to 2,975 in Hurricane Maria

By Ray Sanchez, CNN

© Updated 2:56 PM ET, Wed August 29, 2018

Puerto Rico revises Hurricane Maria death toll 01:39

(CNN) — Puerto Rico’s true death toll from Hurricane Maria remains elusive as the storm’s one-year anniversary approaches.

The island government raised the official death toll to 2,975 on Tuesday after maintaining for months that 64 people had died as a result of the storm.
Fig. 1: 1963–2012 U.S. Atlantic tropical cyclone indirect deaths distributed by primary factor present. Note that power problems, beyond being the primary antecedent in the incidents having a purple shading, also occurred in another 2–3% of the other factors shown. Vehicle accidents where traffic lights had lost electricity are an example. To avoid double-counting these cases, they only contribute to the totals of those other factors. Table 1 provides additional information.
Drought has shaped society
“Floods kill people, but droughts destroy civilizations.”

~U.S. Government Official at a Drought Meeting
Dust Bowl of the 1930s

Dust Storm 3/26/35, Naponee, Nebr.
Connecting Drought to Health
Percentage of disaster-deaths worldwide according to each category of climate-related hazard, (1900-2013)
Drought Impacts

Estimated Deaths and Billion Dollar Losses from Extreme Events in the U.S., 2004–2013

- Heat Waves
- Tornadoes
- Hurricanes
- Floods
- Wind Storms
- Lightning
- Cold Waves
- Winter Storms

Billion Dollar Losses from Disasters (2004-2013)

- $392 Billion Hurricanes
- $78 Billion Heat Waves/Droughts
- $46 Billion Tornadoes/Severe Storms
- $30 Billion Flooding/Severe Storms

Bell et al., 2016
Billion-Dollar Disasters are Increasing
## Summary Statistics

Billion-dollar events to affect the United States from 1980 to 2021 (CPI-Adjusted)

<table>
<thead>
<tr>
<th>Disaster Type</th>
<th>Events</th>
<th>Events/Year</th>
<th>Percent Frequency</th>
<th>Total Costs</th>
<th>Percent of Total Costs</th>
<th>Cost/Event</th>
<th>Cost/Year</th>
<th>Deaths</th>
<th>Deaths/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought</td>
<td>29</td>
<td>0.7</td>
<td>9.4%</td>
<td>$285.4B</td>
<td>13.2%</td>
<td>$9.8B</td>
<td>$6.8B</td>
<td>4,139</td>
<td>99</td>
</tr>
<tr>
<td>Flooding</td>
<td>35</td>
<td>0.8</td>
<td>11.3%</td>
<td>$164.2B</td>
<td>7.6%</td>
<td>$4.7B</td>
<td>$3.9B</td>
<td>624</td>
<td>15</td>
</tr>
<tr>
<td>Freeze</td>
<td>9</td>
<td>0.2</td>
<td>2.9%</td>
<td>$32.8B</td>
<td>1.5%</td>
<td>$3.6B</td>
<td>$0.8B</td>
<td>162</td>
<td>4</td>
</tr>
<tr>
<td>Severe Storm</td>
<td>143</td>
<td>3.4</td>
<td>46.1%</td>
<td>$330.7B</td>
<td>15.3%</td>
<td>$2.3B</td>
<td>$7.9B</td>
<td>1,880</td>
<td>45</td>
</tr>
<tr>
<td>Tropical Cyclone</td>
<td>56</td>
<td>1.3</td>
<td>18.1%</td>
<td>$1,148.0B</td>
<td>53.2%</td>
<td>$20.5B</td>
<td>$27.3B</td>
<td>6,697</td>
<td>159</td>
</tr>
<tr>
<td>Wildfire</td>
<td>19</td>
<td>0.5</td>
<td>6.1%</td>
<td>$120.2B</td>
<td>5.6%</td>
<td>$6.3B</td>
<td>$2.9B</td>
<td>401</td>
<td>10</td>
</tr>
<tr>
<td>Winter Storm</td>
<td>19</td>
<td>0.5</td>
<td>6.1%</td>
<td>$78.6B</td>
<td>3.6%</td>
<td>$4.1B</td>
<td>$1.9B</td>
<td>1,277</td>
<td>30</td>
</tr>
<tr>
<td><strong>All Disasters</strong></td>
<td>310</td>
<td>7.4</td>
<td>100.0%</td>
<td><strong>$2,159.9B</strong></td>
<td>100.0%</td>
<td><strong>$7.0B</strong></td>
<td><strong>$51.4B</strong></td>
<td><strong>15,180</strong></td>
<td><strong>361</strong></td>
</tr>
</tbody>
</table>

1 Deaths associated with drought are the result of heat waves. (Not all droughts are accompanied by extreme heat waves.)

Flooding events (river basin or urban flooding from excessive rainfall) are separate from inland flood damage caused by tropical cyclone events.

The confidence interval (CI) probabilities (75%, 90% and 95%) represent the uncertainty associated with the disaster cost estimates. Monte Carlo simulations were used to produce upper and lower bounds at these confidence levels (Smith and Matthews, 2015).
Drought can be a slow evolving
The impacts are not immediate
Can require multiple steps for health outcomes
Surveillance is not designed to connect drought and health
Health Outcomes

- Respiratory Issues
- Allergy-related Illnesses
- Injuries
- Infectious Disease
- Hunger/Famine
- Heat Illnesses
- Gastrointestinal Illnesses
- Mental Health Consequences

Exposure Pathways

- Increase in Dust and Dust Storms
- More Frequent Wildfires
- Decrease in Water Quality and Quantity
- More Frequent and More Intense Heat Waves
- Change in Vector Habitat and Range
- Loss of Agriculture and Food Security

Environmental & Institutional Context
- Water Supply
- Local Environmental Conditions
- Preparedness of Health Departments
- Agricultural Management Practices
- Power, Transportation, Communication and Healthcare Infrastructure

Drought Types
- Meteorological Drought
- Agricultural Drought
- Hydrological Drought
- Socio-economic Drought

Social & Behavioral Context
- Social Determinants of Health
- Occupation
- Rural/Urban
- Race/Literacy/Age
- Dependence on Caregivers and Medication

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Health Risks from Drought Change

2010 – 2014

2015 – 2019

High I High (High Risk)  Low I Low (Low Risk)  Low I High  High I Low

Fard et al. Evaluating Changes in Health Risk from Drought Over the Contiguous United States. IJERPH just accepted
Threat Multiplier

Notice
An algae bloom has made this area potentially unsafe for water contact. Avoid direct contact with visible surface scum.
Increase in Mortality with Drought

Drought Mortality in Nebraska

• white females aged 45-54
• white males aged 45-64

Courtesy of Dr. Azar Abadi
Compromised Quantity and Quality of Water

Surface Water

Groundwater

Courtesy of USGS

Courtesy of USDA
Drought May Lead to Elevated Levels of Naturally Occurring Arsenic in Private Domestic Wells

Release Date: MARCH 18, 2021

An estimated 4.1 million people in the lower 48 states are potentially exposed to arsenic levels that exceed EPA's drinking water standards.

A new U.S. Geological Survey study highlights the importance of homeowners testing their well water to ensure it is safe for consumption, particularly in drought-prone areas. The first-of-its-kind national-scale study of private well water, conducted in collaboration with the Centers for Disease Control and Prevention, showed that drought may lead to elevated levels of naturally occurring arsenic and that the longer a drought lasts, the higher the probability of arsenic concentrations exceeding U.S. Environmental Protection Agency’s standard for drinking water.

Researchers estimate that during drought conditions, 4.1 million people in the lower 48 states who use private domestic wells are potentially exposed to unsafe levels of arsenic. This is an increase of 54% from the estimated 2.7 million people exposed to unhealthy arsenic levels in private wells during normal, non-drought conditions.

Arsenic is a metal that can occur naturally in bedrock and sediments around the world and is commonly reported in drinking-water supply wells. However, chronic exposure to arsenic from drinking water is associated with an increased risk of several types of cancers, including bladder, lung, prostate and skin cancers. Other adverse effects include developmental impairments, cardiovascular disease, adverse birth outcomes and impacts on the immune and endocrine systems.

The study’s findings can help public health officials and emergency managers notify well owners in areas potentially affected and further refine their strategies for addressing the issue. The EPA regulates public water supplies, but maintenance, testing and treatment of private water supplies are the

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Secondary/Related Events

- Extreme heat
- Wildfires
- Dust storms/haboobs
- Rain/storm effects

Courtesy of FCC

Courtesy of USGS

Courtesy of NOAA
Extreme Heat and Drought

Heat Wave Index: 4-day, 1-in-5yr

Dust Bowl

Bell et al., 2018
Climate Change Impacts Air Quality: Wildfire Smoke

Since 1970
- Western US wildfire season increased by 78 days
- Average duration of fires increased five fold

Westerling et al. Warming and earlier spring increase western U.S. forest wildfire activity Science. 2006 Aug 18;313(5789):940-3
Increased Disease Incidence

- Infectious disease
- Chronic disease
- Vectorborne and zoonotic disease
Life Cycle of Coccidioidomycosis
Additional Health Risks

- Sanitation and hygiene
- Recreational risks
- Mental and behavioral health
Local

Kansas farmer on alarming suicide rate: 'Nothing gets farmers more down than a drought'

By: Emily Younger

Kansas farmer on alarming suicide rate: 'Nothing gets farmers more down than a drought'

2 minutes left

Farmer's recovery from depression which led to two suicide attempts shows cost of drought at family level

STEVE Germon left a suicide note on the porch and set about putting down calves he couldn’t feed before turning the gun on himself. Then a ute screamed towards him, his 17-year-old daughter at the wheel.

JACK MORPHET

DAIRY farmer Steve Germon knows what it’s like to be on the brink of suicide. He has been there twice in the past three years.

NSW struck by severe drought

Farmers are sowing crops into barren land in hope of rain.

DAIRY saved him in 2015, but those lonely moments last year
Drought Causes Stress in Farmers

The effect estimate for drought was 4x greater magnitude than people reporting pain in multiple body parts.
What Connections Do You See?
Engagement
NATIONAL DROUGHT & PUBLIC HEALTH SUMMIT
June 17-19, 2019 | Atlanta, GA

Thank you to our Summit Planning Partners:

Centers for Disease Control and Prevention (CDC)
National Integrated Heat Health Information System (NIHHIS)
Environmental Protection Agency (EPA)
Natural Resources Defense Council (NRDC)
UNL National Drought Mitigation Center (NDMC)
Future Needs:

- Still much to be learned about drought and public health
  - What do public health departments need?
- Research is needed in many different areas:
  - Analysis of surveillance data
  - Improved environmental monitoring
  - Role of public health departments
  - Economic impact of drought on public health
  - Lessons learned and best practices
UNMC Center for Preparedness Education
• Rachel Lookadoo, JD
• Keith Hansen, MBA

CDC Climate and Health
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• Paul Schramm, MS MPH

NIDIS
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• Veva Deheza
• Rocky Bilotta
• Molly Woloszyn
• Britt Parker

My Team
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• Yeongjin Gwon, PhD
• Jagadeesh Puvvula
• Mike Hobbins

All of the state and local partners

All of the federal and academic partners