Objectives:

1. Action Agenda
2. Research Agenda
3. Opportunities to advance both
Climate Change, Health, and Equity

Wildfires and Health Symposium
Linda Rudolph, MD, MPH
April 30, 2019
Highest levels CO$_2$ in at least 800,000 years

January 22: 413.86 ppm
Carbon emissions in less than one week from the October 2017 wildfires in Sonoma-Napa equal to that of every car, truck and big rig on the state’s roads in a year.
HEALTH IMPACTS OF CLIMATE CHANGE

- Potentially catastrophic for human survival
- Undermine the last half-century of gains in development and global health
- A medical emergency

(Lancet Commission on Health and Climate, 2015)
Extreme Heat

- Leading cause of weather-related deaths
- Exacerbates cardiovascular, respiratory and renal disease
- Reduces labor productivity
- Project 2,100-4,300 excess deaths in CA (2025)
Drought

- Water quality and quantity
- Crop loss and food insecurity
- Infectious disease risk
  - Valley Fever
  - Dengue and WNV
- Wildfire risk
- Migration and conflict

The total economic impact of the 2015 drought to California’s agriculture is estimated to be $2.7 billion—including losses in crop revenue, livestock and jobs.
Rainfall, Storms & Floods

- Risk of injury from floods and severe storms
- Worsening indoor air quality: mold
- Increased waterborne pathogen exposure from sewer runoff and overflow
- Increased winter precipitation → increased pollen production in spring
- Recreational water risks
Climate Change and Mental Health

• Economic stress, anxiety
• Displacement, trauma and PTSD
• Chronic disease management and comorbid depression
• At risk groups
  – First responders
  – Pregnant women and children
  – Pre-existing mental illness
• Solastalgia
• Increased patient visits (e.g., heat, air quality)

• Extreme weather events

• Disruptions in critical services
  - Electricity
  - Clean drinking water
  - Food service delivery
  - Evacuations
  - Damage facility infrastructure
  - Disrupt services

• Financial impacts
  - Waste disposal and treatment
  - Health Care System at Risk
The “Climate Gap”
COP24 SPECIAL REPORT
HEALTH & CLIMATE CHANGE

CALIFORNIA'S FOURTH CLIMATE CHANGE ASSESSMENT

Fourth National Climate Assessment

Global Warming of 1.5°C
An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

Lancet Countdown: Tracking Progress on Health and Climate Change

Volume II
Risks, and Adaptation in the United States
Report-in-Brief
• We’re already at 1.0°C warming.
• Big difference between 1.0°C and 1.5°C and huge difference between 1.5°C and 2.0°C
• Warming projected to exceed 3°C under Paris Agreement
• How much more is up to us.
• Window to keep warming below 1.5°C closes in 2030
• Need to cut GHGE in half by 2030 and entirely by 2040 to avoid catastrophic effects
• Multiple pathways for health impacts
• Impacts disproportionately affect disadvantaged and vulnerable
• Climate change a poverty multiplier
• The greater the warming, the greater the risks to health overall
• Strong public health case for limiting warming to the greatest extent possible.
• Important health gains from actions necessary to limit warming
• Speed of reducing emissions will affect the level of adaptation ambition required
• Longer it takes to reduce emissions, greater adaptation needed to protect population health
• No matter the extent of mitigation residual health risks need management
Lancet Countdown

• Present day changes provide early warning of compounded and overwhelming impacts expected if temperature continues to rise.

• Slow progress in reducing emissions and building adaptive capacity threatens both human lives and the viability of the national health systems they depend on, with the potential to disrupt core public health infrastructure and overwhelm health services.

• Nature and scale of response to climate change will be determining factor in shaping the health of nations for centuries to come

• Ensuring a widespread understanding of climate change as a central public-health issue will be vital in delivering an accelerated response
Climate change affects health of all Americans; health/well-being of Americans already affected

- Greater health risks: children, older adults, low-income communities, some communities of color.
- Adverse health consequences will worsen with more climate changes

- Neither global efforts to mitigate the causes of climate change nor regional efforts to adapt to the impacts currently approach the scales needed to avoid substantial damages to the U.S. economy, environment, and human health and well-being over the coming decades
Changing, more variable climate is the most likely, highest-impact global risk to society as a whole and presents a clear and present danger to health security.

Greater warming = greater risks for human health.

Speed and type of mitigation has direct health effects.

Longer it takes to reduce GHGE, greater adaptation required to protect health.

Energy, transport, industry, agriculture, waste management and land use are main sources of GHGE, PM, and other air pollutants.
“A health-in-all-policies” approach is therefore required, in which the health implications of decisions in all public policies are accounted for, synergies are promoted and negative health outcomes avoided, in a transparent and accountable process.”
Community Engagement

• Effectively tackling climate change and maximizing benefits for health require broad public support.
• Health community and civil society can play a role.

• Need accelerated engagement of health sector as committed advocates for climate action.
What did the reports say?

• Climate change impacting our health now.
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Climate change is a global health emergency.
Health Impacts from Wildfires in a Changing Climate

John R. Balmes, MD
University of California, San Francisco and Berkeley
Outline

• Wildfire
• Climate change
• What’s in wildfire smoke
• Community health effects
• Post-fire concerns
• Wildland firefighter health issues
Sonoma-Napa Wildfires – Oct. 2017
Southern CA Wildfires – Dec. 2017
Carr, Mendocino Complex, and Camp Fires - 2018
2017 and 2018 were Bad Wildfire Years - Why?

- 5 years of drought 2011-2016; many dead trees
- *El Nino* winter of 2017 brought lots of rain, ending the drought
- Increased growth of vegetation in spring
- Normally dry and very hot summer weather generating lots of fuel
- Lack of rain in fall
Climate Change and Increase in Wildfires

Source of data: Western and Bryant, “Climate change and wildfires in and around California: Fire modeling and loss modeling” (2010), www.climatechange.ca.gov
Emissions from Wildfires

Primary air pollutants
- Particulate Matter (PM)
- CO
- NO₂
- Polycyclic aromatic hydrocarbons (PAHs)
- Volatile organic compounds (VOCs)

Secondary air pollutants
- Particulate Matter (PM)
- Ozone
Coffey Park neighborhood burning
When Buildings and Vehicles Burn

• Structural fire smoke contains other toxic air contaminants, including
  – HCN, HCl, phosgene, metals
  – toluene, styrene, dioxins

• The Sonoma-Napa, Thomas, and Camp fires caused many buildings and motor vehicles to burn
  – Local residents exposed to more than wood smoke

• The plumes that travelled to the SF Bay Area and Greater Los Angeles were almost entirely wood/biomass smoke
Wildfire emissions and related health impacts

Youssouf et al. Atmospheric Environment 2014;97:239-251
Northern California Rim Fire 2013

Daily Mass Intake
µg PM$_{2.5}$ per person

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<tr>
<th>Range</th>
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<tr>
<td>0 - 486</td>
<td>Yellow</td>
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<tr>
<td>487 - 1459</td>
<td>Orange</td>
</tr>
<tr>
<td>1460 - 2919</td>
<td>Red</td>
</tr>
<tr>
<td>2920 - 18141</td>
<td>Dark Red</td>
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</table>

Higher (RED) exposures levels are 500 times the 24-hour National Ambient Air Quality Standard

Reference:
EPA 24 hr PM$_{2.5}$ standard = 35µg/m$^3$

Camp Fire – Nov. 9, 2018
Poor Air Quality in Bay Area

• Nov. 14, 2018 – AQI goes over 200 that Thurs. evening and is projected to stay high for days
  – UC Berkeley cancels classes, but does not close campus
  – UC Berkeley postpones the “Big Game” with Stanford scheduled for Sat. Nov. 16
Even Poorer Air Quality Closer to Fire

Nov. 15, 2018 – AQI goes over 300 in Sacramento and over 400 in Yuba City
Clear evidence of an association between wildfire smoke and respiratory health

- Asthma exacerbations significantly associated with higher wildfire smoke *in nearly every study*
- Exacerbations of chronic obstructive pulmonary disease (COPD) significantly associated with higher wildfire smoke in most studies
- Growing evidence of a link between wildfire smoke and respiratory infections (pneumonia, bronchitis)
Cardiovascular effects
Victoria, Australia - Dec 1, 2006 - Jan 31, 2007

Haikerwal et al. 2015 J Am Heart Assoc
• **Wildfire-PM$_{2.5}$** associated with heart attacks and strokes for all adults, particularly for those over 65 years old.

• **Increase in risk the day after exposure:**
  - All cardiovascular, 12%
  - Heart attack, 42%
  - Heart failure, 16%
  - Stroke, 22%
  - All respiratory causes, 18%
  - Abnormal heart rhythm, 24%
    (on the same day as exposure)

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**All Cardiovascular Causes**

- Relative Risk: Adults 18-44, Adults 45-64, Adults 65+, All Adults

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Slide credit: Wayne Cascio

Wettstein Z, Hoshiko S, Cascio WE, Rappold AG et al. Jaha April 11, 2018
Wettstein Z, Hoshiko S, Cascio WE, Rappold AG et al. JAHA April 11, 2018
Other Health Outcomes

• Adverse birth outcomes
• Mental health
• Based on the PM$_{2.5}$ literature
  – Metabolic outcomes
  – Cognitive decline
  – Child neurodevelopment
  – Health of pregnant mothers
Family in LA – Dec. 2017
Post-Wildfire Problems

- Post-traumatic stress
- Housing shortage, especially for low-income, immigrant renters
- Post-fire structural building clean-up
  - Much of the work done by day workers
- Mudslides
Wildland Firefighters

• Crews
  – Hand
  – Smokejumpers
  – Engine/Dozer

• Work Conditions
  – Long shifts
  – Rough terrain
  – Elevations
  – Remote locations
Wildland Firefighter Health Effects

• Cross-shift changes in lung function, urinary biomarkers of exposure, and blood biomarkers of inflammation

• Pre-post season changes in lung function, airway responsiveness, and airway inflammation

• Do the fire season-associated changes persist?
Research Needs

- Longitudinal Study
- Exposure Assessment
- Chronic Health Outcomes
  - Lung and heart disease
  - Lung cancer
- PPE for Wildland Firefighters

https://www.flickr.com/photos/usdagov/9491326225
Summary

• The duration of the wildfire season is longer and catastrophic wildfires are increasing in frequency due to climate change
• Acute respiratory effects are well documented, but new studies suggest acute cardiovascular effects as well
• Post-fire health effects are impactful
• Long-term effects in wildland firefighters need further study
What can health sector do?

• Data, surveillance, monitoring
• Emergency preparedness and response
• Intersectoral collaboration
• Community engagement
• Community capacity
Data and Surveillance

- **Map community vulnerability**
  - Engage community residents using community science

- **Work with local air quality control agencies to understand and enhance plans for monitoring of wildfire smoke**
  - Where are fixed stations
  - Deployment of low-cost portable monitors? Satellite data?
  - How will data be modeled for forecasts? Shared?

- **Syndromic surveillance**
  - With local health care partners

- **Surveillance after the event using CASPER**
  - (Community Assessment for Public Health Surveillance)
Intersectoral Collaboration

• Zoning
  • Land use at WUI

• Building and code enforcement
  • Local building codes in wildfire-prone areas

• Local fire agencies
  • Id at-risk

• Local forest service
  • Forest management practice alternatives

• Air quality control districts
  • Monitoring
  • Community outreach/education/alerts

• Social services
  • Identify/prepare vulnerable individuals and groups
  • Connect to needed services, HEPA filters, cleaner air stations, etc.

• School districts
• Health providers
• Tribal nations and indigenous communities
• Emergency management agencies
Prepare and Respond

• Build community/social cohesion
• Plan for cleaner air shelters or home air filtration
• Work with partners to pre-plan e.g.,
  – school closures, prescription renewals, evacuation, cleanup and debris removal
• Mental health services
• For everyone! (undocumented, PWD, children, non-English speaking, facilities)
Communication

• Consistent
• Accessible to all
• Build awareness of climate connection
Community Capacity and Resilience

- Social cohesion
- Community power
- “Bouncing forward”
Will it help to “bounce forward”? 

- Addressing needs of all?
- Possible unintended consequences?
- Impacts on vulnerable populations?
- Impacts on under-resourced communities?
- Co-benefits optimized?
- Mitigation-adaptation-resilience?
- Redresses underlying social, economic, health, power inequities?
“Because if climate change has to stop, then we must stop it. It is black and white. There are no grey areas when it comes to survival. Either we continue as a civilisation or we don’t. One way or another, we have to change...Some say I should be in school. But why should any young person be made to study for a future when no one is doing enough to save that future? What is the point of learning facts when the most important facts given by the finest scientists are ignored by our politicians?.... You say you love your children above all else, and yet you are stealing their future in front of their very eyes.”

Greta Thunberg, age 15, Sweden
A CALL TO ACTION
ON CLIMATE AND HEALTH

https://static1.squarespace.com/static/5ad4c58be2ccd1dbbc7a094b/t/5b9826f8575d1f453678a44f/1536698104984/call-to-action.pdf
CALIFORNIA CALL TO ACTION
ON CLIMATE, HEALTH, AND EQUITY
2019
U.S. CALL TO ACTION
ON CLIMATE, HEALTH, AND EQUITY:
A POLICY ACTION AGENDA
2019
GROUP A: Reducing health impacts in high-risk fire areas (Near-term solutions)

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<tr>
<th>DRAFT Problem Defined:</th>
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<tr>
<td>1. California wildfires have increased in size and severity and they are projected to increase further due to climate change.</td>
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<td>2. At the same time, an increasing number of Californians are living in and around higher-fire risk areas.</td>
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<td>3. Immediate fire impacts can include burns, broken bones, etc. while smoke can cause serious respiratory and cardiovascular health problems, particularly among individuals with pre-existing conditions.</td>
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<td>4. Long-term health issues for fire victims can include mental health stress/trauma, pollution of water supplies, loss of jobs and forced relocation.</td>
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<td>5. Avoiding fires and smoke is critical for the health of residents in fire-prone areas, but the lack of information and resources before and during fires keeps many residents from taking protective action.</td>
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<td>6. Low-income residents, non-English speakers, seniors, and disabled individuals may have more trouble during fires and will have a harder time with long-term recovery.</td>
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<thead>
<tr>
<th>Top 5 Solutions</th>
<th>Actions Needed to Implement Solution (legislation, $5, new program, etc.)</th>
<th>Research Needed to Support Solution</th>
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A: Reducing health impacts in high fire risk areas (N-T)
B: Reducing health impacts by reducing fire risk (L-T)
C. Protecting fire workers & post-fire workers
D. Reducing health impacts from smoke (outside fire area)
Opportunities to advance:

1. Action Agenda
2. Research Agenda
Catalyzing California Action on Health, Wildfires & Climate Change

UC Berkeley — April 30, 2019