Global Warming and the OEM Physician

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Estimated % of adults who think global warming is happening, 2018

Select Question: Global warming is happening

Click on map to select geography, or:

National
States
Congressional Districts
Metro Areas
Counties

National Average: 70%
Estimated % of adults who think global warming is happening, 2018
Environmental Health Literacy

The degree to which individuals have the capacity to recognize, understand, evaluate and analyze environmental health information and apply this information to make appropriate health decisions and take action in their communities.

Adapted from Healthy People 2010 and Liam O’fallon’, and Symma Finn’s EHL model
How can OEM Physicians Enhance Environmental Health Literacy?

- Publically Speak in your community about:
  - Health impacts of climate change
  - How air pollution causes asthma and heart attacks
  - How runoff of chemicals from yards and farms impacts drinking water
    - at your township environmental committee
    - at the local high school
    - at the parent teachers meeting at a school
How Does Climate Change Impact Human Health

- Changing the severity or frequency of health problems that are already affected by weather

- Creating unanticipated health threats in places where they have not previously occurred
Number of reported disasters by type

Global reported natural disasters by type
The annual reported number of natural disasters, categorised by type. This includes both weather and non-weather related disasters.

Source: EMDAT (2017): OFDA/CRED International Disaster Database, Université catholique de Louvain – Brussels – Belgium

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CEET
CENTER OF EXCELLENCE IN ENVIRONMENTAL TOXICOLOGY
US Regional Projected Climate Trends

Figure 1: Major U.S. national and regional climate trends. Shaded areas are the U.S. regions defined in the 2014 NCA.² ⁴
Impact of Climate Change on Human Health

- Injuries, fatalities, mental health impacts
- Asthma, cardiovascular disease
- Heat-related illness and death, cardiovascular failure
- Severe Weather
- Air Pollution
- Changes in Vector Ecology
- Malaria, dengue, encephalitis, hantavirus, Rift Valley fever, Lyme disease, chikungunya, West Nile virus

- Extreme Heat
- Environmental Degradation
- Increasing Allergens
- Respiratory allergies, asthma

- Forced migration, civil conflict, mental health impacts
- Water and Food Supply Impacts
- Water Quality Impacts
- Cholera, cryptosporidiosis, campylobacter, leptospirosis, harmful algal blooms

- Malnutrition, diarrheal disease
- Increasing Sea Levels
- Rising Temperatures
- More Extreme Weather

www.cdc.gov
Who is most at risk?

- **Exposure** - working outside, living in an industrialized community

- **Sensitivity** - Children, Elderly, Co-morbidities: Stroke- Diabetes- Asthma- Mental illness

- **Adaptive Capacity** - poverty at household and community level
Cumulative Risk Factors for Heat-Related Illness

- High Temperature
- High Humidity
- No recent heat exposure
- Older Age
- Pregnancy
- Medication
- PPE
- Physical Exertion
- Dehydration
- Limited air movement
- Medical Conditions
- Radiant heat
Extreme Heat: Outdoor Workers

Heat Related Illness-
• Heat exhaustion
• Heat stroke
• Exacerbation of heart disease and hypertension

Interventions-
✓ Be aware of extreme heat days
✓ Make sure workers know signs of heat illness
✓ Hydration and salt replacement
✓ Advise rotation into cool environments
OSHA-NIOSH Heat Safety Tool App

iPhone Screenshots

Heat Index
- Location: McAllen Texas
- Temperature: 80°F
- Humidity: 84%
- Feels Like: 85°F
- Low Risk
- Moderate Risk
- High Risk
- Extreme Risk
- Precautions
- Increased risk for heat-related illness.

Hourly Index
- 10:00 AM
- Feels Like
- 91°F
- Moderate Risk
- Location: McAllen Texas
- Precautions

First Aid
- Heat Stroke
- Review the signs and symptoms of heat stroke
  - THIS IS A MEDICAL EMERGENCY: Call 911.
  - Stay with the worker until help arrives.
  - Move the worker to a shady, cool area.
  - Remove outer clothing.
  - Cool quickly with a cold water or ice bath if possible; wet the skin, place cold wet towels on skin, or soak clothing in cool water.
  - Fan air around the worker.
  - Place cold wet towels or ice on the worker's head, neck, armpits, and groin.

- Heat Exhaustion
- Review the signs and symptoms of heat exhaustion
  - Take the worker to a clinic or emergency room for medical evaluation and treatment.
  - If medical care is unavailable, call 911.
  - Stay with the worker until help arrives.
  - Remove the worker from the hot area and
Projected # Extreme Heat Days 2020

Projected number of future extreme heat days

Darker areas represent higher numbers of future extreme heat days

CDC’s Environmental Public Health Tracking
www.ephtracking.cdc.gov
Extreme Heat Events and Mental Health

- Increased aggression and criminal activity
- Increased suicide rates
- Increased rates of hospitalization for pre-existing mental health disorders
- Decreased mental task capacity of workers
Extreme Heat Events: Mortality in the elderly

- June 30-July 13, 2012 Extreme Heat Event
- Temperatures averaged 84-104 degrees (9 degrees higher than usual)
- Maryland, Ohio, Virginia and West Virginia
- Preceded by thunderstorm with strong wind that knocked out power to 3.8 million
- Power was not restored to some for 8 days
- 32 deaths over two weeks related to heat compared with average of 4 for same period averaged over last three years
- Median Age 65, 72% Male, 75% living alone
- co-morbidities of CVD, DM, pulmonary disease
- 69% died at home with 91% lacking air conditioning
- 5 people had air conditioning but had not turned it on

Interventions for EHE for the Elderly

- Keep track of those who live alone
- Provide information about the dangers of excessive heat
- Encourage use of air conditioning during these times
- Encourage contact with friends and family throughout EHE
- Provide hot line numbers to those at high risk
- Encourage those at high risk to go to shelter during EHE
Meeting The Paris Agreement’s Temperature Goal Avoids Substantial Heat-Related Mortality In U.S. Cities

DOI: 10.1126/sciadv.aau4373
Down pours with huge amounts of water are more common and more likely to lead to flooding.

- Fast moving water can trap people and sweep them away.

Physical hazards from falling and flying debris and electrical wire.
• Adult Psychiatric Morbidity Survey of adults in England

• Provides national data on prevalence of mental health disorders using diagnostic criteria

• N=7525 from 2014-2015

• Asked about experience with damage to their home due to wind, rain, snow or flood in previous 6 months

• Storm and flood related damage was associated with depression, anxiety and suicidal ideation and attempt

• When depression and anxiety were considered together the association of storm and flood related damage and these conditions had an OR of 1.5 (CI 1.08-2.07)

• Relationship persisted when other known vulnerabilities were adjusted for:
  • female, young age, financial difficulty, poor general health, increased alcohol use
Flooding
Pigs drown during hurricane Floyd in North Carolina 1999

Hurricane Florence 2018 breaches Coal Ash Ponds

Hurricane Harvey inundated 13 hazardous waste sites around Houston 2017

Source: US Energy Information Administration via Frontier Group
Water Quality

River after a storm
Poor Water Quality

- **Run off leads to diarrheal illness**: cholera, cryptosporidia, campylobacter, leptospirosis

- Higher temperatures increase algae in ponds and lakes. Some algal blooms are toxic and even when not toxic use up oxygen and lead to death of fish
Cyanobacterial Harmful Algal Blooms will increase the most in the Northeast US

Due to a combination of increased temperature and nutrients in waterways

Current mean number of HAB days is 7/waterway
Expected to rise to 16-23 in 2050 and 18-39 in 2090
Strong turbulence benefits toxic and colonial cyanobacteria in water: A potential way of climate change impact on the expansion of Harmful Algal Blooms

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HABs and Public Health

- Exposure pathways: ingestion (water or food), inhalation, dermal contact
- Fresh or Salt water
- One Health issue – humans, animals, and the environment
- Risk Factors: warming climate, nutrient pollution
- Challenges: identifying and characterizing HAB-associated illnesses
# Marine HAB toxins

<table>
<thead>
<tr>
<th>Poisoning</th>
<th>Toxin/Species</th>
<th>Region</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciguatera Fish Poisoning</td>
<td><em>Ciguatera toxin</em> – <em>Gambierdiscus toxicus</em></td>
<td>Tropical and subtropical fish</td>
<td>Hawai, Puerto Rico, South Florida, Gulf of Mexico</td>
</tr>
<tr>
<td>Neurotoxic Shellfish Poisoning</td>
<td><em>Brevetoxin</em> – <em>Karenia brevis</em></td>
<td>Shellfish</td>
<td>Gulf of Mexico and Mid-Atlantic waters</td>
</tr>
<tr>
<td>Paralytic Shellfish Poisoning</td>
<td><em>Saxitoxins</em> – <em>Alexandrium</em></td>
<td>Shellfish</td>
<td>Pacific states New England</td>
</tr>
<tr>
<td>Domoic Acid Poisoning</td>
<td><em>Domoic acid</em> – Diatoms: Pseudo-nitzschia, Nitschia, Amphora</td>
<td>Shellfish</td>
<td>Pacific coast, North east coast, west coast Florida</td>
</tr>
<tr>
<td>Diarrhetic Shellfish Poisoning</td>
<td><em>Okadic acid &amp; dinophysistoxins</em> – <em>Dinophysys, Procentrum</em></td>
<td>Shellfish</td>
<td>Gulf Coast of Texas</td>
</tr>
<tr>
<td>Azaspiacid Shellfish Poisoning</td>
<td>dinoflagellate</td>
<td>Shellfish</td>
<td>Eastern Canada</td>
</tr>
</tbody>
</table>
Drinking-water sources serving the U.S. population

- Domestic wells: 16%
- Public-supply wells: 34%
- Public-supply reservoirs and streams: 50%

USGS
Impacts on Drinking Water Sources

- Drinking water treatment plants were built to eliminate standard pathogens using chlorine.
- Increasing run-off from streets, farms and CAFOs.
- Increase in pathogens resistant to chlorine: microsporidia, mycobacterium avium, hepatitis A, rotavirus, cryptosporidium.
US Water Infrastructure

- Drinking water treatment plants built in 70’s-80’s were built to remove pathogens not chemicals

- USGS found that drinking water plants do not adequately remove emerging contaminants in ground and surface water
Chemical contamination of flood waters
Interventions to improve water quality

- Regulation that decreases run-off from sources of animals and fertilizers
- Minimize the use of fertilizers
- Improved waste water collection systems that separate household sewage from storm sewage
- Protect watersheds from industrial chemicals
- Every well used for drinking water should be tested regularly
- Do not flush medications down toilet- dispose at a take back site
Mold

- Anyone can be sensitized to mold
- Atopic people are more likely to be sensitized
- Exposure to large numbers of mold spores - hypersensitivity
- Pneumonitis
- Molds can produce toxins but ingestion (eating moldy food with toxin) is the only proven way of becoming sick

Intervention

- Actively drying carpets, floors, furniture within 36 hours can prevent mold growth
- Clean up of mold more than a couple of square feet should be done by a professional
- Wear a dust mist fume respirator for clean up of any mold more than a square foot.
- Discard or remove porous items that became moldy
Air Pollution: Expected to Worsen

- Higher temperatures and lower temperatures will increase energy needs
- Smoke from forest fires

- This satellite image shows smoke from forest fires in Quebec, Canada

- The fires resulted in 30-fold increase in fine particles in the air in Baltimore, Maryland, a thousand miles downwind.

- Higher VOCs and toxics in air due to storm events
Smoke from Forest Fires on West Coast
Air Pollution: Ozone

Ground level ozone is harmful

\[ \text{NOx} + \text{VOCs} + \text{sunlight} = \text{ozone} \]

Nitrogen oxides (NOx): fuel combustion (motor vehicles, coal power plants)

Volatile Organic Compounds (VOCs): paints, pesticides, gasoline vapors

Many US cities are not currently in compliance with Federal Standards for O3 (ozone) or PM (particulate matter)
Smog in Houston after Hurricane Harvey

Air Quality
US Greenhouse Gas Emissions by Economic Sector

Total U.S. Greenhouse Gas Emissions by Economic Sector in 2017

- Agriculture: 9%
- Commercial & Residential: 12%
- Transportation: 29%
- Industry: 22%
- Electricity: 28%

Total Emissions in 2017 = 6,457 Million Metric Tons of CO₂ equivalent

Air Pollution Has been Associated with

- Increased bronchial hyper-responsiveness
- Increased airway inflammation
- Decreased lung function
- Increased hospital admissions and ER visits for exacerbations of lung conditions
- Enhanced airway inflammation induced by allergen exposure
- Priming of the airways to allergic responses
- Increased hospital admissions for stroke and MI
- Increased risk for cancer

Shah AS¹, Lee KK², McAllister DA³, et al.. BMJ. 2015 Mar 24;350
Air Pollution and Neurocognitive Effects

- Chronic air pollution decreases cognitive function

- Chronic air pollution may increase risk for developing Alzheimer’s and other dementia

Exposure to ambient air pollution and the incidence of dementia: A population-based cohort study

Hong Chen, Jeffrey C. Kwong, Ray Copes, Perry Hystad, Aaron van Donkelaar, Karen Tu, Jeffrey R. Brook, Mark S. Goldberg, Randall V. Martin, Brian J. Murray, Andrew S. Wilton, Alexander Kopp, Richard T. Burnett

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Air Pollution and Poor Birth Outcomes

- 40 good quality studies

- Preterm birth and low birth weight associated with PM2.5, PM 10, SO2, NO2, CO and O3

- Small for gestational age was associated with NO2
Potential mechanisms of PM$_{2.5}$

- **Cardiovascular and pulmonary effects**
  - Changes in vascular tone/blood pressure
    - Inflammation
    - Altered cardiac autonomic function
    - Accelerated atherosclerosis
    - Oxidative stress

- **Carcinogenesis**
  - Primarily in the lung
Polyaromatic hydrocarbons formed during combustion

Present in particulate and gaseous states

Several PAHs Group 1 Carcinogens
Changes in vector ecology (ticks, mosquitoes, fleas)

- Geographic and seasonal distribution of vectors and vector borne diseases

- Ticks carrying disease causing bacteria will show earlier seasonal activity and a northward expansion in response to increasing temperatures

- Mosquitoes carrying west nile virus, malaria, and zika will be more abundant and their distribution will change

- Transmission of vector-borne illness to humans is based on more than climate change alone
Vector-borne illnesses

**Tick**
- Lyme
- Spotted fever Rickettsia
- Anaplasmosis/Ehrlichiosis
- Babesiosis
- Tularemia

**Mosquito**
- West Nile
- Malaria
- Dengue
- Eastern Equine Encephalitis
- Powasson
- Chikungunya
- Zika
Climate Change Effects on Vector-borne Transmission of Illness

Vector/host
- survival
- reproduction
- development
- activity
- distribution
- abundance

Pathogen
- Development
- replication
- maintenance transmission
- geographic range of pathogens

The most vulnerable to health impacts of climate change

- children
- the elderly
- women (especially pregnant and post-partum)
- people with pre-existing medical illness
- low-income persons
- people who are homeless or alone
- first-responders
Community Vulnerability to Climate Change

- Poverty
- Social division
- Poor health and social service infrastructure
- Inadequate planning for disasters
- Local economy lacks diversification
- Location in coastal area or island
- Location in area with expected drought
Costs of Inaction, Adaptation, Mitigation

Triangle diagram from the IPCC Forth Assessment Report (Chapter 18) describing the relationship between adaptation, mitigation, and inaction. (Image: IPCC AR4)

Adaptation—reducing the vulnerability to the impacts of climate change

Mitigation—reducing the magnitude of climate change through emissions reductions
Mitigation Strategies

- Safer Aviation Fuel
- UN International Maritime Organization’s energy efficiency measures for ships
- Reduction in emissions from fossil fuel
- Closing old fossil fuel plants
- Subsidies for renewable energy
- Elimination of diesel vehicles built before 2007
- Stricter standards on chemicals used in refrigeration
- Greening of cities
Adaptation Strategies

- Increase use of sustainable agricultural practices that can be more adaptive to extreme environments

- Land use strategies that integrate planting, animal, forest activities can reduce erosion and maximize conservation of natural resources

- Retrofit all drinking water treatment plants to remove chemicals and emerging pathogens

- Pass ordinances that protect watersheds from farm and street runoff

- Enhance local surveillance strategies to enhance the early identification of changing vector ecology
Adaptation: Flooding Prevention

Thames Barrier, London, 1984

Photo: Phil Dolby
Employer Initiatives toward Adaptation

- Paid healthcare
- Paid leave for disaster related time away from work
- Employee Assistance Programs which include services for disaster related remediation
- Enhanced employee autonomy in pace of work decision making especially for outdoor workers (rest periods)
- Changing wages away from ‘piece rate’ for outdoor workers
- Provision of hydration stations for outdoor workers
- Green Design of buildings
- Increased tree planting on corporate properties
- Improve disaster risk management plans to better protect against chemical releases
- Increase pre-positioned supplies to address disasters
- Provide monitoring equipment to local fire departments
OEM Physician Roles

- Corporate
  - participate in policy review
  - introduce climate change considerations into discussion
  - consider disasters that are relevant to your location

- Community
  - your voice will be well respected as a physician
  - go to meetings, talk about health issues
  - write letters to the newspapers
  - contact legislators- you do not have to understand everything
  - submit testimony and better yet show up to give it
The Time For Action is Now