Climate Change & Health: What Clinicians Need to Know

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Thanks to PSR, the Climate and Health Literacy Consortium, CDC, Ed Maibach, Gina Solomon, Peter Joseph
What you need to know about global climate change

- It’s real
- We’re causing it (unequally)
- It’s bad for us (unequally)
- There are things we can do
- There are “co-benefits” to doing them
1. It’s real
“Climate change is the biggest global health threat of the 21st century… The impacts will be felt all around the world – and not just in some distant future but in our lifetimes and those of our children.”

--The Lancet, 11/09

Source: http://www.thelancet.com/climate-change
Temperatures compared with 20\textsuperscript{th} century average

20\textsuperscript{th} century +1.4°F
Estimates for 21\textsuperscript{st} century
+4°F to +11.5°F. (IPCC, 2007)
Changes in temperature, sea level and Northern Hemisphere snow cover

(a) Global average surface temperature

(b) Global average sea level

(c) Northern Hemisphere snow cover

IPCC-AR4, 2007
Models project more extreme climate events, not just gradual warming

- These cause most of the death and destruction
From extreme drought, heat waves and floods to unprecedented tornado outbreaks, hurricanes, wildfires and winter storms, a record 12 weather and climate disasters in 2011 each caused $1 billion or more in damages — and most regrettably, loss of human lives and property. NOAA’s National Weather Service has redoubled its efforts to create a "Weather-Ready Nation", where vulnerable communities are better prepared for extreme weather and other natural disasters.
Heat, Flood or Icy Cold, Extreme Weather Rages Worldwide
By Sarah Lyall

“Each year we have extreme weather, but it’s unusual to have so many extreme events around the world at once,” -- Omar Baddour, World Meteorological Organization
2. We’re causing it
The world energy system is increasingly dominated by oil and gas.

EJ = Exajoules = $10^{18}$ Joules
CO₂ Record from Antarctic Ice Bubbles

http://www.ncdc.noaa.gov/indicators/
Not just CO₂

*Global Warming Potential (relative to CO₂)

- Carbon Dioxide (CO₂) GWP*=1
- Methane (CH₄) GWP=23
- Nitrous Oxide (N₂O) GWP=298
Solar radiation powers the climate system.

Some solar radiation is reflected by the Earth and the atmosphere.

About half the solar radiation is absorbed by the Earth’s surface and warms it.

Infrared radiation is emitted from the Earth’s surface.

The Greenhouse Effect
Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth’s surface and the lower atmosphere.

Source:
Global Average Temperature Models

http://www.ncdc.noaa.gov/indicators/
Climate change models

- Best science summary from Intergovernmental Panel on Climate Change (IPCC)
- 130 countries, 450 lead authors, 2500 expert reviewers
- Peer review process - high level of transparency and scrutiny
- 4th Assessment Report (AR-4) from 2007. (AR-5 draft has been leaked)
- Google “IPCC”
Figure 19.1. Probability (see ‘Key caveat’ above on low confidence for specific quantitative results) of exceeding an equilibrium global warming of 2°C above pre-industrial (1.4°C above 1990 levels), for a range of CO₂-equivalent stabilisation levels. Source: Hare and Meinshausen (2005).
Positive feedback loops

- These are scary and increase uncertainty of projections
- Warmer temperatures $\rightarrow$ ice melts $\rightarrow$ less heat is reflected, more heat is absorbed $\rightarrow$ warmer temperatures
- Warmer temperatures $\rightarrow$ more water vapor (a greenhouse gas) $\rightarrow$ warmer temperatures
- Warmer temperatures $\rightarrow$ permafrost melts $\rightarrow$ release of methane $\rightarrow$ warmer temperatures
Methane release from melting permafrost

- Twice as much carbon in permafrost as in the atmosphere
- It’s melting


3. It’s bad for us (unequally)
Heat Waves

**2006 California heat wave**
- Daytime temperatures > 100 degrees for 2 weeks
- Record nighttime highs
- > 1 million people lost electricity
- Excess ER visits: 16,000
- Excess hospitalizations: 1000
- Deaths: 150-450

**2003 European heat wave**
- Death toll > 35,000
Increase in Wildfires

- 4x increase in major fires, 6x increase in area burned in Western US, 1987-2005 vs. 1970-86*
- Increased particulate pollutants and ozone
- Most vulnerable: elderly, children, people with respiratory illnesses
- Another positive feedback loop

*Westerling et al. Science 2006; 313:940-943
Heat increases ozone

Ozone versus Temperature

Riverside, 2003-2005

Fresno, 2003-2005

$R^2 = 0.80$

$R^2 = 0.82$
Zoonotic and Vector-Borne Diseases

- Increased geographical range and risk of current diseases
- Re-emergence of formerly prevalent diseases
- Examples: West Nile Virus, Dengue Fever, Malaria
More Droughts

- Loss of summer arctic cooling of Northern Hemisphere
- Lower crop yields, food insecurity, malnutrition, disease, armed conflict
Increased Storms and Flooding

- Direct injuries and deaths
- Long term psychological and physical effects
- Increased risk of infectious diseases
- Contaminated water supplies
- Superstorm Sandy $62 billion in damages in US
Sea Level Rise

- More coastal flooding during storms
- Loss of coastal wetland ecosystems
- Salt water intrusion into fresh water supplies
- IPCC estimate +7” to +23” by 2100; some estimates much higher
Who is causing it?

USA: 4% of world’s population, 25% of GHG

Carbon emissions, 2000
http://www.worldmapper.org/display.php?selected=295
Who is affected?

Carbon emissions, 2000

Killed by Drought, 1975-2000

Killed by Floods, 1975-2000

Killed by Storms, 1975-2000
Deaths Attributed to Climate Change: 150,000 per year

Deaths from climate change

Estimates by WHO sub-region for 2000 (WHO World Health Report, 2002). Copyright WHO 2005. All rights reserved.
More certainty is not required

- Given risks and disproportionate effects, even low probability would warrant action

- Interventions have co-benefits
  - Reduced dependence on foreign oil
  - Reduced air pollution and environmental degradation from extraction and burning of coal and oil
  - Better health from eating less meat and from walking and cycling rather than driving
Positive proof of global warming.
What you can do

- Advocate actions that improve health and reduce greenhouse gas emissions (such as eating less meat, walking and biking more, using public transit)
- Reduce your own carbon footprint
- Try to improve healthcare value
- Be a change agent – get politically active!
  - Or at least give money!
Estimating your carbon footprint

- Many online calculators
- Most include household electricity and gas and transportation
- Best ones include food, show effects of changes you can make, and are state-specific
- Google “Carbon footprint calculator”
  – (I recommend The Nature Conservancy site.)
Importance of airplane travel

- 1 East Coast round trip from California = 1-2 tons CO₂
- Typical California per capita household electricity consumption ~ 3 tons CO₂
- Reduce travel by
  - Combining trips
  - Skipping trips
  - Videoconferencing, Skype, etc.
Carbon Offsets

- Basic idea: for each ton of CO$_2$ you generate, absorb or prevent a ton from another source

- Examples
  - Subsidize new renewable energy projects (e.g., wind farms)
  - Methane capture from manure
  - Tree planting (not as good)

- Many websites now sell carbon offsets
Carbon footprint of your food*

- Livestock contribution to global warming: 18% of global greenhouse gases
  - Deforestation
  - N\textsubscript{2}O: 296 x CO\textsubscript{2} Global Warming Potential (GWP)
  - CH\textsubscript{4}: 23 x CO\textsubscript{2} GWP
  - Increasing steeply

Source: *UN Food and Agriculture Organization, U.N. News Centre. 29 Nov 06
Carbon footprint of your food*

Carbon footprint of your food*

- Red meat @ 49% of calories ~ SUV
- Poultry, fish, dairy, eggs @ 28% of calories ~ Camry
- Plants only ~ Prius


Based on 8332 vehicle miles traveled, US per capita average
Co-benefit of eating less meat: lower ischemic heart disease rates

<table>
<thead>
<tr>
<th>Diet group</th>
<th>Number of deaths</th>
<th>Death rate ratio*</th>
<th>(95% confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular meat eater¹</td>
<td>912</td>
<td>1.00 (ref group)</td>
<td></td>
</tr>
<tr>
<td>Fish only, or occasional meat²</td>
<td>293</td>
<td>0.78 (0.68-0.89)</td>
<td></td>
</tr>
<tr>
<td>Vegetarian³</td>
<td>538</td>
<td>0.66 (0.53-0.83)</td>
<td></td>
</tr>
</tbody>
</table>

Test for trend: \( P < 0.001 \)

**Fig. 1** Ischaemic heart disease death rate ratios by diet group. *Death rate ratios are adjusted for age, sex and smoking, and for study using a random effects model.¹ Meat eaten at least once per week.² Fish but not meat eaten, or meat eaten less than once per week.³ No meat or fish eaten.

The overuse of antibiotics in food animals & what supermarkets and consumers can do to stop it
Improve Healthcare Value

- Healthcare currently 1/6 of US GDP; enormous use of natural as well as financial resources
- Discretionary funding for ANYTHING (including infrastructure, conservation, renewable energy) severely constrained by healthcare costs
- *Trying to reduce the environmental footprint from healthcare without examining what we do is like trying to reduce our footprint from travel without considering what trips we take.*
International Comparison of Spending on Health, 1980–2006

Data: OECD Health Data 2008 (June 2008). From Commonwealth fund
A Solar Grand Plan*

- “By 2050 solar power could end U.S. dependence on foreign oil and slash greenhouse gas emissions.”
- “But $420 billion in subsidies from 2011 to 2050 would be required to fund the infrastructure and make it cost-competitive”
- This is about 4 months of excess US spending on health care (compared with median of OECD countries)**


Tucson Electric Power's 4.6-megawatt plant in Springerville, AZ.
UCSF Department of Medicine Leadership

- “Choosing Wisely” campaign of the American Board of Internal Medicine
  - Catherine Lucey, Robert Wachter

- “Less is More” in the Archives of Internal Medicine
  - Rita Redberg and Deborah Grady

- American College of Physicians “High Value Cost Conscious Care” initiative
  - Molly Cooke, Christopher Moriates

- CTSI Center for Healthcare Value
  - Clay Johnston, Deborah Grady, Minnie Kahlon
Did you know...

- Raising livestock contributes more to global warming than transportation. Livestock production also threatens water supplies and biodiversity and constitutes 80% of antibiotic sales in the US.
- Your share of the carbon footprint of each round trip you make to the East Coast is about 2 tons of CO₂, about 2/3 of your home electricity consumption for an entire year.
- UCSF's carbon footprint in 2010 was 160,000 metric tons of CO₂ equivalent—about the same as 16,000 California households, and almost twice 1990 levels.
- The U.S. has only 4% of the world’s population, with more than 25% of all greenhouse gas emissions worldwide.

References

3. American College and University Presidents Climate Commitment. (Accessed 8/23/12, at http://www.presidentsclimatecommitment.org/)
Become a change agent

- Understand the problem
- Speak up
- Work together; have fun
- Be persistent
- Set an example
- Get politically active
The problem: Market failure

- "Climate change is a result of the greatest market failure the world has seen... The problem of climate change involves a fundamental failure of markets: those who damage others by emitting greenhouse gases generally do not pay."

--- Stern Review on the Economics of Climate Change
Do the Math: 3 numbers*

- **2° C**: Need to keep temperature rise below this number to avoid catastrophe.

- **565 gigatons**: the amount of additional CO$_2$ we can add to the atmosphere and still have some hope of staying below a 2° C increase.

- **2,795 gigatons**: the amount of CO$_2$ from burning *known reserves* of fossil fuel.

*McKibben W.
Fossil Fuel Companies as the Enemy

- Known fossil fuel reserves are their assets. Must be extracted and burned, to retain their value
- Will fight any attempt to restrict this
- Extremely rich and powerful
  - Ability to buy scientists, media, politicians, and laws
Divestment movement

- 192 Campus organizations in 1\textsuperscript{st} month
- Seattle City Employees’ Retirement System (SCERS)
- Support from Nelson Mandela
- “If it's wrong to wreck the climate then it's wrong to profit from that wreckage.” – Bill McKibben, 350.org
Speak Up

Would you recommend this hotel? ____________
Are you a Priority Club member? ____________
Did everything in your room work? ____________
If no, what items were not working? (Mark all that apply)
- HVAC/CONDITIONING
- TELEVISIONS
- PHONE/DATA PORTS
- BATHROOM FACILITIES
- LIGHTING
- OTHER

Purpose of Stay:
- PLEASURE
- BUSINESS
- GROUP MEETING/CONFERENCE/BANQUET AT THE HOTEL

Tell us one thing that made a difference during your stay:
LIGHTS WORK BUT INCANDESCENT BULBS CAUSE ME ECOLOGIC PAIN!
JUST WASTEFUL! PLEASE CHANGE TO COMPACT FLUORESCENTS!

Outstanding Employees:

Name: T. Newman
Room No: 809
Date of Departure: 5/14/10
Group: UIC
HOTEL USE ONLY
San Mateo-Hayward Bridge
Existing sign outside Foster City Costco, 2001
E-mail excerpts - #1

Below is the result of your feedback form. Wednesday, September 5, 2001 at 20:41:08

On behalf of the Social Action Committee of the Unitarian Universalists of San Mateo (which thinks globally and acts locally), I'm writing to call attention to a problem that wastes time and energy.

The problem is that it is too easy accidentally to get on Highway 92 Eastbound at Foster City Blvd, and be forced to drive all the way to Hayward...
At 02:32 PM 10/22/2002 -0700, Robert_Haus@dot.ca.gov wrote:

Dear Dr. Newman:

I forwarded your remarks, once again, to the person in charge of Signing for San Mateo County...
As we said previously: Signing is a matter of balance... Too few signs can lead to confusion, but too many signs can lead to the same result...
Greetings, Mr. Haus --

I was over at the Foster City Costco this afternoon, so naturally my thoughts turned to you. How are you doing? I hope you have a happy holiday season, and don't forget that the wish of the Unitarian Universalists of San Mateo this year, as in 2001, 2002, and 2003, is that someday every trip to Hayward will be a wanted trip to Hayward.

Will our wish someday come true? You could make it happen.
Entrance to San Mateo Bridge (before)
Entrance to San Mateo Bridge
(after September, 2005)
LAST EXIT
What we need to do: Everything

NRDC, based on Pacala and Socolow, Science 2004
Instead of this

We get this
Instead of this

We get this
Summary

- Climate change poses grave threats to health of people and the planet
- Healthcare contributes because of its own large footprint and its costs
- You can reduce your own environmental footprint by conserving energy, reducing travel, eating less meat, and offsetting carbon
- This will not be enough. We all need to become change agents!
- There are CO-BENEFITS
- Get involved! Join PSR (www.psr.org)
  - Let me know what you do!
  newman@epi.ucsf.edu
CLIMATE SUMMIT

WHAT IF IT'S A BIG HOAX AND WE CREATE A BETTER WORLD FOR NOTHING?

- ENERGY INDEPENDENCE
- PRESERVE RAINFORESTS
- SUSTAINABILITY
- GREEN JOBS
- LIVABLE CITIES
- RENEWABLES
- CLEAN WATER, AIR
- HEALTHY CHILDREN
- ETC. ETC.
Additional slides
References and Resources

**Major help with this presentation:**
Climate Health Literacy Consortium

**Current reports of the IPCC (Intergovermental Panel on Climate Change).**
http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml

**Lancet series on climate change**
Overview: http://www.thelancet.com/climate-change

**Organizations:**
Interfaith Power and Light  http://interfaithpowerandlight.org/
National Resources Defense Council  www.nrdc.org

**Physicians for Social Responsibility**
National: www.psr.org
S.F. Bay Area http://www.sfbaypsr.org/
Los Angeles http://www.psr-la.org/
Union of Concerned Scientists http://www.ucsusa.org/

**Carbon Offsets:**
What is Cheat Offsetting?
When you cheat on your partner you add to the heartbreak, pain and jealousy in the atmosphere.

Cheatneutral offsets your cheating by funding someone else to be faithful and NOT cheat. This neutralises the pain and unhappy emotion and leaves you with a clear conscience.

Can I offset all my cheating?
First you should look at ways of reducing your cheating. Once you’ve done this you can use Cheatneutral to offset the remaining, unavoidable cheating.

are you a cheater?
cheatneutral can help you offet your indiscretions.

loyal and faithful?
become an offset project and get paid for not cheating

Projects
Some of the people who are offsetting your cheating:
alex
chris
mim
rich

so far, cheatneutral has offset 65,768 cheats and has 9002 faithful people ready to neutralise your misdemeanours.
Carbon Offsets Controversies

- Comparison to indulgences in middle ages
  - Pay money instead of repenting and changing
  - Satirized, e.g. CheatNeutral.com:

- “What is Cheat Offsetting?”
  When you cheat on your partner you add to the heartbreak, pain and jealousy in the atmosphere. Cheatneutral offsets your cheating by funding someone else to be faithful and NOT cheat. This neutralises the pain and unhappy emotion and leaves you with a clear conscience.

- “Can I offset all my cheating?”
  First you should look at ways of reducing your cheating. Once you've done this you can use Cheatneutral to offset the remaining, unavoidable cheating.”

http://www.cheatneutral.com accessed 6/2/10
Carbon Offsets - Controversies

- Analogies fail because CO$_2$ is fully interchangeable
- Emitting 1 ton and preventing another ton is the same as not emitting 1 ton and not preventing the other ton
- Passes the “What if everybody did it?” test
- Problem: being sure you are preventing that other ton from being emitted.
Carbon Offsets: Evaluation

- Certification
  - Do independent auditors verify claims?
  - “Gold” standard toughest

- Additionality
  - Could the project have happened anyway?
  - Economic viability
    - Irony: generating energy from methane capture reduces “additionality” because the project becomes more economically viable
Costs of Carbon Offsets

- Marked variability in price for a clear conscience:

<table>
<thead>
<tr>
<th>Provider</th>
<th>Total Cost</th>
<th>Cost per ton</th>
<th>Tons to Offset</th>
<th>Certif.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmosfair</td>
<td>$ 72.00</td>
<td>$ 31.17</td>
<td>2.31</td>
<td>Gold</td>
</tr>
<tr>
<td>STI (MyClimate)</td>
<td>$ 61.24</td>
<td>$ 34.99</td>
<td>1.75</td>
<td>Gold</td>
</tr>
<tr>
<td>NativeEnergy</td>
<td>$ 24.00</td>
<td>$ 12.37</td>
<td>1.94</td>
<td>a CPA</td>
</tr>
<tr>
<td>CarbonFund</td>
<td>$ 12.64</td>
<td>$ 5.50</td>
<td>2.3</td>
<td>ERT,CCX,CCBA</td>
</tr>
<tr>
<td>TerraPass</td>
<td>$ 12.38</td>
<td>$ 13.17</td>
<td>0.94</td>
<td>CRS, CCX</td>
</tr>
</tbody>
</table>

- Cost in same range as the value of frequent flier miles

All websites accessed 1/28/08, based on 4838 miles
We’re all causing climate change.

Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the … increase in (human-caused) green-house gas concentrations (in our atmosphere).

—IPCC (2007)
"We're Number 37" - Paul Hipp

The World Health Organization's ranking of the world's health systems.
- Within 2 years develop action plan for becoming carbon neutral
- Tangible actions in the interim
- Action plan, inventory, progress to be publicly available: **Sustainability Tracking, Assessment, and Rating System (STARS)**
- Signed by UC President Dynes, March 2007

**Association for the Advancement of Sustainability in Higher Education**
Antibiotics and Meat Timeline

- 1945 Alexander Fleming warns of misuse of penicillin leading to resistance
- 1977 FDA proposes withdrawing approval for use of penicillin and tetracycline in animal feed - Congress requires further study
- 1980 National Academy of Sciences report
- 1983 National Resources Defense Council letter signed by 300 scientists urges a ban on penicillin and tetracycline in animal feed
- 1984 CDC study directly linking antibiotic additives in beef to 18 cases of severe Salmonella poisoning in the Midwest published in NEJM
Cumulative carbon emissions

(b) 1751–2010 Cumulative Emissions

- USA: 26.8%
- Rest of World: 13.9%
- Rest of Europe: 18.0%
- UK: 5.6%
- Germany: 6.3%
- Japan: 4.1%
- Russia: 7.3%
- India: 2.8%
- China: 9.8%
- CanAUS: 3.1%
- Ships/Air: 2.3%