Climate Change and Population Health: Insights and Implications for Public Health

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Outline

- Extended look at impact of CC on population health
- Important pathways through which CC affects pop health
- Why look at CC and pop health
- Economic costs and benefits
- Impacts on health disparities population
  - Within and beyond geopolitical boundaries
- What should PHP do?
  - Generic recommendations
- What can PHP do?
  - Specific recommendations
Am I a believer?

• Coming from India
  – Impact of weather on lives
  – Scarcity means
  – Degradation

• Environmental conflict
  – Resource conservation is important

  – Laws of thermodynamics

  – Property, power, people and progress
<table>
<thead>
<tr>
<th>Am I a believer?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Four groups</strong></td>
</tr>
<tr>
<td>- Believers</td>
</tr>
<tr>
<td>- Deniers and non-believers</td>
</tr>
<tr>
<td>- I do not know</td>
</tr>
<tr>
<td>- I do not care</td>
</tr>
<tr>
<td><strong>As for me:</strong> Yes!</td>
</tr>
<tr>
<td><strong>Preponderance of evidence</strong></td>
</tr>
<tr>
<td><strong>International agencies</strong></td>
</tr>
<tr>
<td>- CDC</td>
</tr>
<tr>
<td>- USEPA</td>
</tr>
</tbody>
</table>
Am I a believer?

- Climate change is a result of the externality associated with GHG
- It is global in its causes and consequences;
- The impacts of climate change are long-term and persistent;
- Uncertainties and risks in the economic impacts are pervasive; and
- There is a serious risk of major, irreversible change with non-marginal economic effects.
Figure 1.1. Variations in Earth's average surface temperature, over the past 20,000 years

Average temperature over past 10,000 years = 15°C

- IPCC (2001) forecast: +2-3°C, with band of uncertainty
- 21st century: very rapid rise
Figure 1.2 Global temperature record, since instrumental recording began in 1860, and projection to 2100, according to the IPCC
Figure 3.1. Pathways by which climate change affects human health (modified from reference 2)

CLIMATE CHANGE

Human exposures
Regional weather changes
- Heatwaves
- Extreme weather
- Temperature
- Precipitation

Contamination pathways
Transmission dynamics
Changes in agro-ecosystems, hydrology
Socioeconomic and demographic disruption

Modulating influences

Health effects
- Temperature-related illness and death
- Extreme weather-related health effects
- Air pollution-related health effects
- Water and food-borne diseases
- Vector-borne and arboviral diseases
- Effects of food and water shortages
- Mental, nutritional, infectious and other health effects

http://www.who.int/globalchange/climate/en/
<table>
<thead>
<tr>
<th>Region</th>
<th>Total DALYs (1000s)</th>
<th>DALYs / million population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa region</td>
<td>1894</td>
<td>3071.5</td>
</tr>
<tr>
<td>Eastern Mediterranean region</td>
<td>768</td>
<td>1586.5</td>
</tr>
<tr>
<td>Latin America and Caribbean region</td>
<td>92</td>
<td>188.5</td>
</tr>
<tr>
<td>South-East Asian region</td>
<td>2572</td>
<td>1703.5</td>
</tr>
<tr>
<td>Western Pacific region*</td>
<td>169</td>
<td>111.4</td>
</tr>
<tr>
<td>Developed countries**</td>
<td>8</td>
<td>8.9</td>
</tr>
<tr>
<td>WORLD</td>
<td>5517</td>
<td>920.3</td>
</tr>
</tbody>
</table>

* without developed countries; ** and Cuba.
<table>
<thead>
<tr>
<th>Type of outcome</th>
<th>Outcome</th>
<th>Incidence/Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and water-borne disease</td>
<td>Diarrhoea episodes</td>
<td>Incidence</td>
</tr>
<tr>
<td>Vector-borne disease</td>
<td>Malaria cases</td>
<td>Incidence</td>
</tr>
<tr>
<td>Natural disasters*</td>
<td>Fatal unintentional injuries</td>
<td>Incidence</td>
</tr>
<tr>
<td>Risk of malnutrition</td>
<td>Non-availability of recommended daily calorie intake</td>
<td>Prevalence</td>
</tr>
</tbody>
</table>

*All natural disaster impacts are separately attributed to coastal floods and to inland floods/landslides*
Pathways...

- Changes in weather patterns...
  - Air, food, and water quality affected
    - Physical environment > Disease burden

- We know these...

- But, what about...
Pathways...

• What about determinants of health?
  – Social determinants of health (SDoH)

  • Major contributors to health
    – Living conditions
    – Working conditions
    – Diet (nutrition)
Figure 1. Factors that could help avoid premature mortality.

Figure 2. Upstream and downstream determinants of population health.
Comprehensive look

General socioeconomic, cultural and environmental conditions

Living and working conditions

Unemployment

Water and sanitation

Health care services

Individual lifestyle factors

Age, sex and constitutional factors

Social and community networks

Agriculture and food inundation

Education

Work environment

Housing
Extended impacts...SDoH

- Where we live
  - How we live

- Where we work
  - How we work

- What we consume
  - How we consume

- What we dispose
  - How we dispose
Extended impacts...SDoH

- Economics
  - Health disparities populations
    - Vulnerable populations
Extended impacts... SDoH

- Economic costs
  - Private and social cost
  - Short-term and long-term costs
- Proximal and distal costs
- Direct and indirect costs
The US Economic Impacts of Climate Change and the Costs of Inaction

A Review and Assessment by the Center for Integrative Environmental Research (CIER) at the University of Maryland

October 2007

1. Economic impacts of climate change will occur throughout the country.

2. Economic impacts will be unevenly distributed across regions and within the economy and society.

3. Negative climate impacts will outweigh benefits for most sectors that provide essential goods and services to society.
4. Climate change impacts will place immense strains on public sector budgets.

5. Secondary effects of climate impacts can include higher prices, reduced income and job losses.
The US Economic Impacts of Climate Change and the Costs of Inaction

Figure 5. Billion Dollar Weather Disasters, 1980 - 2005

1990-2005
$540 billion

(Source: NCDC 2007)
The US Economic Impacts of Climate Change and the Costs of Inaction

Figure 6. Billion Dollar Weather Disasters by Type

<table>
<thead>
<tr>
<th>DISASTER TYPE</th>
<th>NUMBER OF EVENTS</th>
<th>PERCENT FREQUENCY</th>
<th>NORMALIZED DAMAGES (Billions of Dollars)</th>
<th>PERCENT DAMAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical Storms/Hurricanes</td>
<td>24</td>
<td>34.2%</td>
<td>308</td>
<td>64.6%</td>
</tr>
<tr>
<td>Non-Tropical Floods</td>
<td>12</td>
<td>17.1%</td>
<td>65</td>
<td>9.8%</td>
</tr>
<tr>
<td>Heatwaves/Droughts</td>
<td>12</td>
<td>17.1%</td>
<td>151</td>
<td>26.6%</td>
</tr>
<tr>
<td>Severe Weather</td>
<td>0</td>
<td>11.5%</td>
<td>3</td>
<td>2.4%</td>
</tr>
<tr>
<td>Fires</td>
<td>7</td>
<td>10.0%</td>
<td>14</td>
<td>2.4%</td>
</tr>
<tr>
<td>Freezes</td>
<td>2</td>
<td>2.9%</td>
<td>6</td>
<td>1.1%</td>
</tr>
<tr>
<td>Blizzards</td>
<td>2</td>
<td>3.9%</td>
<td>9</td>
<td>1.6%</td>
</tr>
<tr>
<td>Ice Storms</td>
<td>2</td>
<td>3.9%</td>
<td>5</td>
<td>-0.9%</td>
</tr>
<tr>
<td>Nor'easter</td>
<td>1</td>
<td>1.4%</td>
<td>2</td>
<td>-0.3%</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td></td>
<td>564</td>
<td></td>
</tr>
</tbody>
</table>

(Source: NCDC 2007)
The US Economic Impacts of Climate Change and the Costs of Inaction

Table 10. Estimated Life Expectancies and Replacement Costs for 15 Types of Public Infrastructure

<table>
<thead>
<tr>
<th>Type of Infrastructure</th>
<th>Count/Length</th>
<th>Useful Life (years)</th>
<th>Replacement Cost per unit ($2000)</th>
<th>Units</th>
<th>Total Replacement Costs Today ($2000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airports</td>
<td>373</td>
<td>30</td>
<td>36 million</td>
<td>Whole</td>
<td>5.06 billion</td>
</tr>
<tr>
<td>Bridges</td>
<td>923</td>
<td>40</td>
<td>10,000</td>
<td>Per foot</td>
<td>1.7 billion</td>
</tr>
<tr>
<td>Courthouse facilities</td>
<td>42</td>
<td>40</td>
<td>16 million</td>
<td>Whole</td>
<td>678 million</td>
</tr>
<tr>
<td>Hot metal buildings</td>
<td>179</td>
<td>40</td>
<td>256,100</td>
<td>Whole</td>
<td>54 million</td>
</tr>
<tr>
<td>Emergency services (fire stations, others)</td>
<td>233</td>
<td>20</td>
<td>467,000</td>
<td>Whole</td>
<td>108 million</td>
</tr>
<tr>
<td>Energy (fuel tanks, other structures off power grid)</td>
<td>974</td>
<td>30</td>
<td>90,000</td>
<td>Whole</td>
<td>7 million</td>
</tr>
<tr>
<td>Museums, government buildings</td>
<td>1,971</td>
<td>40</td>
<td>1 million</td>
<td>Whole</td>
<td>1.5 billion</td>
</tr>
<tr>
<td>Power grid lines, transmission, substations</td>
<td>68</td>
<td>15</td>
<td>100,000</td>
<td>Per mile</td>
<td>17 million</td>
</tr>
<tr>
<td>Misc. health buildings (clins, other non-hospital facilities)</td>
<td>246</td>
<td>30</td>
<td>1.5 million</td>
<td>Whole</td>
<td>355 million</td>
</tr>
<tr>
<td>Harbors</td>
<td>131</td>
<td>30</td>
<td>10 million</td>
<td>Whole</td>
<td>1.3 billion</td>
</tr>
<tr>
<td>Public buildings</td>
<td>11</td>
<td>40</td>
<td>44.7 million</td>
<td>Whole</td>
<td>400 million</td>
</tr>
<tr>
<td>Law enforcement facilities (police, fire stations, prisons, other correctional)</td>
<td>66</td>
<td>30</td>
<td>4 million</td>
<td>Whole</td>
<td>259 million</td>
</tr>
<tr>
<td>Alaska Railroad</td>
<td>45 structures</td>
<td>30</td>
<td>2.8 million</td>
<td>Per mile</td>
<td>2.3 billion</td>
</tr>
<tr>
<td>Roads</td>
<td>10,476 roads</td>
<td>20</td>
<td>1 million</td>
<td>Per mile</td>
<td>18.7 billion</td>
</tr>
<tr>
<td>airports</td>
<td>6,500 miles</td>
<td>(appraisal)</td>
<td>100,000</td>
<td>(appraisal)</td>
<td>10 billion</td>
</tr>
<tr>
<td>Subways</td>
<td>562</td>
<td>40</td>
<td>2.5 million</td>
<td>Whole</td>
<td>1.5 billion</td>
</tr>
<tr>
<td>Sewer systems</td>
<td>124</td>
<td>20</td>
<td>30 million</td>
<td>Whole</td>
<td>1.7 billion</td>
</tr>
<tr>
<td>Telecommunications (phones, satellites, others)</td>
<td>275</td>
<td>10</td>
<td>300,000</td>
<td>Whole</td>
<td>82 million</td>
</tr>
<tr>
<td>Telephone lines*</td>
<td>20,330 miles</td>
<td>15</td>
<td>50,000</td>
<td>Per mile</td>
<td>11.1 million</td>
</tr>
<tr>
<td>Water systems</td>
<td>242</td>
<td>20</td>
<td>5 million</td>
<td>Whole</td>
<td>1.2 billion</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12,665</strong></td>
<td></td>
<td><strong>394,400</strong></td>
<td></td>
<td><strong>394,400</strong></td>
</tr>
</tbody>
</table>

* The counts and the replacement costs in these categories are low because of limited data availability, especially for defense facilities. In part for security reasons, little public information is available about the size and value of defense facilities.

Source: Leiseri 2007
• Measures taken by the world's governments to reduce GHG
  – One% of world GDP

• Cost of in action
  – Five to 10% of world GDP
  • Developing countries most affected
## Projected Impacts of Climate Change

<table>
<thead>
<tr>
<th>Global temperature change (relative to pre-industrial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>Food</strong></td>
</tr>
<tr>
<td><strong>Water</strong></td>
</tr>
<tr>
<td><strong>Ecosystems</strong></td>
</tr>
<tr>
<td><strong>Extreme Weather Events</strong></td>
</tr>
<tr>
<td><strong>Risk of Abrupt and Major Irreversible Changes</strong></td>
</tr>
</tbody>
</table>
STERN REVIEW:
The Economics of Climate Change

Stabilisation and Commitment to Warming

Eventual temperature change (relative to pre-industrial)

<table>
<thead>
<tr>
<th>0°C</th>
<th>1°C</th>
<th>2°C</th>
<th>3°C</th>
<th>4°C</th>
<th>5°C</th>
</tr>
</thead>
</table>

- 5% 400 ppm CO$_2$e 95%
- 450 ppm CO$_2$e
- 550 ppm CO$_2$e
- 650 ppm CO$_2$e
- 750 ppm CO$_2$e
Emissions Paths to Stabilisation

Global Emissions (GtCO₂eq/y)

- 450ppm CO₂e
- 550ppm CO₂e
- Business as Usual
• Four major strategies
  – Emissions trading
  – Technology co-operation
  – Action to reduce deforestation
  – Adaptation
Adaptation: Scaling up Overseas Development Aid

- ODA as a % of GNI (left scale)
- Total ODA (right scale)
- Total ODA to Africa (right scale)
<table>
<thead>
<tr>
<th>The Market Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Perfectly competitive markets</td>
</tr>
<tr>
<td>2. Efficient markets</td>
</tr>
<tr>
<td>- Lead to inequities</td>
</tr>
<tr>
<td>- Underclass, underrepresented, under privileged, underserved</td>
</tr>
<tr>
<td>3. Endowments: Capacities and capabilities</td>
</tr>
</tbody>
</table>
The Market Place

• For instance...

![Supply and Demand Graph](image-url)
The Market Place

- People who have the
  - Endowments
    - Parents
    - Individuals
      - Capacities and capabilities

- Determine success

- Disparities populations...
Health Disparities

- Determinants of health and health disparities

- Five dimensions of HD
  1. Race/ethnicity
  2. Socioeconomic status
  3. Geography
  4. Age
  5. Gender
Health Disparities

- Climate change affects the most vulnerable
  - R/E minorities
  - Lower SES
  - Rural
  - Aged
  - Women
<table>
<thead>
<tr>
<th>Poverty (2003):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family of 4: $18,810;</td>
</tr>
<tr>
<td>Family of 3: $14,680;</td>
</tr>
<tr>
<td>Family of 2: $12,015; and</td>
</tr>
<tr>
<td>Unrelated individuals: $9,393.</td>
</tr>
</tbody>
</table>

- People in poverty 35.9 million (12.5%)
Health Disparities

- Race and Hispanic Origin
  - Non-Hispanic whites was 8.2% (44% of all people in poverty).
  - Blacks: 24.4%
  - Asians: 11.8%
  - Hispanics: 22.5%
  - AIAN: 23.2%

- Age
  - For all children under 18: 17.6% (12.9 million)
  - People 18 - 64 years: 10.8%
  - People > 65 years: 10.2%
Health Disparities

- Health disparities populations most affected
  - Property most prone
  - Cannot engage in defensive behavior
  - Cannot recover at same rate

- Catastrophes
  - Large cuts in social programs
    - Most deserving most affected
But, what about...?

- China and India?
  - Developmental stage
  - Technology transfers

- Help depends on nationalists
  /sovereign or globalists
  - Concentric circles of loyalty

- Human rights approach
- Interdependence
### Why take action?

- **Moral and Ethnical Obligation**

- **Economic Costs**
  - Poor most affected
  - Spillover effects (negative externalities)
    - Increasing conflicts

- **Tied Prosperity**
  - Within and beyond borders
<table>
<thead>
<tr>
<th>GCC</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>False</td>
<td>Depression</td>
</tr>
<tr>
<td>True</td>
<td>SAFE</td>
</tr>
</tbody>
</table>
Time to take action!
<table>
<thead>
<tr>
<th>What should we do?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>Change &gt; carbon neutral</strong></td>
</tr>
<tr>
<td>• <strong>The way we live</strong></td>
</tr>
<tr>
<td>– Reduce</td>
</tr>
<tr>
<td>– Recycle</td>
</tr>
<tr>
<td>– Recycle (Buy)</td>
</tr>
<tr>
<td>• <strong>Big 3</strong></td>
</tr>
<tr>
<td>– Automobile (Built environment)</td>
</tr>
<tr>
<td>– Home (Built environment)</td>
</tr>
<tr>
<td>– Energy</td>
</tr>
</tbody>
</table>
What should we do?

- Depends on how we define health...
  - “...physical, social and mental wellbeing...”

- Depends on what we consider the determinants of health are...
  - Extended view
  - Interconnectedness
What can we do?

- Back to basics—
  - “fulfill society’s interest in assuring conditions in which people can be healthy.” IOM. 1988

- Assessment
- Policy Development
- Assurance
What can we do?

- Empowerment
  - Freire. *Pedagogy of the oppressed*

- Alinsky. *Rules for radicals*

- Public health leadership
  - Agenda setting
  - Moving from focusing on diseases and conditions to
    - Environmentalism and resource conservation
What can we do?

- Get involved
  - Talk about it

- Advocacy

- The Hunger Site

- Care2connect
What can we do?

- Agenda setting
  - The 3 streams and window of opportunity
    - Problem: Agreement
    - Policy: Solution
    - Political stream: on the agenda

- Incrementalism v. punctuated equilibrium

Kingdon 1984
In conclusion...

- Full circle
  - Property, power, people and progress
  - There are widespread consequences of CC

- Economic impacts are huge

- Health disparities: population most vulnerable

- Action needed
Thank You!

- Comments

- Questions

- Contact
  - arekere@iupui.edu