Lecture 2-
Planetary Health Dimensions

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Climate Change: Health Impact Pathways

Physical systems:
(river flow, vegetation, soils, ocean temp, etc.)

Economic/social impacts:
infrastructure, economic productivity, jobs, coastal displacement, resource-related conflict/warfare

Biological & ecological processes

Direct ("primary") impacts (extreme weather, heatwaves, air pollution)

Human Health
- Injuries/deaths; mental stress
- Thermal stress impacts
- Infectious diseases
- Under-nutrition
- Mental stresses
- Trauma/deaths

Indirect ("secondary") impacts, ecologically-mediated: changes in food, water, mosquitoes

Indirect ("tertiary") health impacts - socially & politically mediated
LECTURE FOCUS -
Link between human activities and Health

Malaria dilemma - Present benefits vs discounted costs

Legacy of Lead Poisoning?

Energy Crisis, Air Pollution and Health outcomes!
Malaria burden

The sensitivity of the vector borne diseases like malaria, to climate change continues to raise considerable concerns over the implications of climate change on future disease dynamics.

Malaria resurgence and changes in the mosquito behaviour being reported in the country and also in the Southern Africa sub-region could be attributed to changes in the climate among other factors.
A study was done using health data from the HMIS and Climatic data of high malaria transmission areas.

Results showed that the incidence of confirmed malaria cases in Zambia increased by 0.2% with every 1 mm increase in rainfall (P = .028).

Correlations with humidity indicated that malaria incidence increased by 2% for every 10% increase in humidity (P = .294).

The correlation between rainfall and all malaria cases was positive and highly significant (r = 0.197; P = .0006).
MALARIA DILLEMA - Background

Malaria is still a leading cause of death and hospital admissions in Zambia;

Mostly affected are pregnant women and children;

To address this, the Ministry of Health in Zambia put into place an Integrated Vector Management (IVM) strategy which includes Indoor Residual House Spray with DDT among other chemicals.
What is DDT?

• Dichloro Diphenyl Trichloroethane

  ▫ **Persistent Organic Pollutant (POP)**
    • unique combination of physical & chemical properties:
    • resist degradation in environment, breakdown products- DDE, DDD and DDA also stable (i.e. persistent)
    • low, but significant, vapor pressure (“semi-volatile”) leads to distribution in all environmental media

• **Banned under the Stockholm Convention but allowed for Public Health use in some countries.**
DDT Bioaccumulation and
Magnification

From Miller, Living in the Environment, Brooks-Cole.
What is the problem?

- Several studies have shown that DDT causes thinning of bird egg shells and finds its way into the food chain if improperly handled.
- DDT is an endocrine disruptor and has been shown to cause human health effects.
Evidence of Carcinogenicity and Cancer in Humans:

- Rated as “a possible carcinogen” Group 2b by the International Agency for Research on Cancer (IARC).

- Liver cancer- Mc Glynn et al, 2000- the risk of liver cancer was elevated in Chinese men with the highest blood levels of DDT- OR= 3.8; 95% CI, 1.7-8.0.

Two studies done on occupationally exposed men in the US and Australia found a 7.4 fold higher risk of pancreatic cancer deaths.
Evidence of Consequences to the fetus

• increased risk of fetal loss in previous pregnancies; *

• high breast milk DDE concentrations were associated with shorter lactation duration. **

*Longnecker et al, 2005.
Evidence of Reproductive consequences

• Reduced Male fertility-
  • low semen volume,
  • impaired sperm motion parameters including % of motile sperm.
  • Low sperm quality and count.

• Reduced female fertility-
  • long menstrual cycles,
  • earlier age of menopause,
  • delays in conception.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Study Population</th>
<th>Setting</th>
<th>Evidence of effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Rogan et al, 1986</td>
<td>Neonates</td>
<td>USA</td>
<td>Yes</td>
</tr>
<tr>
<td>2. Sagiv et al, 2008</td>
<td>Neonates</td>
<td>USA</td>
<td>Yes-irritability</td>
</tr>
<tr>
<td>3. Gladden et al, 1988</td>
<td>6-24 MONTHS</td>
<td>USA</td>
<td>No</td>
</tr>
<tr>
<td>4. Darvell et al, 2000</td>
<td>6-12 months</td>
<td>USA</td>
<td>No</td>
</tr>
<tr>
<td>5. Ribas-Fito et al, 2003</td>
<td>13 months</td>
<td>Spain</td>
<td>Yes-cognitive, motor and social development</td>
</tr>
<tr>
<td>6. Eskananzi et al, 2006</td>
<td>6 and 12 24 months</td>
<td>Mexican-American children (USA)</td>
<td>Yes and No</td>
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<tr>
<td>7. Ribas-Fito et al, 2006</td>
<td>4 and 5 years</td>
<td>Spain</td>
<td>Yes-general cognitive, memory etc</td>
</tr>
<tr>
<td>8. Torres-Sanchez et al, 2007</td>
<td>3, 6 and 12 months</td>
<td>Mexico</td>
<td>Yes- psychomotor</td>
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</tbody>
</table>

**Review of Selected Studies on Neurodevelopmental Effects of DDT on Children**
Why is DDT still in use for malaria control?

- Malaria burden resurgences
- Still recommended by WHO for IRS
- DDT has never been banned by MoH for IRS
- Documented insecticide resistance to other chemicals
- Research into viable alternatives to DDT not done
There were no significant differences in concentrations by the areas.
Environmental parameters

<table>
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<tr>
<th></th>
<th>Chawama</th>
<th>Chongwe</th>
<th>Mongu</th>
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<tbody>
<tr>
<td>Water bodies</td>
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<td>Yes</td>
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<td></td>
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<td>No</td>
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<td>Crops</td>
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<td>Livestock</td>
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<td>Yes</td>
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<td>No</td>
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</tr>
<tr>
<td>Location</td>
<td>Where?</td>
<td>Sampling year</td>
<td>DDTs (ng/g d.w.)</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------</td>
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</tr>
<tr>
<td>Spain</td>
<td>Top soil ~5 cm</td>
<td>1990</td>
<td>14.7</td>
</tr>
<tr>
<td>Mexico</td>
<td>Top soils ~10 cm</td>
<td>2006</td>
<td>66.5</td>
</tr>
<tr>
<td>Uganda</td>
<td>Top soils ~15 cm.</td>
<td>2004/05</td>
<td>59</td>
</tr>
<tr>
<td>China</td>
<td>Top soils ~10 cm</td>
<td>2007</td>
<td>45</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>Top soils ~25 cm</td>
<td>1992–2009</td>
<td>34.2</td>
</tr>
<tr>
<td>Zambia</td>
<td>Top Soils 5 cms</td>
<td>2012</td>
<td>106.71</td>
</tr>
</tbody>
</table>
Summary of Survey results

<table>
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<tr>
<th>It was also found that an average of 65% of houses where chemicals were in use had both children under five and pregnant women.</th>
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<tbody>
<tr>
<td>100% of the houses were the government had undertaken IRS had both pregnant women and children under five.</td>
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</table>
Pb  Lead

Atomic Number: 82
Atomic Mass: 207.20
We made it to the top 10!!!
What is Lead?

Lead is a blush gray metallic element which occurs naturally (in small amounts) in the earth’s crust.

It is dense, hence its use as a ballast, ammunition, or radiation shield.

Lead is insoluble in water, but some salts are soluble.
Lead - Absorption

- Inhalation
- Dermal
- Orally
- Consumed Lead Absorbed In Place of Calcium

CHILDREN – 30-50% OF LEAD
ADULTS – 5-10% OF LEAD

Increased During Pregnancy
There were significant differences in BLL concentrations by the areas.
There were significant differences in ND scores by the areas. *except FM domain*
Caregiver’s Concerns

- Child has a problem with appetite, mother had hearing complications in childhood
- Child has eye problems often and there is a history of hearing problems in the family
- Mother is concerned about child’s weight and lack of interaction with others
  - Child has delayed speech and was not feeling well, child is very hyperactive
  - History of hearing impairment in older sibling
- Child had malaria and anemia, child fights a lot, child gets sick a lot
  - Child has delay in speech and he is not walking yet
- Child has speech problem, child walked for three days of which after she stopped
- Child has delayed in speaking, the child's paternal uncle has a hearing problems
- Child is too much quite, the aunt has hearing problem, the child had fever
ENERGY CRISIS!!!!
Background

- The shortage of electricity has been increasing –this has been attributed to reduced water levels at Kariba North Bank, Kafue Gorge and Victoria falls (Banda, 2006; CSO 2010).
- Unsustainable harvesting of trees and use of charcoal has adverse effects both on human health and the environment.
- Respiratory infections have been ranked among the top two causes of mortality in Zambia since 2013.
- These illnesses can be acute or chronic in their manifestation.
Background ctd

• Climate change affects respiratory health in a variety of ways and pathways.
• This is both directly through Greenhouse Gas emissions and indirectly by exacerbating already existing conditions including asthma and bronchitis.
• Coping mechanisms to the energy crises has seen households resorting to using cooking fuels that have harmful levels of indoor pollutants.
• Scientists also predict rising incidence of allergies and respiratory diseases as warmer air grows more charged with pollutants, mould spores and pollens.
Justification

Public health linkage to energy use and negative health outcomes are under researched in Zambia.

Understanding the dynamics of the energy and health relationship will help develop sustainable energy measures.

Provide policy makers an insight to establish efficient and well rounded measures to safeguard health.

Contribute to the body of knowledge

- enhance multi-sectoral collaboration among key energy using organs for well rounded and efficient long term policies
- Enlightenment on importance of formulating and enforcing local indoor air guidelines and regulations.
ENERGY OPTIONS

- Charcoal: 94.45%
- Firewood: 0.18%
- Crop residue: 0.18%
- Gas: 0.36%
- Electricity: 0.18%
- Wooden Pellets: 3.40%
Location of cooking sites

- Indoor
- Indoor and Outdoor
- Outdoor

2020/12/03
Air Pollution Measurements in Matero Households

INDOOR POLLUTANT LEVELS AND WHO LIMITS

- **PM 10**: WHO Limits - Charcoal, Wooden palletes
- **PM 2.5**: WHO Limits - Charcoal, Wooden palletes
- **PM 1.0**: WHO Limits - Charcoal, Wooden palletes
- **Volatile organic compounds**: WHO Limits - Charcoal, Wooden palletes
- **Formaldehyde**: WHO Limits - Charcoal, Wooden palletes
- **Carbon Monoxide**: WHO Limits - Charcoal, Wooden palletes
Indoor Air Pollutants

- carbon monoxide
- hydrogensulphide
- volatile organic compounds
- combustibles
- formaldehyde
- PM1.0
- PM2.5

Air Quality Index:
- Purple: Very unhealthy (201-300)
- Red: Unhealthy (151-200)
- Orange: Unhealthy for sensitive groups (101-150)
- Yellow: Moderate (51-100)
- Green: Good (0-50)
Findings related to Children

428 (75%) of the sampled households had children living there;

Reported that they cooked with children in the same area.

Burns and fires were reported in 18 households with half of these having children present.
Reported health effects

- Coughing
- Sneezing
- Rapid pulse rate
- Fatigue
- Unconsciousness
- Dizziness
- Throat dryness

- Tears
- Runny nose
- Headache
- Chest pain
- Red eyes
- Swollen eyes
- Shortness of breath
After statistical analysis, it was revealed that cooking indoors with closed windows was significantly associated with prevalence of respiratory conditions. This therefore implies that households have to improve their ventilation status since a significant number cook from inside their houses.
Daubed/mud-thatched houses
IS IT ALL DOOM AND GLOOM????
How do we change the horizon???

Transformation of how we “do” Science!!

Move from the laboratory like settings where everything is at “STP”;

Translate the knowledge, innovations into packaged interventions that will meet various societal and ecosystem needs.
ARE THESE ENOUGH????
• PLANETARY HEALTH - FROM KNOWLEDGE TO TRANSFORMATIVE CHANGE,
  Local Solutions
  Go back to the communities
We need to make a choice between Present benefits vs discounted costs.
• Conducting Training programs that eliminate geographical barriers;
• Integrating Planetary Health thinking into traditional teaching resources;
• Sharing of resources across the global divide;
• Holistic, transdisciplinary thinking and action.
Reflections for developing countries

- Housing design, water reticulation systems
  - Rural and urban planning implications
- Integrated vector control that takes into account climatic variations, social determinants and other ecological factors
  - Total homestead environment approach that looks at the entire planet.
“One of the most alarming aspects of the chemical pollution of water is the fact that here—in river or lake or reservoir, or for that matter in the glass of water served at your dinner table—are mingled chemicals that no responsible chemist would think of combining in his laboratory.”

RACHEL CARSON
SILENT SPRING
THE EARTH IS IN OUR HANDS
Vielen Dank!!
Dzikomo Kwambiri!!

Questions are welcome