A Toolkit for Eco-epidemiological Enquiry Under Global Ecological Change

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Can epidemiology remain relevant in the face of global ecological change?

“We seem to have been living for a long time on the assumption that we can safely deal with the parts, leaving the whole to take care of itself. But now the news from everywhere is that we have to begin gathering up the scattered pieces, figuring out where they belong, and putting them back together. For the parts can be reconciled to each other only within the pattern of the whole to which they belong.”

- Wendell Berry (b. 1934)
Contemporary global-scale issues with major human health implications

→ *complexity through globalization*

- **Global geo-climatic system changes** (e.g., global warming, sea level ↑, ocean acidification); Permafrost melting with releases of Methane (CH$_4$) and CO$_2$ levels continuing to ↑
- **Population growth**; rapid urbanization; development of mega-cities; Mass forced and voluntary migrations
- **Expansion of consumption-intensive lifestyles** (e.g., into China and India, each with 1B + populations)
- **Over-fishing of the oceans**; fish stock imbalances
- ↑ **global & within-country disparities**; ↑ **social dis-ease**
- **Fresh water declines** everywhere
- **Resurgence of old diseases and emergence of new** (e.g., malaria and tuberculosis, HIV/AIDS, SARS)
- **Species extinctions**; the loss of biodiversity
- **Growth-bound paradigm is entrenched**; consume & waste
- **Global debt/money crisis**; the threat of economic collapse
Problem definition

- Epidemiology is not well-equipped to address human health problems associated with global consumption and production practices driving ecosystem degradation in local or in distant locales.

- Development of new methods and concepts is needed for epidemiology to contribute usefully to this realm of major emerging health concerns.
Eco-epidemiology

A sub-specialty of epidemiology, focusing on the relationships between human health and the dynamics of global ecological change.

... Colin Soskolne (2003)
Eco-epidemiology – recent evolution

A term applied to ecological influences on human health

Mervyn Susser used the term within a conceptual approach that unifies molecular, clinical, and social epidemiology in a multilevel application of methods aimed at identifying causes, categorizing risks, and controlling public health problems.

A perspective that balances traditional biomedical concepts of risk with the broader social and environmental context.

Epidemiology, Environmental Epidemiology, and Eco-epidemiology

A proposed revised definition is:

The study of the relationships between human health and ecosystem health, which may be observed at micro, meso and macro levels. Examples include:

i. invasion of the micro ecosystem of the vagina by pathogens such as streptococcus leading to toxic shock syndrome (a micro level example);

ii. alteration of a marine ecosystem off the Pacific coast of South America by fluctuating water temperature that led to proliferation of zooplankton when water temperature rose. These zooplankton had a symbiotic relationship to cholera vibrio that were introduced by a ship from India. The result was a cholera epidemic with half a million cases and several thousand deaths (a meso level example); and

iii. global climate change could lead to disruption of essential life-supporting ecosystems with potentially catastrophic consequences for human health (a macro level example).
Dualism vs. Complexity Paradigms

- Reductionism vs. Holism
- Predictability vs. unpredictability
- Linear vs. non-linear
- Uncertainties acknowledged
- Deterministic vs. non-deterministic
- System equilibrium vs. instability
Toolkit – a glimpse at 3 of 8 tools

- Integrated Assessment
- Integrated Scenario Analysis
- Participatory methods
- Ecological Footprint Analysis (EFA) and Disaggregated EFA
- The DPSEEA model
- Product Life-Cycle Analysis (PLCA)
- I=PAT
- Kuznets curves
Integrated Assessment (since 1996)

“A structured process of dealing with complex issues, using knowledge from various scientific disciplines and/or stakeholders, such that integrated insights are made available to decision-makers”

Rotmans, 1998
Integrated Assessment - Applied

- A systems-based perspective
- Holistic and integrated (disciplinary) approach, providing perspectives for addressing global health issues
- Greater emphasis on understanding processes (pathways) than on prediction (cause and effect)
- Interdisciplinary approach is required
- Makes explicit multiple interactions that exist between natural, economic and social systems
Participatory Methods

- Policy exercises and focus groups
- Linked to ‘post-normal science’
  (Functowicz and Ravetz, 1994)
- Involvement of relevant stakeholders
Participatory Methods - Applied

- Focus groups elicit preferences, opinions, and viewpoints
- Participatory modeling allows stakeholders to explore the implications of their ideas
- In scientist-stakeholder workshops, a research agenda can be formulated
- By stakeholders identifying key issues, a range of possible futures can be explored
- In policy exercises, participants assume different roles to simulate a decision-making process
I=PAT \ldots \textit{Ehrlich and Holdren (Science, 1971)}

\textbf{Impact} = \textbf{Population} \times \textbf{Affluence} \times \textbf{Technology}

Stresses the interdependence of forces which often are treated independently as needs for “population control,” “reduced consumption,” or “green technologies”. It helps in making our values and assumptions transparent
In addressing threats to global life-supporting ecosystems, determinants at play are stressors relating to each of the need for controlling population growth, over-consumption, and inappropriate uses and abuses of technology.

The interplay of all determinants is critical for their recognition, investigation, and in formulating policy.
Summary (1 of 3)

- **Integrated Assessment**: Interdisciplinary approach provides understanding of cross-linkages and pathways under complexity.

- **Integrated Scenario Analysis**: Permits understanding of where current trends will lead.

- **Participatory Methods**: Provides a mechanism for broadening understanding of complex issues.
Summary (2 of 3)

- **Ecological Footprint**: provides comparative measure of gross demand on the biosphere

- **Disaggregated EFA**: connects our consumption patterns with ecological impacts relevant to population health

- **DPSEEA**: Helps free us from being “prisoners of the proximate” to look at powerful distal determinants of health
Summary (3 of 3)

- **Product Life-Cycle Analysis**: assists in identification of source ecosystems affected by consumption/production practices.

- **I=PAT**: Reminds us to treat population growth, consumption, and technological issues interdependently.

- "**Kuznets**" curves: help in hypothesis generation.
Recommendations

Improve basic ecological, economic, sociological, geopolitical, and systems thinking education among epidemiology students

Encourage and support transdisciplinary eco-epidemiological investigations of real-world, globalized industrial practices
Thank you

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