Topic A: Challenges of managing uncertainty of low dose effects in chronic public exposure situations, Science Aspects-Focus on Epidemiology

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Professor and Division Leader
I have no competing financial interests to declare
Outline

Introduction to Disaster Epidemiology

Disaster Epidemiology Methods

Historical Development of Disaster Epidemiology within our context
Objective

To understand the role of epidemiologists in the *practice* and *research* efforts after environmental public health disasters
Context- Hill’s Causal “Criteria”

Strength of the association
Consistency
Specificity
Temporality
Biological gradient
Plausibility/Coherence
Experiment
Analogy

Smoking and Lung Cancer
Epidemiologic Focus- Etiologic research
Disaster Epidemiology

Epidemiology is a **clinical** science, a clinical **practice**. **Our patient is a population**, not just a person.

In disaster applications our role is to **treat our patient**, not just study them.

**Environmental public health disaster victims are not laboratory rats.**
What *can* be done?

What *should* be done?
"The reason for collecting, analyzing and disseminating information on a disease is to control that disease. Collection and analysis should not be allowed to consume resources if action does not follow."

William H. Foege, M.D.

*International Journal of Epidemiology* 1976; 5:29-37
Research View

“Ultimately, as perverse as it may sound, epidemiologists must view disasters as important opportunities to learn about the etiology of disease, the relation between exposures and responses, the efficacy of surveillance systems, the strength of emergency response measures, and the intervention strategies that may reduce the burden of future disasters.”

Domenici, Levy, Louis; *Epidemiologic Reviews*; 2005
Research as a Part of Public Health Emergency Response

Nicole Lurie, M.D., M.S.P.H., Teri Manolio, M.D., Ph.D., Amy P. Patterson, M.D., Francis Collins, M.D., Ph.D., and Thomas Frieden, M.D., M.P.H.

In the past decade, a succession of public health emergencies has challenged preparedness and response capacities of government agencies, hospitals and clinics, public health agencies, and academic researchers, in the United States and abroad. The epidemic of the severe acute respiratory syndrome (SARS) in 2003, to the H5N1 avian influenza

Lurie, NEJM, March, 2013
Practice View

Good Public Health

Good Research

Svendsen, et. al., 2010
Focus: “What *should* epidemiologists do?” Not “What *can* we do?”

- Prevent epidemics of disease and injury following disaster events
- Mitigate the effects of epidemics of disease and injury that do occur following disaster events
- Prevent secondary epidemics of recurrent, long-term, and chronic disease following disaster events
- Evaluate the efficacy of public health interventions
### Disaster Epidemiology Methods

#### Practice-based Methods
- Disease Surveillance
- Outbreak investigations
- Cluster investigations
- Exposure registries
- Public health interventions
- Evaluation studies

#### Research-based Methods
- Ecologic studies
- Cohort studies
- Case-control studies
- Cross-sectional studies
- Quasi-experimental studies
- Experimental studies
Conflicting Interests

Disaster Epidemiology Practice vs.

Disaster Epidemiology Research

Practice - giving to

Research - taking away

Available Services

Victims Needs
Strengths of Disaster Epidemiology Research Studies

Randomization
Exposure distribution
Discrete population
Unity

Scale of exposures allow for studies which cannot be done experimentally due to ethical limitations


Natural Experiments, Quasi-experiments
Quasi-experimental designs

Used frequently in

› Public health evaluations to demonstrate the efficacy of disease control measures
› Environmental epidemiology - to study the health effects of novel exposures that cannot be studied with RCTs due to ethical concerns

Can correlate strongly with results from randomized controlled trials if internal validity is maximized
Quasi-experimental designs

Types of bias

› Population level trends/cycles
› Other concurrent uncontrolled interventions
› Selection bias (using appropriate control groups)

Strongest design: natural experiment

› Where exposure is randomly distributed in an uncontrolled fashion under naturally occurring circumstances such that the design resembles an experiment

Types of specific designs

Interrupted time series
Regression discontinuity
Pre-post tests, either with or without controls
Stochastic changes in time
Regression Discontinuity Designs in Disaster Epidemiology

Dietary supplementation with radionuclide free food improves children's health following community exposure to $^{137}$Cesium: a prospective study

Daria M. McMahon¹, Vitaliy Y. Vdovenko², Yevgenia I. Stepanova², Wilfried Karnaus³, Hongmei Zhang³, Eulidez Irving⁴ and Erik R. Svendsen⁵*
Reduced Lung Function in Children Associated with Cesium 137 Body Burden

Erik R. Svendsen\textsuperscript{1,2}, Igor E. Kolpakov\textsuperscript{3}, Wilfried J. J. Karmaus\textsuperscript{4}, Lawrence C. Mohr\textsuperscript{2}, Vitaliy Y. Vdovenko\textsuperscript{3}, Daria M. McMahon\textsuperscript{5}, Benjamin A. Jelin\textsuperscript{1}, and Yevgenia I. Stepanova\textsuperscript{3}

\textsuperscript{1}Tulane University, New Orleans, Louisiana; \textsuperscript{2}University of South Carolina, Columbia, South Carolina; \textsuperscript{3}Research Center for Radiation Medicine, Academy of Medical Sciences of Ukraine, Kyiv, Ukraine; \textsuperscript{4}University of Memphis, Memphis, Tennessee; and \textsuperscript{5}Medical University of South Carolina, Charleston, South Carolina

Table 4. The logistic association of log-transformed weight-adjusted Cesium 137 whole-body burden (Bq/kg) with lung function outcomes in the Narodichi Children’s Cohort, Narodichesky, Ukraine, 2008–2010 (n = 517)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Odds Ratio</th>
<th>95% Confidence Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restrictive impairment</td>
<td>1.51</td>
<td>1.18–1.93</td>
</tr>
<tr>
<td>FEV\textsubscript{1} &lt; lower limit of normal</td>
<td>1.03</td>
<td>0.82–1.28</td>
</tr>
<tr>
<td>FVC &lt; lower limit of normal</td>
<td>1.54</td>
<td>1.20–1.97</td>
</tr>
<tr>
<td>Bronchodilator responsiveness</td>
<td>1.18</td>
<td>0.93–1.51</td>
</tr>
</tbody>
</table>

Models are adjusted for number of cigarettes/day, secondhand smoke, antibiotics use, dog exposure, cat exposure, and coal/coke/wood stove use. Restrictive impairment: FVC < lower limit of normal and FEV\textsubscript{1}/FVC > lower limit of normal (37); bronchodilator responsiveness is a ≥12% improvement in FEV\textsubscript{1} or FVC and a ≥200-ml volume increase (36).
Potential Weaknesses in Disaster Epidemiology Research Studies

No baseline health data (rarely healthy)

**Poor exposure estimation**

Discrete $n$

Urgency

Contrasting science needs vs. public health needs

Community distrust

Resources- human and financial

Potential confounding with traumatic effects

Potential selection biases

Potentially confounded by disparate medical care


Health Disparities, Secondary Surge

The Impact of Disasters on Populations With Health and Health Care Disparities

Jennifer R. Davis, MSPH; Sacoby Wilson, PhD; Amy Brock-Martin, DrPH; Saundra Glover, PhD; Erik R. Svendsen, PhD

ABSTRACT

**Context:** A disaster is indiscriminate in whom it affects. Limited research has shown that the poor and medically underserved, especially in rural areas, bear an inequitable amount of the burden.

**Objective:** To review the literature on the combined effects of a disaster and living in an area with existing health or health care disparities on a community’s health, access to health resources, and quality of life.

**Methods:** We performed a systematic literature review using the following search terms: disaster, health disparities, health care disparities, medically underserved, and rural. Our inclusion criteria were peer-reviewed, US studies that discussed the delayed or persistent health effects of disasters in medically underserved areas.

**Results:** There has been extensive research published on disasters, health disparities, health care disparities, and medically underserved populations individually, but not collectively.

**Conclusions:** The current literature does not capture the strain of health and health care disparities before and after a disaster in medically underserved communities. Future disaster studies and policies should account for differences in health profiles and access to care before and after a disaster.

*(Disaster Med Public Health Preparedness. 2010;4:1-9)*

**Key Words:** disaster, health disparities, health care disparities, medically underserved, surge capacity

Davis, et. al., *Disaster Med Public Health Preparedness*, 2010
FIGURE 3—Potential timeline scenarios for secondary surge of primary care need and health system capacity in postdisaster recovery, (a) no change in primary care need during phase II; (b) increased demand for primary care exceeds pre-event capacity in the weeks and months following the disaster but returns to baseline a year after the disaster; (c) increased demand for primary care exceeds system capacity in the weeks, months, and years following the disaster and does not return to pre-event baseline; and (d) baseline health disparities, characterized by excess unmet primary care need exceeding maximum system capacity pre-event, perpetuate unmet primary care in long-term phase II disaster recovery.

Runkle, et. al., AJPH, 2012
Issue: Scientific Evidence for evidence-based decision making

Hurricane Andrew, 1992: Introduction of Rapid Needs Assessment through cluster sampling

Use the minimum level of design complexity necessary
Public Law 106–390  
106th Congress  

An Act  

Oct. 30, 2000  
[H.R. 707]  

To amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act to authorize a program for predisaster mitigation, to streamline the administration of disaster relief, to control the Federal costs of disaster assistance, and for other purposes.  

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,  

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.  

(a) SHORT TITLE.—This Act may be cited as the “Disaster Mitigation Act of 2000”.  

(b) TABLE OF CONTENTS.—The table of contents of this Act is as follows:
Preventing for Disaster

The cataclysmic eruption of Mount St. Helens on May 18, 1980 resulted in displacement of one and one-half cubic kilometers of mountain covering over 100 square miles of the "blast zone" with volcanic debris destroying all in its path and claiming the lives of at least 63 people who were voluntarily or mistakenly caught within the "blast zone." For several reasons, the relatively few individuals killed in this disaster must be considered fortunate:

- The timing of the eruption coming at 8:00 AM on a Sunday morning reduced not only the number of hikers in the area who might have ignored warnings to the public, but also the number of loggers who had been working in certain restricted areas under permit.
- The direction of the primary blast to the more sparsely populated north and northeast rather than the more populous Columbia River Valley was clearly a factor.
- And the role of the National Geological Survey in forecasting the approximate time and the area likely to be affected by the eruption was an important factor.

The Mount St. Helens eruption also provided a major test for federal, state, and community disaster plans. For those of us involved in the immediate public health response, Mount St. Helens provided some important lessons in organizing a disaster team, in documenting the impact on the public's health, and in preparing for future disasters. The Biological Effects of Volcanic Ash (BEVA) monograph that is the subject of the supplement to this issue of the Journal provides a planning model for future volcanic eruptions and other major disasters. It should be viewed in its broadest context.

Within the past year, three other major public health disasters have occurred.

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Challenges to these recommendations

Northridge Earthquake
San Francisco Earthquake
*Hurricane Hugo, Coastal South Carolina*
Hurricane Andrew, South Florida

Flood of 1993
Fran, Floyd
Oklahoma City Bombing
9/11
Hurricanes Katrina/Rita
Practice vs. Research in Disaster Epidemiology

Disaster Epidemiology Review

Ethics - when to research, when not to
› Beneficence, justice, susceptibility
› Priorities
› Timing
› Practice vs. Research

Benefits
› Natural experimental design
› Novelty

Limitations
› Urgency
› Ethics
› Reference group
› Lack of exposure data
› Risk communication

A poorly done study makes things worse and wastes valuable resources
The following correspondence was sent on January 22, 2016, to authorities in Japan including

Ms. Tamako Kitajima, Director General, Environmental Health Department, Ministry of the Environment Government of Japan

Mr. Hirohiko Kabayashi, Chief, Department of Health and Welfare, Section for Fukushima Health Management Survey

Ms. Tamayo Morikawa, Minister of the Environment (ascertained), Ministry of the Environment Government of Japan

On behalf of environmental epidemiologist, we at the International Society for Environmental Epidemiology (ISEE), the largest international professional organization for such scientists, are concerned about the recent scientific evidence suggesting an increase in the risk of thyroid cancer among residents of Fukushima that is much higher than previously anticipated.

The recently published study1 demonstrates a 12-fold higher risk of developing thyroid cancer among residents of Fukushima compared to the rest of the Japanese population. This is an exceptionally high risk, as pointed out in the commentary to the published paper. This study builds on previous concerns about the lack of appropriate data and studies to monitor the long-term impact of the Fukushima nuclear disaster on local residents. Preliminary results of the study were presented at a special Symposium, organized at the ISEE Annual Meeting in Sao Paulo in September 2015. The discussion at the Symposium demonstrated great scientific interest of the Society members in follow up of health consequences of Fukushima accident.

The study illustrates the need for the on-going, systematic screening of the population affected by the accident, enabling early detection and treatment of the cases of thyroid cancer. Besides direct benefits to the affected population, such prospective study has great value for building up global knowledge about risks of ionizing radiation.

We appeal to the government as the stakeholder serving the interest of the people, to develop a series of measures to scientifically document and follow up the health of residents of Fukushima and to better understand and estimate the risks from the accident that happened in 2011. We believe that detailed monitoring of population exposure to radiation possibly remaining in the environment after the accident remains necessary both for scientific and preventive reasons. Such studies would provide invaluable contribution to the global body of knowledge on health consequences of nuclear accidents and ways for reducing such risks in affected populations.

ISEE would be available to assist and support studies where needed by utilizing the expertise of its members. We would be interested to know if, and how, you would envision the involvement of ISEE as an independent international professional organization.

We would appreciate hearing back your perspective regarding our letter and your future plans regarding this important matter.

Sincerely,

Francine Laden PhD
President of ISEE

cc: World Health Organization

1 Tenders I et al, Thyroid Cancer Detection by Ultrasound Among Residents Aged 10 Years and Younger in Fukushima, Japan: 2011 to 2014. Epidemiology 2015 DOI: 10.1097/EDE.000000000000035
Case-study: What should we do?

Thyroid screening

Risk Communication

ISEE 2015, Sao Paulo, Brazil

Public Health practice vs. research

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Introduction to Disaster Epidemiology

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Questions?