

ANALYSIS OF CANCER RISKS IN POPULATIONS NEAR NUCLEAR FACILITIES: PHASE 1

OURANIA KOSTI, PROGRAM OFFICER
KEVIN D. CROWLEY, STUDY DIRECTOR

NRC'S FUEL CYCLE INFORMATION EXCHANGE FCIX 2011
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THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

TOPICS TO BE ADDRESSED

- National Academies organization
- Study request
- History of the concern
- Epidemiologic study design (basic concepts)
- Examples of past studies
- Study task
- Study schedule
- Committee expertise and membership
- Work plan

NATIONAL ACADEMIES ORGANIZATION

The National Academies

- National Academy of Sciences (NAS)
- National Academy of Engineering (NAE)
- Institute of Medicine (IOM)
- National Research Council (NRC)

Congressionally chartered (1863)

Private & nonprofit

“Advisors to the Nation on Science, Engineering, and Medicine”

STUDY REQUEST

- U.S.NRC approached NAS to update the 1990 NCI study
 - ecologic study, county level data, mortality as endpoint
 - no data on exposures
 - included only facilities that were operational as of 1982
- NAS agreed to carry out a two-phase study
 - Phase 1: Scoping study to identify scientifically sound approaches for carrying out the cancer risk assessment
 - Phase 2: Cancer risk assessment informed by Phase 1 results

HISTORY OF THE CONCERN

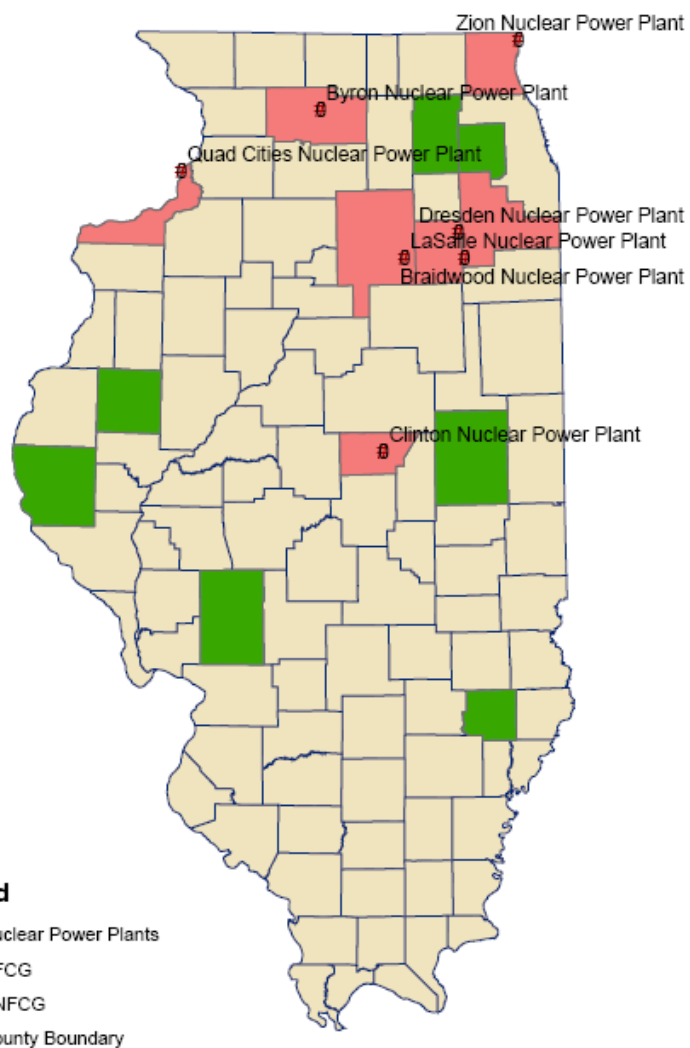
- 1983, UK: television documentary entitled *Windscale: The Nuclear Laundry* reports an excess of childhood leukemia around Sellafield reprocessing plant
- 1984, UK: government sets up an Advisory Group which confirms the observation but also reports that the estimated discharges could not account for the observed incidence based on available knowledge
- 1983-today: ~ 50 independent studies, >10 countries, different epidemiologic study designs, inconclusive findings

MAIN TYPES OF EPIDEMIOLOGIC STUDIES

TYPE OF STUDY		CHARACTERISTICS
EXPERIMENTAL		Studies preventions and treatments for diseases; investigator actively manipulates which groups receive the agent
OBSERVATIONAL		Studies causes, preventions and treatments for diseases; investigator passively observes as nature takes its course
ANALYTICAL DESCRIPTIVE	COHORT	Typically examines multiple effects of an exposure; subjects are defined according to their exposure levels and followed for disease occurrence
	CASE-CONTROL	Typically examines multiple exposures in relation to a disease; subjects are defined as cases and controls and exposure histories are compared
	CROSS-SECTIONAL	Examines relationship between exposure and disease prevalence in a defined population at a single point in time
	ECOLOGIC	Examines relationship between exposure and disease at population level rather than individual level data

Adapted from Aschengrau and Seage III, Essentials of Epidemiology in Public Health, 2003 Jones and Barlett Publishers International

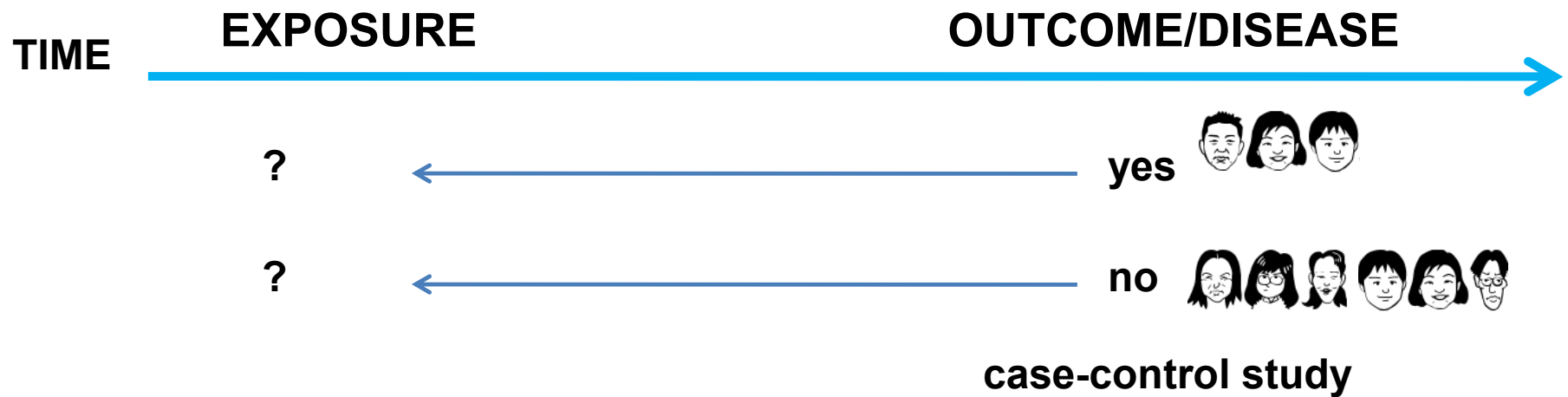
ECOLOGIC STUDY DESIGN



NFZG = nuclear facility ZIP code group
NNFZG = non-nuclear facility ZIP code group

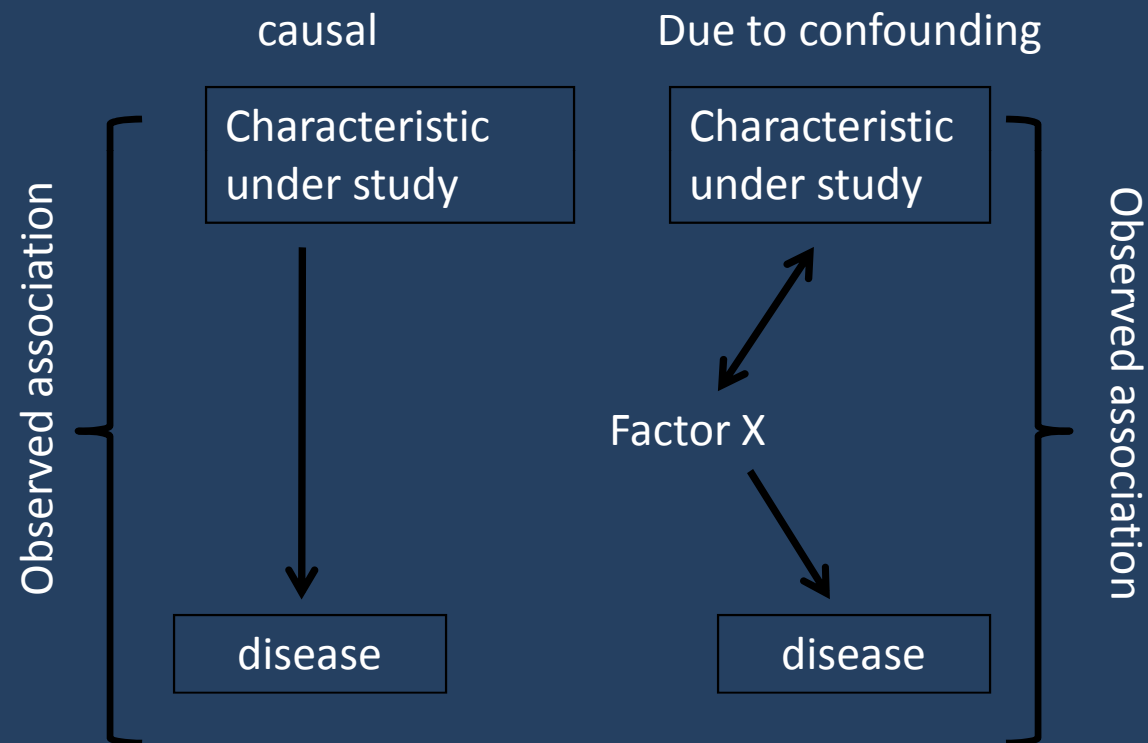
Publication of the Illinois Department of Public Health, 2006

CASE CONTROL AND COHORT STUDIES



FROM ASSOCIATION TO CAUSATION

- If an association is observed, is it real?
- If an association is real, is it causal?



Cancer in Populations Living Near Nuclear Facilities

A Survey of Mortality Nationwide and Incidence in Two States

Seymour Jablon, MA; Zdenek Hrubec, ScD; John D. Boice, Jr, ScD

Int. J. Cancer: 1220, 721–726 (2008)
© 2007 Wiley-Liss, Inc.

FAST TRACK

Leukaemia in young children living in the vicinity of German nuclear power plants

Peter Kaatsch^{*}, Claudia Spix, Renate Schulze-Rath, Sven Schmiedel and Maria Blettner

The incidence of childhood leukaemia around La Hague nuclear waste reprocessing plant (France): a survey for the years 1978–1998

Childhood leukaemia incidence below the age of 5 years French nuclear power plants

Dominique Laurier^{1,*}, Denis Hémon², and Jacqueline Clavel²

British Journal of Cancer (1996) 73, 672–679
© 1996 Stockton Press. All rights reserved 0007–0920/96 \$12.00

Leukaemia and non-Hodgkin's lymphoma in young persons resident in small areas of West Cumbria in relation to paternal preconceptional irradiation

R Wakeford¹ and L Parker²

Br. J. Cancer (1989), 59, 476–485.

© The Macmillan Press Ltd., 1989

Geographical variation in mortality from leukaemia and other cancers in England and Wales in relation to proximity to nuclear installations, 1969–78

British Journal of Cancer (2006) 94, 1342–1347
© 2006 Cancer Research UK. All rights reserved 0007–0920/06 \$30.00
www.bjcancer.com

Childhood leukaemia incidence around French nuclear installations using geographic zoning based on gaseous discharge dose estimates

Results of case-control study of leukaemia and lymphoma among young people near Sellafield nuclear plant in West Cumbria

A-S Evrard^{1,2}, D

Martin J Gardner, Michael P Snee, Andrew J Hall, Caroline A Powell, Susan Downes, John D Terrell

Incidence of leukaemia and other cancers in birth and school cohorts in the Dounreay area

Roger J Black, James D Urquhart, Stephen W Kendrick, Kathryn J Bunch, Jan Warner, David Adams Jones

Population mixing and leukaemia in young people around the La Hague nuclear waste reprocessing plant

O Boutou^{*,1,2}, A-V Guizard³, R Slama², D Pottier⁴ and A Spira²

Example 1: ecologic study, Jablon et al., 1991, US **(the 1990 NCI study)**

Setting, outcome measure and subjects: 107 exposed counties around 62 nuclear installations (includes reprocessing, weapon) in the US , 1950-1984, cancer mortality (limited incidence data), 16 cancers, all ages

	Relative Risk (RR)	
	Pre-start up*	Post-start up*
Leukemia, 0-9 y	1.08	1.03
Childhood cancers (excl. leukemia)	0.94	0.99
Leukemia, all ages	1.02	0.98
All cancers, all ages	1.00	1.01

* of nuclear installation

Example 2: case-control, Kaatsch et al., 2008, Germany

Setting, outcome measure and subjects: 593 leukaemia cases , <5 years, diagnosed between 1980 and 2003 and 1766 matched population controls, close to 16 West German nuclear power plants

	OR	Lower 95%-CL	Cases in the 5-km zone (N)
All leukaemias			
≤5 km to >5-km zone	2.19	1.51	37
≤10 km to >10-km zone	1.33	1.06	95

Example 3: descriptive study, Evrard et al., 2006, France

Setting, outcome measure and subjects: 23 nuclear installations in France, incidence of childhood leukemia , 1990-2001

		Estimated dose due to gaseous release ($\mu\text{Sv}/\text{year}$)							
		<u>0.045-0.072</u>		<u>0.072-0.316</u>		<u>0.316-1.0</u>		<u>≥ 1.0</u>	
	No. COM	O	E	O	E	O	E	O	E
Total NPPs	1583	22	28.03	95	88.39	23	25.54	3	8.58
SIR (95% CI)		0.78 (0.49-1.19)		1.07 (0.87-1.31)		0.90 (0.57-1.35)		0.35 (0.07-1.02)	

O=observed
E=expected

STATEMENT OF TASK (1)

1. Methodological approaches for assessing off-site radiation dose, including consideration of:
 - Pathways, receptors, and source terms
 - Availability, completeness, and quality of information on gaseous and liquid radioactive releases and direct radiation exposure from nuclear facilities
 - Approaches for overcoming potential methodological limitations arising from the variability in radioactive releases over time and other confounding factors
 - Approaches for characterizing and communicating uncertainties

STATEMENT OF TASK (2)

2. Methodological approaches for assessing cancer epidemiology, including consideration of:
 - Characteristics of the study populations (e.g., socioeconomic factors, all age groups, children only, and nuclear facility workers)
 - Geographic areas to use in the study (e.g. county, zip codes, census tracts, or annular rings around the facility at some nominal distances)
 - Cancer types and health outcomes of morbidity and mortality

STATEMENT OF TASK (3)

- Availability, completeness, and quality of cancer incidence and mortality data
- Different epidemiological study designs and statistical assessment methods (e.g., ecologic or case-control study designs)
- Approaches for overcoming potential methodological limitations arising from low statistical power, random clustering, changes in population characteristics over time, and other confounding factors
- Approaches for characterizing and communicating uncertainties

STUDY SCHEDULE

- Study approved by NAS: July 2010
- Provisional committee appointed: December 2010
- First committee meeting: February 24-25, 2011
- Final report released to U.S.NRC and public:
December 31, 2011
- Sponsor and public comments on Phase 1 report:
January-February 2012

COMMITTEE EXPERTISE

- Biostatistics
- Contaminant fate and transport
- Environmental exposure monitoring
- Epidemiology
- Public health and medicine
- Radiation dosimetry
- Radiobiology
- Social science/risk communication
- Toxicology

COMMITTEE MEMBERSHIP

John E. Burris, Chair, Burroughs
Wellcome Fund

John C. Bailar, III, University of Chicago
(retired)

Harold L. Beck, Environmental
Measurements Laboratory (retired)

Andre Bouville, National Cancer Institute
(retired)

Phaedra S. Corso, University of Georgia

Patricia J. Culligan, Columbia University

Paul M. DeLuca, Jr., University of
Wisconsin

Raymond A. Guilmette, Lovelace
Respiratory Research Institute

George M. Hornberger, Vanderbilt
Institute for Energy and Environment

Margaret Karagas, Dartmouth University

Roger E. Kasperson, Clark University
(retired)

James E. Klaunig, Indiana University

Timothy Mousseau, University of South
Carolina

Sharon B. Murphy, University of Texas
Health Science Center (retired)

Roy E. Shore, Radiation Effects
Research Foundation

Daniel O. Stram, University of Southern
California

Margot Tirmarche, Institute of Radiation
Protection and Nuclear Safety

Lance Waller, Emory University

Gayle E. Woloschak, Northwestern
University

Jeffrey J. Wong, California
Environmental Protection Agency

WORK PLAN

Meeting # 1: Organizational meeting, (Washington DC, February 24-25)

Meetings # 2 – 5: Regional meetings

#2 Chicago (April 18-19)

#3 Atlanta (May 23-24)

#4 Los Angeles (July 20-21)

#5 TBD (August 29-30)

- obtain briefings from subject-matter experts
- solicit public input
- tour facilities

Meeting #6: finalize report for NAS review

QUESTIONS, COMMENTS OR SUGGESTIONS?

Please contact us:

Dr. Kevin D. Crowley, study director
kcrowley@nas.edu

Dr. Ourania (Rania) Kosti, program officer
okosti@nas.edu

Phone: 202-334-3066

Website: <http://dels.nas.edu/global/nrsb/CancerRisk>