

SYLLABUS

PM 553: EXPOSURE ASSESSMENT FOR PUBLIC HEALTH

Dr. Scott Fruin, Assistant Professor
Environmental Health Division
Dept of Preventive Medicine
Keck School of Medicine
phone: (323) 442-2870
email: fruin@usc.edu

Time: Tuesdays, 4-7:30 pm
Location: Soto Building, Health Sciences Campus
Office Hours: TBD
Pre-requisites: For MPH students, PM 510. For other graduate students, one semester of statistics, or instructor permission.

DESCRIPTION

PM 553 provides an overview of all aspects of environmental exposure assessment. Exposure assessment is a key component of environmental health and the goal of much of environmental monitoring. This class will cover all major exposure media (air, water, food, soil, etc.) and all important pathways (inhalation, ingestion, absorption, etc.). It will also include exposure assessment study design, the strengths and weaknesses of various exposure assessment techniques, and how to link exposure assessment with environmental health.

GOALS

This course has four broad goals:

1. Present the history of exposure assessment as well as the current state of the science
2. Detail the most important human exposures by source, media (air, water, etc.) and route of exposure (inhalation, ingestion, etc.)
3. Present the various techniques of assessing exposure by route of exposure
4. Review and critique seminal exposure assessment literature

COMPETENCIES

Upon completing the course, the student will meet the following MPH competencies:

1. Understand the importance of accurate exposure assessment in environmental health;
2. Understand the key challenges in accurately assessing exposure and time-activity patterns that affect exposure;
3. Understand the differences in assessing exposure for: a) different health outcomes, b) different routes of exposure, and c) acute versus chronic health effects;
4. Understand how to weigh and evaluate the associated strengths and weaknesses of various exposure assessment techniques to select the most appropriate methods to characterize a given exposure;

5. Know how to evaluate potential environmental exposure differences based on a person's activities, lifestyle, occupation, and living location, and what to recommend for effective and practical exposure reduction techniques tailored to this information;
6. Understand how different chemical properties affect chemical transport and fate and how this affects exposure assessment;
7. Appreciate the role of uncertainty in exposure assessment, how to best characterize uncertainty statistically, and the role of uncertainty in evaluating exposure;
8. Know how to apply appropriate statistical methods to measurement data;
9. Know how to evaluate and interpret exposure assessment literature.

COURSE COMPONENTS:

The class time will consist of lectures (~one third), critiques of important papers in the field (~one third), and lab exercises (~one third).

1. Lectures

Each week the course professors will provide lectures on major exposure assessment topics

2. Readings and critiques

There is no text. Each week, text chapters will be provided. Text chapters are frequently from "Exposure Analysis" Wayne Ott, editor, Taylor & Francis Group, 2007 and "Exposure Assessment in Occupational and Environmental Epidemiology" Oxford Medical Publications by Mark J. Nieuwenhuijsen, 2003.

Scientific articles related to the lecture material will also be provided for evaluation and critique in an open discussion format. An emphasis is on covering state-of-the-art studies, so the articles listed are subject to change.

Students will be expected to have not only read the material, but to also be have synthesized the material well enough to offer thoughtful critiques of the research presented in the articles and participate in class discussion.

3. Lab exercises

Lab exercises will cover exposure assessment study design, measurement and analysis of environmental measurements, and analysis of uncertainty. All exercises will have practical relevance to real-world situations or be real measurements. Written and oral presentations will be geared toward work setting standards (short, concise, clear writing, and effective oral presentations).

GRADING:

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|-----|-------------------------------------|
| 25% | Lab 1: Exposure Reduction Exercise |
| 25% | Lab 2: Exposure Simulation Exercise |
| 25% | Midterm exam |
| 25% | Final exam |

There will be two in-class, open-book exams consisting of short answer or short essay questions covering lecture, course reading material and lab exercises.

WEEK BY-WEEK LIST OF TOPICS AND READINGS:

Jan 14, Week 1. The Importance and Challenges of Exposure Assessment.

Class overview. The history and importance of exposure assessment. Overview of basic statistical assumptions and special statistical aspects of environmental data relevant to assessing environmental exposures.

Lab One: Week 1, Intro to electromagnetic fields (EMFs), how to measure, how to reduce exposure, why important. Variability versus uncertainty.

Jan 21, Week 2. Exposure Assessment Overview: Differences by Media and the Role of Chemical Properties.

Overview of exposure assessment including the most important exposures by pathway (inhalation, ingestion, etc.) and media (air, water, etc.). How chemical properties affect contaminant fate and transport. Overview of the various techniques of exposure assessment.

Read: Chapter One - Exposure Analysis, Ott, W. editor (class text)

Chapter One - Introduction to Exposure Assessment, Nieuwenhuijsen, editor

Optional but recommended. (Required if no previous background in epidemiology):

Chapter Two: Toxicology. (Richardson and Miller) (from Frumkin, H. "Environmental Health. From Global to Local."):

Chapter Three, Epidemiology. (Steenland and Moe) *An excellent and concise summary.*

To critique:

Shuz et al., "Cellular Telephone Use and Cancer Risk: Update of a Nationwide Danish Cohort." J of the Nat Cancer Inst. 2006. *Are cell phones risk free?*

Lab One: Week 2, Checking on EMF measurement results, questions.

Jan 28, Week 3. Air Pollution Overview.

Major sources of outdoor air pollution; air pollution regulations; air quality trends; dilution, fate and transport of air pollutants

Read: Frumkin, Ch. 14: Air Pollution

Ott, Ch. 8: Exposure to Particles

To critique:

Dockery, D. et al. "An association between air pollution and mortality in six U.S. cities." New England J of Medicine, 1993. Perhaps the most famous air pollution epidemiology paper. *Large mortality differences associated with average PM2.5 and PM10 concentrations.*

Lab One: Week 3, Discussion of EMF measurement results, questions, uncertainty analysis.

Feb 4, Week 4. Estimating Exposures to Ambient Air Pollution. Air Pollution Epidemiology in Los Angeles.

LA as an air pollution success story. Air pollution epidemiology and the USC Children's Health Study. Estimating exposures from outdoor measurements.

To critique:

Week 3: Gauderman, J. et al. "Effect of exposure to traffic on lung development from 10 to 18 years of age: a cohort study." (2007) Lancet. *A seminal Children's Health Study paper linking roadway proximity to lung function.*

Lab Two: Week 4, Overview of measurement simulation lab. Strengths and weaknesses of ambient air measurements.

Feb 11, Week 5. More Refined Spatial Assessments of Outdoor Air Pollution.

Dispersion models, land use regression models, kriging, spatial models; time-activity patterns and GIS; near-road exposures.

Read: Nieuwenhuijsen, Ch. 4: Geographic Information Systems

Ott, Ch. 4. Inhalation, Exposure, Uptake, and Dose.

To critique:

Henderson et al., "Application of Land Use Regression to Estimate Long-Term Concentrations of Traffic-Related Nitrogen Oxides and Fine Particulate Matter." ES&T, 2007. *One of the best LUR studies to date. PM measures also included, rare for LUR models.*

Larson et al., "Mobile Monitoring of Particle Light Absorption Coefficient in an Urban Area as a Basis for Land Use Regression." ES&T, 2009. *An excellent, hybrid model combining LUR techniques with mobile monitoring. Clever distributional analysis showed different contributions from different fuel types.*

Lab Two: Week 5, Strengths and weaknesses of dispersion modeling results. Should you buy them?

Lab One: Week 5, Short oral presentations of EMF results.

Feb 18, Week 6. Environmental Justice: Is Proximity an Adequate Exposure Surrogate?

The history of environmental justice; environmental versus other socioeconomic disparities; the role of exposure assessment in EJ; defining environmental injustice; case studies of EJ; risk assessment; cumulative risk

Read (one will be critiqued, TBD):

Maantay et al. Mapping environmental injustices: pitfalls and potential of Geographic Information Systems in assessing environmental health and equity. *Envl Hlth Persp*, 2002.

Payne-Sturges et al. Personal exposure meets risk assessment: a comparison of measured and modeled exposures and risks in an urban community. *Envl Hlth Persp*, 2004.

Morello-Frosch et al. Separate and unequal: residential segregation and estimated cancer risks associated with ambient air toxics in U.S. metropolitan areas *Envl Hlth Persp*, 2006.

Balazs, C. et al. Social disparities in nitrate-contaminated drinking water in California's San Joaquin Valley, *Envl Hlth Persp*. 2011

Lab One: Week 6: EMF lab write-ups due

Lab Two: Week 6, Strengths and weaknesses of micro-environmental measurements (indoor, in-vehicle, etc.). Importance of air exchange rates.

Feb 25, Week 7. Traffic: Transport as a Potent Route of Exposure.

Overview of traffic emissions pollution, measurement; near-road exposures; in-transit exposures; special measurement challenges of high variability environments; intermodal comparisons. Airports as a source.

Read (one will be critiqued, TBD):

Fruin, S. et al. Measurements and predictors of on-road ultrafine particle concentrations and associated pollutants in Los Angeles. *Atm Env.* 2008.

McCreanor, J. et al. Respiratory effects of exposure to diesel traffic in persons with asthma. *New Eng. J of Med.*, 2007

McNabola, A. et al. Relative exposure to fine particulate matter and VOCs between transport microenvironments in Dublin: personal exposure and uptake. *Atm. Env.* 2008.

Lab Two: Week 7: Strengths and weaknesses of personal exposure measurements

Mar 4, Week 8. Water Pollutants and Exposure: Why Bottle Water?

Water sources; common surface water and ground water contamination problems; overview of water treatment and sewage treatment processes; evolution of water quality standards; important water-related exposures including arsenic and other metals, disinfection by-products; challenges in assessing water exposure. Review of water quality reports

Read: Frumkin, Ch. 18, Water and Health

To critique:

Bouchard et al. Intellectual impairment in school-age children exposed to manganese in drinking water. *Envl Hlth Persp*, 2011.

Lab Two: Week 8: First round (of three) simulation sampling choices due. Questions.

Mar 11, Week 9. House Dust and other Multi-Pathway Exposures.

The importance of the home indoor environment in inhalation exposures including multiple routes of exposure such as house dust for semi-volatile compounds like flame retardants (PBDEs); indoor pollutants of greatest concern; other indoor microenvironments such as inside vehicles, etc.; micro-environmental monitoring and modeling; the role of time activity patterns; questionnaires as an assessment tool. Inside-to-outside differences.

Read: EHP overview of PBDE flame retardants

Nieuwenhuijsen, Ch. 2 "Questionnaires"

To critique:

Imm et al., "Household Exposures to Polybrominated Diphenyl Ethers (PBDEs) in a Wisconsin Cohort." *Envl Health Persp.* 2009. *One of the best studies comparing PBDE levels in materials, house dust and air with blood concentrations.*

Lab Two: Week 9: Second round of simulation sampling choices due. Questions.

Spring recess Mar 18.

Mar 25, Week 10 Midterm

Apr 1, Week 11. Exposure to Lead and other Toxic Metals

Most important routes of exposure to lead and other metals; neurological effects of metals and possible relationship to crime rates.

Read: McCally, Ch. 4. Toxic Metals

Mother Jones, "America's Real Criminal Element, Lead." 2013. *Is crime decreasing because of reductions in lead exposure?*

To critique:

Lamphear et al., "Environmental lead exposure during early childhood." The Journal of Pediatrics, 2002. *House dust Pb and blood concentrations*
Wright et al., Association of Prenatal and Childhood Blood Lead Concentrations with Criminal Arrests in Early Adulthood." PLoS Medicine, 2008.

Lab Two: Week 11: Third round of simulation sampling choices due

Apr 8, Week 12. Endocrine Disrupting Chemicals: Is Obesity a Symptom?

A revisit of key chemical properties that determine environmental fate and transport; overview of bioaccumulation; persistent organic pollutants compounds with multi-media routes of exposure; introduction to hormonal properties of endocrine disruptors, types, effects. Possible effects of EDCs on obesity. Exposure assessment aspects of EDCs.

Read: McCally, Ch. 13. Risk Assessment.

Summary on endocrine disruptors, National Institute of Environmental Health Sciences
The Learning Curve, Nature

Overview of Obesogens, Envl Hlth Persp. 2012

To critique: Valvi et al., "Prenatal Concentrations of Polychlorinated Biphenyls, DDE, and DDT and Overweight in Children: A Prospective Birth Cohort Study." EHP, 2012.

Apr 15, Week 13. Food Exposures and Bioaccumulation.

Pesticide, POPs, and metal exposures through food ingestion; toxins produced by cooking; the value of organic farming; bioaccumulation; mercury in fish and effects of health advisories;

To critique:

Debes et al., "Impact of prenatal methylmercury exposure on neurobehavioral function at age 14 years." Neurotoxicology and Teratology. 2006. *The primary study behind current advisories regarding pregnant women and fish intake.*

Wier et al., "Titanium Dioxide Nanoparticles in Food and Personal Care Products." Envl Sci & Tech, 2013. *Little-known but common use of nano-particles as a whitener in food.*

Lab Two: Week 13: Short oral presentations of simulation results

Apr 22, Week 14. Radiation Exposure: The Most Feared but Least Understood

The physics of radiation; ionizing and non-ionizing radiation; electromagnetic fields. Sources of exposure; measuring exposure; UV radiation.

Read: Frumkin, Ch. 24, Radiation

To critique:

Darby et al., "Radon in homes and risk of lung cancer: collaborative analysis of individual data from 13 European case-control studies." British Medical Journal, 2004.

Lab Two: Week 14: Simulation write-ups due

Apr 29, Week 15. Noise Exposure: Is It All in Your Head?

The physics of noise; how noise is measured; sources of noise, what affects exposure; perception of noise; traffic noise versus air pollution.

Read: McCally, Ch. 8. UV Radiation

Seto, E. et al. Spatial distribution of traffic induced noise exposures in a US city: an analytic tool for assessing the health impacts of urban planning decisions. Intl J of Hlth Geographics. 2007

Selander, J. et al. Saliva cortisol and exposure to aircraft noise in six European countries. *Envl Hlth Persp.*, 2009.

As time permits: Biomarkers: Accurate but Costly.

Direct measurements of exposure, biomarkers. The advantages and disadvantages of biomarker methods to assess exposures. How to evaluate if a biomarker is an appropriate measure of exposure.

Read: Ott, Ch. 5, Personal Monitors

Ch. 11, Biological Monitoring

Rappaport, S. et al. The relationship between environmental monitoring and biological markers in exposure assessment. *Envl Hlth Persp.*, 1995.

May 6, Study week, no class.

May 13, Week 17 Final Exam.