Society for Risk Analysis - New England

NEW RESEARCHER POSTER SESSION
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New Researcher Poster Abstracts

Gellyfish – An in-situ equilibrium-based sampler for determining multiple free metal ion concentrations in aquatic systems

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Free ions are thought to be the most bioavailable metal species to aquatic organisms, yet they are also hard to measure at naturally occurring levels using currently available techniques, not to mention that they tend to co-exist as mixtures in natural waters. Here an in-situ sampling tool for determining multiple free metal ions in aquatic systems was developed and refined. The method is based on equilibrium between metal ions and iminodiacetate binding groups within the gel matrix of the sampler, and equilibration can be achieved in about a day. Apparent stability constants were measured for the binding products involving five metals, Cu, Zn, Pb, Ni, Cd, and tested in a series of metal competition experiments. The results suggested that UltraThin Gellyfish samplers, along with a spreadsheet model we developed to calculate free ion concentrations from the Gellyfish measurements, were useful tools for monitoring the free ion levels in metal mixtures. Compared to other sampling tools for free metal ions, Gellyfish is inexpensive, quick, recyclable, easy to use, and has the potential advantages of sampling multiple metals simultaneously and generating large quantities of data with much less effort. Thus it may serve as a powerful new instrument for assessing ecological exposure to multiple heavy metals in natural aquatic systems.

Pesticide exposure as independent predictor of neurological functioning and blood pressure in Ecuadorian school children.

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Objectives: To study pesticide exposure during pregnancy and at present in school-age children and its association with several health outcomes.
Methods: In a community in northern Ecuador with intensive floriculture and a high female employment rate, we invited 87 eight-year-olds attending a local public school for clinical testing. These included physical audiometric, neurophysiologic (delayed brainstem evoked potential latencies) and neuropsychological examination in addition to electro cardiogram testing. The maternal interview was used to gather information about

the occupational history and to determine pesticide exposure during pregnancy. Current pesticide exposure was assessed by urinary excretion of organophosphate metabolites.
Results: 96 % of the eligible children participated in the study. 35 children were considered exposed to pesticides during pregnancy because of direct maternal exposure and 23 indirectly through paternal exposure. 22 children showed detectable levels of current exposure. Only the children from direct maternal exposure during pregnancy showed consistent negative results among several neuropsychological outcomes after covariate adjustment, including stunting: Motor speed and coordination (Finger Taping: beta (SD) = -5 (2.2)); visual performance (Stanford-Binet Copying Test: beta (SD) = 0.48 (0.24)); and visual memory (Stanford-Binet Recall Test: OR (CI) = 10.24 (1.45-72.15)). Among the other health outcomes studied, only systolic blood pressure (beta (SD) = 4.5 (2.2)) was positively associated with maternal pesticide exposure during pregnancy. These results confirmed the previous pilot study.
Conclusions: Eight-year-olds with maternal exposure to pesticides during pregnancy are at higher risk than similar eight-year old children to show deficits in neuropsychological functioning and higher levels of blood pressure. The other outcomes studied didn't show significant differences between the groups.

Fish consumption and mercury exposure in a US recreational fishing population

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The goal of this study was to characterize fish consumption and mercury (Hg) exposure in a group of recreational anglers in coastal Louisiana. During summer-fall of 2006, 534 recreational anglers living in Louisiana were recruited either at dockside or through a web-based survey. Anglers completed a questionnaire detailing how frequently they consumed 88 different types of fish and shellfish from both recreational and commercial sources. Hair samples were collected from 402 anglers and analyzed for total Hg. Anglers' median hair-Hg concentration was 0.81 μg/g (range: 0.02-10.7 μg/g). Total Hg intake was estimated for each participant by combining self-reported frequency of consumption of each fish type with fish Hg concentration data from regionally specific databases. Multivariable linear regression models indicated that consumption of finfish from all sources ($p<0.0001$) and estimated total Hg intake ($p<0.0001$) were both significantly associated with hair-Hg after controlling for age, gender, BMI, race, education, and type of survey (web or in-person). Of the total Hg intake calculated across the group, more than 60% came from intake of recreationally caught fish and shellfish. Our results suggest that anglers in coastal Louisiana are more highly exposed to Hg than the general US population, and that their consumption of a wide variety of fish species, particularly recreationally caught species, contributes to this exposure. Assessments of

exposure and risk in this and similar groups should account for local consumption patterns and region-specific fish types and fish Hg levels.

Contact angle and defect size resolution: A probabilistic examination of the EPAs pressure based integrity test for low-pressure membranes applied to drinking water treatment

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Low-pressure, hollow fiber membranes must undergo daily direct integrity tests (DIT) under the US EPA's Long-term-2 Enhanced Surface Water Treatment Rule (LT2ESWTR). This test for broken fibers or defects must be sensitive to contributions as small as 3 micrometers to determine the degree to which the membrane is a barrier to oocyts of the smallest disinfectant resistant waterborne pathogen, *Cryptosporidium*. We report on a probabilistic analysis of the pressure based DIT. We solve for the Defect Size Resolution (*DSR*) and back calculate the maximum tolerable variability and/or uncertainty in a key variable, the contact angle. Where the *DSR* exceeds 3 microns the integrity test is not valid, the presence of an absolute barrier to oocyts can not be confirmed, and in theory any number of defects large enough to allow oocyts to pass may be present but not detected by the DIT. Distributions for applied test pressures, pore shape correction factors, and maximum hydraulic back pressure are derived from literature, theory, practice and estimation. Surface tension variability is modeled using annual temperature profiles representative of the Niagara, Missouri and Sacramento Rivers. Contact angle measurement error and variability from membrane fouling, roughness and aging, polymer oxidation, grafting, and reorientation, and drop–age is derived from literature and combined with the discrete values applied in current designs. Finally a Probability Bounds Analysis (PBA) will be performed, bounding a 2-D MC analysis and providing an analyses of sensitivity to assumptions of independence or possible correlations between the contact angle and surface tension.

Environmental impact assessment of wastewater irrigation in Syria's Aleppo Region

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Rapid increase in urban population growth and higher living standards in Syria have increased water use in urban settings, thereby generating greater volumes of wastewater. Farmers having access to wastewater tend to use it for irrigation because of its year round reliable availability, savings on fertilizers (wastewater contains nutrients), and less cost than pumping groundwater.

Irrigation with untreated, partially treated, or diluted wastewater has environmental and health implications. A joint ICARDA-IWMI study in Syria's Aleppo region addresses environmental impact assessment of wastewater irrigation. The study found the presence of excess salts in the irrigation water. Currently, these levels have little impact on crop yield, but prolonged use of this water using current irrigation methods may render the land unusable for agriculture.

An algal toxicity database of organic toxicants derived by a closed-system technique

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This study presents the toxicity data of 90 organic compounds with various modes of actions, to *Pseudokirchneriella subcapitata.* The assessment was conducted using a closed system technique and a biomass-type endpoint based on the cell density was employed. The above toxicity data were compared with test results from ciliate (*Tetrahymena Pyriformis*), water flea (*Daphnia magna*), fish (*Pimephales promelas*), and luminescent bacteria (*Photobacterium phosphoreum*, Microtox). Satisfactory correlation relationships between toxicity data from algae and other aquatic organisms were found with the square of correlation coefficient (r^2) varied from 0.66 to 0.82. *Pseudokirchneriella subcapitata* revealed considerably higher sensitivity to organic toxicants compared with other organisms. Benzenes, aldehydes, and alkanes were also found to be highly selective to the test alga. In addition, results from the present study show that conventional algal batch tests tend to underestimate the toxicity of organic compounds, except for the case of 4-chlorophenol. Toxicity observed from the closed system test is approximately 2 to 380 times higher than that estimated by the conventional batch tests. Such a phenomenon can be found in nearly all organic compounds, regardless of the chemical's Henry's law constant. In the risk assessment of chemicals, following the European Union's practice, approximately 30% (7 out of a total of 23) of the cases may result in a more strict classification when the batch test is replaced by the closed system test. More effort is therefore needed to revise the algal toxicity database using the closed system test method.

Characterization of the economic and public health impacts of traffic congestion

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Traffic volumes are anticipated to increase in upcoming decades, which could contribute to increased economic and public health impacts. Increased congestion is associated with greater tailpipe emissions for multiple air pollutants, increased time in a high-exposure microenvironment, increased fuel utilization and vehicle costs, and lost time and productivity. Previous studies have quantified subsets of these impacts but have not considered them jointly in a single analytical framework, and have rarely considered the influence of time-varying factors. In this study, we project population and traffic density out to 2030 for various metropolitan areas in the United States. We estimate increases in time spent in traffic, reductions in vehicle speeds, and increasing periods of congested conditions under different transportation infrastructure scenarios. We use MOBILE6.2 to estimate emissions given changes in vehicle technologies and speeds, and we link emissions estimates for particulate matter and particle precursors with models linking emissions with population exposure in different areas of the country. We estimate particle-related premature mortality impacts in monetary terms, accounting for changes over time in the age distribution of the population. We similarly estimate time trajectories of the economic value of lost productivity and vehicle expenses. Comparisons among these impact categories allow us to determine the dominant contributors to monetized impacts at different points in time and the degree to which this varies across different metropolitan areas. In the long term, our analysis provides a basis for optimal design of congestion mitigation measures.

Evaluating heterogeneity in risk to pesticides for children living in an urban low-income environment.

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Abstract: In urban low-income multi-unit dwellings, pesticide exposures may be elevated due to frequent applications to address pest infestation. Non-dietary exposures in the urban indoor environment may therefore contribute significantly to aggregate exposure in this high-risk subpopulation. Even within a single housing development, doses may vary substantially as a function of pesticide concentrations, time-activity patterns, diet, age, genetic polymorphisms, or other factors that influence exposure-dose relationships. Understanding drivers of dose variability and factors that put children at risk for elevated pesticide doses could inform future interventions. To quantify and compare sources of variability in pesticide doses, we linked physiologically based pharmacokinetic (PBPK) models for organophosphates and pyrethroids with exposure models for these compounds. Pesticide residue and dust concentrations were collected from 42 low-income dwellings within the Boston Healthy Public Housing Initiative. We simulated exposures by fitting distributions to the measurements, incorporating correlations

between pesticides, and linking this information with simulated activity patterns. We built PBPK models for the organophosphates diazinon and chlorpyrifos and for the pyrethroids permethrin, cypermethrin and cyfluthrin. PBPK model parameters were modified to assess variability due to polymorphic enzymes, using enzyme parameter data from the literature. We compared doses to other non-dietary and dietary doses to understand contribution to aggregate dose, and assessed variability in delivered doses, comparing the contribution to variability from genetic polymorphisms, PBPK model parameters, and exposure and concentration factors. Our analyses suggest substantial variability in delivered doses within a defined subpopulation and allow for refined characterization of heterogeneity in risk.

Modeling P&D truck driver on-road exposure to PM2.5 in Denver, CO

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Integrated samplers have been routinely used to estimate the time-weighted-average (TWA) exposure to particulate matter smaller than 2.5 micrometers in aerodynamic diameter ($PM_{2.5}$) in diesel-heavy environments. The lack of temporal resolution in TWA data is considered as the fundamental problem in determining high exposure scenarios and their contributing factors for mobile study subjects. To assess pickup and delivery truck drivers' on-road exposure patterns to $PM_{2.5}$ while they drive on road, a four-day sampling trip was made at a large truck terminal in Denver, CO in August 2006. Attempts of measuring two drivers were made on each sampling day. On each sampled truck, real-time measurement of in-cabin and regional $PM_{2.5}$ concentration, geographic information of truck location and its surrounding area, metrological and driver behavioral information were recorded throughout its daily routine. In-cabin $PM_{2.5}$ TWA measurements were also taken to compare to their matching real-time readings on moving trucks. Using multivariate AR(1) method, we predicted truck driver's in-cabin exposure as a function of meteorological, geographic and driver behavioral factors combined. The primary advantage of multivariate AR(1) in this setting is the ability to simultaneously predict exposure at each of the thousands of sampling locations along the daily truck route, while accounting for autocorrelation that often presents in real-time measurements. The statistically significant results and high R^2 in the city of Denver supports the broader application of this method in assessing truck driver exposures in other cities of U.S.