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Workshop on Optimizing Exposure Metrics for the National Children's Study

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July 21, 2010

Workshop Goal

Explore and propose innovative exposure metrics and exposure classification schemes for relating environmental exposures during critical windows of development to better understand potential health outcomes of interest.

Approach

- Three areas with clear exposure-to-health outcome linkages were selected:
  - Air pollution and asthma
  - Insecticides and neurological development
  - Endocrine disrupting chemicals and reproductive endpoints
- Three separate workgroups were formed. Each included experts from outside EPA:
  - Epidemiologist
  - Exposure scientists
  - Toxicologist
  - EPA facilitator
- A series of teleconferences were held to address the workgroup charge and develop recommendations for discussion at a face-to-face workshop held on April 12 & 13, 2010 in Research Triangle Park, NC

Framework for Discussions

- Chemicals of interest
- Sources, routes, and pathways of exposure
- Critical time windows of exposure
- Biological samples
- Environmental samples
- Non-measurement approaches (Questionnaires, GIS, etc.)
- Protocol recommendations
- Research recommendations

Chemicals of Interest

- Asthma – PM, NO_2, allergens, endotoxins
- Neurological development – insecticides – organophosphates, pyrethroids, carbamates, fipronil, PBO, future active ingredients
- Endocrine disruption – phthalates, PBDEs, bisphenol A, phytoestrogens, PFCs, perchlorate, triclosan/triclocarban, other phenols, other flame retardants, PCBs, PAHs, and co-exposures of concern (pesticides, organotins, cotinine, mercury, lead)

Critical Time Windows of Exposure – Common Themes for All Three Workgroups

- First trimester – very high importance for exposure assessment
- Third trimester – high importance
- First year after birth – very high importance; exposure samples essential
- Years 1 through 4 – critical time window for exposure – samples should be collected annually if possible
- For endocrine disruption, samples should be collected at puberty (approximately ages 6 to 8 years)
- Critical to understand how a single or short-term measurement can represent exposure during the entire window of susceptibility

Biological Samples

- Blood
  - Mother – 1st trimester (highest priority) and 3rd trimester for persistent chemicals
  - Child – As early in life as possible; annually when possible for persistent chemicals
- Urine
  - Mother – 1st trimester (highest priority) and 3rd trimester for non-persistent chemicals and biomarker metabolites
  - Child – 1st year (highest priority); annually for non-persistent chemicals and biomarker metabolites
- Breast milk – collect if possible for insecticides and EDCs, especially if blood is not available; and collect as dietary source of exposure
- Hair – useful for mercury and nicotine; use if available, but not high priority
- Saliva – useful for cotinine, cortisol, EDCs, and maybe pesticides, but more research is required to implement in NCS

Environmental Samples – All Three Workgroups

- House dust is the highest priority environmental sample to be collected
- Single sample can be collected during the same visit to address all three health outcomes
- Need to measure dust loading in the home (not only concentration)
- Need standardized method
- Vacuuming method appears to be most feasible. But need to evaluate alternatives such as deposition samples or wipes
- Protocol needs to be developed to address collection of single sample for multiple analytes

Asthma Workgroup Recommendations - Pollutant-Based Exposure Metrics

- Combination of measurements and models for exposures to ambient (outdoor) and indoor pollutants:
  - Ambient measurements – using data from existing monitoring networks
  - Ambient modeling – optional enhancement
  - Exposure algorithms – low-cost qualitative/semi-quantitative exposure estimates; more research needed for validation
  - Indoor measurements – priorities would be for dust and particulate matter

Asthma Workgroup Recommendations - Source-Based Exposure Metrics

- Exposures estimated primarily using proximity metrics based on:
  - Questionnaires
  - GIS
  - Geo-databases

Asthma Workgroup Recommendations - Prioritization of Exposure Metrics

- Highest priority - Existing data
  - Ambient monitoring networks, AirNow, National Air Toxics Assessments (NATA), pollen counts
- Level 1
  - Indoor dust measurements, source proximity data
- Level 2
  - Indoor PM measurements, ambient air modeling, algorithms, exposure modeling
- Level 3
  - Supplemental ambient air measurements, other indoor air measurements

Non-Measurement Approaches

- Asthma – use of existing data and modeling approaches (described above); GIS data (must be archived)

- Insecticides – Questionnaires for:
  - Gated questions (pets, occupational, lice treatments)
  - Dietary intake
  - GIS data (must be archived)
  - Pesticide use (not shown to be highly predictive)

- EDCs – Questionnaires for:
  - Phytoestrogens – use of soy formula
  - Product use and inventories have not been shown to be highly predictive for most EDCs that would be present in consumer products; however, product use questions may be useful for young children because of the limited number of products used
  - Consider bar code tracking inventories

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Research Recommendations – House Dust

- Development of methods for relating house dust loading and/or concentrations to exposure in order to effectively use house dust for exposure classification in the NCS; requires systematic analysis of available data
- Evaluation of potential methods (vacuum cleaner dust, settled dust, deposition sampler) for estimating house dust loading of pesticides, other organic chemicals, allergens, and endotoxins
- Development of a method for the efficient and effective sampling, processing, and storage of dust samples
- Development of protocols for documenting storage stability of dust samples for selected EDCs, pesticides, allergens, and endotoxins

Research Recommendations – Air Exposures

- Development of the protocols and modeling approaches proposed by the Asthma workgroup for the exposure metrics for onset and exacerbation of asthma

- Further development of low cost, low burden methods for collection of indoor PM and other pollutants

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Research Recommendations – Blood

- Development and evaluation of adduct techniques on blood spots to characterize infant exposures
- Evaluation of storage stability of blood for analyses of EDCs

Research Recommendations – Urine

- Evaluation of the relevance and applicability of short-term (spot) urine samples for extrapolation to long-term exposures; protocols for collection of urine samples for biomonitoring of non-persistent chemicals need to be developed based on an improved understanding of urinary variability

- Development of new and improved methods for collecting infant urine samples (improved diaper or bag method)

- Development of alternative methods for biological sample collection for non-persistent EDCs and pesticides

Research Recommendations – Non-Measurement Approaches

- Development and evaluation of improved surveys for categorizing dietary exposures to pesticides
- Evaluation of questionnaires to categorize or estimate exposures to pesticides and EDCs; analyze data from EPA/NIEHS Children's Centers studies and other studies and conduct literature reviews and analyses of existing questionnaires and data
- Evaluation of the usefulness of inventories of consumer products (including pesticides) in the home for predicting exposure - they are costly and generally not useful; but, there may be some limited-use products for which inventories may be useful; innovative approaches (eg. bar code tracking) need to be developed
- Development of protocols for collecting and archiving GIS data

Overall Recommendations

- Consider house dust as a high priority environmental measurement in the NCS – conduct evaluations of existing data; develop protocols; evaluate protocols in Vanguard study (potential area for collaboration with EPA-NERL, NCS Scholars program)

- Develop and evaluate workgroup approaches recommended for exposure metrics for the asthma hypothesis (potential collaboration with EPA-NERL)

- Conduct analyses to better understand urinary variability for non-persistent chemicals (potential collaboration with EPA-NERL)