IMPROVING EXPOSURE DATA INPUTS
NEEDED TO ASSESS ENVIRONMENTAL RISKS OF OLDER ADULTS

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AGING INITIATIVE BACKGROUND

A goal of the US EPA's Aging Initiative is the development of a coordinated program to address the environmental health concerns and risks that may confront the nation's rapidly expanding population of older adults. To address health issues, the Office of Research and Development (ORD) Laboratories and Centers are working together to apply the environmental public health paradigm to better understand the relationships between external pollution sources, human exposures, internal doses, early biological effects, and adverse health effects for older adults.

In addition to considering the health effects of exposures on healthy older adults, EPA will use information about aging-related changes in activity, exposure, and pharmacokinetic and pharmacodynamic factors to identify particularly vulnerable subgroups within this diverse population.

It is important to understand the range of older adults' physical activities, activity patterns, and residential locations to understand their potential exposures to environmental contaminants. Those experiencing both higher exposures and increased biological susceptibility may be at elevated risk for adverse health outcomes.

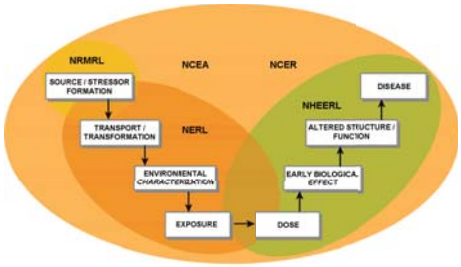

Figure 1. The Environmental Public Health Paradigm and ORD Labs and Centers

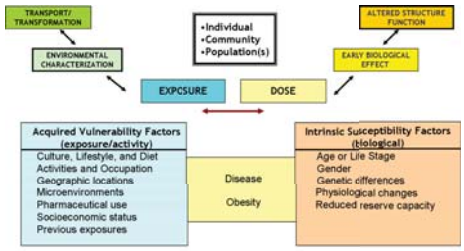

Figure 2. Susceptibility and the Public Health Paradigm

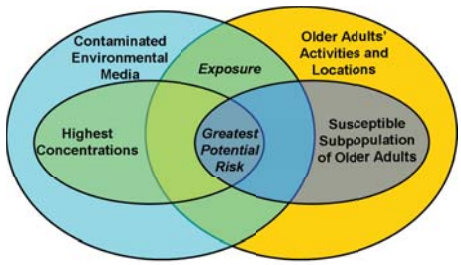

Figure 3. Activity, Exposure, and Susceptibility

SCIENCE ISSUES

There are many uncertainties that must be addressed in the areas of exposure and activity assessment in order to better understand potential risks to environmental stressors in the aging population. These include:

- Which chemical and biological stressors have been associated with impaired health in older populations?
- What is the range of exposures to these stressors for older adults?
- Do exposures to chemical and biological stressors change (increase or decrease) with aging?
- How do aging-related changes in lifestyle, physical activity, activity patterns, locations, pharmaceutical use, and diets affect exposures and pharmacokinetic processes?
- What groups of older persons are more susceptible to risks from environmental exposures? What do we know about exposures and activities for these groups?

IMPACT OF RESEARCH FOR AGING POPULATIONS

- Research on older adults' activities, exposures, and their subsequent pharmacokinetic responses will reduce uncertainties in risk assessment through understanding and elucidating the fundamental determinants of exposure and dose.
- This work will compile and consolidate existing data for use in exposure-to-dose and pharmacokinetic models applicable to aging populations, and will provide additional aging-specific information for the EPA's Exposure Factors Handbook.
- The information will be used by risk managers and risk assessors who need to incorporate the differential susceptibility of this heterogeneous group into decisions affecting risk and public health.

AGING-RELATED RESEARCH IN THE NATIONAL EXPOSURE RESEARCH LABORATORY

Work in the National Exposure Research Laboratory is directed toward characterizing what is known about activity, exposure, and dose for environmental stressors at different life stages in the aging population and to identifying key data gaps. Completed and ongoing research is described in several areas.

EXPOSURE ASSESSMENT

- An outcome-based literature review is being performed to identify chemical and biological stressors that may pose health risks for older adults.
- Information is being compiled on exposures to environmental contaminants for older adults from literature sources and extant databases such as the National Health and Nutrition Examination Survey and the National Human Exposure Assessment Survey.
- Panel studies of exposures experienced by older adults to particulate matter (PM) have been completed in several regions of the country. Longitudinal data were collected for exposures, exposure factors, and activity patterns.

Location	Mean Age	% Retired	% Time Indoors	% Time Outdoors	% Time Other	Mean (Range) $PM_{2.5}$ Personal Exposure (µg/m³)
Baltimore	81	96	94	4	2	13 (6.8 – 25)
Fresno I	82	100	--	--	--	13 (0.4 – 24)
Fresno II	82	100	~91	~8	< 1	11 (7.2 – 16)
RTP I	64	86	84	4	12	28 (7.8 – 86)
RTP II	67	92	85	7	8	22 (8.3 – 100)

Figure 4. Example of Information from Selected PM Panel Studies

ACTIVITY PATTERNS AND PHYSICAL ACTIVITY

- Age-specific information will be compiled for physical activity, activity pattern, location and microenvironment, and physiology from extant literature and databases such as the Consolidated Human Activity Database (CHAD).
- These activity and physiological data will be analyzed to understand and identify important differences in the aging population and to determine the adequacy of existing data, particularly with regard to longitudinal patterns and for susceptible sub-populations.
- Results will be organized to support human exposure and pharmacokinetic modeling and for inclusion in an older adult Exposure Factor Handbook.

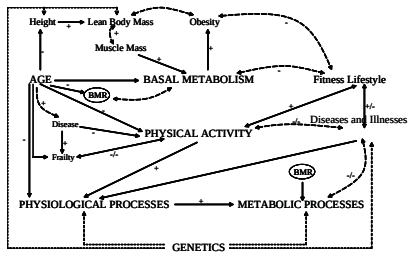

Figure 5. Conceptual Framework for Aging Activity and Physiological Relationships

EXPOSURE AND DOSE MODELING

- Aging-related changes in physiological parameters will be applied in physiologically based pharmacokinetic models such as the Exposure Related Dose Estimating Model (ERDEM).
- Sensitivity and uncertainty analysis of modified models will be performed to determine key parameters and identify data gaps where more information is needed to reduce model uncertainties for older adults.

IDENTIFYING SUSCEPTIBLE SUB-POPULATIONS

- It is important to develop information on activities and exposures for subgroups of the aging population that may be more vulnerable to environmental hazards. However, age-based groupings alone are not sufficient for identifying groups that may be more highly exposed due to their locations or activities or more susceptible due to their health status.
- Research will be performed to identify potentially vulnerable sub-populations and what is known about their health, activities, diets, and pharmaceutical use that might increase risk. Critical data gaps can then be identified in important sub-populations for future research activities.