O_3 Health Assessment Plan: Scope and Methods for Exposure Analysis and Risk Assessment

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Purpose of Scope and Methods Plan

- Outline scope and approaches to estimating exposure and health risk posed by current O_3 levels and upon attainment of the current 8-hour O_3 standard and alternative standards
- Obtain CASAC and public input in advance of completing the analyses, which will be used in the Policy Assessment

Background: Exposure, Lung Function Risk

- For the last review exposure estimates for the general population, children, and asthmatic children were developed for current conditions, just meeting the 8-hour standard, and just meeting alternative 8-hour standards in 12 urban areas
- Risk estimates were developed for >10, >15, and >20% lung function (FEV1) decrements
- Exposure and risk assessment played an important role in rationale for decision on establishing new 8-hour standard

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Air Quality

- Air quality scenarios:
  - Current conditions (2008 – 2010)
  - Just meeting the current 8-hour standard
  - Just meeting alternative standards
- Using the quadratic rollback approach to simulate just meeting standards (as in last review)
- Contributions from natural background and international transport will be considered

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Natural Background and International Transport

- GEOS-Chem 2006-2008 modeling runs:
  - Natural background (no anthropogenic emissions)
  - Only anthropogenic emissions outside of N. America
  - Only anthropogenic emissions outside of U.S.
  - Current conditions
- Anthropogenic methane emissions accounted for

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Exposure: APEX Model

- Simulates individuals (not cohorts)
- Ambient O_3 from monitored data
- Microenvironmental concentrations
  - Mass balance model: Indoor locations
  - Factors approach: In vehicles
- Use of human activity data
  - Consolidated Human Activity Database (CHAD)
  - Simulates longitudinal activity patterns
  - Commuting patterns

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Exposure: Populations to be Analyzed

- General population
- School age children (5 to 18)
- Asthmatic school age children
- Outdoor workers*
- Elderly (70 and older)**

* Modeled in the 1997 review but not the previous review
** Modeled in the previous review but not broken out as a separate group

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Exposure: New Analyses

- Evaluating attributes of most exposed and highest ΔFEV_1 risk populations
- Ranking activities and microenvironments by contribution to exposure and ΔFEV_1 risk
- Estimating fractional contributions to exposure and ΔFEV_1 risk from international and natural sources
- Qualitative analysis of the effect of AQI on exposures

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Exposure: Variability

- APEX models variability directly
  - Population demographics
  - Population physiology
  - Ozone concentrations
  - Activity patterns
  - Microenvironment characteristics:
    - Air exchange rates
    - Ozone decay and deposition rates
    - Penetration factors
    - Type of air conditioning

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Exposure: Uncertainty

- Quantitative uncertainty assessment
- Two-dimensional Monte Carlo method
- Joint characterization of variability and uncertainty
- Challenges:
  - Quantitative characterization of uncertainties of model inputs
  - Model formulation/structural uncertainty

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Lung Function Risk Assessment

- Lung Function (FEV_1 decrements): > 10, 15, 20%
- Based on exposure-response relationships derived from controlled human exposure studies
- Exposure distributions combined with exposure-response relationships (as in last review)
- Estimating FEV_1 decrements based on the model of McDonnell, Stewart, and Smith (2007) (new)

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New Model for Reduced Lung Function[1]

- Predictions of ΔFEV_1 based on individuals' ages, heights, weights, and time course of ventilation rates, O_3 exposures
- Data from 15 studies (241 subjects) were used to fit the model (ages 16-35, 0, 80 – 400 ppb)
- Kim et al.[2] (60 ppb) and any other available data will be used to refit the model. Less emphasis on concentrations > 150 ppb.
- Uncertainty analyses for population represented by the data
- Issues
  - Extension to ages <16 and >35
  - Uncertainty for population not represented by the data will be unknown

[1] McDonnell W., Stewart P., Smith M. (2007). The temporal dynamics of ozone-induced FEV_1 changes in humans: an exposure-response model. Inhal Toxicol. 19:483-494
[2] Kim, C. et al. (2011) Lung function and inflammatory responses in healthy young adults exposed to 0.06 ppm ozone for 6.6 hours. Am. J. Respir. Crit. Care Med. 183:1215-1221

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