Exposure and Risk Information in Policy Assessment

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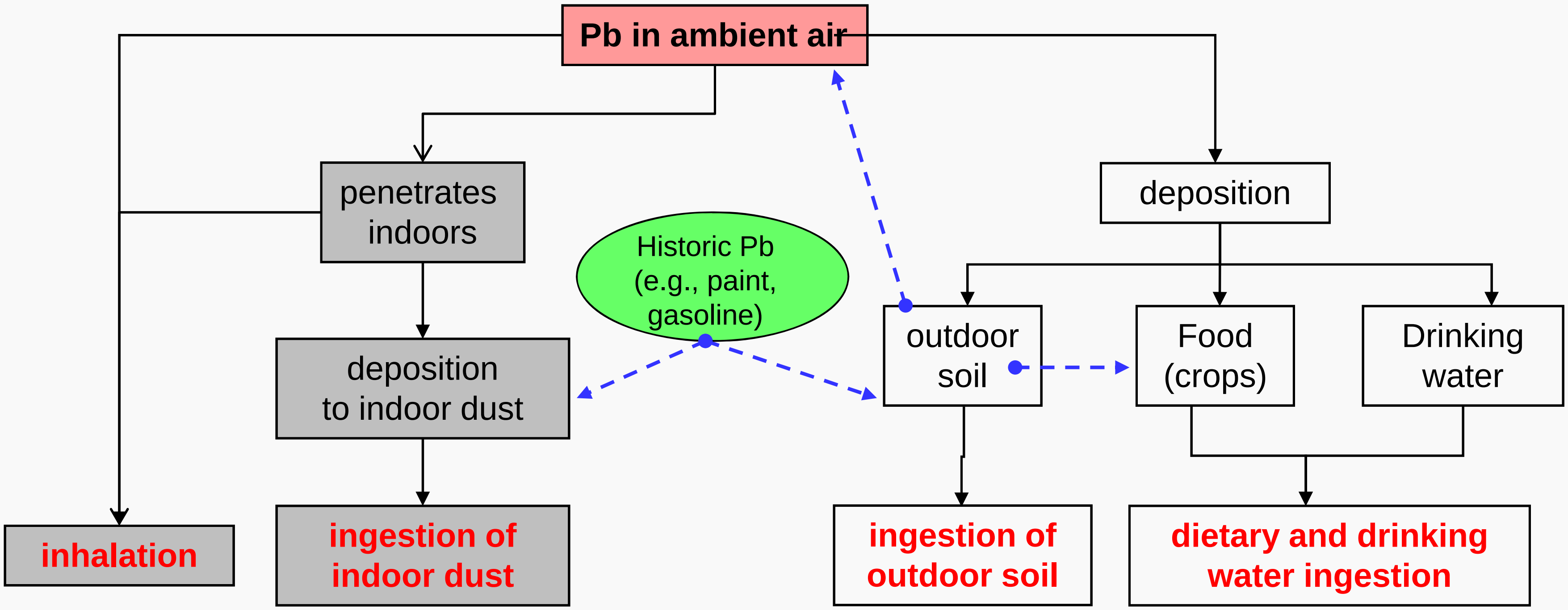
Presentation Objectives

- Summarize background and key aspects of 2008 risk/exposure assessment and associated results
- Recognize areas of 2008 assessment and recent information for consideration in Policy Assessment

Background - Lead (Pb) Air Pollution

- Pb occurs naturally and is emitted by many anthropogenic sources
  - Highest levels generally near lead smelters
- Pb is generally emitted into the air in the form of particles
  - Can end up in water, soil and surface dust
- People are exposed by inhaling air Pb or ingesting Pb that has settled onto surfaces or soils
  - Ingestion is the main route of human exposure to air Pb
  - Children are more likely to be exposed to Pb because they exhibit greater "hand-to-mouth" activity
  - Once in the body, Pb is rapidly absorbed into the bloodstream
- Pb is persistent
  - People can be exposed to Pb emitted just yesterday or years ago

Human Exposure Pathways for Air-related Pb



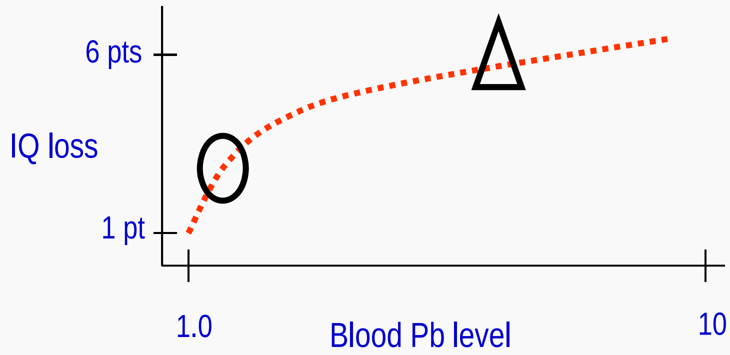
Model links change in ambient air Pb to change in risk

Pathways assessed; but model does not link change in ambient air Pb to change in risk.

Estimation of Air-related Pb Exposure/Risk

- Objective for assessment was to evaluate health impact (IQ loss) associated with Pb emitted into ambient air
- However, we lack epidemiological studies linking ambient air Pb levels to health impacts (IQ)
  - Do have studies linking biometric (blood Pb levels) to health IQ loss
- Therefore, needed to estimate link between ambient air Pb and blood Pb levels

- Non-linearity in Pb exposure modeling and IQ concentration-response called for modeling of **total Pb** exposure and risk followed by pathway apportionment

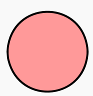


Multimedia Case-study Approach

- Multimedia, multipathway probabilistic population assessment of exposure and risk to young children
- Two types of population exposures represented
  - Highly exposed to air-related Pb
    - General urban case study (uniform air concentration, uniform population density)
    - Primary lead smelter case study (small area closest to smelter)
  - Broad distribution of air-related exposures
    - Location-specific urban case studies
      - Large majority of each population in areas with air Pb well below each standard assessed
      - Only subset (in small sub-areas) exposed at the standard assessed

Risk Assessment – Different Case Studies

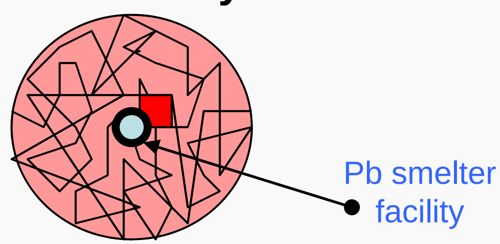
General urban case study



Small neighborhood with ambient air levels at standard

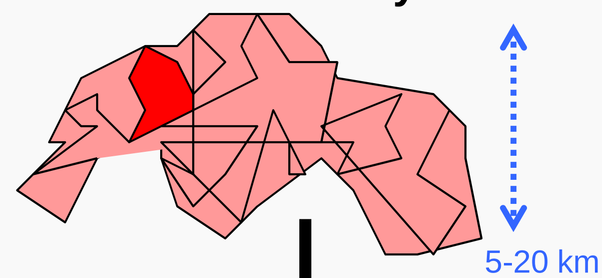
One single exposure zone (uniform ambient air Pb level and demographics)

Primary Pb smelter case study



2km radius residential area surrounding large Pb smelter with varying ambient air Pb levels and demographics

Location-specific urban case study



Larger urban area with varying ambient air Pb levels and demographics

Each US Census block is a separate exposure zone (varying ambient air Pb levels and demographics across study area)

Different Methods for Characterizing Key Media Concentrations Across Case Studies

- Ambient air Pb (spatial pattern for different air quality scenarios)
  - Ambient monitoring data (location-specific urban case studies)
  - Air dispersion modeling (primary Pb smelter)
  - Uniform concentration across study area (general urban case study)
- Indoor dust Pb
  - Site-specific regression models linking ambient air Pb to indoor dust Pb levels (primary Pb smelter)
  - Sophisticated mechanistic model (urban case studies)
- Outdoor soil Pb
  - Site-specific measurements (primary Pb smelter)
  - National/regional data (urban case studies)

Results Reflect Complex Multi-Dimensional Nature of Analysis

- For each case study, air-related IQ loss in children estimated to fall within ranges that reflect:
  - Uncertainties in characterizing different air-related exposure pathways
    - Pathways responding most quickly to air Pb (inhalation, ingestion of indoor dust)
    - Pathways responding more slowly to changes in air Pb (soil ingestion)
    - Pathways for which response to air Pb is more complex (diet and drinking water ingestion)
  - The assessment's multiple dimensions, such as:
    - Multiple concentration-response functions for lowest blood Pb levels
    - Different dust Pb modeling approaches

Interpreting Exposure/Risk Estimates and Associated Uncertainties

Modeling element	New evidence	Application in enhancing understanding of risk model
Ambient air Pb (spatial variation)	No new data available to enhance characterization of urban gradients	
Soil and drinking water Pb	Updated information on media concentrations – but no new data on correlations between pathways	Although lack of improved data on correlations limits utility of updated soil/drinking water data, we can speak to potential direction of impact on risk estimates
Simulating indoor dust Pb linked to ambient air	New data on cleaning efficiency	Although data do not support quantitative refinement of dust model, they improve our understanding of uncertainty related to dust modeling
Pathway apportionment of Pb exposure	NHANES and NHEXAS studies on pathway/source contributions to child PbB	Although studies do not cover ambient air link to indoor dust Pb levels (critical factor), we can assess potential implications for risk estimates
Predicting population distribution of PbB levels (IEUBK and GSD)	No significant advancements in IEUBK model, however is updated information on PbB variability (refinement of GSD)	Although new GSD information is limited by lack of data on pathway correlations producing "higher" PbB levels, we can consider implications to total IQ loss estimates.
IQ loss modeling in children	New studies not providing information on appreciably different C-R relationship (in addition, evidence on other endpoints does not support development of C-R functions at this time)	

Exposure/Risk Based Considerations

- Implications of newly available information on exposure/risk estimates
- Current understanding of air-related exposure situations
  - Consider any additional situations of interest in light of case studies from 2008 assessment (situations represented and associated range of results)
- Potential public health implications of exposure/risk information

Policy Assessment for Lead NAAQS

Dr. Deirdre Murphy,
Office of Air Quality, Planning and Standards, OAR

April 11, 2012

First Draft Policy Assessment

- Purpose and Background
- Ambient Air Lead
  - Environmental Pathways, Sources, Ambient Air Quality, Ambient Air Lead in Other Media, Ambient Monitoring Considerations
- Health Effects and Exposure/Risk Information
  - Blood Lead as Biomarker, Nature of Effects, At-Risk Populations
  - Exposure and Risk
  - Public Health Implications
- Review of the Primary Standard for Lead (Adequacy)
- Welfare Effects and Exposure/Risk Information
- Review of the Secondary Standard for Lead (Adequacy)

Schedule for the Current Review

Major Milestones		Projected Completion Date	Projected CASAC Review Date
Workshop to Discuss Key Policy-Relevant Issues		May 2010	
Integrated Review Plan	Draft Final	March 2011 Nov 2011	May 5, 2011
Integrated Science Assessment	First Draft Second Draft Final	May 2011 Feb 2012 July 2012	July 20-21, 2011 April 10-11, 2012
Risk/Exposure Assessment	Planning Document	June 2011	July 21, 2011
Policy Assessment (PA) Rulemaking	First Draft PA Second Draft PA Final PA Proposed Rulemaking Final Rulemaking	Sept 2012 Feb 2013 June 2013 Jan 2014 Nov 2014	Oct 2012 March 2013

Current Pb NAAQS Review Team

Office of Air Quality Planning and Standards

Health and Environmental Impacts Division

- Dr. Deirdre Murphy, Team Lead
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Air Quality Assessment Division

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- Mr. Mark Schmidt , air quality analysis
- Dr. Halil Cakir, air quality analysis
- Mr. Josh Drukenbrod, emissions inventory

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Dr. John Vandenberg, Director, NCEA-RTP Division

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Appendix - Background Material

Historical Background

- 1976 – Lead added to list of criteria pollutants
- 1978 – Primary and secondary NAAQS set
  - Secondary standard set identical to primary
- 1980s-90 – NAAQS Review
  - Criteria Document – 1986, with 1990 supplement
  - No change to standards
- 1991 - Agency-wide Integrated Lead Strategy
  - NAAQS enforcement, soil abatement, waste policy, drinking water, products, recycling, research
- 2005 – 2008 NAAQS review
  - Criteria Document (2006), Screening Ecological Risk Assessment (2006), Health Risk Assessment (2007), Staff Paper (Policy Assessment) (2007)
  - Rulemaking notices 2007-2008 →Substantial revisions to standards
- Current NAAQS review

For More Information on Pb NAAQS

- Basic information on Pb NAAQS (fact sheets, etc)
  - http://www.epa.gov/air/lead/
- Documents for current review
  - http://www.epa.gov/ttn/naaqs/standards/pb/s_pb_index.html
- Documents from review completed in 2008
  - http://www.epa.gov/ttn/naaqs/standards/pb/s_pb_cr.html