Expert Judgment about Uncertainty in PM$_{2.5}$-Mortality: What Have We Learned?
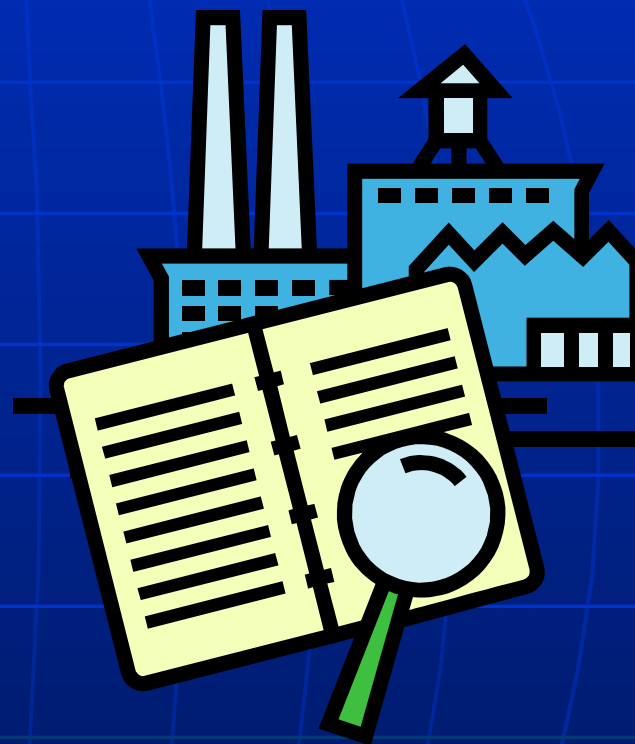
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Overview

- EPA PM$_{2.5}$ – Mortality Expert Judgment Elicitation Project

- Promises and Pitfalls   Challenges

USEPA Pilot Expert Elicitation of PM$_{2.5}$ -Mortality Relationship: Impetus for Study

- Premature deaths avoided by reduction of PM$_{2.5}$ constitute 85-95 % of monetized benefits
  - $93 billion in reduced mortality (U.S. EPA Clean Air Interstate Rule)

- National Academy of Sciences (2002). "Estimating the Public Health Benefits of Proposed Air Pollution Regulations"

- OMB Circular A-4

USEPA's Primary Benefit Analysis

- Uncertainty in the mortality estimate is characterized by the confidence interval from the standard error of one epidemiological study, Pope et al. (2002).
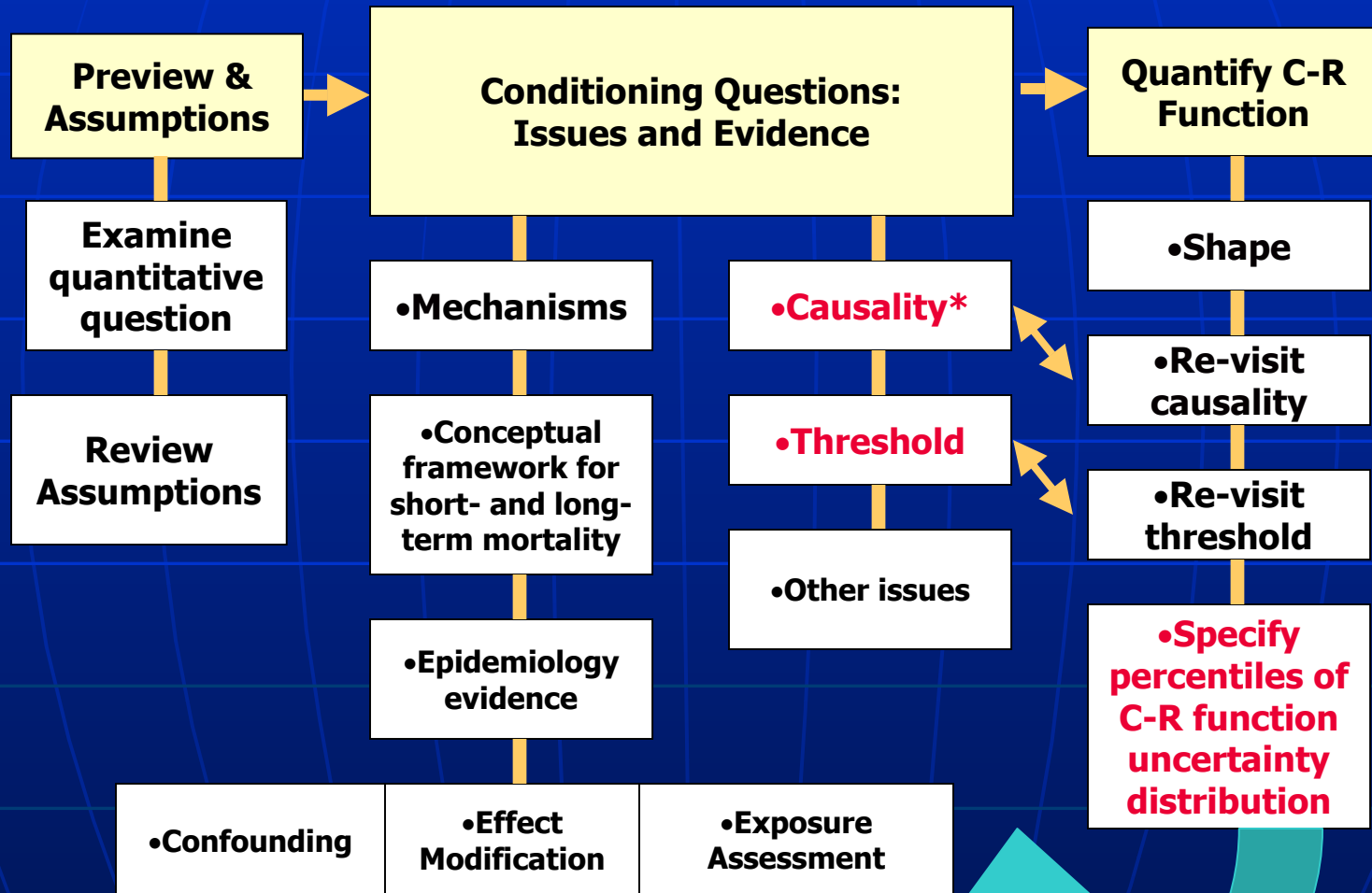
- Why might we need anything else?

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Uncertainties in PM$_{2.5}$-Mortality Relationship

- How strong is the likelihood of a causal relationship?

- What is the true shape of the dose-response relationship? Threshold?

- What is the impact of confounders and effect modifiers?

- How do potential errors in measuring exposure influence results?

- What is the impact of relative toxicity of PM components or sources?

Overview of PM Expert Elicitation Project Elements

Elements	Pilot Study	Full Study
Elicitation team (Walker, Kinney)	√	√
Selection of experts	5	12
Structured Protocol	√	√
Pilot testing of protocol	√	√
Pre-elicitation workshop		√
Elicitation and verification of individual judgments	√	√
External Peer Review	√	√

Protocol Structure

Preview & Assumptions → **Conditioning Questions: Issues and Evidence** → **Quantify C-R Function**

Examine quantitative question

Review Assumptions

- Mechanisms

- Conceptual framework for short- and long-term mortality

- Epidemiology evidence

- Confounding
- Effect Modification
- Exposure Assessment

- **Causality***

- **Threshold**

- Other issues

- Shape

- Re-visit causality

- Re-visit threshold

- **Specify percentiles of C-R function uncertainty distribution**

Re-visit

***Red items involve quantitative responses**

Pilot Elicitation Results:
Comparison to Studies Used in EPA Analyses

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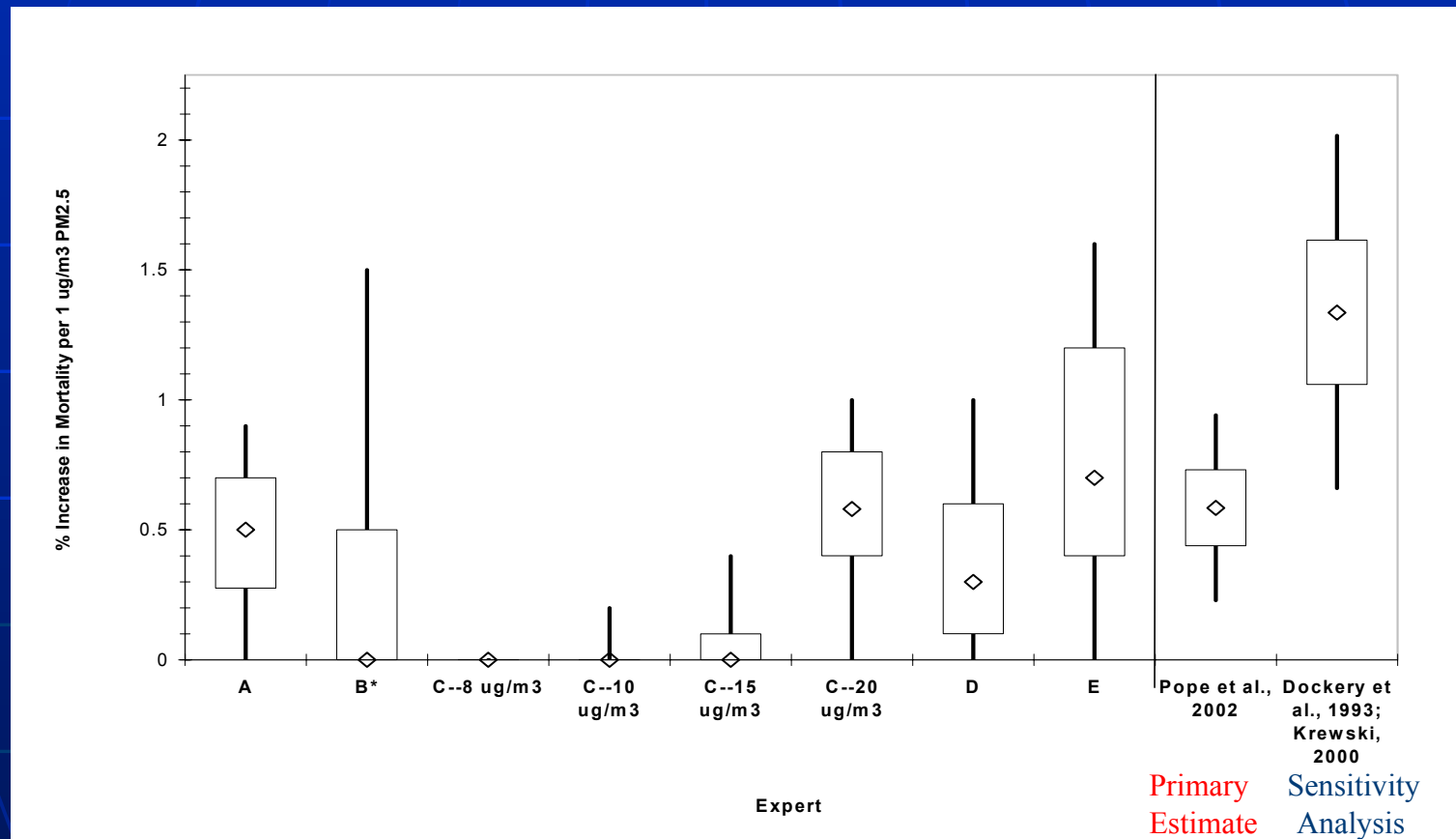
Promises

- Intellectual "cross-fertilization" in uncertainty analysis
- Well-defined questions
- Individual expert opinions
- Structured consideration of the evidence
- Comprehensive and explicit characterization of uncertainties typically left unquantified

Challenges

- Practical
- Methodological
- Political

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Practical

- Cost
  - *This is not a low cost solution*!

- Logistics involving experts
  - Overuse/Conflicts
  - Limits on numbers of experts imposed by federal regulations

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Promises and Pitfalls

Methodological

- Expert selection
  - No "one size fits all" methodologies
  - Who is an "expert" for complex multi-disciplinary questions?

- Assuring elicitation of "informed" but independent judgments
  - Design of protocol and elicitation method
  - Role and influence of the "elicitors"
  - Identifying and eliminating motivational biases (real or perceived)
  - Role of pre- or post-elicitation workshops

- How good are experts' judgments about uncertainty?

Policy Challenges:
We've Characterized Uncertainty. Now what?

Non-road Diesel Rule Annual Change in Mortality Incidence in 2030
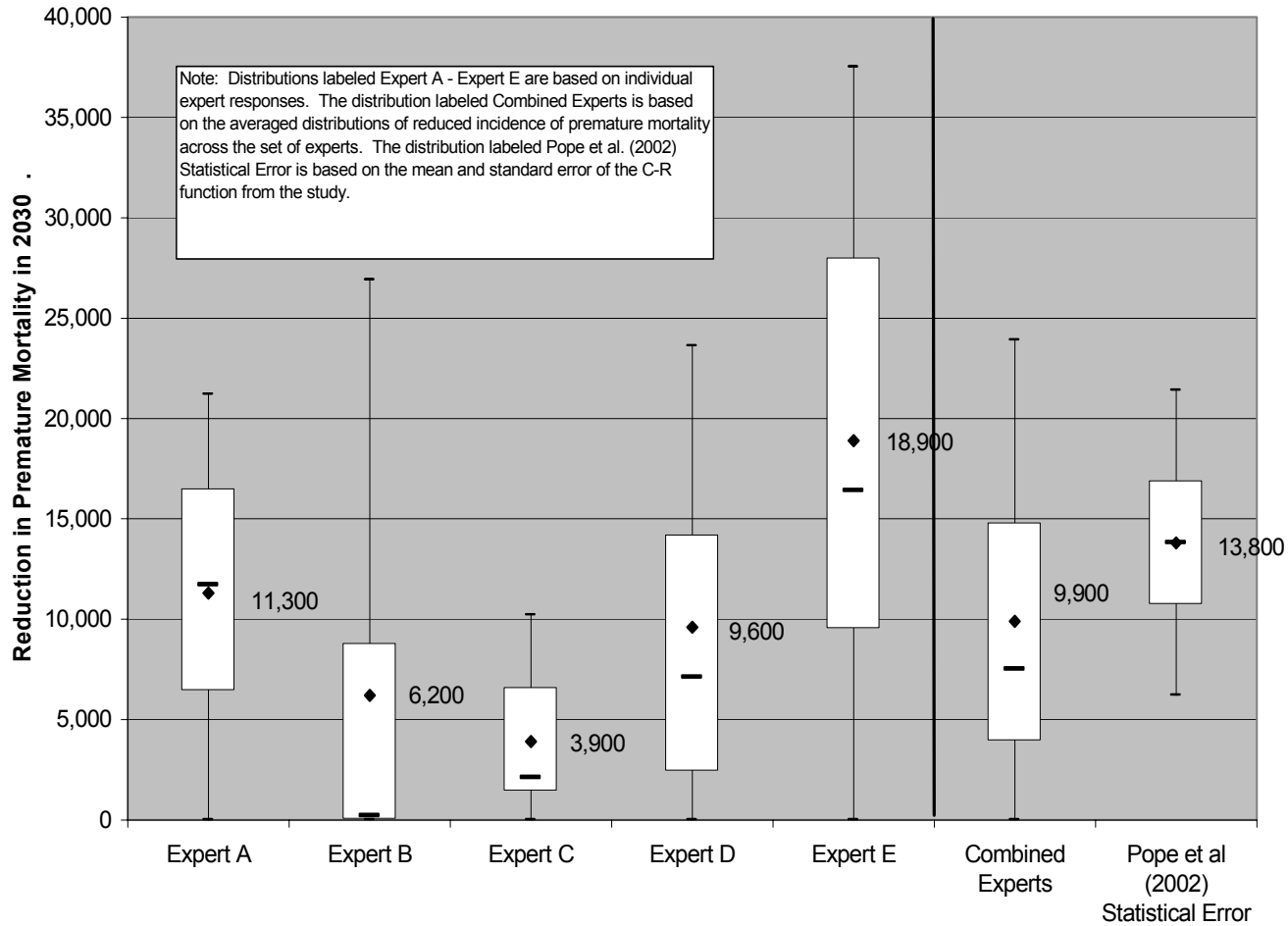
Recommendations

- **Near term:** Develop internal policies for dealing with quantitative measures of uncertainty

- **Longer term:** Applied research on expert judgment methodology on complex problems

Disclaimer

- The opinions, findings, and conclusions expressed are those of the authors and do not necessarily represent those of the U.S. EPA