Review Panel on:

HEI Program to Assess Health Effects of Long-Term Exposure to Low Levels of Ambient Air Pollution

Phase 1 reports

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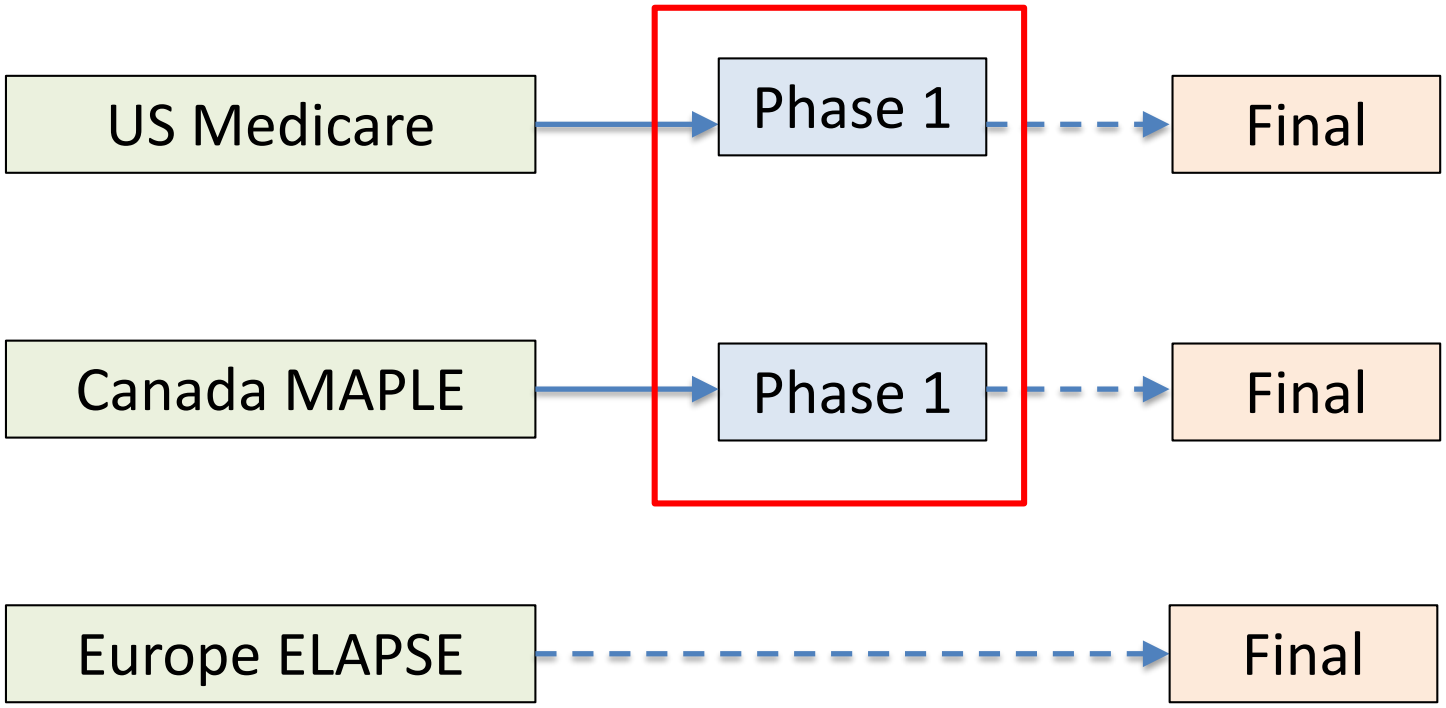
Some background

- plausibility – our Bayesian prior
- fewer susceptible to dying at low concentrations, so lots of data needed
- but, data quality inversely related to data quantity?
- advanced and new statistical methods
- causal modeling – revolution or another tool in the toolkit?
- the EPA “design value”

3 studies



ELAPSE - Effects of Low-Level Air Pollution: A Study in Europe

US Medicare (responded to panel review of draft report)

- daily national $PM_{2.5}$ & ozone predictions
- estimated associations
  - long-term exposure and mortality
  - short-term exposure and mortality
- causal modeling

$PM_{2.5}$= fine particulate matter

US Medicare: daily national $PM_{2.5}$ & ozone predictions

strengths
• many model inputs
• 1x1 km grid spatial resolution

issues to consider
• measurement error - random - systematic – more error in low concentration areas?
• 1x1 km grid spatial resolution

$PM_{2.5}$= fine particulate matter

US Medicare: estimated associations

- long-term exposure and mortality

strengths
• N = 61 million! 460 million person-years; an enormous undertaking
• sub-study (Medicare Current Beneficiary Survey**)** to assess confounders
• statistical methods
• extensive sensitivity analyses

US Medicare: estimated associations

- long-term exposure and mortality

issues to consider
• quasi-ecologic data – very complex hybrid design
• Medicare mortality (and exposure) at zip code resolution
• temporal trends in PM and mortality
• spatial correlation
• effect modification findings – window into residual confounding? (e.g., men > women)
• propagation of exposure uncertainty in health estimates, but to be addressed

PM = particulate matter

US Medicare: estimated associations

- short-term exposure and mortality

strengths
• N = 22,433,862 deaths (20,955,387 at $PM_{2.5}$ < 25ug/m^3 & ozone <60ppb)
• zip code specific exposure estimate

issues to consider
• effect modification findings – window into residual confounding? (e.g., women > men)
• exposure-response curves flatten at 20ug/m^3 & 60ppb

$PM_{2.5}$ - fine particulate matter
ppb – parts per billion

US Medicare: causal modeling

strengths
• welcome addition
• ultimate aim to account for measurement error, model misspecification, measured and unmeasured confounding

issues to consider
• assumptions met? e.g., IPTW assumes no unmeasured confounding
• so far, not directly applied to relevant study design or analyses, although proposed/planned
• a very challenging task in remaining time – tractable?

IPTW = inverse probability treatment weighting

Canada MAPLE (panel comments on draft report communicated)

- national $PM_{2.5}$, NO_2 & ozone predictions

- estimated associations
  - long-term exposure and mortality

MAPLE - Mortality-Air Pollution Associations in Low Exposure Environments
$PM_{2.5}$ - fine particulate matter
NO_2 - nitrogen dioxide

Canada MAPLE: $PM_{2.5}$, NO_2 and ozone predictions

strengths
• many model inputs
• 1x1 km grid spatial resolution for $PM_{2.5}$
• also for ozone, NO_2 and combined gas oxidant capacity

issues to consider
• 1x1 km grid spatial resolution
• poorer spatial resolution for NO_2 (10x10 km) and ozone (21x21 km)
• poorer model performance back in time - impact?

MAPLE - Mortality-Air Pollution Associations in Low Exposure Environments

$PM_{2.5}$= fine particulate matter

NO_2 = nitrogen dioxide

Canada MAPLE: estimated associations between long-term exposure and mortality

strengths
• N = 8.5 million (151 million person-years; 1.5 million deaths) in CanCHEC
• outcomes at postal code level (850,000 in Canada; average of 14 households in each)
• rich set of individual-level covariate data
• smaller cohort (CCHS) with richer covariate data
• used calendar time as time axis
• extensive sensitivity analyses

MAPLE - Mortality-Air Pollution Associations in Low Exposure Environments
CanCHEC - Canadian Census Health and Environment Cohort
CCHS - Canadian Community Health Survey

Canada MAPLE: estimated associations between long-term exposure and mortality

issues to consider
• ensemble model selection based on AIC
• effect estimates (HRs) very sensitive to covariate adjustment, including ozone
• effect modification findings (e.g., women > men [vs. CCHS]; age 25-64 greater than older)
• propagation of exposure uncertainty in health estimates
• refine rationale and characterization of immigrant variable effects

MAPLE - Mortality-Air Pollution Associations in Low Exposure Environments
AIC- Akaike Information Criterion
HR – Hazard Ratio
CCHS - Canadian Community Health Survey

Next Steps for the Review Panel

PHASE 1

- Dominici Medicare study: preparing commentary
- Brauer MAPLE study: awaiting response from investigators on initial review and then prepare commentary
- HEI estimates publication of reports and commentaries in mid-summer to early-fall