PM2.5 Public Health Community of Practice – Baltimore, MD

IDEAS FOR THE CONSTRUCTION OF A SINGLE PM2.5 INDEX FOR DIFFERENT PUBLIC HEALTH GOALS – 2008

PM2.5 Community of Practice Participants

- EPA Region III
- Maryland Department of Health and Mental Hygiene
- Maryland Department of the Environment
- EPA Office of Research and Development, Narragansett (facilitator)

Community of Practice Goals

- Community of Practice (CoP) PM2.5 Project Purpose:
  - Create at least one PM2.5 indicator for the purpose of demonstrating that our environmental programs are improving public health – as defined by the CoP.
- Consider the audience – different public health agencies have different target audience and goals but all must work from same data.
- Ideas to consider:
  - Measure of impact of PM2.5 or on public health?
  - How does this inform public health solutions?

PM2.5 Community of Practice -- Straw Hierarchy Goals

- 3 types of indicators – health, policy, budget
- Consider available data and what we do with it.
- Show accountability; access program success
- Retrospective/prospective indicators

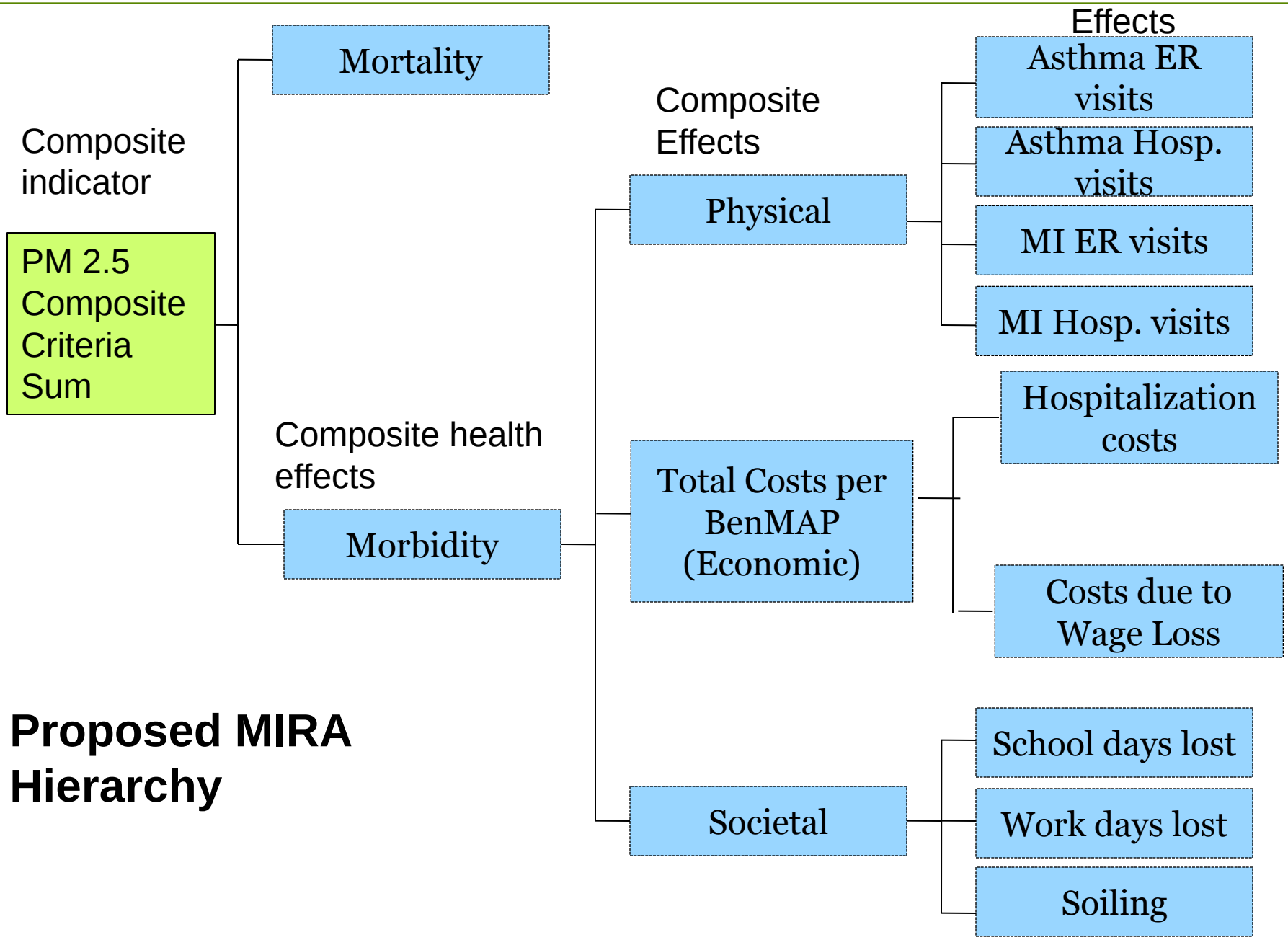
CoP Decision Question

- How much of a change in PM concentration equates to a significant change in public health?

BUT, what do we mean….?

- How do we define public health? Depends on:
  - The # and variety of metrics (data) used
  - How they are combined/organized (the hierarchy will be a fundamental component of how public health is viewed)
  - How they are valued relative to each other (Value set)

NOTE: Each separate definition of public health is represented by a separate composite indicator.


Effects
Mortality
Composite indicator
Composite Effects
Asthma ER visits
Asthma Hosp. visits
Physical
PM 2.5 Composite Criteria Sum
MI ER visits
MI Hosp. visits
Hospitalization costs
Composite health effects
Total Costs per BenMAP (Economic)
Morbidity
Costs due to Wage Loss
Proposed MIRA Hierarchy
School days lost
Societal
Work days lost
Soiling

Metrics (Data)

- From BenMAP (= Environmental Benefits Mapping and Analysis Program; http://www.epa.gov/airquality/benmap/index.html)
  - Mortality = # deaths
  - Morbidity = # asthma, MI – ER and hospital visits
  - Economic= Actual costs of asthma, MI ER and hospital visits; Estimates of wages lost due to each of those conditions
  - Societal health = Actual school/work days lost, Soiling (old data but better than none?)
- From this study, add (possibly)
  - Morbidity: Case crossover-- asthma and MI: ER and hospital visits
  - Economic = Baltimore specific actual costs of asthma and MI – ER and hospital (?)
- Others?

Defining Terminology

- Effects = individual pieces of data; e.g., asthma visits or actual hospitalization cost of an asthma admission.
- Composite effects = a combination of those metrics whose importance (value) can be appropriately compared.
- Composite Health effects = in this case, a combination of physical, economic and social effects that relate to overall Health (i.e., morbidity/illness).
- Composite Indicator = One possible measure of $PM_{2.5}$ public health (as defined by: 1) selected $PM_{2.5}$ related metrics, 2) hierarchy construction, 3) value set).

Proposed PM2.5 CoP Study Purpose

- Purpose:
  - 1) Show how BenMAP valuations represent one possible definition (or composite indicator) of $PM_{2.5}$ public health (i.e. BenMap valuation can be represented in MIRA through appropriate hierarchy construction, indexing and value setting).
  - 2) Allow Community of Practice to discuss and experiment with different ways of defining public health through MIRA. That is, by varying any of the following:
    - The selection of metrics
    - How the metrics are organize in a hierarchy
    - The value set established among metrics
  - 3) Through this procedure develop a final set of $PM_{2.5}$ accountability indicators.

Proposed PM2.5 CoP Study Steps - MIRA

- Construct MIRA hierarchy
  - Decide on one MIRA hierarchy, for now, using only BenMap incidence and actual cost data (if time permits we can explore different hierarchies)
- Indexing (MIRA)
  - Quantitatively connect all metrics to the decision question (i.e., convert actual units to decision units)
- Preferencing/obtaining value set (MIRA)
  - Pairwise comparison of criteria in MIRA hierarchy.

Proposed PM2.5 CoP Study Steps - BenMAP

- BenMAP Valuation (benchmark)
  - BenMAP valuation has implicit value set; determine what this is.
- "Calibrate" BenMAP valuation with MIRA composite indicator.
  - Determine the degree to which MIRA can replicate BenMap results. That is, what is the implicit hierarchy and value set contained in BenMAP valuation procedures that would allow a MIRA analysis (using BenMap incidence data) to produce equivalent BenMAP result?

PM2.5 CoP Analysis – Comparison of MIRA with BenMAP

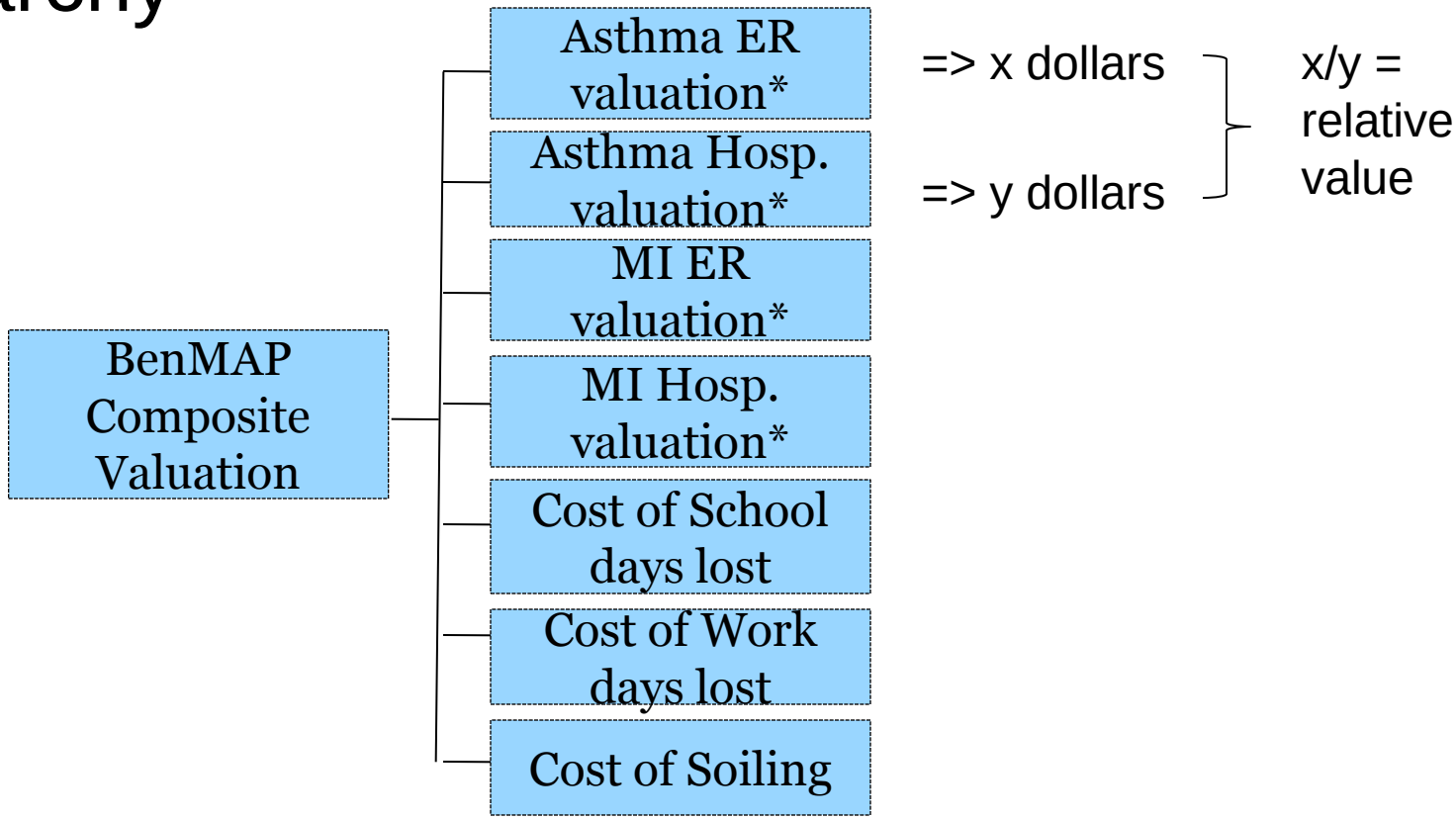
- Experiment with different data (BenMAP default response functions vs. Baltimore case crossover) and different value sets (BenMAP default vs. MIRA experiments).
  - Purpose: to better understand the variety of ways $PM_{2.5}$ public health can be define.
  - The ultimate intent: possible tailoring of the composite indicators for different public health concerns.

PM2.5 CoP Study: Comparison Sets – Proposal

Response Function (Data)	Preferences (Values)
• Case crossover =>	• MIRA value sets**
• Case crossover =>	• BenMAP value set*
• BenMAP default =>	• MIRA value sets **
• BenMAP default =>	• BenMAP value set*

- *One indicator per given hierarchy
- ** Many indicators possible for a given hierarchy

BenMAP "Default": Same Data, Different Hierarchy



* Combination of actual ER/hosp costs and lost wages.

BenMAP Defaults

- BenMAP value set is automatically defined by dollars.
  - So the value set of what is more important (e.g., asthma ER vs asthma hospitalization) is a ratio of the dollar amounts.
  - Ratio of x dollars/y dollars calculation in next slide is the implicit weighting within BenMAP (not changeable by stakeholders).

PM2.5 CoP Proposed Analysis

- Compare BenMAP's composite valuation with MIRA's Composite indicator (Criteria Sum) first as a benchmark ("calibration").
- Alter MIRA value sets, alter response functions
  - Compare criteria sums to each other and to BenMAP's default.
  - Identify different composite indicators that deal with different perspectives of the $PM_{2.5}$ public health problem
- Alter PM2.5 change in concentrations, re-run BenMAP and case crossovers and see how BenMAP's composite valuation and MIRA's Composite indicators change.

  Examine the prospect that different composite indicators may be more or less sensitive to the same change in $PM_{2.5}$ ambient concentrations.

Pm2.5 CoP Add-on: Potential for Additional Analysis (more runs required)

- Using CMAQ sensitivity runs (reductions in NOx, NH3, across the board or certain sectors), generate different modeled PM fields.
  - Each sensitivity run = control option
- Construct another MIRA hierarchy to answer the question: Which control options look better from a public health perspective?
  - Use the composite PM2.5 indicators developed in this study as input metrics to a separate MIRA analysis designed to examine the merits of the various control options

If we do add-on…

- How do the BenMAP valuation indicator and the MIRA indicators compare in sensitivity to changes in control scenarios and PM2.5 concentration changes?
  - Is the BenMAP indicator more/less sensitive than the MIRA indicators in different situations/concentration ranges?
  - From a public health perspective, in which situations might it be more appropriate to use one or the other kind of indicator?