A framework for the development and evaluation of environmental public health indicators (EPHI): A tool for environmental health practitioners

Presenter - Kristen Malecki PhD, MPH[1]
Beth Resnick, MPH[2]
Thomas A. Burke, PhD, MPH[2]

APHA Annual Conference
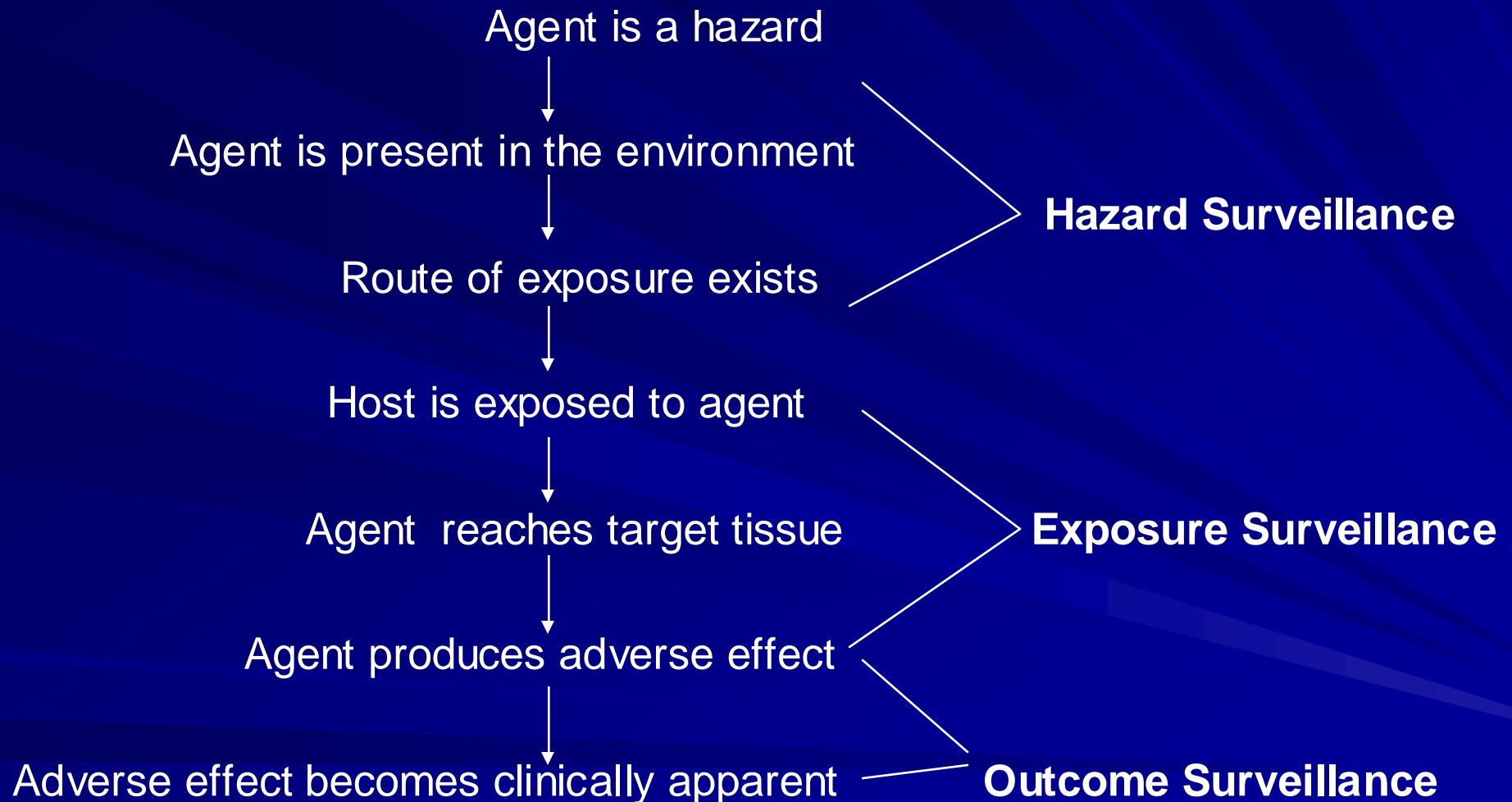**Washington, DC**
November 6, 2007

Presentation

- Project Background
- Overview of Environmental Public Health Indicators
- Developing Framework
- Presentation of Core Elements and Criteria
- Examples
- Conclusions and Recommendations

Background: Environmental Public Health Surveillance

◼ 2000: Pew Foundation Report identifies:

"environmental health information gap"

◼ 2002: Environmental Public Health Tracking = surveillance

– Ongoing, systematic collection, analysis and assessment of environmental hazard, exposure and health effect data for public health action

Environmental Health Surveillance, Thacker et al. - 1996

Agent is a hazard

↓

Agent is present in the environment

↓

Route of exposure exists

Hazard Surveillance

↓

Host is exposed to agent

↓

Agent reaches target tissue

Exposure Surveillance

↓

Agent produces adverse effect

↓

Adverse effect becomes clinically apparent

Outcome Surveillance

Source: Thacker et. al, 1996

Project Goals and Objectives

- Core set of scientifically valid criteria

- Outline a process

- Provide a tool for EH Practitioners

Background: Why a framework?

- **Environmental health surveillance systems are complex**
  - Pull data from multiple sources
  - Wide range of potential topics
- **Prioritization needed**
  - Systematic decision-making
    - Utility
    - Consistency
    - Transparency
- **Evaluation**

Why Indicators?

- **Understandable presentation of data**
  - Data ---information
- **Interpretation of Numbers**
  - Information --- Meaning
    - Good v. Bad
    - Our results v. norm
- **Track important things in time and space**
  - Social, economic, technological, climate changes
- **Make informed decisions**
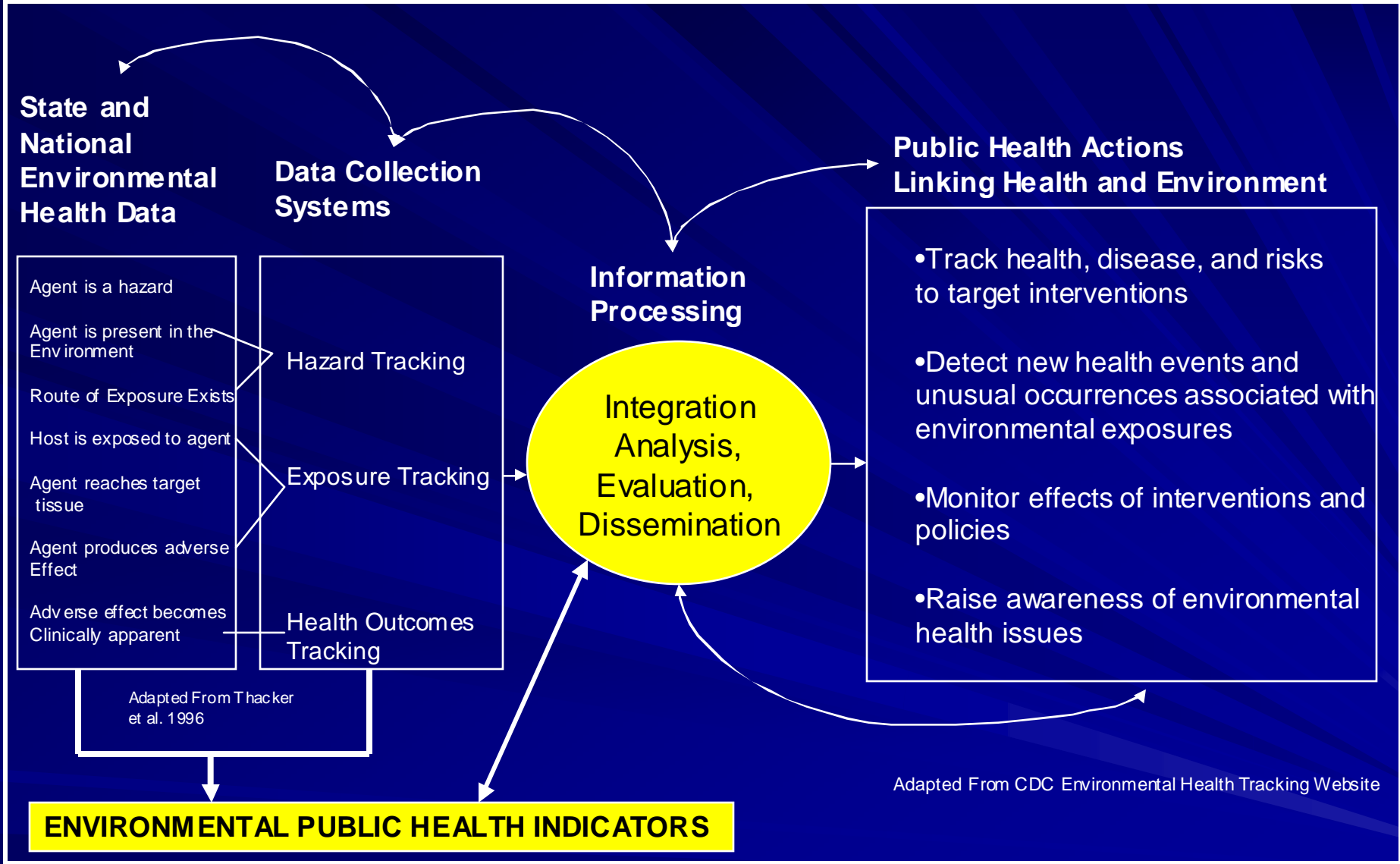- **Evaluate program progress overtime**

Environmental Public Health Indicators and the Core Functions of Public Health

- ## ASSESSMENT AND ASSURANCE

"provide **information** about a population's **health status** with respect to **environmental factors**. They (It) can be used to **assess health** or a **factor associated with health** (i.e. a risk factor, intervention) in a specified population through **direct** or **indirect measures**." (CDC/CSTE, 1999)
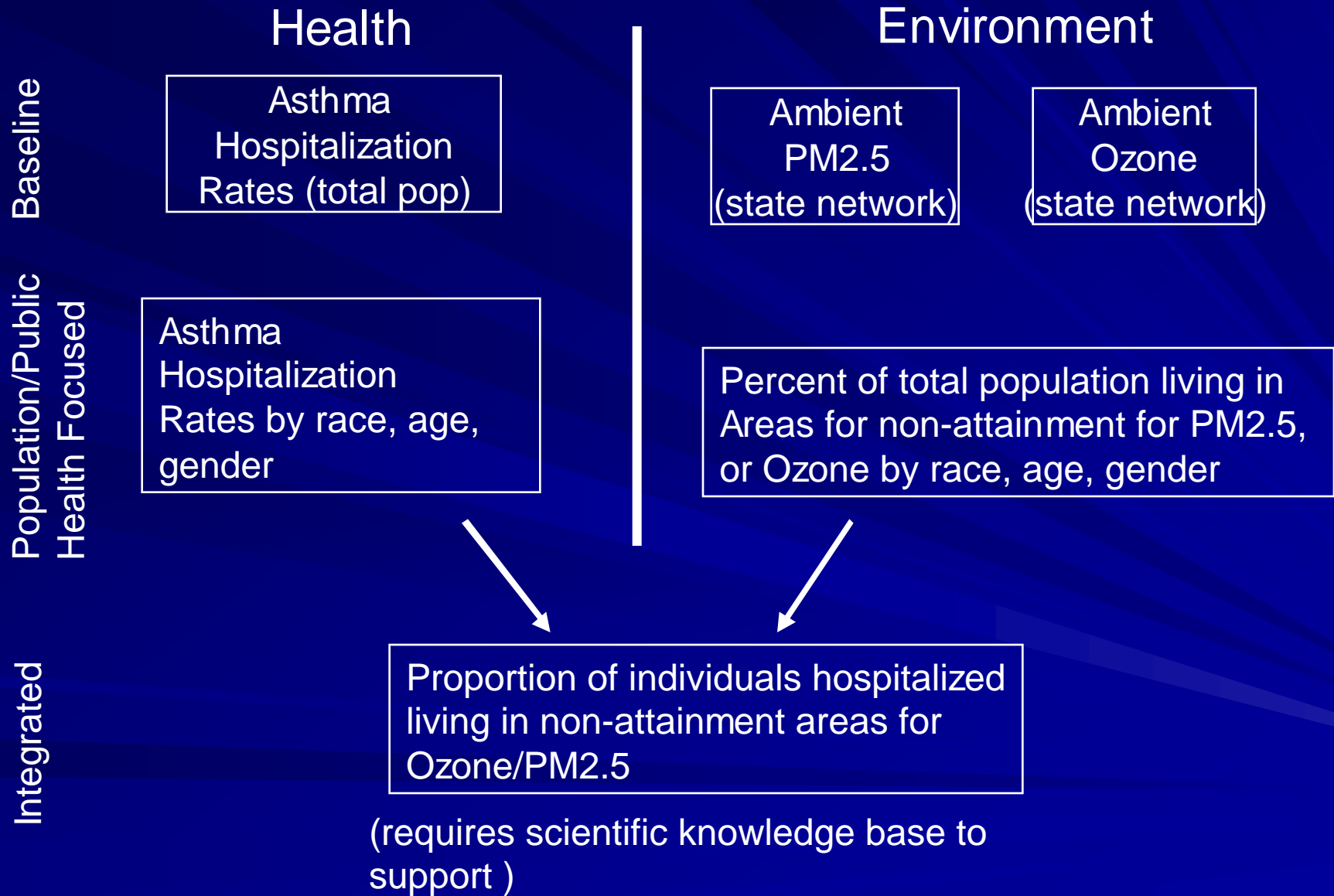
- ## POLICY DEVELOPMENT AND PLANNING

"An **expression** of the **link** between environment and health; **targeted** at an issue of specific **policy** or **management concern** and present in a form which **facilitates** interpretation for **effective decision-making**.". (Coravalan et al., 1996, p.19)
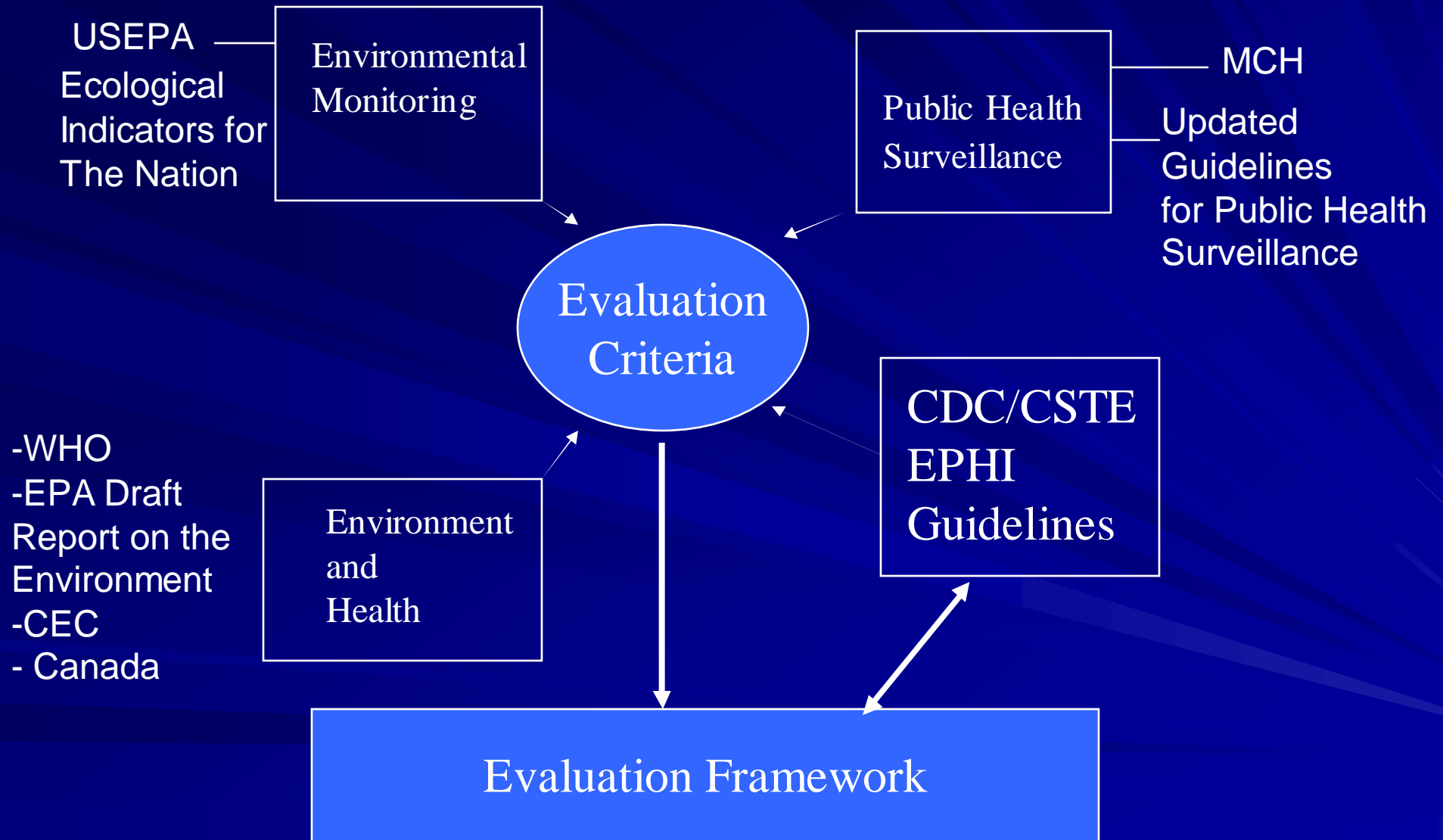
State and National Environmental Health Data

Data Collection Systems

Agent is a hazard

Agent is present in the Environment

Route of Exposure Exists

Host is exposed to agent

Agent reaches target tissue

Agent produces adverse Effect

Adverse effect becomes Clinically apparent

Hazard Tracking

Exposure Tracking

Health Outcomes Tracking

Adapted From Thacker et al. 1996

Information Processing

Integration Analysis, Evaluation, Dissemination

Public Health Actions Linking Health and Environment

• Track health, disease, and risks to target interventions

• Detect new health events and unusual occurrences associated with environmental exposures

• Monitor effects of interventions and policies

• Raise awareness of environmental health issues

Adapted From CDC Environmental Health Tracking Website

ENVIRONMENTAL PUBLIC HEALTH INDICATORS

Indicators within an Environmental Public Health Surveillance System

EPHI EXAMPLES

Health

Environment

Baseline

Asthma
Hospitalization
Rates (total pop)

Ambient
PM2.5
(state network)

Ambient
Ozone
(state network)

Population/Public
Health Focused

Asthma
Hospitalization
Rates by race, age,
gender

Percent of total population living in
Areas for non-attainment for PM2.5,
or Ozone by race, age, gender

Integrated

Proportion of individuals hospitalized
living in non-attainment areas for
Ozone/PM2.5

(requires scientific knowledge base to
support)

Methods: Convergence

USEPA Ecological Indicators for The Nation

Environmental Monitoring

Public Health Surveillance

MCH

Updated Guidelines for Public Health Surveillance

Evaluation Criteria

-WHO
-EPA Draft Report on the Environment
-CEC
- Canada

Environment and Health
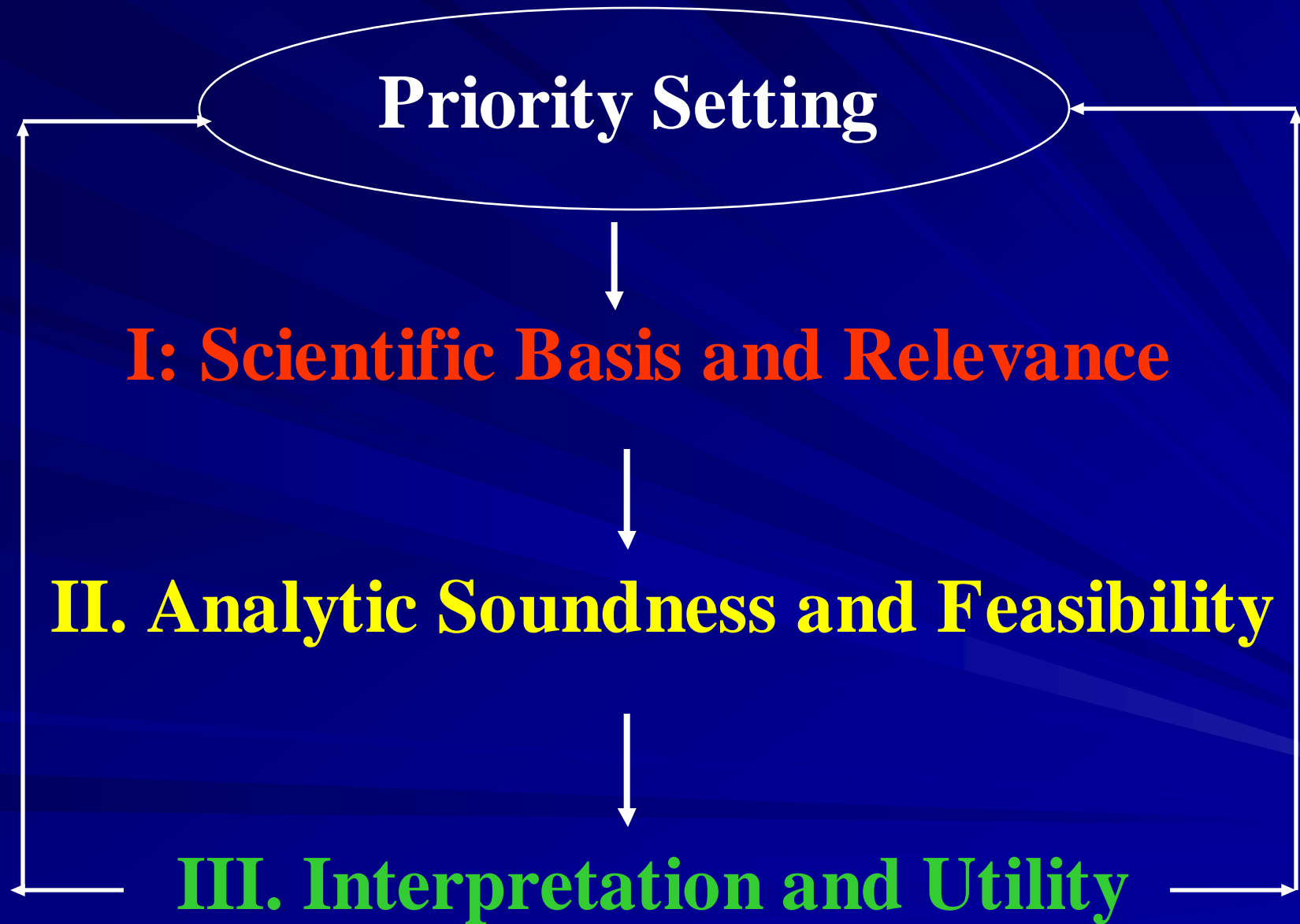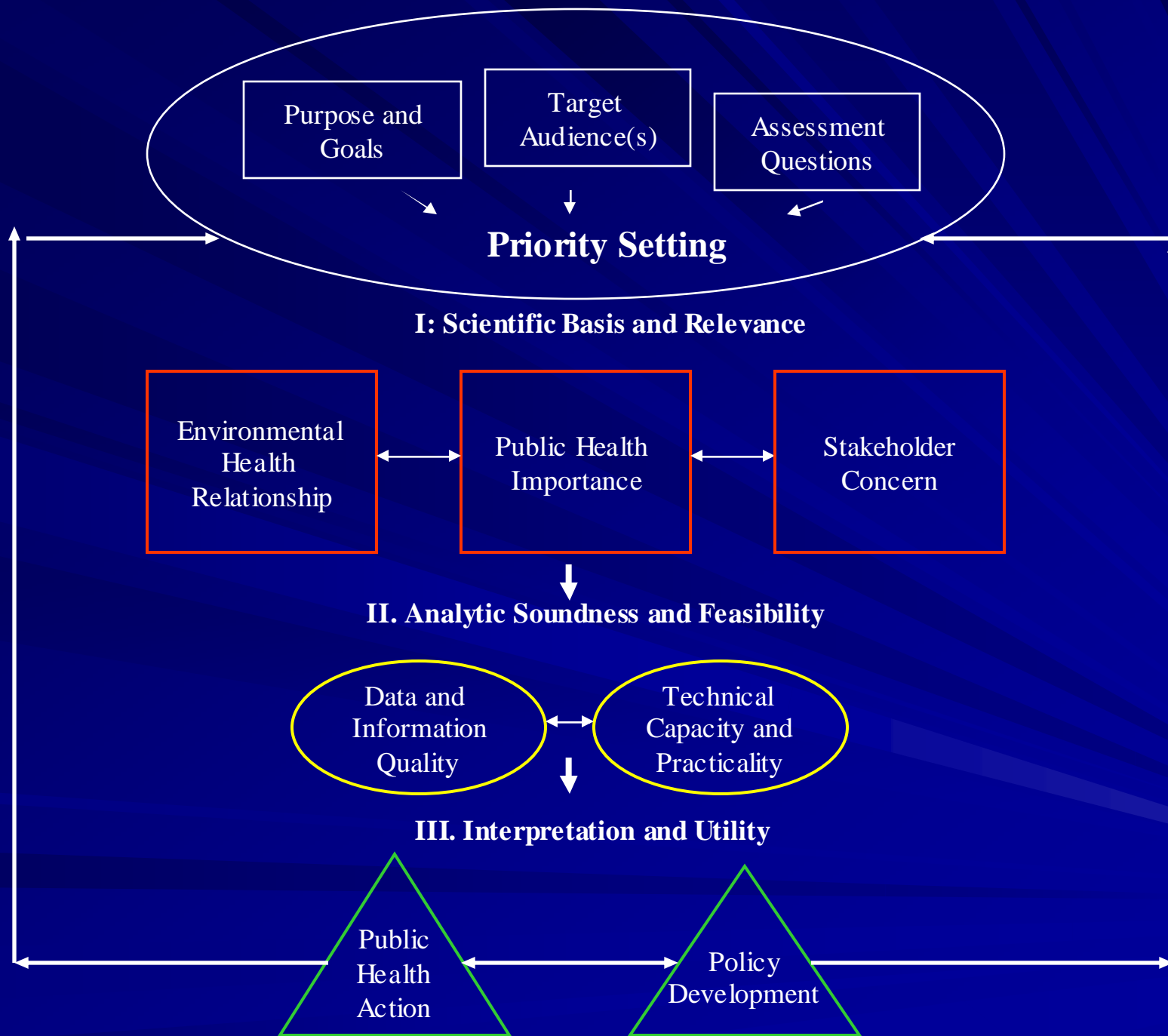
CDC/CSTE EPHI Guidelines

Evaluation Framework

Adapted From: Yin, R. *Case Study Research:Design and Methods*. Third Edition. 2002.

Methods: Convergence of Criteria and Core Constructs

Construct	Core Element	Criteria	References
Scientific Basis and Relevance	Environmental Health Importance	Scientific Validity	7,13,15,20,29
		Strength of Evidence	15,17,29
		Representativeness	7,9,19,29
		Authoritative Standard	7,9,23,26
	Public Health Importance	Magnitude	13,17,20,21,22,24,26
		Rarity	20,23
		Vulnerable Sub-population	18,23
		Exposure Potential	7,20
		Potency	7,20
		Importance	7,21,22
Analytic Soundness and Feasibility	Technical Capacity and Practicality	Available	7,11,17,18,20
		Measurable	7,15,19,23
		Feasible	7,11,13,15,17
		Collectable	11,26
		Spatially and Temporally Scaled	11,13,19
		Trackable	7,13,19,20
		Timely	7,19

The Framework

Priority Setting

I: Scientific Basis and Relevance

II. Analytic Soundness and Feasibility

III. Interpretation and Utility

Priority Setting

I: Scientific Basis and Relevance

Purpose and Goals

Target Audience(s)

Assessment Questions

Environmental Health Relationship

Public Health Importance

Stakeholder Concern

II. Analytic Soundness and Feasibility

Data and Information Quality

Technical Capacity and Practicality

III. Interpretation and Utility

Public Health Action

Policy Development

Priority Setting

■ **Purpose and Goals**
- Why are you setting up the surveillance system?
- What are you trying to accomplish?
- Management Goals
- Existing Programs or Policies

■ **Target Audiences**
- Legislature
- The public
- Fellow practitioners
- Local Health Departments
- All of the above?

■ **Assessment Questions**
- What are the priority environmental health contaminants?
- Is air pollution a problem for asthmatics in the state?
- Are environmental contaminants contributing to racial and ethnic disparities in health outcomes across the state?

Example: Implementing the Framework

■ Children's Environmental Health

– Water

■ drinking water and recreational water

■ impact on reproductive health.

■ Indicators

- Population exposure to TTHM's in public drinking water supplies

- Levels of PCBs and Mercury in Fish

- Percent low birth weight

PHASE I - **Scientific Basis and Relevance**

- **Environmental Health Importance**
  - Strength of Evidence, Scientific Validity, Representativeness, Authoritative Standard
- **Public Health Importance (Magnitude)**
  - Magnitude, Rarity, Vulnerable Sub-Populations, Exposure Potential, Potency, Importance
- **Stakeholder Concern (Public Concern/Policy Makers)**
  - Voluntary, controllable, beneficial, equitable, natural or man-made, potentially catastrophic, familiar, trusted, impacts children

Environmental Health Importance – Concentrations of Mercury in Fish Tissue

| Region	Mean Fish Tissue Mercury Concentration (mg/kg)[1]	Dose of Mercury (ug/kg-day)	Hazard Index (Dose/RfD)[2]
Chester	0.063	0.126	**1.26**
Choptank	0.042	0.084	0.84
Elk River	0.003	0.006	0.06
Gunpowder	0.435	0.870	**8.70**
Lower Susquehanna	0.149	0.298	**2.98**
Nanticoke/Wicomico	0.172	0.344	**3.44**
Patapsco	0.233	0.466	**4.66**
Pocomoke	0.009	0.018	0.18

1) FDA guidance concentration = 1 ppm (mg/kg)
2) Mercury RfD = .1 ug/kg bw/day

*It is estimated that an average consumer eats approximately 17.5 g/day and a high-end consumer eats approximately 100 g/day.

Examples: Environmental/Public Health Importance

TTHMs in Drinking Water
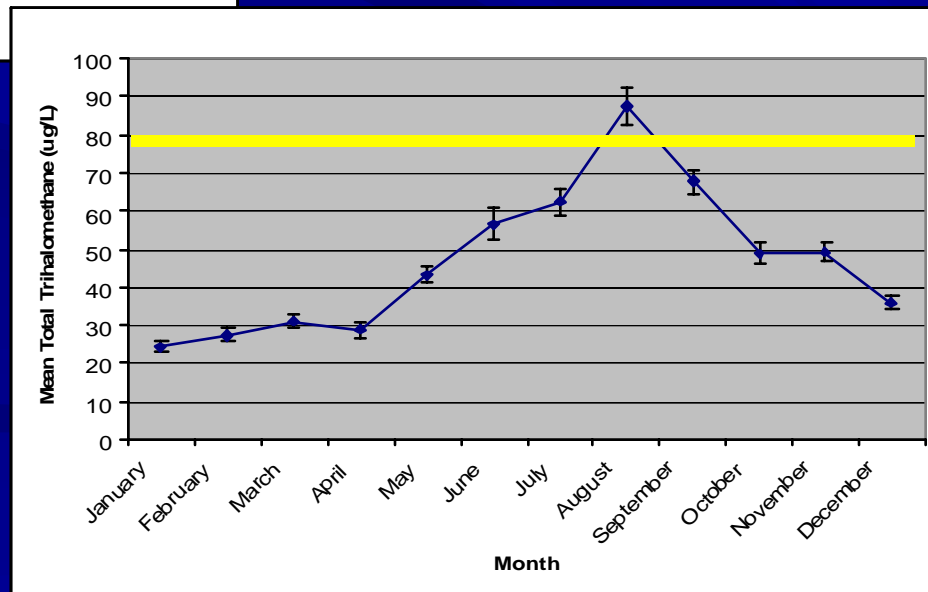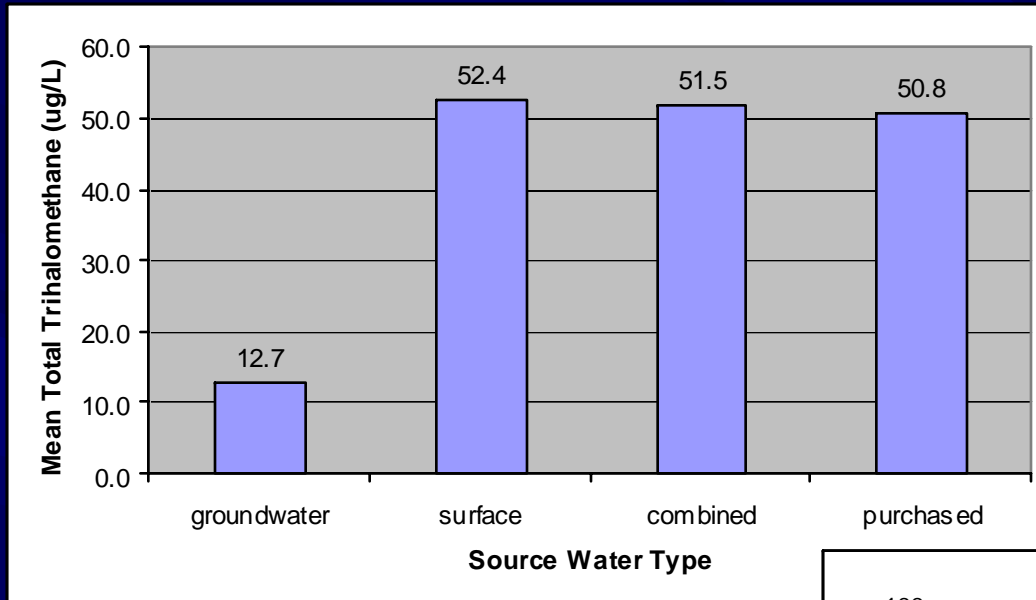
Public Health Importance
5 Leading Causes of Infant Death
Maryland, 2002

Neonatal n=434 (<28 days)		Post neonatal n=153 (28-365 days)		Infant n=587 (>1 yr)	
Short Gestation, LBW	28.3% (123)	SIDS	30.1% (46)	Short Gestation, LBW	21.8% (128)
Congenital Malformations	15.4% (67)	Congenital Malformations	16.3% (25)	Congenital Malformations	15.7% (92)
Maternal Complications	9.7% (42)	Homicide	6.5% (10)	SIDS	7.3% (43)
Complications of the placenta, cord	7.8% (34)	Short gestation, LBW	3.3% (5)	Maternal complications	7.3% (43)
Bacterial sepsis	6.2% (27)			Complication Of placenta, cord	5.8% (34)

Adapted from: Maryland Department of Health and Mental Hygiene. (2002). *Child Death Report, 2002*. Baltimore, MD: Vital Statistics.

Framework Implementation

TOPIC/INDICATOR	Environmental Health Importance	Public Health Importance	Stakeholder/ Public Concern
PCB and Mercury concentrations in fish tissue	HIGH	MEDIUM	LOW
Total Trihalomethanes (TTHM) in Drinking Water	MEDIUM	MEDIUM	HIGH
Percent Low Birth Weight (% LBW)	LOW	HIGH	MEDIUM

PHASE II: Analytic Soundness and Feasibility

- **Data and Information Quality**
  - Accurate, reliable, repeatable, scientifically valid, robust, sensitive, unbiased
- **Technical Capacity, Feasibility**
  - Available, Measurable, Feasible, Collectable, Spatially and Temporally Scaled, Trackable, Timely

TOPIC/ INDICATOR	Technical Capacity and Feasibility	Data and Information Quality
Mercury/PCB	LOW	MEDIUM
TTHM	MEDIUM	MEDIUM
LBW	HIGH	HIGH

PHASE III - Interpretation and Utility

■ **Public Health Action (Meaningful for)**

- Anticipatory, available and appropriate, cost effective, spatially and temporally scaled, easily quantifiable, timely

■ **Policy Development**

– Understandable and applicable, objective oriented, grounded by political will or support, relevant and informative

TOPIC/ INDICATOR	Public Health Action	Policy Development
Mercury/ PCB	LOW	MEDIUM
TTHM	MEDIUM	MEDIUM
LBW	HIGH	HIGH

Relative Ranking

ELEMENTS	Relative Ranking for Environmental Public Health Surveillance		
	TTHMs	Mercury and PCBs	Low Birth Weight
Environmental Health Importance	Medium	High	Low
Public Health Importance	U/D	U/D	High
Stakeholder/Public Concern	Medium	High	Low
Technical Capacity and Feasibility	Medium-Low	Low	High
Data Information Quality	Medium-Low	Medium	High
Public Health Action (Meaningful)	Medium	High	U/D
Policy Development***	High	High	Low

SUMMARY RANKING FOR DECISION ANALYSIS

Topic Area	Scientific Basis and Relevance	Analytic Soundness and Feasibility	Interpretation and Utility
TTHMs	Good	Good	Good
Mercury and PCBs	Good	Fair	Good
% LBW	Poor	Excellent	Fair

Conclusions and Recommendations

- **Environmental Health Surveillance Systems are complex**
  - Systematic
  - Efficient and effective
- **Environmental Health Practitioners are Accountable for decision-making**
  - Scientifically valid
  - Transparent
  - Inclusive: science, policy and key constituents
- **Environmental Health Practice is dynamic**
  - Flexible
  - Simple or Complex

Acknowledgements

- CDC EPHT program
- Johns Hopkins Bloomberg School of Public Health – EPHT Center of Excellence in EPHT
- Amy Kyle – UC Berkeley
- Wisconsin Bureau of Environmental and Occupational Health, Division of Public Health, Department of Health and Family Services

Questions?

Thank you