

Relative Risk Evaluation: Mosquito Control and West Nile Virus



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What is Risk?

- Our personal view of risk is shaped by perceptions
 - risk = $f(\text{perception})$

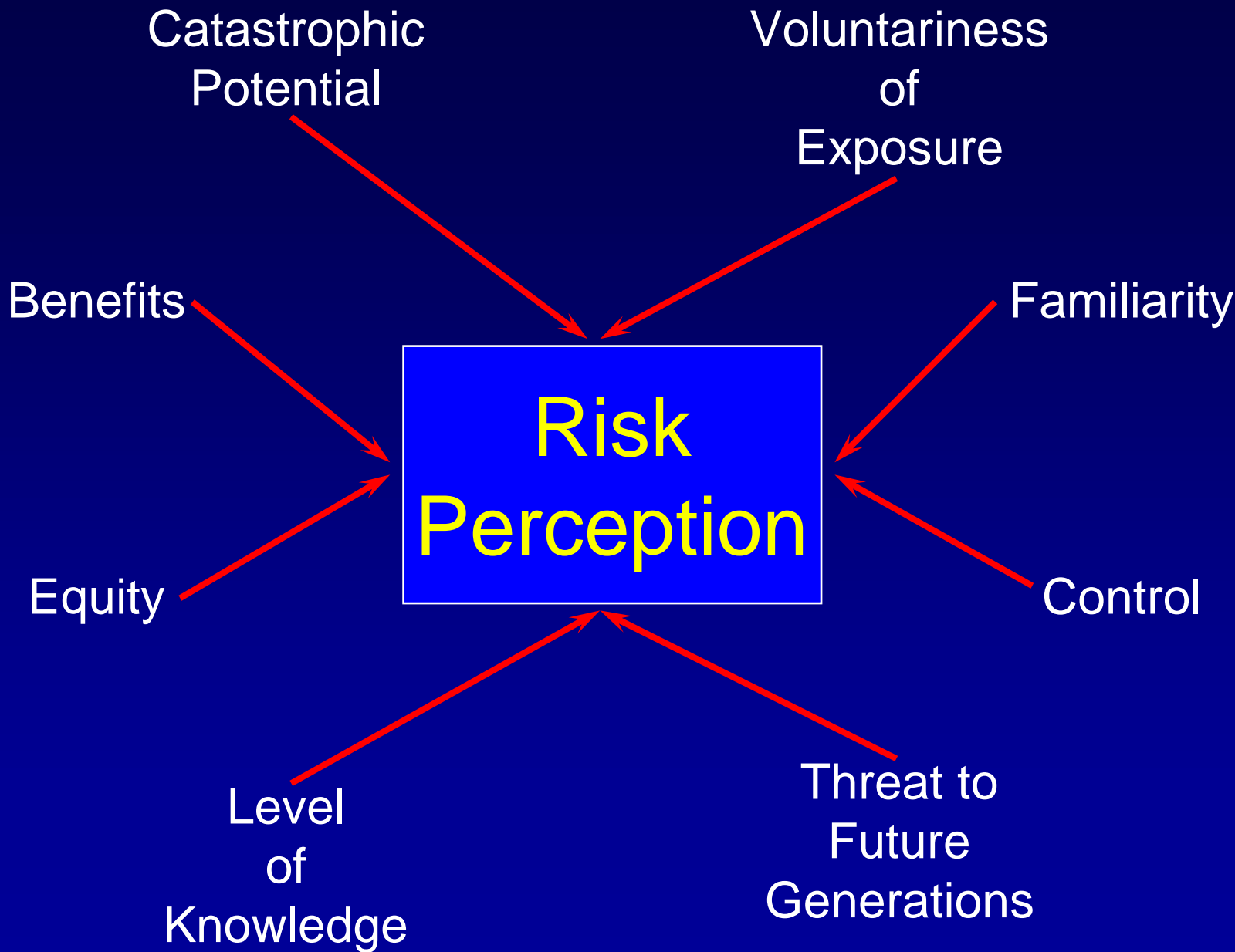
Microwave Ovens ◆
Water Fluoridation ◆ Nitrites ◆
Valium ◆ Antibiotics ◆
◆ Caffeine
Non-Dread Risk ◆ Vaccines

Unknown Risk
◆ DNA Technology
◆ Electric Fields
◆ Radioactive Waste
◆ Pesticides
Nuclear Accidents ◆
◆ DDT
◆ Fossil Fuels
Dread Risk

Smoking (Diseases) ◆
◆ Power Mowers
◆ Skiing Alcohol ◆
Motorcycles ◆

Nerve Gas Accidents ◆
Nuclear War ◆
◆ Commercial Aviation
◆ Auto Accidents
◆ Handguns

Known Risk



WNV vs. Pesticides

- 29% (257/880) more worried about getting sick from WNV than pesticides
- 23% (198/880) more worried about getting sick from pesticides than WNV
- 31% (276/880) equally afraid of WNV and pesticides

Perceptions of Risk

- *Poisoning the Big Apple*

- *by Mitchel Cohen, Green Party of New York*

- ...the vast majority of dead birds ... had been killed not by the West Nile Virus ... but by pesticide poisoning and air pollution.

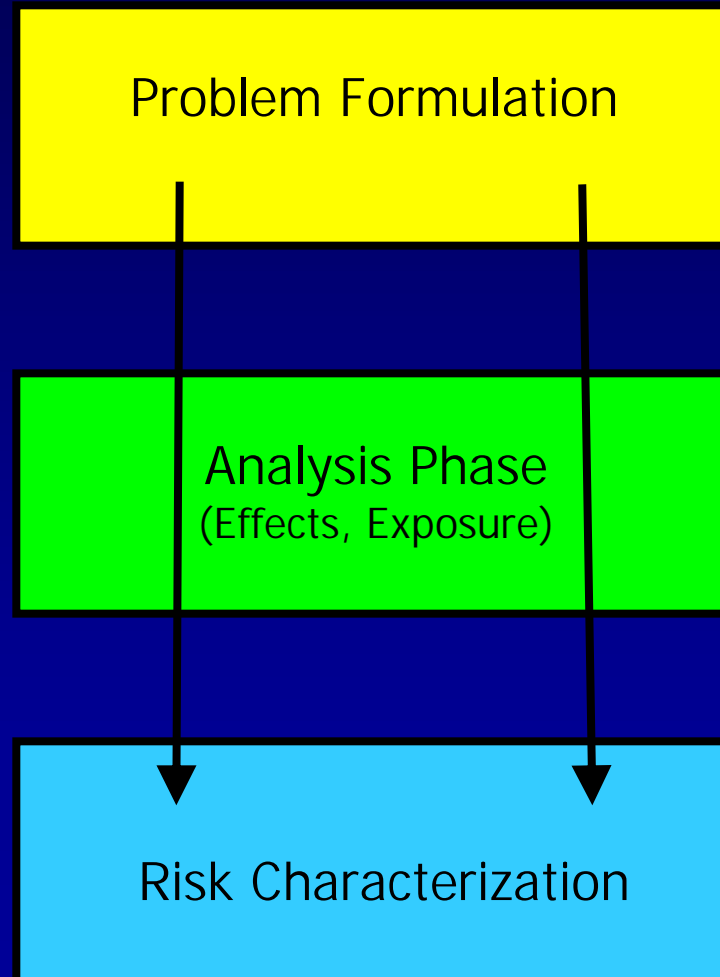
What is Risk?

- The science based understanding of risk
 - risk = $f(\text{hazard}, \text{exposure})$
 - therefore risk = how bad * how often

Risk Assessment

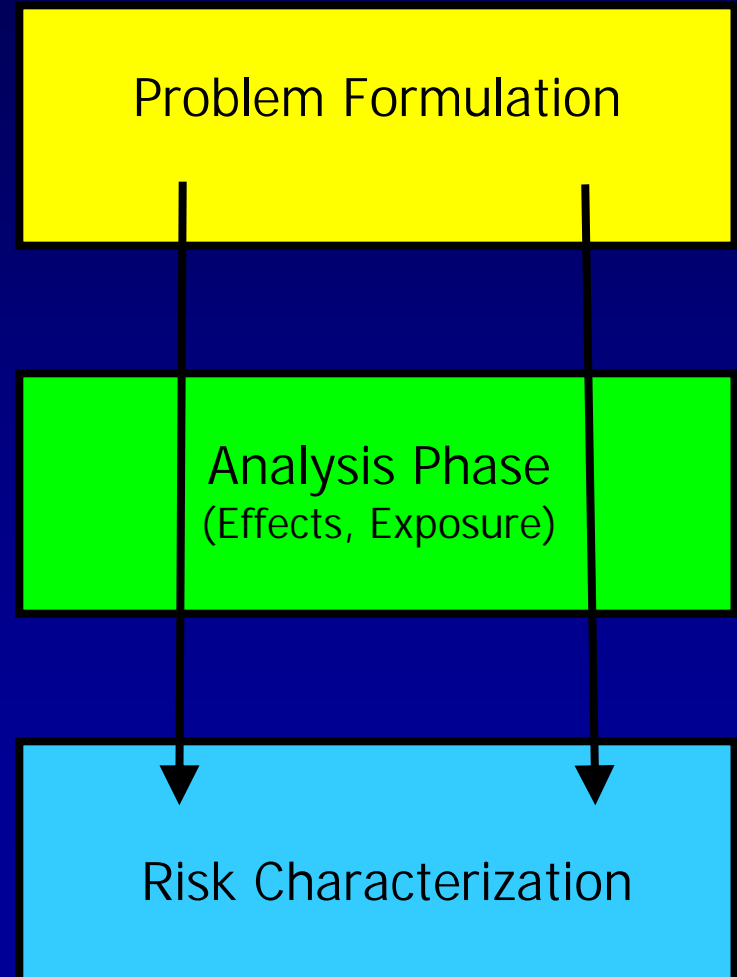
- Risk assessment is a **formalized** basis for the **objective evaluation** of risk in a manner where **assumptions and uncertainties are clearly evident.**

Risk Assessment Paradigm



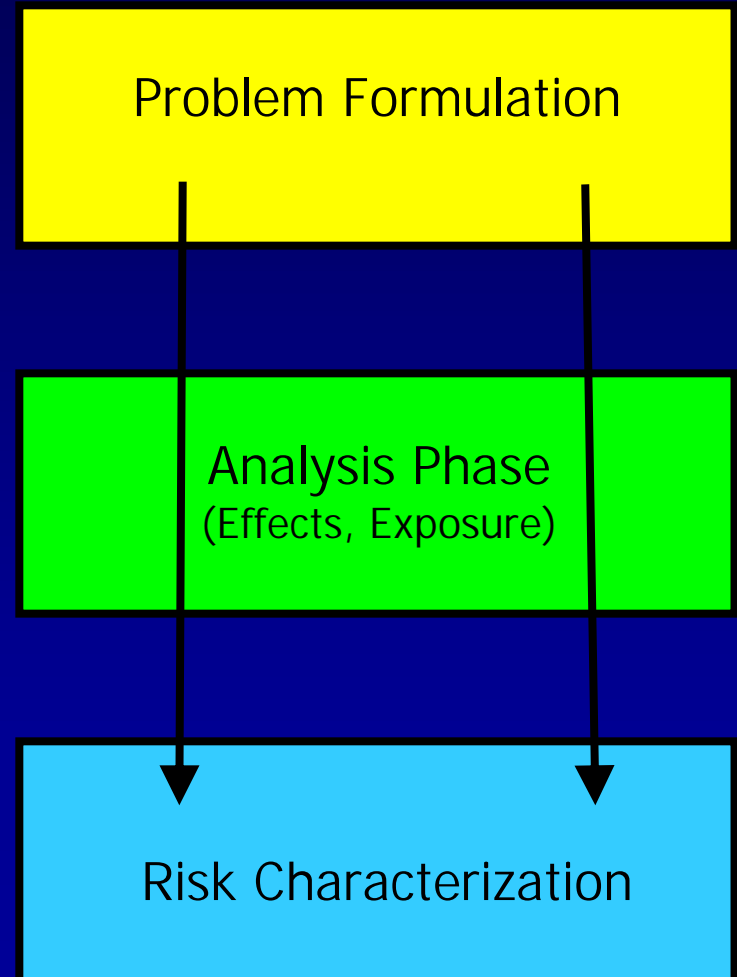
Risk Assessment Paradigm

- Problem Formulation
 - Establishes the goals, breadth, and focus of the assessment
 - conceptual model



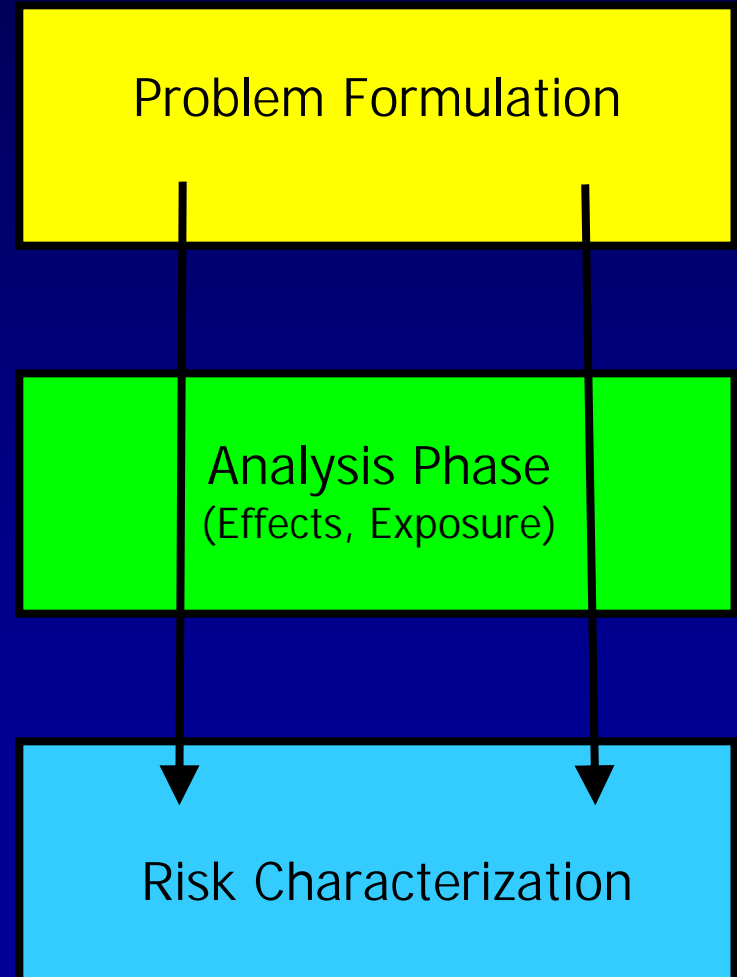
Risk Assessment Paradigm

- Analysis Phase
 - Effects
 - ability of the stressor to impact ecological receptors
 - Exposure
 - the interaction of stressors with ecological receptors

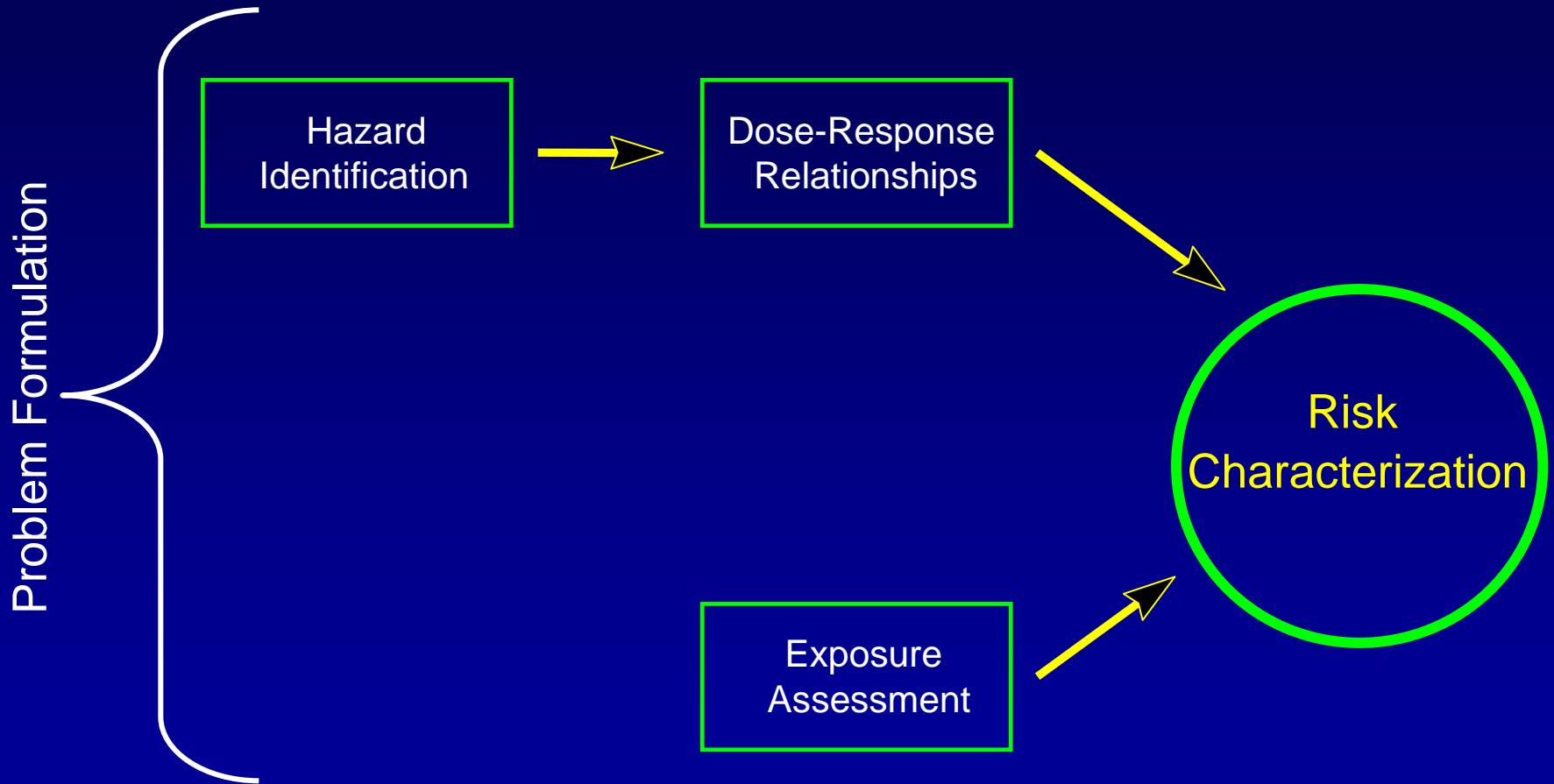


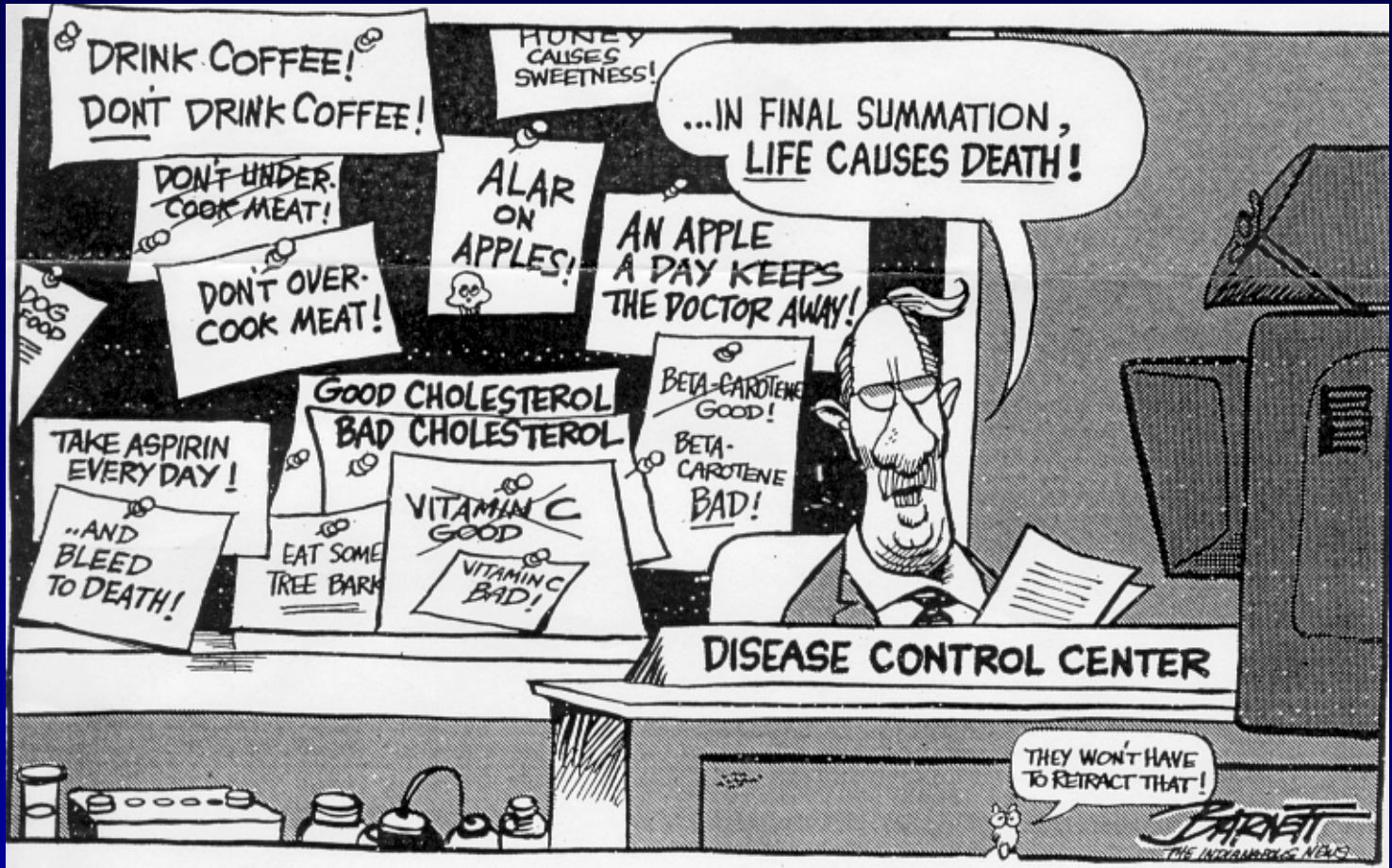
Risk Assessment Paradigm

- Risk Characterization
 - Effect is considered in juxtaposition with exposure to determine risk or to determine what additional data are needed to calculate or refine risk estimates.



Risk Assessment Paradigm





DRINK COFFEE!
DONT DRINK COFFEE!

HONEY
CAUSES
SWEETNESS!

DONT UNDER-
COOK MEAT!

ALAR
ON
APPLES!

...IN FINAL SUMMATION,
LIFE CAUSES DEATH!

AN APPLE
A DAY KEEPS
THE DOCTOR AWAY!

DONT OVER-
COOK MEAT!

DOG
FEED

TAKE ASPIRIN
EVERY DAY!
..AND
BLEED
TO DEATH!

GOOD CHOLESTEROL
BAD CHOLESTEROL

BETA-CAROTENE
GOOD!
BETA-
CAROTENE
BAD!

EAT SOME
TREE BARK

VITAMIN C
GOOD
VITAMIN C
BAD!

DISEASE CONTROL CENTER

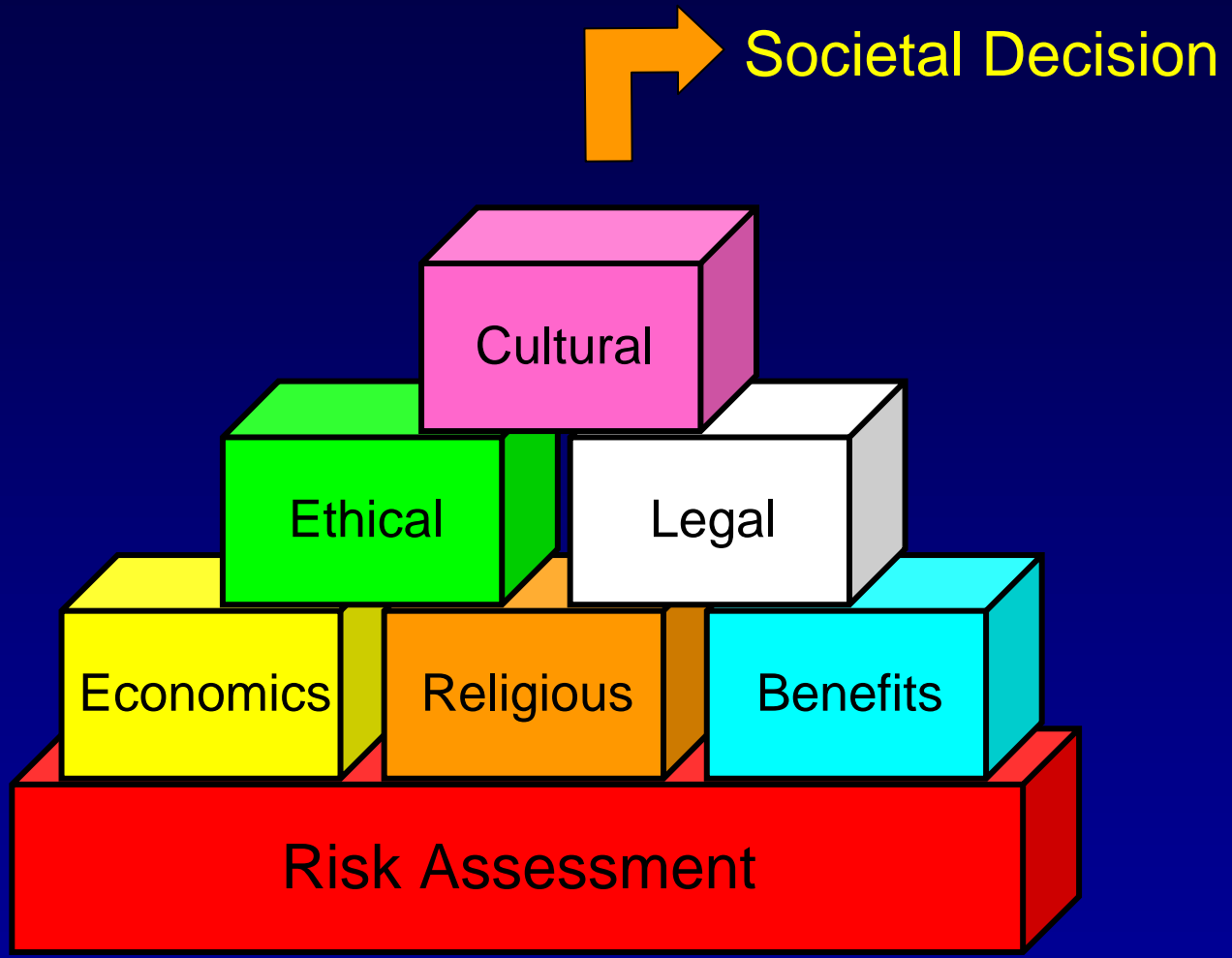
THEY WON'T HAVE
TO RETRACT THAT!

BARNETT
THE INTRAMURAL NEWS

Risk Analysis



Science → Technology ↗

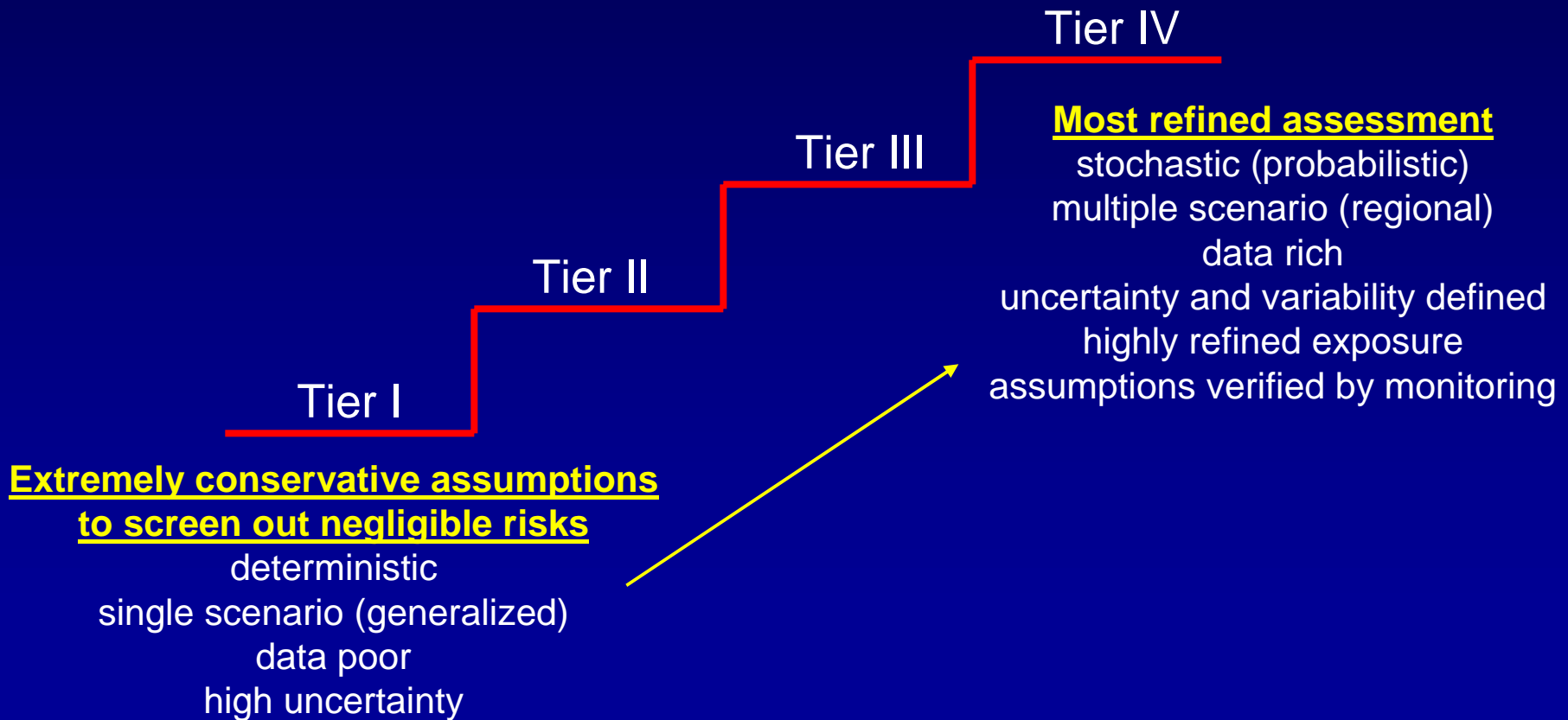


Societal Decision

Once a Pesticide is Registered in the U.S.

- It must be used according to the label
 - The risks from its labeled use are acceptable (according to EPA)
 - The risks are calculated using the risk assessment paradigm
 - Risks assessed based on 142 effects and exposure studies

Risk Assessment



Risk Characterization

- Risk Quotients
 - Estimated Environmental Concentration ÷ Effect
 - $[EEC] \div [Effect] = RQ$
 - Exposure ÷ Toxic Endpoint = RQ
 - RQ that exceed a Level of Concern show risk

Tier 1 Risk Assessment for Mosquito Adulticides

- Adult Humans - Malathion

Exposure	EPA Exposure Threshold	Subchronic Risk Quotient (RQ)
0.00034	0.024	0.014

Assumptions:

Reasonable Worst Case Exposures – Season long spraying (treatment area within 300 ft. of the spray source, sprayed on day 1, 4, 14, 17, 27, 30, 40, 53, and 56)

Effects = No Observed Effect Level (NOEL) of 2.4 mg/kg body weight w/ 100 fold safety factor

Tier 1 Risk Assessment for Mosquito Adulticides

- Adult Humans

Pesticide	Subchronic Risk Quotient (RQ)	EPA Level of Concern
Resmethrin	0.0044	1
Malathion	0.014	1

Assumptions:

Reasonable Worst Case Exposures – Season long spraying (treatment area within 300 ft. of the spray source, sprayed on day 1, 4, 14, 17, 27, 30, 40, 53, and 56)

Effects = NOEL w/ 100 fold safety factor

Risk Comparisons

- Humans (once exposed)

Risk Factor	Risk (%)
WNV Illness	20
WNV Encephalitis	0.7
WNV Death	0.1 – 7*
Resmethrin (NOEL)	0.004

*2002 case data from CDC. Mortality rate from confirmed cases.

Tier 1 Risk Assessment for Mosquito Adulticides

- Birds

Pesticide	Acute Risk Quotient (RQ)	EPA Levels of Concern for Birds
Resmethrin	0.0000009	0.1 – 0.5
Malathion	0.0003504	0.1 – 0.5

Tier 1 Risk Assessment for Mosquito Adulticides

- Birds



Perceptions of Risk

- *Poisoning the Big Apple*

- *by Mitchel Cohen, Green Party of New York*

- ...the vast majority of dead birds ... had been killed not by the West Nile Virus ... but by pesticide poisoning and air pollution.

Tier 1 Risk Assessment for Mosquito Adulticides

- Fish (ponds)

Pesticide	Acute Risk Quotient (RQ)
Resmethrin	140
Malathion	320

Assumptions:

Rate of exposure at pond surface = application rate
No atmospheric dilution, no photolysis

Risk Assessment for Mosquito Adulticides

- Fish (ponds) – Tier 2

Pesticide	Acute Risk Quotient (RQ)	EPA Levels of Concern for Fish
Resmethrin	0.09	0.05 – 0.5

Assumptions:

1% of applied material drifts onto pond

5% runoff from large rainfall event within 24 hours of application

Risk Comparisons

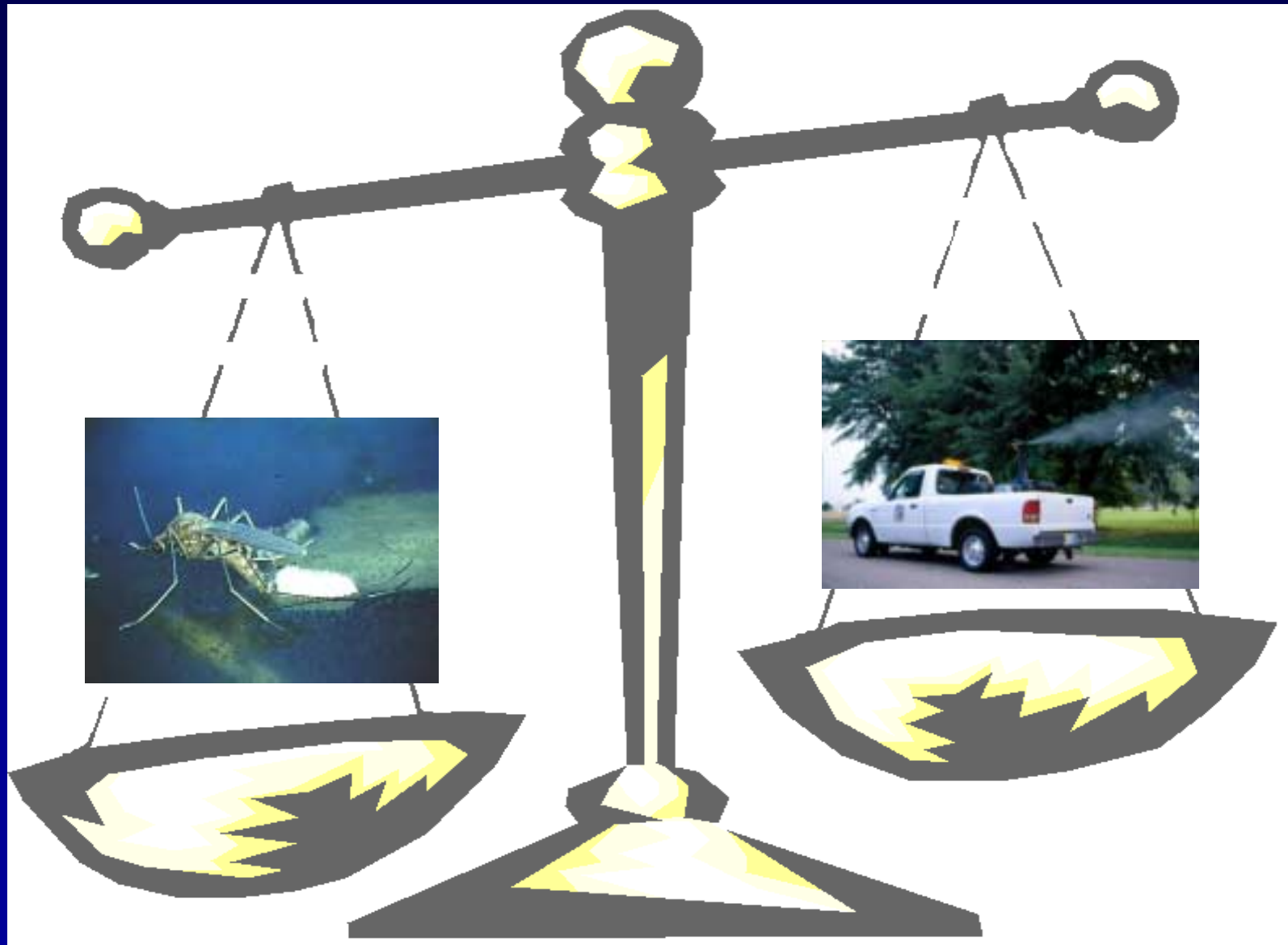
- Horses (once exposed)

Risk Factor	Risk (%)
WNV Illness	10
WNV Death*	3-4
WNV Vaccine Failure Rate**	6
WNV Vaccine Risk	~0
Resmethrin Acute Inhalation (% of LOEL)	0.007

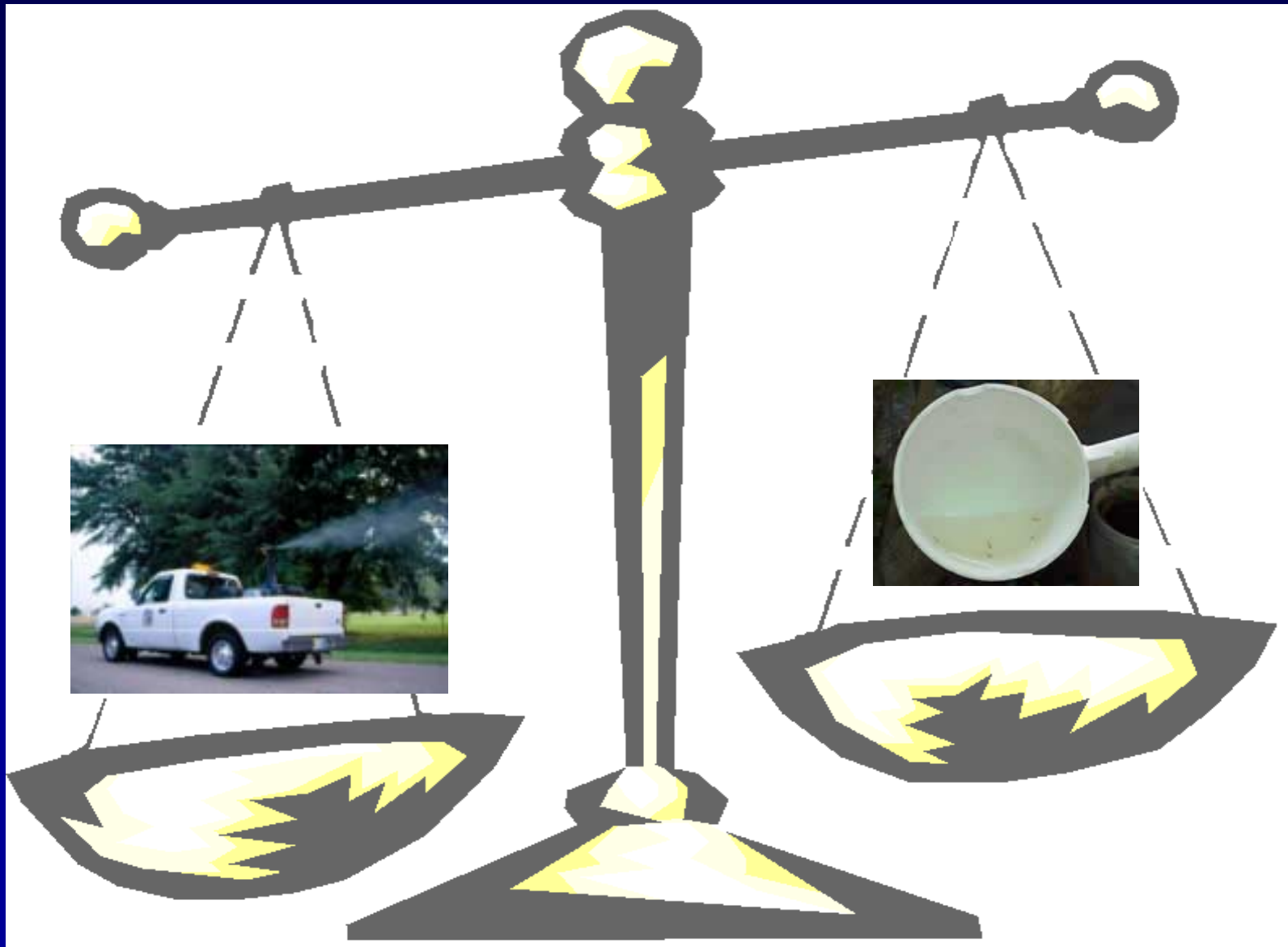
*Probability of death if infected (Herbert & Church 2002).

**T. Creekmore, WY Dept. of Public Health, 2003.

Comparative Risks from WNV & Mosquito Control



Comparative Risks from WNV & Mosquito Control



What We Need

- The public needs transparent, objective, and independent information about the human-health and environmental risks from insecticides used in mosquito control.
- At MSU, we can conduct and communicate risk assessments for the pesticides most commonly used in mosquito control.
- Funding????