

1<sup>st</sup> Annual Northwest Environmental Health Conference  
“Bridging Research, Care, and Policy”

# The why and how of “Prevention First”

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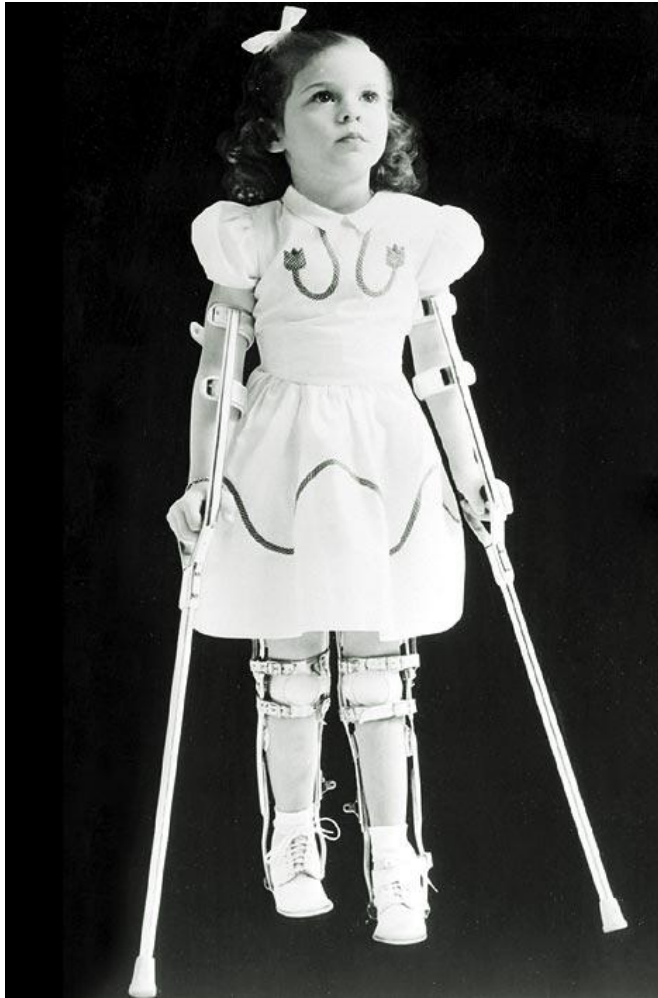
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- Understand the relative costs and benefits associated with levels of prevention
- Be able to apply the biologic impact pathway to analyze problems
- Understand the core functions of public health, as applied to environmental problems
- **Be awake!**

# What is “prevention”?



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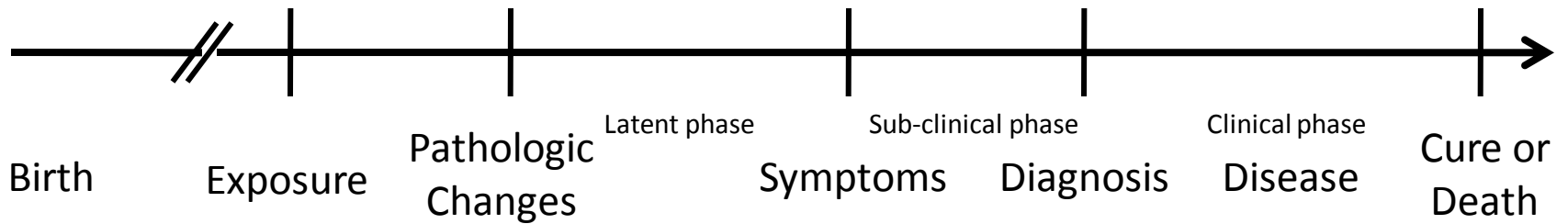
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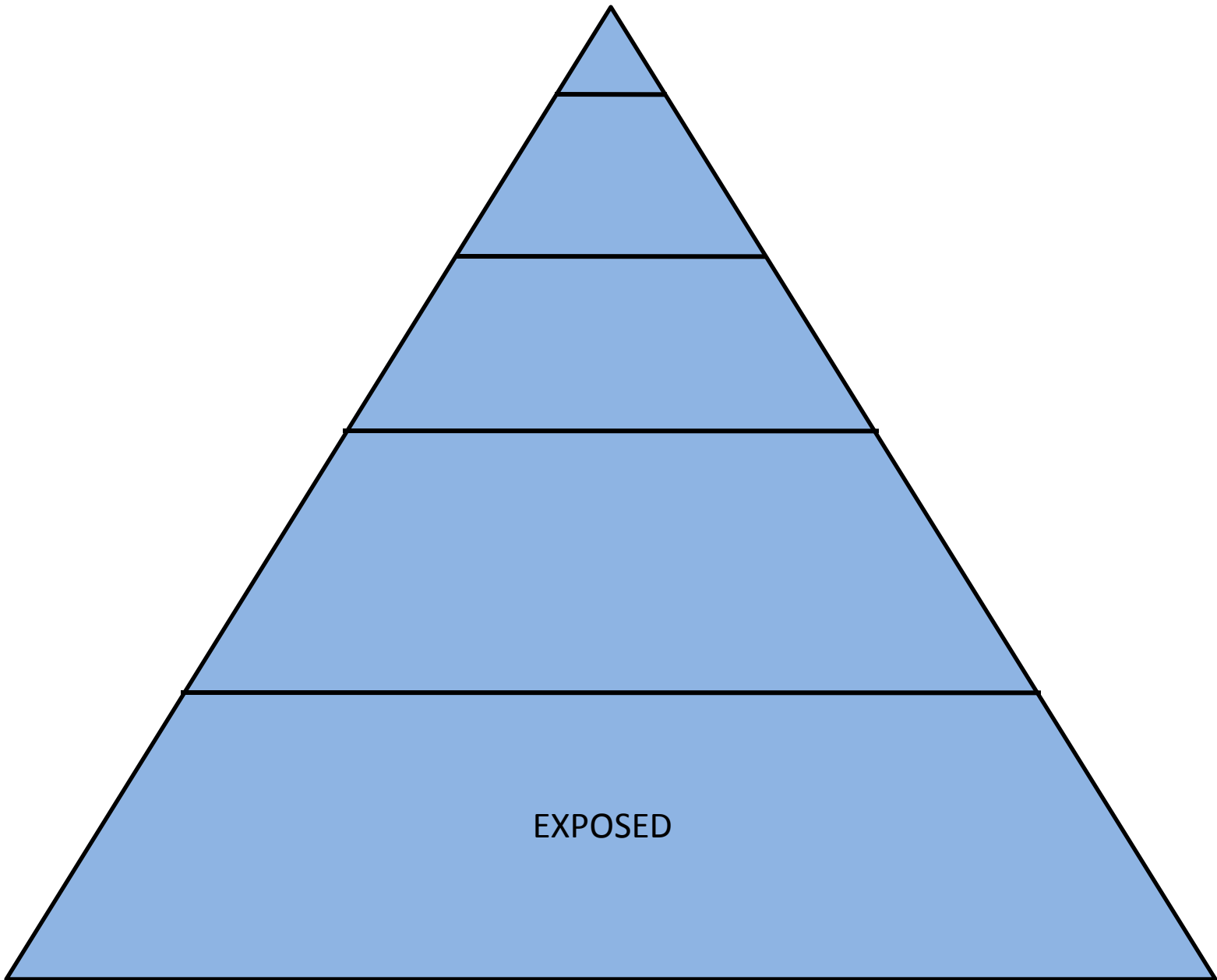
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    - **Some are still unknown**

# Implications

- Public has high expectations for prevention programs
- Although complete eradication is not possible, many chronic diseases can be greatly reduced
- Prevention requires organized action at *both* the individual and community levels
- We must think in terms of populations, “attributable risk”, and “upstream” causes

# Spectrum of disease



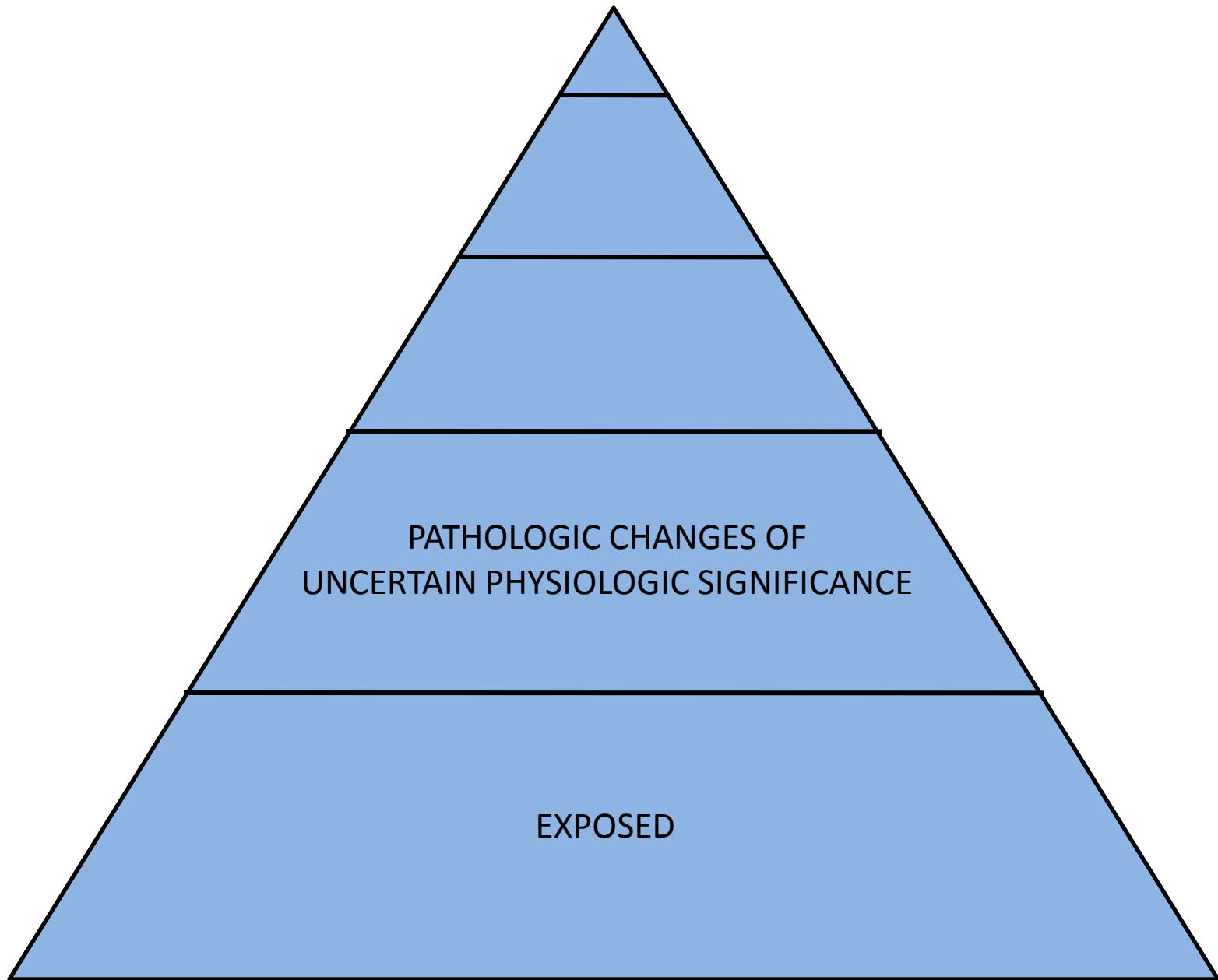


EXPOSED



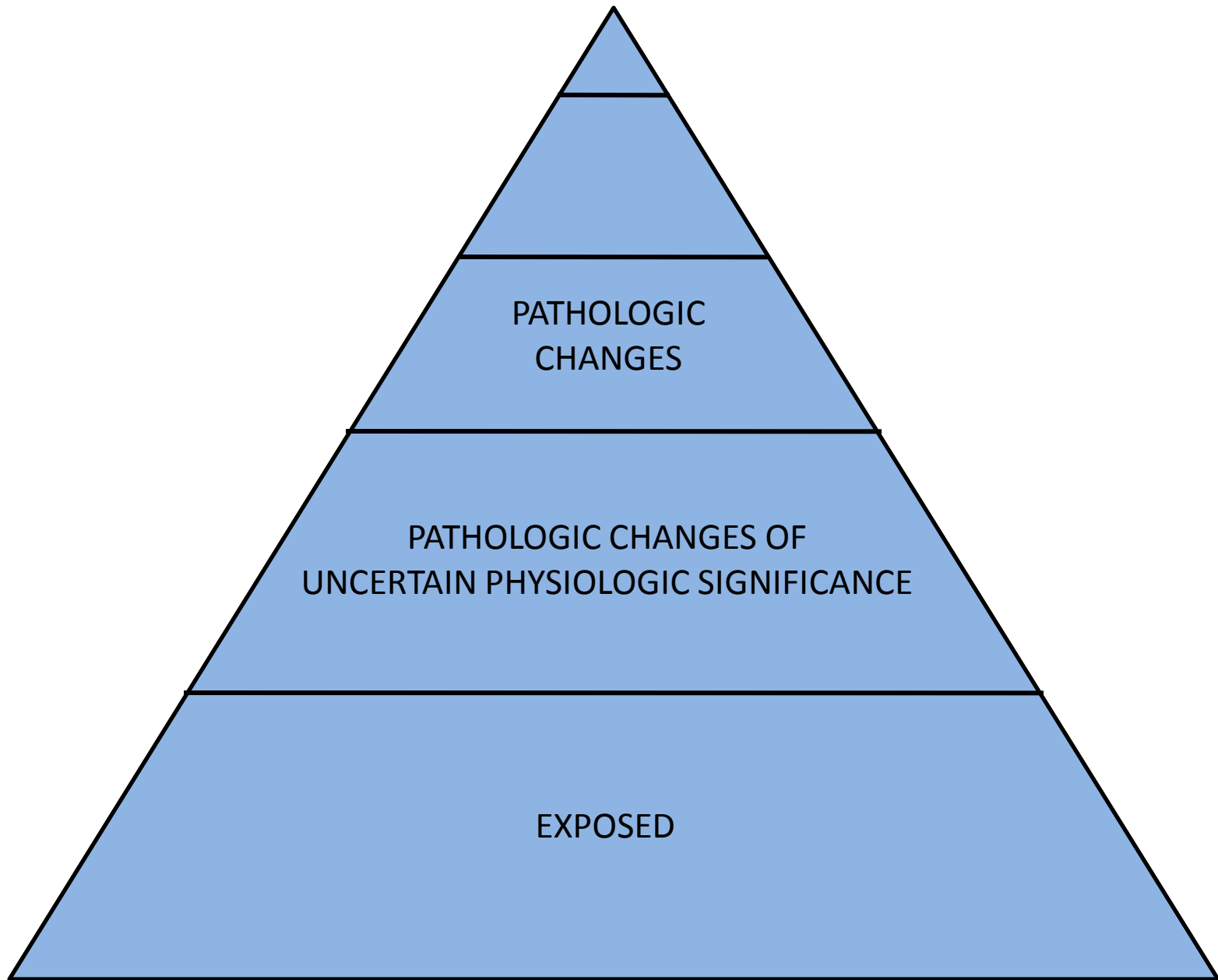
**Proportion of Affected Population**





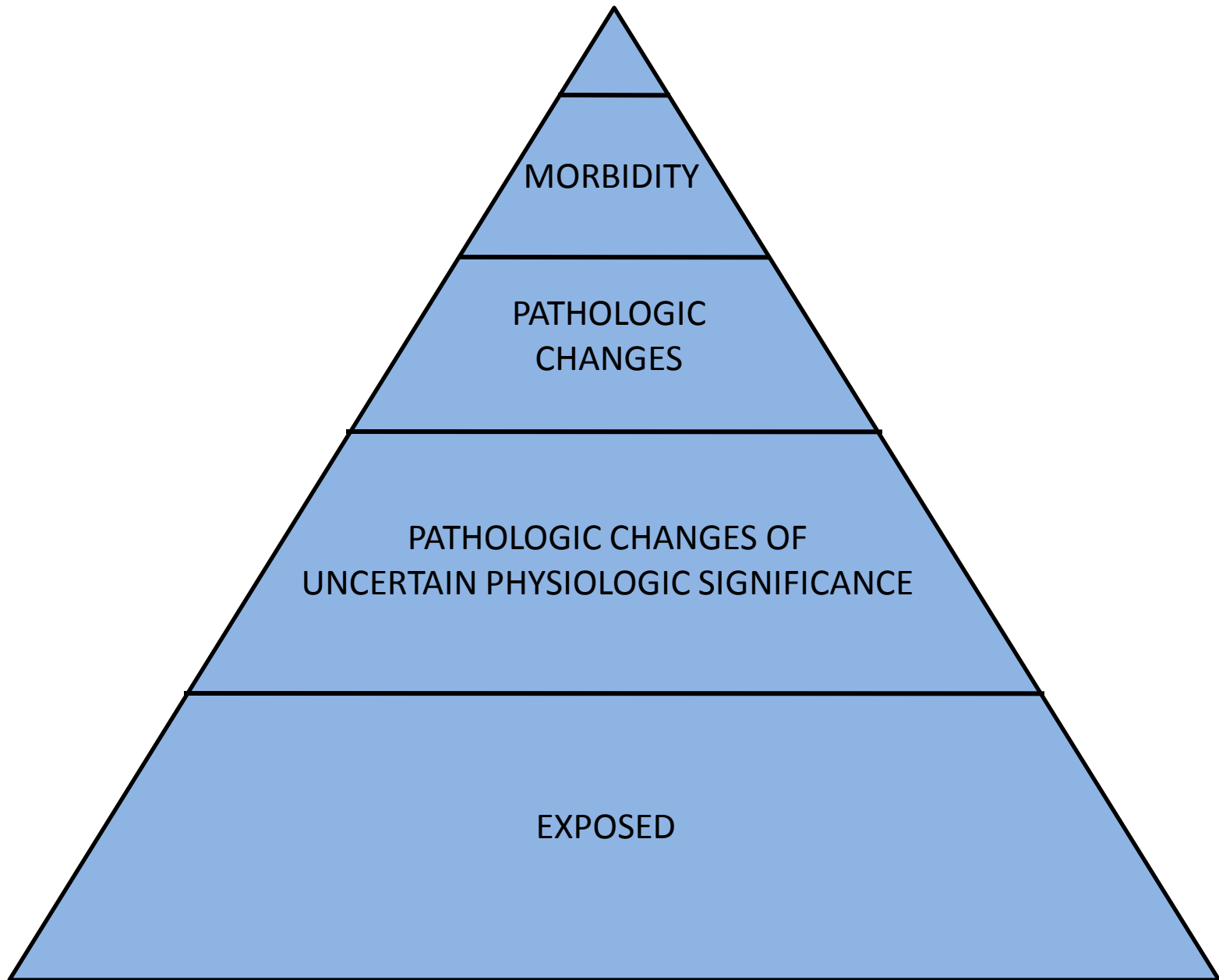
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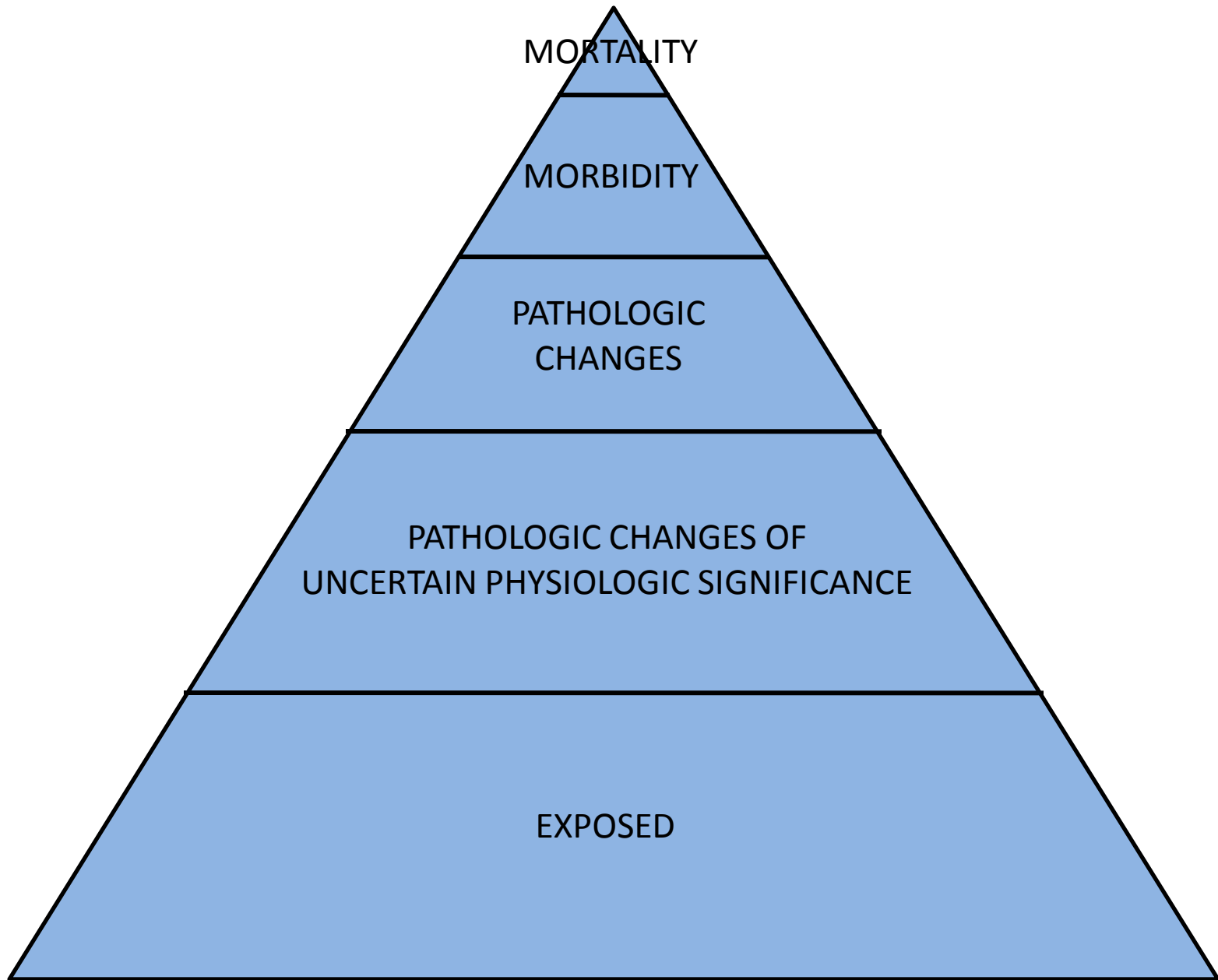
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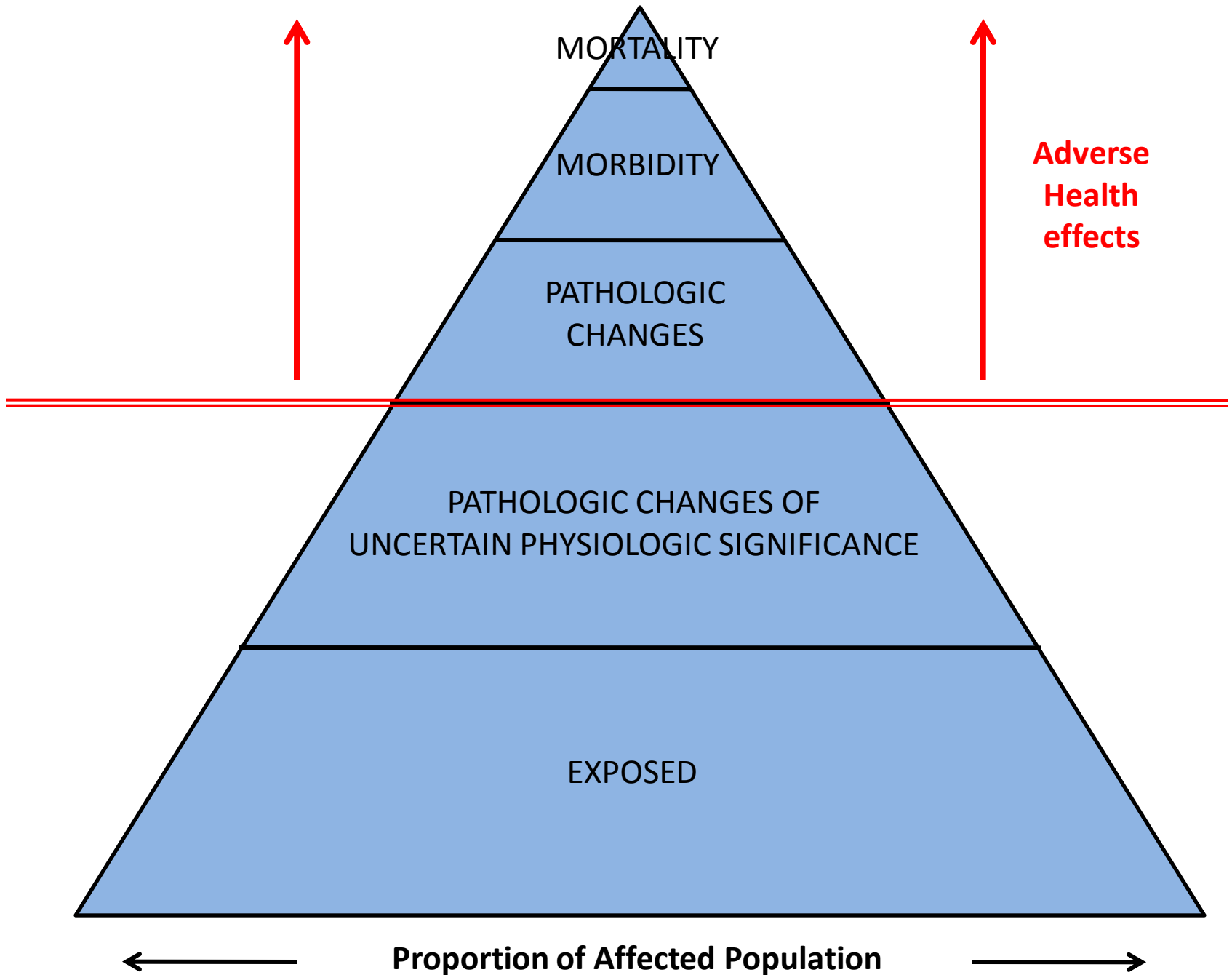
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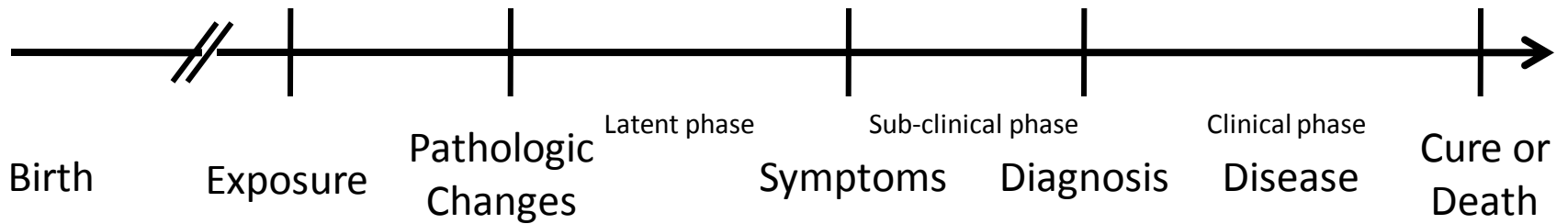
Secondary – early detection (screening)

Tertiary – treatment to slow or prevent progression, reduce the consequences of disease

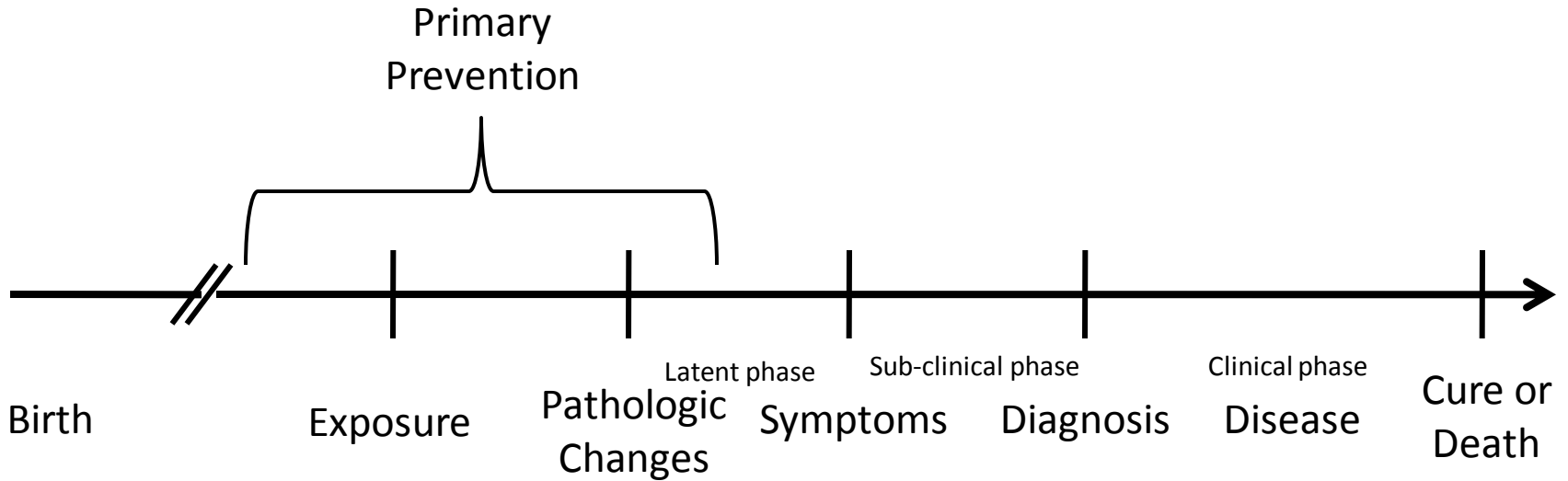
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- Prevention activities have multiple forms which are not always distinguished.
  - Primary – reduce or eliminate exposure
  - Secondary – early detection (screening)
  - Tertiary – treatment to slow or prevent progression, reduce the consequences of disease
- **Historically, most money is directed at screening and treatment, rather than reducing exposure to the hazard**

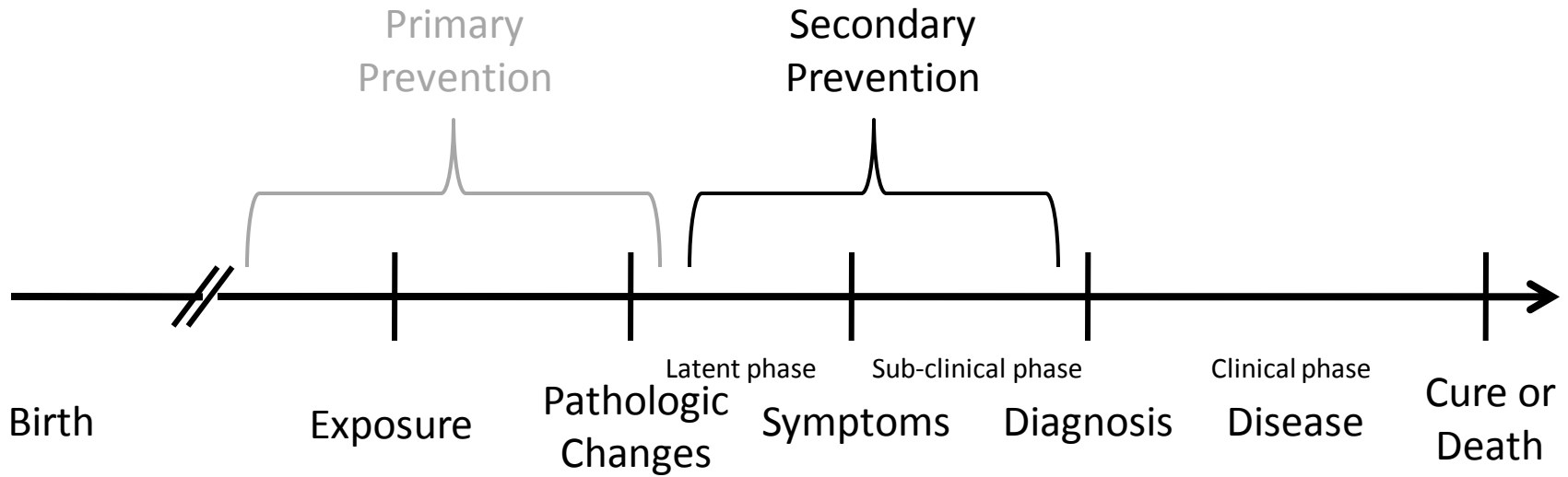
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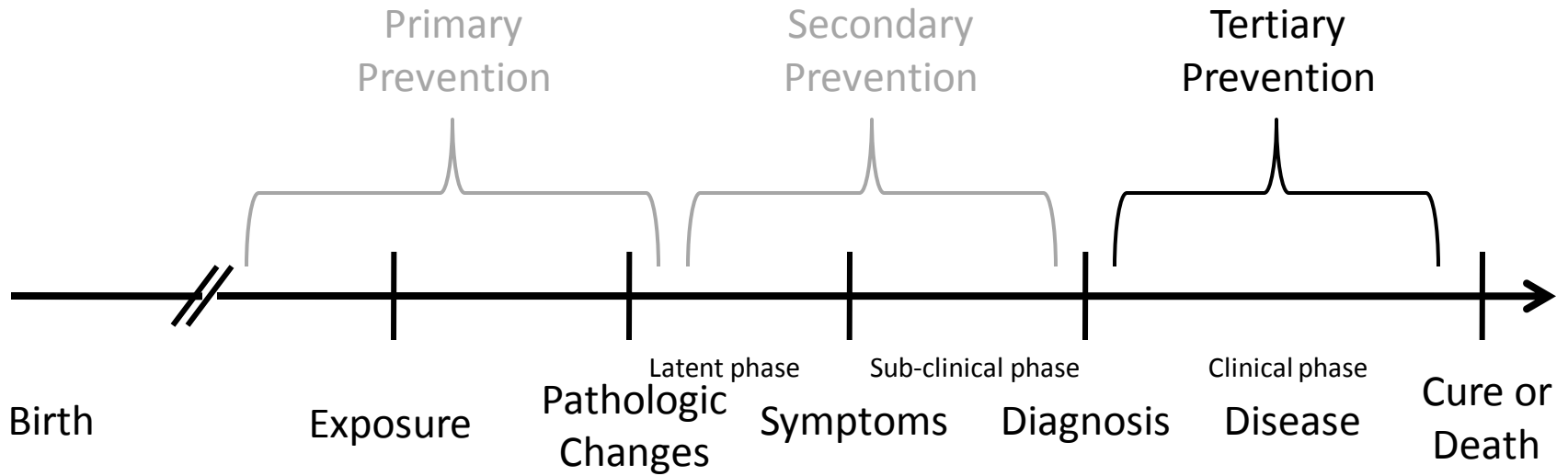
# Primary prevention takes place “upstream”

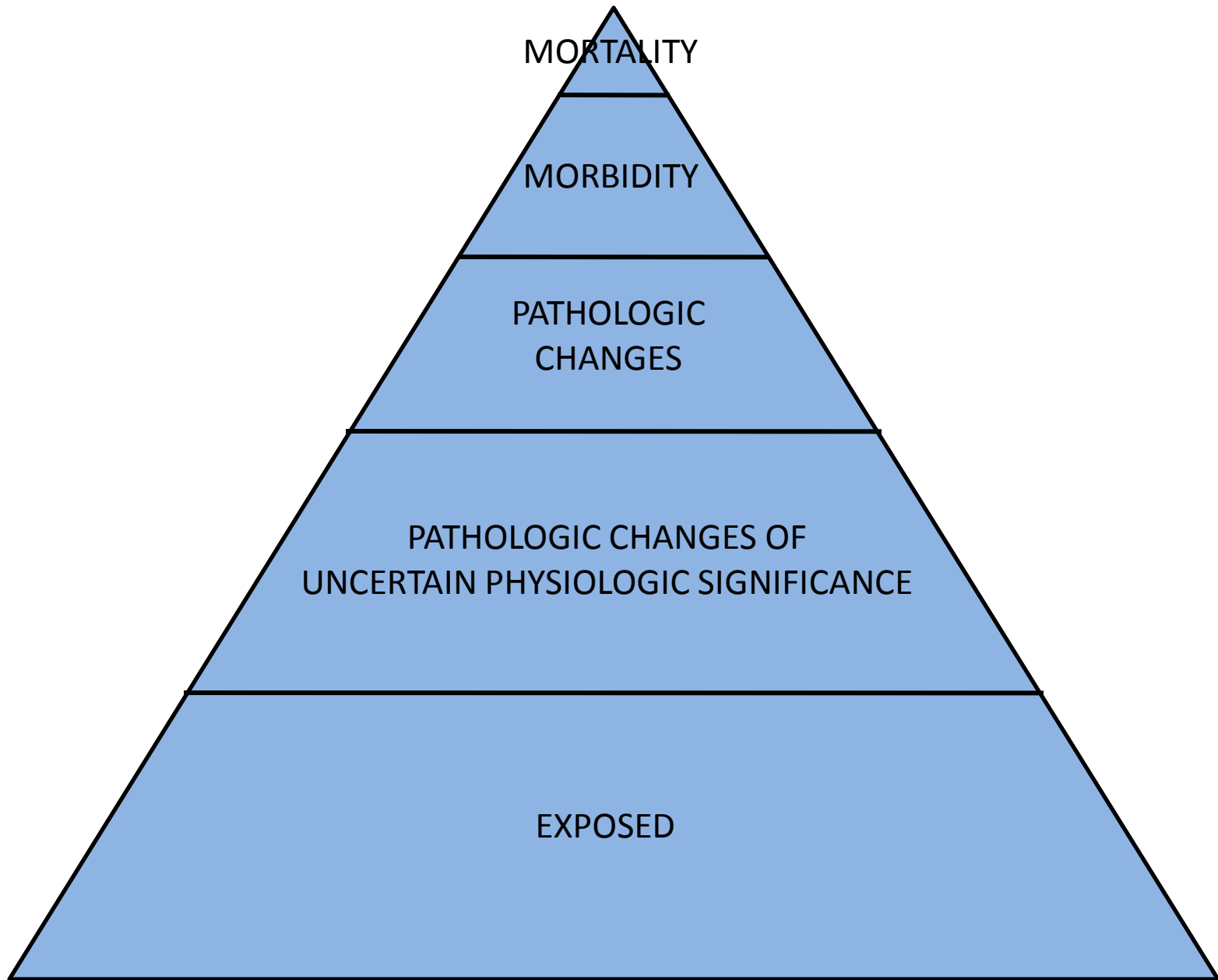


# True secondary prevention (population screening) also occurs “upstream”



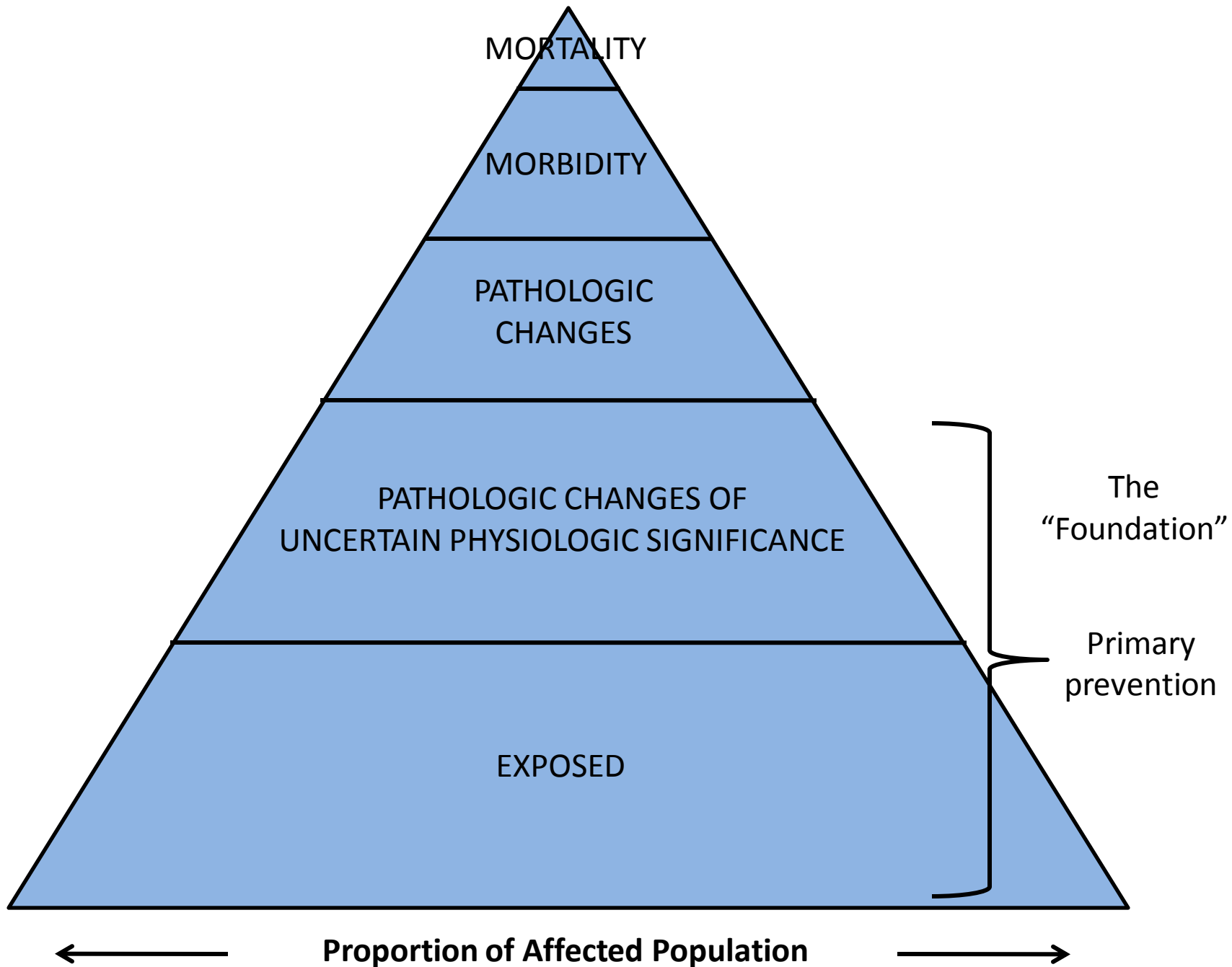
# Tertiary prevention: “the horse is out of the barn”

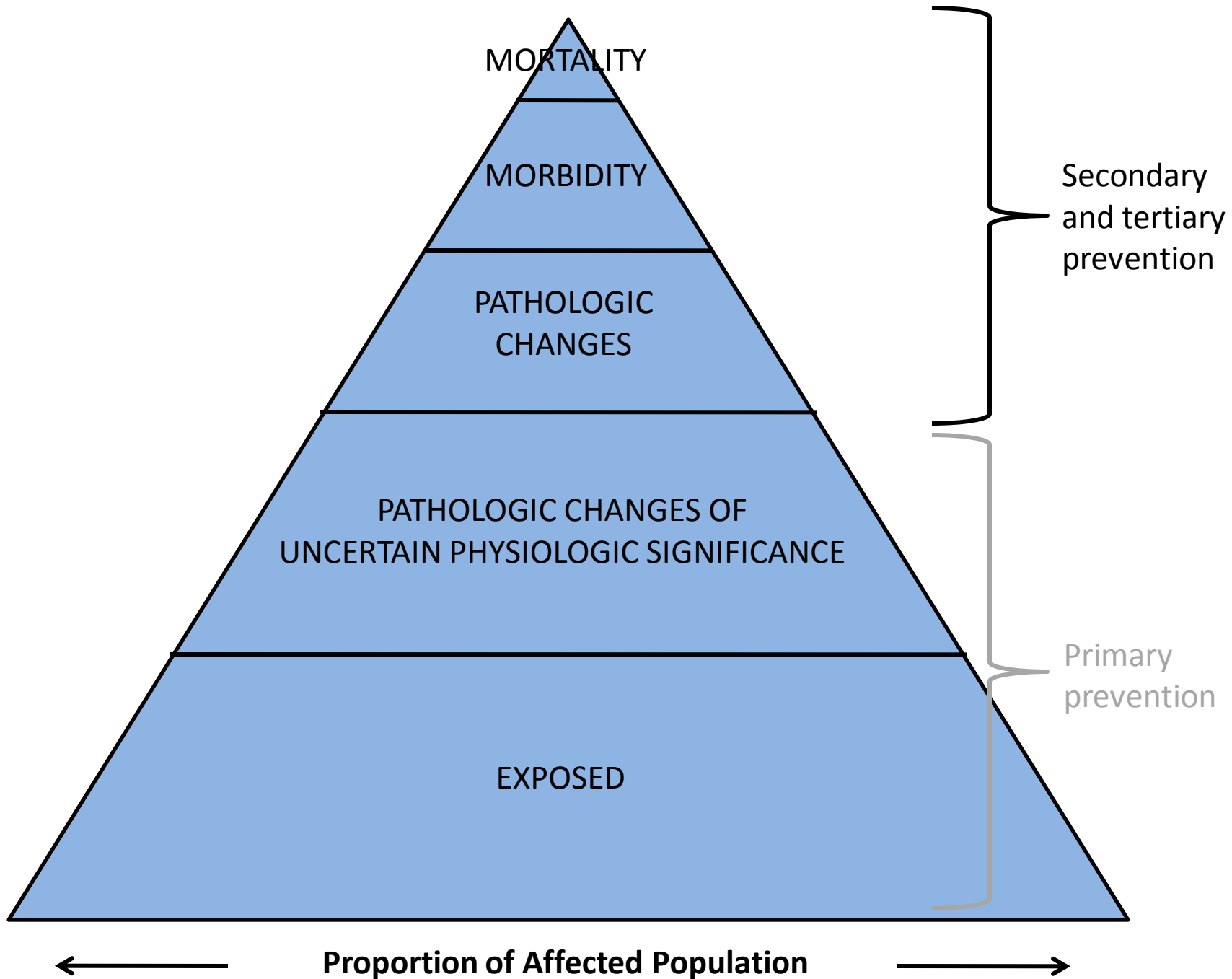




**Proportion of Affected Population**







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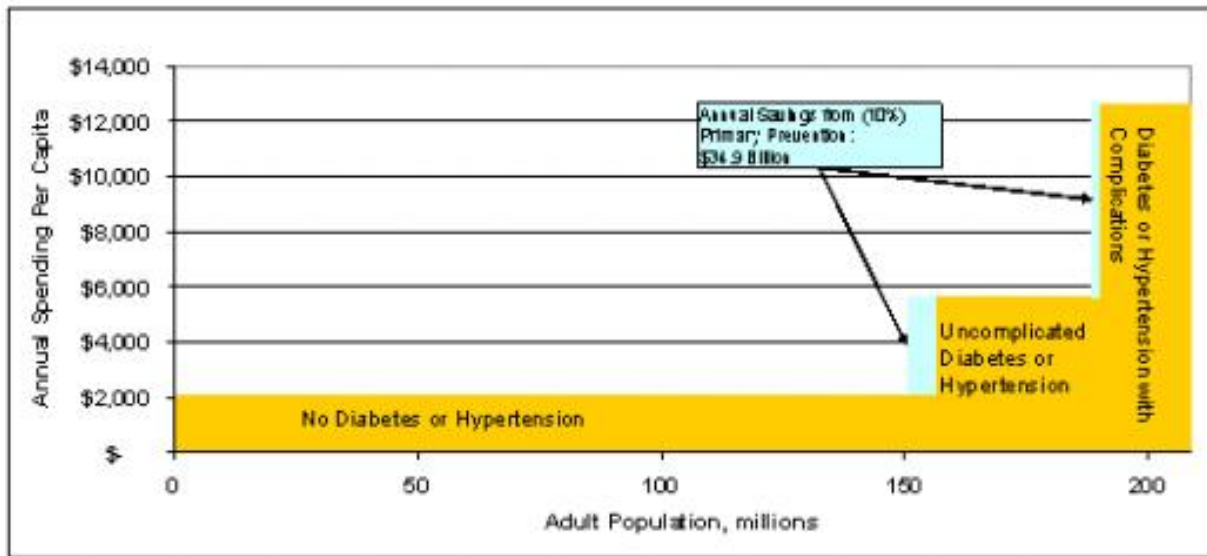
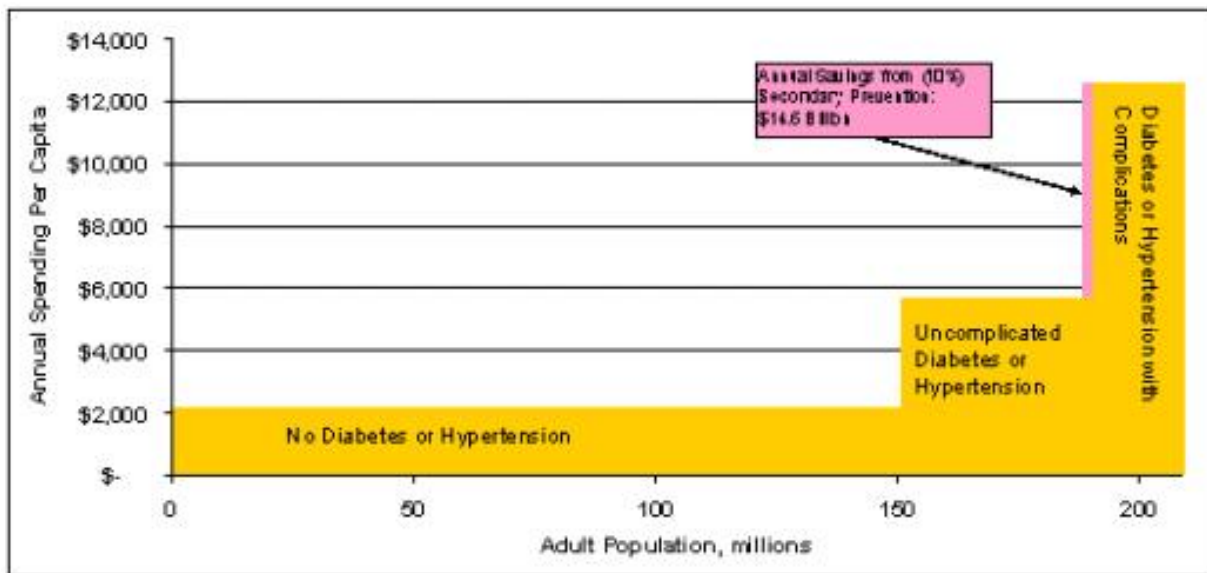
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  - No increase in medical costs
  - Spillover effects to improved local quality of life and economic vitality

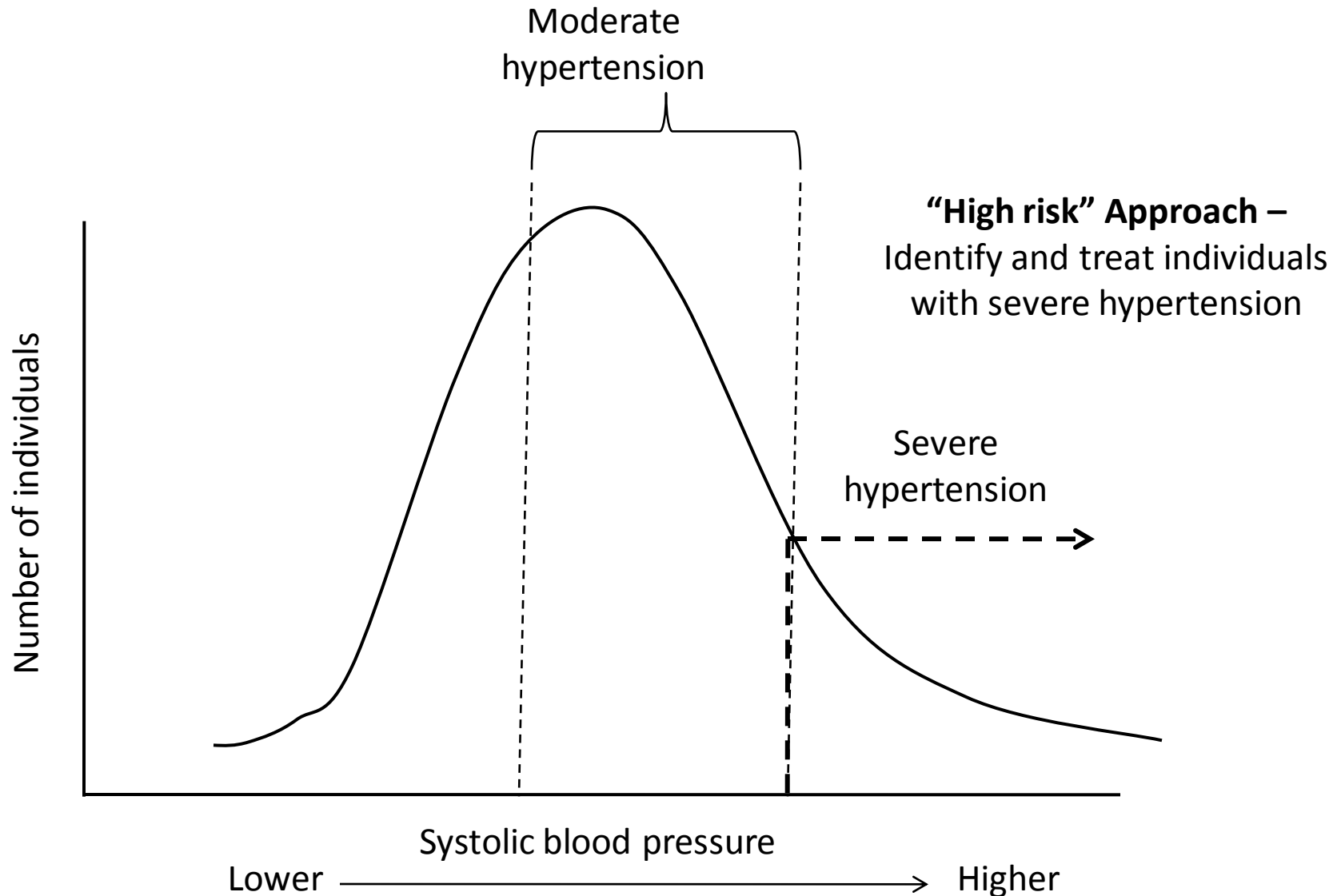
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- **So, what are the savings?**

# Savings in primary vs. clinic-based secondary prevention (per capita 2004 dollars)

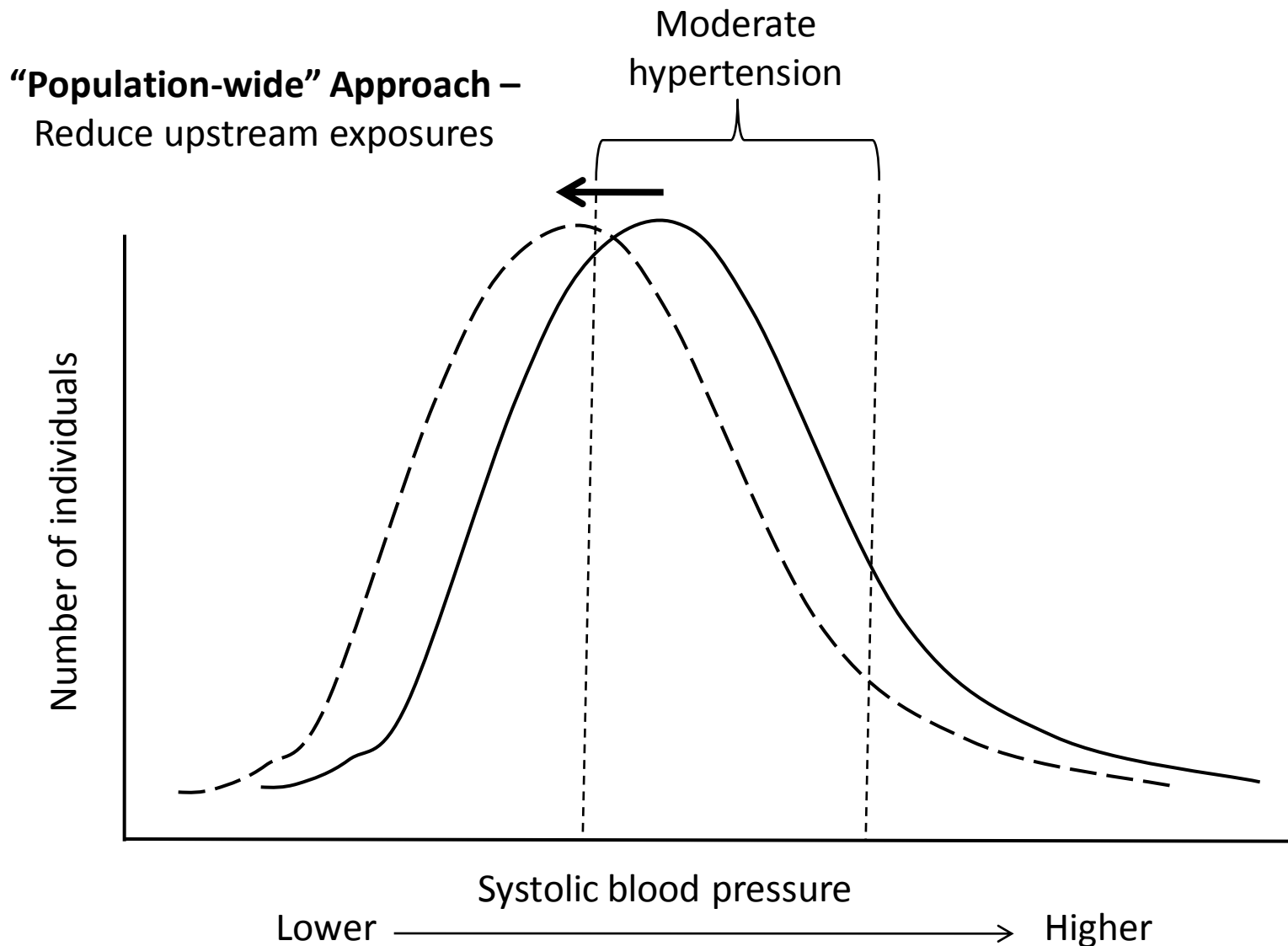


# The “high risk” approach to prevention



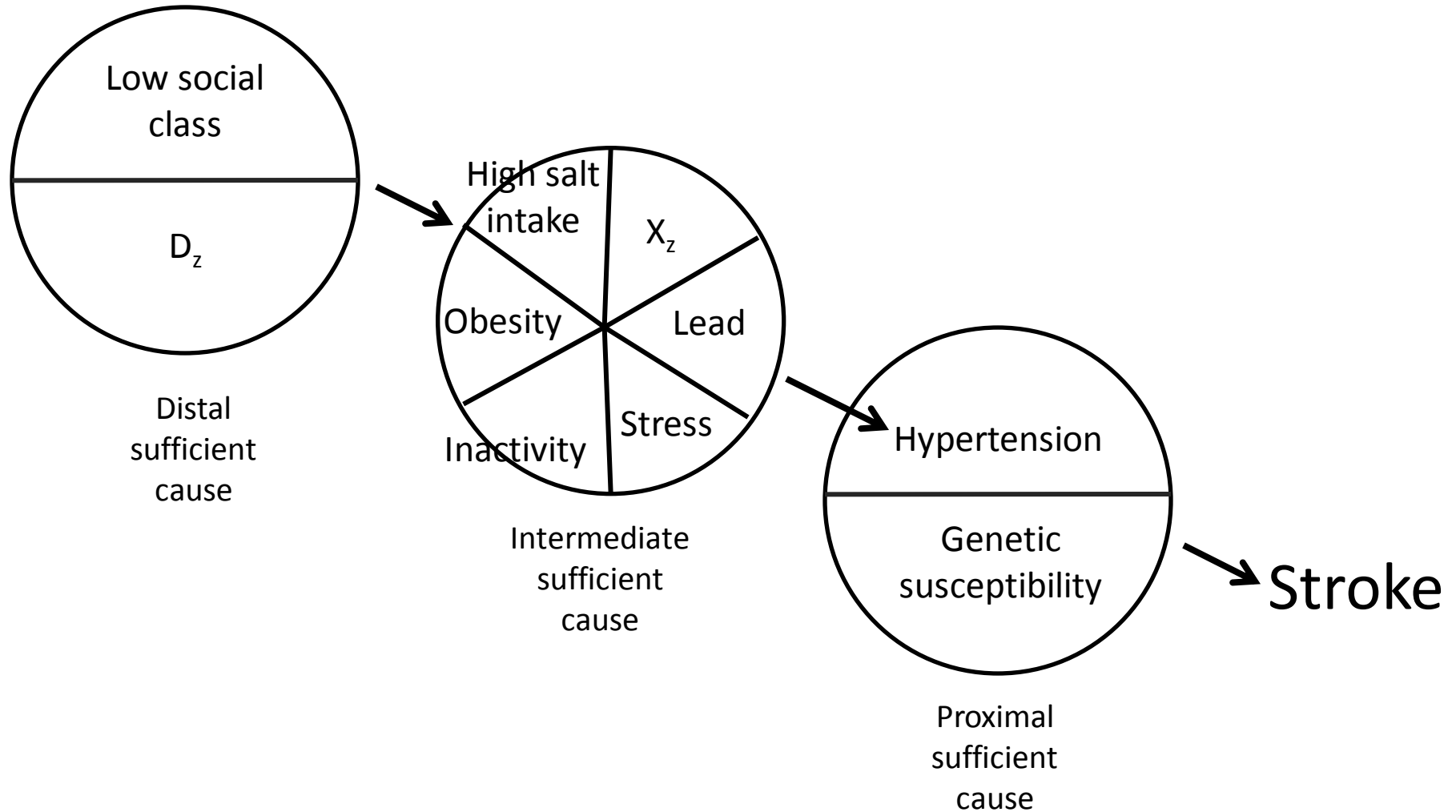
Adapted from Szklo and Nieto 2007

# Primary prevention has bigger gains

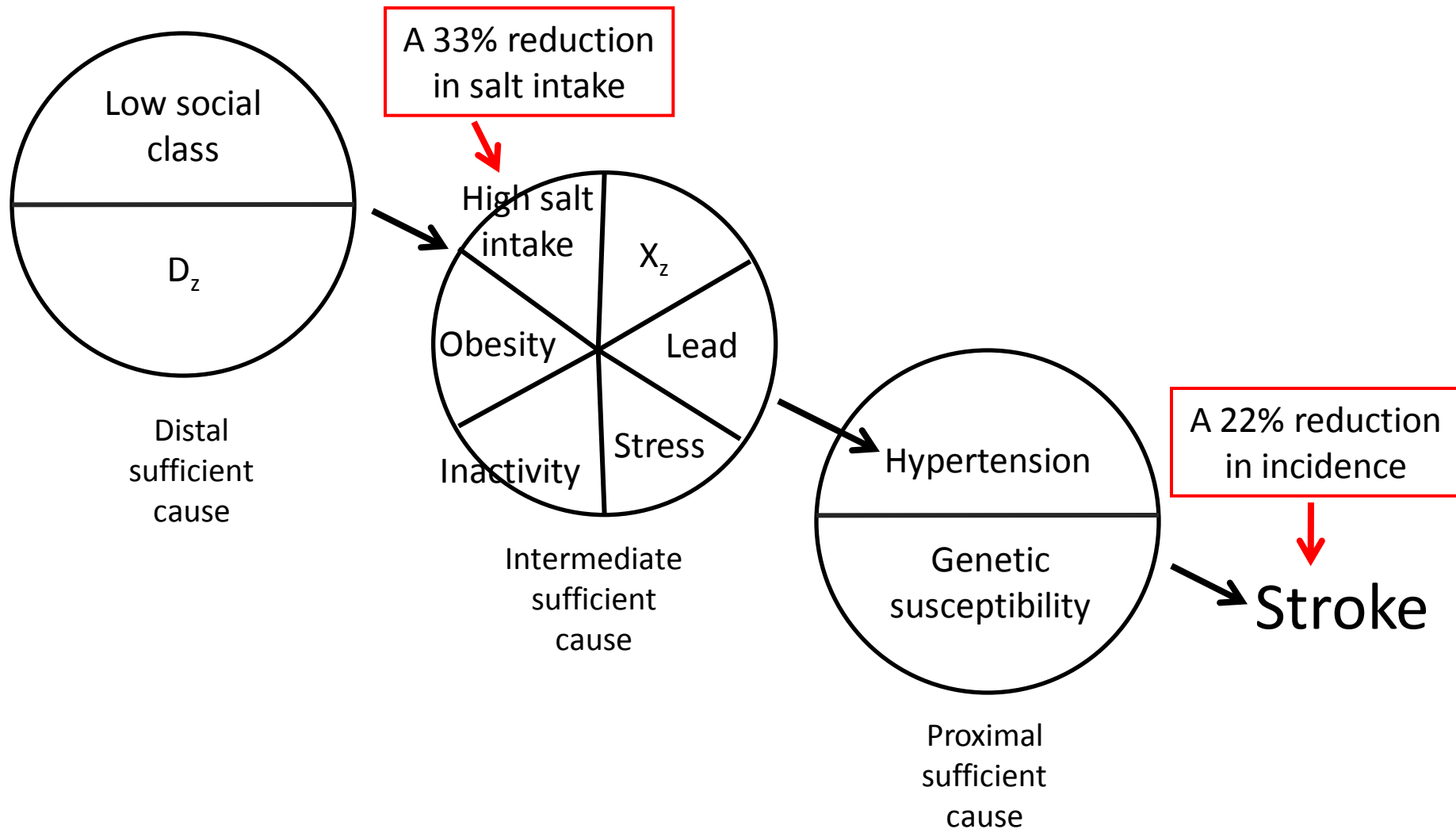


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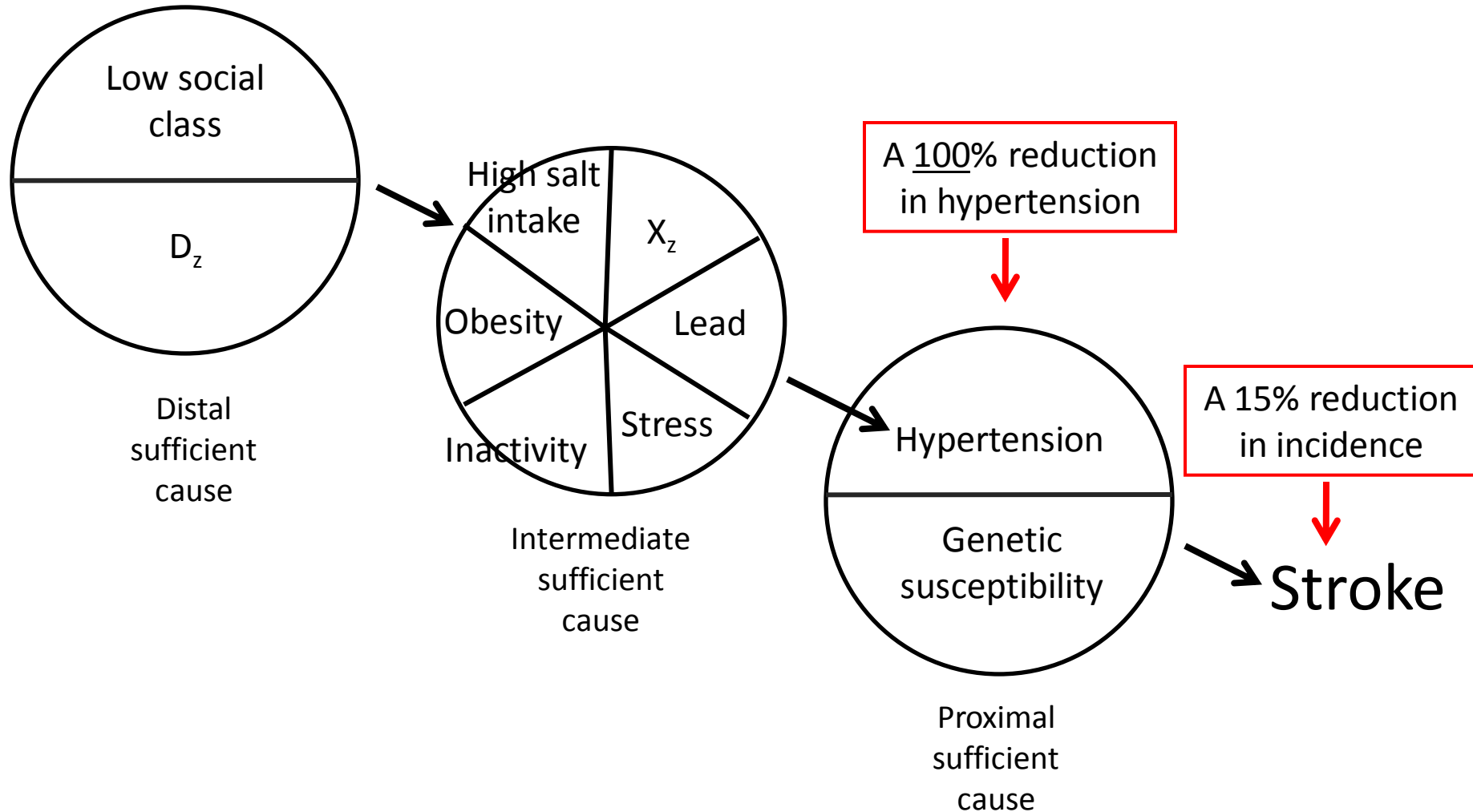
# Proximate, intermediate, and distal causes



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- **Calculated as:  $(I_t - I_o) / I_t \times 100\% = \%PAR$**   
where  $I_t =$  *incidence in all persons, exposed plus non-exposed*  
and  $I_o =$  *incidence in non-exposed*

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- Epidemiologic research focuses on proximate causal components
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- This reductionist approach fits well with clinically-oriented “high risk” strategies for prevention
- The study of upstream causes may provide clues for the development of prevention strategies at the level of the total target population
- **Social epidemiology considers the interface between individual-level (usually proximate) and group-level (distal or intermediate) variables (multi-level or hierarchical models)**

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- Spending at secondary and tertiary levels (physician services and pharmaceuticals) would result in less benefit in terms of disease reduction
- **The spillover benefits will be less:**
  - Fewer new jobs overall
  - Many fewer jobs among low-income workers (community infrastructure, construction)

# For greatest effect on population health and the economy

- Prevention funding should focus on primary prevention and be targeted to communities with the highest disease prevalence

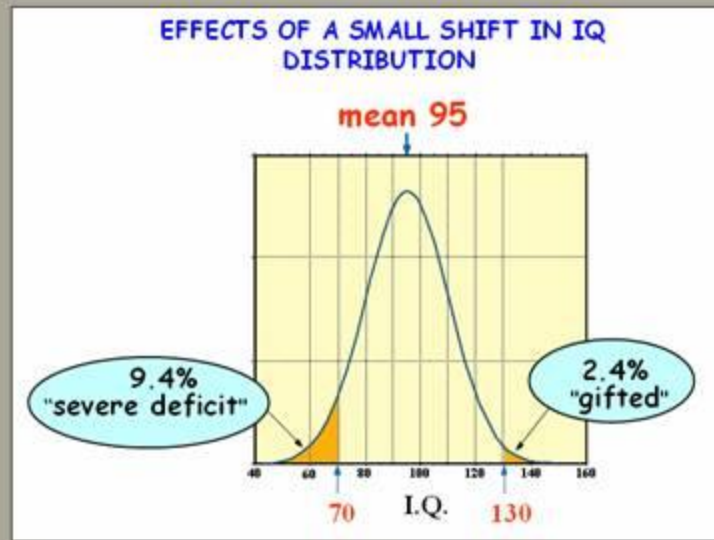
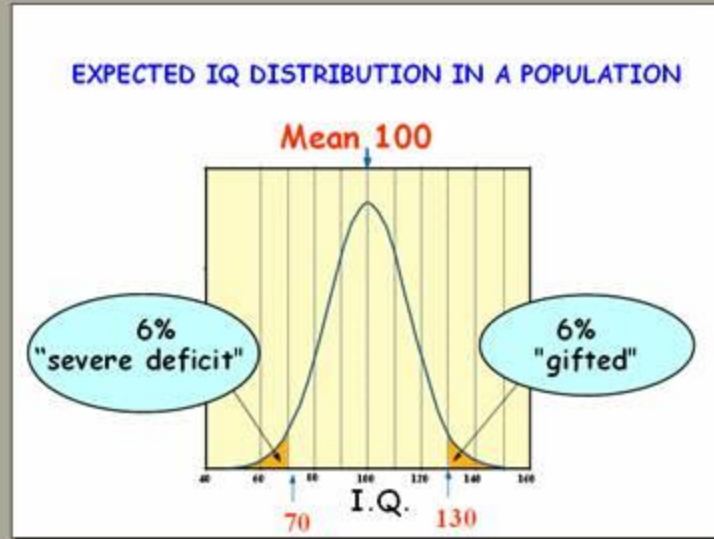
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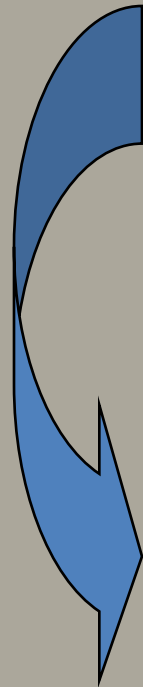
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- Assessments of primary prevention programs should consider avoided medical costs
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- Evaluation should be built into all programs so policymakers can learn what works best where.

# Are a Few IQ Points Significant?



57% increase  
in special ed kids

60% decrease  
in gifted kids



# Economic Costs of Childhood Lead Poisoning in Washington State (Davies 2005)

|       | Estimated # of 5-year Olds in WA (2004) | Total Expected Income (2004 \$billion) | Total Lost Expected Lifetime Income (2004 \$billion) |
|-------|---|--|--|
| Boys  | 41,500                                  | 43.03                                  | 0.946  |
| Girls | 39,500                                  | 24.17                                  | 0.532  |
| Total | 81,000                                  | 67.2                                   | 1.478  |

Mean blood level for 5-year olds = 2.0 ug/dl

IQ loss of 0.46 points per ug/dl, yielding a reduction of 0.92 pts per child

Salkever's estimate of 2.39% reduction in lifetime earnings per IQ pt

# Economic Costs of Environmental Disease in Washington State (Davies 2005)

| Disease/<br>Disability | Best<br>Estimate<br>(2004 \$m) | Direct Costs<br>(2004 \$m) | Indirect<br>Costs<br>(2004 \$m) | Range<br>(2004 \$m) | Basis                               |
|------------------------|--------------------------------|----------------------------|---------------------------------|---------------------|-------------------------------------|
| Asthma                 | 127.8                          | 75.5                       | 52.3                            | 42.6-149.2          | WA DOH /<br>WA Asthma<br>Initiative |
| Cardio-<br>vascular    | 592.8                          | 364.8                      | 228.0                           | 395.2-790.4         | NHLBI                               |
| Cancer                 | 203.5                          | 74.4                       | 129.1                           | 81.4-407.2          | NHLBI                               |
| Lead                   | 1,500                          |                            | 1,500                           |                     | Landrigan                           |
| Birth defects          | 5.5                            | 1.5                        | 4.0                             | 5.5-10.9            | Waitzman                            |
| Neuro-<br>behavioral   | 305.6                          | 265.9                      | 39.7                            | 152.8-611.1         | NHLBI                               |
| Total child            | 1,875                          | 310.6                      | 1,565                           | 1,600-2,200         |                                     |
| Total child &<br>adult | 2,734                          | 782.1                      | 1,953                           | 2,800-3,500         |                                     |

# Biologic Impact Pathway



# Biologic Impact Pathway

Dispersion  
Transformation  
Decay



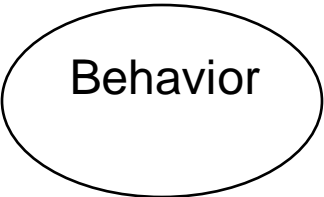
Product  
Tailpipe  
Smokestack  
Outfall

Concentration

# Biologic Impact Pathway

Dispersion  
Transformation  
Decay

Time-Activity  
Diet  
Ingestion  
Breathing rate



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Outfall

Concentration

Conc x *t*

# Biologic Impact Pathway

Dispersion  
Transformation  
Decay

Time-Activity  
Diet  
Ingestion  
Breathing rate

Transport in body  
Metabolism  
Elimination  
Sequestration

Fate &  
Dispersion

Behavior

Pharmaco-  
kinetics



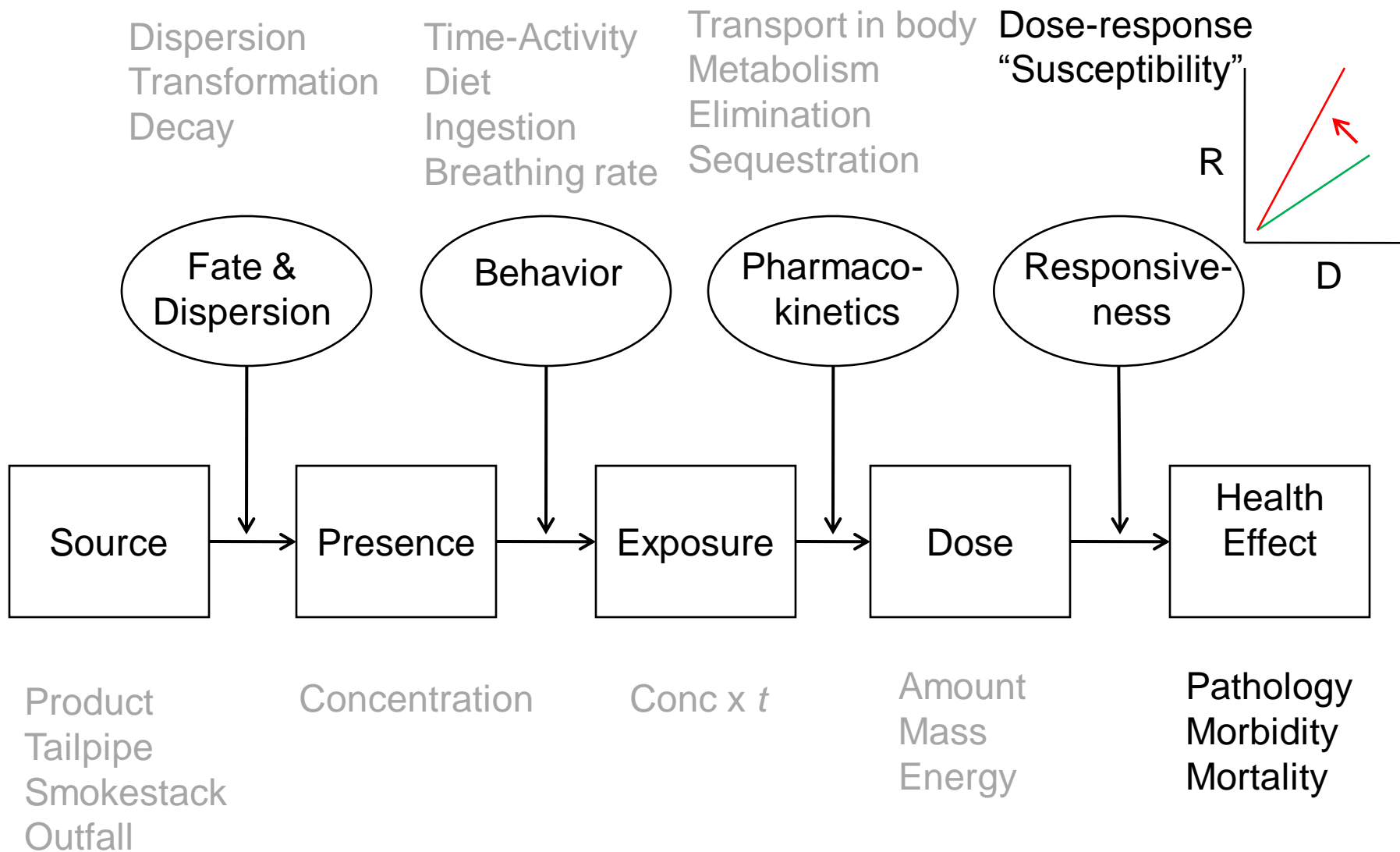
Product  
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Concentration

Conc x *t*

Amount  
Mass  
Energy

# Biologic Impact Pathway



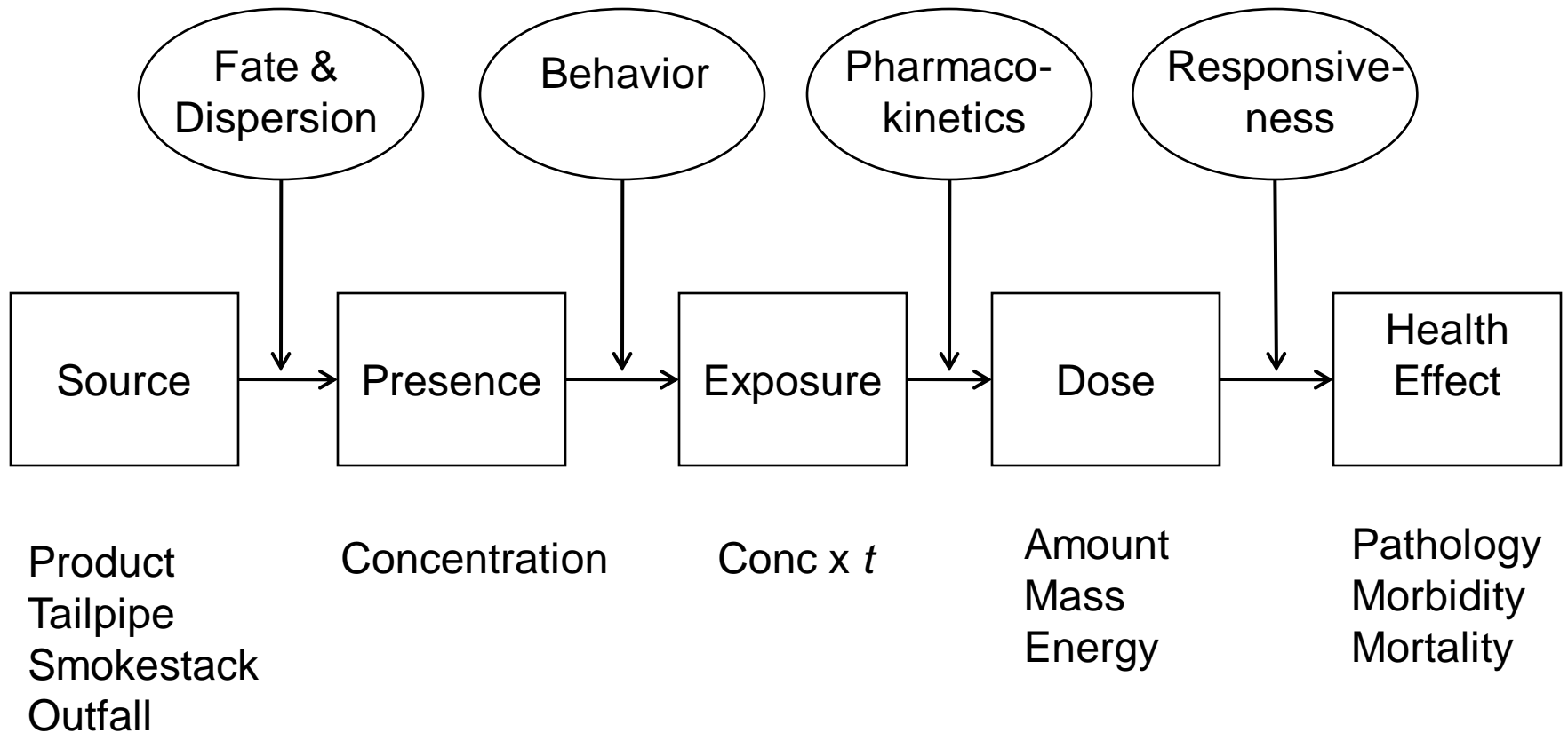
# Strategies for prevention?

Dispersion  
Transformation  
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Time-Activity  
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Transport in body  
Metabolism  
Elimination  
Sequestration

Dose-response  
Susceptibility



# Strategies for prevention?

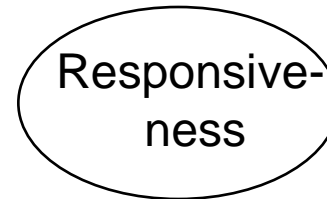
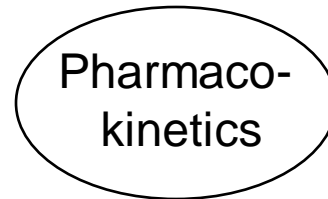
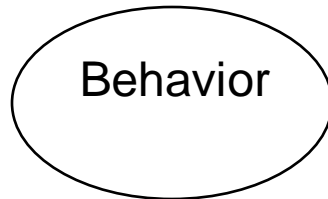
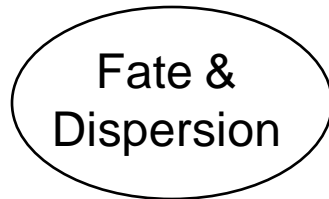
Dispersion  
Transformation  
Decay

Engineering  
Controls

Time-Activity  
Diet

Transport in body  
Metabolism  
Elimination  
Sequestration

Dose-response  
Susceptibility



Product  
Tailpipe  
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Outfall

Concentration

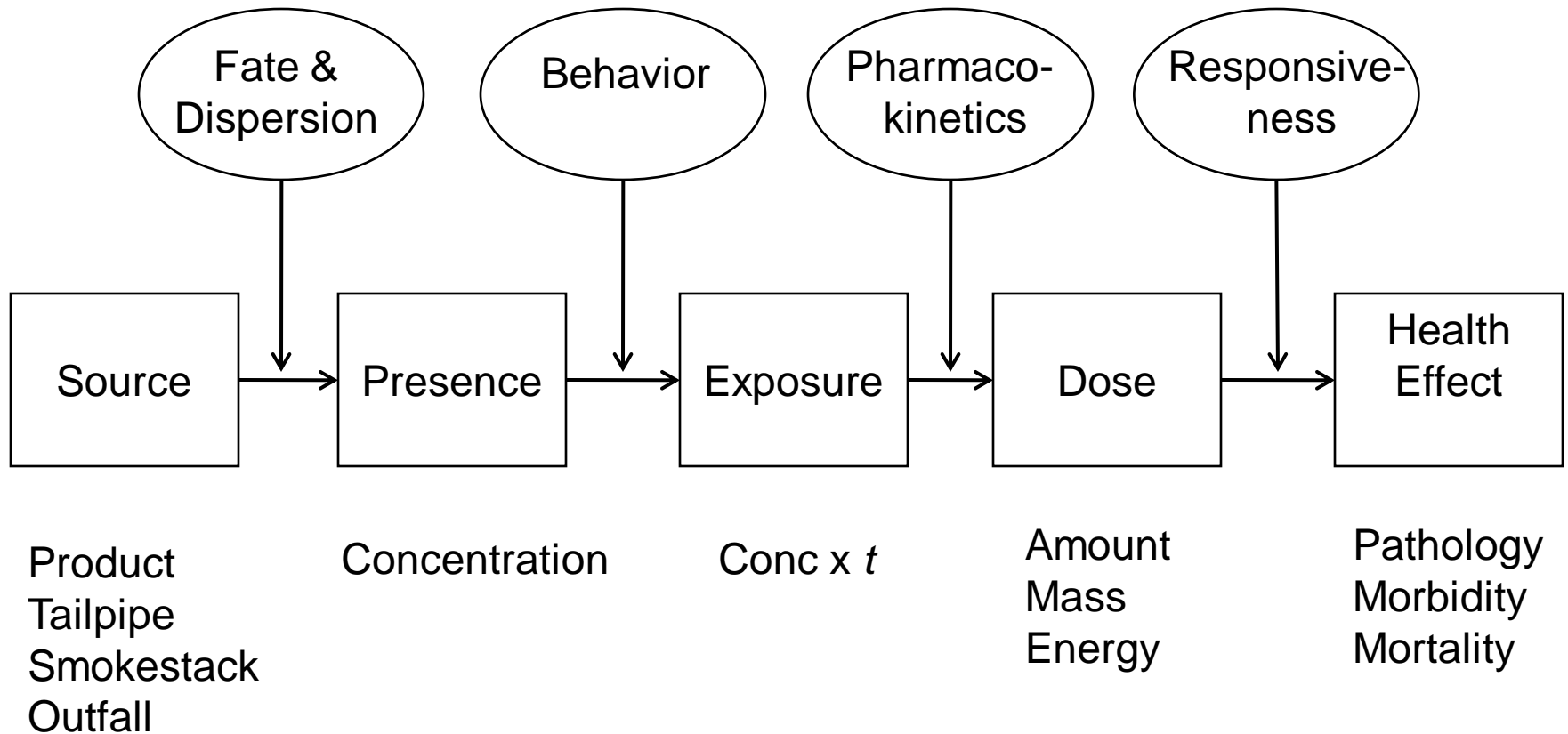
Conc x  $t$

Amount  
Mass  
Energy

Pathology  
Morbidity  
Mortality

# Strategies for prevention?

|                             |                        |                   |                |
|-----------------------------|------------------------|-------------------|----------------|
| Dispersion                  | Time-Activity          | Transport in body | Dose-response  |
| Transformation              | Diet                   | Metabolism        | Susceptibility |
| Decay                       |                        | Elimination       |                |
| <b>Engineering Controls</b> | <b>Behavior Change</b> | Sequestration     |                |
|                             | <b>PPE</b>             |                   |                |



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Dispersion  
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Decay

Time-Activity  
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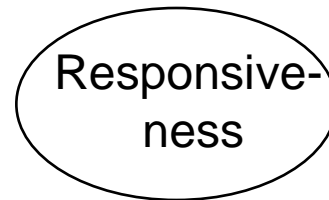
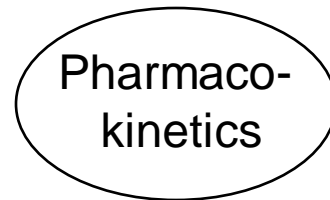
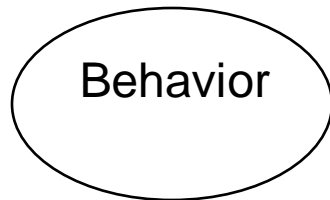
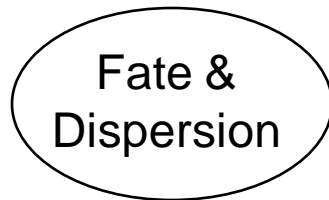
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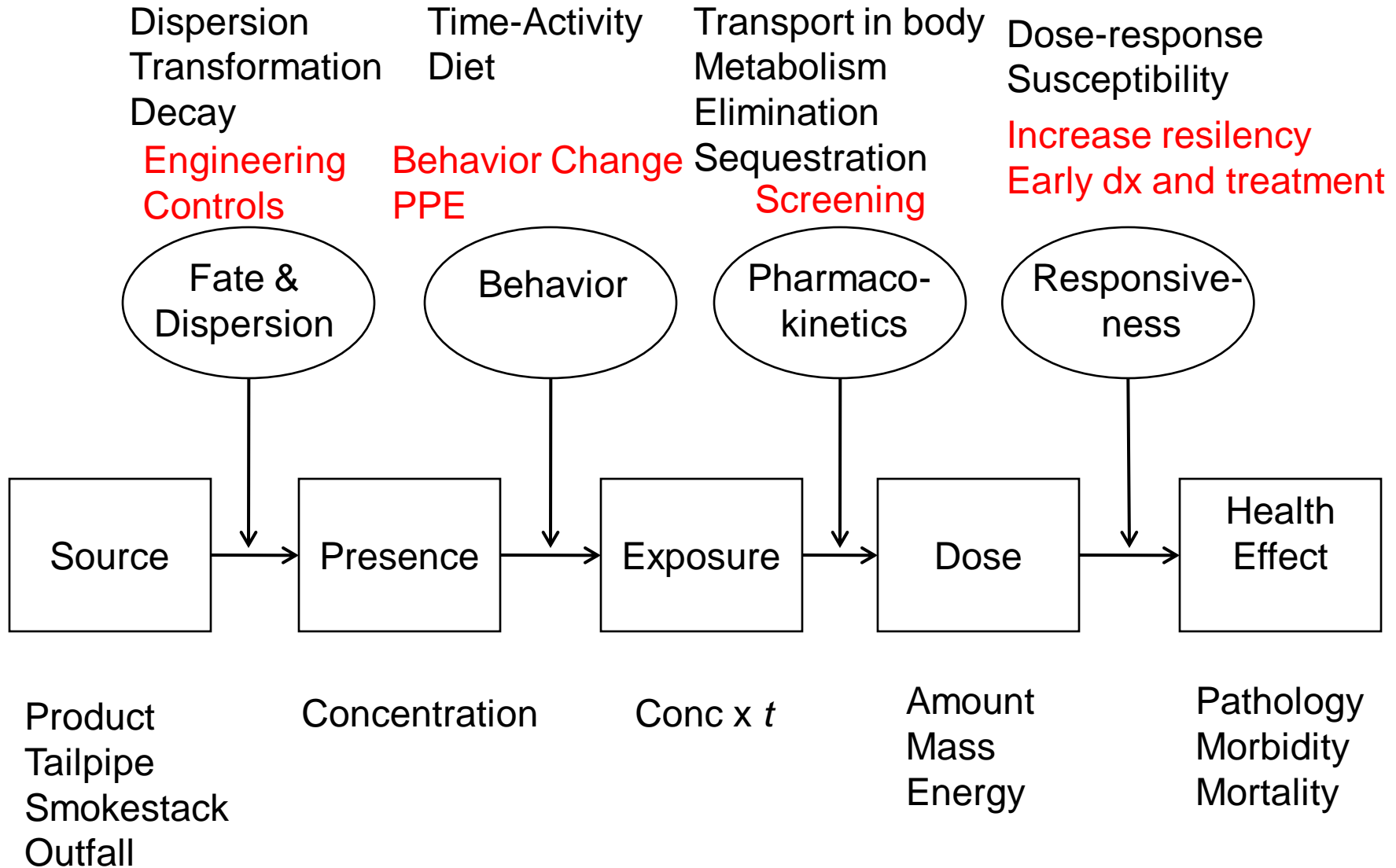
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# The Government Role in Environmental Public Health



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### Diagnosis

- Surveillance
- Monitoring
- Id causes
- Research
- Evaluation

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- Apply technical knowledge

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## Action

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## Exercise Authority

- Implementation of legislative mandates
- Maintain statutory responsibilities
- Maintain accountability
- Guarantee certain health services

# Learning Objectives

- Understand how to apply concepts of prevention to environmental health problems
- Understand the relative costs and benefits associated with levels of prevention
- Be able to apply the biologic impact pathway to analyze problems
- Understand the core functions of public health, as applied to environmental problems
- Be awake!