

Analytical Epidemiology

“Agent-Host-Environment”

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Analytical Epidemiology

- Second major type of epidemiology
- Focus on individual within population unlike descriptive epidemiology.
- Analytic studies tend to be more specific than descriptive studies in their focus.
- objective not to formulate hypothesis but to test hypothesis.
- Statistical association between a disease and suspected factor, its strength of association.
- Types of study designs:
 - Case control study
 - Cohort study

Analytical Epidemiology

1. Descriptive Epidemiology is the Antecedent to Analytical Epidemiology.
2. Analytic epidemiology studies require information to
 1. know where to look.
 2. know what to control for.
 3. Test viable hypotheses

Purpose of Studying Causal Models

- Studying how different factors can lead to ill health is important to generate knowledge to help prevent and control diseases.
- The classic epidemiological triangles or triads help understanding the relation between a disease and the agent causing the disease

Epidemiologic Activities

- **...are often framed under the mantle of descriptive and analytic epidemiology**
 - **Descriptive epidemiology – person, place & time**
 - Demographic distribution
 - Geographic distribution
 - Seasonal patterns etc.
 - Frequency of disease patterns
 - **Useful for:**
 - Allocating resources
 - Planning programs
 - Hypotheses development

Epidemiologic Activities

- **Analytic epidemiology**

- Built around the analysis of the relationship between two items
 - Exposures
 - Effects (disease)
- Looking for determinants or possible causes of disease
- Useful for
 - hypothesis testing

The Analytical Epidemiologic Triad

This model comprises a susceptible host (the person at risk for the disease), a disease agent (the proximate cause), and an environmental context for the interaction between host and agent.

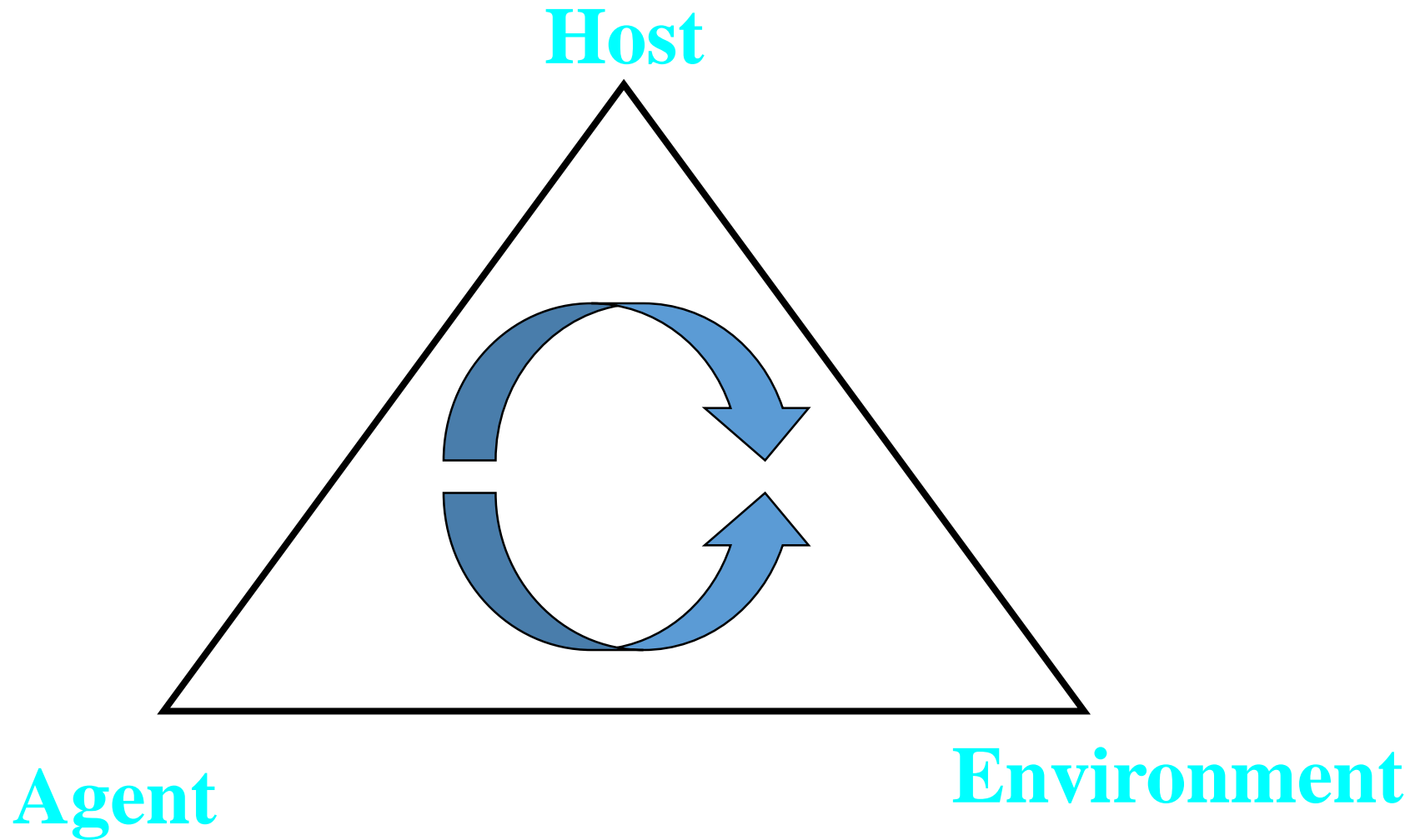
Thus, development of disease is a combination of events:

- A harmful agent
- A susceptible host
- An appropriate environment

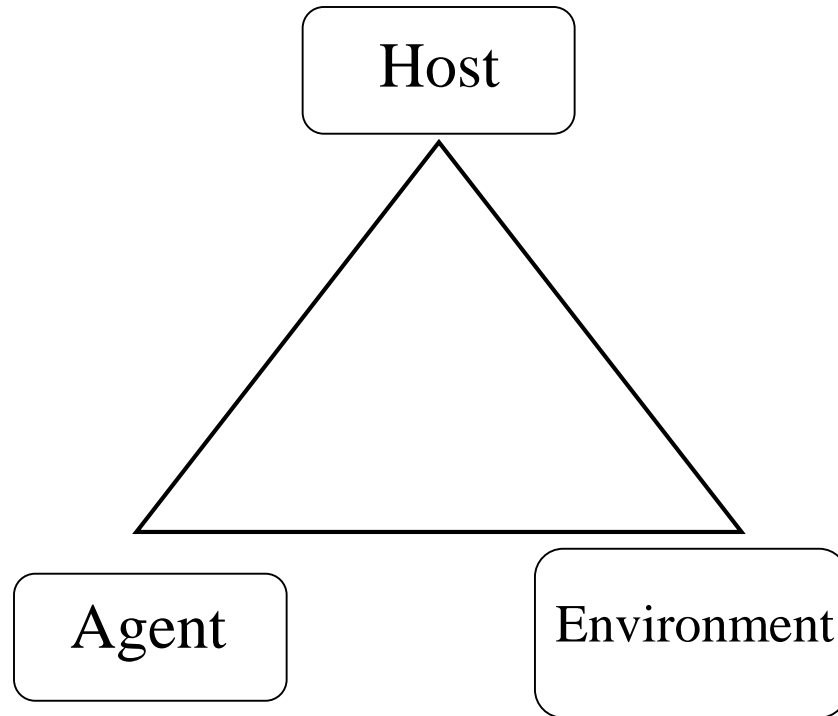
Three essential characteristics that are examined to study the cause(s) for disease in analytic epidemiology are...

- **Host**
- **Agent**
- **Environment**

Epidemiologic Triangle



The Epidemiologic Triangle



Host Factors

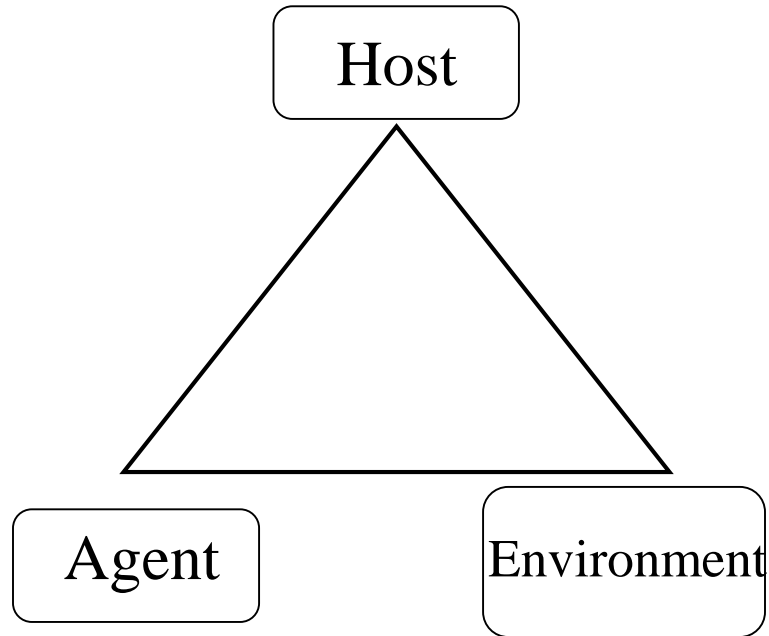
Personal traits

Behaviors

**Genetic predisposition
immunologic factors**

**Influence the chance for
disease or its severity**

The Epidemiologic Triangle



Agents

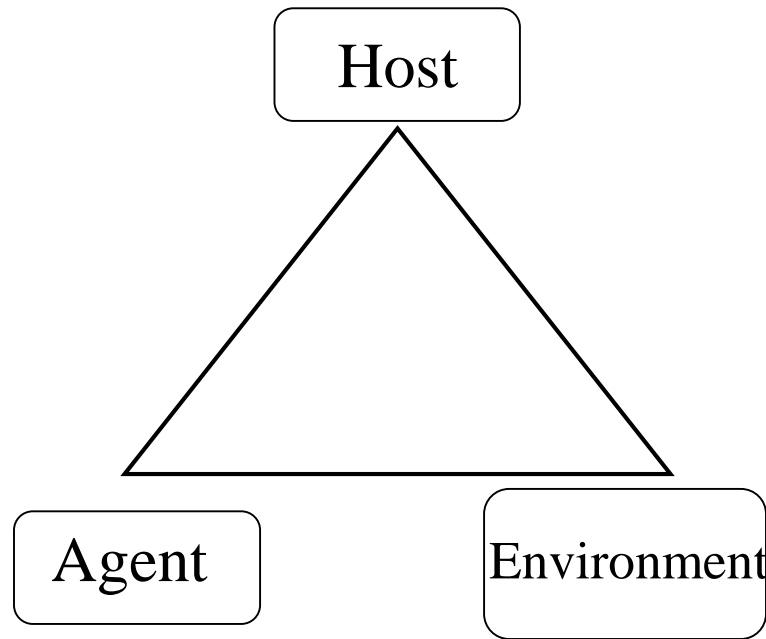
Biological

Physical

Chemical

**Necessary for
disease to occur**

The Epidemiologic Triangle



Environment

**External conditions
Physical or biologic
or social**

**Contribute to the
disease process**

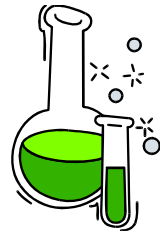
The Analytical Epidemiology Triad

Host:

Intrinsic factors, genetic, physiologic factors,
psychological factors, immunity



Health
or
Illness
?



Agent:

Amount, infectivity,
pathogenicity, virulence,....

Environment:

Physical, biological, social

Epidemics arise when host, agent, and environmental factors are not in balance

- **Due to new agent**
- **Due to change in existing agent (infectivity, pathogenicity, virulence)**
- **Due to change in number of susceptible in the population**
- **Due to environmental changes that affect transmission of the agent or growth of the agent**

INCREASED RISK OF NUTRITIONAL DISEASE

Host Characteristics	Type of Agents and Examples	Environmental Factors
Age	Biologic	Temperature
Sex	Bacteria, viruses	Humidity
Race	Chemical	Altitude
Religion	Poison, alcohol,	Crowding
Customs	smoke	Housing
Occupation	Physical	Neighborhood
Genetic profile	Trauma, radiation,	Water
Marital status	fire	Milk
Family background	Nutritional	Food
	Lack, excess	Radiation
Previous diseases		Air pollution
Immune status		Noise

Agents

- Biological (micro-organisms)
- Physical (temperature, radiation, trauma, others)
- Chemical (acids, alkalis, poisons, tobacco, medications / drugs, others)
- Environmental (nutrients in diet, allergens, others)
- Nutritional (under- or over-nutrition)
- Psychological experiences

Host Factors

- Host factors are **intrinsic** factors that influence an individual's exposure, susceptibility, or response to a causative agent. These include:
 - **Genetic** endowment
 - **Immunologic** state
 - **Personal behavior** (life-style factors): diet, tobacco use, exercise, etc
 - **Personal characteristics** (described before, under "person"), including: age, gender, socio-economic status, etc.

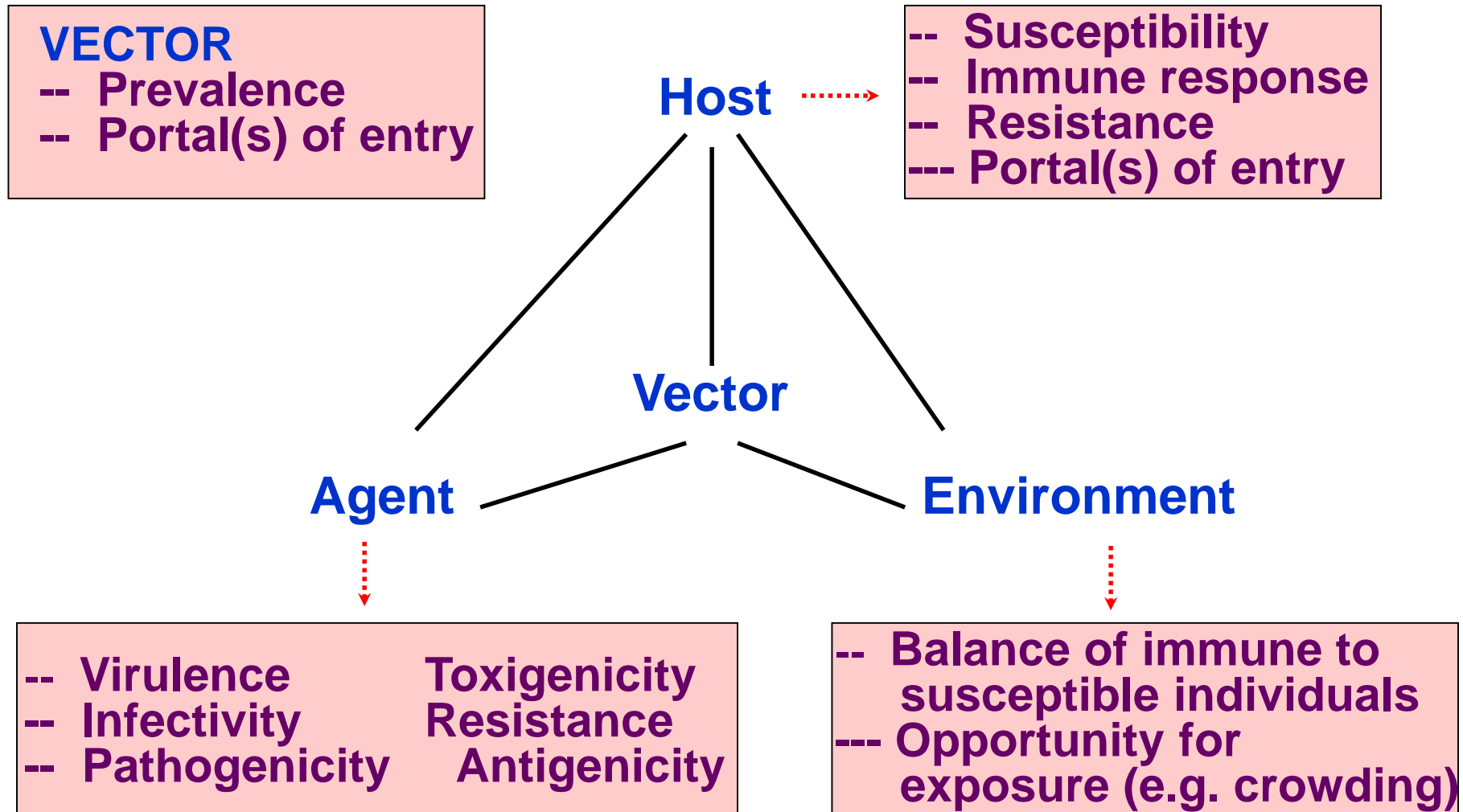
Environment

Environmental factors are **extrinsic** factors which affect the agent and the opportunity for exposure. These include:

- **Physical** factors: e.g. geology, climate (temperature, humidity, rain, etc)
- **Biological** factors: e.g. insects that transmit an agent
- **Socioeconomic** factors: e.g. crowding, sanitation, and the availability of health services

Phenomena which bring the host and agent together: vector, vehicle, reservoir, etc

Factors Affecting Disease Transmission and Symptomatic Clinical Disease



Summary of Analytical Triad

- ***Agent factors*** include infectious microorganisms, e.g. virus, bacterium, parasite, or other agents.
 - They may be ***necessary*** but not always ***sufficient*** alone to cause disease.
- ***Host factors*** are intrinsic factors that influence an individual's exposure, susceptibility, or response to a causative agent
- ***Environmental factors*** are extrinsic factors which affect the agent and the opportunity for exposure.

Analytical Studies

- Comparison is a fundamental research strategy to identify variables which help to explain why one group of persons or objects differs from another.
- Examines the differences between intact groups on some dependent variable of interest.
- Similar to experimental design but the researcher does not manipulate the independent variable (it is inherent characteristic).
- Attempts to establish causes or risk factors for certain problems.

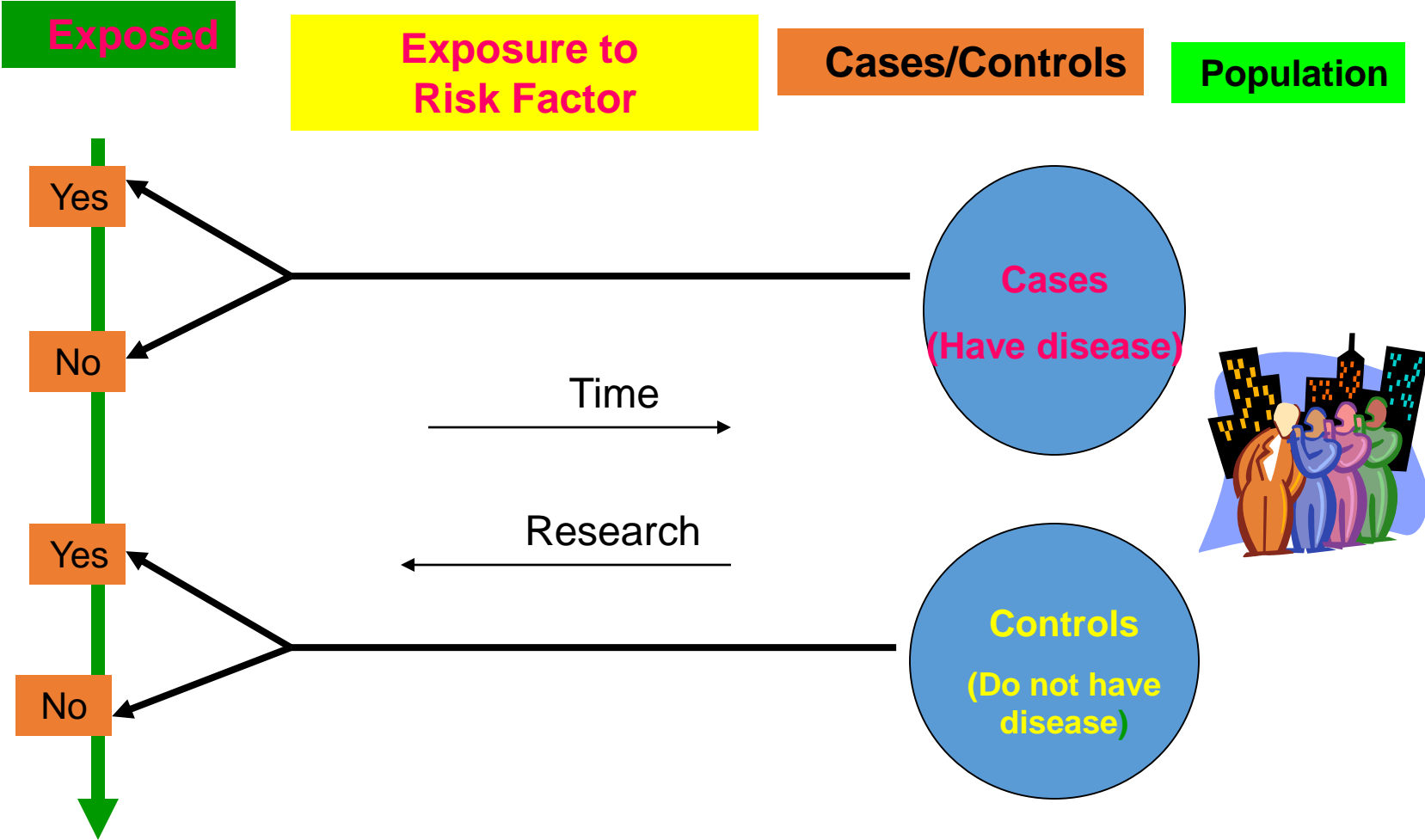
Comparative studies

- Two types:
 - Retrospective: (ex post facto studies or after the fact).
 - Prospective: The independent variable is identified at the present time, and then subjects are followed in the future to observe the dependent variable.
 - Prospective studies may use an experimental approach whereas retrospective studies would never use this type of design

Case - Control Studies

- In a case control study the investigator compares one group among whom the problem that he wishes to investigate is present and another group called a control or comparison group, where the problem is absent in order to find out what factors have contributed to the problem.

Case-Control Studies



Source: Clinical epidemiology; Fletcher and Fletcher

Characteristics of CC studies

- Population at risk may be undefined
- Cases selected by investigator from an available pool
- Controls selected by investigator to resemble cases
- Exposure measured, reconstructed, recollected after development of disease
- Risk or incidence of disease cannot be measured directly.

Case-Control Studies

Advantages

- Enable study of rare conditions (outcomes)
- Are of short duration
- Relatively inexpensive
- Relatively small sample sizes
- Allow approximation of risk.

Case-Control Studies

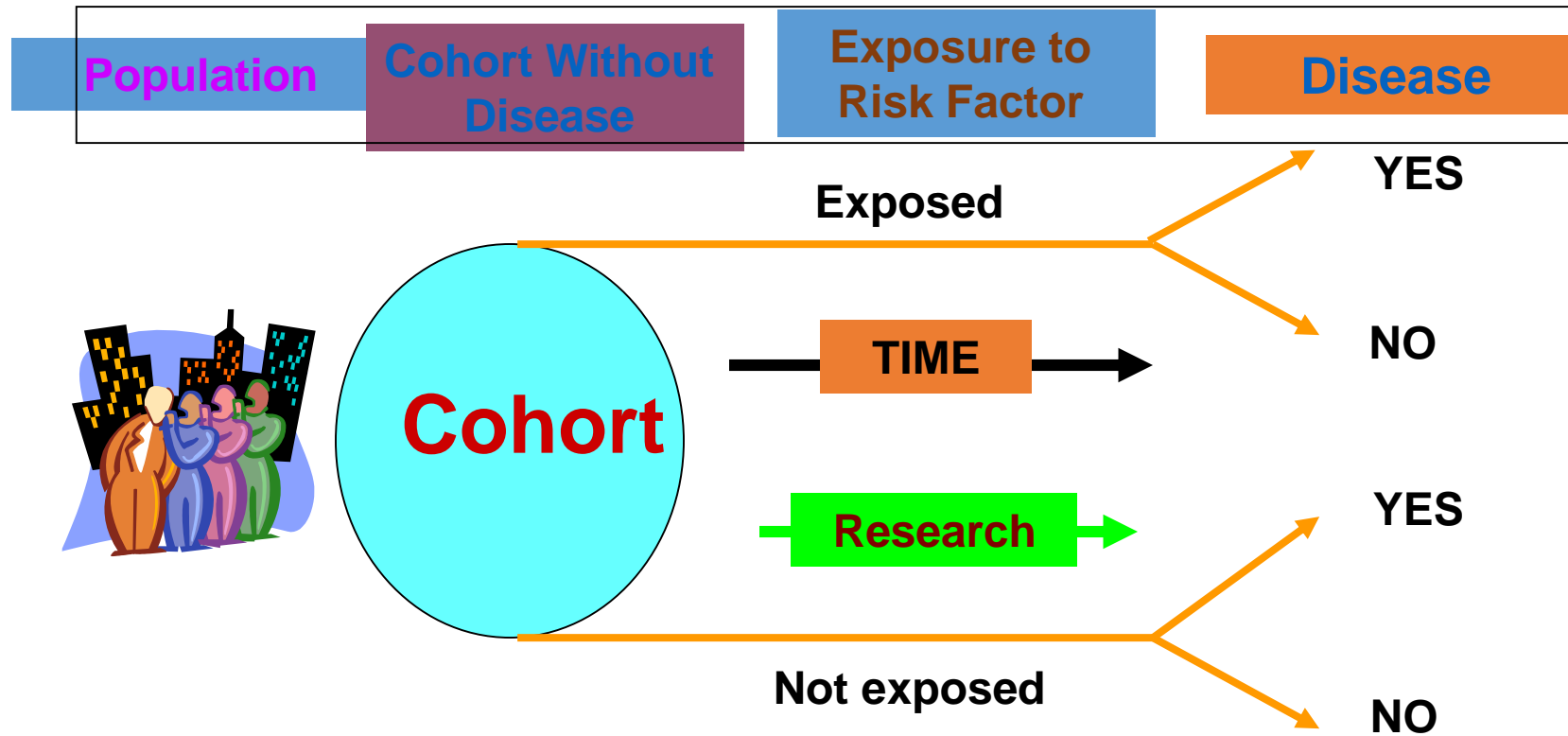
Disadvantages

- Limited to one outcome variable.
- Susceptible to bias:
 - Selection
 - Measurement
 - Survivor
- Cannot establish temporal sequence of events
- Do not yield absolute risk (incidence)

Cohort Studies

- In a cohort study, a group of individuals that is exposed to a risk factor (*study group*) is compared to a group of individuals not exposed to the risk factor (control group).
- The researcher follows both groups over time and compares the occurrence of the problem that he expects to be related to the risk factor in the two groups to determine whether a greater proportion of those with the risk factor are indeed affected.

Cohort Studies



Cohort Studies

Advantages

- The only way to establish incidence directly (absolute risk)
- Exposure can be measured without bias because outcome is not known
- Exposure precedes outcome (more reliable evidence of causality)
- Can assess multiple outcomes
- Can study multiple factors

Cohort Studies

Disadvantages

- Need to follow up large numbers for rare outcome.
- Expensive.
- Results not available for a long time
- Assess exposures that are known at the start of the study.

SHOKRAN



I Welcome your Comments & Questions