Lecture 0: Introduction to Epidemiology

Dankmar Böhning

Southampton Statistical Sciences Research Institute
University of Southampton, UK

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What is Epidemiology?

Epidemiology is the study of the determinants, distribution, and frequency of disease (who gets the disease and why)

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- epidemiologists study sick people
- epidemiologists study healthy people
- to determine the crucial difference between those who get the disease and those who are spared
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- epidemiologists study exposed people
- epidemiologists study non-exposed people
- to determine the crucial effect of the exposure

What is Epidemiology? Last's dictionary gives a detailed definition:

The study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to control of health problems.

Uses of Epidemiology

- to determine, describe, and report on the natural course of disease, disability, injury, and death
- to aid in the planning and development of health services and programs
- to provide administrative and planning data

Uses of Epidemiology

- to study the cause (or etiology) of disease(s), or conditions, disorders, disabilities, etc.
- to determine the primary agent responsible or ascertain causative factors
- to determine the characteristics of the agent or causative factors
- to determine the mode of transmission
- to determine contributing factors
- to identify and determine geographic patterns

Purpose of Epidemiology

- to provide a basis for developing disease control and prevention measures for groups at risk
- this translates into developing measures to prevent or control disease

Two Broad Types of Epidemiology:

- descriptive epidemiology: examining the distribution of disease in a population, and observing the basic features of its distribution
- analytic epidemiology: investigating a hypothesis about the cause of disease by studying how exposures relate to disease

descriptive epidemiology is antecedent to analytical epidemiology:

analytical epidemiology studies require information to ...

- know where to look
- know what to control for
- develop viable hypotheses

three essentials characteristics of disease that we look for in descriptive studies are ...

- Person
- Place
- Time

Person

- age, gender, ethnic group
- genetic predisposition
- concurrent disease
- diet, physical activity, smoking
- risk taking behavior
- SES, education, occupation

geographic Place

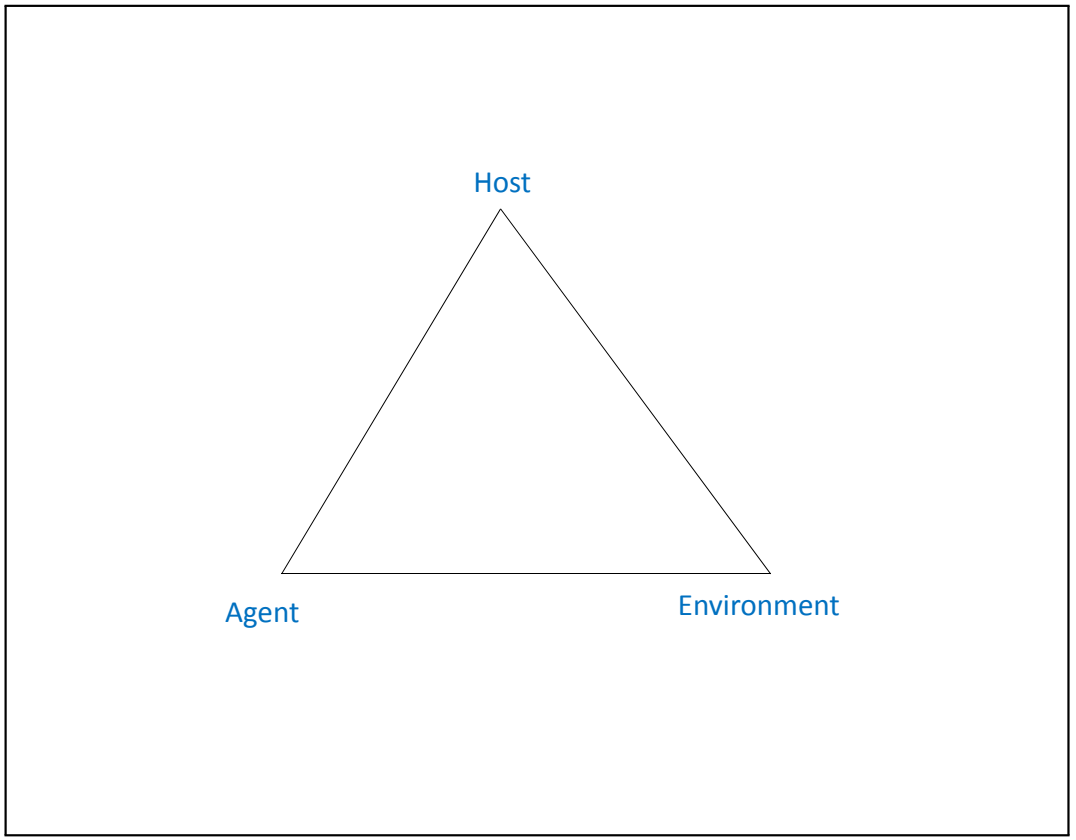
- presence of agents or vectors
- climate
- geology
- population density
- economic development
- nutritional practices
- medical practices

Time

- calendar time
- time since an event
- physiologic cycles
- age (time since birth)
- seasonality
- temporal trends

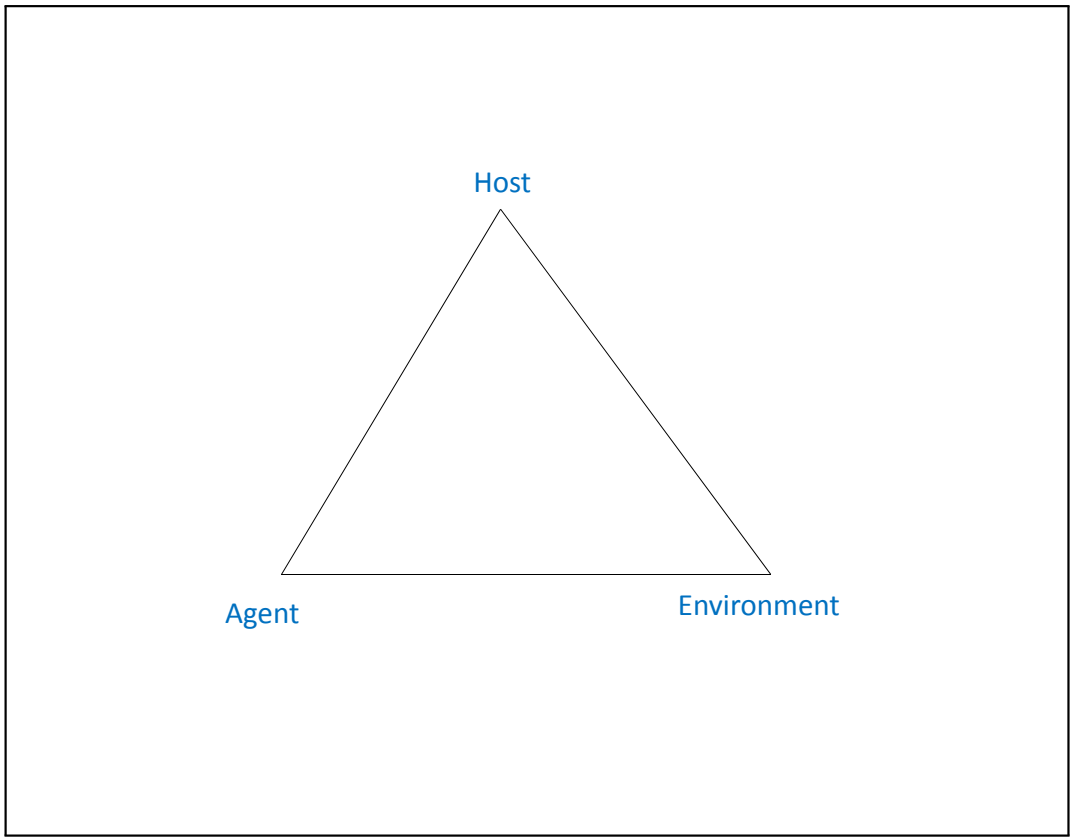
The Epidemiologic Triangle: three characteristics that are examined to study the cause(s) for disease in analytic epidemiology

- host
- agent
- environment



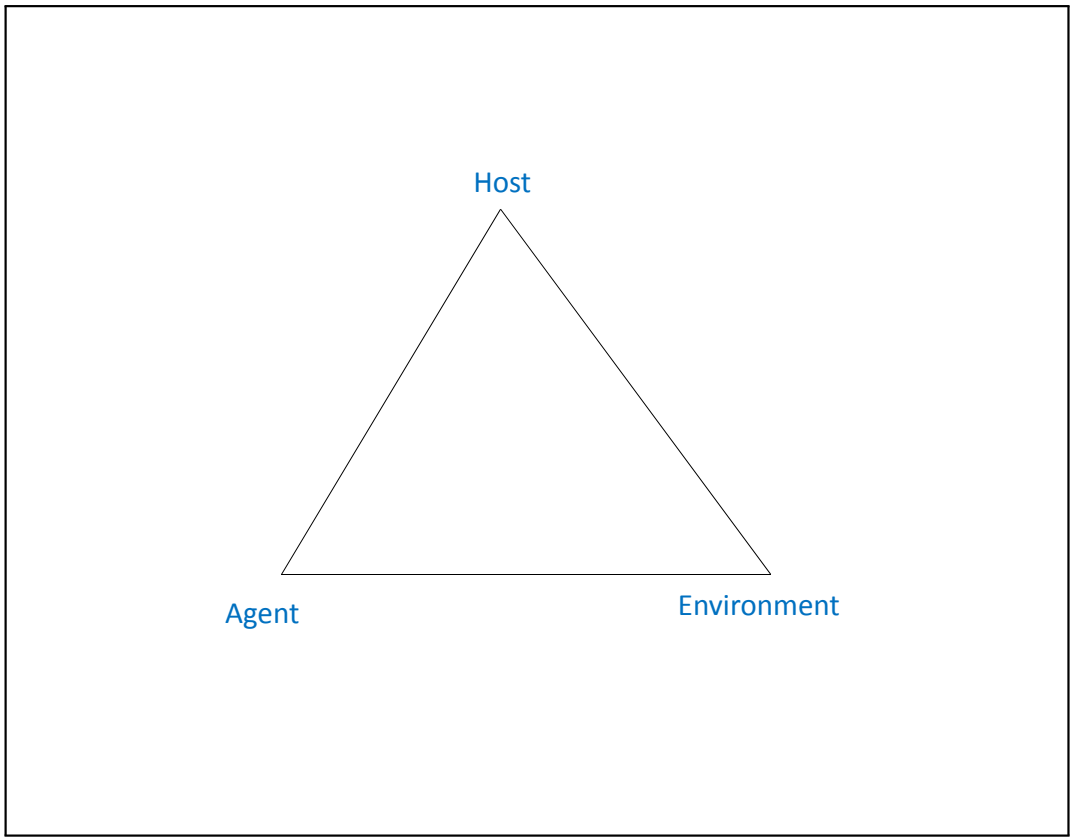
The Epidemiologic Triangle

- **host**
- personal traits
- behaviors
- genetic predisposition
- immunologic factors
- ...



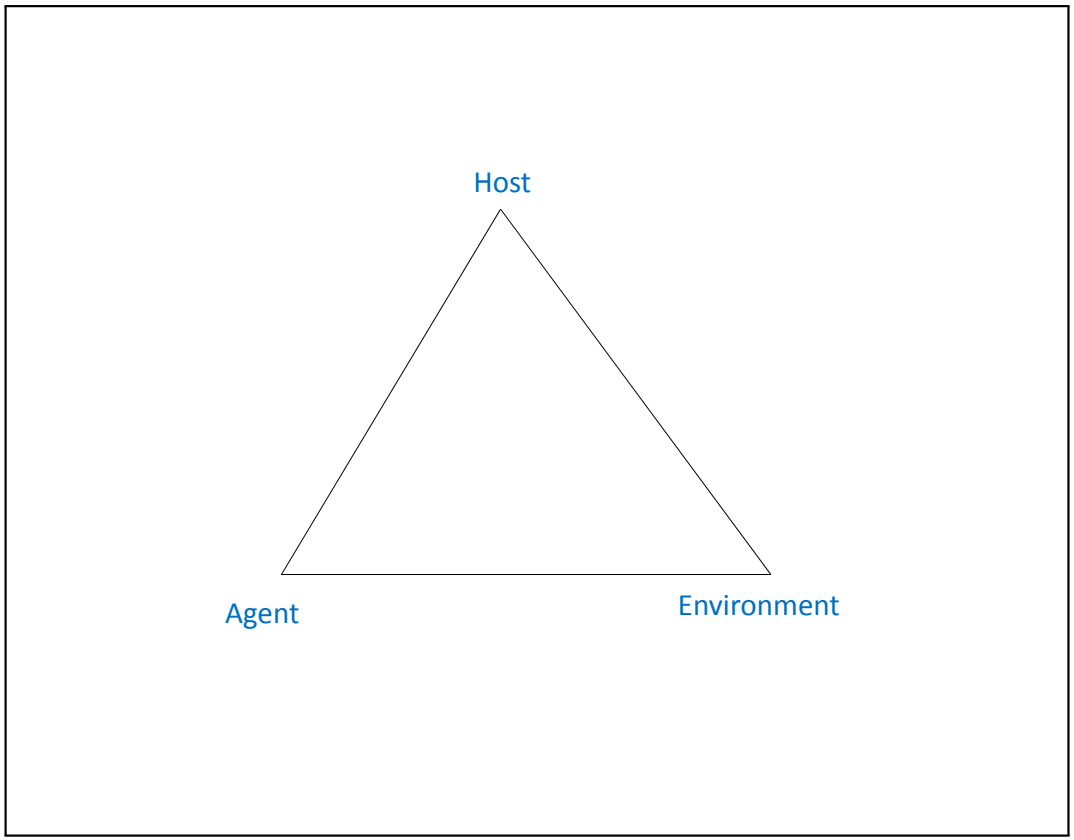
The Epidemiologic Triangle

- **agents**
- biological
- physical
- chemical
- ...
- influence the chance for disease or its severity



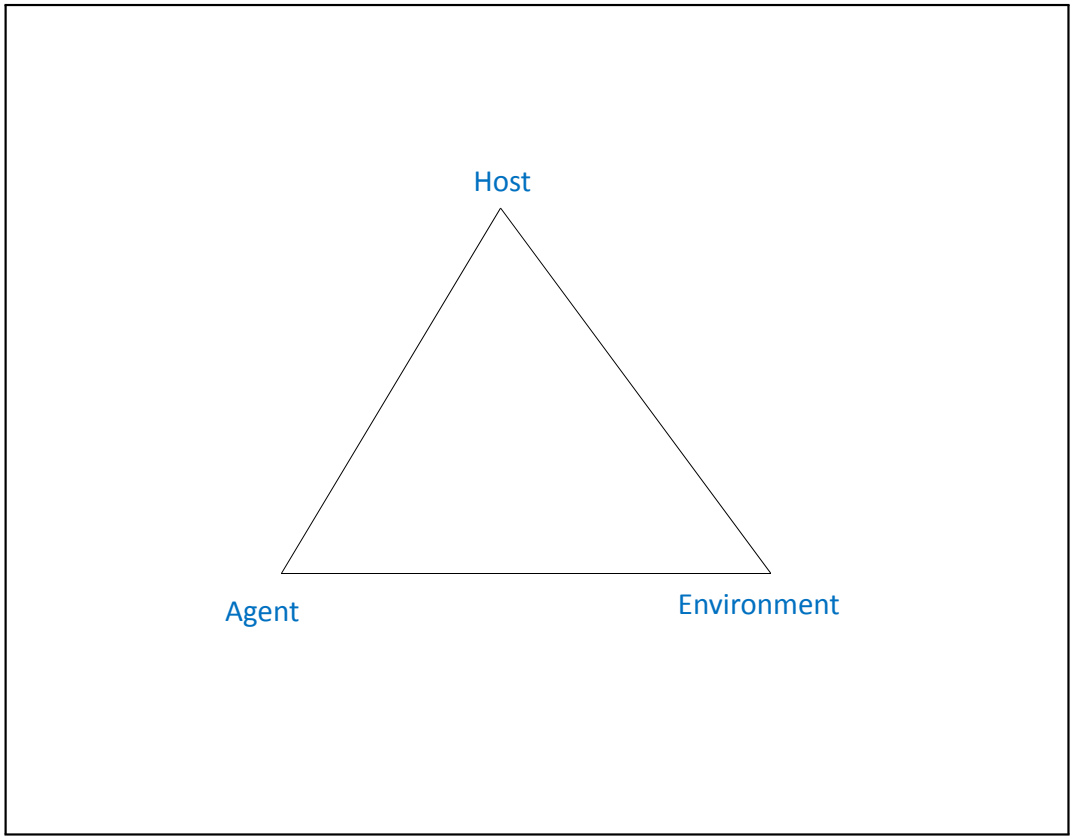
The Epidemiologic Triangle

- **environment**
- external conditions
- physical/biological/social
- ...
- contribute to the disease process



Epidemics occur 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 susceptibles in the population
- due to environmental changes that affect transmission of the agent of growth of the agent



Epidemiologic Activities

- often concentrate on PPT
- demographic distribution
- geographic distribution
- seasonal patterns and temporal trends
- frequency of disease patterns

Epidemiologic Activities

- are built around the analysis of the relationship between
  - exposures
  - disease occurrence
- are built around the analysis of differences between
  - cases
  - healthy controls

Epidemiologic Study Types

- cross-sectional studies
- studies with time component
  - observational studies
  - interventional studies

Study Types

- Cross-sectional (Survey)

  (descriptive epidemiology)

observational period

- Longitudinal (Cohort)

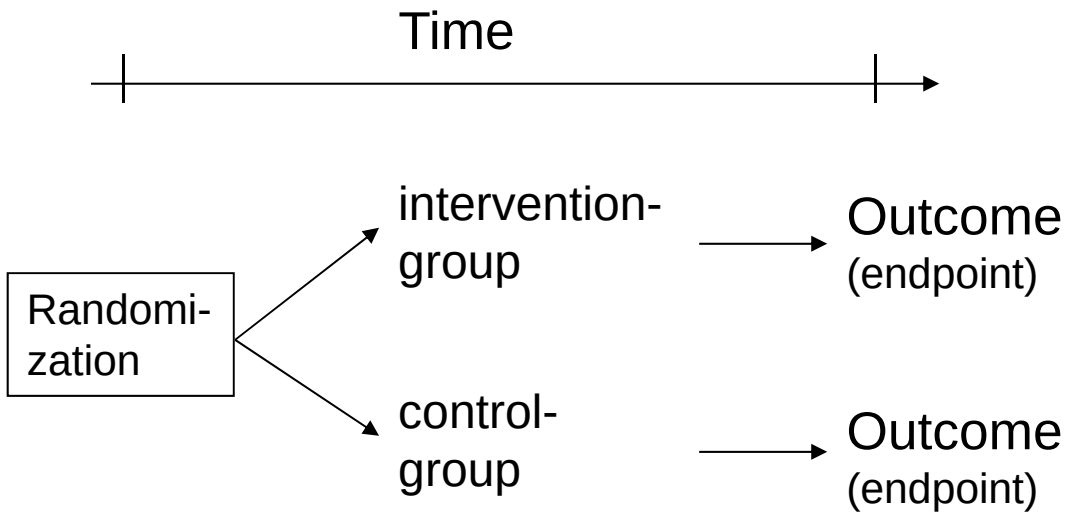
  (analytical epidemiology)

  1. observational studies
     - case-control study (matched/unmatched)
     - cohort study
  2. interventional studies
     - Clinical Trial
     - Randomized Controlled Trial (RCT)

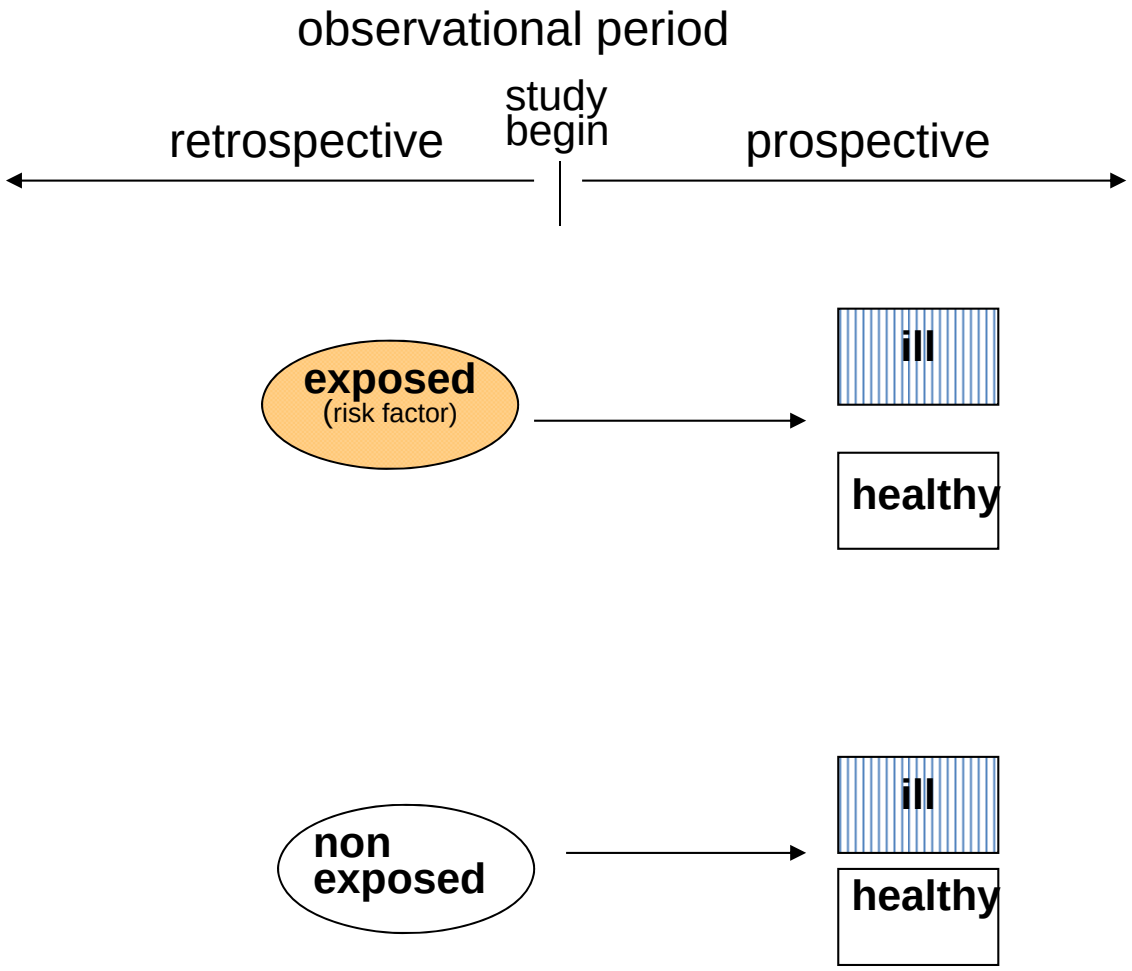
Interventional studies

RCT: Randomized Controlled Trial

- **randomized**
  (Baseline-Characteristics)
- **intervention group**
  (Medication, Radiation, Surgery)
- **control group**
  (Standard therapy, Placebo)
- **controlled**
  (to control = to steer)
- **blinding** (single, double, triple)

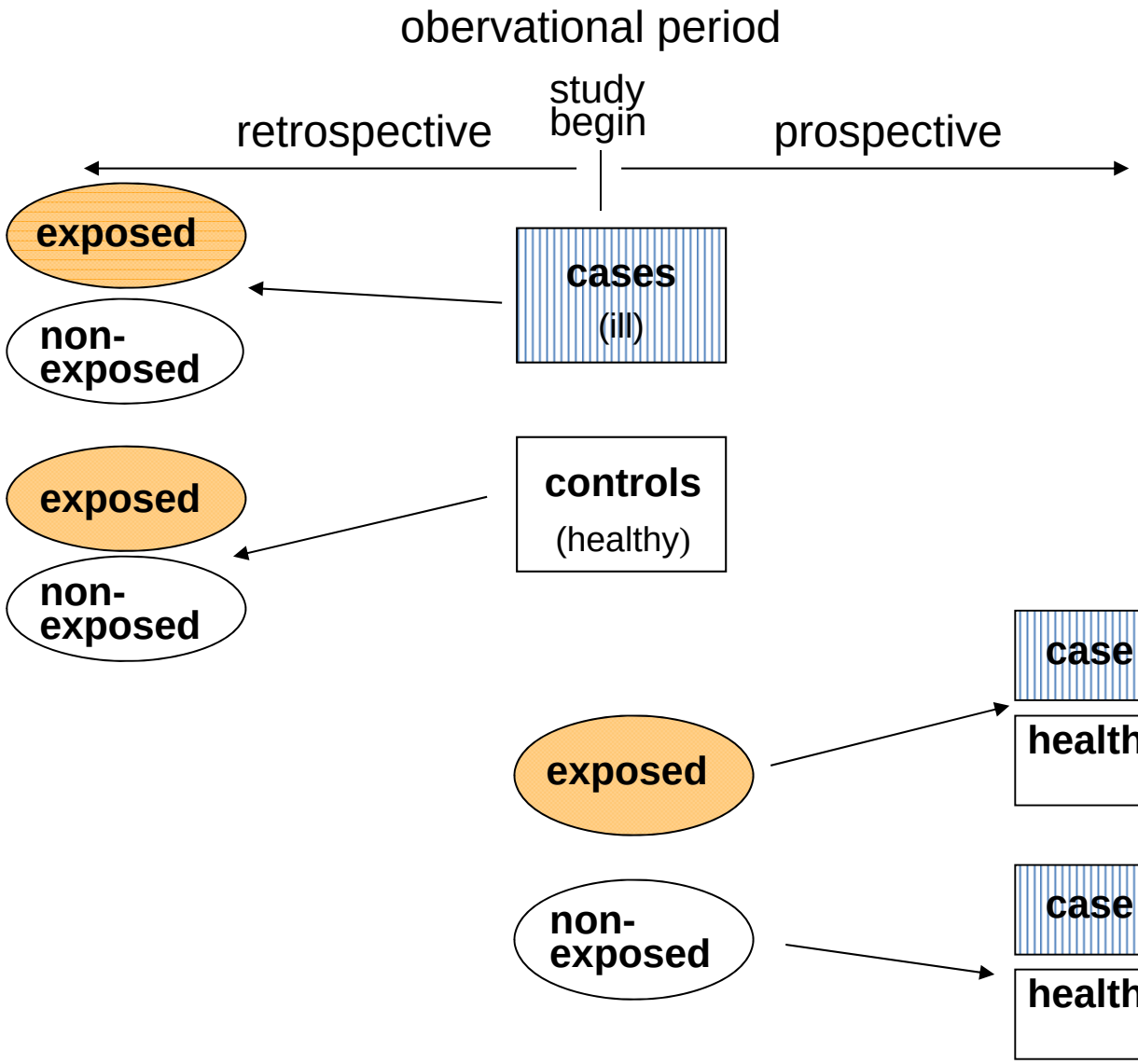


observational studies



cohort study

observational studies



case-control study

cohort study

pros and cons of **cohort studies**

pros:

- exposure determined prior to occurrence of disease
- suitable for investigating rare exposures
- suitable for investigating different diseases simultaneously

cons:

- can be expensive and last long
- exposure status might change over time
- sample size problem and Bias caused by drop-outs

pros and cons of **case-control studies**

pros:

- usually relative inexpensive
- faster done than cohort study
- suitable for rare diseases
- suitable for investigating several exposure factors simultaneously

cons: Bias

- selection bias in case and control group
- investigator bias
- exposure measurement bias

Analytical Studies: Summary

	Cross-Sectional	Case-Control	Cohort	RCT
Cost	+	++	+++	++++
Duration	+	++	+++	+++
Sample Size	Varies	Small	Large	Varies
Incidence, Prevalence	Prevalence	None	Incidence	Incidence
Multiple Outcomes	Yes	No	Yes	Yes
Bias Prone	Yes	Yes	No	No
Causality	No	No	No	Yes

Epidemiologic proof

- temporal sequence
- reproducibility
- strength of statistical asscoiation
- dose-response relationship
- effect of removal of risk factor
- biological plausibilty

hierarchy of study types for interventional problems

Level	
1	systematic review of RCTs, single RCT
2	systematic review of cohort studies, single cohort
3	systematic review of case-control studies, single case-control study
4	case report (no control group)
5	expert opinion

Oxford Centre for Evidence-based Medicine Levels of Evidence (May 2001)
http://cebm.jr2.ox.ac.uk/docs/levels.html