EPIDEMIOLOGY

Part IV: 04 SEP 2024

Dr Kalyani Addya

Sources of Error

- Confounding
- Chance
- Bias

Confounding

Increased risk of coronary heart disease

Properties of confounders

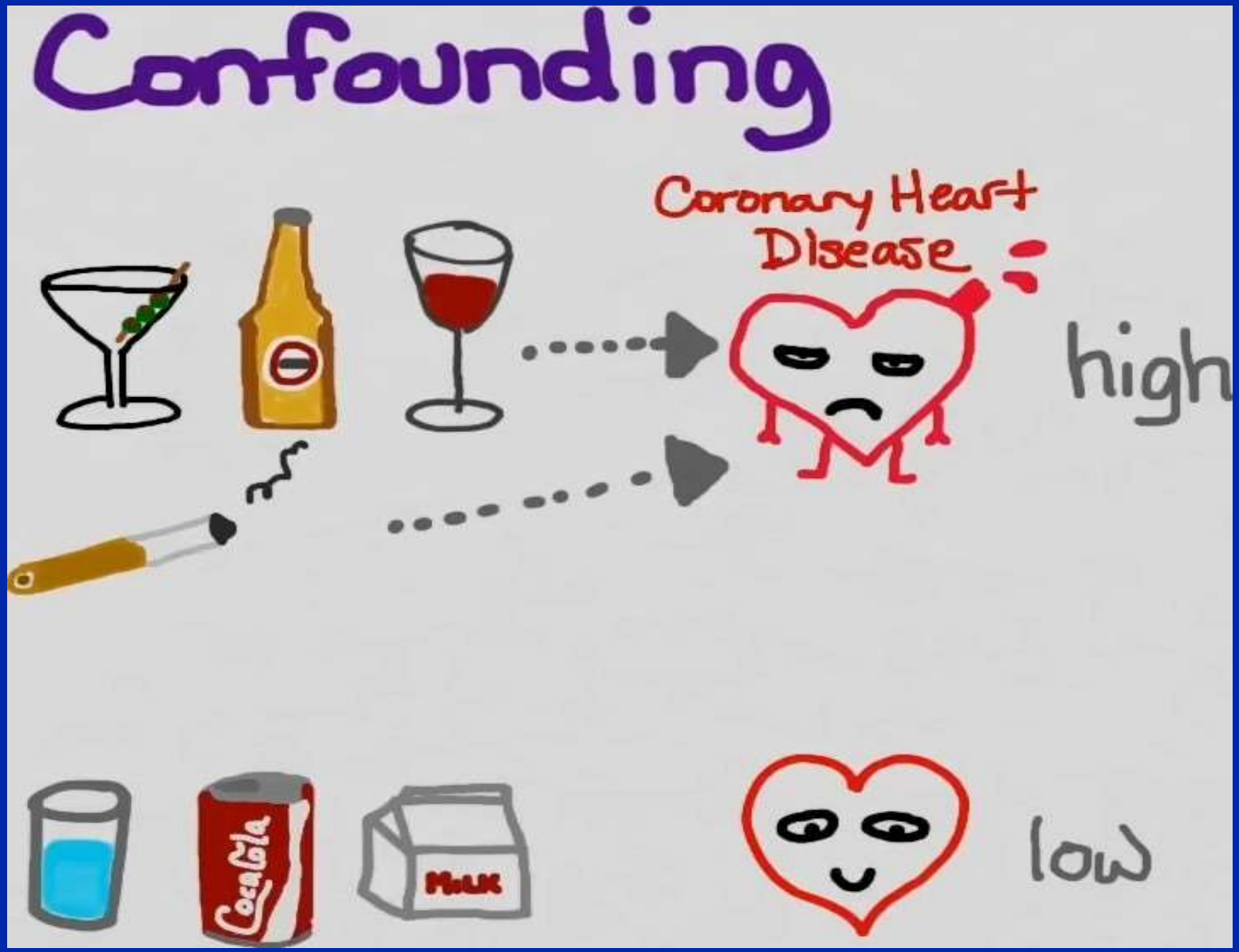
- Is associated with the outcome independently from the exposure
- Is related to the exposure
- Is not on the causal pathway between exposure and outcome

How do you deal with confounders?

- The incidence of known confounders can be avoided in the planning phase i.e., restriction
- Confounders taken into account during analysis i.e., stratification, multivariate analyses

What do you do when a confounder is unknown?

- **RANDOMIZATION**
- **Study participants are randomly allocated to study arms**
- **Randomization leads to an equal distribution of known and unknown confounders in the study groups**


Confounding
Coronary Heart Disease
high
low
Coca-Cola
Milk

Confounding Variable

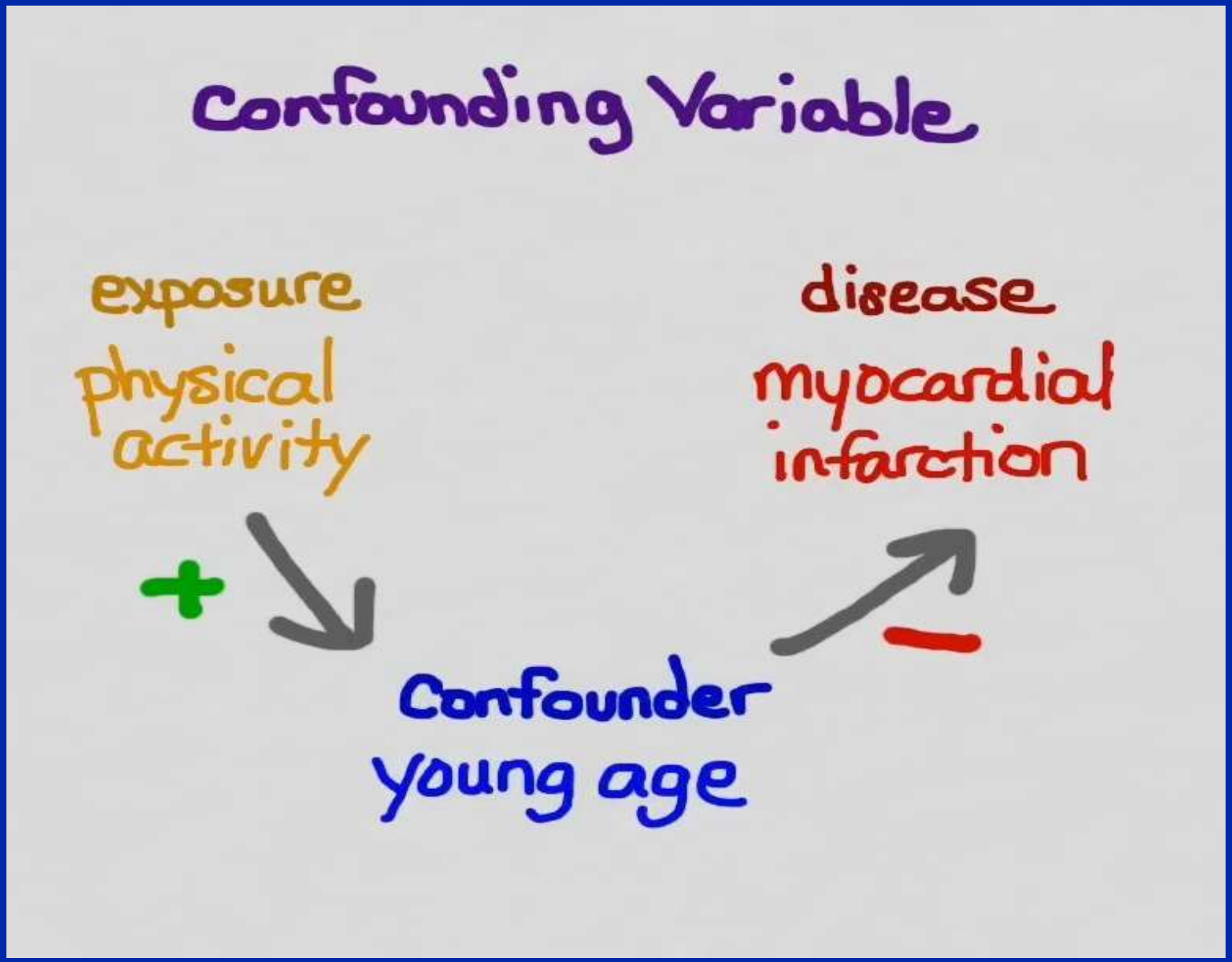
exposure

alcohol consumption

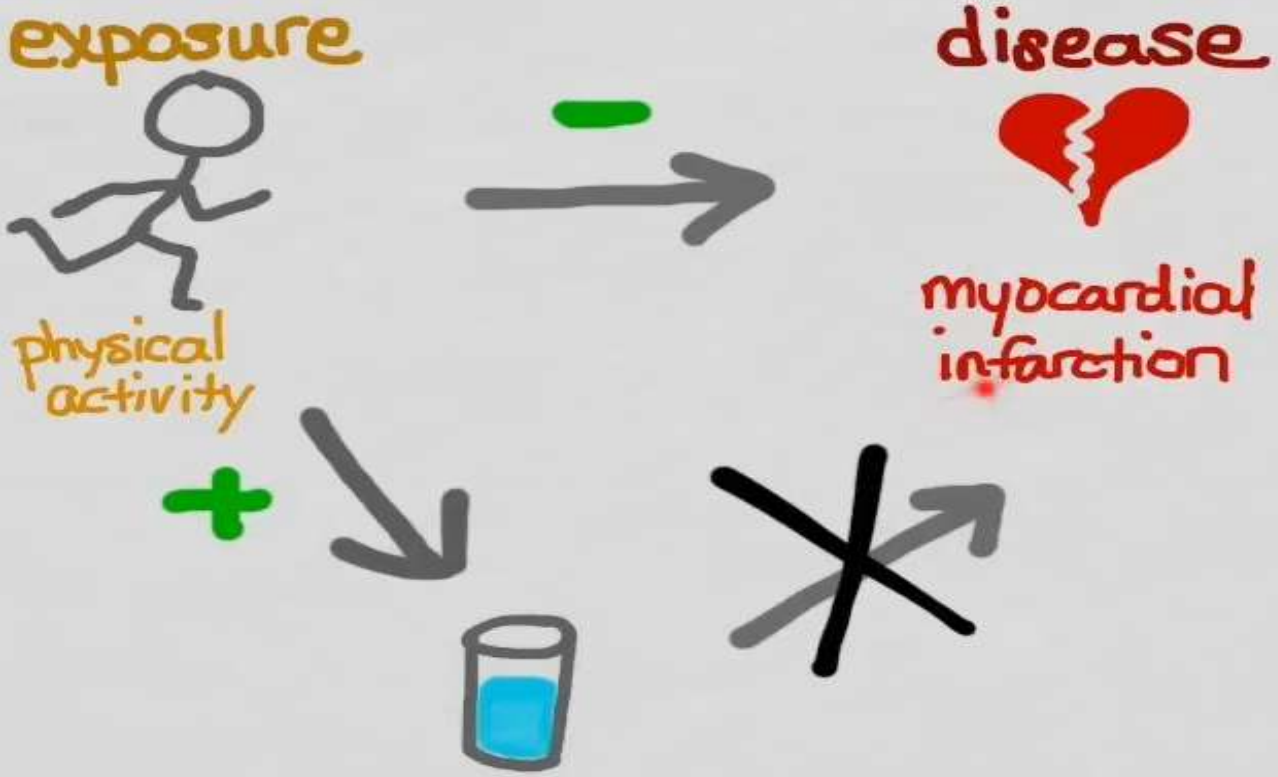
disease

Coronary Heart Disease

Smoking


Confounding Variable
exposure
physical activity
disease
myocardial infarction
+
−
Confounder
young age

Confounding Variable



Chance

- Random deviation from the truth without specific direction
- One can minimize the influence of chance by large sample size
- Less than 300 participants, random variability can lead to unequal distribution of patient characteristics
- Low event rates
- A large study size can minimize the risk of random error

Bias

- A systematic error in the design or execution of studies that distort the results
- Important types of bias:
  - Selection bias
  - Performance bias
  - Measurement bias
  - Attrition Bias

Selection bias

Systematic differences arise through the allocation of study participants

- **Relevant criteria:**
- **Randomization**
- **Secrecy of the randomization sequence (allocation concealment)**

Performance bias

- Systematic differences in the treatment or care of patients
- Relevant criteria
- Standardized treatment concept
- Blinding of participants and staff

Measurement bias

- Systematic differences in measuring outcomes
- Relevant criteria:
- Blinding the participants and the people measuring outcomes

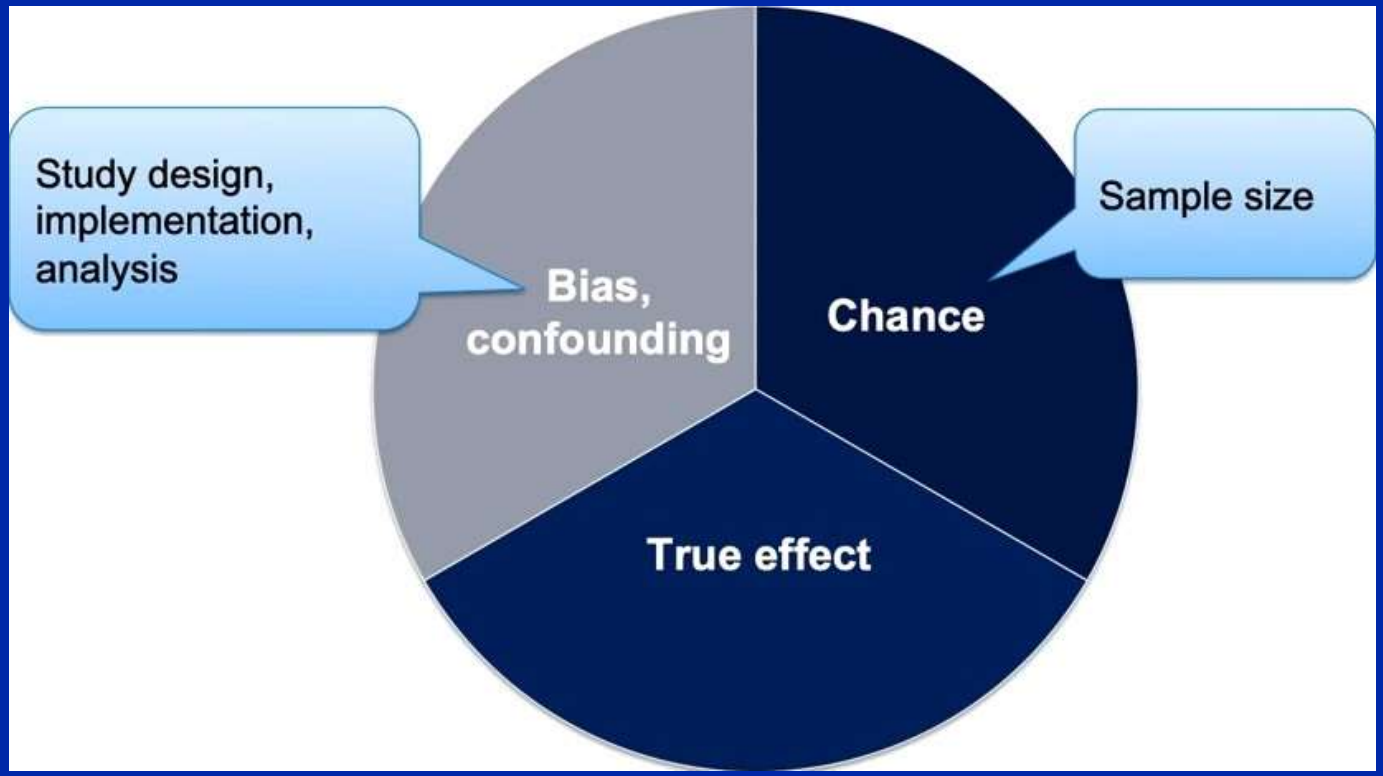
Attrition bias

- Systematic differences between study groups in case of premature withdrawal from the study
- Relevant criteria:
- Intention-to-treat analysis
- Complete description of dropouts from the study

Risk of bias

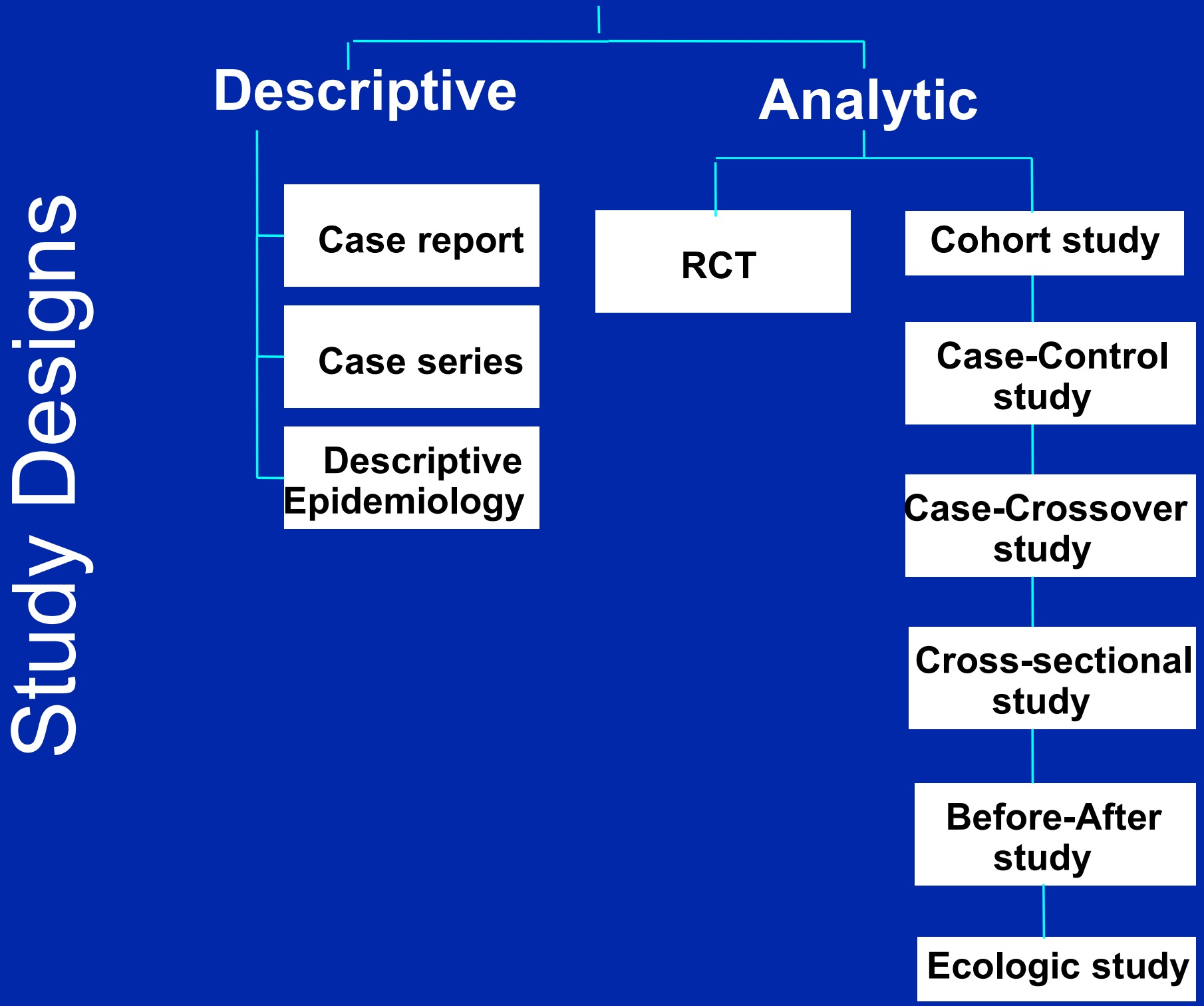
- Bias can not be measured directly
- The risk of bias can only be assessed indirectly through the evaluation of the study design and the execution of studies
- Risk of bias may vary between outcomes

Components of a study result



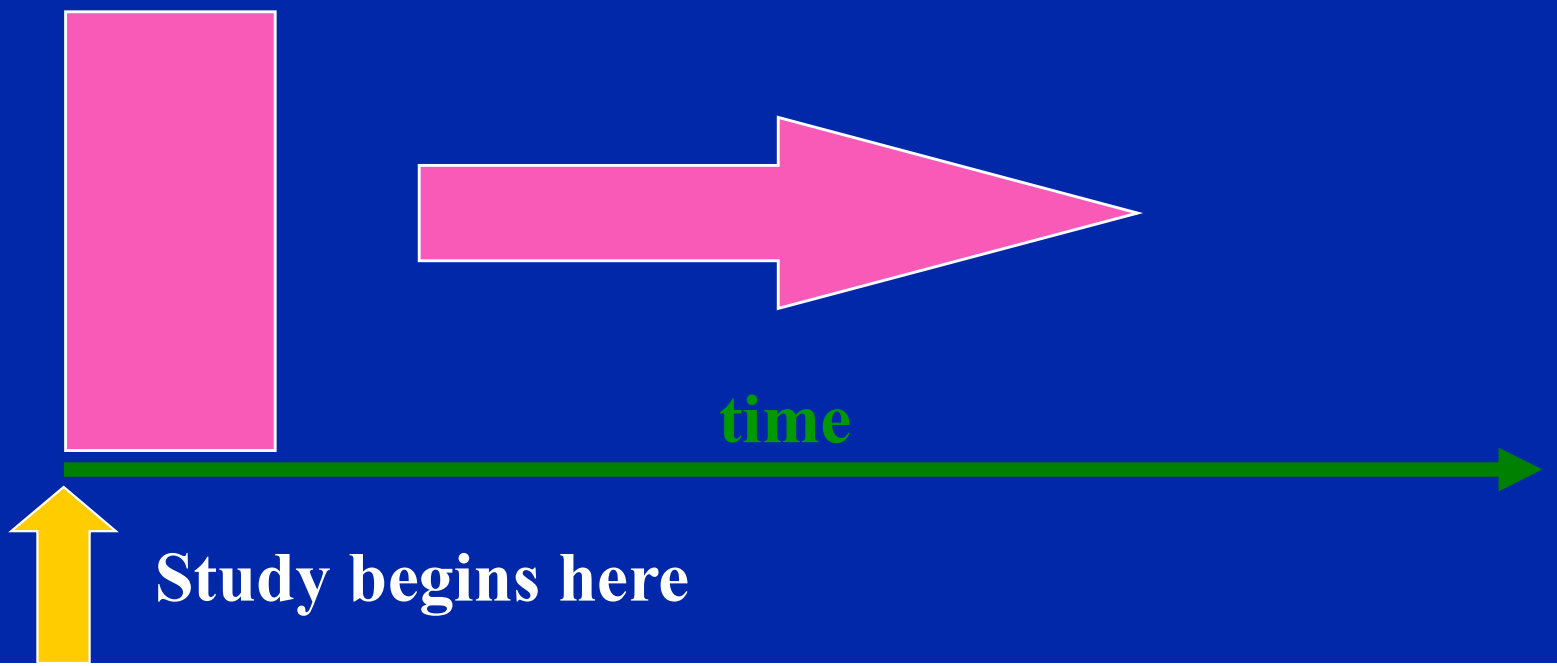
Study Designs in Epidemiologic Research

Study Designs



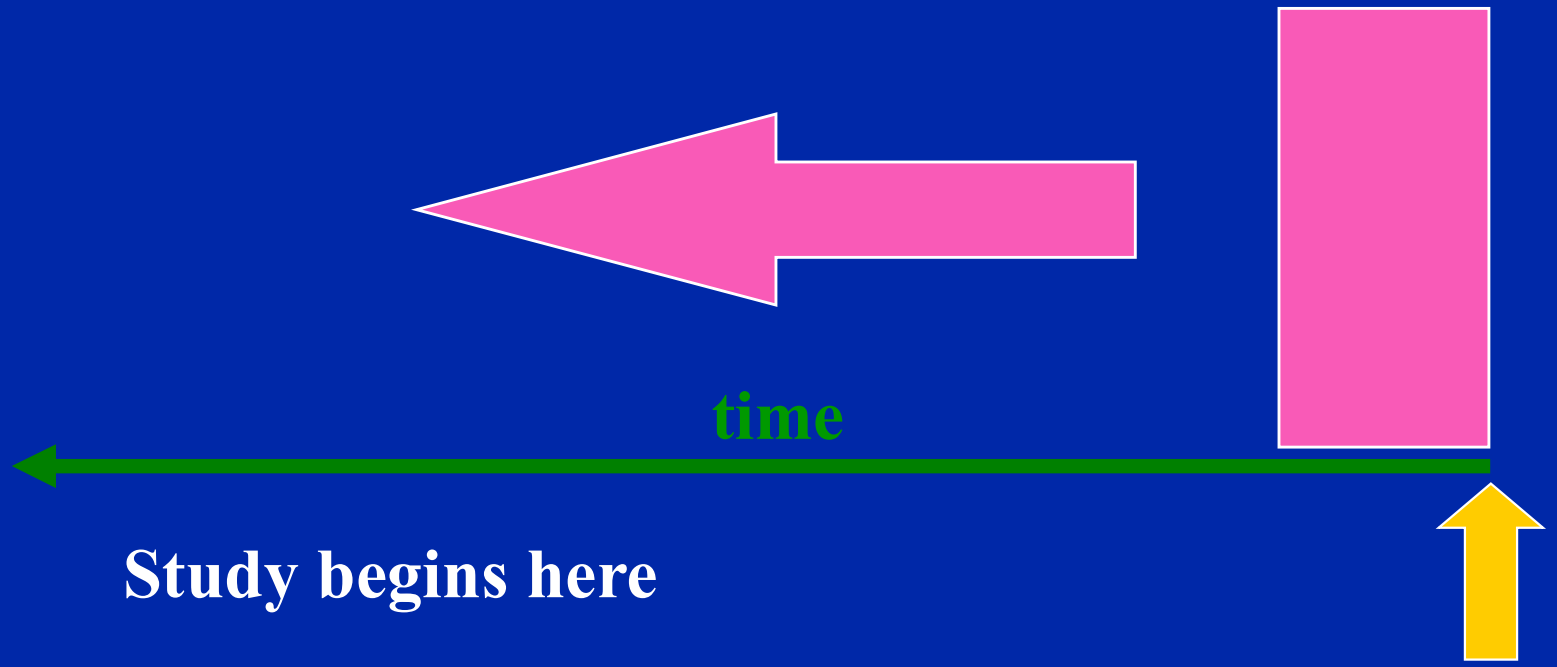
Timeframe of Studies

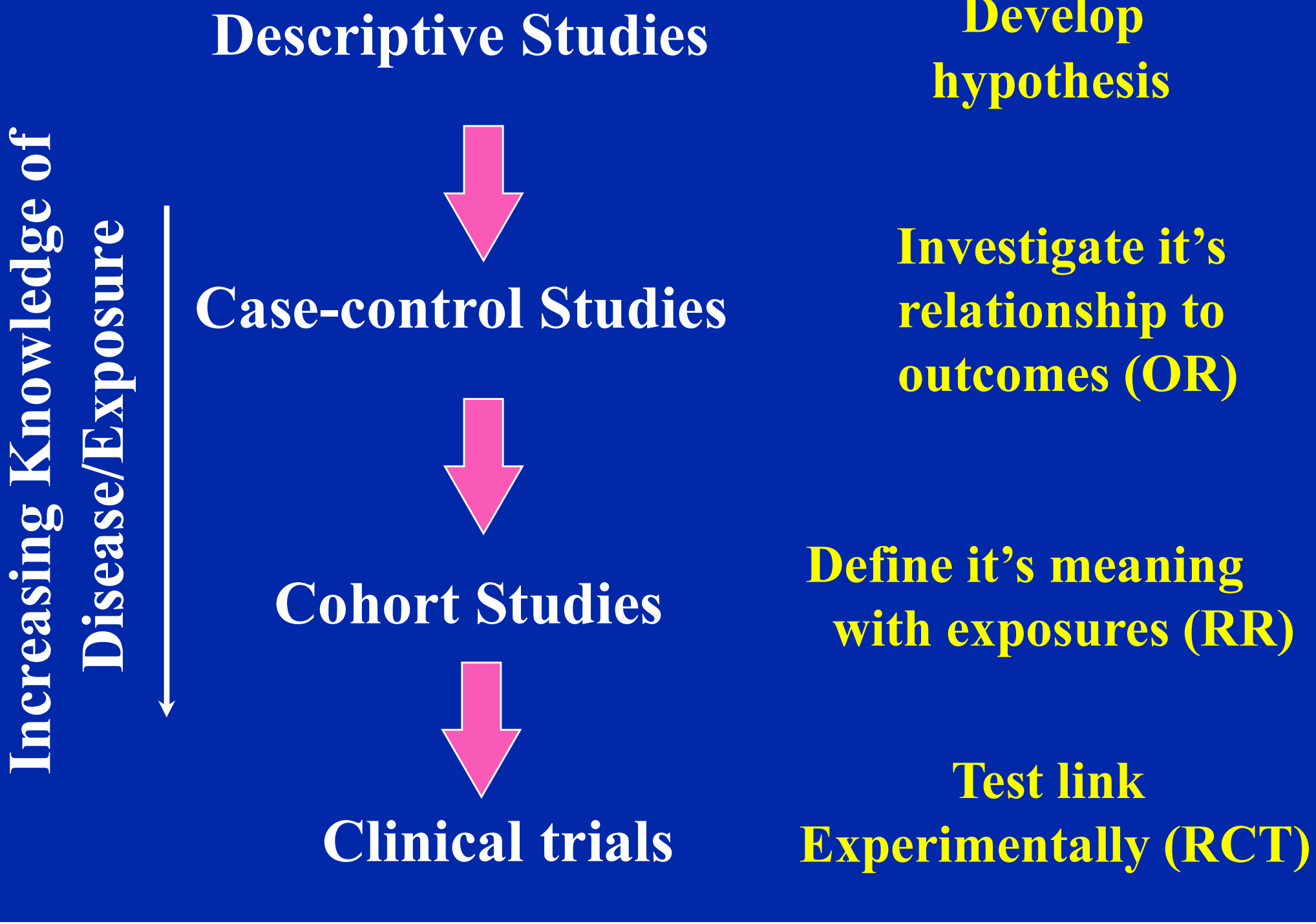
- **Prospective Study** - **looks forward/ future, examines future events, follows a condition, concern or disease into the future**



Timeframe of Studies

- **Retrospective Study** - "to look back", looks back in time to study events that have already occurred




Descriptive Studies
Develop hypothesis
Increasing Knowledge of Disease/Exposure
Case-control Studies
Investigate it's relationship to outcomes (OR)
Cohort Studies
Define it's meaning with exposures (RR)
Clinical trials
Test link Experimentally (RCT)

Descriptive Studies

Case Reports

- Detailed presentation of a single case or handful of cases
- Generally report a new or unique finding
    - e.g. previous undescribed disease
    - e.g. unexpected link between diseases
    - e.g. unexpected new therapeutic effect
    - e.g. adverse events

Case Series

- Experience of a group of patients with a similar diagnosis
- Assesses prevalent disease
- Cases may be identified from a single or multiple sources
- Generally report on new/unique condition
- May be only realistic design for rare disorders

Case Series

- Advantages
  - Useful for hypothesis generation
  - Informative for very rare disease with few established risk factors
  - Characterizes averages for disorder
- Disadvantages
  - Cannot study cause and effect relationships
  - Cannot assess disease frequency

Case Report → **One case of unusual findings**

Case Series → **Multiple cases of findings**

Descriptive Epidemiology Study → **Population-based cases with denominator**

Analytical Studies

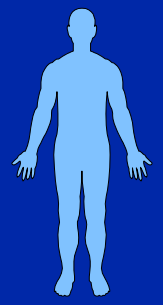
Analytic Epidemiology

- **Observational Studies**
  - **Group data**
    - **Ecologic**
  - **Individual data**
    - **Cross-sectional**
    - **Cohort**
    - **Case-control**
    - **Case-crossover**
- **Experimental Studies**
  - **Randomized controlled clinical trials (RCT)**
  - **Community trials**

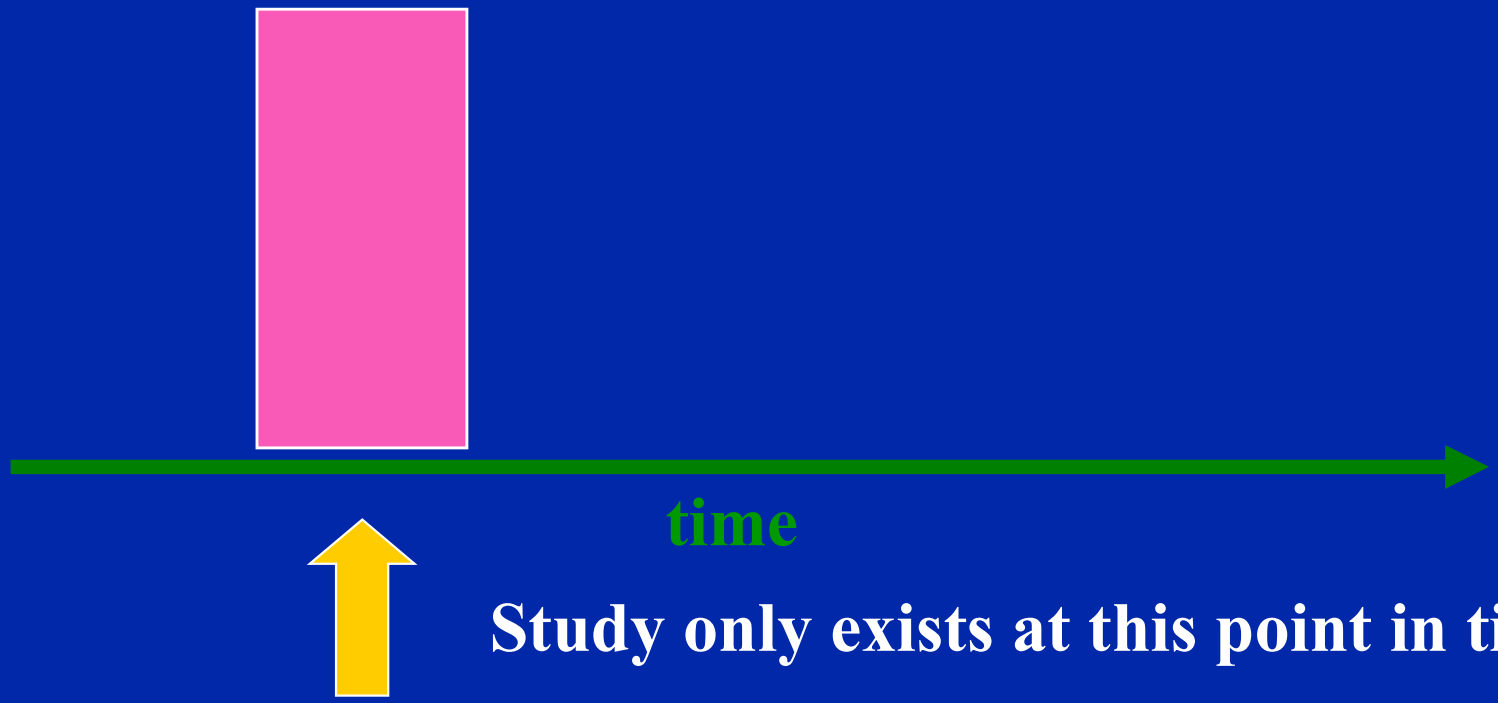
Observational Studies

- non-experimental
- there is no individual intervention
- treatment and exposures occur in a "non-controlled" environment
- individuals can be observed prospectively, retrospectively, or currently

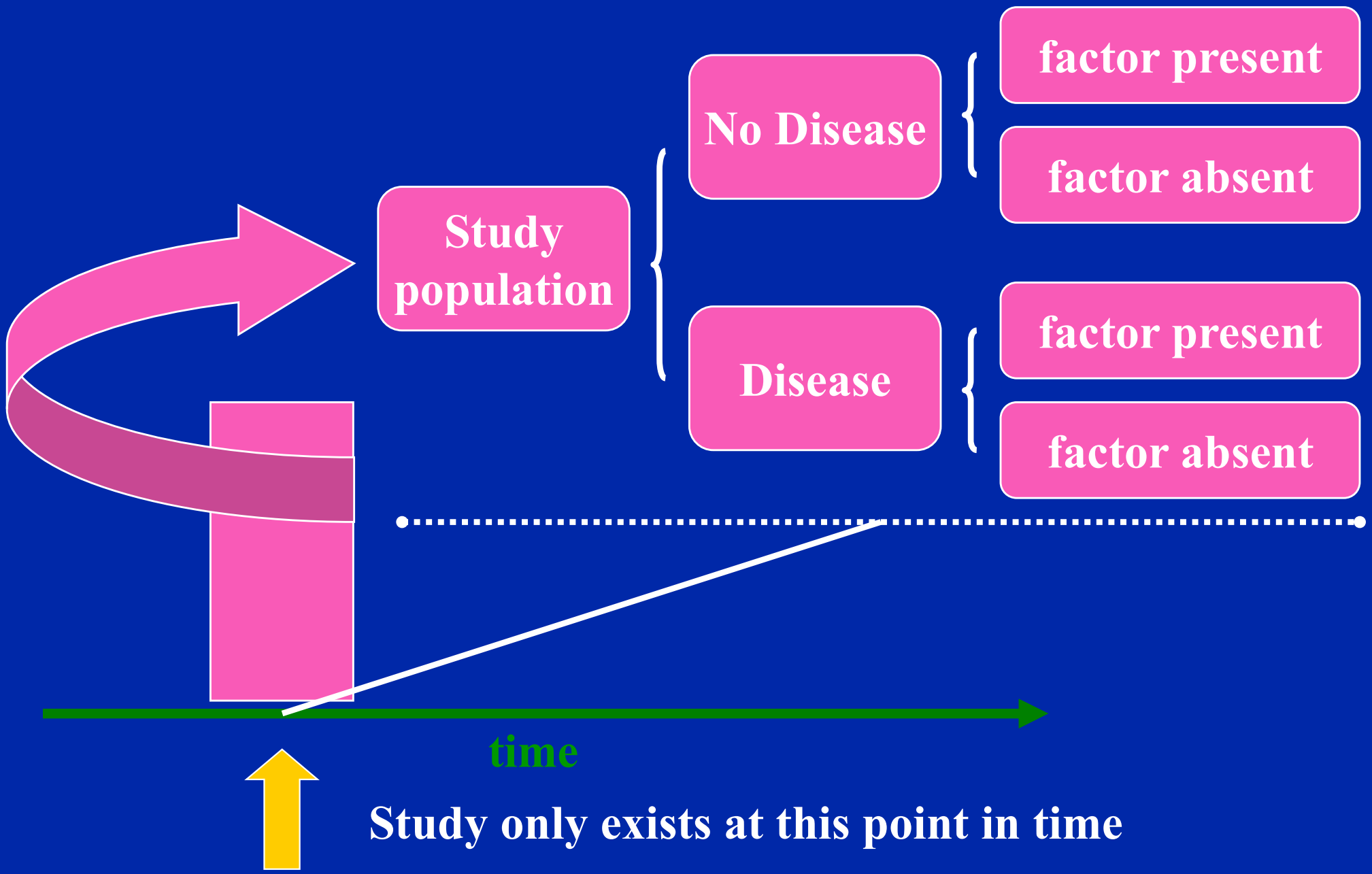
Cross-sectional studies



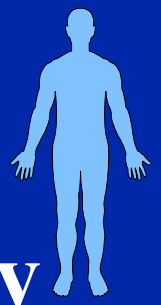
- An "observational" design that surveys exposures and disease status at a single point in time (a cross-section of the population)



Cross-sectional Design

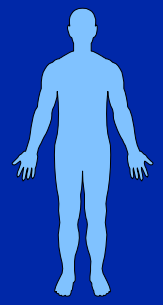


Cross-sectional Studies



- Used to study conditions that are relatively frequent with long duration of expression (nonfatal, chronic conditions)
- Measures prevalence of disease
- Example: community surveys
- Not suitable for studying rare or highly fatal diseases/ disease with short duration of expression
- Similar to cohort study but collects data from one point of time for a short period

Cross-sectional studies

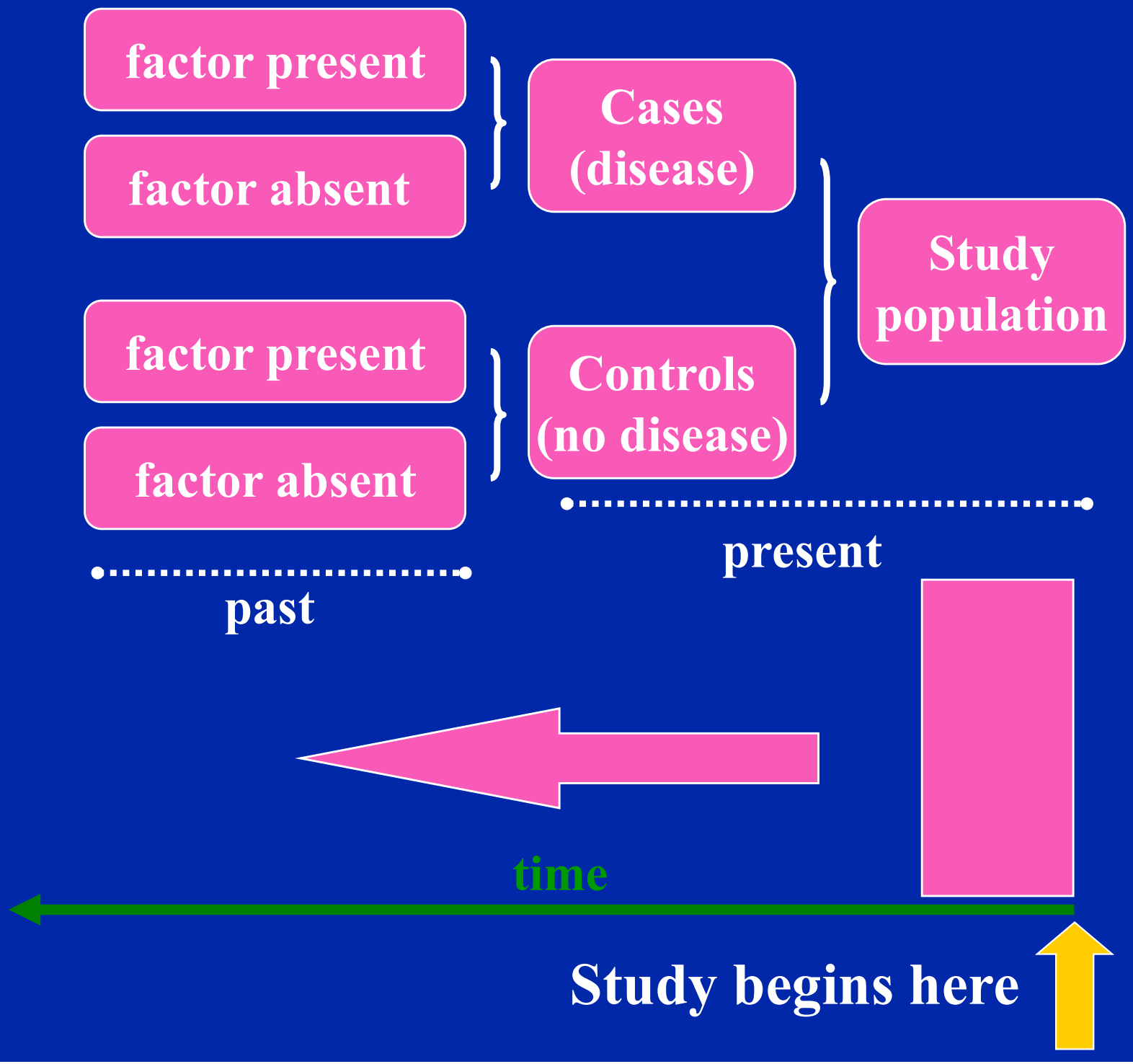


- **Disadvantages**
  - **Weakest observational design, (measures prevalence, not incidence of disease). Prevalent cases are survivors**
  - **The temporal sequence of exposure and effect may be difficult or impossible to determine**
  - **Usually do not know when disease occurred**
  - **Rare events/quickly emerging diseases are a problem**

Epidemiologic Study Designs

- **Case-Control Studies**
  - **an "observational" design comparing exposures in disease cases vs. healthy controls from same population**
  - **exposure data collected retrospectively**
  - **most feasible design where disease outcomes are rare**
  - **E.g.- Association of colon cancer with high fat diet**

Case-Control Design



Case-Control Study

- **Strengths**
  - **Less expensive and less time consuming**
  - **Efficient for studying rare diseases**
- **Limitations**
  - **Inappropriate when disease outcome for a specific exposure is not known at the beginning of study**
  - **Exposure measurements taken after disease occurrence**
  - **Disease status can influence selection of subjects**

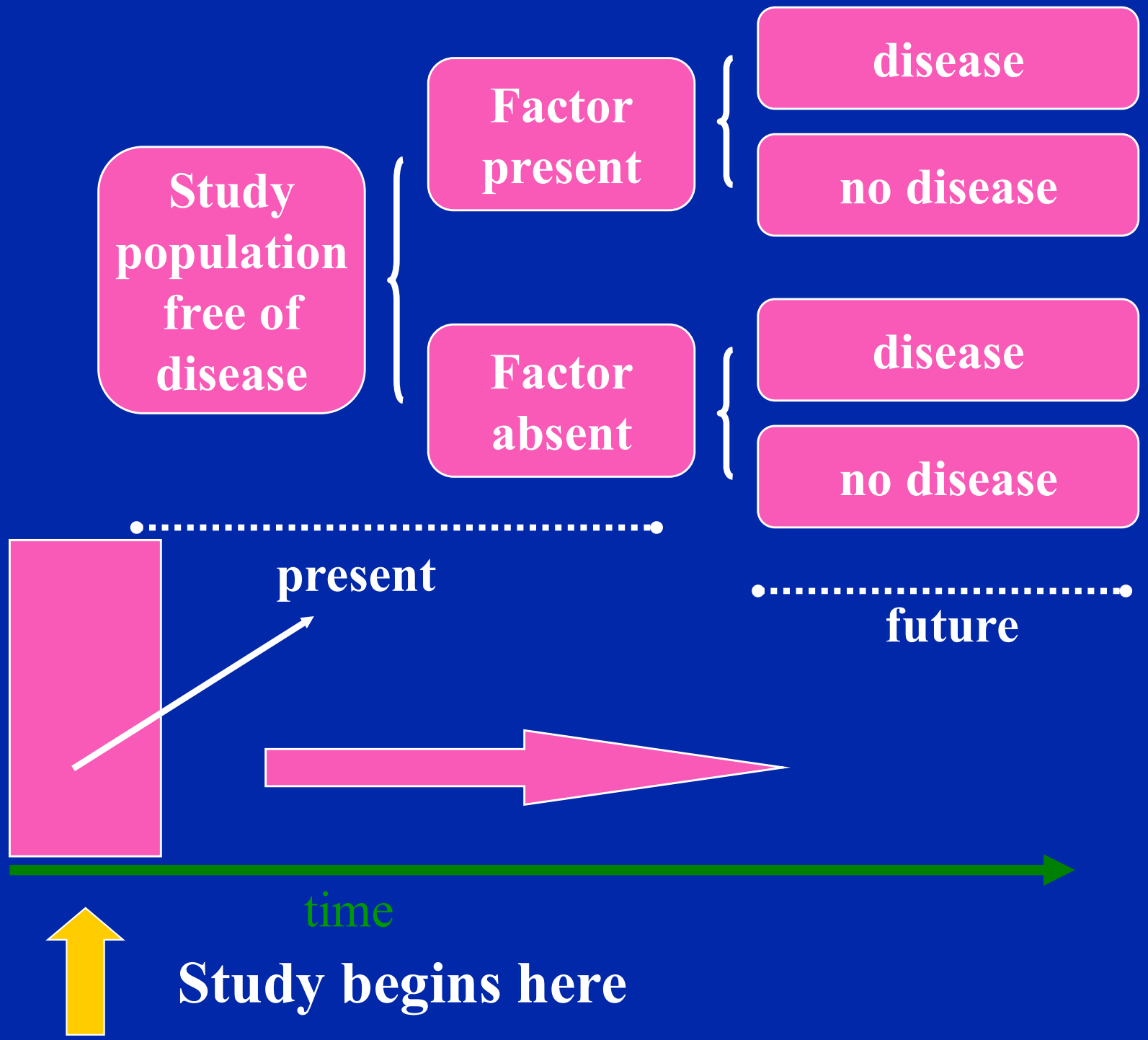
Hypothesis Testing: Case-Crossover Studies

- Study of “triggers” within an individual
- ”Case" and "control" component, but information of both components will come from the same individual
- ”Case component" = hazard period which is the time period right before the disease or event onset
- ”Control component" = control period which is a specified time interval other than the hazard period

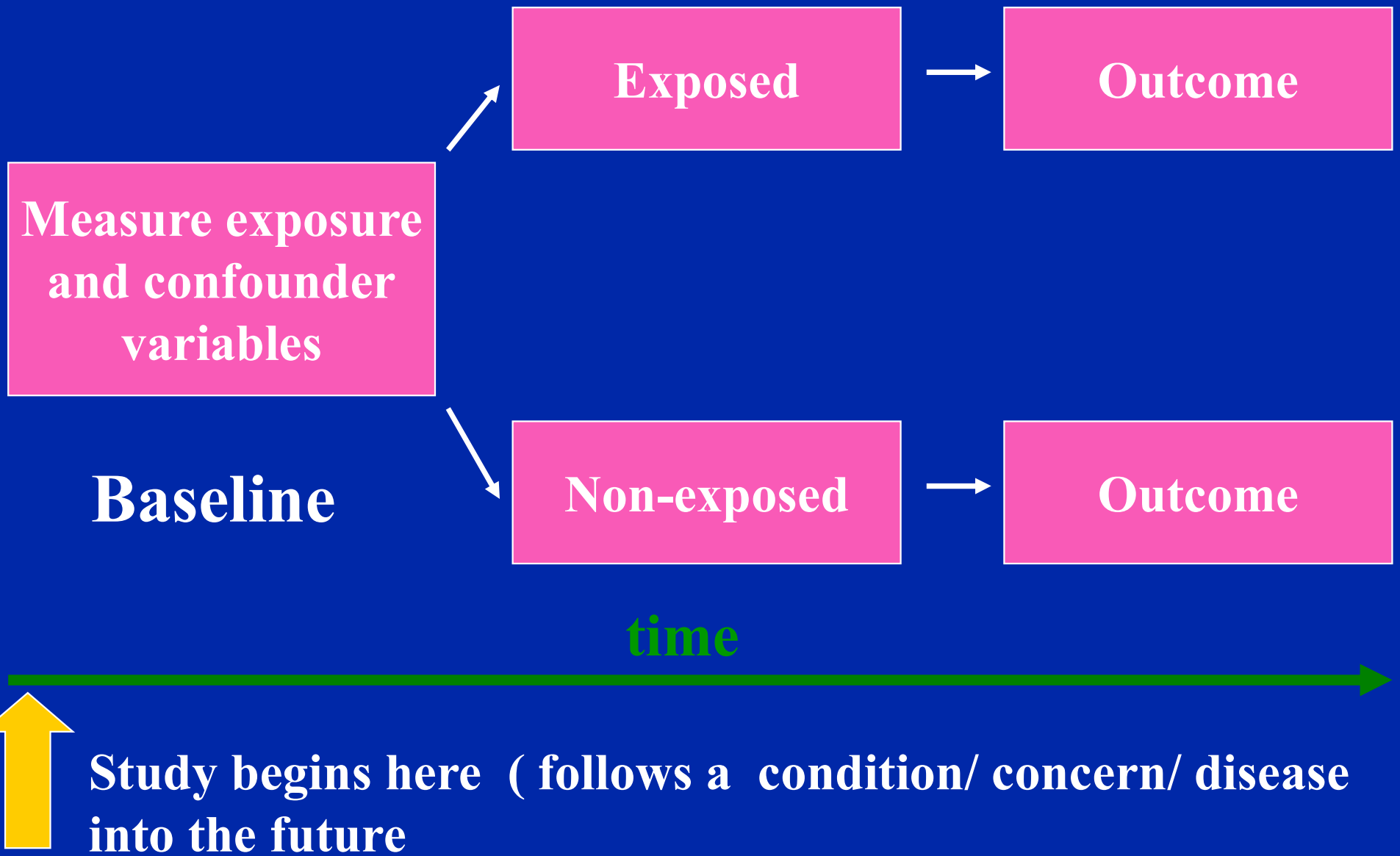
Epidemiologic Study Designs

- Cohort Studies
  - an "observational" design comparing individuals with a known risk factor or exposure with others without the risk factor or exposure
  - looking for a difference in the risk (incidence) of a disease over time
  - best observational design
  - data usually collected prospectively (some retrospective)

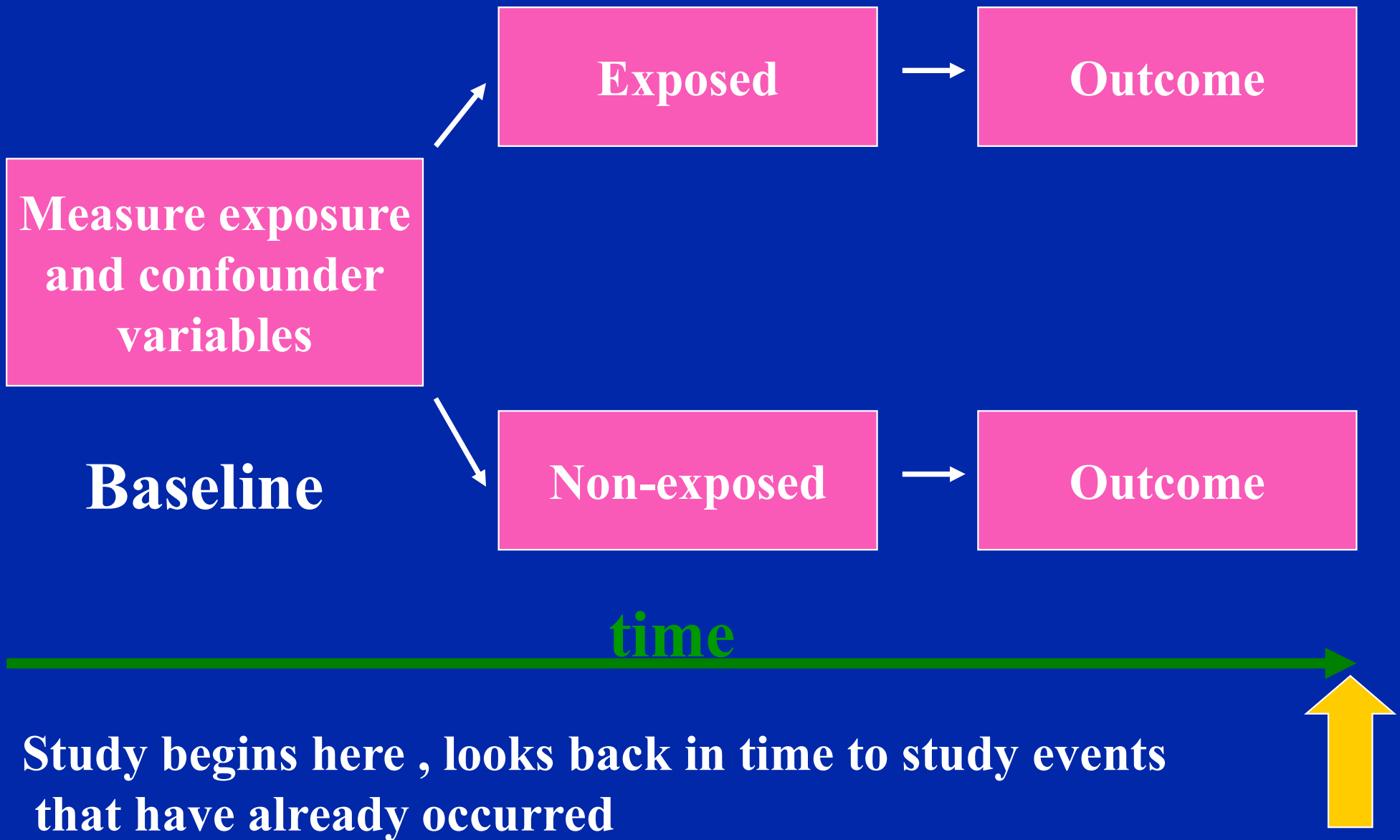
Cohort Design



Prospective Cohort study



Retrospective Cohort study



Study begins here , looks back in time to study events that have already occurred

Cohort Study

- Strengths
  - Exposure status determined before disease detection
  - Subjects selected before disease detection
  - Can study several outcomes for each exposure

- Limitations
  - Expensive and time-consuming
  - Inefficient for rare diseases or diseases with long latency
  - Loss to follow-up

Experimental Studies

- treatment and exposures occur in a "controlled" environment
- planned research designs
- clinical trials are most well known experimental design.
- Clinical trials use randomly assigned data.
- Community trials use nonrandom data

Experimental Studies

- Types of experimental studies
  - Clinical Trial (Therapeutic trial)
  - Community Trial
  - Field trial

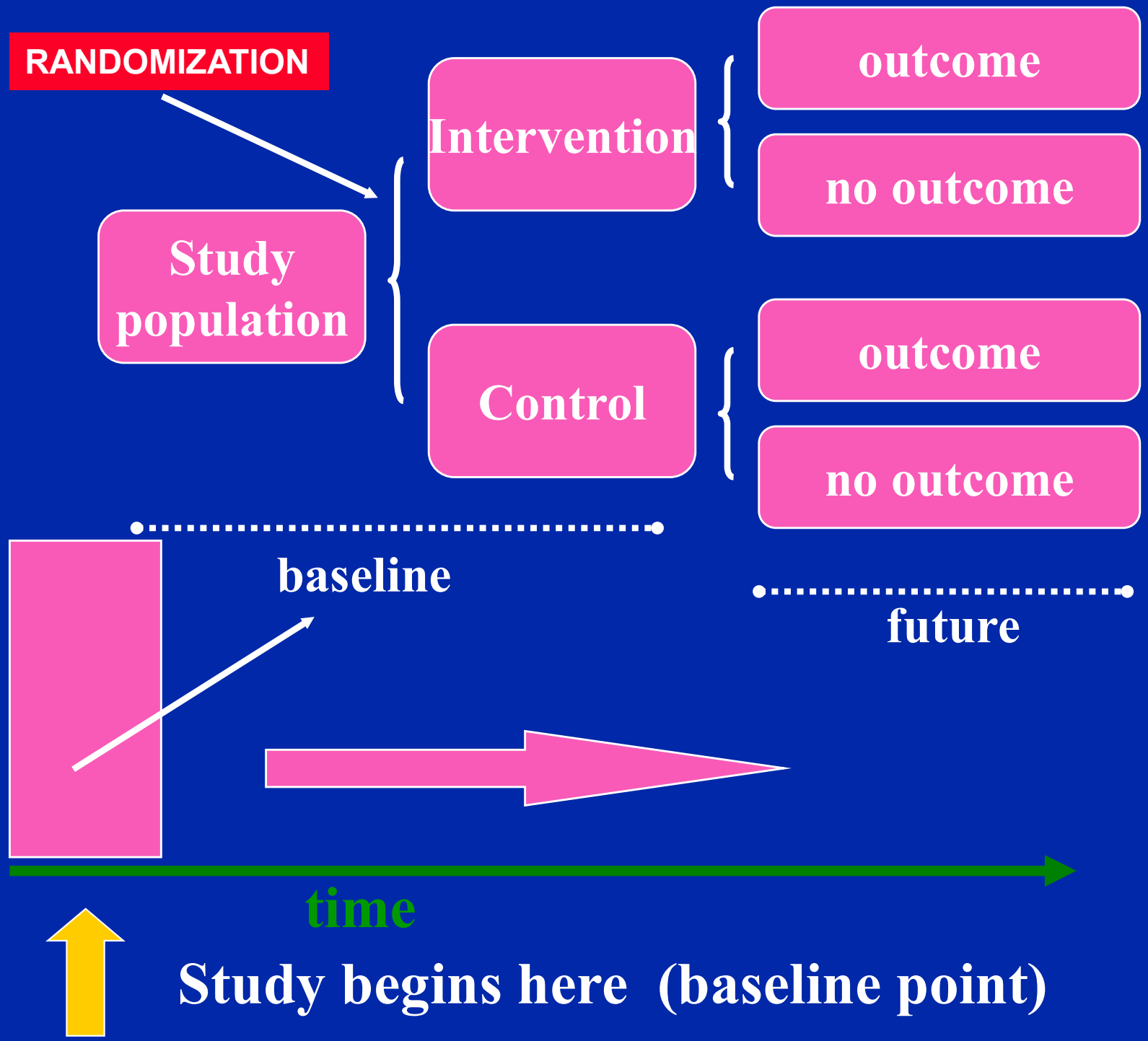
Experimental Studies

- The subjects who receive the treatment of interest are called the **treatment group**.
- The subjects who receive no treatment or a different treatment are called the **comparison group**.
- Akin to laboratory experiments except living populations are the subjects

Epidemiologic Study Designs

- **Randomized Controlled Trials (RCTs)**
  - **Also called intervention / experimental studies**
  - **the "gold standard" of research designs**
  - **Subjects randomly assigned to "treatment" and "comparison" groups**
  - **provides evidence of relationship between exposure and effect**
  - **Not used to test effects of exposures that are expected to be harmful, for ethical reasons**

Experimental Design



Advantages

- Scientifically ideal method
- Removes a large number of biases related to selection and measurement
- Controls for confounding through randomization
- Ensures temporal relationship between exposure and outcome

Disadvantages

- Very expensive
- Study of risk / prognostic factors random allocation of humans into two groups is not possible
- Ethics becomes a very important issue

When to use?

- Studying the efficacy of a preventive procedure
- Studying the efficacy of a therapeutic procedure
- Studying the efficacy of a health care system
- Random allocation is
  - Feasible
  - Ethical

Conducting a RCT

- Step 1: Clearly define the research question and its background significance
- Step 2:
  - Clearly define your reference population and study population.
  - Specify the general settings of the study
  - Specify the time frame

Conducting a RCT

- Step 3: Clearly specify the exclusion criteria
- Step 4: Specify the intervention and the scales of measurement
- Step 5: Specify the outcome variable of interest
  - Occurrence or non occurrence of an event
  - Consider the entire spectrum of the disease

Conducting a RCT

- Step 6: Specify the important potential confounding factors
  - Demonstrate no significant difference between the groups in respect of imp confounders
- Step 7: Calculate the sample size
  - Outcome on dichotomous scale
  - Outcome on continuous scale

Conducting a RCT

- Step 8: Sampling
  - Select the study subjects by random sampling
    - Simple random
    - Systematic random
    - Stratifies random
- Step 9:
  - Subject the study sample to random allocation

Conducting a RCT

- Step 10: Enunciate the stoppage rules
  - Continuously analyse data
  - Stop on clear statistical evidence
- Step 11: Organize for field work & data collection
  - Take administrative sanction
  - Clearance from ethical committee
  - Funds, logistics, equipment
  - Training of data collectors
  - Proper pretesting: Pilot Study

Conducting a RCT

- Step 12: Take informed consent
  - Clearly explain the purpose and scope
  - Potential benefits and hazards
  - Possibility of being assigned to study or control group
  - Consent without fear, prejudice, coercion
  - Exclude those who don't give consent
  - Compare those who gave consent with those who did not

Conducting a RCT

- Step 13: Randomise
  - Two groups: Drug and placebo
  - Three groups: Drug, placebo, standard treatment
  - More groups: Different doses of drug
  - Do a baseline comparison to check whether there is any difference between the groups

Conducting a RCT

- Step 14: Ensure Blinding
  - Single: Subjects not aware in which gp
    - Reporting bias removed
  - Double: Subject & investigator not aware
    - Reporting and ascertainment bias removed
  - Triple: Subject, investigator and data analyser not aware

Conducting a RCT

- Step 15: Administer the intervention and follow up
  - Similar action for both intervention and placebo
  - Duration of followup depends on outcome of interest
  - Constantly watchout for drop outs
  - Lookout for side effects

Conducting a RCT

- Step 16: Final assessment of outcome
  - During followup and at the termination
  - Positive results
  - Negative results

DISCUSSION

2021

Mid Term Project: Epidemiology

Total Marks: 15

Individual Participation Marks: 05

Group Participation Marks: 10

LAYOUT: PROJECT ON EPIDEMIOLOGY

2021

- Introduction
  - Global Statement
  - Indian Scenario
  - Known / Unknown Factors
  - Existing Gaps
  - Reasons for Gaps
- Methodology
  - Study Setting – College, School, Community, Workplace, Private, Government
  - Time Period
  - Type of Design
  - Sample Size
  - Cases / Cohort
  - Followup
  - Duration of Exposure
  - Outcome – Credits, Awards, Scholastic
- Result
  - Exposure / Outcome / Two by Two Table
- Conclusion

SYNDICATE 1

Boys in medical colleges who have a girl friend for more than 12 months duration score 25% less overall marks in final exams than those without a girlfriend.

SYNDICATE 2

Young married men whose wives have been working as a professional for more than 5 years after marriage have higher happiness quotient than those with house wives.

SYNDICATE 3

Drinking four cups of coffee for five days a week leads to anxiety

SYNDICATE 4

Nuclear family members who go out on vacations outside their home station for more than once in a year have higher interpersonal relationship score than those who do not go out.

SYNDICATE 5

MBBS students who stay in hostel for atleast 4 years duration are likely to get higher ranks in post-graduate entrance exams as compared to those who stay at home.

SYNDICATE 6

Individuals using earphones for at least three hours in a day for 5 days a week have hearing loss than those who do not use earphones

SYNDICATE 7

Individuals staying alone on the 10th floor and above have better lung health than others

SYNDICATE 8

Children of working mothers do better academically than children of housewives

SYNDICATE 9

Adult Indian women who have watched Hindi TV serials for atleast 2 hours per day for atleast 5 years are likely to develop psycho- depressive disorders after 50 years of age as compared to others.

SYNDICATE 10

In first 10 years of professional career in a government medical institute, paraclinical faculties have more indexed publications as compared to clinical faculties.