Introduction to Study Designs

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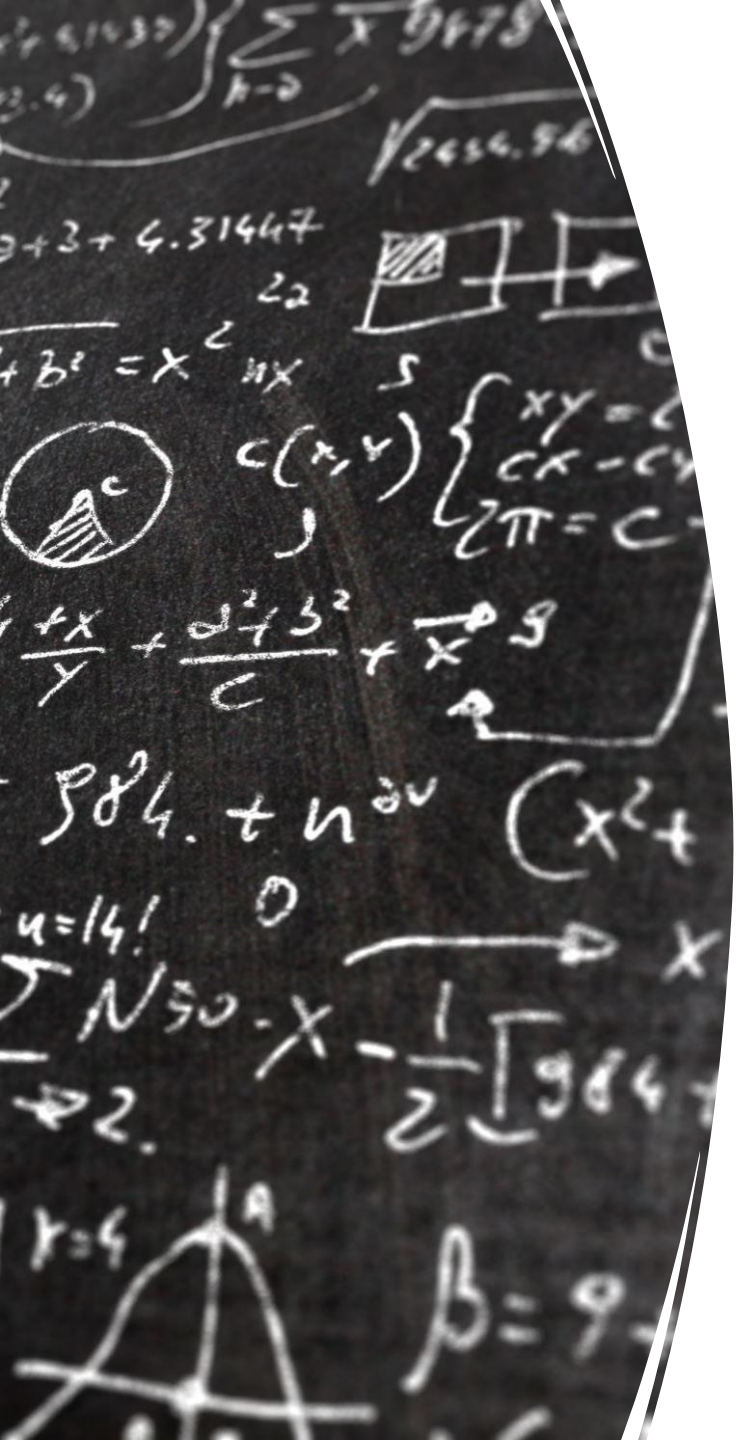


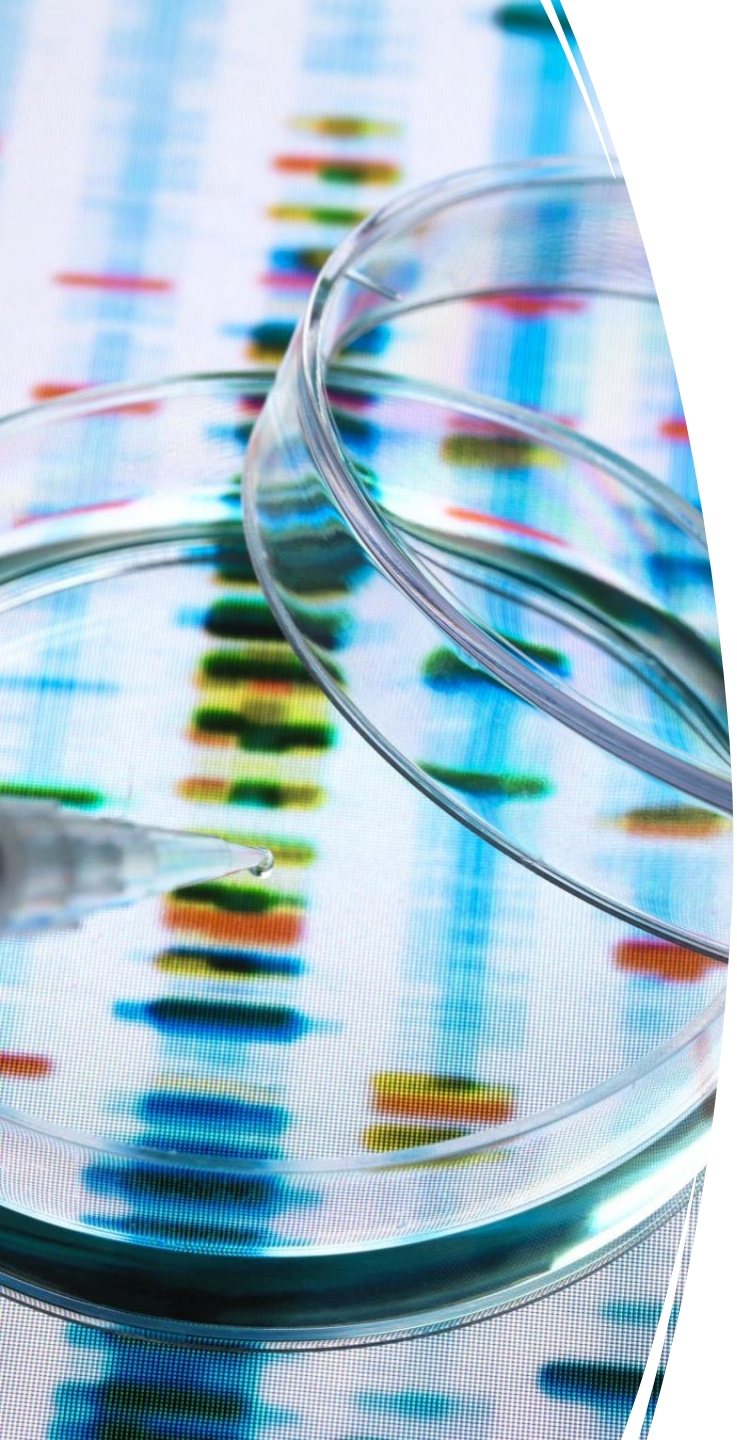
Why Study Designs Matter?

Study design is the structure or strategy of investigation to obtain answers to research questions.

Ensures validity and reliability of data.

Helps avoid bias and errors.

To decide data collection methods

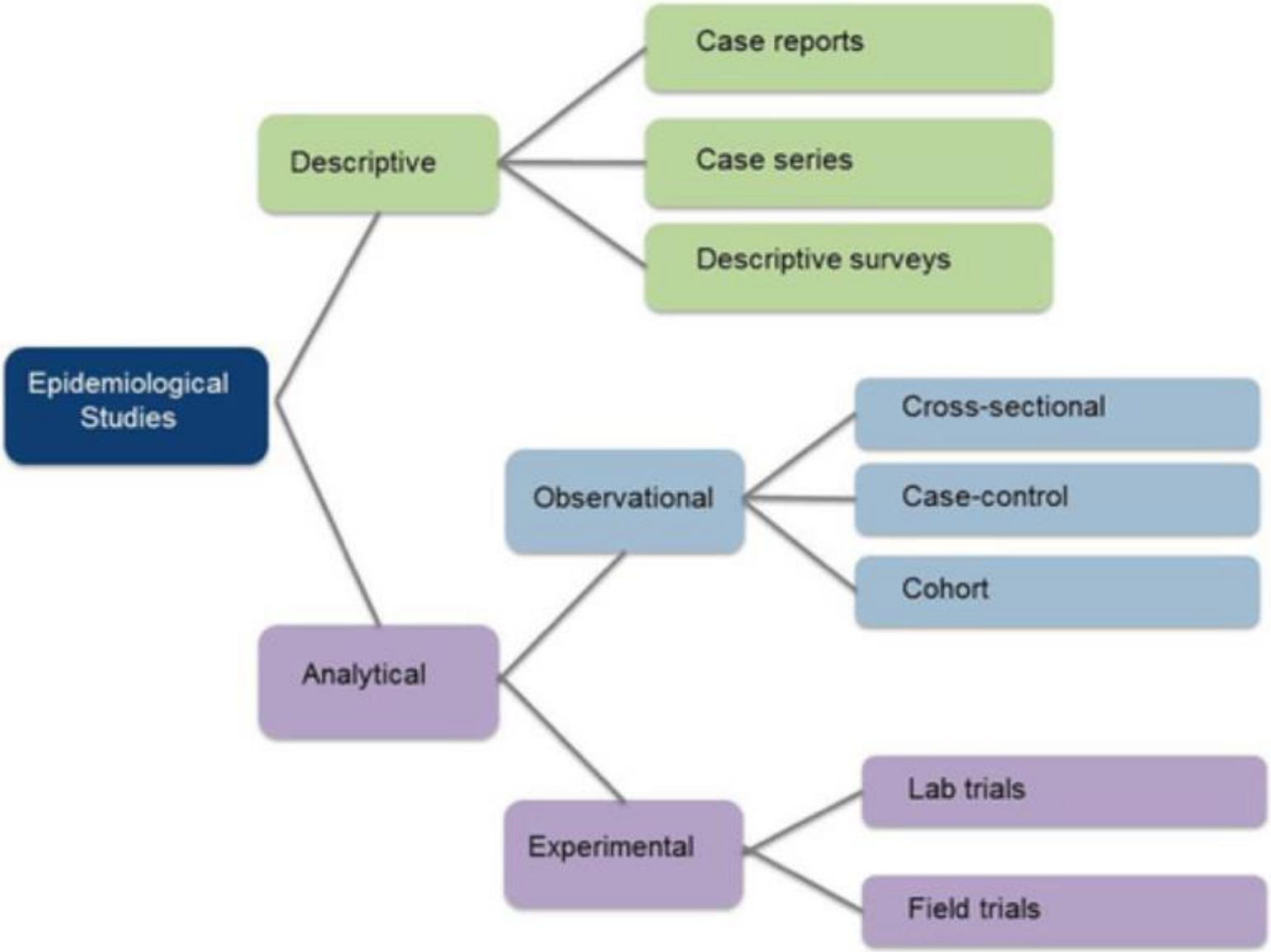


Two Main Types of Study Designs

1. Observational Studies – Researcher observes without intervention.

2. Experimental Studies – Researcher assigns intervention.

- Simple Analogy:
- Observational = Watching
- Experimental = Testing


Epidemiological Studies
Descriptive
Case reports
Case series
Descriptive surveys
Analytical
Observational
Cross-sectional
Case-control
Cohort
Experimental
Lab trials
Field trials

Descriptive studies

- Describes specific characteristics in a population of interest
- The most common forms are case reports and case series
- In a case report, we discuss our experience with the patient's symptoms, signs, diagnosis, and treatment
- In a case series, several patients with similar experiences are grouped.

Descriptive Studies

- Describe the occurrence of a disease or other health-related characteristics.
- Example: “What % of dental students have exam stress?”
- Used for generating hypotheses, not testing them.

Observational studies

- **An observational study** is a type of research where the investigator **watches and records** information about participants **without altering their environment or assigning treatments**.

Observational Studies

- Definition: Studies designed to test hypotheses and identify associations.

- Types:
- Cross-sectional
- Case-control
- Cohort

- These studies explore the relationship between exposure and outcome.

Cross-Sectional Study

- Definition: Observes a defined population at a single point in time or time interval.
- Example: “Is there an association between sugary diet and cavities in students?”
- Pros: Quick, inexpensive.
- Cons: Cannot infer causality.

Cross-sectional study:

- This design is transverse where we take a specific sample at a specific time without any follow-up
- It allows us to calculate the frequency of disease (**prevalence**) or the frequency of a risk factor
- This design is easy to conduct
- **For example** – if we want to know the prevalence of migraine in a population, we can conduct a cross-sectional study whereby we take a sample from the population and calculate the number of patients with migraine headaches.

Case-Control Study

- Definition: Compares patients with a disease (cases) to those without (controls), looking back in time.
- Example: “Did students with cavities consume more soft drinks?”
- Pros: Useful for rare diseases.
- Cons: Recall bias, no incidence data.

Case-Control Study

- We conduct this study by comparing 2 groups: one group with the disease (cases) and another group without the disease (controls)
- This design is always retrospective
- We aim to find out the odds of having a risk factor or an exposure if an individual has a specific disease **(Odds ratio)**
- Relatively easy to conduct
- **For example** – we want to study the odds of being a smoker among hypertensive patients compared to normotensive ones. To do so, we choose a group of patients diagnosed with hypertension and another group that serves as the control (normal blood pressure). Then we study their smoking history to find out if there is a correlation.

Cohort Study

- Definition: Follows a group over time to see who develops the outcome of interest.
- Example: “Track floss users vs. non-users to see who develops fewer cavities.”
- Pros: Stronger evidence.
- Cons: Time-consuming and expensive.

Cohort study:

- We conduct this study by comparing two samples from the population: one sample with a risk factor while the other lacks this risk factor

- It shows us the risk of developing the disease in individuals with the risk factor compared to those without the risk factor (**RR = relative risk**)

Cohort Study

- We may approach this study by 2 longitudinal designs:
    - **Prospective**: we follow the individuals in the future to know who will develop the disease
    - **Retrospective**: we look to the past to know who developed the disease (e.g. using medical records)
- This design is the strongest among the observational studies
- **For example** – to find out the relative risk of developing chronic obstructive pulmonary disease (COPD) among smokers, we take a sample including smokers and non-smokers. Then, we calculate the number of individuals with COPD among both.

Experimental Studies

- Definition: The researcher actively introduces an intervention and studies its effects.
- Best for identifying cause-and-effect relationships.
- Main type: Randomized Controlled Trial (RCT)

Experimental Studies

- Also known as interventional studies
- Can involve animals and humans
- Pre-clinical trials involve animals
- Clinical trials are experimental studies involving humans

Experimental Studies

- In clinical trials, we study the effect of an intervention compared to another intervention or placebo. As an **example,** I have listed the **four phases** of a drug trial:

I: We aim to assess the safety of the drug (**is it safe ?**)

II: We aim to assess the efficacy of the drug (**does it work ?**)

III: We want to know if this drug is better than the old treatment (**is it better ?**)

- IV: We follow-up to detect long-term side effects (**can it stay in the market ?**)

- n randomized controlled trials, one group of participants receives the control, while the other receives the tested drug/intervention. Those studies are the best way to evaluate the efficacy of a treatment.

Randomized Controlled Trial (RCT)

- Definition: Participants are randomly allocated to receive different interventions.
- Example: “Compare plaque levels in students using toothpaste A vs. B.”
- Gold standard for clinical research.

Summary of Study Designs

Study Design	Purpose	Time Frame	Example
Descriptive	Describe characteristics or trends	Present (snapshot)	Survey on dental anxiety among students
Cross-Sectional	Identify associations	Present (snapshot)	Sugar intake vs. presence of dental caries
Case-Control	Investigate causes retrospectively	Past to Present	Soda history in students with vs. without cavities
Cohort	Follow outcomes over time	Present to Future	Follow flossing vs. non-flossing students for 6 months
Randomized Controlled Trial (RCT)	Test interventions, determine causality	Present to Future	Compare effectiveness of Toothpaste A vs. B on plaque

How to Choose a Study Design?

- Ask yourself
- What is my research question?
- Can I intervene?
- What resources and time do I have?
- Are there ethical constraints?

- Choose the design that best fits your goal and constraints.

Quick Quiz: Match the Design!

- 1. Tracking students over a semester to study stress levels – ___
- 2. Comparing sugary drink intake in students with and without cavities – ___
- 3. Surveying how many students brush twice daily – ___
- 4. Testing new fluoride toothpaste vs. standard – ___

- A. Cross-sectional
- B. RCT
- C. Case-control
- D. Cohort

Quiz Answers

- 1 – D. Cohort
- 2 – C. Case-control
- 3 – A. Cross-sectional
- 4 – B. RCT

References

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