



# PG Residency Pediatrics

Introduction & Resources  
Including Biostatistics

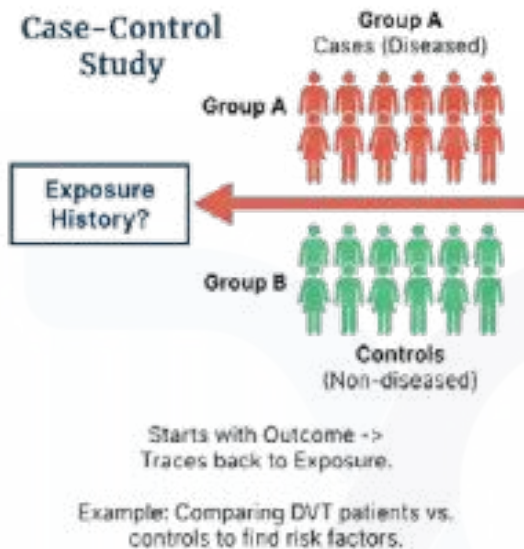
Smart Notes. Better Scores.



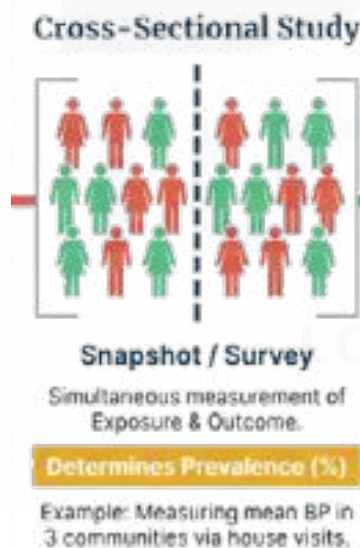
## Observational Study Designs: Defining the Timeline

Classifying research based on the temporal relationship between exposure and outcome.

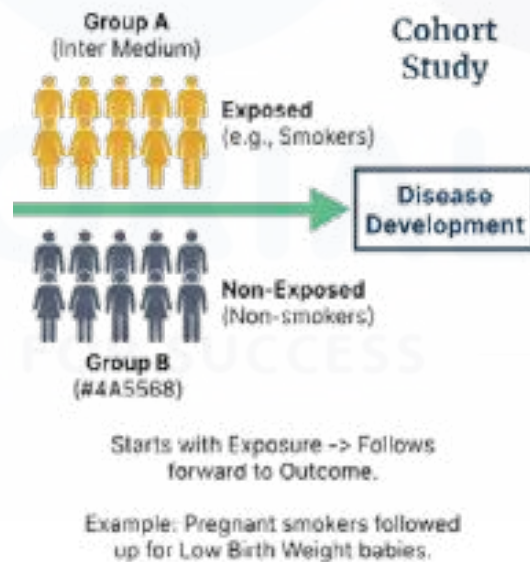
Past



Present

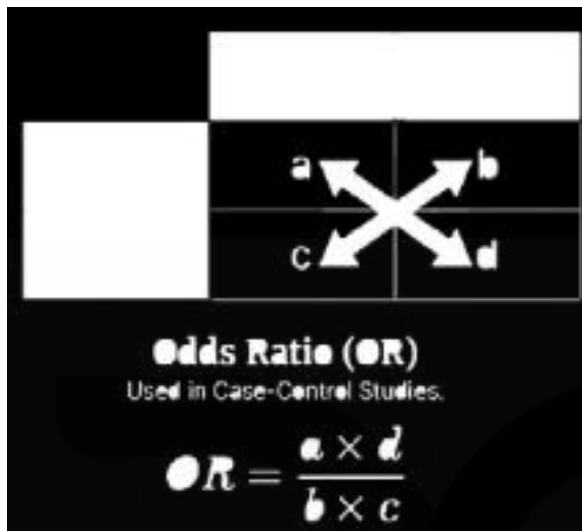


Future



## Measuring Risk: Strength of Association

Quantifying the link between exposure and disease using the 2x2 Table.



OR = 6 implies exposed individuals have a 6x higher chance of disease.

## Relative Risk (RR)

Used in Cohort Studies.

RR =  $\frac{\text{Incidence in Exposed}}{\text{Incidence in Non-Exposed}}$

RR =  $\frac{a / (a + b)}{c / (c + d)}$

## Reye's Syndrome & Aspirin

27 Cases (26 used Aspirin) vs 140 Controls (53 used Aspirin).

Result: OR = 42 (Strong Association).

### Interpreting Values

- RR/OR = 1: No Association (Null)

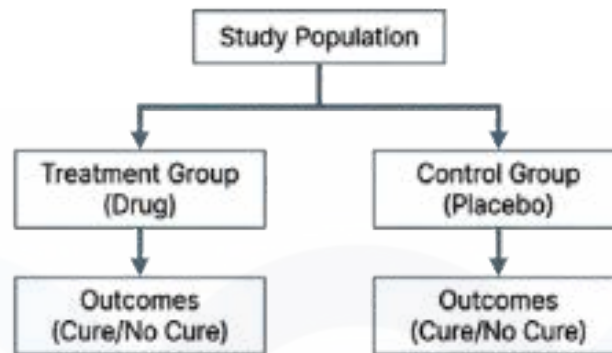
↑ RR/OR > 1: Factor (Exposure increases disease)

↓ RR/OR < 1: Protective Factor (Exposure prevents disease)

## Randomized Control Trials (RCTs) & Efficacy

Calculating treatment impact and Number Needed to Treat (NNT).

### Study Structure



### Key Terms

- **Intention to Treat:** Includes drop-outs in analysis (Preferred/Real-world).
- **Per Protocol:** Excludes drop-outs (Ideal conditions only).

### Efficacy Formula

Efficacy = 1 - Relative Risk (RR)

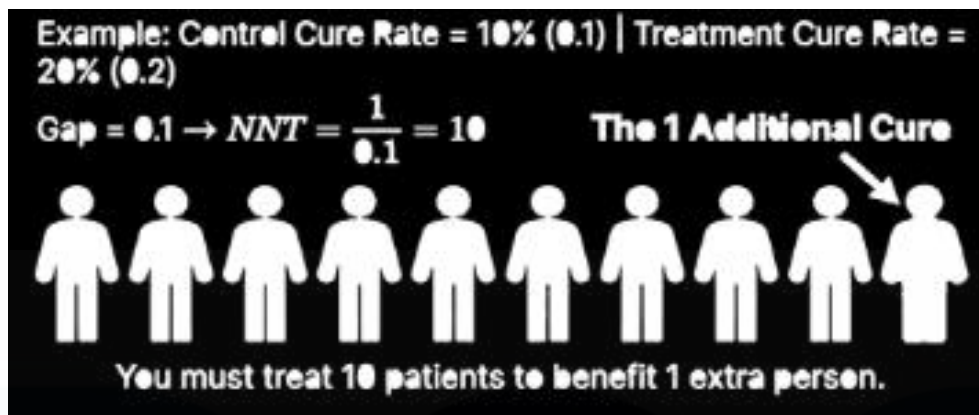
### Number Needed to Treat (NNT)

Minimum patients treated to achieve one additional cure compared to control.

$$\text{NNT} = \frac{1}{\text{Incidence in Control} - \text{Incidence in Treated}}$$

$$\text{NNT} = \frac{1}{\text{Absolute Risk Reduction}}$$

## Visual Example



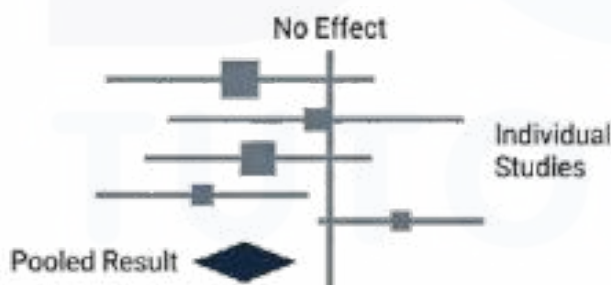
## Evidence Synthesis & Reporting Standards

Methodologies for combining data and guidelines for transparent reporting.

### Meta-Analysis

Systematic combination of results from previous research to reach a new conclusion.

Data is collected from studies, **not directly from patients**.

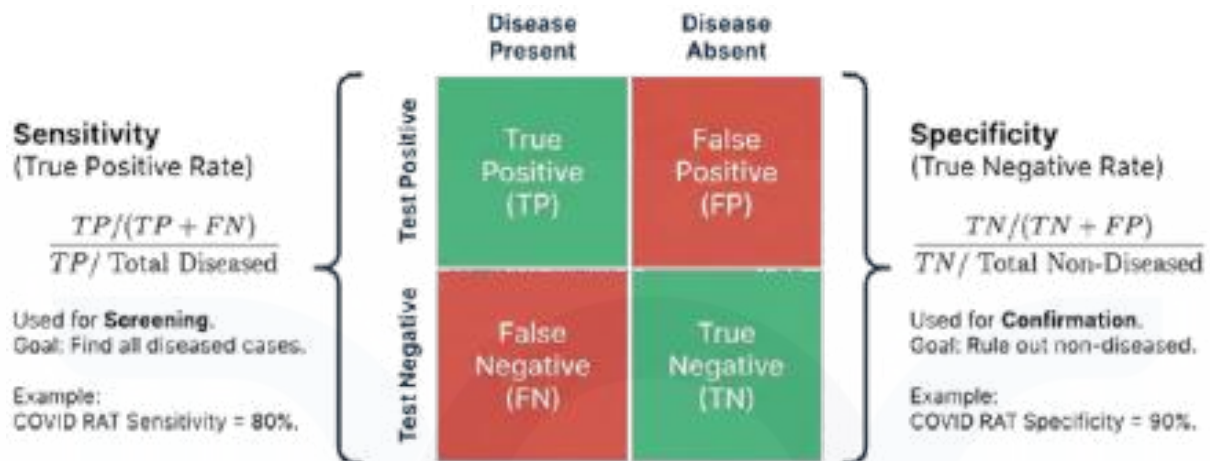


## Reporting Guidelines

| Study Design                                 | Guideline Acronym                         |
|----------------------------------------------|-------------------------------------------|
| Systematic Reviews & Meta-Analyses           | <b>PRISMA</b> (Preferred Reporting Items) |
| Meta-Analyses (Quality Focus)                | <b>QUOROM</b> (Quality of Reporting)      |
| Randomized Control Trials (RCT)              | <b>CONSORT</b> (Consolidated Standards)   |
| Observational Studies (Cohort, Case-Control) | <b>STROBE</b> (Strengthening Reporting)   |
| Diagnostic Accuracy Studies                  | <b>STARD</b> (Standards for Reporting)    |

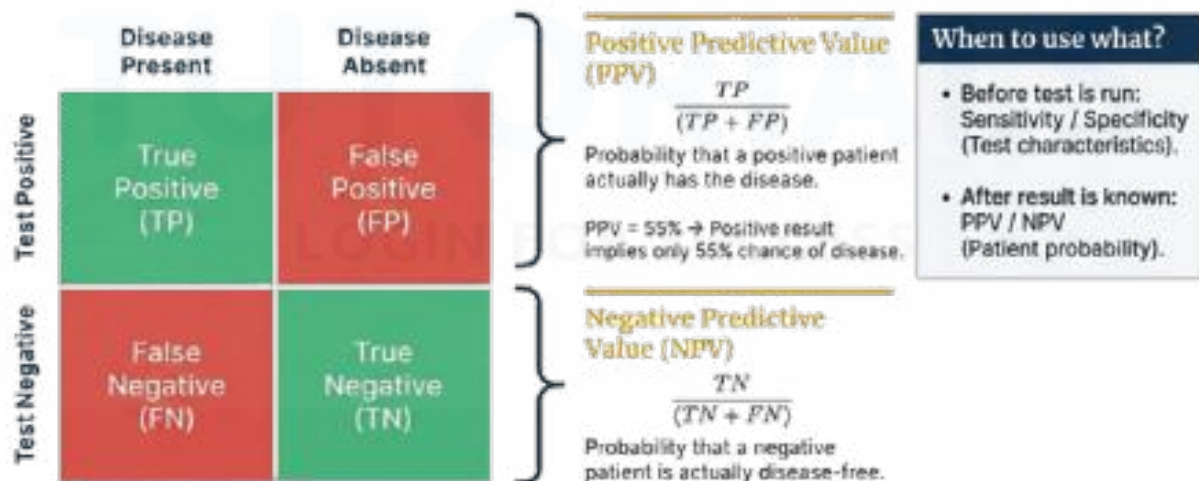
## Evidence Synthesis & Reporting Standards

Methodologies for combining data and guidelines for transparent reporting.



## Predictive Values: Interpreting Results

Post-test probability: How likely is the result correct?





## Hypothesis Testing & Types of Error

Alpha, Beta, and the Power of a Study.

**The Truth Table of Errors**

|                       | Reality: Effective                                                                            | Reality: Not Effective                                                                                                            |
|-----------------------|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Result: Effective     | <b>True Positive (Power)</b><br>Correct Conclusion.                                           | <b>Type I Error (Alpha)</b><br>False Positive.<br>Rejecting Null Hypothesis when it is true.<br>Significance Level $(P) < 0.05$ . |
| Result: Not Effective | <b>Type II Error (Beta)</b><br>False Negative.<br>Accepting Null Hypothesis when it is false. | <b>True Negative</b><br>Correct Conclusion.                                                                                       |

### Key Formulas & Definitions:

**P-Value:** Probability of committing a Type I error (False Positive).

**Power:** Probability of correctly finding a difference  $(1 - \text{Beta})$ .

Example: If Type II error (Beta) is 10% (0.1), Power = 90%.

## Sampling Techniques: Representative vs. Biased

Methods for selecting a study population.

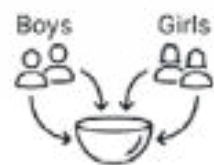
### Random Sampling (Representative)



- **Simple Random:** Equal known chance (e.g., lottery).



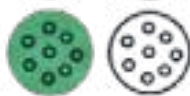
- **Systematic:** Every nth person selected.



- **Stratified:** Divided into strata -> random pick.



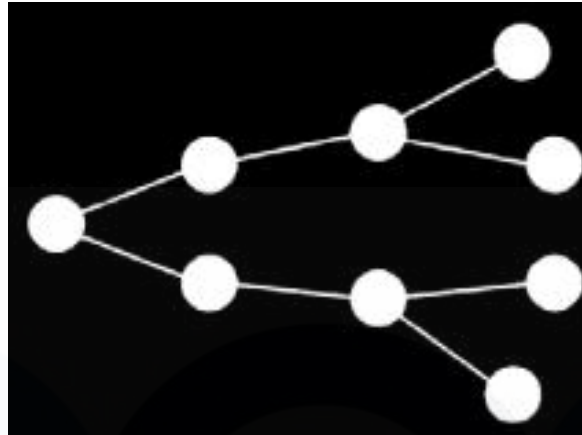
- **Cluster:** Study natural groups (e.g., schools).



- **Multistage:** Levels: State -> District -> School.

## Non-Random Sampling (Biased)

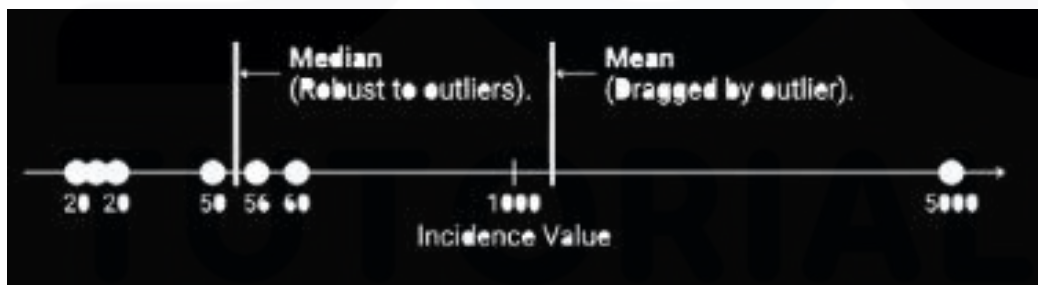
- **Snowball Sampling:** Used for hidden/hard-to-access subjects (e.g., Rare diseases, CommercialSexWorkers).



- **Other Types:** Convenience, Purposive, Quota.

## Measures of Central Tendency

Mean vs. Median: The Effect of Outliers.



### Measures of Central Tendency:

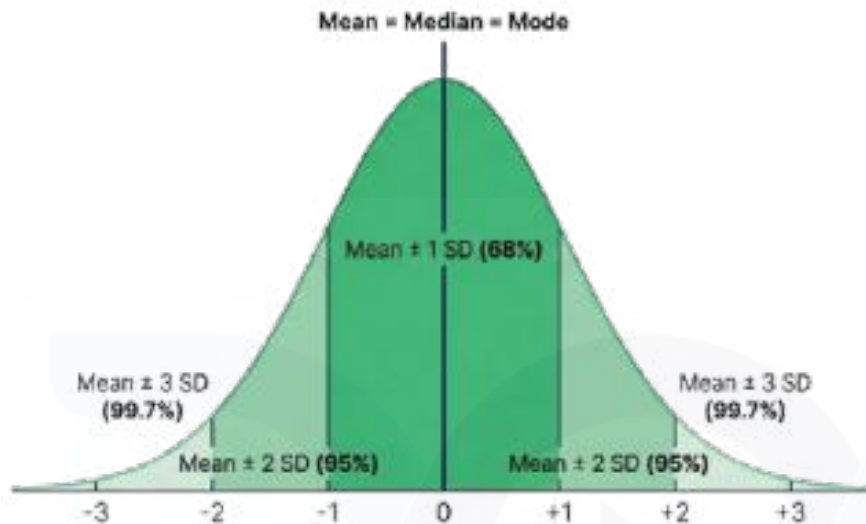
- **Mean (Arithmetic):** Sum / n. Disadvantage: Sensitive to extremes.
- **Median:** Middle value  $[(n+1)/2]$ . Best for skewed data or outliers.
- **Mode:** Most frequent value.

**Case Example:** Malaria Incidence: [20, 20, 50, ... 5000]. The '5000' is an outlier, making Median the most accurate measure.



## The Normal Distribution & Dispersion

Understanding the Bell Curve and Empirical Rules



### Standard Deviation (SD):

- Measures average spread around the mean.
  - Small SD = Clustered data.
  - Large SD = Dispersed data.

### Pediatric Application:

- Used to define normal ranges for growth charts and lab values.

## Confidence Intervals & Standard Error

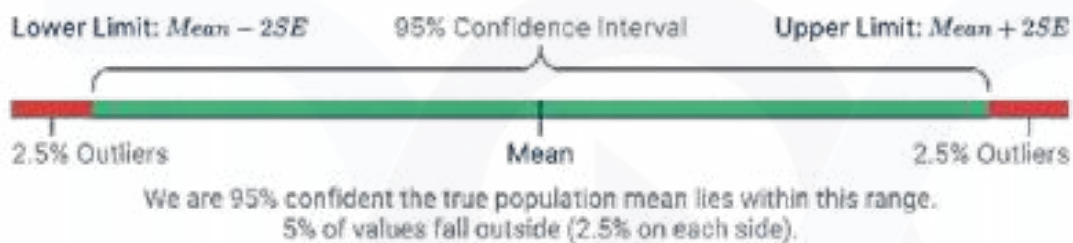
Predicting population values from a sample.

### Standard Error (SE)

Predicts how well the sample mean represents the population mean.

$$SE = \frac{SD}{\sqrt{n}}$$

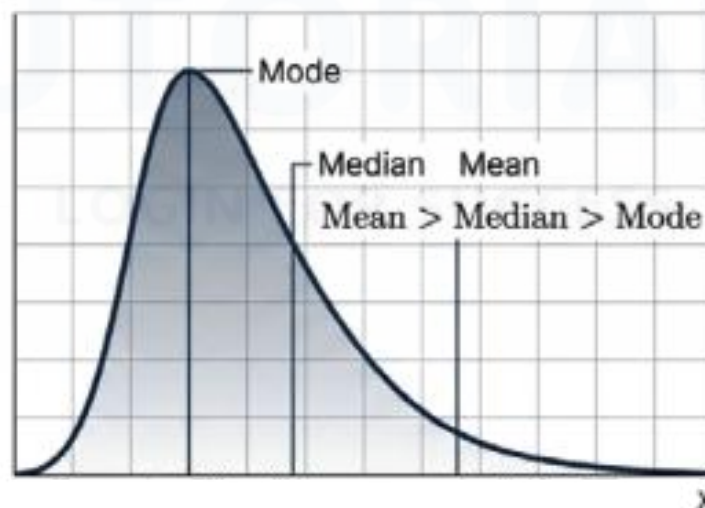
### 95% Confidence Interval (CI)



## Skewed Distributions: Analyzing Asymmetry

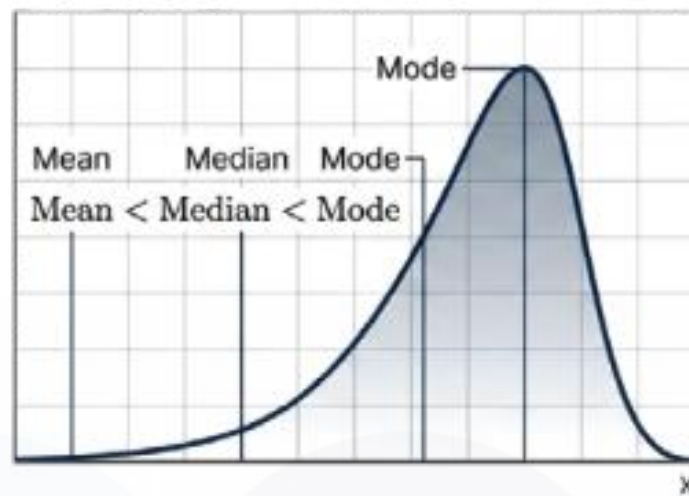
Identifying the Tail and the Mean-Median-Mode relationship.

**Graph A (Left): Right Sided (Positive) Skew**



Example: Hb values in malignancy (Majority low/anemic, tail extends to high).

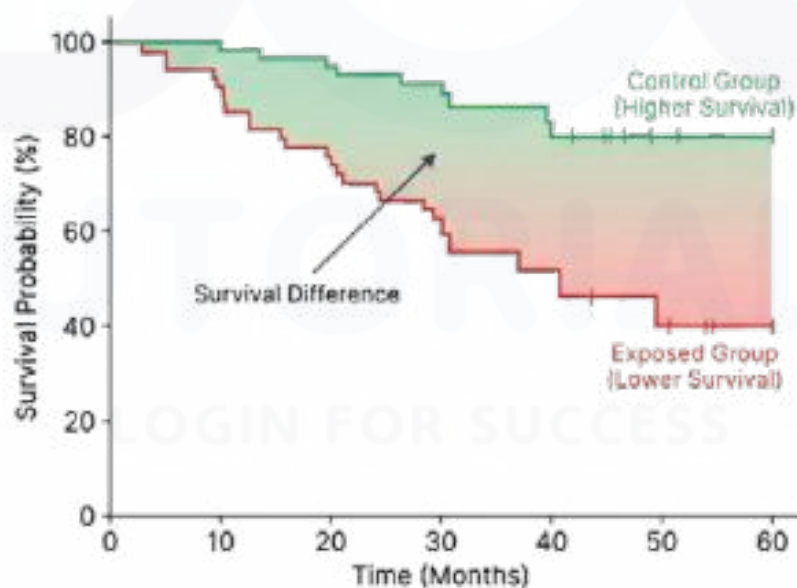
**Graph B (Right): Left Sided (Negative) Skew**



Example: Age of death (Majority old, tail extends to young).

## Survival Analysis: Kaplan-Meier & Hazard Ratio

Tracking outcomes over time in longitudinal studies.



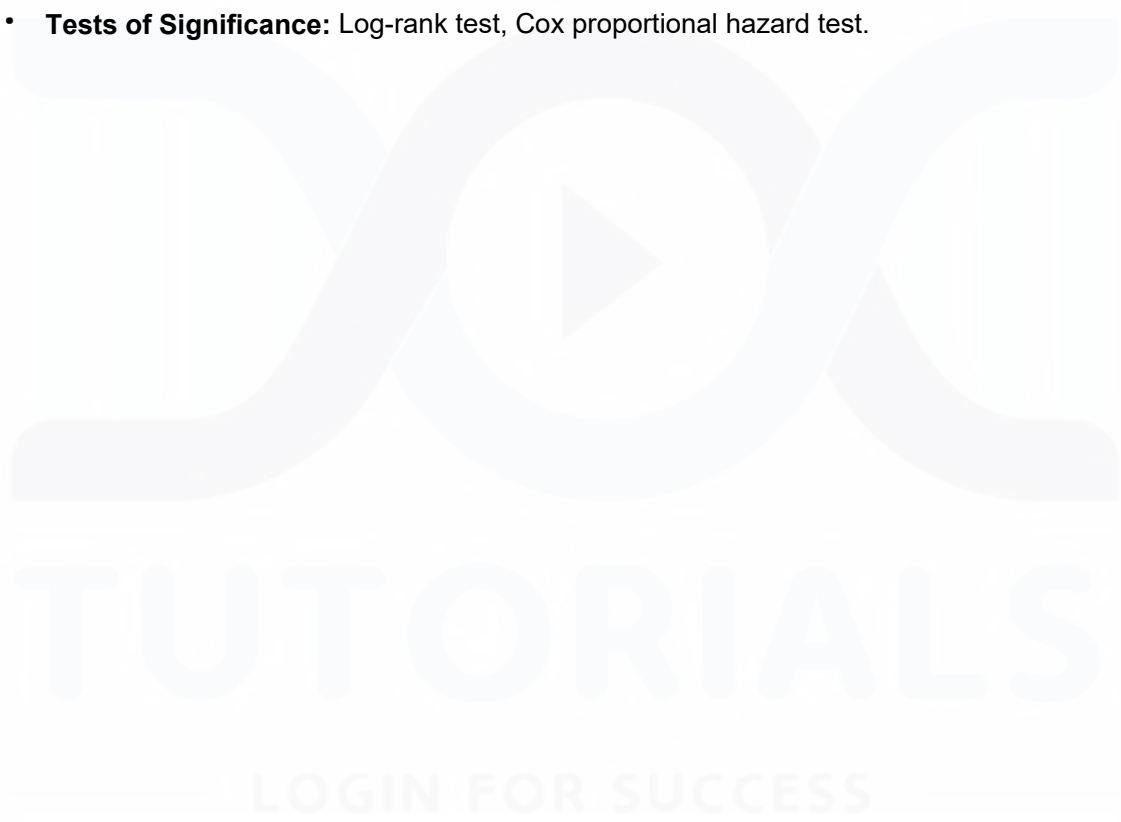
## Key Concepts

- **Kaplan-Meier (KM) Curve:** Plots probability of survival. Steps occur at every event (death).
- **Hazard Ratio (HR):**

$$HR = \frac{\text{Incidence in Exposed}}{\text{Incidence in Control}}$$

- **HR > 1:** Risk Factor (Higher risk in exposed group, e.g., HR=2 means 2x risk).
- HR < 1:** Protective (Lower risk in exposed group, e.g., HR=0.5 means half risk).

- **Tests of Significance:** Log-rank test, Cox proportional hazard test.



Pediatrics

**Theory**

Structured Theory Videos



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