- **Definition:**

It is probability of developing an outcome when exposed to a drug depending on variety of factors like age, sex physical condition.

Measurement of risk:

Attributable risk

It is difference in incidence rate of disease (or death) b/w exposed groups and non-exposed groups.

- It is also referred as risk difference
- Its is express in percent

$$AR = \frac{\text{incidence of disease rate among exposed} - \text{incidence of disease rate among non-exposed}}{\text{incidence rate among exposed}}$$

- **Application:**
- To describe clinical outcomes
- It simply quantifies how much higher one rate is than that of its comparator
- It guides policymakers in planning public health interventions

disease in exposed individuals that can be attributed to the exposure.

- To develop approaches for disease prevention

□ Advantages:

- Simple to calculate
- Simple to understand
- maintains the information about the amount of disease
- It may be used as a priority index for ranking the importance of factors associated with the risk of disease

□ Relative Risk (RR)

- It is ratio of incidence of disease (or death) among exposed and incidence among non-exposed
- Its is also referred as risk ratio

$$RR = \frac{\text{Incidence of disease (or death) among exposed}}{\text{Incidence of disease (or death) among non-exposed}}$$

□ Applications:

- To identify risk factors for disease
- To compare success rates

- It is used frequently in statistical analysis of binary outcomes where outcome of interest has relatively low probability.
- It is suited to clinical trial data where it is used to compare the risk of developing a disease in people not receiving the new medical treatment (or receiving a placebo) versus people who are receiving an established standard of care treatment.
- Alternatively, it is used to compare the risk of developing a side effect in people receiving a drug as compared to the people who are not receiving the treatment (or receiving a placebo).
- It is particularly attractive because it can be calculated by hand in the simple case.
- It requires large sample so that the comparison group can provide an accurate estimate of baseline risk in population of interest.

□ Advantages:

- The advantages of RR are that it is a one number

index of the strength of association between disease and the proposed determinant which may be easily compared between levels of exposure to the determinant.

- It is easily evaluated for statistical significance by means of chi square(X2) or construction of a confidence interval
- The drawback that it is unitless and obliterates any information about the amount of disease contained in the original incidence rates from which it is derived.

Example:

Cigarette smoking	Developed lung cancer	Did not developed lung cancer	total
yes	70	6930	7000
no	3	2997	3000

Incidence rates :

- among smokers 70 /7000/ = 10 per 1000
- among non smokers 3/3000 = 1 per 1000

So:

- Relative risk = 10/1=10
- Attributed risk=10-1/10=0.9 x 100 = 90 per cent

Odds ratio:

- Its measure of strength of association between risk factor and outcome
- Odds ratio is closely related to relative risk
- Derivation of odds ratio is based on 3 assumptions:

1. the disease being investigated must be relatively rare
2. the case must be representative of those with disease
3. the control must be representative of those without disease

Odds ratio is cross product of entries in following table:

	Disease	
	yes	no
Exposed	a	b
Non exposed	c	d

odds ratio = ad/bc

- Applications:

The odds ratio is commonly used in survey research in epidemiology, and to express the results of some clinical trials, such as in case-control studies.

It provides rough estimate of relative risk and it is interpreted similarly

Advantages:

1. The odds has a great advantage that it is invariable across case control, follow-up and cross-sectional studies and thus it can be used to directly compare findings of different study designs.

2. The odds ratio has an advantage that it can be computed directly from the regression coefficients of logistic regression.

3. The odds ratio is a good estimator of risk ratio if the disease is rare and the cases and controls are randomly selected from the population

Disadvantages:

1. The odds ratio has the disadvantage that it ignores the level i.e ratio 1:10 is the same as 10:100

2. OR is good for establishing causal relations but is not that useful to the public health practitioner who is interested in knowing how much decrease in

disease burden will be achieved by specific interventions. RD is a better measure than OR for such public health purposes.

Ex:

	Cases with lung cancer	Controls without lung cancer
Smokers (less than 5 cigarettes a day)	33 (a)	55 (b)
Non smokers	2 (c)	27 (d)
total	35 (a+c)	82 (b+d)

$$\text{odds ratio} = \frac{ad}{bc}$$

$$= \frac{33 \times 27}{55 \times 2} = 8.1$$

So the smokers of less than 5 cigarettes per day showed a risk of having 8.1 times that of non smokers.

Confidence interval:

- When risk estimators such as RR or OR are calculated, they are usually presented along with the confidence interval.
- Most commonly 95% CI is calculated which

means that we are 95% certain that the true value lies b/w this limits.

- Alternatively if we did 100 studies, 95 of the results would fall within those limits.
- For <u>risk ratio</u>, confidence interval may be calculated as follows:

$$CI = RR^{*} \exp(\pm Z^{*} SE)$$

- Where Z is standard normal deviate (1.96 for 95% CI) and SE is standard error.
- For risk ratio the SE is calculated as follows:

$$\sqrt{B/A^{*}(A+B) + D/C^{*}(C+D)}$$

The odds ratio has a parallel formula:

$$CI = OR^{*} \exp(\pm Z^{*} SE)$$

where

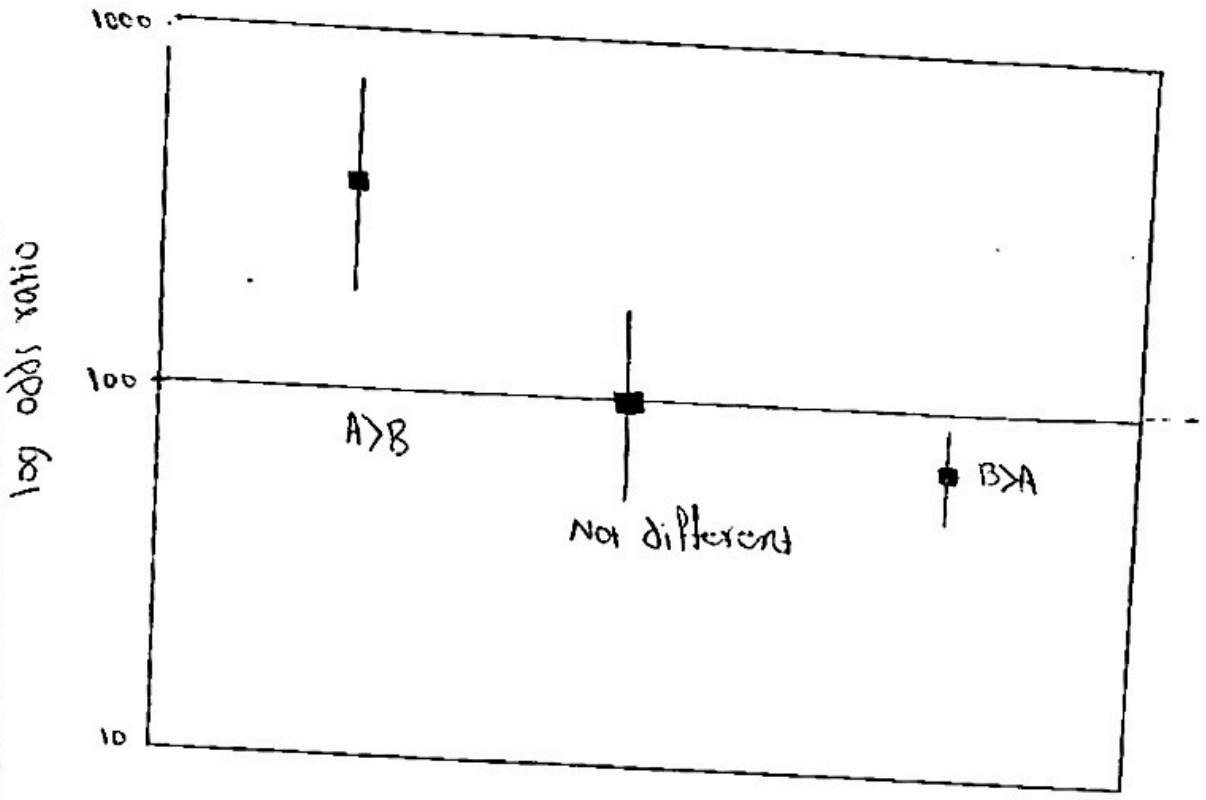
$$\sqrt{SE} = [1/A + 1/B + 1/C + 1/D]$$

□ <u>Depicting And Interpreting Confidence Interval Graphically</u>

- The ideal presentation of risk estimators and

their 95% CI is on Semilog scale.

- Since the OR and RR distributed exponentially so its best to use their natural log or to plot them on semi log scale which produces symmetrical CIs.



- The above figured picts 3 possible scenarios
  - First: drug A is associated with significantly greater outcome than drug B

If outcome is positive drug A cures more patients than drug B.

. If negative drug A is associated with more ADRs than drug B

• Second: Confidence interval overlaps with line of unity therefore there is no difference between them.

• Third drug A produces statistically less outcome than drug B

. If outcome is POSITIVE drug A is not as beneficial as drug B

. If outcome is ADVERSE, drug A is protective against that outcome.