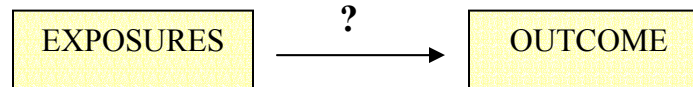
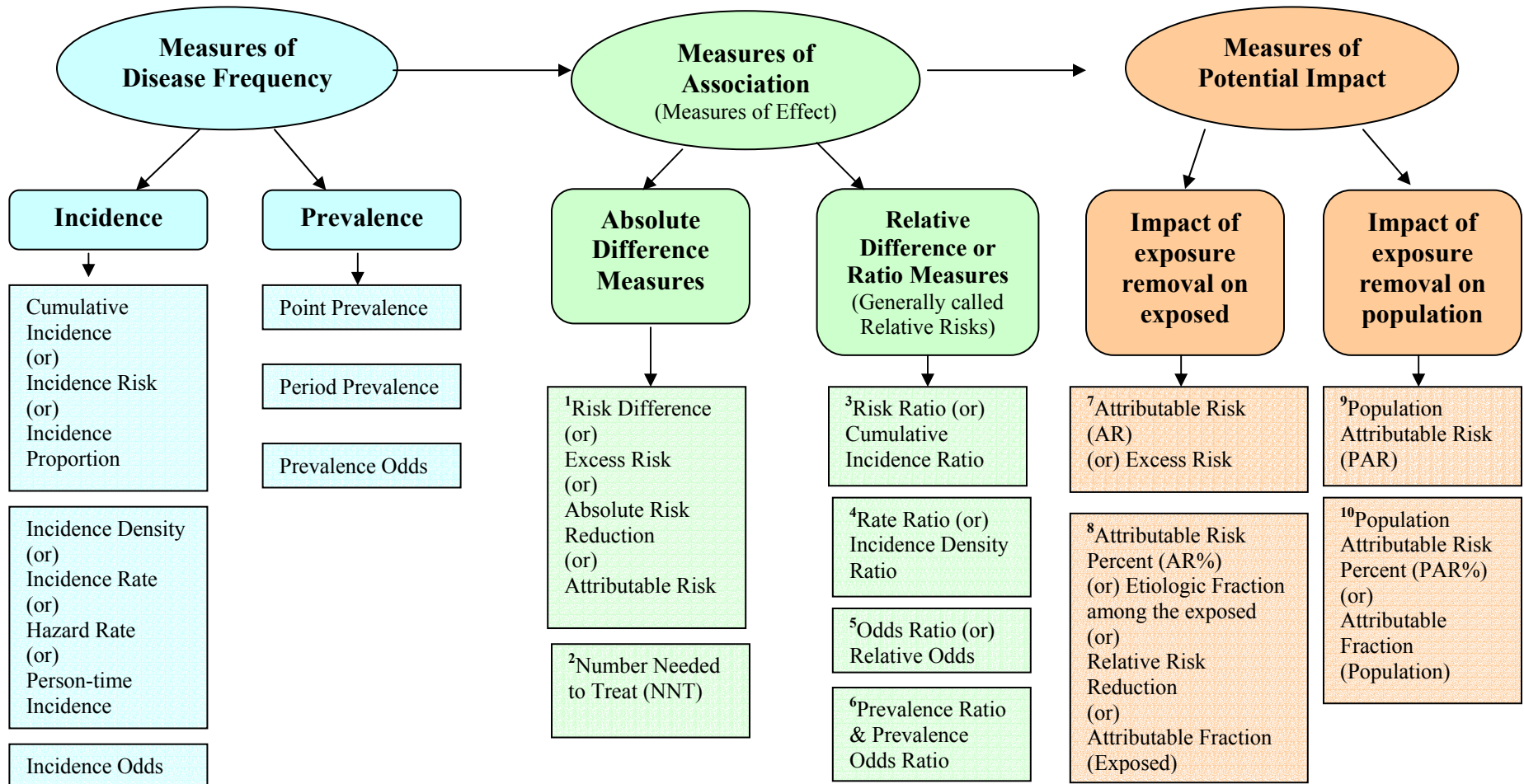


AN OVERVIEW OF MEASUREMENTS IN EPIDEMIOLOGY



Epidemiology is about identifying associations between exposures and outcomes. To identify any association, exposures and outcomes must first be measured in a quantitative manner. Then rates of occurrence of events are computed. These measures are called “*measures of disease frequency*.” Once measured, the association between exposures and outcomes are then evaluated by calculating “*measures of association or effect*.” Finally, the impact of removal of an exposure on the outcome is evaluated by computing “*measures of potential impact*.” In general, measures of disease frequency are needed to generate measures of association, and both these are needed to get measures of impact. There is some overlap between these measures, and terminology is poorly standardized.



The superscript numbers refer to the formulae used to compute those measures (formulae shown separately in the following pages)
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AN OVERVIEW OF MEASUREMENTS IN EPIDEMIOLOGY

FORMULAE USED TO COMPUTE THE MEASUREMENTS

The following formulae are based on this typical epi 2 x 2 table with standard notation:

		Outcome (Disease)		
		Yes	No	
Exposure	Yes	a	b	a + b
	No	c	d	c + d
		a + c	b + d	

Other notation used:

- I_o = Incidence of outcome among the unexposed (baseline risk)
- I_e = Incidence of outcome among the exposed
- I_t = Incidence of outcome in the total population (exposed and unexposed)
- P_{exp} = Prevalence of exposure in the population
- P_o = Prevalence of outcome among the unexposed
- P_e = Prevalence of outcome among the exposed
- RR = Relative Risk (could refer to a Risk Ratio or a Rate Ratio)
- PR = Prevalence Ratio
- OR = Odds Ratio
- AR = Attributable Risk
- PAR = Population Attributable Risk
- ARR = Absolute Risk Reduction
- RRR = Relative Risk Reduction
- NNT = Number Needed to Treat
- CIR = Cumulative Incidence Ratio
- IDR = Incidence Density Ratio
- PF = Prevented Fraction

$$^1\text{Risk Difference (ARR, AR)} = \frac{a}{a+b} - \frac{c}{c+d} = I_e - I_o$$

$$^2\text{Number Needed to Treat (NNT)} = 1 / \text{ARR}$$

$$^3\text{Risk Ratio (RR, CIR)} = \frac{\frac{a}{a+b}}{\frac{c}{c+d}} = I_e / I_o$$

$$^4\text{Rate Ratio (RR, IDR)} = \text{see end of this handout}$$

$$^5\text{Odds Ratio (OR)} = \frac{a/c}{b/d} = \frac{ad}{bc}$$

⁶Prevalence Ratio (PR)	=	P_e / P_o
⁷Attributable Risk (AR)	=	Same formula as Risk Difference
⁸Attributable Risk Percent (AR%)*	=	$\frac{I_e - I_o}{I_e} * 100 = \frac{AR}{I_e} * 100$
	=	$\frac{a/(a+b) - c/(c+d)}{a/(a+b)}$
Alternative formula for AR%	=	$\frac{(RR - 1) * 100}{RR}$
AR% in a case-control study	=	$\frac{(OR - 1) * 100}{OR}$
⁹Population Attributable Risk (PAR)	=	$I_t - I_o$
Alternative formula for PAR	=	$AR * P_{exp}$
¹⁰Population Attributable Risk Percent (PAR%)	=	$\frac{I_t - I_o}{I_t} * 100$
Alternative formula for PAR%	=	$\frac{P_{exp}(RR-1)}{P_{exp}(RR-1) + 1} * 100$
⁴Rate Ratio (RR, IDR)	=	$\frac{a/N1}{b/N2}$

This formula for Rate Ratio is based on the following 2 x 2 table format:

	Cases (Outcome)	Person-time
Exposed	a	N1
Unexposed	b	N2

* Note: In some situations (like in a clinical trial or a vaccine field study), the exposure is protective. In such situations, some of the above formulae will have to be computed and interpreted differently. Also, the names will change. For example, when the exposure is protective, the AR% is meaningless because the I_e is less than I_o , because exposure leads to a lower incidence. In this situation, the formula changes to:

$$RRR (PF) = \frac{I_o - I_e}{I_o} * 100$$

The name changes from AR% (also called *etiologic fraction*), to Relative Risk Reduction [RRR] (also called *prevented fraction*). Similarly, when the exposure is protective, AR (also called Excess Risk) becomes Absolute Risk Reduction (ARR) and the formula becomes: $ARR = I_o - I_e$