



# EBM Calculator

## Formulas for Effect Estimates

	Outcome	No Outcome	Total
(+)	$a$	$b$	$a + b$
(-)	$c$	$d$	$c + d$
Total	$a + c$	$b + d$	$a + b + c + d$

$z = 1.959964$  for 95% CI

### Experimental Event Rate

$$\text{EER} = \frac{a}{a + b}$$

### Control Event Rate

$$\text{CER} = \frac{c}{c + d}$$

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## Absolute Risk Reduction

$$ARR = CER - EER$$

### Confidence Interval (Wilson score bounds with error propagation)

$$\text{Lower Bound: } ARR - z \cdot \sqrt{\frac{u_2(1-u_2)}{r_1} + \frac{w_1(1-w_1)}{r_2}}$$

$$\text{Upper Bound: } ARR + z \cdot \sqrt{\frac{u_1(1-u_1)}{r_2} + \frac{w_2(1-w_2)}{r_1}}$$

where...

$$r_1 = a + b, \quad r_2 = c + d$$

$$u_1 = \frac{2c + z^2 + z \sqrt{\frac{4(c \cdot d)}{r_2} + z^2}}{2r_2 + 2z^2}$$

$$u_2 = \frac{2a + z^2 + z \sqrt{\frac{4(a \cdot b)}{r_1} + z^2}}{2r_1 + 2z^2}$$

$$w_1 = \frac{2c + z^2 - z \sqrt{\frac{4(c \cdot d)}{r_2} + z^2}}{2r_2 + 2z^2}$$

$$w_2 = \frac{2a + z^2 - z \sqrt{\frac{4(a \cdot b)}{r_1} + z^2}}{2r_1 + 2z^2}$$

## Risk Ratio

$$RR = \frac{EER}{CER}$$

### Confidence Interval (Log-normal, Zhou)

$$\text{Lower Bound: } \exp \left( \ln(RR) - z \cdot \sqrt{\left( \frac{1}{a} - \frac{1}{a+b} \right) + \left( \frac{1}{c} - \frac{1}{c+d} \right)} \right)$$

$$\text{Upper Bound: } \exp \left( \ln(RR) + z \cdot \sqrt{\left( \frac{1}{a} - \frac{1}{a+b} \right) + \left( \frac{1}{c} - \frac{1}{c+d} \right)} \right)$$

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## Relative Risk Reduction

$$RRR = 1 - RR$$

### Confidence Interval (Derived from Log-normal RR)

$$\text{Lower Bound: } 1 - \exp \left( \ln(RR) + z \cdot \sqrt{\left( \frac{1}{a} - \frac{1}{a+b} \right) + \left( \frac{1}{c} - \frac{1}{c+d} \right)} \right)$$

$$\text{Upper Bound: } 1 - \exp \left( \ln(RR) - z \cdot \sqrt{\left( \frac{1}{a} - \frac{1}{a+b} \right) + \left( \frac{1}{c} - \frac{1}{c+d} \right)} \right)$$

## Odds Ratio

$$OR = \frac{ad}{cb}$$

### Confidence Interval (Log-normal)

$$\text{Lower Bound: } \exp \left( \ln(OR) - z \cdot \sqrt{\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d}} \right)$$

$$\text{Upper Bound: } \exp \left( \ln(OR) + z \cdot \sqrt{\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d}} \right)$$

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## Formulas for Diagnostic Tests

	Disease	No Disease	Total
(+)	$a$	$b$	$a + b$
(-)	$c$	$d$	$c + d$
Total	$a + c$	$b + d$	$a + b + c + d$

$z = 1.959964$  for 95% CI

### Sensitivity

$$\text{Sensitivity} = \frac{a}{a + c}$$

### Confidence Interval (Wilson Score)

$$\text{Lower Bound: } \frac{(2 \cdot a) + z^2 - z \cdot \sqrt{\left(\frac{4ac}{a+c}\right) + z^2}}{2 \cdot (a + c) + 2z^2}$$

$$\text{Upper Bound: } \frac{(2 \cdot a) + z^2 + z \cdot \sqrt{\left(\frac{4ac}{a+c}\right) + z^2}}{2 \cdot (a + c) + 2z^2}$$

### Specificity

$$\text{Specificity} = \frac{d}{b + d}$$

### Confidence Interval (Wilson Score)

$$\text{Lower Bound: } \frac{(2 \cdot d) + z^2 - z \cdot \sqrt{\left(\frac{4db}{b+d}\right) + z^2}}{2 \cdot (b + d) + 2z^2}$$

$$\text{Upper Bound: } \frac{(2 \cdot d) + z^2 + z \cdot \sqrt{\left(\frac{4db}{b+d}\right) + z^2}}{2 \cdot (b + d) + 2z^2}$$

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## Positive Likelihood Ratio

$$LR(+) = \frac{\text{Sensitivity}}{1 - \text{Specificity}} = \frac{a/(a+c)}{b/(b+d)}$$

### Confidence Interval (Log-normal, Zhou)

$$\text{Lower Bound: } \exp \left( \ln \left( \frac{(b+d) \cdot a}{(a+c) \cdot b} \right) - z \cdot \sqrt{\left( \frac{c}{a \cdot (a+c)} \right) + \left( \frac{d}{b \cdot (b+d)} \right)} \right)$$

$$\text{Upper Bound: } \exp \left( \ln \left( \frac{(b+d) \cdot a}{(a+c) \cdot b} \right) + z \cdot \sqrt{\left( \frac{c}{a \cdot (a+c)} \right) + \left( \frac{d}{b \cdot (b+d)} \right)} \right)$$

## Negative Likelihood Ratio

$$LR(-) = \frac{1 - \text{Sensitivity}}{\text{Specificity}} = \frac{c/(a+c)}{d/(b+d)}$$

### Confidence Interval (Log-normal, Zhou)

$$\text{Lower Bound: } \exp \left( \ln \left( \frac{(b+d) \cdot c}{(a+c) \cdot d} \right) - z \cdot \sqrt{\left( \frac{a}{c \cdot (a+c)} \right) + \left( \frac{b}{d \cdot (b+d)} \right)} \right)$$

$$\text{Upper Bound: } \exp \left( \ln \left( \frac{(b+d) \cdot c}{(a+c) \cdot d} \right) + z \cdot \sqrt{\left( \frac{a}{c \cdot (a+c)} \right) + \left( \frac{b}{d \cdot (b+d)} \right)} \right)$$

## Positive Predictive Value

$$PPV = \frac{a}{a+b}$$

### Confidence Interval (Wilson Score)

$$\text{Lower Bound: } \frac{(2 \cdot a) + z^2 - z \cdot \sqrt{\left( \frac{4ab}{a+b} \right) + z^2}}{2 \cdot (a+b) + 2z^2}$$

$$\text{Upper Bound: } \frac{(2 \cdot a) + z^2 + z \cdot \sqrt{\left( \frac{4ab}{a+b} \right) + z^2}}{2 \cdot (a+b) + 2z^2}$$

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## Negative Predictive Value

$$\text{NPV} = \frac{d}{c + d}$$

## Confidence Interval (Wilson Score)

$$\text{Lower Bound: } \frac{(2 \cdot d) + z^2 - z \cdot \sqrt{\left(\frac{4dc}{c+d}\right) + z^2}}{2 \cdot (c + d) + 2z^2}$$

$$\text{Upper Bound: } \frac{(2 \cdot d) + z^2 + z \cdot \sqrt{\left(\frac{4dc}{c+d}\right) + z^2}}{2 \cdot (c + d) + 2z^2}$$

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# Formulas for Post-Test Probability

## Post-Test Probability

$$\text{PostProb} = \frac{\text{PostOdds}}{\text{PostOdds} + 1}$$

## Post-Test Odds

$$\text{PostOdds} = \text{PreOdds} \times \text{LR}$$

## Pre-Test Odds

$$\text{PreOdds} = \frac{\text{PreProb}}{1 - \text{PreProb}}$$

## Conversions

$$\text{Odds} = \frac{\text{Probability}}{1 - \text{Probability}}$$

$$\text{Probability} = \frac{\text{Odds}}{\text{Odds} + 1}$$

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