

Prevalence and Negative Predictive Value [diagnostic versus screening edition]

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TL;DR

The Negative Predictive Value (NPV; how much can I trust a – result) of a test varies^(*) depending on the Prevalence of the condition in the population tested. Low prevalence is key!

(*) From 100% when the prevalence is 1 in 1000[[see here](#)] to 0% when the prevalence is 1 in 1 [[see here](#)]



Diagnostic Test

(diffusion-weighted imaging)

True negatives **97%** (specificity)

False negatives: **10%** (1 - sensitivity)



Massive screening

Stroke

Screening context

[e.g. everyone 45-54 y.o.]

1 out of 1000



Diagnostic context

[clear symptoms → ER!]

868 out of 1000



Massive screening

Stroke

Screening

1 out of 1000



Screening context

True
negatives
97%

False
negatives
10%

Prevalence
1 out of 1000

$p(\text{Healthy} | -)$?

How much can I trust a – result?


<25%

25-49%


50%

51-75%

>75%

 Healthy person

1 out of 1000

Sick person 



Screening context

True
negatives
97%

False
negatives
10%

Prevalence
1 out of 1000

$p(\text{Healthy} | -)$?

How much can I trust a – result?

<25%

25-49%

50%

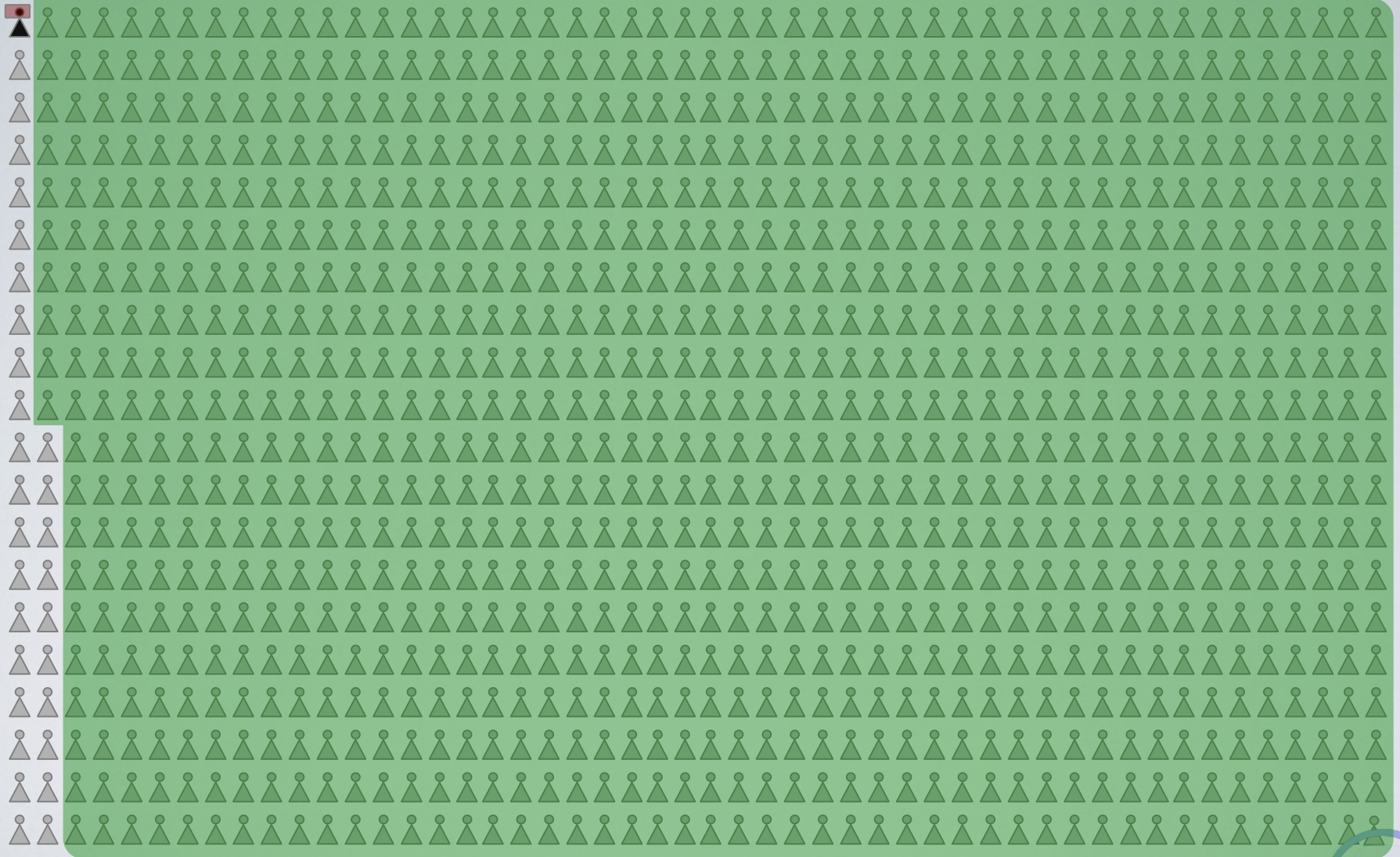
51-75%

>75% (100%)

True negatives **97%**

1 out of 1000

False negatives **10%**



NPV = 100%

True negatives **97%**

1 out of 1000

False negatives **10%**

$$\frac{\text{TRUE -}}{\text{TRUE -} + \text{FALSE -}} = \frac{\text{[Green Box]}}{\text{[Green Box] + [Red Box]}}$$



True negatives **97%**

1 out of 1000

False negatives **10%**

$$p(\text{Healthy} | -) = \frac{p(\text{Healthy}) \cdot p(- | \text{Healthy})}{p(\text{Healthy}) \cdot p(- | \text{Healthy}) + p(\text{Sick}) \cdot p(- | \text{Sick})}$$

NPV = 100%



True negatives **97%**

1 out of 1000

False negatives **10%**

$$p(\text{Healthy} | -) = \frac{p(\text{Healthy}) \cdot p(- | \text{Healthy})}{p(\text{Healthy}) \cdot p(- | \text{Healthy}) + p(\text{Sick}) \cdot p(- | \text{Sick})}$$

NPV = 100%



ER diagnostic test
Stroke

Diagnostic [ER]

868 out of 1000



Diagnostic context

True
negatives
97%

False
negatives
10%

Prevalence
868 out of 1000

$p(\text{Disease}|\text{+})?$

How much can I trust a + result?

<25%

25-49%

50%

51-75%

>75%

Diagnostic context

True
negatives
97%

False
negatives
10%

Prevalence
868 out of 1000

$p(\text{Disease}|\text{+})?$

How much can I trust a + result?

<25%

25-49%

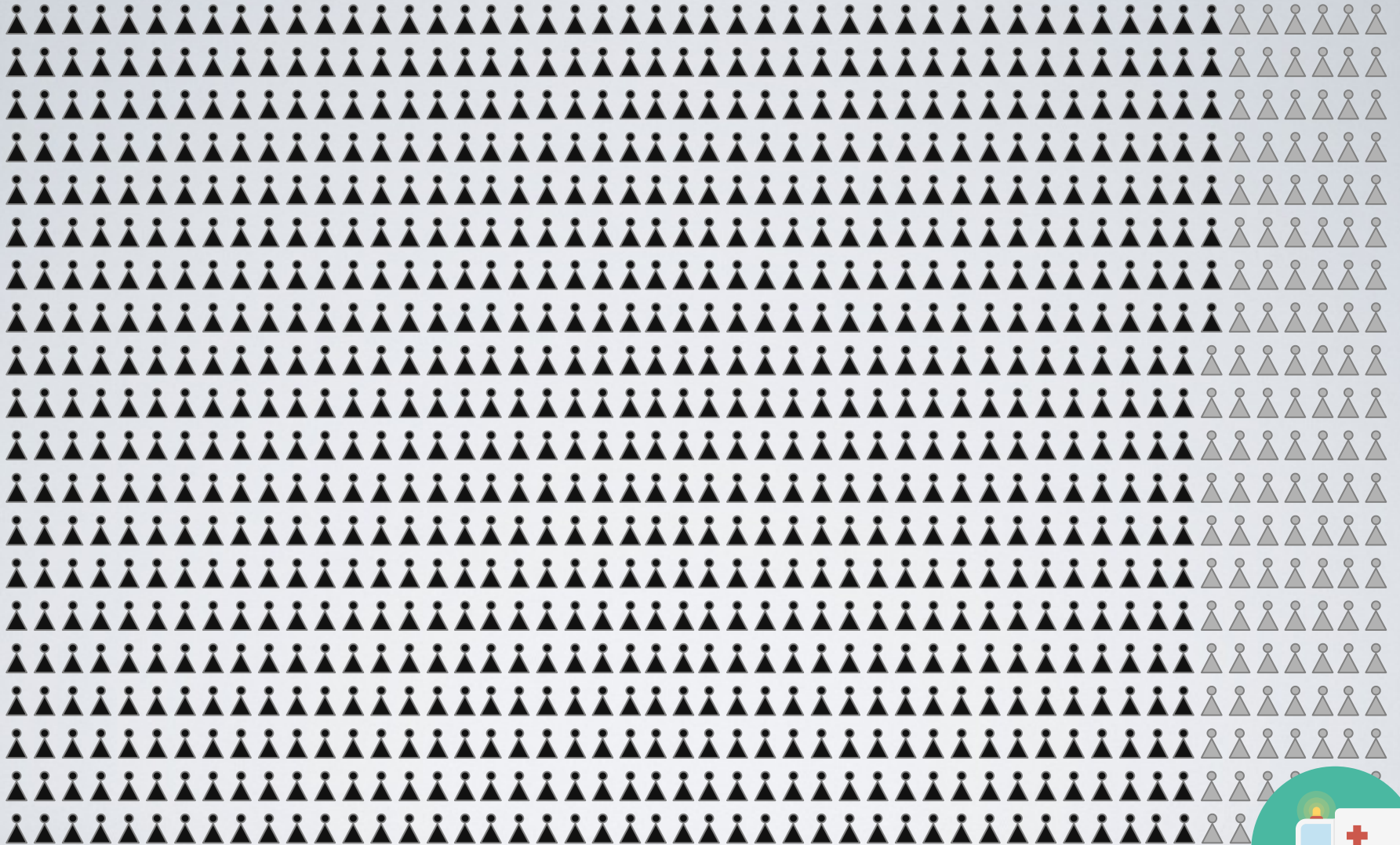
50%

51-75%

>75%

(60%)

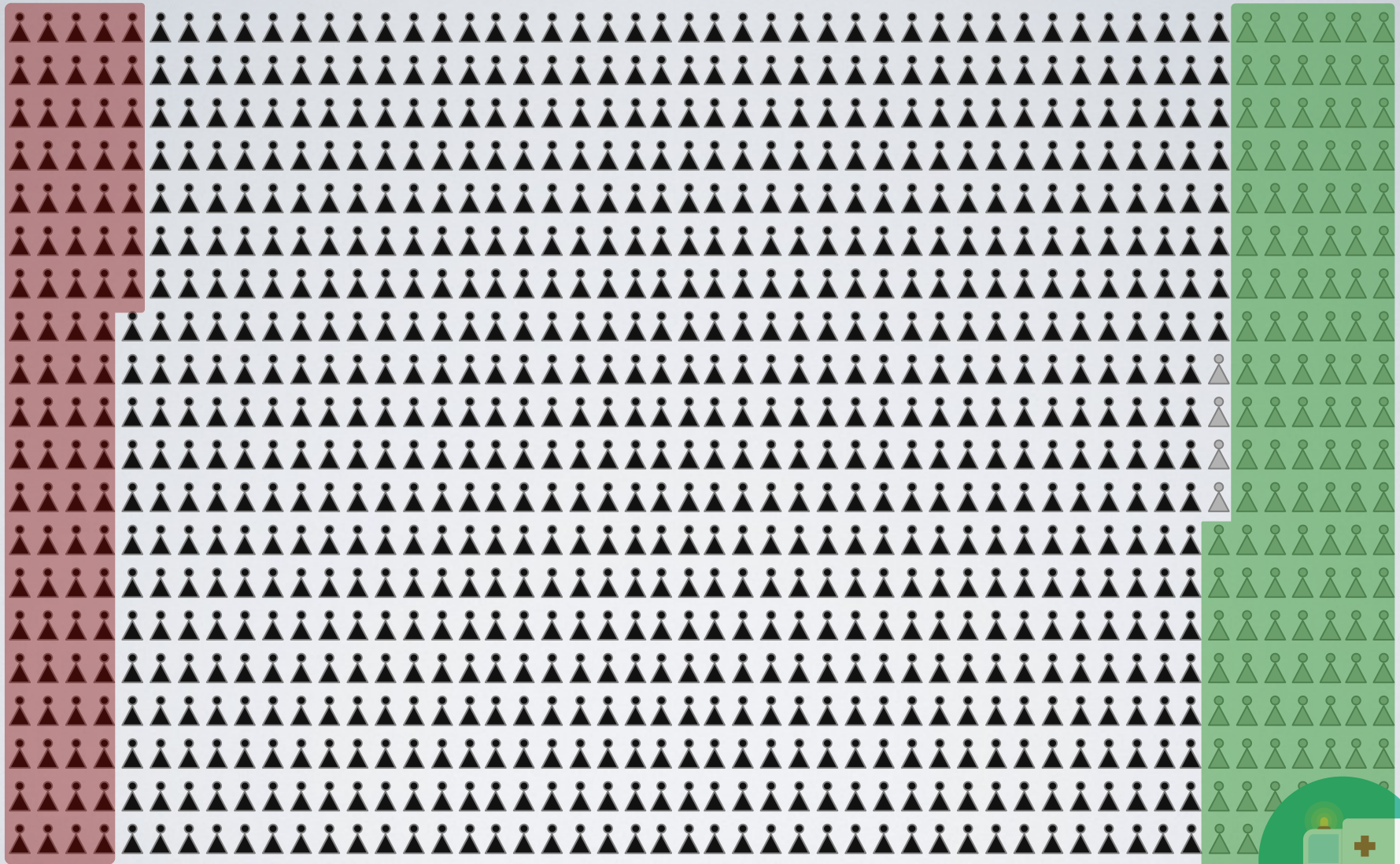
868 out of 1000



True negatives **97%**

868 out of 1000

False negatives **10%**



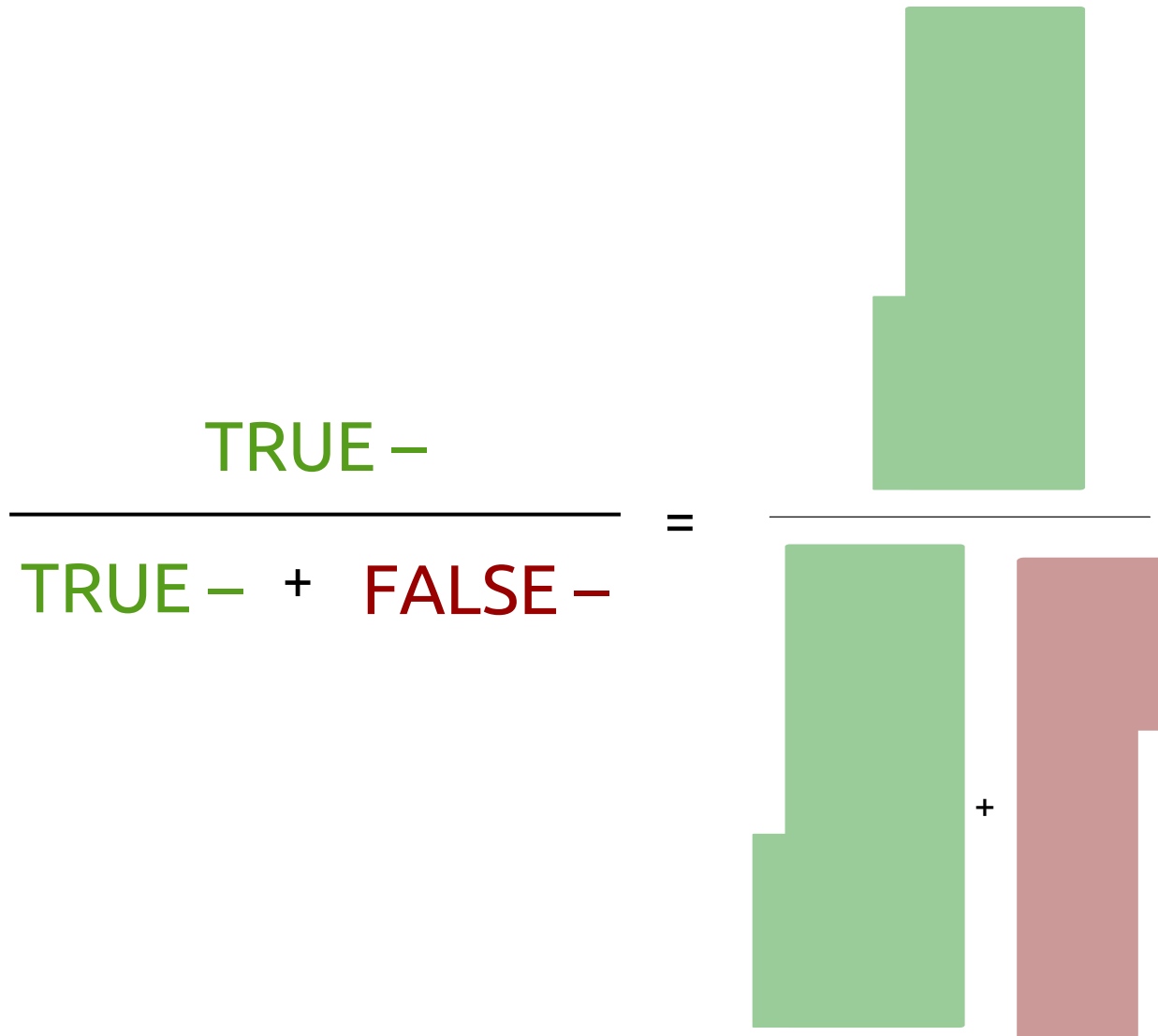
NPV = 60%



True negatives **97%**

868 out of 1000

False negatives **10%**



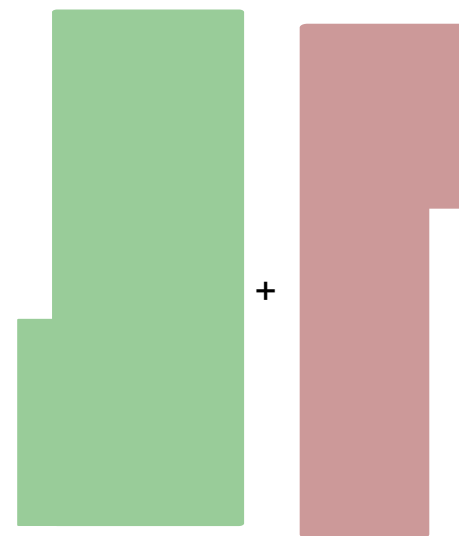
Screening Context

1 out of 1000



Diagnostic Context

868 out of 1000



In screening contexts, NPV are great!

In diagnostic tests, be careful with the NPV!



Prevalence and Negative Predictive Value

[diagnostic versus screening edition]

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Presentation in:

<https://github.com/gorkang/presentations>

PPV or NPV depending on Sensitivity, Specificity and Prevalence:

<https://gorkang.shinyapps.io/BayesianReasoning/>

Diagnostic context Stroke example from: Brunser, A. M., Hoppe, A., Illanes, S., Díaz, V., Muñoz, P., Cárcamo, D., Olavarria, V., Valenzuela, M., & Lavados, P. (2013). Accuracy of Diffusion-Weighted Imaging in the Diagnosis of Stroke in Patients With Suspected Cerebral Infarct. *Stroke*, 44(4), 1169–1171.
<https://doi.org/10.1161/STROKEAHA.111.000527>

Prevalence of stroke in general population: Kissela, B. M., Khoury, J. C., Alwell, K., Moomaw, C. J., Woo, D., Adeoye, O., Flaherty, M. L., Khatri, P., Ferioli, S., De Los Rios La Rosa, F., Broderick, J. P., & Kleindorfer, D. O. (2012). Age at stroke: Temporal trends in stroke incidence in a large, biracial population. *Neurology*, 79(17), 1781–1787. <https://doi.org/10.1212/WNL.0b013e318270401d>



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