Choosing and Using Diagnostic Tests

Wait, Don't I Know This Stuff Already?!

- Why Do We Run Tests?
  - To inform decision making (ours and the client's)
    - Diagnosis
    - Treat or Don't Treat
    - Select Therapy
    - Euthanize?
  - Ultimate Goals
    - Improve Patient's Life
    - Meet Client's Goals

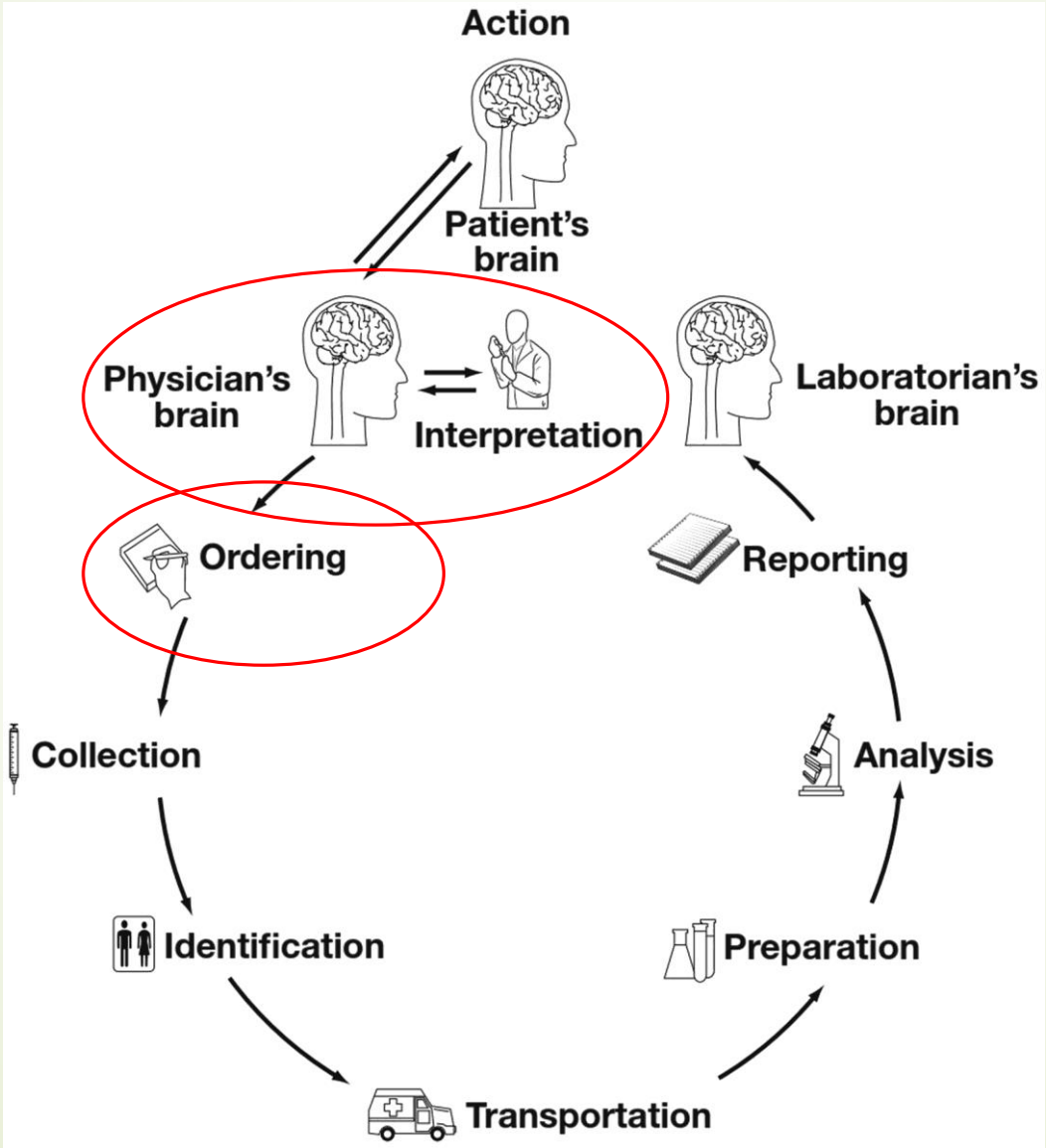
Cardinal Rule #1

If the result isn't going to change what you do, don't run the test!

How Do You Know if Results Will Change Action?

- Client Variables
- Patient/Disease Variables
- TestingVariables
- Doctor Variables

Testing-related Error



Testing-related Error

Box 1: Five causes taxonomy of testing-related diagnostic error

- An inappropriate test is ordered
- An appropriate test is not ordered
- An appropriate test result is misapplied
- An appropriate test is ordered, but a delay occurs somewhere in the total testing process
- The result of an appropriately ordered test is inaccurate

Testing-related Errors We Own

- Test selection
- Test Interpretation
- Cognitive bias/error

The Bayesian Approach

Meeting the Reverend Thomas Bayes

$$P(A \mid B) = \frac{P(B \mid A)P(A)}{P(B)}$$

- An Introduction to the Doctrine of Fluxions, and a Defence of the Mathematicians Against the Objections of the Author of the Analyst (published anonymously in 1736)

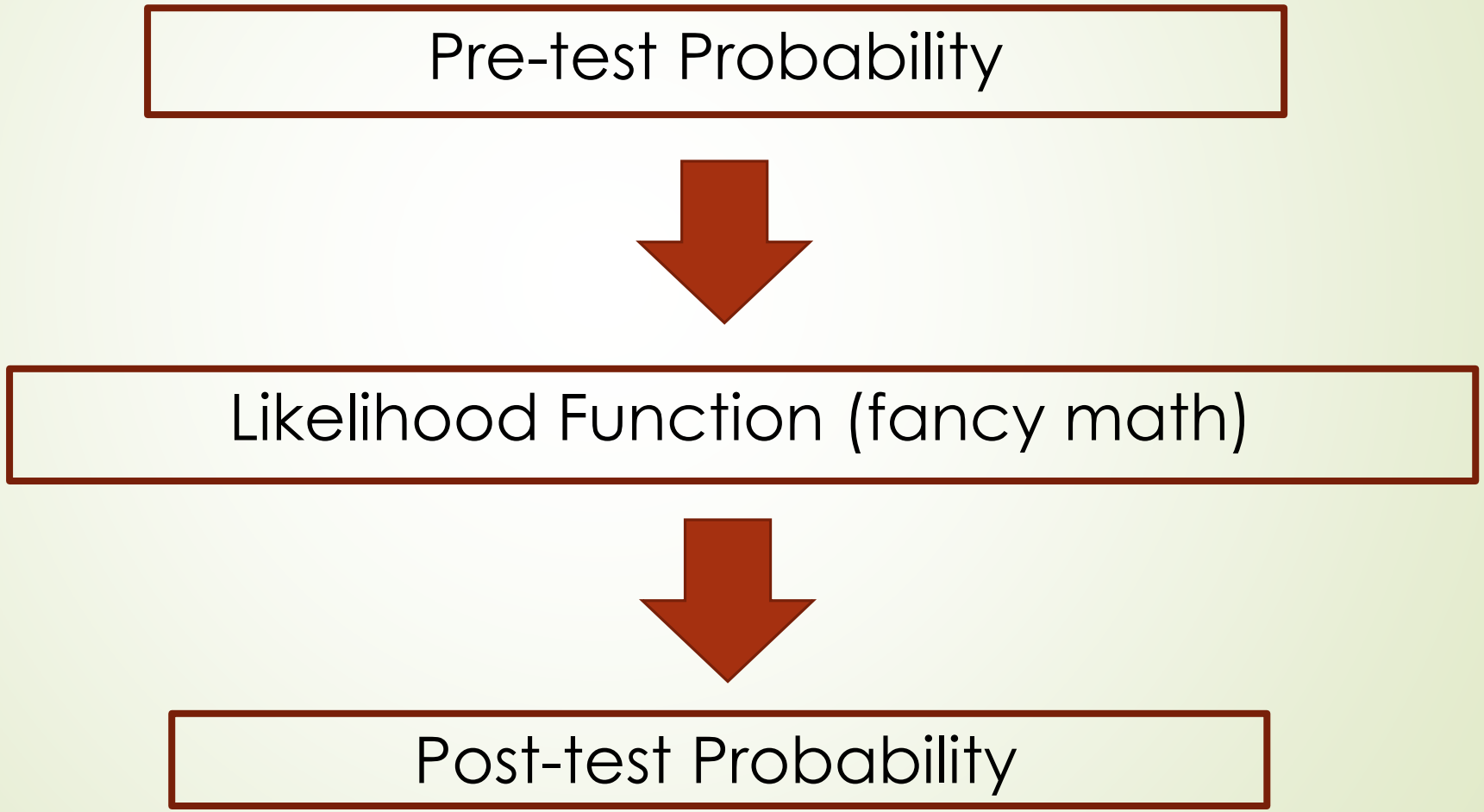
The Bayesian Approach- For Dummies

How Likely is the Dx Before the Test?

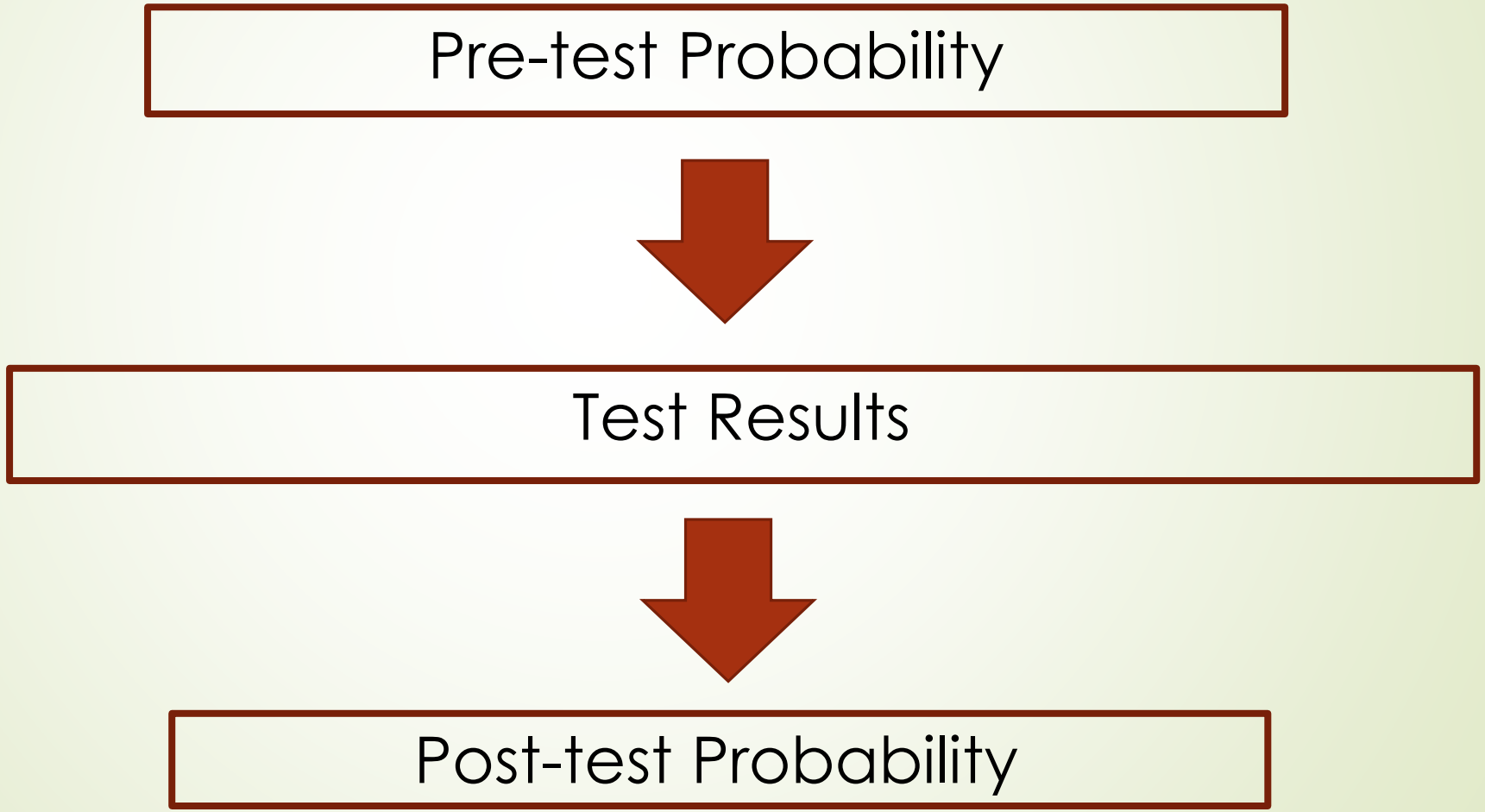
Does the Test Make the Dx More or Less Likely?

How Likely is the Dx After the Test?

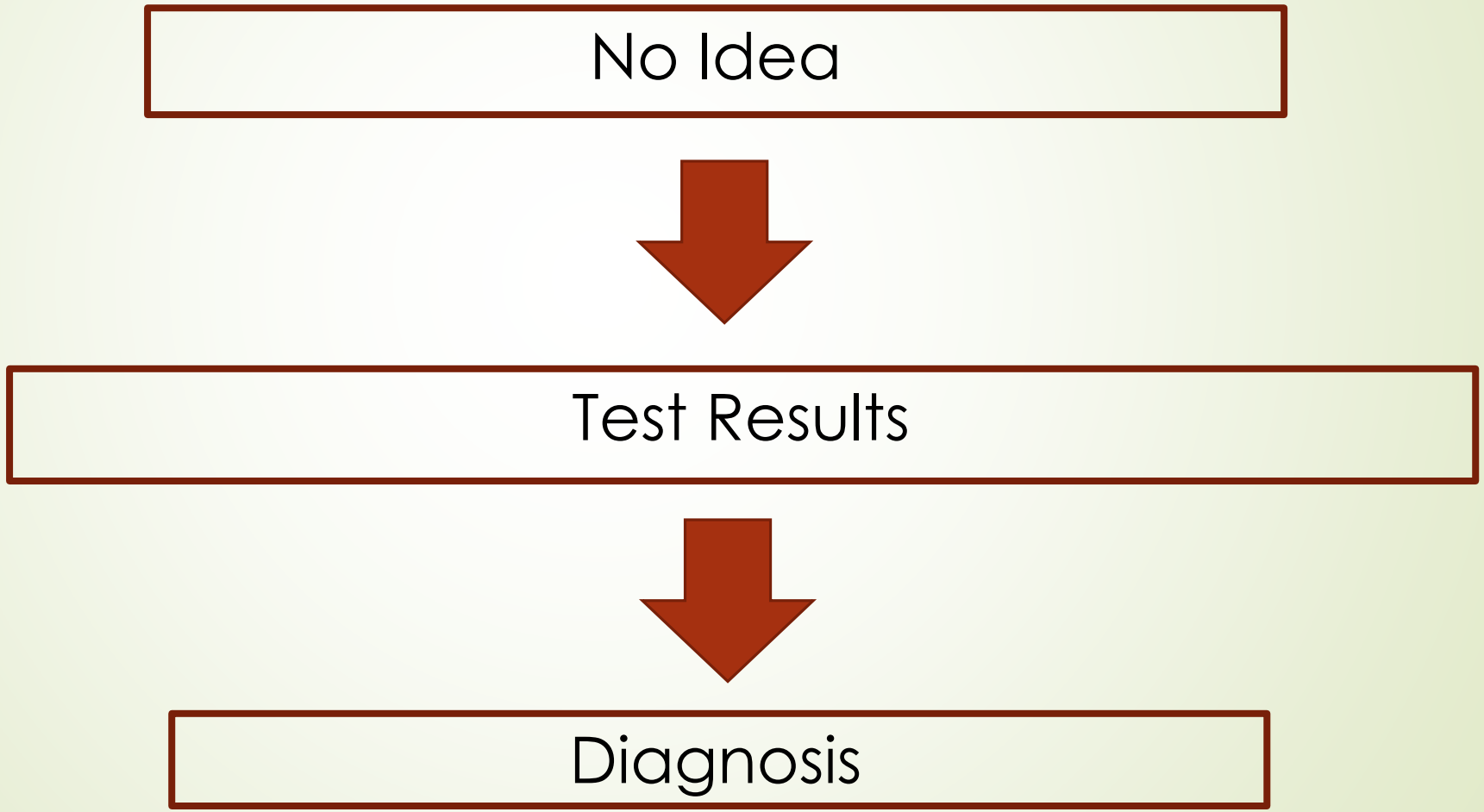
The Bayesian Approach- For Dummies



The Bayesian Approach- For Dummies



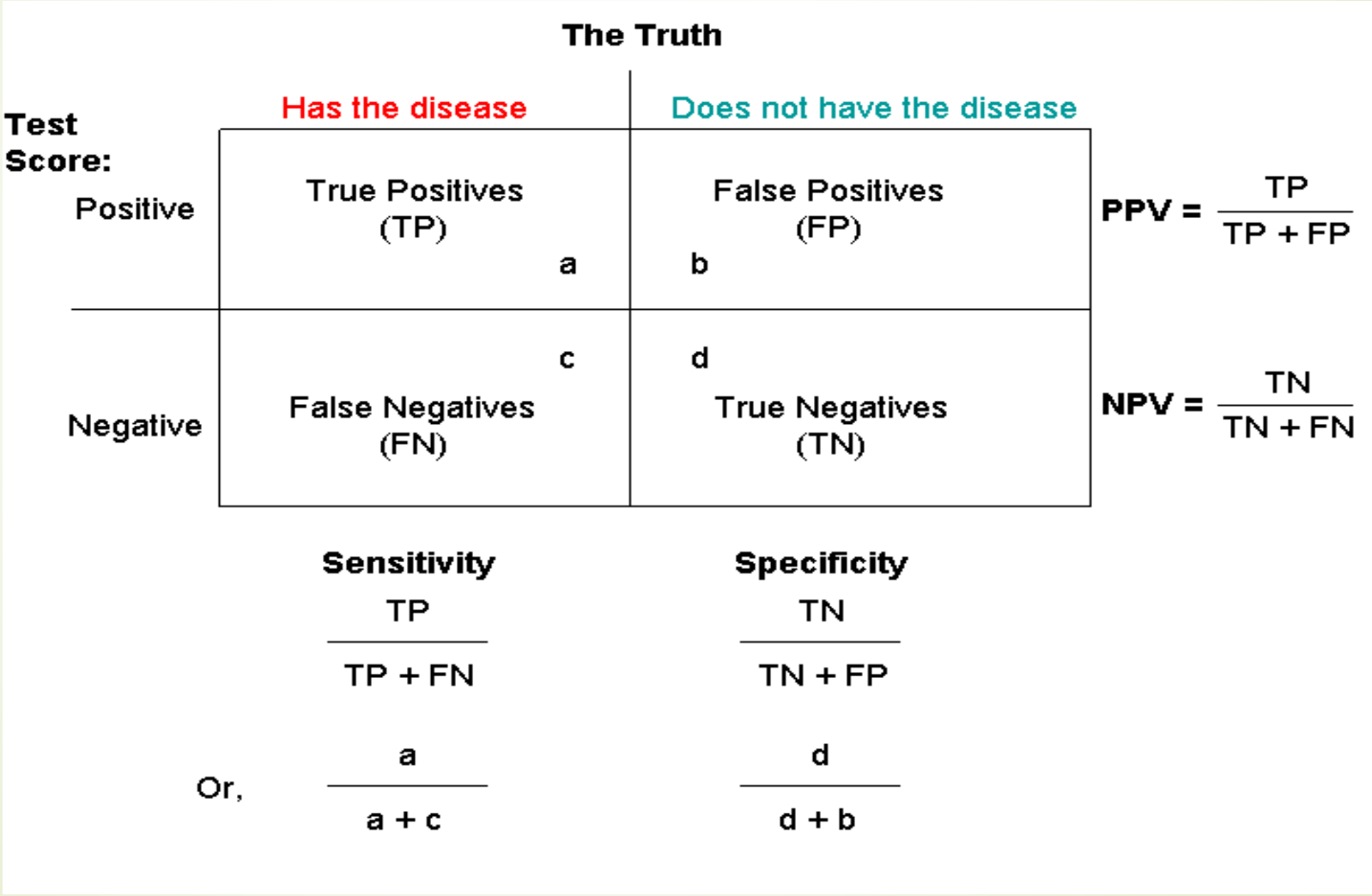
The Bayesian Approach- **NOT!**



Important Variables

- Sensitivity & Specificity
- Positive & Negative Predictive Value

Test Variables



Test Variables- For Dummies

- Sensitivity

The proportion of True Positives identified by the test

The percentage of patients with the disease who correctly test positive

Higher = Less Likely to Miss a Real Case

- Specificity

The proportion of True Negatives identified by the test

The percentage of patients without the disease who correctly test negative

Higher = Less Likely to Wrongly Diagnose a Healthy Patient

Test Variables- For Dummies

- Positive Predictive Value

The probability patients with a positive test actually have the disease

Changes with prevalence!!!!

- Negative Predictive Value

The probability patients with a negative test really don't have the disease

Changes with prevalence!!!!

Test Variables- For Dummies

100 patients tested, 2 have Dz (e.g. FIV)

- Sensitivity- TP/TP+FN

Sens = 2/(2+0)= 100% (no false negatives)

- Specificity- TN/TN+FP

Spec = 96/(96+2)= 97.96% (about 2% false positives)

- Negative Predictive Value- TN/TN+FN

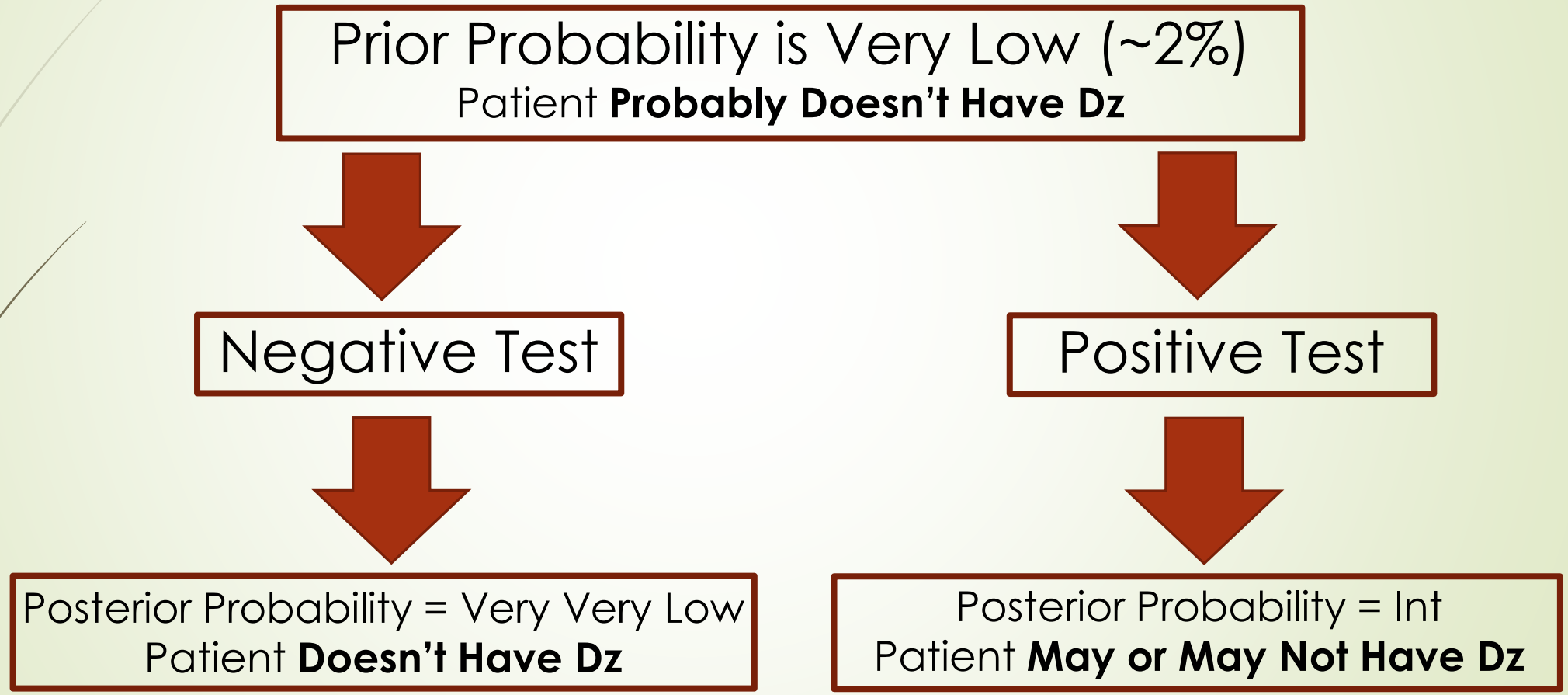
= 96/(96+0) = 100% (no cat with negative test has FIV)

- Positive Predictive Value- TP/TP+FP

= 2/(2+2) = 50%

(half of cats with positive test DON'T HAVE FIV!!)

The Bayesian View



Test Variable- For Dummies

100 patients tested, 12 have Dz (e.g. hyperthyroidism)

- Sensitivity- TP/TP+FN

Sens = 12/(12+0)= 100% (no false negatives)

- Specificity- TN/TN+FP

Spec = 88/(88+2)= 97.78% (about 2% false positives)

- Negative Predictive Value- TN/TN+FN

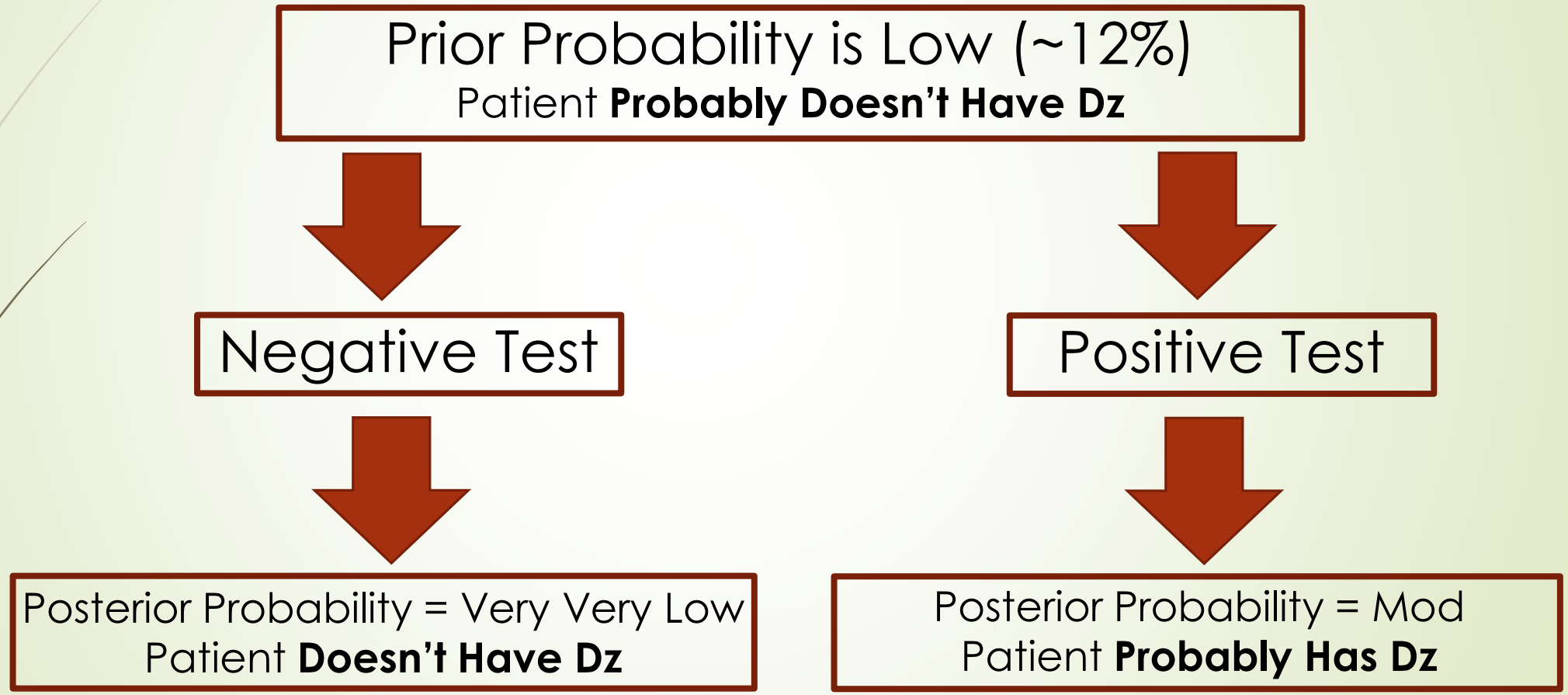
= 88/(88+0) = 100% (no cat with negative test has Dz)

- Positive Predictive Value- TP/TP+FP

= 12(12+2) = 85.7%

(~14% of cats with positive test don't have Dz)

The Bayesian View



Setting Prior Probability

- Prevalence
  - Often don't know this
  - Variable, and study population may not be like ours
- Clinical Index of Suspicion
  - signalment, history, clinical signs, previous test results, PE findings

Decision Making Examples

- UTI in cats
  - If no signs, Tx has no benefit and may harm

    Don't Run UC (1%-20% positive)

  - If signs and < 10 years old
    - 1-5% have UTI

    Probably Don't Run UC right away
    (many have FIC)
  - If signs and > 10 years of age
    - 50% have UTI

    Probably Run UC early

UC-
Sensitivity= 55-95%
Specificity= 85-99%

Decision Making Examples

Giardia ELISA-
Sensitivity= 70-89%
Specificity= 70-100%

- Giardia in Dogs
  - If no signs, Tx has no benefit

    Don't Run ELISA (ignore float?)

  - If compatible signs, treatment may be indicated

    Probably Run ELISA (more sensitive than float)

  - After Treatment
    - **If no signs-**
      - **Don't run ELISA (often + but no Tx indicated)**
      - **Maybe run float?**
    - **If signs- ?? (may or may not be due to Giardia)**

Cardinal Rule #1

If the result isn't going to change what you do, don't run the test!

Cardinal Rule #2

If prior probability is very low or very high, skip the test!

Screening

- Testing individuals without clinical signs

(PPV usually very low)

- Goal is to reduce morbidity & mortality by identifying pre-clinical disease and intervening before illness

- Examples-
  - Cancer- PSA, mammography, colonoscopy
  - Puppy fecals,
  - Pre-operative bloodwork ASA-1, annual bloodwork
  - Almost any "Just in Case" testing

Risks of Screening

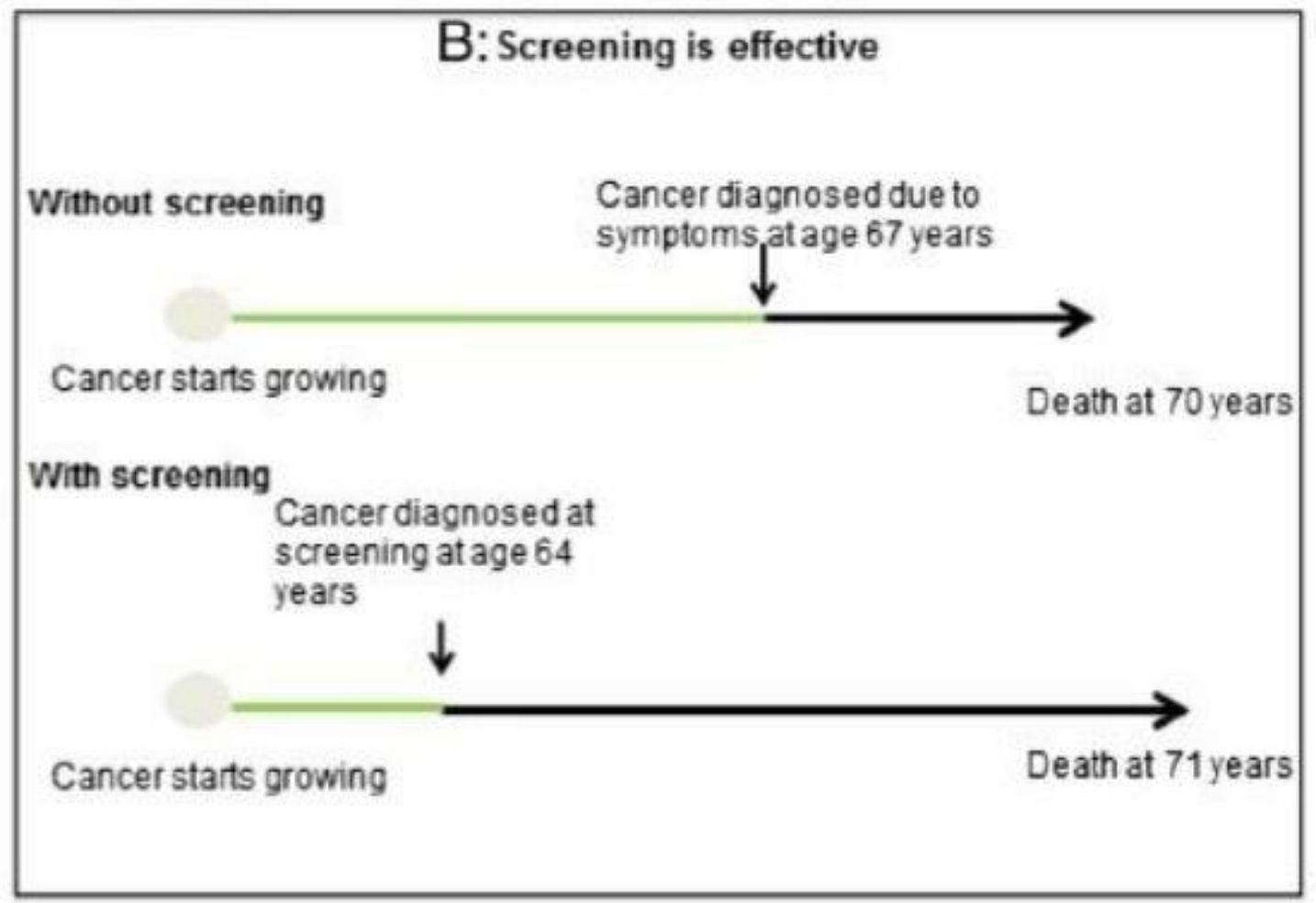
- Direct harm from testing
- False-positive results (misdiagnosis)
- False-negative results (false reassurance)
- Overdiagnosis

What is Overdiagnosis?

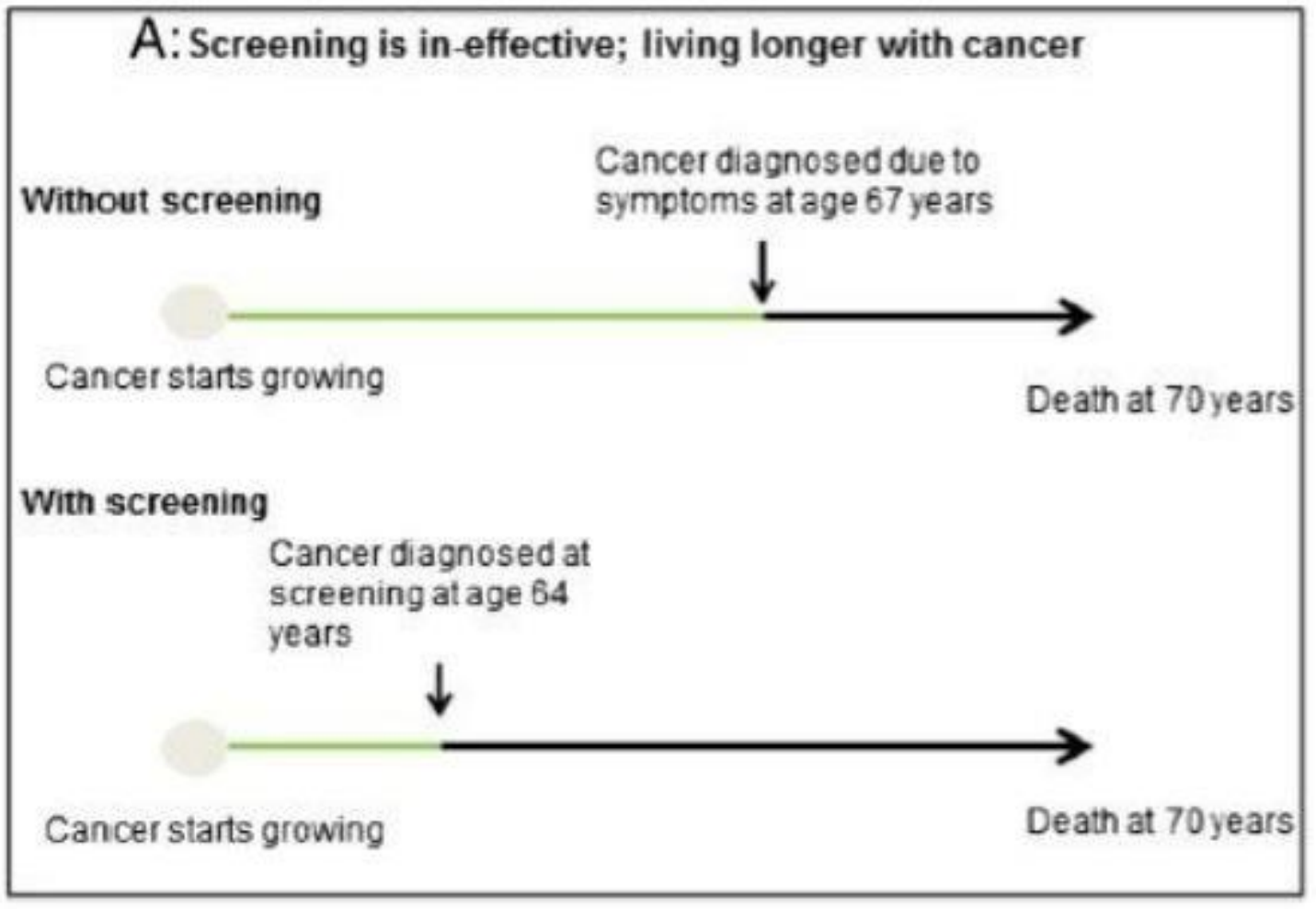
The correct diagnosis of a disease which is present but will never cause significant symptoms or death.

- the detection of clinically irrelevant disease through diagnostic testing of asymptomatic individuals
- the expansion of disease definitions or detection thresholds to reclassify asymptomatic individuals as ill
- the identification of incidental lesions on imaging asymptomatic individuals

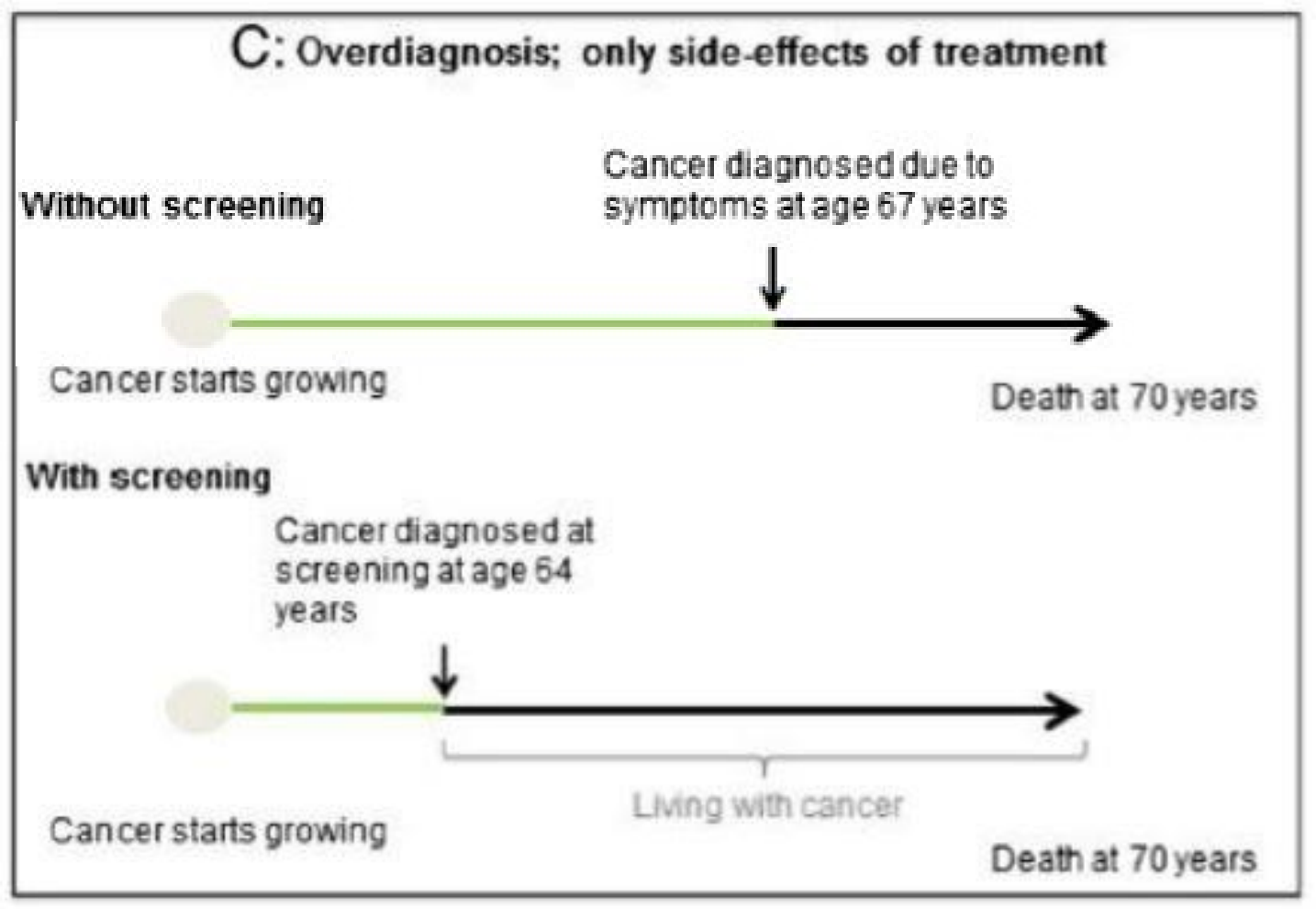
Effective Screening



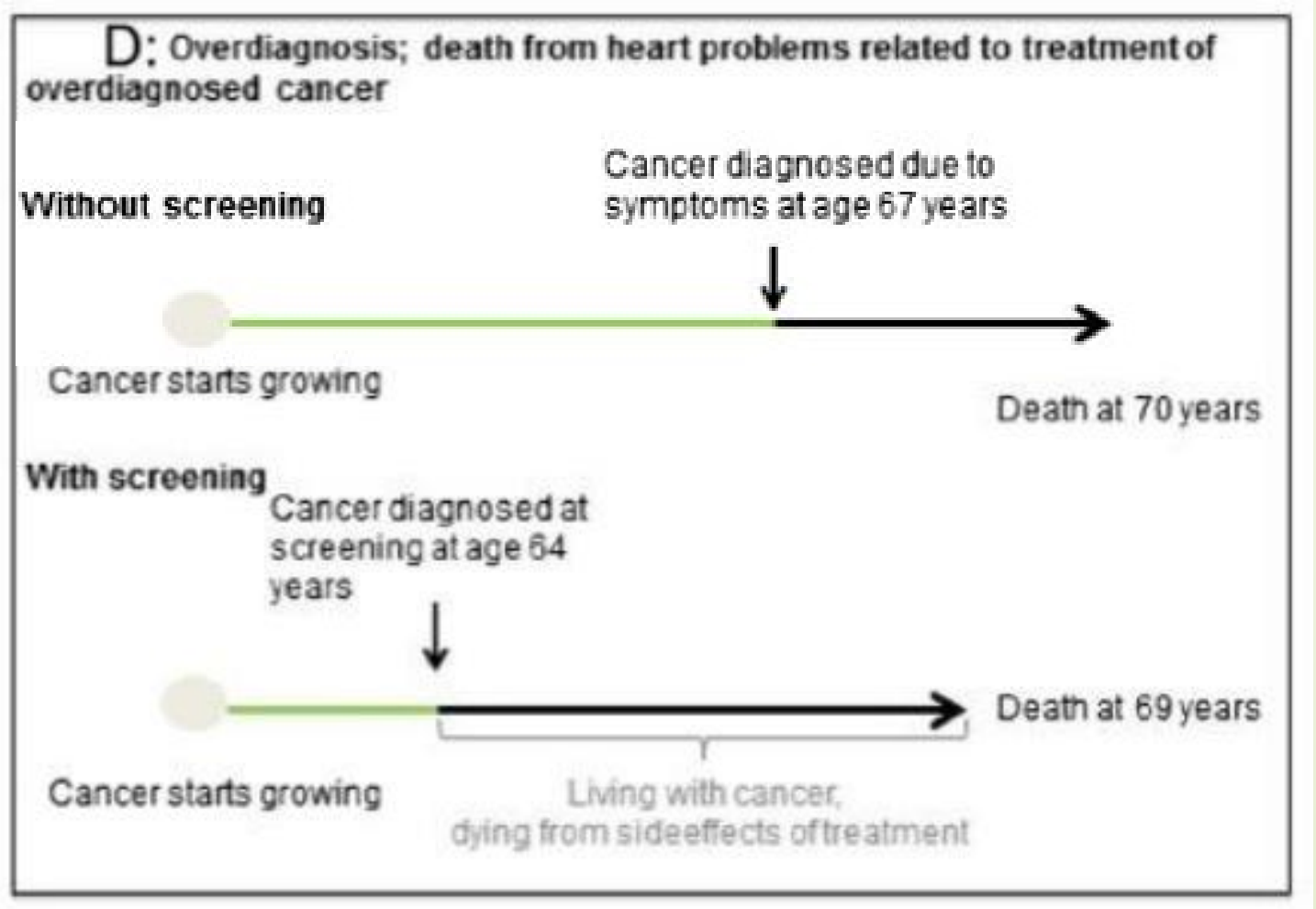
Overdiagnosis- Neutral



Overdiagnosis- Mild Harm



Overdiagnosis- Serious Harm



Harms of Overdiagnosis

- Physical-
  - Patient harms from Dx and Tx
- Financial-
  - Costs of Dx and Tx
  - Reduction of resources for beneficial Dx and Tx
- Psychological-
  - Client anxiety
  - Patient stress from Dx and Tx
- Euthanasia?
  - Premature due to awareness of Dx
  - Refusal to Tx other conditions

Screening Guidelines

- Understand the limitations of the tests used (esp PPV and NPV)
- Consider the risks/benefits of treatment if test is positive
- Consider the response/surveillance if test is negative
- Consider the risk of overdiagnosis
- The overall benefits of screening should outweigh the harm (ideally based on evidence from controlled research)

Cardinal Rule #1

If the result isn't going to change what you do, don't run the test!

Cardinal Rule #2

If prior probability is very low or very high, skip the test!

Cardinal Rule #3

Don't screen (test asymptomatic individuals) without a plan based on evidence benefits>risks.