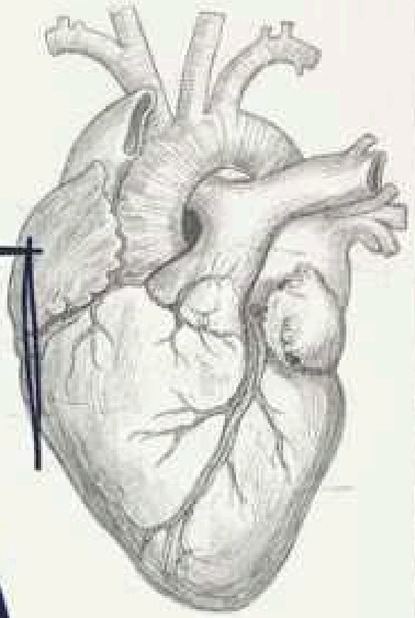
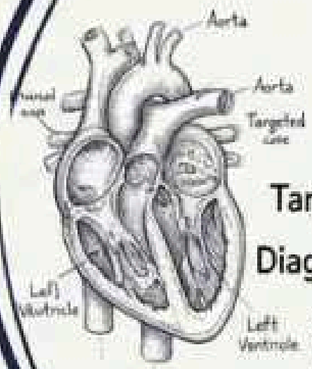
The Mechanics of Diagnosis and Population Screening



Diagnosis (The Individual)



- Symptomatic Presentation
- Clinical Examination
- Targeted Testing
- Diagnostic Workup
- Specific Case Management

Confirmed Disease (D) or No Disease (~D)

Probability & Evidence

$$P(D|T) = \frac{\text{Prevalence} \times \text{Sensitivity}}{\text{Prevalence} \times \text{Sensitivity} + (1 - \text{Prevalence}) \times (1 - \text{Specificity})}$$

- Likelihood Ratios (LR+, LR-)
- Bayes' Theorem

Sensitivity	Specificity
✓	×

- Predictive Values (PPV, NPV)
- Pre-Test Probability

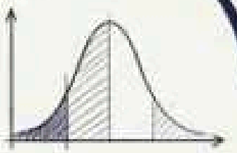
Sensitivity	Specificity
✓	×

- Test Performance Characteristics
- Clinical Utility

Test Result (T+ or T-) → Post-Test Probability of Disease

Screening (The Population)

- Asymptomatic Individuals



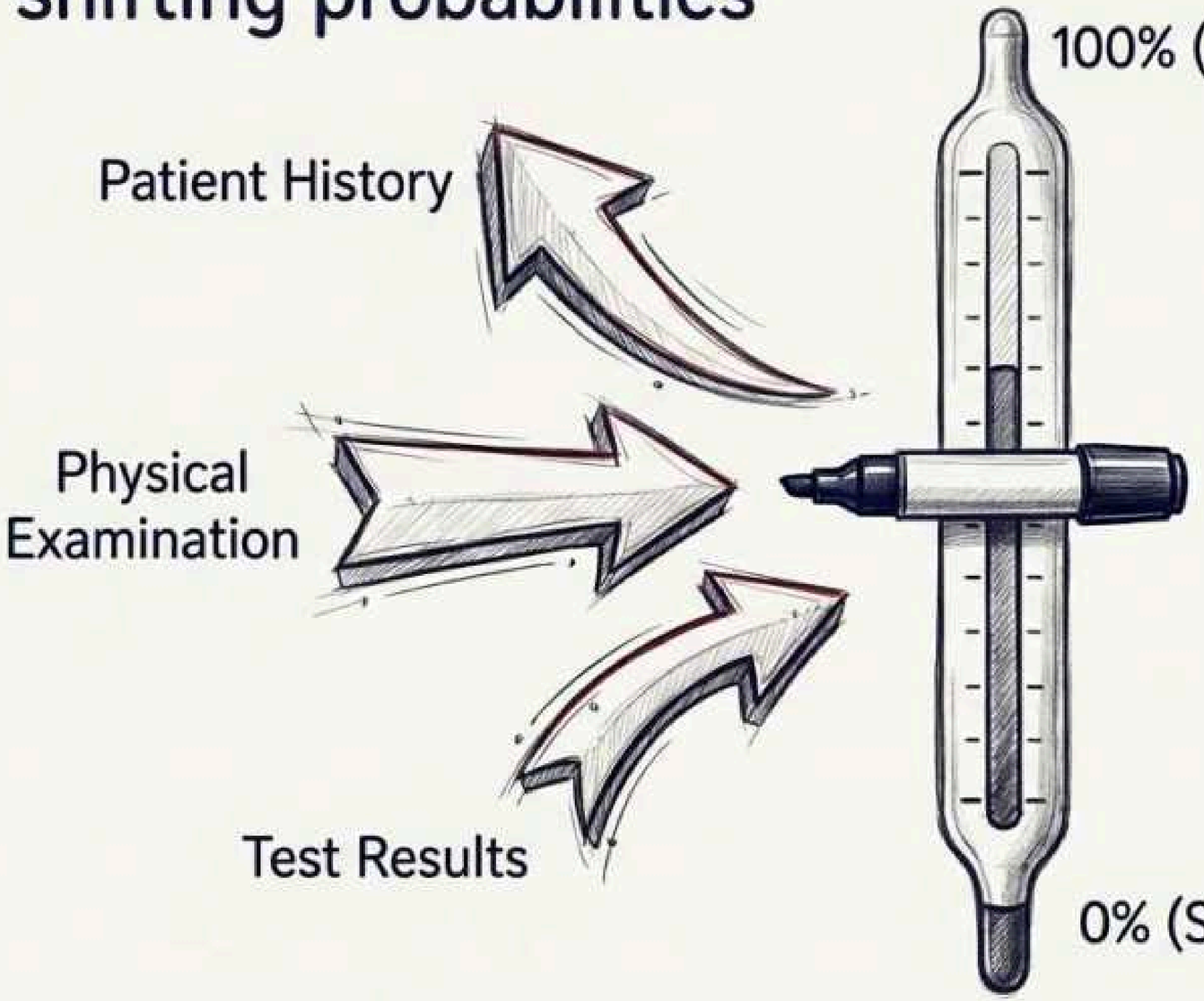
- Broad-Scale Testing
- Risk Assessment
- Early Detection
- Population Health
- Epidemiological Trends



At-Risk or Not At-Risk

Diagnosis is an exercise in shifting probabilities

¶ 4.1

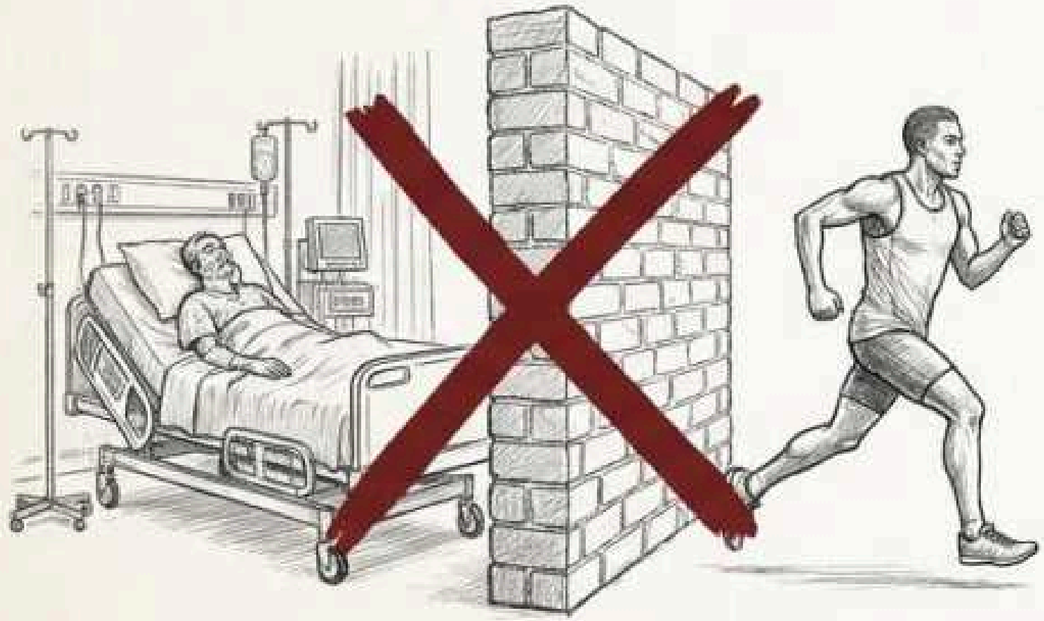


- Doctors rarely know the truth with absolute certainty.
- Clinical tools continuously update probability to actionable thresholds.

¶ 4.2

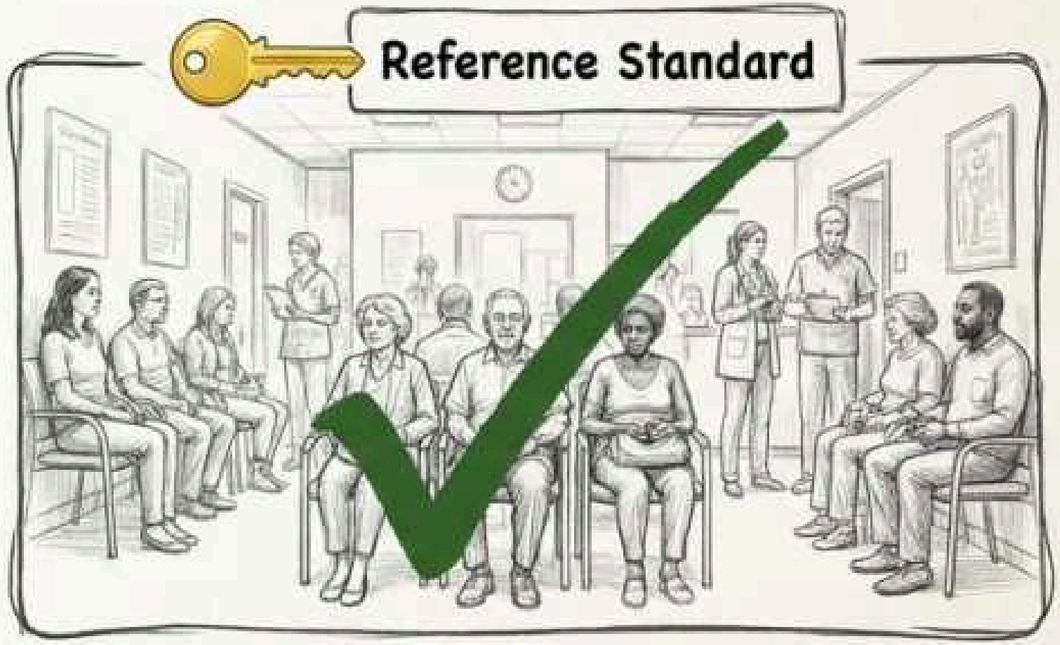
Diagnostic accuracy requires a realistic reference standard

The Flawed Approach



Inflates test accuracy.

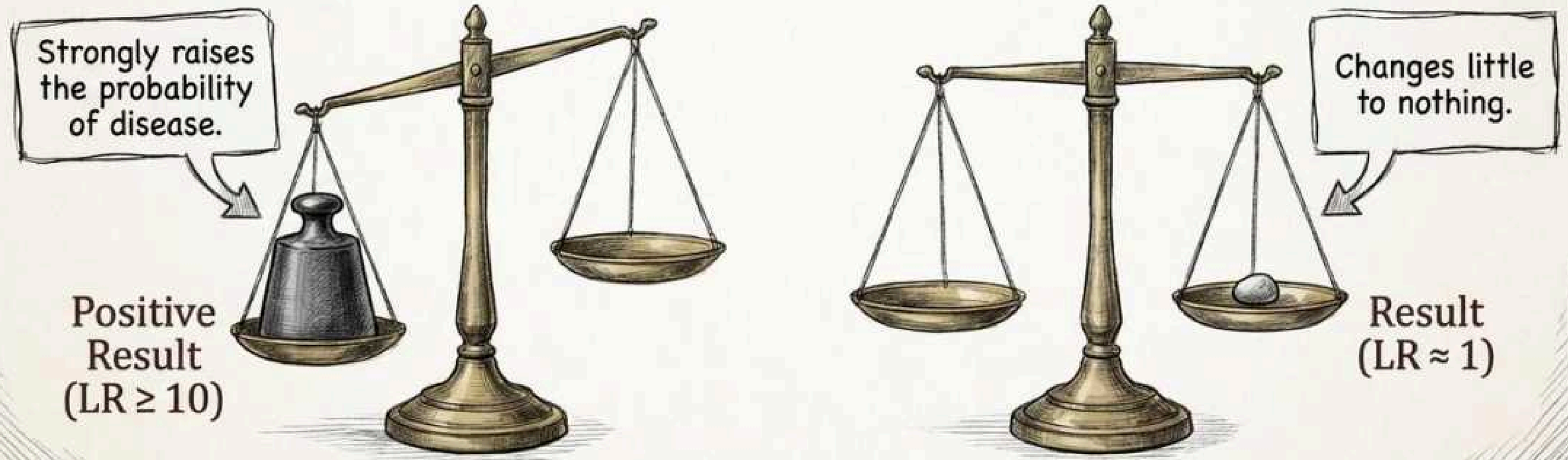
The Correct Approach



The only way to establish true Sensitivity, Specificity, and Predictive Values.

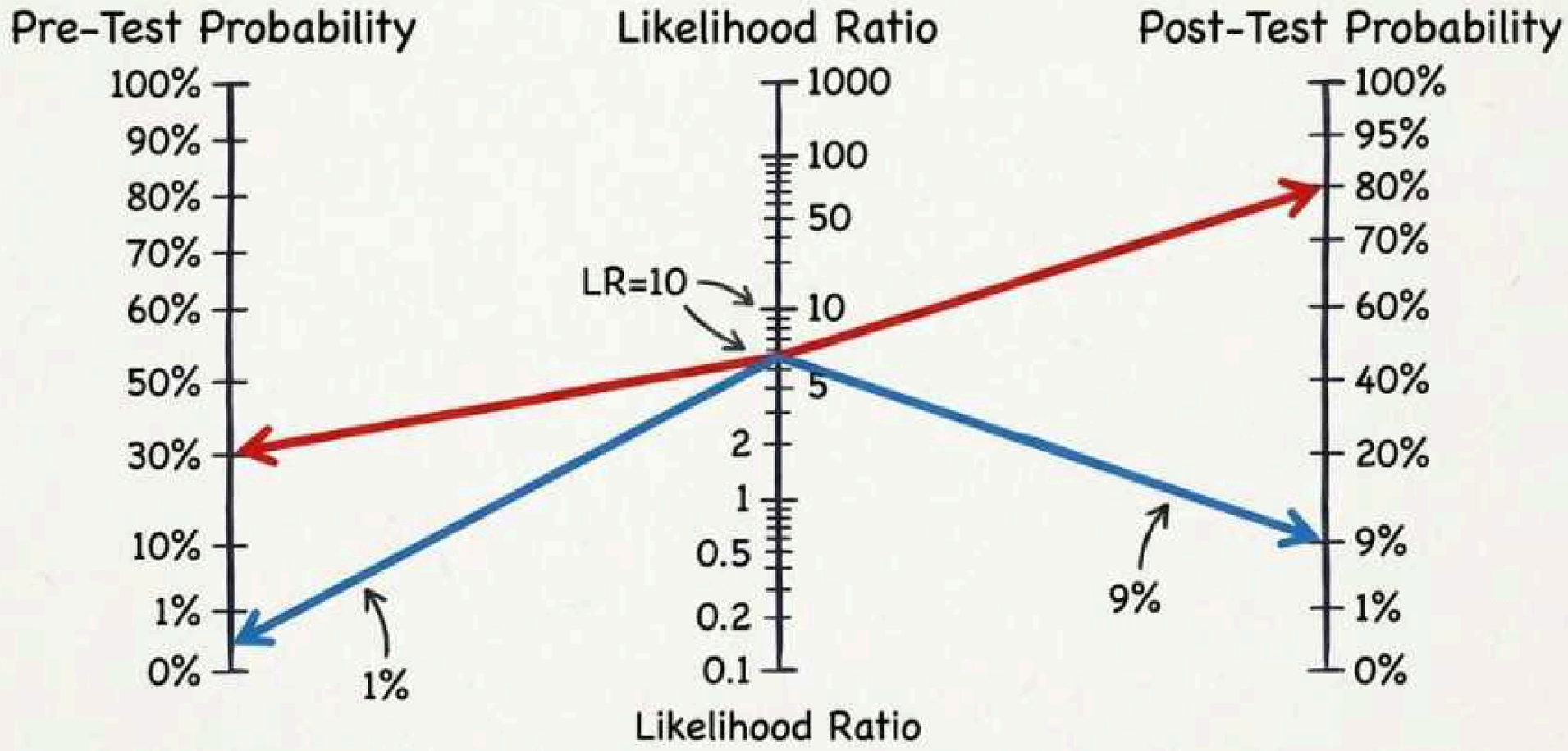
Likelihood ratios translate test results into diagnostic weight

$$LR+ = \frac{\text{Sensitivity}}{1 - \text{Specificity}}$$



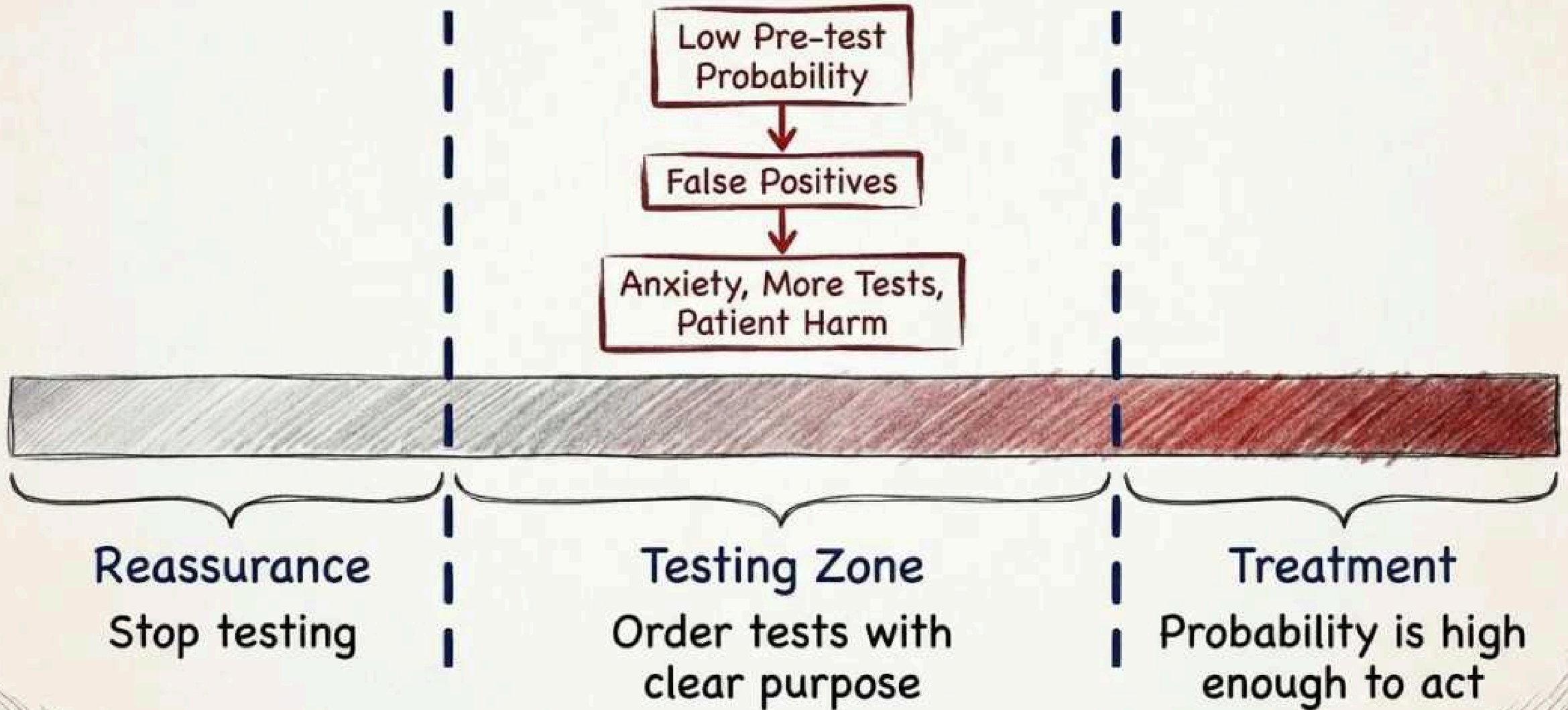
Moving from pre-test to post-test probability

¶ 4.4

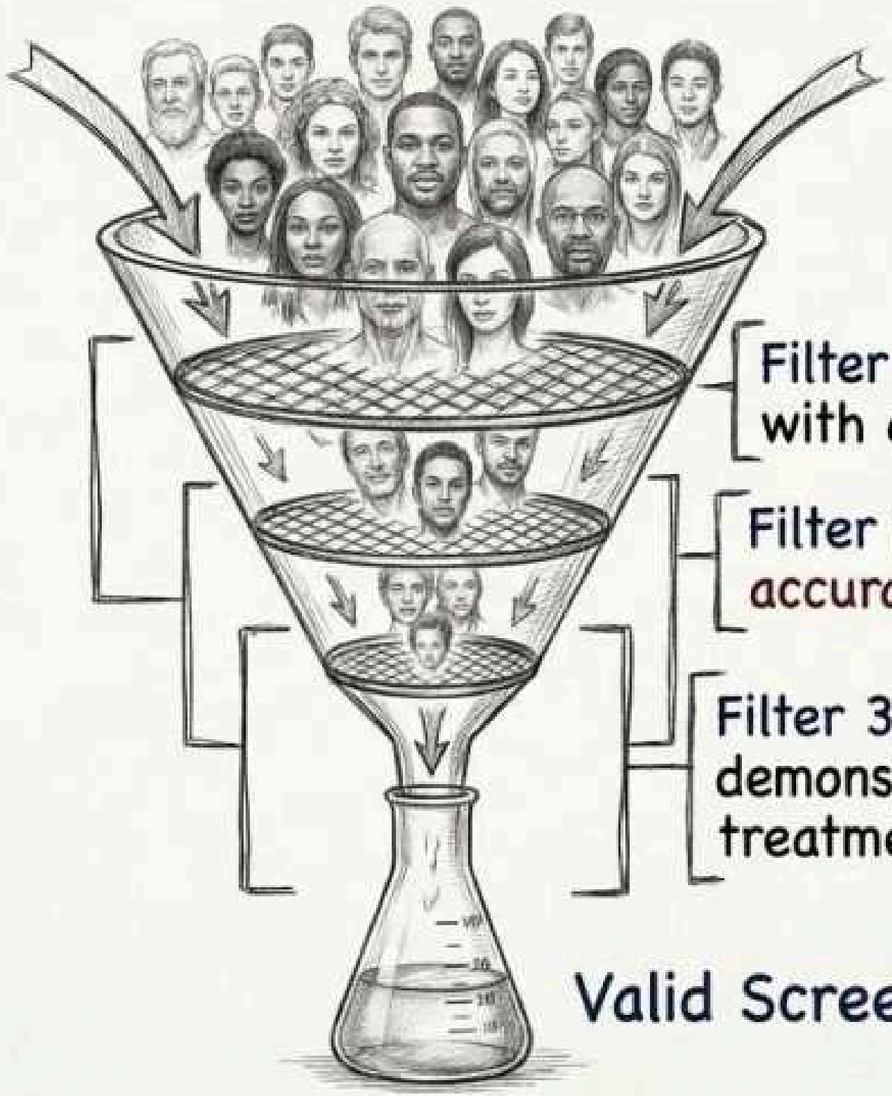


The exact same test yields wildly different post-test certainty depending on the patient's baseline risk.

Action thresholds prevent the harms of aimless testing



The Wilson-Jungner principles filter valid screening targets



Filter 1: Important health problem with a recognizable early stage.

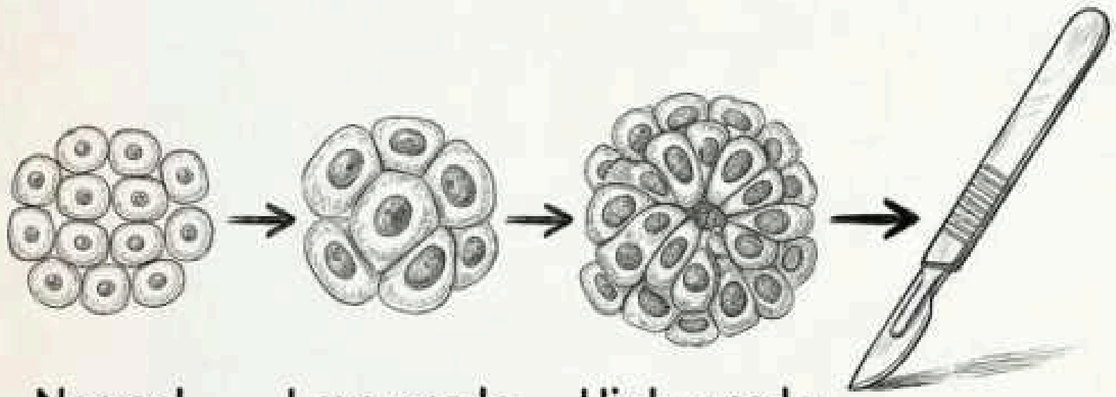
Filter 2: An acceptable, highly accurate test exists.

Filter 3: Early treatment is demonstrably superior to later treatment.

Valid Screening Program

Screening balances saved lives against the burden of overdiagnosis

Benefits

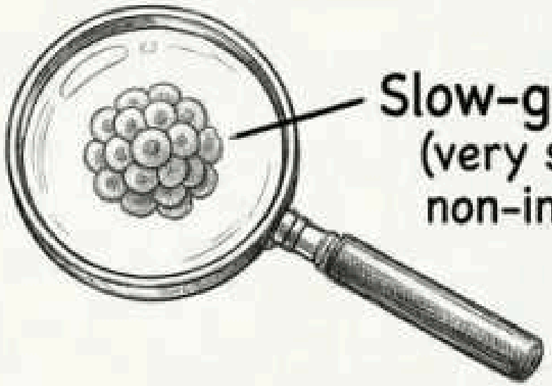


Normal Cervical Cells → Low-grade Precancer → High-grade Precancer



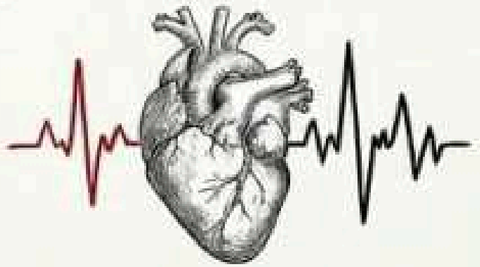
Precancerous changes removed = Lives Saved.

Harms



Slow-growing cancer (very small, compact, non-invasive cluster)

[Overdiagnosis: Conditions that would never cause symptoms in a lifetime.]



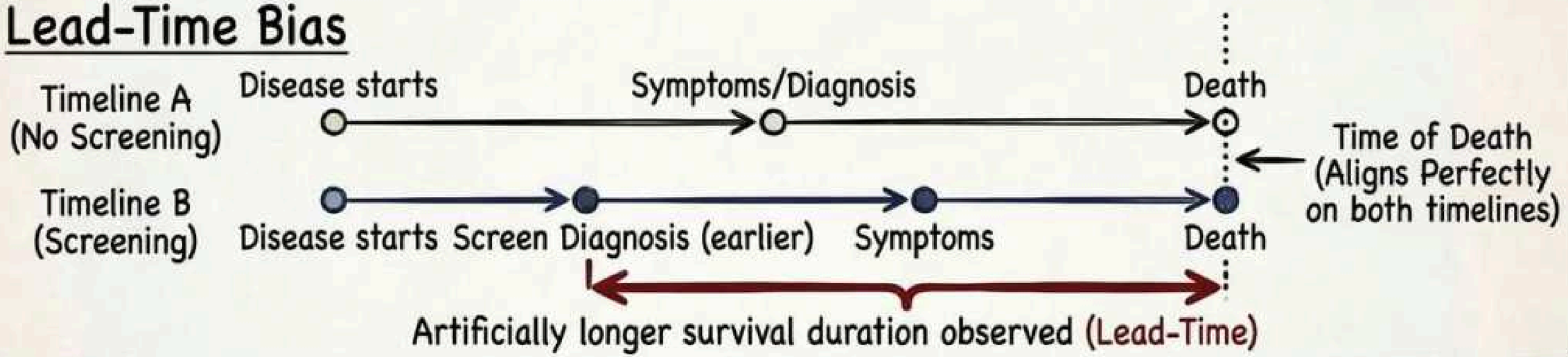
Anxiety



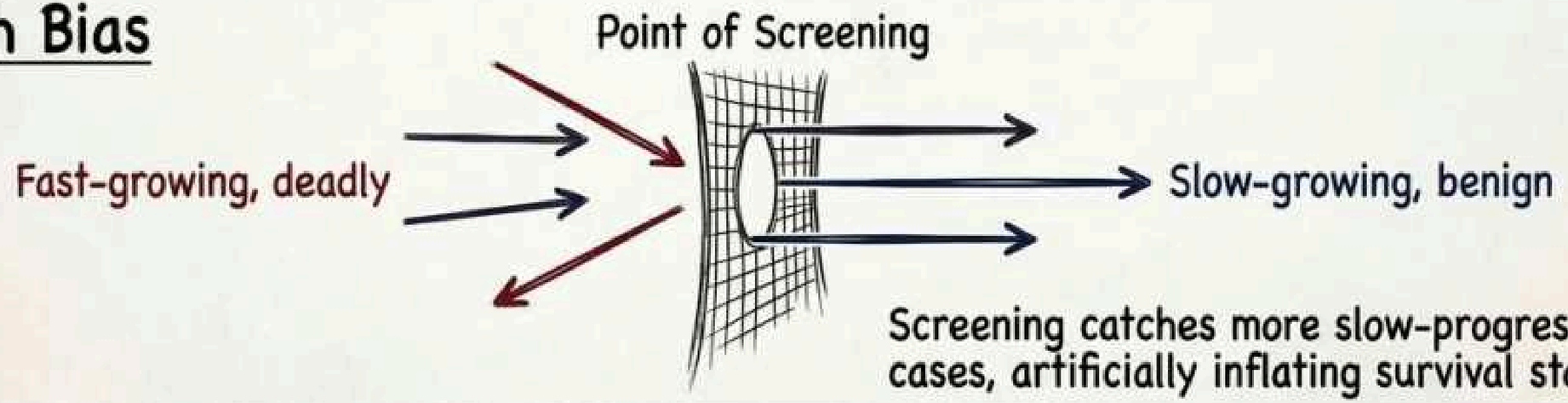
Unnecessary Procedures

Two mechanical biases artificially inflate screening survival times

Lead-Time Bias

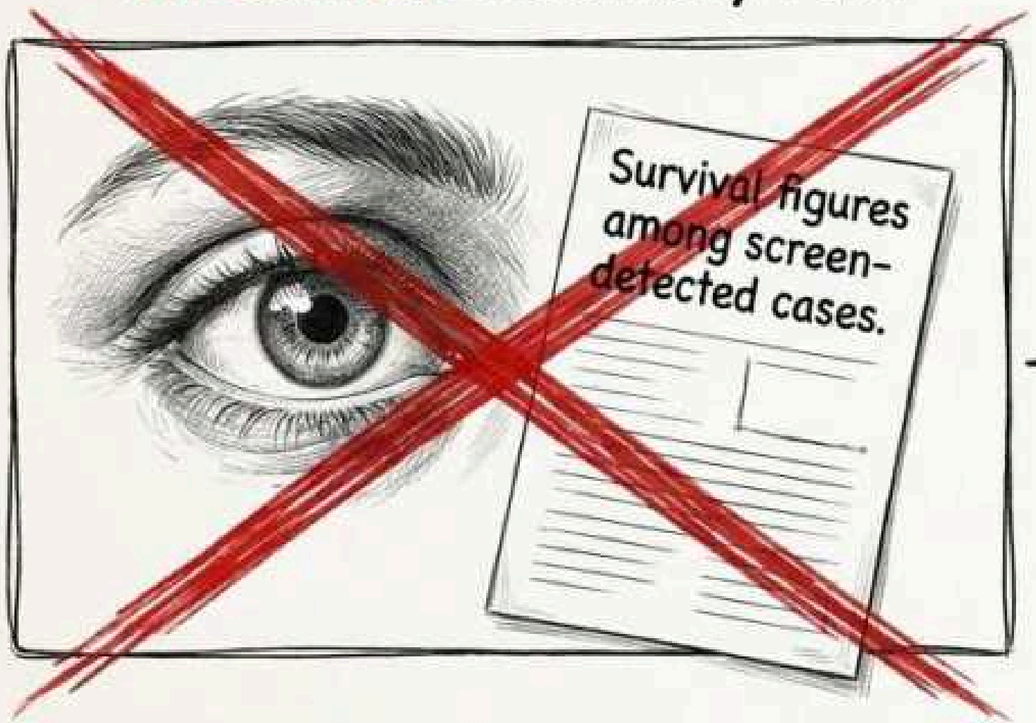


Length Bias



Only randomized trials can prove screening efficacy

Invalidated Evidentiary Path



Invalidated by Lead-Time and Length Biases.

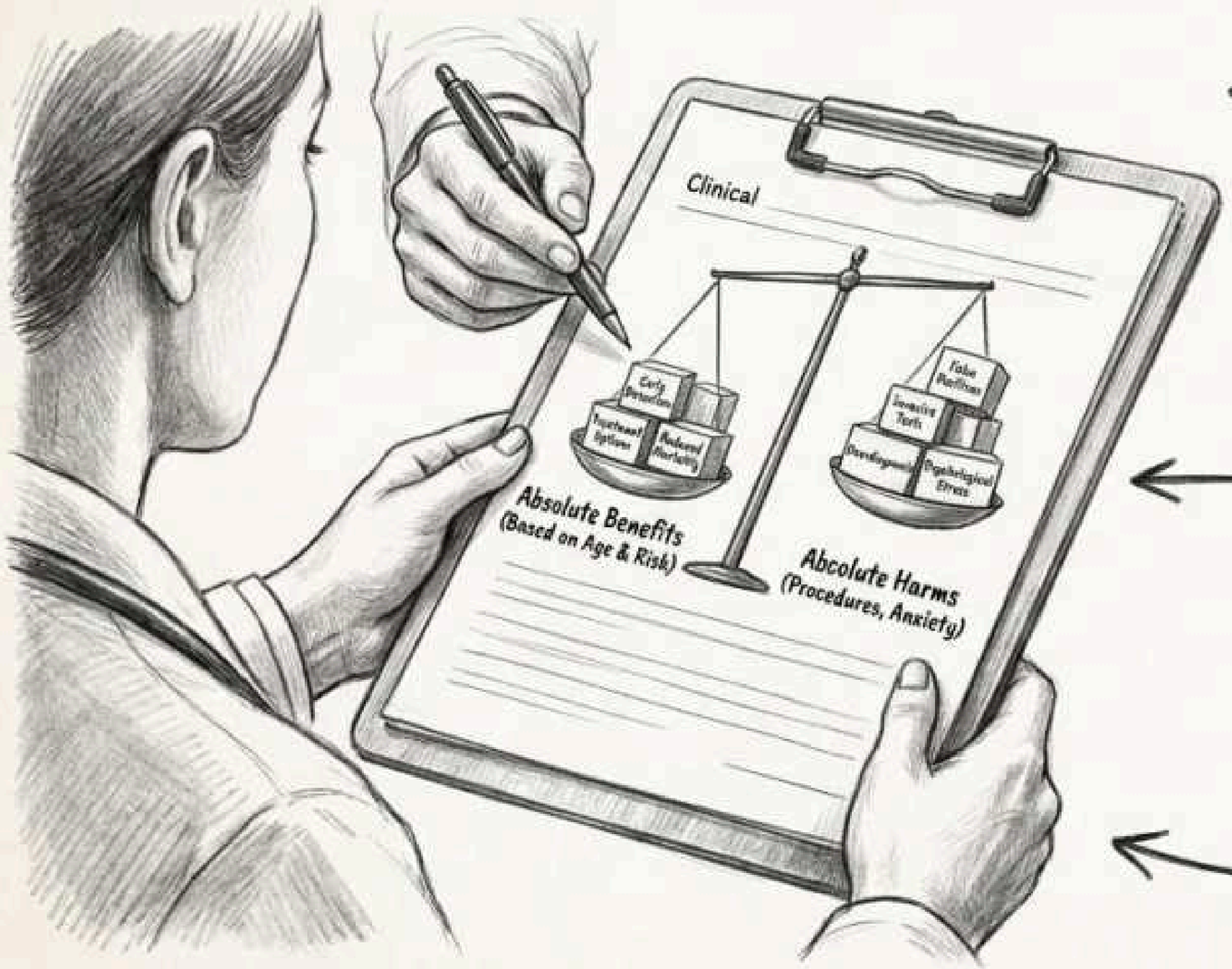
Reliable Evidentiary Path



Randomized Controlled Trials are the only reliable evidence.

¶ 4.10

Modern screening relies on shared decision-making



Population data must be translated into clear, clear, absolute numbers for the individual, empowering them to choose based on personal values.

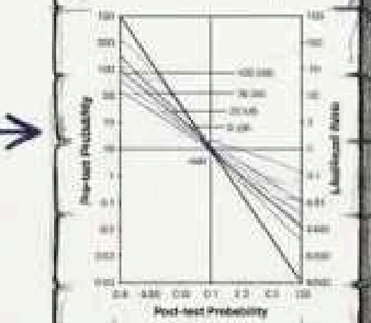
Summary: Rigor at both the individual and population scale

¶ 4.11

Evidence-Based Clinical Decision Making

Diagnosis

Updating probabilities with properly calibrated tests.



Screening

A public health intervention whose benefits must be proven by RCTs, not assumed.



Up Next: Prognosis and measuring treatment efficacy.