The Principles of Screening

National Academy of Medicine Workshop

Challenges in Initiating and Conducting Long-Term Health Monitoring of Population Following Nuclear and Radiological Emergencies in the United States

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Definitions

- Primary prevention
- Secondary prevention
- Tertiary prevention

Criteria for Evaluating Screening Tests

- **Burden of suffering**
- Accuracy and reliability
- Effectiveness of early detection
- Harms
- Balance of benefits and harms

Burden of Suffering

- Frequency: incidence, prevalence
- Severity: morbidity, mortality
- Clinical significance

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Accuracy and Reliability

- Accuracy
  - *Sensitivity* (proportion with disease who test positive)
  - *Specificity* (proportion without disease who test negative)
  - *Positive predictive value* (proportion who test positive who have the disease)
- Reliability

Positive Predictive Value and Prevalence

Prevalence = 7% Sensitivity=100%, Specificity=98%

Ultrasound	Cancer	No Cancer	Total	PPV
Positive	7000	1860	8860	79%
Negative	0	91,140	91,140	
Total	7000	93,000	100,000	

Positive Predictive Value and Prevalence

Prevalence = 0.07% Sensitivity=100%, Specificity=98%

Ultrasound	Cancer	No Cancer	Total	PPV
Positive	70	1999	2069	3%
Negative	0	97,931	97,931	
Total	70	99,930	100,000	

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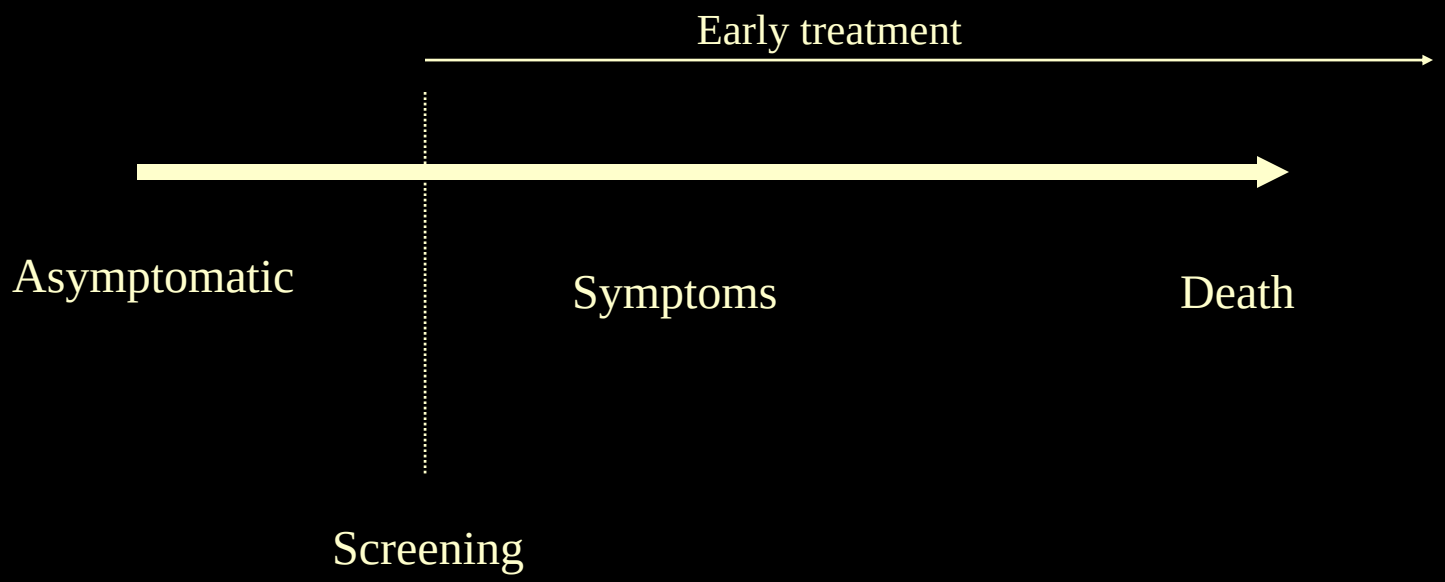
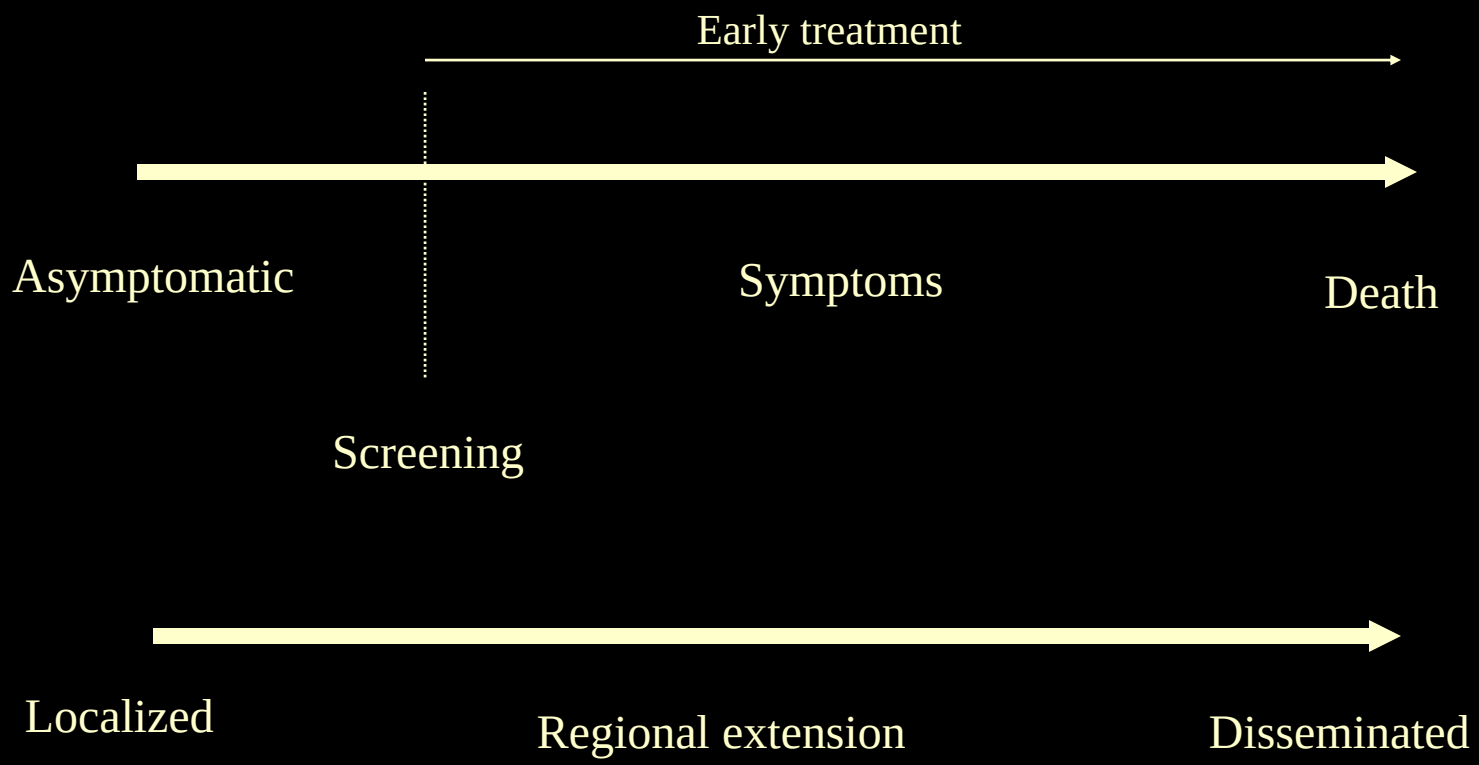
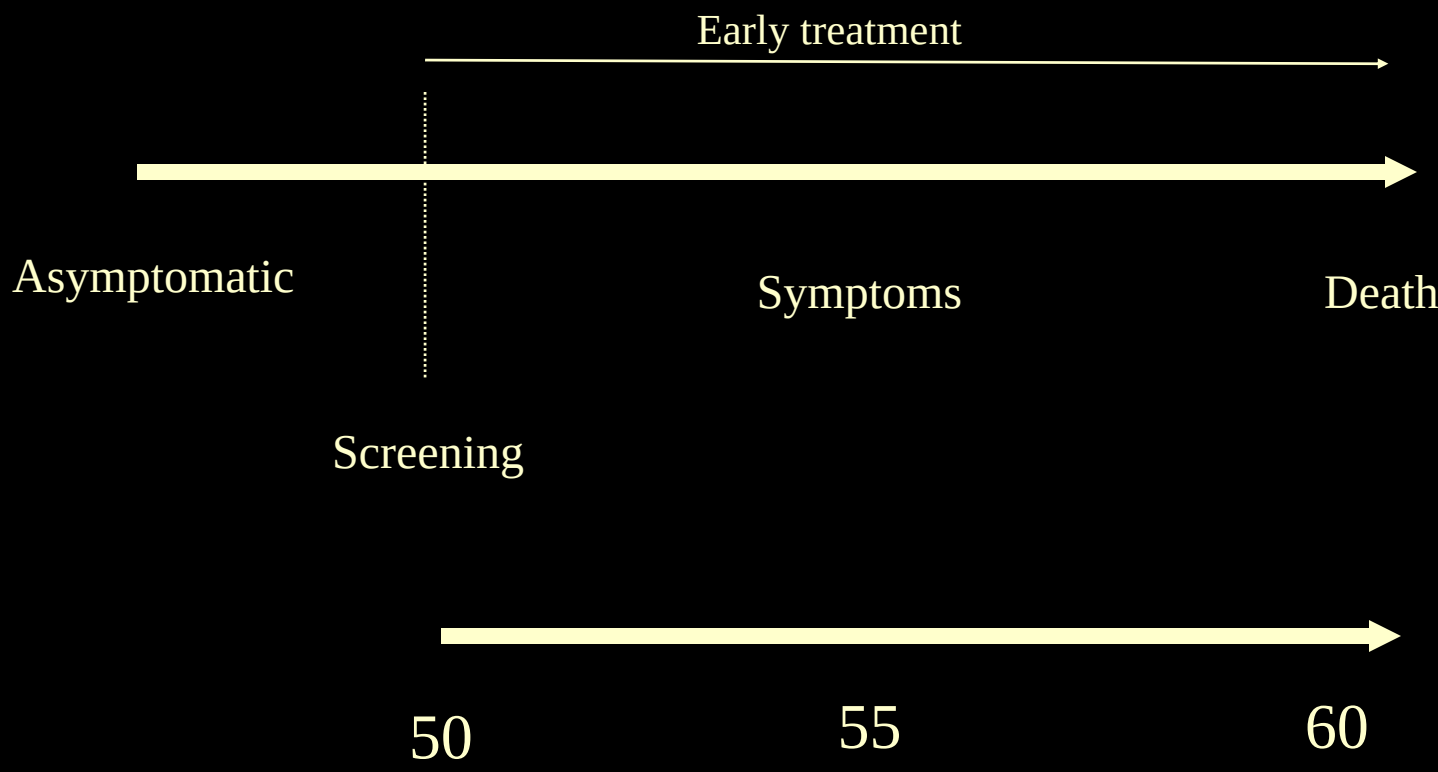
Rationale for Early Detection



Stage Shift


Early treatment
Asymptomatic
Symptoms
Death
Screening
Localized
Regional extension
Disseminated

Lead-Time Bias



Confirming Effectiveness

- Randomized controlled trials
- Well-designed observational studies
- Relative vs. absolute benefit
- Number-needed-to-screen
- Optimal interval
- When to stop
- Selective vs universal screening

Relative versus Absolute Benefit

Example:

"drug X reduces incidence of CRF by 20%"

If baseline risk of CRF is 1:10,000 (0.010%), drug X decreases incidence to 1:12,000 (0.008%) =

$$\frac{\text{Absolute reduction of 0.002\%}}{\text{NNT} = 100/0.002 = 50{,}000}$$

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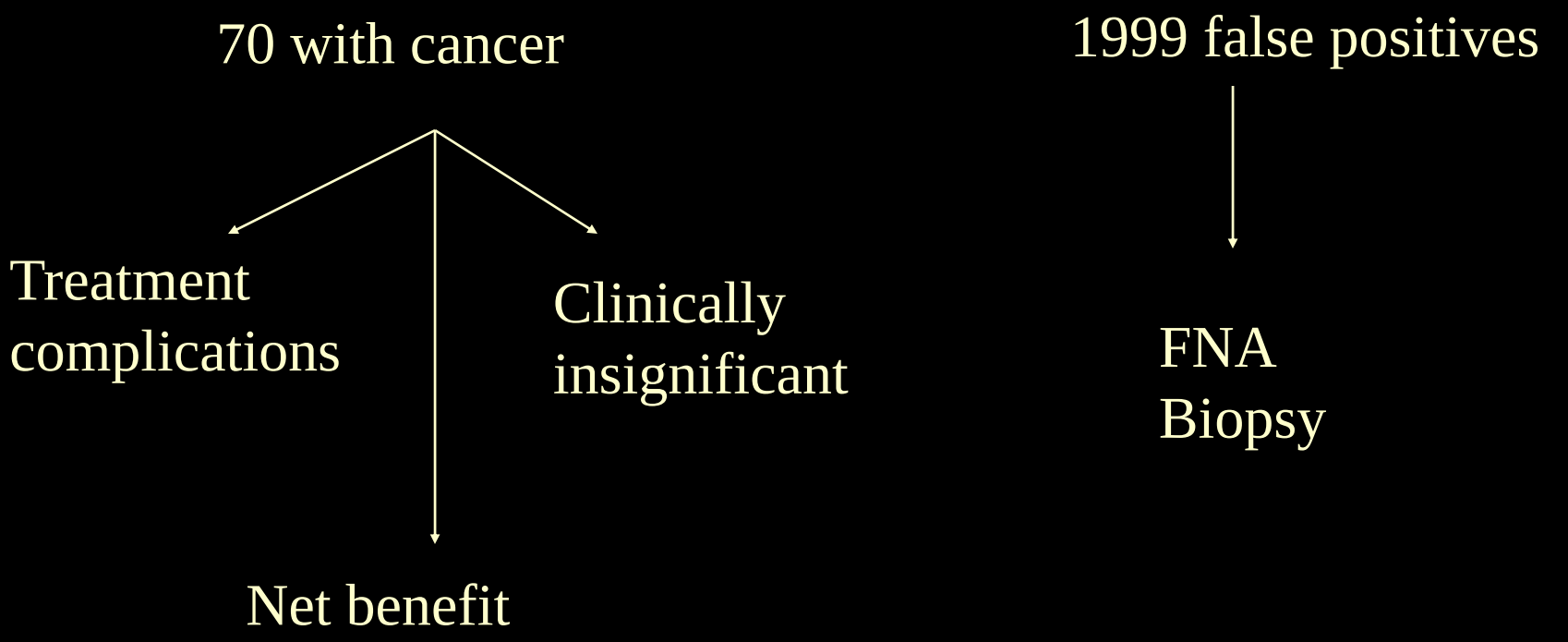
Harms of Screening

- Test procedure
- Anxiety and labeling effects
- False-positive results
- Harms of treatment

Potential Harms



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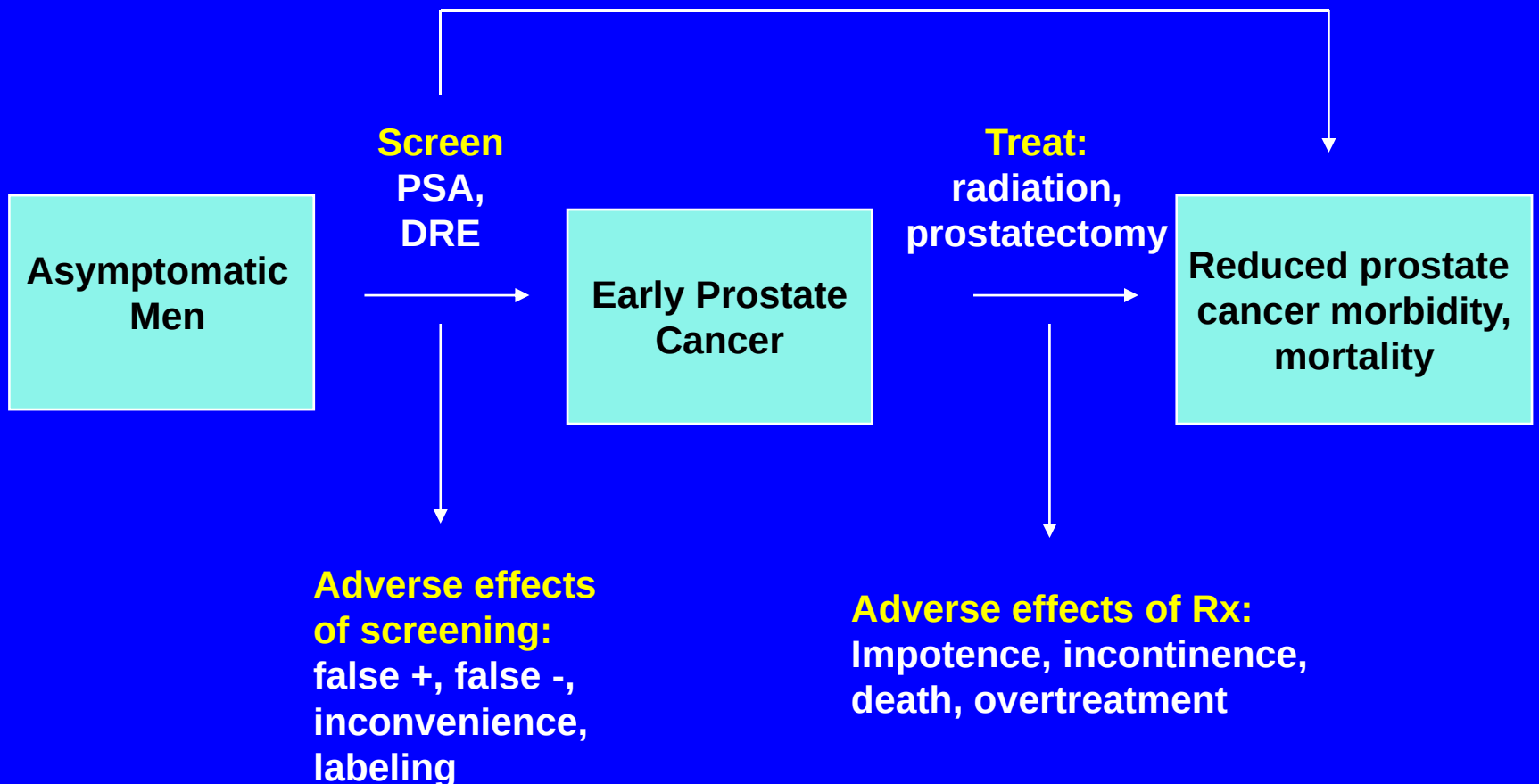
Logic for Screening



Balance of Benefits and Harms

- Objective component
- Subjective component

- Resources
- Feasibility
- Politics and public expectations
- Ethical and legal factors

Who is on the Guideline Panel?

- Topic experts and specialists vs. generalists and experts in analytic science
  - Conflicts of interest
    - Intellectual
    - Financial
  - Referal bias