

# WHO Perspective on Cancer Screening

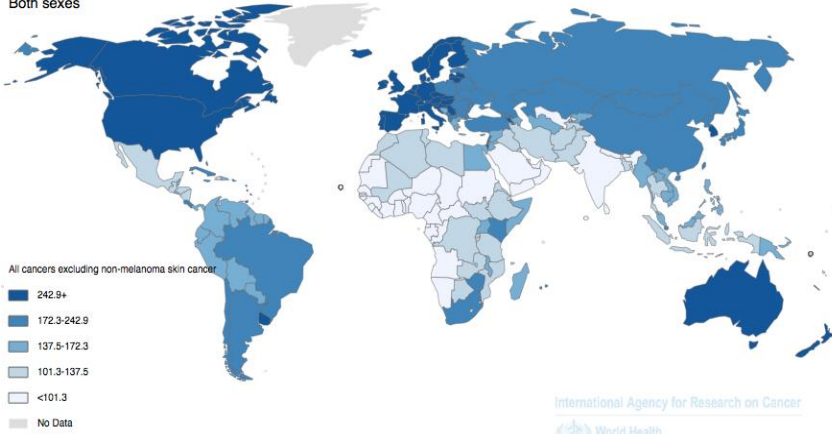
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*Understanding the Impact & Potential Harms*

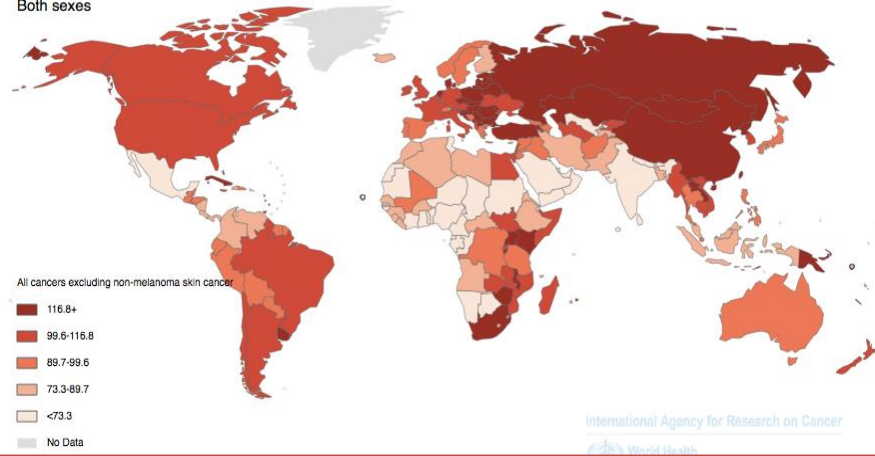
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# Why Cancer Matters

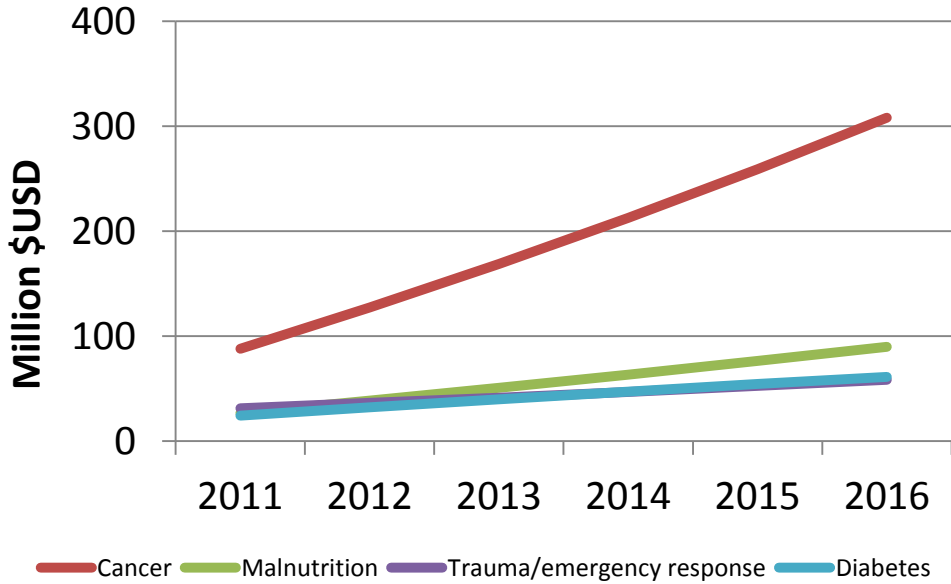
Incidence ASR  
Both sexes



Mortality ASR  
Both sexes



## Lower-middle-income country



Country	Financial catastrophe
India	32%
Haiti	>66%
VietNam	78%
China	21-75%
South Korea	40%
US	12%

# Outline

- Understanding the policy objective
  - Disease criteria for effective screening
  - Organized screening programmes
- Potential harms of screening
- Public health decision-making

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# Programme Objective

- Public health goals
    - Public health surveillance
      - Prevent disease when possible
      - **Detect disease as early as possible**
- Maximize lives saved and reduce burden of disease for population



## CONSTITUTION OF THE WORLD HEALTH ORGANIZATION<sup>1</sup>

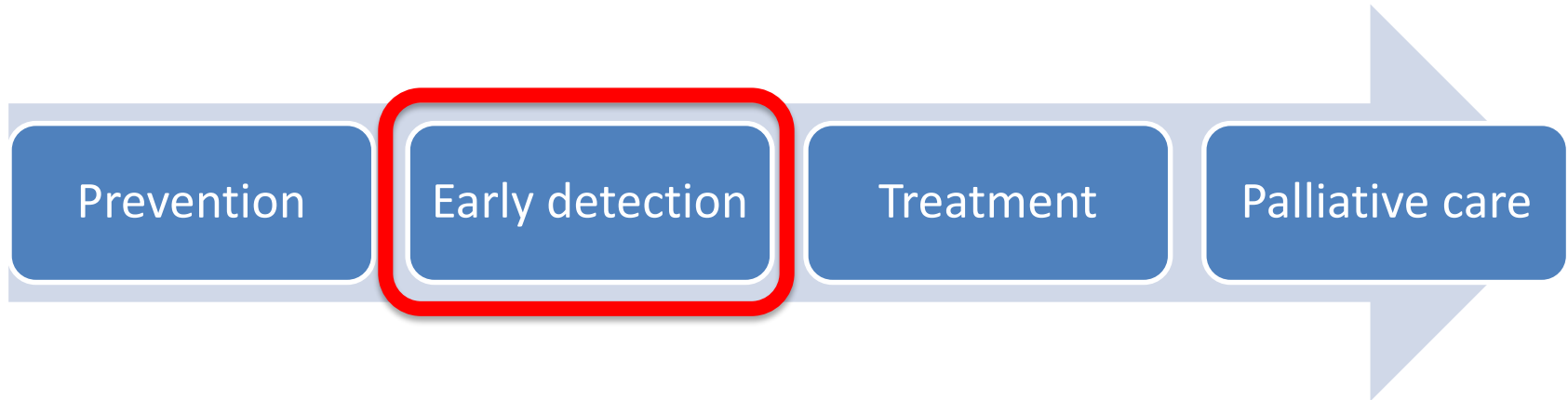
THE STATES Parties to this Constitution declare, in conformity with the Charter of the United Nations, that the following principles are basic to the happiness, harmonious relations and security of all peoples:

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition.

The health of all peoples is fundamental to the attainment of peace and security and is dependent upon the fullest co-operation of individuals and States.

# Comprehensive Cancer Control

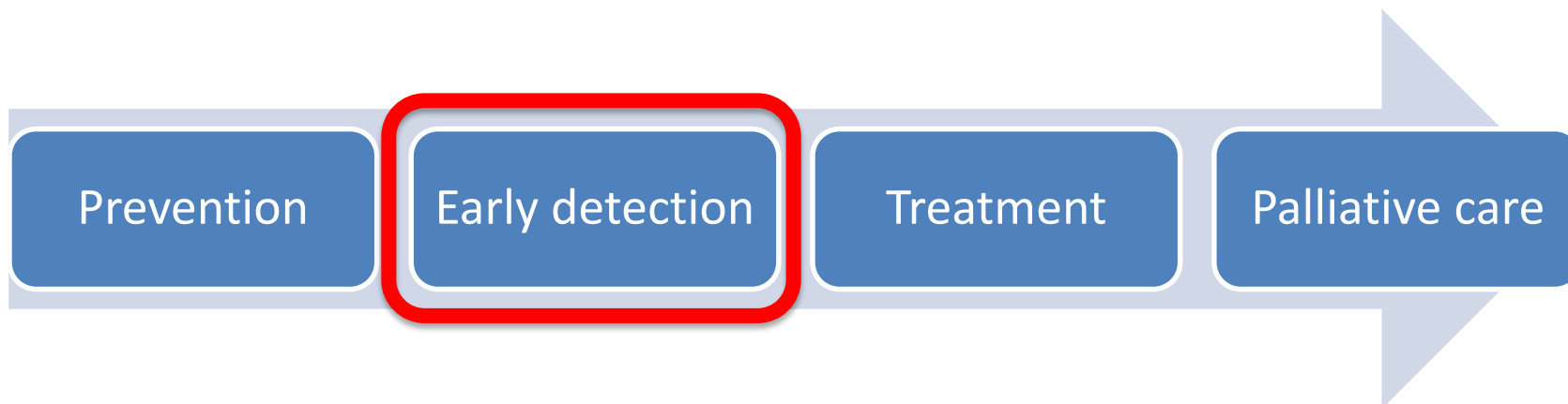


## **Early detection:**

Aims to identify cancer in early stages or pre-cancerous lesions;

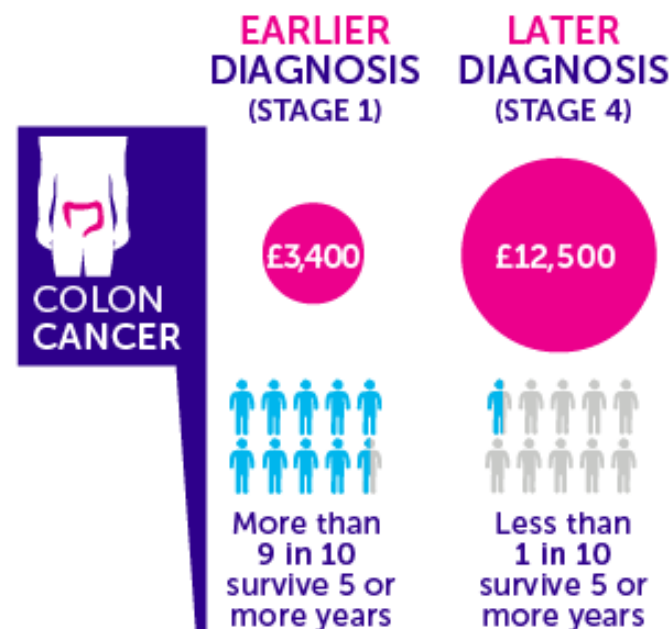
Two strategies: screening & early diagnosis

# Comprehensive Cancer Control

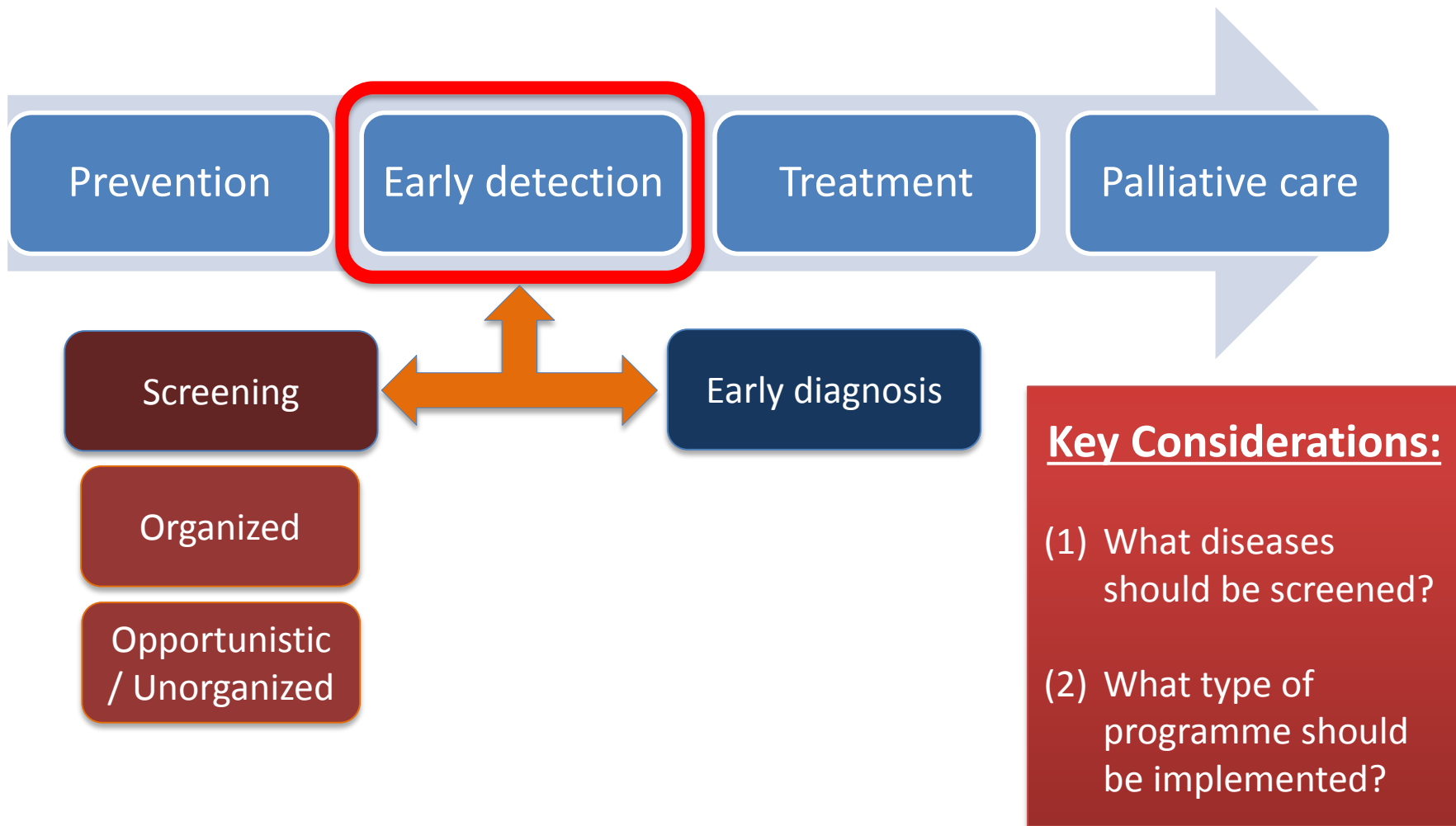


Goal = early identification

- **Reduce mortality / improve survival**
- **Less morbid treatment**
- **Reduced costs of care**



# Early Detection of Cancer





# Screening vs. Early Diagnosis

- **Screening:**

- Presumptive identification of unrecognized disease in general population
- *More than a test*

## Key considerations:

(1) What diseases should be screened?

- **Ear**

- (1) What type of programme should be implemented?
- 

Awareness of symptoms

# Screenable Disease: Wilson and Jungner criteria

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**“The central idea of early disease detection and treatment is essentially simple. However, the path to its successful achievement ... is far from simple though sometimes it may appear deceptively easy.”**

- Wilson JMG, Junger G (*Principles and Practice of Screening for Disease*. WHO, 1968)

stage



WORLD HEALTH ORGANIZATION  
GENEVA

# Cancers to be Considered

## Screenable cancers

- Cervical
- Breast
- Colorectal
- P
- L
- T
- G
- E
- L
- O
- S
- Bladder
- Kidney

## Key considerations:

(1) What diseases should be screened?

(1) What type of programme should be implemented?

*What can be screened?*

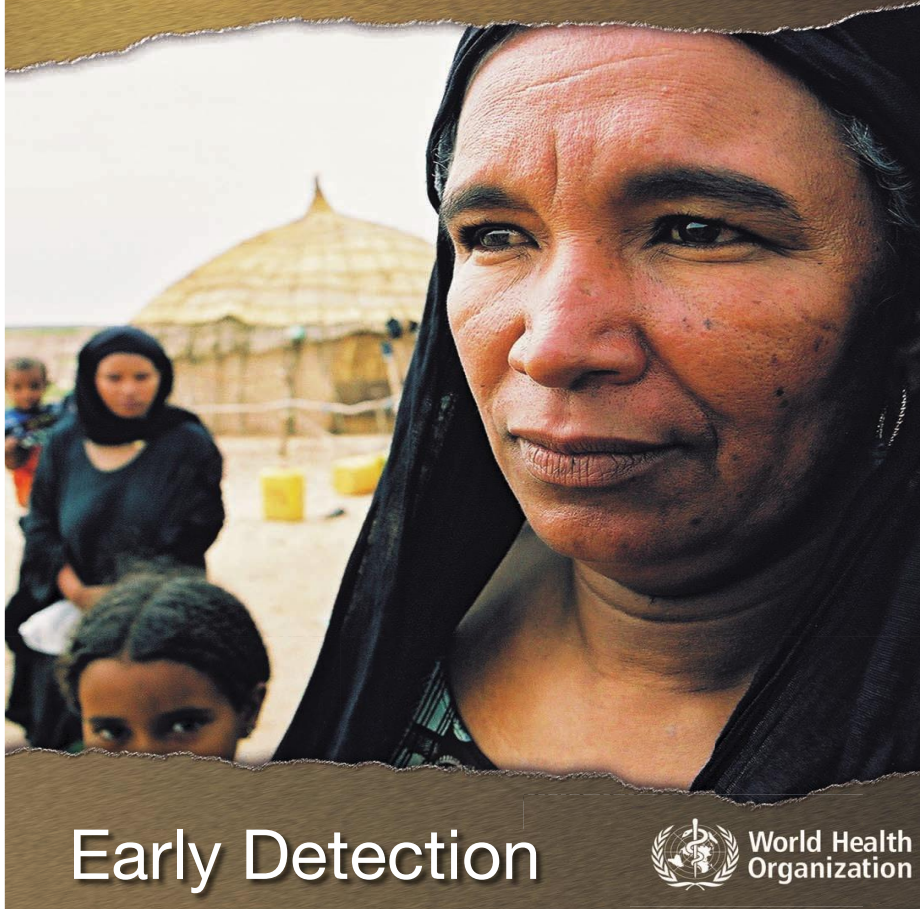


*What should be screened?*

# Screenable Disease: Implementation

## Cancer Control

Knowledge into Action  
WHO Guide for Effective Programmes



Early Detection



***Disease- & test-based criteria***

*PUBLIC HEALTH PAPERS*

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## PRINCIPLES AND PRACTICE OF SCREENING FOR DISEASE

J. M. G. WILSON & G. JUNGNER



*WORLD HEALTH ORGANIZATION  
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# Factor 2: Effective Screening Programmes

## WHO screening targets:

### 1. Organized

(vs opportunistic):

- a. Greatest impact
- b. Fewest harms
- c. Equitable

### 2. >70% participation

Criteria for Organized Screening
National program to make service available
Coordination, centralized at national/regional level
Protocol for screening frequency, target population
Mechanism of inviting target population systematically
Functioning health information system including registries
Monitoring & Evaluation program

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1. Overdiagnosis
2. False (+) result
3. Ineffectual service

# Screening Process

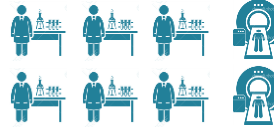
Target population

Population  
screened

*Call mechanism*



# Breast Cancer Screening



Population sensitized to screening test

High quality, accurate, accessible screening test

Confirmatory pathologic diagnosis & staging

Referral for definitive treatment

Treatment accessible, high quality

Sample population: 1 million

55,000 women screened with mammography each year

5,000 with abnormal screening test

350 with confirmed cancer found on screening

4,720 require follow-up & found to have no abnormality

450 women will require treatment

340 women will survive without screening

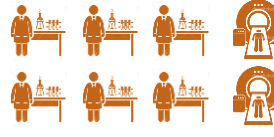
20 women avoid death from breast ca due to screening

30 women will not receive any major benefit (due to overdiagnosis)

Breast ca screening costs in HIC: ~\$10mil per 1mil population

Breast treatment costs in HIC: ~ \$15mil per 1mil population

# Lung Cancer Screening



Population sensitized to screening test

High quality, accurate, accessible screening test

Confirmatory pathologic diagnosis & staging

Referral for definitive treatment

Treatment accessible, high quality

Sample population: 1 million

53,000 women screened with LDCT each year

13,000 with abnormal screening test

500 with confirmed cancer found on screening

12,500 require follow-up & found to have no abnormality

350 require treatment

50 will survive without screening  
250 will die regardless

50 avoid death from lung ca due to screening

50 will not receive any major benefit (due to overdiagnosis)

Lung ca screening costs in HIC: ?

Cost-effectiveness: \$2,000 - \$250,000 per QALY



# Harm #2: False Positive Findings

- Consequences
  - Individual

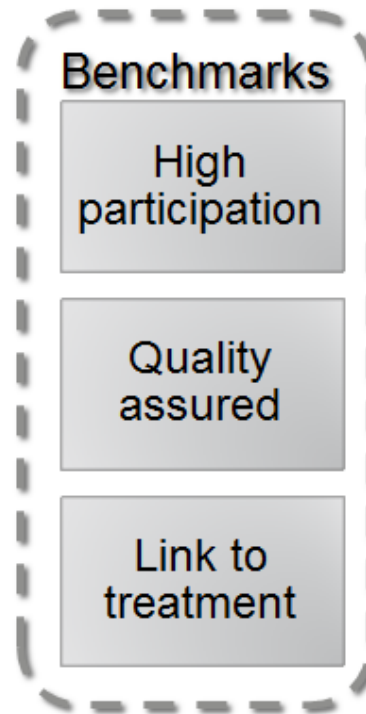
## Key message:

- 1) False + & overdiagnosis: cause significant personal & system costs (~\$USD 4 billion/yr in US)
- 2) Low quality screening tests result in greater harm

- Can be 10-50% of programme costs
- In US, expenditure for false (+) ~ USD\$1-2 bil/yr

# Harm #3: Ineffectual Services

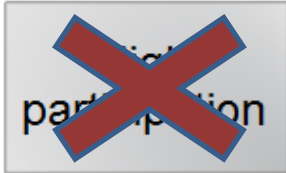
- Organized cancer screening



# Harm #3: Ineffectual Services

Situation	Women screened	Abnormal screening results	False positives	Women benefitting from screening	Program costs
Optimal conditions (Efficacy)	40,000	3,000	2,920	20	\$ 300,000

Benchmarks

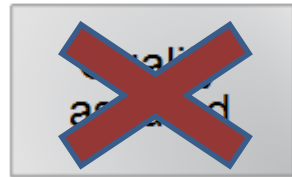


Low participation	20,000	1,500	1,460	10	\$ 150,000
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Situation	Women screened	Abnormal screening results	False positives	Women benefitting from screening	Program costs
Optimal conditions (Efficacy)	40,000	3,000	2,920	20	\$ 300,000

Benchmarks



Low quality	40,000	5,000	4,930	8	\$ 500,000
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# Harm #3: Ineffectual Services

Situation	Women screened	Abnormal screening results	False positives	Women benefitting from screening	Program costs
Optimal conditions (Efficacy)	40,000	3,000	2,920	20	\$ 300,000

Benchmarks



Poor link to diagnosis and treatment	40,000	3,000	2,920	<b>10</b>	\$ 300,000
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# Harm #3: Ineffectual Services, where are we now?

Cancer	Participation	Opportunistic	Co-payment	Inequities
Breast	35-80% (Canton-specific)	Yes		Yes (SES, region, education)
Colorectal	22%	Yes	10% after deductible	Yes (SES)
Cervical	70-80%	Yes		Yes (SES, region)
Prostate	~70\$ (from 50% in 1992)	Yes		Yes (SES, region, education)

**Key message:** Consider public health priorities, budgetary impact, health system capacity when proposing screening programme.

High participation and quality are critical.

# Putting it all together

## Efficacy vs. Effectiveness

Situation	Women screened	Abnormal screening results	False positives	Women benefitting from screening	Program costs
Optimal conditions (Efficacy)	40,000	3,000	2,920	20	\$ 300,000

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- **Public health decision-making**

# Public Health Decision-Making

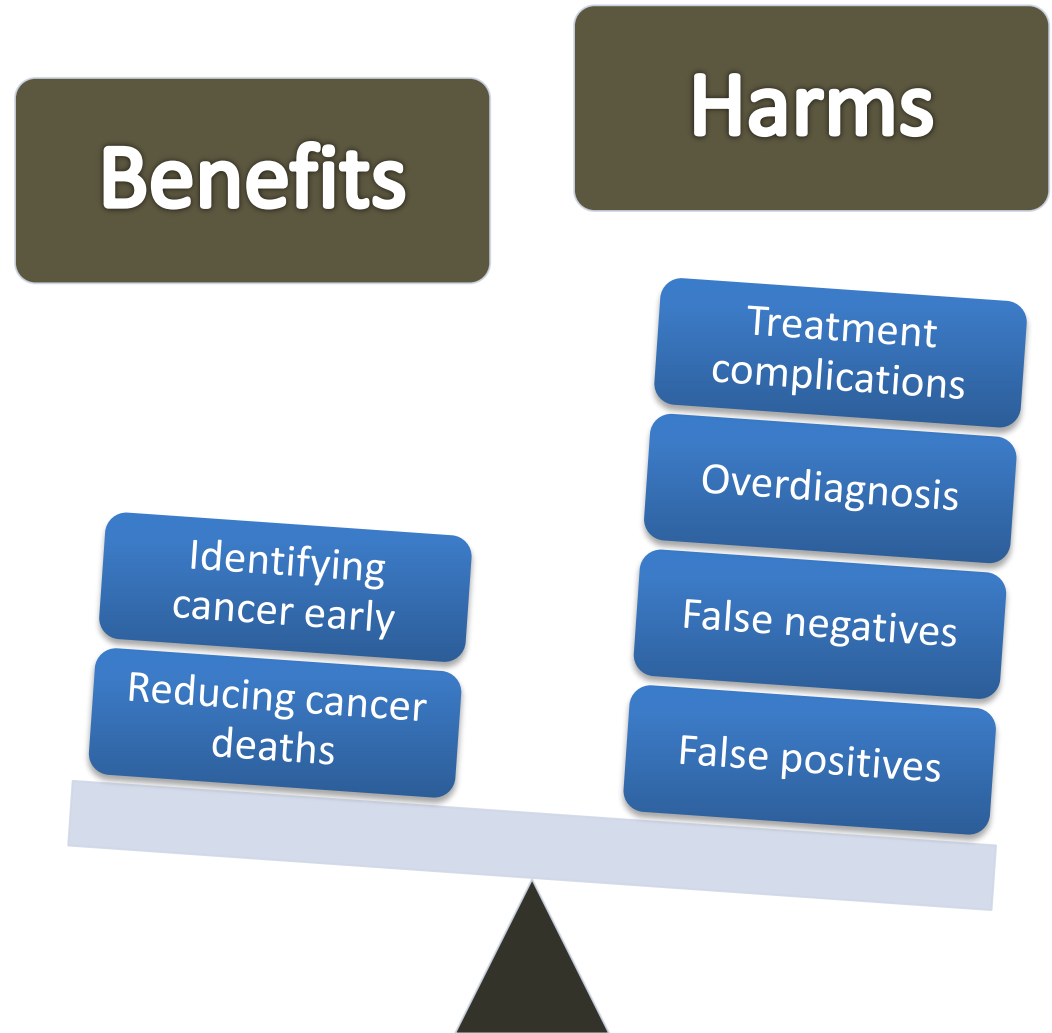
- Cancer screening
  - Must ensure favorable benefit-harm ratio
  - Decision-making options
    1. Regulatory framework
    2. Public funding for programme
  - Considerations
    - Limited data for evidence-based policies
    - Context-specific with acceptable risks for population
    - Mechanism for M&E critical

# Emotional Epidemiology



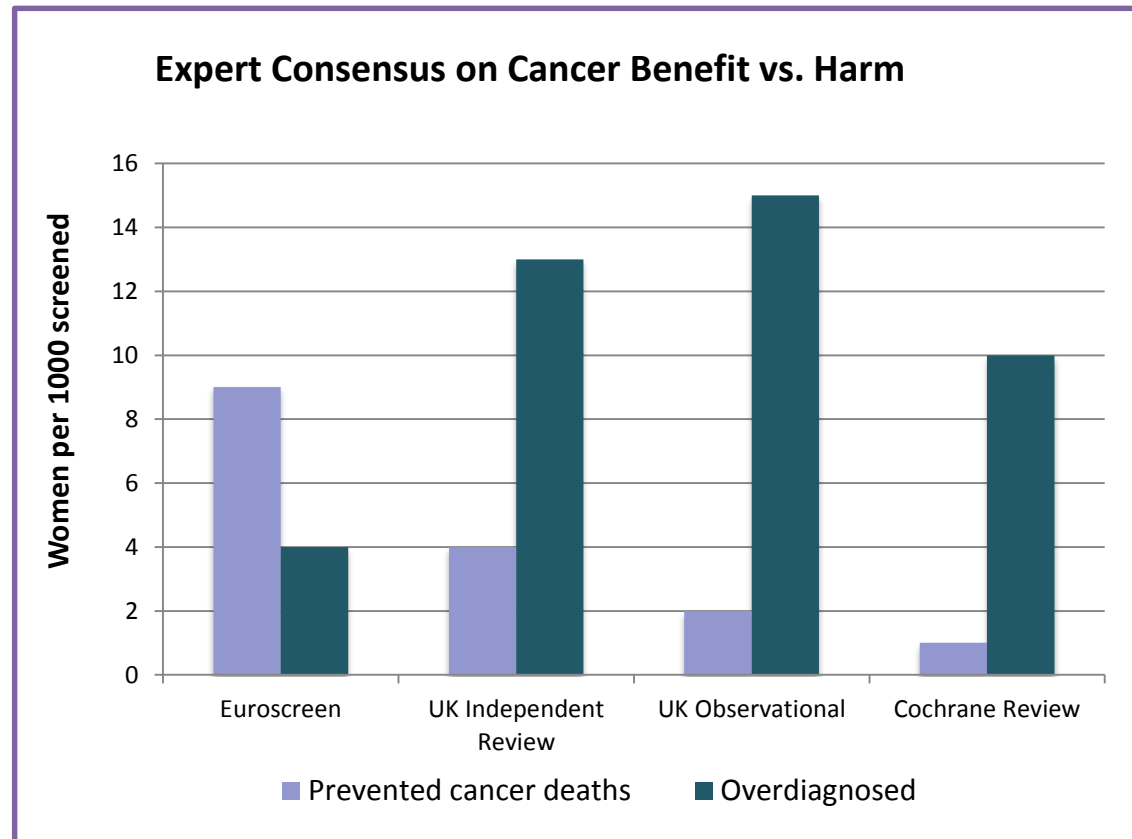
# Interpreting the Results

- Screening is balance of benefits & harms
- Estimations of benefits vs harms, vary  
→ Impact value of screening
- Modeling impact challenging



# Modeling the Impact

- Variables to consider:
  - Appropriate target population (age of exposure, dose, gender)
  - Test quality
  - Test frequency
  - Effectiveness of treatment
- Consider study methodology & biases



# Lung Cancer Evidence

Study	Setting	Outcome	Notes
NLST (National Lung Screening Trial)	USA 55-74yo >30pk-yr hx	20% relative mortality↓	Younger age
NELSON	Belgium/Netherlands 1, 2, 2.5yr interval	TBD Higher interval rate w/ 2.5yrs vs 1,2yr	Comparison w/ no screening 84% male
DANTE	Italy (n=2472) 60-74yo Annual	No impact ? Small sample size	Male only
DLSCT (Danish Randomized Lung Cancer CT screening trial)	Denmark 50-60	No impact ? Greater mass size ? Sample size	Lower risk population
MILD (Multicentric Italian Lung Detection)	Italy	No impact ? Low quality Inadequate randomized	Lower risk population
LUSI (Lung Cancer Screening Intervention)	Germany 50-69yo	TBD	Recall rates decline with each interval Results end of 2018
UKLS (Lung Cancer Screening Intervention)	UK 50-75yo	TBD	Evaluating risk prediction model




# Case for/against Breast cancer screening

## Case for

- ↓ BCa specific mortality
- ↓ morbidity for diagnosed

## Case against


- Personal, financial cost of false +
  - Financial impact of overdiagnosis
  - Discomfort
  - *Radiation (in high-risk subgroups)*
- 

# Case for/against Lung cancer screening

## Case For

- ↓ Lung ca-specific mortality
- ↓ overall mortality
- ? ↓ *morbidity for diagnosed* ?
- ? *Impact on tobacco use* ?

## Case Against

- Focus should remain on prevention (>1000x more cost-effective)
  - High rates of false +, incidental findings
    - Patient distress
    - ↑ cost
  - ↑ incidental findings
  - Radiation exposure
  - Overdiagnosis (13-27%)
  - ? *Impact on tobacco use* ?
- 

# Modeling the Impact: Breast Cancer

## Scenario #1 (Euroscreen)

50,000  
screened

Incidence  
100/100,000

Study  
sensitivity high

High quality  
treatment

### Benefits

40 breast  
cancer deaths  
avoided

Less morbid  
treatment

### Harms

10 Potential  
overdiagnosis

2,000 false (+)

*Per 1,000,000 population*

# Modeling the Impact: Breast Cancer

## Scenario #2 (Cochrane)

50,000  
screened

Incidence  
100/100,000

Study  
sensitivity high

High quality  
treatment

### Benefits

6 breast  
cancer deaths  
avoided

### Harms

100 Potential  
overdiagnosis

5,000 false (+)

*Per 1,000,000 population*

# Modeling the Impact: Lung Cancer

## Scenario #1 (High risk)

25,000  
screened

Incidence  
50/100,000

Specificity  
high (low FP,  
5mm mass)

### Benefits

20 lung  
cancer deaths  
avoided

Reduced  
overdiagnosis

### Harms

Missed  
cancer in  
population

Higher  
programmatic  
costs

# Modeling the Impact: Lung Cancer

## Scenario #2

(Expanded criteria)

Benefits

Harms

50,000  
screened

40 lung  
cancer deaths

20,000 false +

**Key message:** selecting the appropriate target population (high risk, high incidence) and facilitating favourable conditions → increases the effectiveness of screening programme

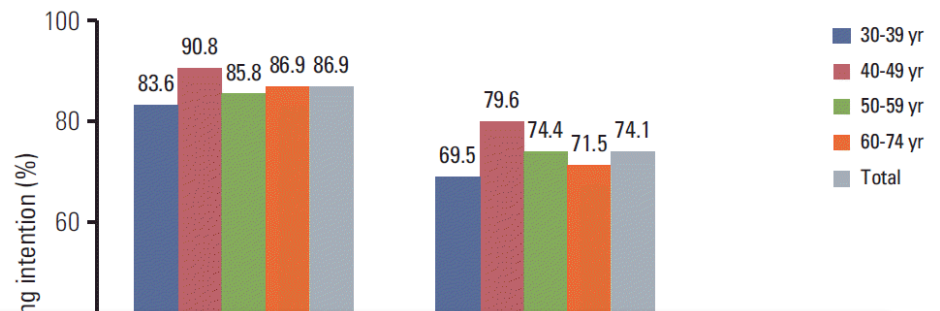
# Providing Integrated People-Centred Care

- Informed decision-making

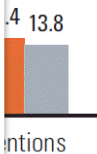
- Expert guidance

- Bias toward intervention, benefits

Change in behavior after counseling for thyroid cancer screening



**Key message:** screening requires balance of all medical ethics principles: autonomy, beneficence, non-maleficence, justice



# Summary

- Just because it can be screened, doesn't mean it should
  - Strict criteria when deciding whether to screen
  - Routine M&E required to ensure programme effectiveness
- Screening can cause real harm to individuals and to health system
  - Communicate balance of benefit/harm to all stakeholders
  - Engagement in public sphere critical



# THANK YOU

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# Next Steps for Lung Cancer Screening

- Additional data pending:
  - 2+ trials pending
  - Cost data / health system impact TBD
- Improving outcomes
  - Screen positive criteria / reduce false +
  - Quality of radiology review
  - Use of biomarkers
  - Review target population