Cancer Screening and Early Detection

Goal

To provide an overview of cancer screening and early detection

The Epidemic of Cancer

Cancer in the 'Developed' World

1900: 1 in 25

1925: 1 in 10

1960: 1 in 4

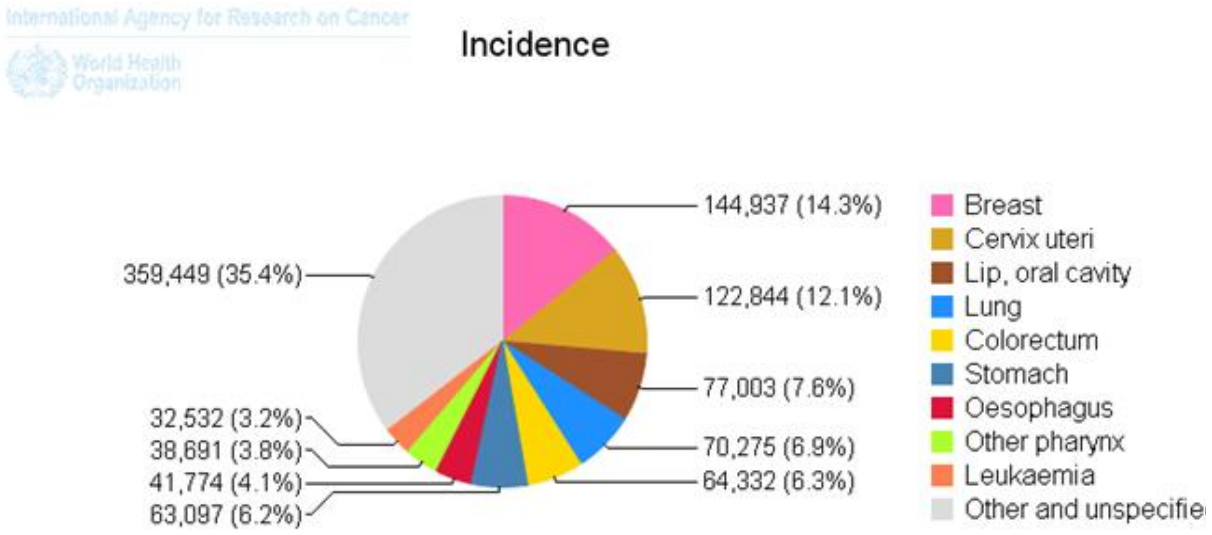
2000: 1 in 3

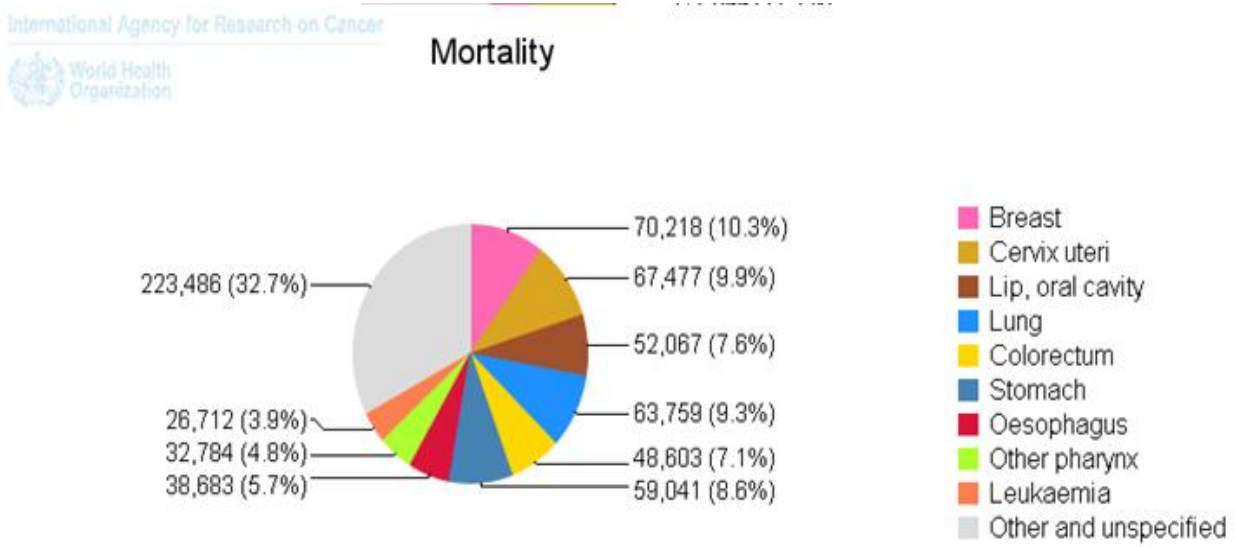
2020 : 1 in 2

The Cost of Cancer

- In 1994, doctors could extend the life of a patient for 1 year
  - Cost of the drugs: $500
- By 2004, they could extend a life by almost 2 years.
  - Cost of the drugs: $250,000
- Canada total cost of cancer: $14 billion (1998)

Indian Scenario





Cancer burden in India: Estimated new cancers

Year	Males	Females	Total
2008	447399	498773	946172
2009	454842	507990	962832
2010	462408	517378	979787
2015	497081	563808	1060889
2020	534354	614404	1148758

Age-adjusted rate of 98 - 143 per 100,000 of population.

One in 8 persons runs the cumulative risk of developing cancer in metropolitan cities in India.

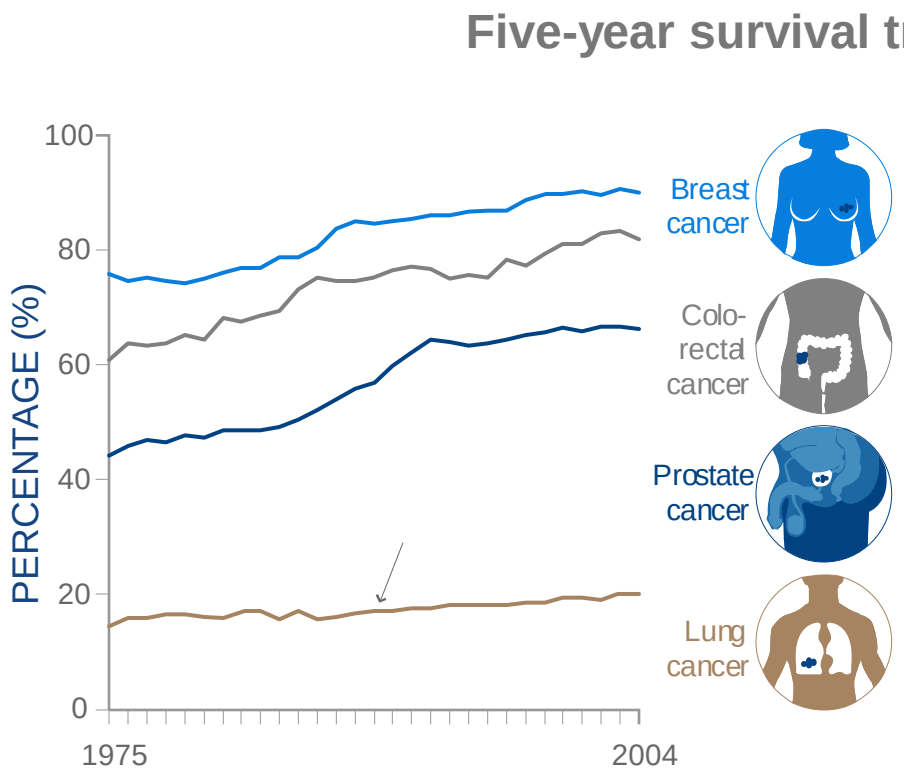
Table 1.1(a): Number (#) and Proportion (%) according to Sex, Sex Ratio Percent - New Cases (2007-2011)

(Calendar years of data shown in parentheses for each registry)

Registry	Males		Females		Sex Ratio%*	Total Cases
	#	%	#	%		
Mumbai *(2006-2007)*	22580	54.9	18528	45.1	122	41108
Bangalore *(2007-2009)*	11273	46.2	13125	53.8	86	24398
Chennai *(2007-2010)*	15731	47.3	17499	52.7	90	33230
Thi'puram *(2007-2010)*	19219	50.5	18809	49.5	102	38028
Dibrugarh *(2007-2011)*	2895	56.0	2276	44.0	127	5171
Guwahati *(2010-2011)*	6803	59.2	4679	40.8	145	11482
Chandigarh *(2011)*	2643	55.8	2092	44.2	126	4735
Total	**81144**	**51.3**	**77008**	**48.7**	**105**	**158152**

** Number of male patients per 100 female patients.*

Survival rates



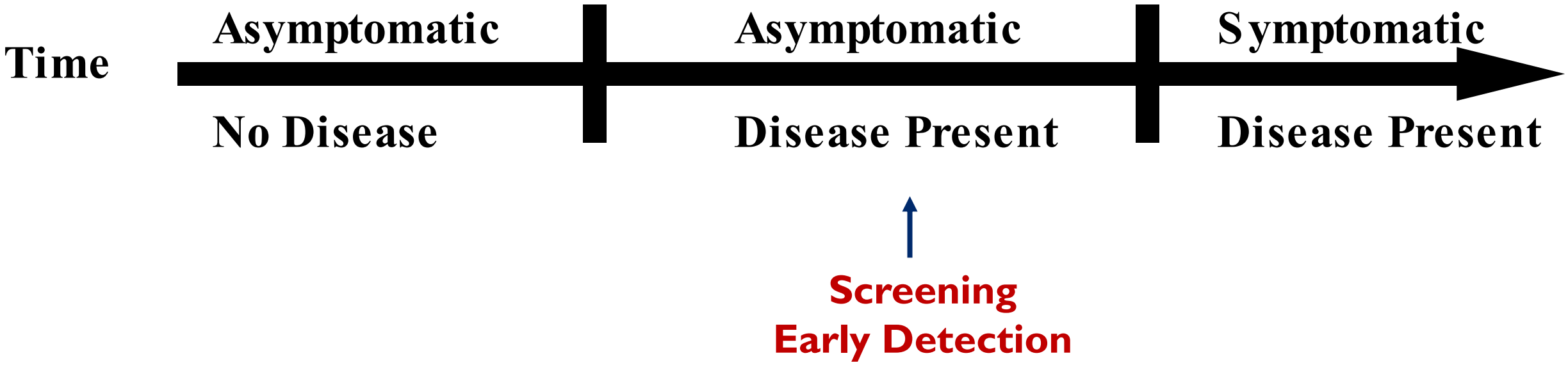
Survival rates vary depending on stage at diagnosis. The later the stage of diagnosis , the lower the survival rates tend to be.

1. SEER. Fast Stats Online. 5 year survival by diagnosis. 1975-2004. All races. All ages. Male and Female. Available online: seer.cancer.gov/faststats/selections.php, accessed on 15/09/2013.

Cancer prognosis

- 55% of all cancers are curable
- 90% of all stage I & stage II
- 40 % - 60% of all stage III
- Majority of stage IV cancers are not curable but a meaningful prolongation of survival is possible

Natural History of Disease



Screening Criteria

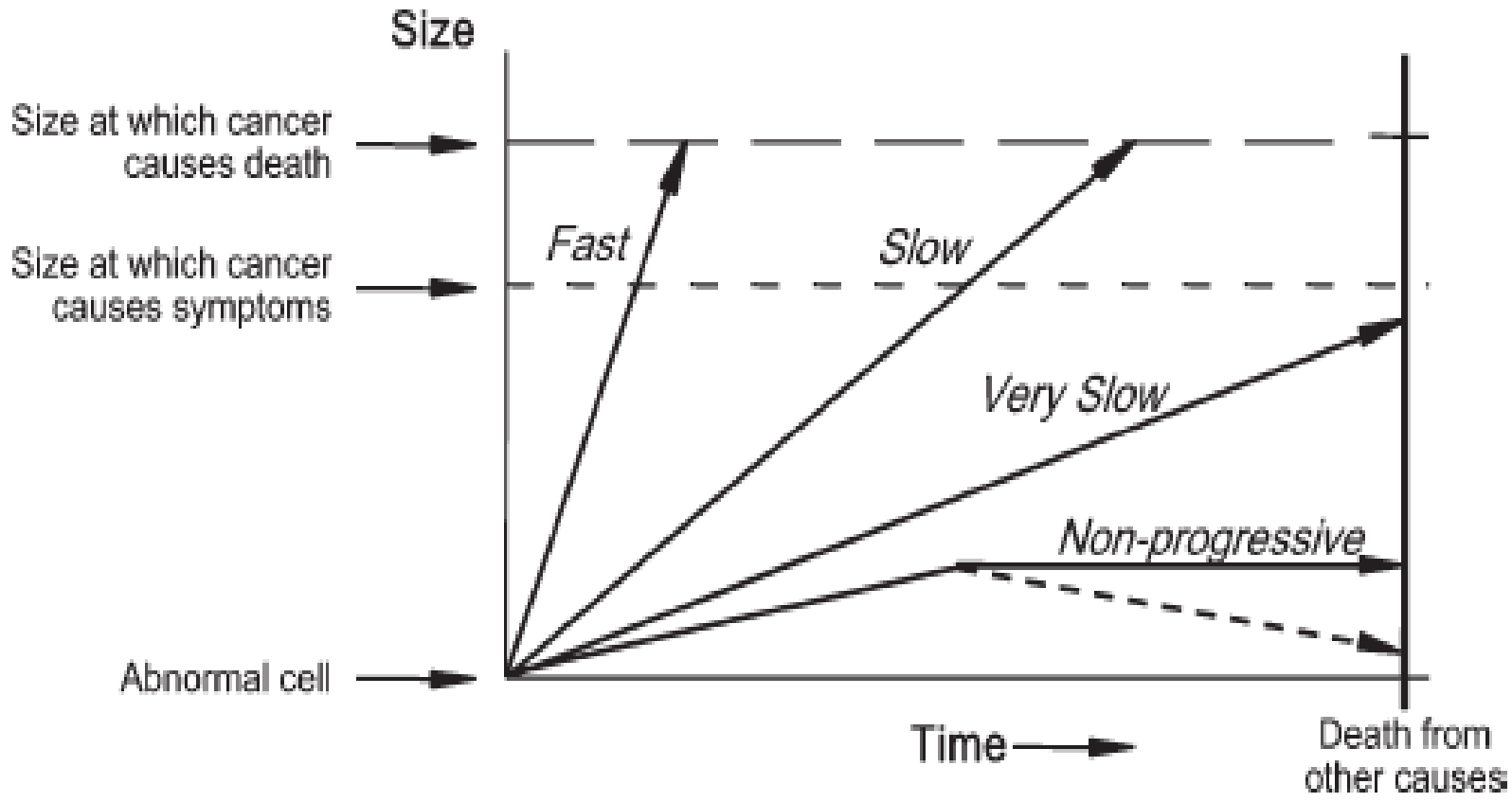
- Significance of the disease, incidence, or burden of suffering
- Disease must have an asymptomatic phase. Detection/treatment must alter natural course.
- A screening procedure must be available with acceptable accuracy.
- Acceptable to physicians (cost, time, skill, equipment)
- Acceptable to patients (cost, time, risks)
- Patients likely to complete diagnostic evaluation
- Cost effective

Two Important Epidemiology Concepts
Incidence and Prevalence

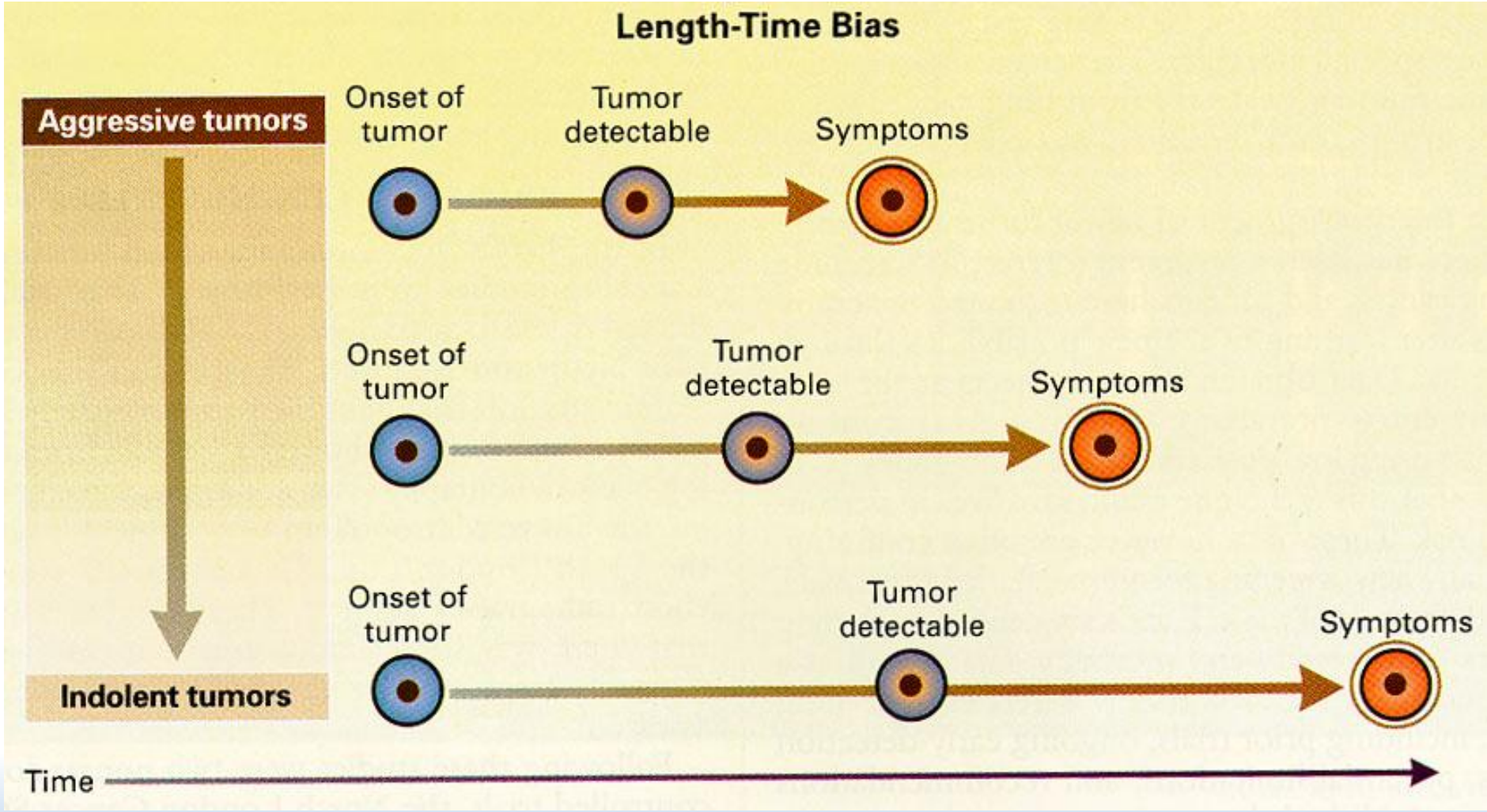
- Incidence = # of new cases per unit of population
  - A measure of risk of developing some new condition over a period of time
  - Incidence rate = # of new cases per unit of population over a period of time
- Prevalence = Total # of cases per unit of population at a given time point
  - Ratio of total number of cases in the total population
  - A measure of disease burden on society

What does “alter the natural course” mean?

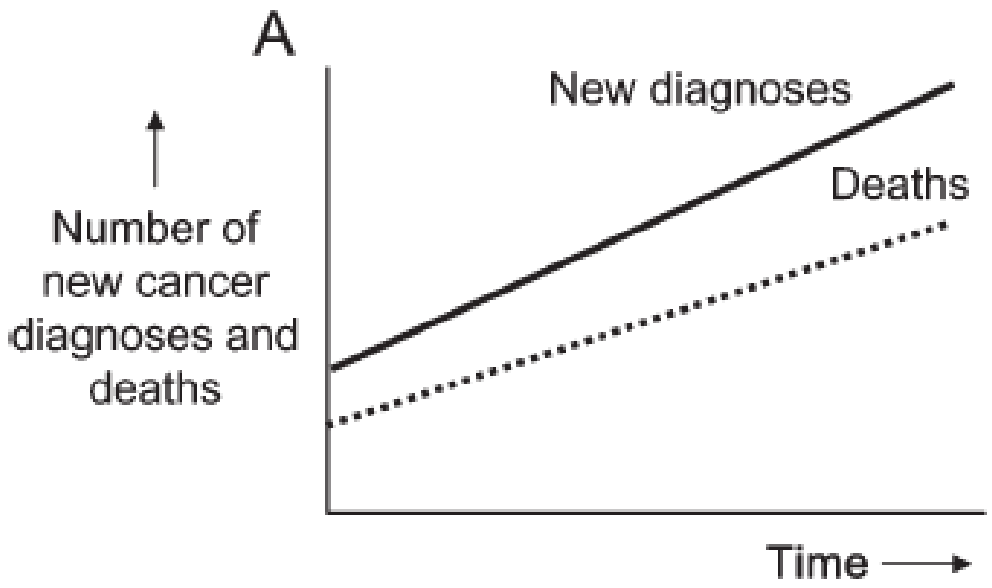
Some Cancers Grow Fast
Others Grow Slowly



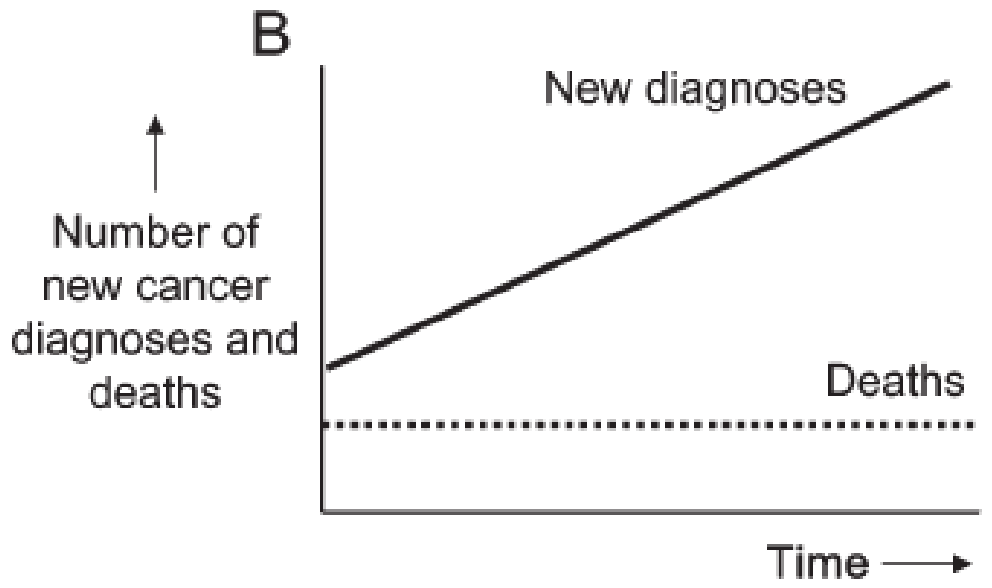
Length Time Bias



Overdiagnosis

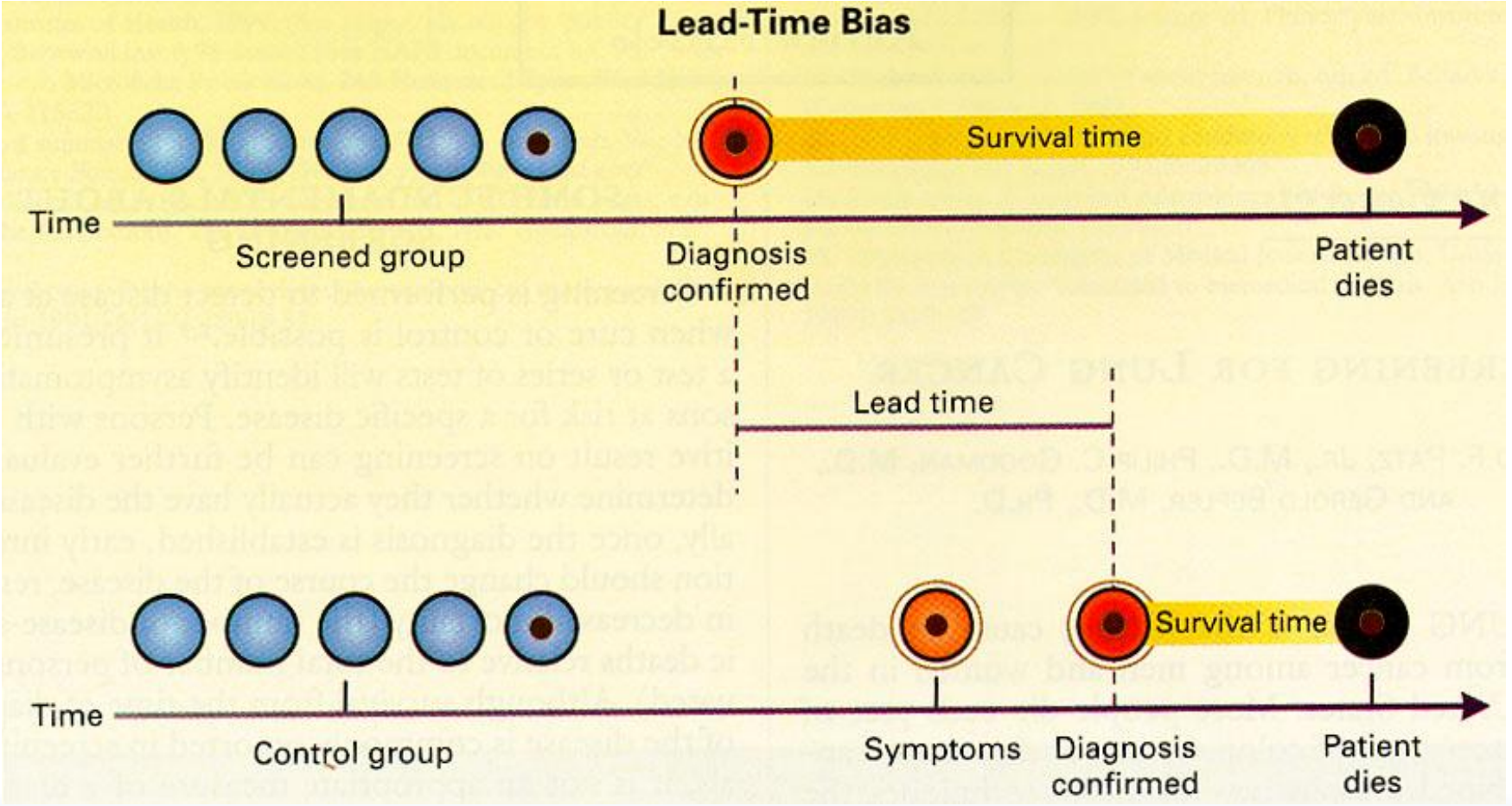


Suggests a true increase in the amount of cancer

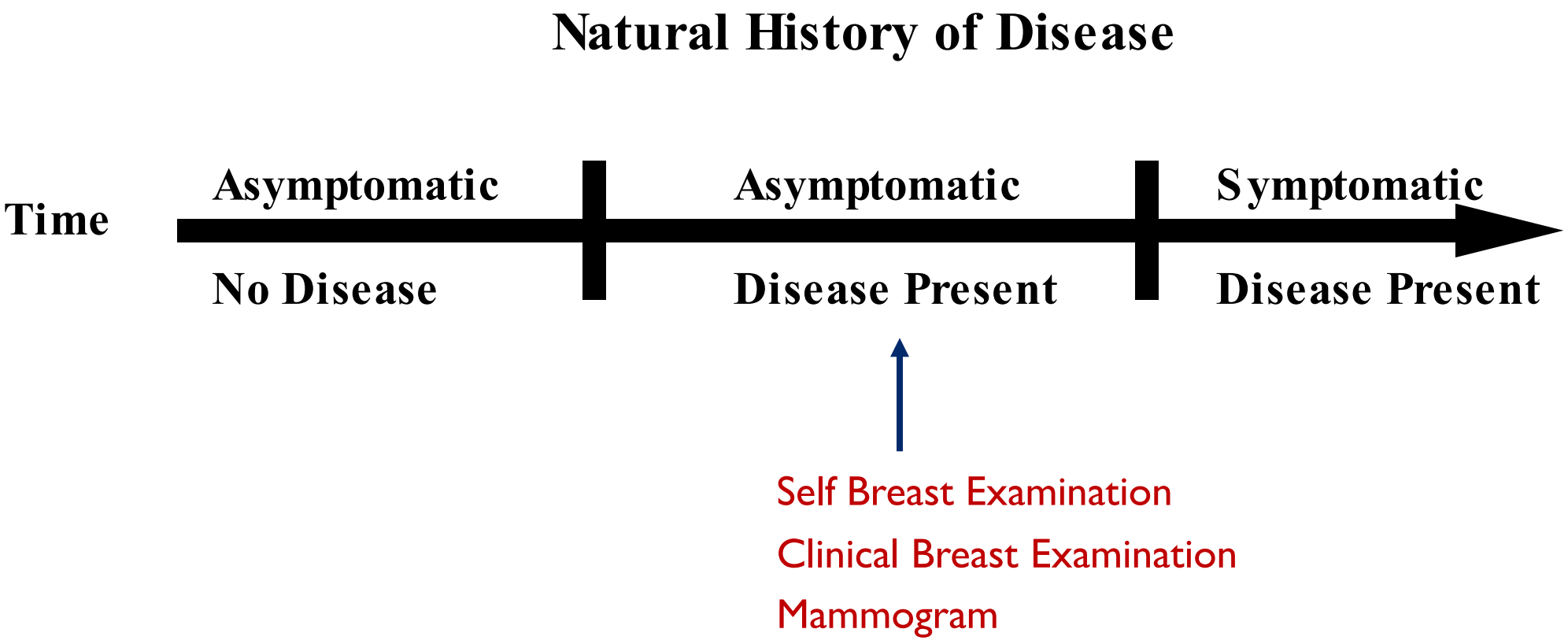


Suggests overdiagnosis of cancer

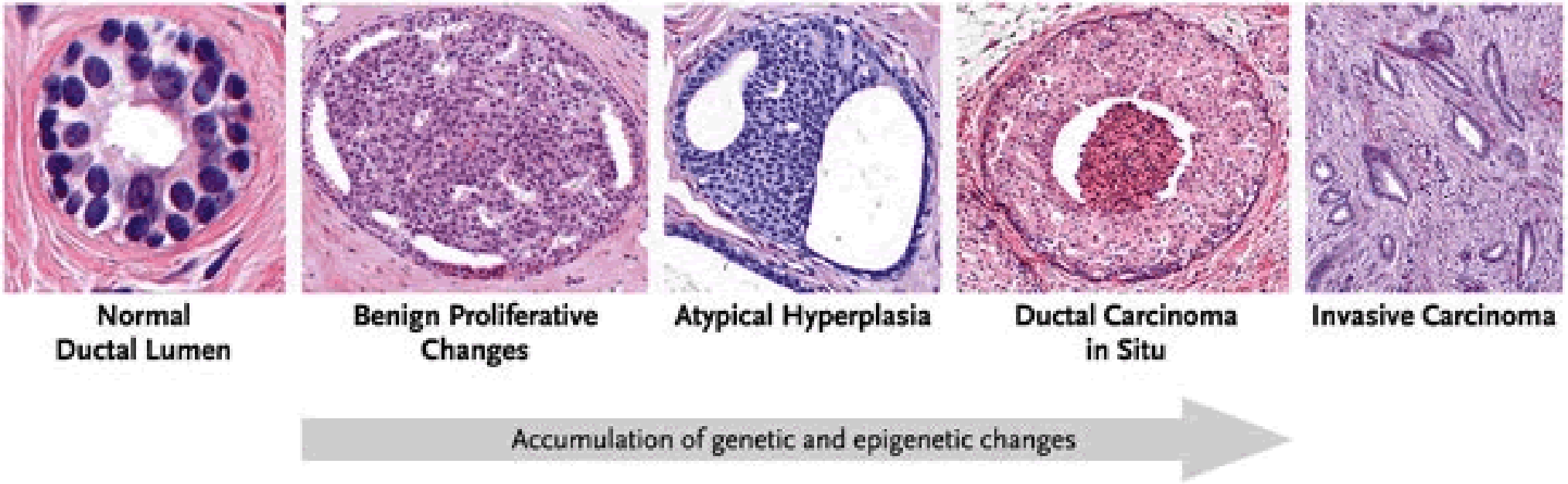
Lead Time Bias



Breast Cancer Screening



Carcinogenesis Progression in the Breast



Breast Cancer: Risk Factors

- 32% of all New Cancers Diagnosed
- Annual Incidence Increased 55% 1950-91
- Lifetime Risk 12.6% or 1/8
- Lifetime Risk of Dying 3.6%
- Duration of menstruation
- Pregnancies, age of first pregnancy
- Family history (sister, mother, grandmother)
  - Genetics (BRCA gene mutation)
- Pre- or Post-menopausal hormone exposure

Breast Cancer

Monthly breast self exam

Clinical Breast Exam - CBE

- Studies suggest 5% of breast cancers are identified by CBE alone
- Community-based study 4% of women with abnormal CBE had cancer
- Canadian National Breast CA study used CBE with and without mammo and found similar mortality
- USPSTF found insufficient evidence “I”

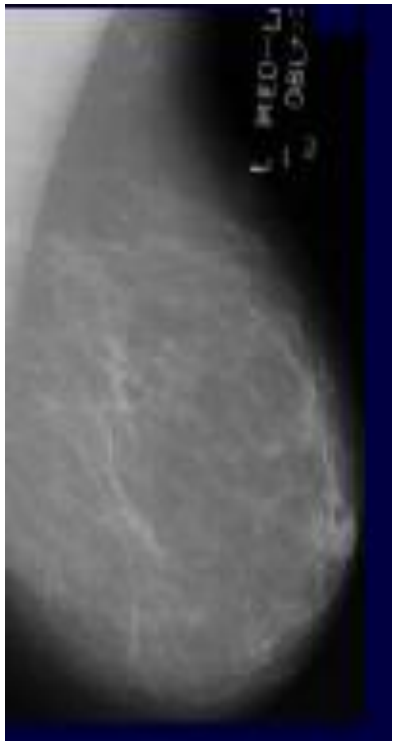
Breast Clinical-Examination

- Exam performed by a trained provider

	Sensitivity	Specificity	PPV	Mortality Reduction?
Breast Self Exam	12-26%	?	?	N
Breast Clinical Exam	45-83%	86-96%	1-4%	N

Agreed upon Recommendations for Breast Cancer Screening

Routine screening for breast cancer every 2 years with mammography alone or mammography and clinical breast exams for women age 50-69.



Potential Impact and Costs

Age 50-69

Annual Clinical Exam+Mammogram

Impact

- Reduce mortality 26-33%
- If 25% of women, then 4,000 fewer deaths per year

Costs

- $16,000-$21,000 per year of life saved

Why the difference between 40-49 and 50 - 74?

- Lower Risk Group (fewer cases in screening)
- More over diagnosis (Ductal carcinoma in situ rather than invasive cancer)
- Breasts thicker, harder to image (technology issues)

Harms Associated with Breast Screening

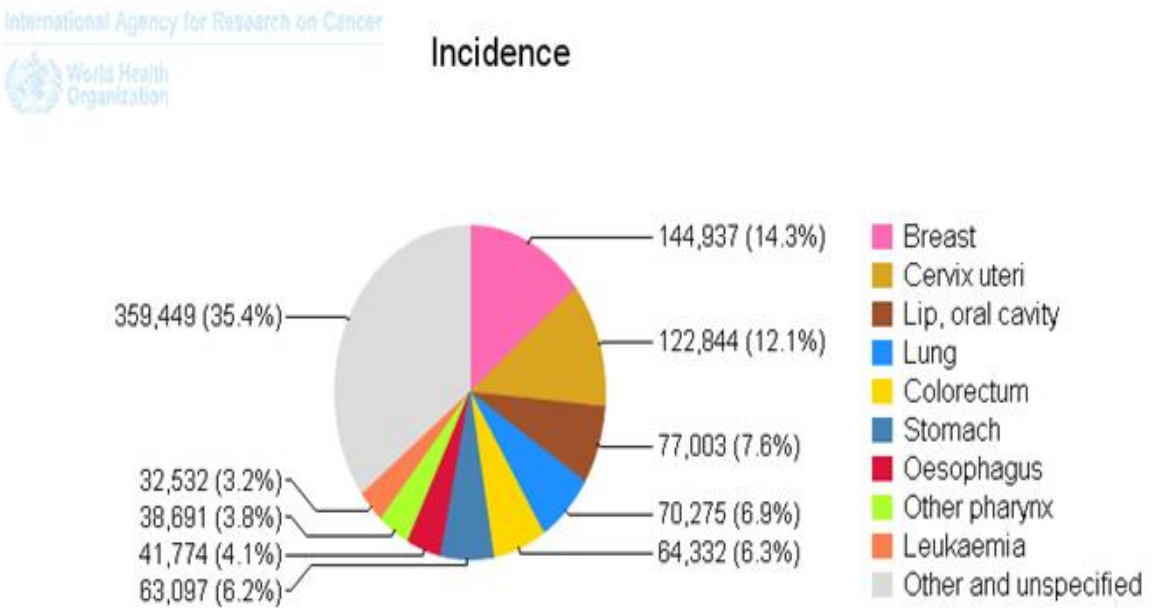
- Increased diagnostic procedures
  - Needle biopsies, excisions
  - Mammography
- Double the number of benign lesions
- Emotional distress of once monthly self exams
- Scar, deformed breast
- Overdiagnosis

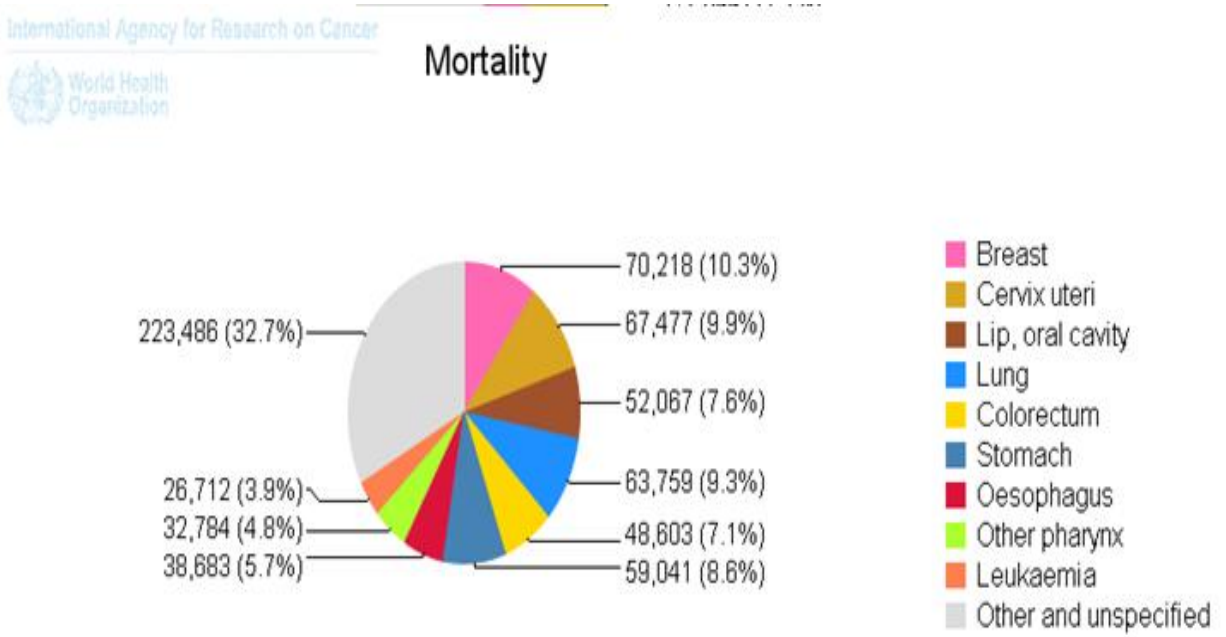
Breast Cancer Screening: Bottom Line Take Home Message

- Routine, mammographic and clinical examination screening every 2 years for women ages 50-74 saves lives.
  - Cost effective
  - Overdiagnosis a problem, but mortality reductions justify
- Self examination does not save lives and is not recommended
- Routine mammographic screening for women between ages 40-49 years is controversial.
  - Individualize on the basis of risk
  - Substantial overdiagnosis with overtreatment a major concern

Screening for cervical cancer

Indian Scenario





Introduction

- It is common knowledge that the most important cause of cervical cancer is persistent papillomavirus infection

- The human papilloma virus (HPV) is detected in 99% of cervical tumors, in particular the oncogenic subtypes such as HPV 16 and 18

Annals of Oncology 23 (Supplement 7): vii27–vii32, 2012

Screening for Cervical cancer

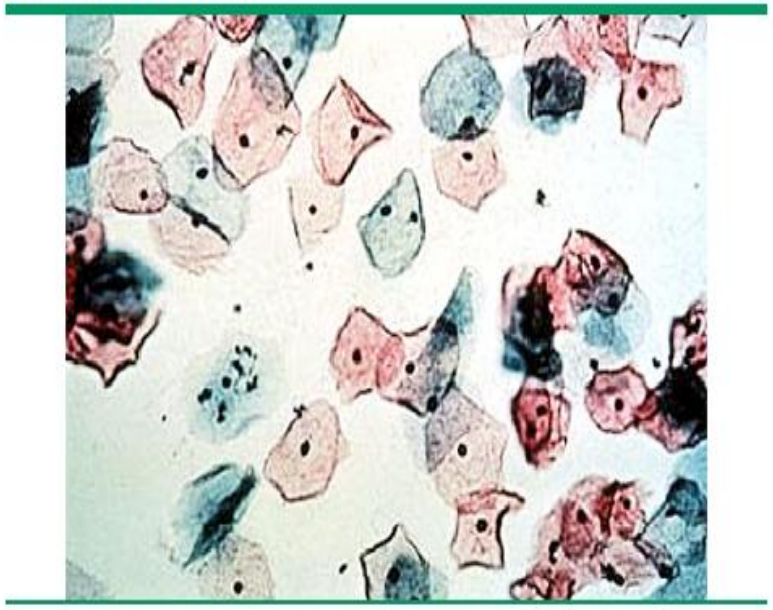
- Cervical cancer screening can detect very early changes that, untreated, could lead to invasive cervical disease over the course of many years

- The generally long latency between the detection of abnormalities by screening and the development of invasive cancer raises questions of the optimal frequency of testing and emphasizes the need to balance benefits of cervical cancer screening with potential harms, especially in younger women

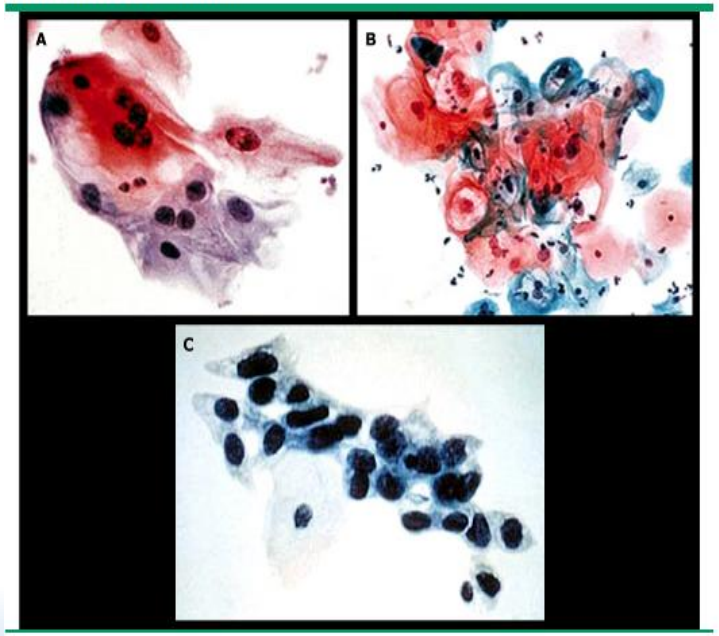
Screening for Cervical cancer

- The **Pap test** aims to identify abnormal cells sampled from the transformation zone, the junction of the ecto- and endocervix, where cervical dysplasia and cancers arise

Normal pap smear



Abnormal pap smear



A) Atypical squamous cells of undetermined significance (ASCUS). B) Low grade squamous intraepithelial lesion (LSIL). C) High grade squamous intraepithelial lesion (HSIL).

Screening for Cervical cancer

- **Primary HPV screening** — HPV testing, either alone or in combination with cervical cytology, has been shown in multiple studies to be more sensitive than cervical cytology alone in detecting high- or low-grade cervical histopathology

- Poor specificity and correspondingly poor positive predictive value, however, limit the use of HPV testing alone as a primary screening modality, particularly in younger women

Screening for Cervical cancer

- Primary HPV testing in women under 30 years of age results in substantial detection of transient HPV infections and unnecessary colposcopies
- Adding HPV to routine primary Pap smear screening, or primary HPV testing alone in women over 30, appears to result in earlier diagnosis of high-grade lesions
- One trial has demonstrated a decrease in the overall incidence of cancer with HPV testing, although a mortality benefit has not been demonstrated

Screening for Cervical cancer

- **Other screening modalities**

- **Visual inspection** — Lesions identified by visual inspection warrant biopsy even in the presence of a normal cervical smear

- Visual inspection with acetic acid (VIA) or Lugol's iodine is used for cervical cancer screening in India.

Recommendations

- All guidelines recommend only cytology screening for women aged 21 to 29 years

- Recommendations differ regarding the combination of cytology plus HPV testing (co-testing) for women 30 years and older

CANCER PREVENTION

Risk Factors

Personal and dietary factors
Smoking
Sun tanning
Absence of UV light (Vit.D)
Obesity
Lack of regular exercise

Other food factors
Processed foods
BGH in milk
Sugar and alcohol
Smoked meats
Non-organic food
Pesticides

Workplace exposure
Solvents
Heavy metals
Diesel fuel
Benzene
Asbestos
+++

Radiation
Solar UV
Ionizing radiation
EMF radiation

Radiation from nuclear
Exposure to toxic substances
By parents or grandparents
Before conception
In the womb
During infancy
In puberty

Air pollution
Second hand smoke
Benzene
Diesel
Asbestos
Indoor air pollutants
Coal-fired power

Endocrine disruptors
Endocrine disrupting chemicals
Increased exposure to natural estrogen
Loss of darkness, reducing melatonin

Other factors
Family history of cancer
Poverty
Loss of Vitamin D from sunlight
Genetic variability

Familial Cancer Syndromes

Water pollution
Chlorine by-products
Industrial chemicals
Pesticide residues
Fluoride
Hormone disruptors

Toxic products
Cosmetics
Fire retardants
Solvents
Non-stick agents
Cleaning products
Building products
Plasticizers
Some drugs
Hormone replacement therapy
Some surgical implants

Natural carcinogens
Radon gas
Fungal aflotoxins in food

Infectious agents
Hepatitis B & C
HIV
Human Papilloma virus

Reduced immunity
Toxic substances that weaken the immune systems ability to fight cancer

Familial Cancer Syndromes

- Cancer in multiple members of a family
- Cancer at early age 10 years earlier than normal
- Cancer before the age of 40 years

- FAP (familial adenomatosis polyposis)
- HNPCC
- Hereditary ovary breast cancer

7 Warning Signs

C hange in bowel or bladder habits

A sore that does not heal

U nusual bleeding or discharge

T hickening or lump in the breast

I ndigestion or difficulty swallowing

O bvious change or discharge in a mole

N agging cough or hoarseness

General Prevention

- Smoking
- Diet
- Obesity
- Alcohol
- Drugs
- Pollution

TABLE 16.2 Preventing Cancer through Diet and Lifestyle

Type of Cancer	Factors that Decrease Risk	Factors that Increase Risk
Breast	Engage in physical activity for at least 4 hours per week; consume lots of fruits and vegetables	Obesity and weight gain; alcohol consumption; hormone replacement therapy
Colorectal	Engage in regular, moderate physical activity; consume lots of fruits and vegetables	High intake of red meat; smoking; alcohol consumption; obesity
Lung	Consume at least 5 servings of fruits and vegetables daily	Tobacco use; some occupations
Oral/Throat	Consume at least 5 servings of fruits and vegetables daily; engage in regular, moderate physical activity	Tobacco use; obesity; alcohol consumption; salted foods
Prostate	Consume at least 5 servings of fruits and vegetables daily	High intake of red meat and high-fat dairy products
Stomach	Consume at least 5 servings of fruits and vegetables daily; refrigerate food	Salted foods; *Helicobacter pylori* bacteria

Here are some additional tips issued by a panel of cancer researchers:

- Avoid being underweight or overweight, and limit weight gain during adulthood to less than 11 pounds.
- If you don't get much exercise at work, take a 1-hour brisk walk or similar exercise daily, and exercise vigorously for at least 1 hour a week.
- Eat 8 or more servings a day of cereals and grains (such as rice, corn, breads, and pasta), legumes (such as peas), roots (such as beets, radishes, and carrots), tubers (such as potatoes), and plantains (including bananas).
- Limit consumption of refined sugar.
- Limit alcoholic drinks to less than 2 a day for men and 1 for women.
- Limit intake of red meat to less than 3 ounces a day, if eaten at all.
- Limit consumption of salted foods and use of cooking and table salt. Use herbs and spices to season foods.

Sources: World Cancer Research Fund, American Institute for Cancer Research, "Food, Nutrition and the Prevention of Cancer," www.wecf-uk.org; American Cancer Society, "The Complete Guide: Nutrition and Physical Activity," www.cancer.org.

Cancer Prevention

- **Prophylactic Surgery:**
  - High risk individuals: Breast, colon, stomach, ovarian & endometrial Cancer

- **Chemoprevention:**
  - Tamoxifen in Breast
  - Bisphosphonates in MM, Breast
  - Metformin
  - Curcumin / Green tea

THANK YOU