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

<table>
<thead>
<tr>
<th>Year</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>1 in 25</td>
</tr>
<tr>
<td>1925</td>
<td>1 in 10</td>
</tr>
<tr>
<td>1960</td>
<td>1 in 4</td>
</tr>
<tr>
<td>2000</td>
<td>1 in 3</td>
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<tr>
<td>2020</td>
<td>1 in 2</td>
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</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Year</th>
<th>Males</th>
<th>Females</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>447399</td>
<td>498773</td>
<td>946172</td>
</tr>
<tr>
<td>2009</td>
<td>454842</td>
<td>507990</td>
<td>962832</td>
</tr>
<tr>
<td>2010</td>
<td>462408</td>
<td>517378</td>
<td>979787</td>
</tr>
<tr>
<td>2015</td>
<td>497081</td>
<td>563808</td>
<td>1060889</td>
</tr>
<tr>
<td>2020</td>
<td>534354</td>
<td>614404</td>
<td>1148758</td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>Registry</th>
<th>Males</th>
<th>Females</th>
<th>Sex Ratio%</th>
<th>Total Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#</td>
<td>%</td>
<td>#</td>
<td>%</td>
</tr>
<tr>
<td>Mumbai (2006-2007)</td>
<td>22580</td>
<td>54.9</td>
<td>18528</td>
<td>45.1</td>
</tr>
<tr>
<td>Bangalore (2007-2009)</td>
<td>11273</td>
<td>46.2</td>
<td>13125</td>
<td>53.8</td>
</tr>
<tr>
<td>Chennai (2007-2010)</td>
<td>15731</td>
<td>47.3</td>
<td>17499</td>
<td>52.7</td>
</tr>
<tr>
<td>Thi'puram (2007-2010)</td>
<td>19219</td>
<td>50.5</td>
<td>18809</td>
<td>49.5</td>
</tr>
<tr>
<td>Dibrugarh (2007-2011)</td>
<td>2895</td>
<td>56.0</td>
<td>2276</td>
<td>44.0</td>
</tr>
<tr>
<td>Guwahati (2010-2011)</td>
<td>6803</td>
<td>59.2</td>
<td>4679</td>
<td>40.8</td>
</tr>
<tr>
<td>Chandigarh (2011)</td>
<td>2643</td>
<td>55.8</td>
<td>2092</td>
<td>44.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>81144</td>
<td>51.3</td>
<td>77008</td>
<td>48.7</td>
</tr>
</tbody>
</table>

* Number of male patients per 100 female patients.
Survival rates vary depending on stage at diagnosis. The later the stage of diagnosis, the lower the survival rates tend to be.

PERCENTAGE (%)

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

Time

Asymptomatic

Disease Present

Symptomatic

Asymptomatic

No Disease

Disease Present

Symptomatic

Disease Present

Screening

Early Detection
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

The diagram illustrates the concept of Length-Time Bias with two types of tumors: Aggressive tumors and Indolent tumors. It shows the progression from the onset of the tumor to when it becomes detectable and eventually symptomatic. The timeline indicates the duration between the onset of the tumor and the appearance of symptoms.
Overdiagnosis

Graph A:
- Number of new cancer diagnoses and deaths vs. time
- New diagnoses and deaths increase over time
- Suggests a true increase in the amount of cancer

Graph B:
- Number of new cancer diagnoses and deaths vs. time
- New diagnoses increase over time
- Deaths remain constant
- Suggests overdiagnosis of cancer
Lead Time Bias
Breast Cancer Screening

Natural History of Disease

Time
Asymptomatic
Disease Present
Symptomatic
Disease Present
Asymptomatic
No Disease

Self Breast Examination
Clinical Breast Examination
Mammogram
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

Breast self-exam:
Manual inspection (reclining)

With fingertips close together, gently probe each breast in one of these three patterns
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 mammography and found similar mortality

- USPSTF found insufficient evidence “I”
Breast Clinical-Examination

- Exam performed by a trained provider

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>Mortality Reduction?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast Self Exam</td>
<td>12-26%</td>
<td>?</td>
<td>?</td>
<td>N</td>
</tr>
<tr>
<td>Breast Clinical Exam</td>
<td>45-83%</td>
<td>86-96%</td>
<td>1-4%</td>
<td>N</td>
</tr>
</tbody>
</table>
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

Incidence

Mortality
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.
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.
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.
• 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

**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

**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

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

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

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

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.

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