**BREAST CANCER**

- Most common non-skin cancer and Second deadliest cancer in women
- Majority are diagnosed by abnormal screening study
- An approach to breast cancer screening should incorporate an individual's level of breast cancer risk, established by history and by use of a risk prediction model.
RISK FACTORS

- Age (Older > Younger)
- Nulliparity
- Menarche <11
- Genetic predisposition
- Estrogen exposure

Breast Density
- Women with 50-74% density have a 3 to 4 fold increased risk of breast CA compared to women with <5% breast density.
- Increased risk is particularly high in women who continue to have dense and nodular breast parenchyma beyond menopause.
Purpose: To stratify women into risk categories that can be used to determine optimal screening strategies and indications for possible prophylactic therapies.

- Breast Cancer Risk Assessment Tool (BCRAT) - also known as the Gail Model

- Tyrer-Cuzick Breast Cancer Risk Assessment Model - also known as IBIS (International Breast Cancer Intervention Study)

- BRCAPRO - University of Texas Southwestern Medical Center at Dallas and Duke University - incorporates 6 predictive models for inherited or familial breast CA

- BOADICEA model - determines breast and ovarian cancer susceptibility b/c of genetic mutations
Women with lifetime risk <15%:

- **Women 50 - 70 y/o:** recommend screening with mammography.
- **Women 40 - 50 y/o:** recommend discussion of the risks and benefits of mammography, the decision to perform mammography should be determined by individual patient risk and values through shared decision-making.
- **Women > 70 y/o:** recommend screening if their life expectancy is at least 10 years.
- **Women < 40 y/o:** advise against breast cancer screening.
Data is limited on the optimal frequency for performing mammography.

Several Randomized trials evaluating the effectiveness of mammogram screening have used varying time intervals without apparent effect on study results.
Family h/o breast, ovarian, or peritoneal cancer - using one of several available risk tools to determine if she is a candidate for genetic testing.

Women with a known genetic predisposition to breast cancer (i.e. BRCA1 or BRCA2 gene mutation) should receive counseling for several preventative options, as well as more intense screening for breast cancer.

Women without a known genetic syndrome, but who have a family h/o breast cancer in a 1st degree relative, screening mammogram should be initiated at an earlier age, particularly if the family member had premenopausal breast cancer.
BRCA1 OR BRCA2 GENE MUTATIONS

- Women who test positive for BRCA1 or BRCA2 mutations are at increased risk of both breast and ovarian cancer.

- Recommend referral for counseling to consider options for reducing risk and intensified surveillance.

- NCCN and ACS Guidelines: recommend annual mammogram and breast MRI for breast cancer surveillance.
# Age to Initiate

<table>
<thead>
<tr>
<th>Society</th>
<th>Recommended Age to Initiate</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Cancer Society</td>
<td>40 yo</td>
</tr>
<tr>
<td>American College of Radiology</td>
<td>40 yo</td>
</tr>
<tr>
<td>American Medical Association</td>
<td>40 yo</td>
</tr>
<tr>
<td>National Cancer Institute</td>
<td>40 yo</td>
</tr>
<tr>
<td>ACOG</td>
<td>40 yo</td>
</tr>
<tr>
<td>NCCN</td>
<td>40 yo</td>
</tr>
<tr>
<td>USPSTF</td>
<td>50 yo</td>
</tr>
<tr>
<td>American College of Physicians</td>
<td>50 yo</td>
</tr>
<tr>
<td>American Academy of FP’s</td>
<td>50 yo</td>
</tr>
<tr>
<td>Canadian Task Force 2011</td>
<td>50 yo</td>
</tr>
<tr>
<td>Advisory Committee on Cancer Prevention in European Union 2000</td>
<td>50 yo</td>
</tr>
</tbody>
</table>
Several groups do not explicitly state at what age breast cancer screening should stop.

<table>
<thead>
<tr>
<th>Society</th>
<th>Age to discontinue</th>
</tr>
</thead>
<tbody>
<tr>
<td>USPSTF</td>
<td>74 yo</td>
</tr>
<tr>
<td>Canadian Task Force</td>
<td>74 yo</td>
</tr>
<tr>
<td>American College of Radiology</td>
<td>Until life expectancy is &lt;5-7 yrs</td>
</tr>
<tr>
<td>ACOG</td>
<td>&gt;75 yo should consult with their clinician</td>
</tr>
</tbody>
</table>
## Screening with Clinical Breast Exam

<table>
<thead>
<tr>
<th>Society</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Cancer Society</td>
<td>Q3 yrs age 20-39, Q1 yr &gt;40</td>
</tr>
<tr>
<td>ACOG</td>
<td>Q1-2 yrs 20-39, Q1 yr &gt;40</td>
</tr>
<tr>
<td>USPSTF</td>
<td>Insufficient Evidence</td>
</tr>
<tr>
<td>Canadian Task Force</td>
<td>Recommends against</td>
</tr>
<tr>
<td>WHO</td>
<td>Does not recommend</td>
</tr>
</tbody>
</table>
## Screening with Breast Self-Exam

<table>
<thead>
<tr>
<th>Society</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian Task Force</td>
<td>Against, on basis of no evidence of reduction of mortality and evidence of increased harm</td>
</tr>
<tr>
<td>USPSTF</td>
<td>Against teaching women the procedure</td>
</tr>
<tr>
<td>American Cancer Society</td>
<td>Women should be educated about the benefits and limitations of BSE</td>
</tr>
<tr>
<td>ACOG</td>
<td>Recommend breast self-awareness, which “can include BSE”</td>
</tr>
<tr>
<td>WHO</td>
<td>Against BSE</td>
</tr>
<tr>
<td>NCCN</td>
<td>Against instruction on SBE</td>
</tr>
<tr>
<td>Advisory Committee on Cancer Prevention in European Union</td>
<td>No convincing evidence for the effect of screening based on BSE or CBE</td>
</tr>
</tbody>
</table>
Breast Cancer Screening Modalities

- Film Mammography
- Full Field Digital Mammography
- MRI
- Thermography
- Ultrasonography
- Tomosynthesis
Sensitivity: 84%
Specificity: 90%

2012 meta-analysis of randomized trials found 20% relative risk reduction for breast CA mortality in women invited to screening compared to controls.

2014 long-term follow up study raises questions of a possible decreased impact of mammography as treatment for breast cancer has become more effective.
FULL-FIELD DIGITAL MAMMOGRAPHY

- Image captured by an electronic detector and stored on a computer
- Several studies have found little difference in cancer detection rates between digital and film mammography
- Benefit is to radiologist because they can be lightened or darkened, and certain sections can be enlarged and looked at more closely.
Screening breast MRI has been found to be more sensitive but less specific than mammography for the detection of invasive cancers in high risk women.
ACS - recommend offering annual MRI w/annual mammogram to women in certain high risk groups:
- Known BRCA mutation carriers
- 1st degree relatives of known BRCA mutation carriers
- Women with a lifetime risk of breast cancer >20%

NCCN - recommend annual MRI w/annual mammogram for women with a strong family history or genetic predisposition:
- BRCA1 or BRCA2 mutation carriers
- Untested women w/1st degree relative w/BRCA1/BRCA2
- Lifetime risk >20%
- Received radiation treatment to chest between ages 10-30 yo
- Genetic mutation in TP53 or PTEN
NIH recommends offering annual MRI in addition to mammography to the following high-risk groups:

- BRCA1/BRCA2 mutation carriers, and untested women with >30% probability of BRCA carrier, starting at age 30 until age 49; for women with a dense breast pattern continue until age 69
- TP53 mutation carriers, starting at 20-69 yo
- Untested women with >30% probability of TP53 carrier, starting at age 20-49; for women with dense breast pattern, continue until age 69
The use of thermography to detect occult breast cancer was based on the observation that patients have elevated breast skin temperatures over their breast cancers.

Specificity: LOW

No major organization making screening recommendations recommend thermography.
Ultrasound has not been evaluated in randomized trials of breast cancer screening for an effect on reducing breast cancer mortality.

- NOT appropriate for initial screening
- Used as an adjunct to mammography for screening in women with increased breast density
TOMOSYNTHESIS

- Provides 3D images and is a modification of digital mammography using a moving x-ray source and digital detector.
- Approved in the US for breast cancer screening when used in combination with mammography.
- Tomosynthesis + Mammogram = modestly increased rates of cancer detection and decreased recall rates for false-positive mammography readings.
- Effects on breast cancer mortality have not been assessed.
False Positive Readings
- More common in younger women, women with dense breast tissue, women who have mammograms more frequently
- Heightened anxiety
- May impact future screening behavior

Over diagnosis
- Slow growing Cancers/regression of tumors - detection of disease that would not have caused morbidity or mortality had it not been found
- 10-30% estimate of over diagnosis
Ductal Carcinoma In Situ

- As breast cancer screening has increased, the detection of DCIS has risen.

- 20% of the breast CA diagnosed in the US are DCIS.

- The natural history of DCIS is not clear, may cases may not proceed to invasive CA.
Ionizing radiation increases the risk for breast CA

Excess risk of breast CA after 10 year latent period is linearly dependent on:
- Radiation dose (high doses increase risk)
- Age at onset of screening (Younger age at exposure increases risk)
- Attained age or number of years since exposure (risk increases with increased time since exposure)
COMPRESSION

- Increases the image contrast and quality
- Decreases the radiation dose
- Allows for uniform x-ray penetration through the tissues
- Reduces motion and minimizes superimposition of tissues
Mammographic screening can be uncomfortable or painful, as the breast needs to be compressed to achieve adequate images.

One well-designed study found that *patient-controlled breast compression* reduced patient discomfort while achieving good image quality.

Pre-medication with *Tylenol* or *Ibuprofen* did not reduce pain.

Topical application of *4% Lidocaine gel* to the breast and chest wall reduced discomfort.

Reduced discomfort correlated with increased intent to return for another screening exam.
ABNORMALITIES ON MAMMOGRAM

- **Spiculated focal mass** - positive predictive value is 81%
- **Density of a non-calcified mass** - 70% of masses with high density are malignant, 22% of masses with low density are malignant
- **Clustered Microcalcifications** - (>4/5 per cubic cm), seen in approx 60% of cancers. Represent intraductal calcifications in areas of necrotic tumor or calcifications within mucin-secreting tumors.
- **Linear Branching Microcalcifications** - have a higher predictive value for malignancy than do granular, particularly for high grade DCIS.
BI-RADS CLASSIFICATION

- **BI-RADS 0**: Incomplete assessment - Need additional imaging and/or prior mammograms for comparison
- **BI-RADS 1**: Negative
- **BI-RADS 2**: Benign Findings - Benign nodules such as fibroadenomas, cysts, vascular or parenchymal calcifications
- **BI-RADS 3**: Probably benign findings - likelihood of malignancy is <2%. Usually followed with diagnostic mammogram and US Q6 mo x 1 year, then annually for additional 2 years.
- **BI-RADS 4**: Suspicious abnormality - Bx should be considered
- **BI-RADS 5**: Highly suggestive of Malignancy - spiculations, pleomorphic calcifications, skin retraction. The suspicion for malignancy is 95 to 100%
- **BI-RADS 6**: Biopsy-proven malignancy
SPECIAL PATIENT POPULATIONS

- **Breast implants** -
  - obscure small lesions,
  - require 4 views instead of usual 2 views per breast
  - Implants placed behind the pectoralis muscle are easier to position

- **Prior biopsy or surgery for benign disease**
  - Reduced mammogram specificity and lower positive predictive value

- **Breast reconstruction/post mastectomy**
  - Mammogram not routinely performed follow mastectomy when no breast tissue is left behind

- **Pregnancy and Lactation**
  - Only preformed for evaluation of suspected cancer and to assess clinical findings not clarified with ultrasound
  - Most breast disorders encountered during this period are benign and secondary to hormonal changes
  - However, breast cancer in pregnancy represents up to 3% of all breast cancers

- **Postmenopausal hormone therapy**
  - Increases breast density and may decrease sensitivity of mammogram

- **Males**
  - Only done for suspected masses
SCREENING VS DIAGNOSTIC

- **Screening**
  - No clinical symptoms or complaints
  - 2 standard views obtained for each breast

- **Diagnostic**
  - Women or men who present with breast complaints or have an abnormal clinical exam and in women who have abnormal screening mammograms
  - Always supervised by a radiologist
  - Views are tailored to specific abnormality
  - Focal Spot compression - applying focal compression to the area of interest in the breast using a small compression paddle
  - Magnification spot compression - performed to further characterize the morphology of calcifications and shape of a mass
  - 90 degree lateral view - true lateral view of the breast
References up on request