

# Breast Cancer

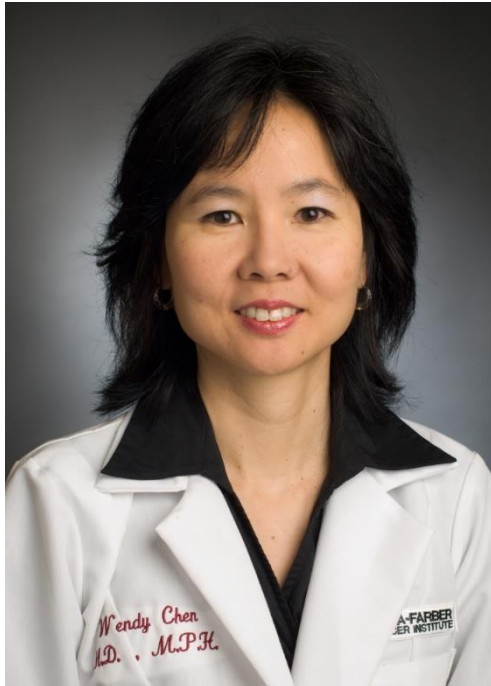
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**CONTINUING MEDICAL EDUCATION  
DEPARTMENT OF MEDICINE**



**HARVARD MEDICAL SCHOOL  
TEACHING HOSPITAL**

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- **Disclosures:**
  - **None related to this presentation**

# Learning objectives

- *Review current breast cancer screening recommendations*
- *Review key breast cancer risk factors*
- *Review options for breast cancer prevention*
- *Counsel patients regarding genetic testing*
- *Review current treatment trends*





Breast	316,950	32%
Lung & bronchus	115,970	12%
Colon & rectum	71,810	7%
Uterine corpus	69,120	7%
Melanoma of the skin	44,410	4%
Non-Hodgkin lymphoma	35,210	4%
Pancreas	32,490	3%
Thyroid	31,350	3%
Kidney & renal pelvis	28,570	3%
Leukemia	28,170	3%
<b>All sites</b>	<b>988,660</b>	

## Cancer cases



Lung & bronchus	60,540	21%
Breast	42,170	14%
Pancreas	24,930	8%
Colon & rectum	24,000	8%
Uterine corpus	13,860	5%
Ovary	12,730	4%
Liver & intrahepatic bile duct	10,840	4%
Leukemia	10,040	3%
Non-Hodgkin lymphoma	8,330	3%
Brain & other nervous system	8,160	3%
<b>All sites</b>	<b>294,220</b>	

## Cancer deaths

# Screening mammography

## ***2024 USPTF guidelines***



# Screening question

**45 y.o. woman wants to know more about breast cancer screening. You advise her that:**

- A. Mammograms do not reduce mortality for women aged 40-49
- B. MRI reduce breast cancer mortality more than mammograms
- C. Breast density decreases with higher body mass index
- D. Ultrasound is superior to mammography as screening tool for dense breasts

# Answer to screening question

**55 y.o. woman wants to know more about breast cancer screening. You advise her that:**

- A. Mammograms **DO** reduce mortality for women aged 40-49.
- B. MRI has **NOT** been shown to reduce breast cancer mortality
- C. *Breast density decreases with higher BMI*
- D. Ultrasound is **NOT** superior to mammography as screening tool for dense breasts



# Why the controversy about mammograms?

- **2024 USPSTF guidelines - Women aged 40-74 should get routine screening mammogram**
  - Randomized controlled trials and meta-analyses => 15-20% ↓↓ mortality
  - Recommended screening interval 2 years
- **Why age 50 before?**
  - Breast cancer less common < age 50 so absolute benefits smaller
  - More false positives in women 40-50
- **What changed?**
  - Breast cancer ↑↑ 2% per year in women aged 40-50
  - Black women earlier age at dx and higher mortality

# When to stop screening?

- **No large RCT enrolled women > 75 yrs**
  - RR breast cancer mortality 1.12 (95% CI 0.73-1.72) for Swedish trial with ~5000 women aged 70-74
- **Annual Medicare costs for screening, diagnosis, and treatment ~ \$1.36 billion**
  - \$410 million spent on women aged 75+
- **Guidelines vary when to stop screening**
  - Screening detects small cancers that are unlikely to lead to death

# Different society guidelines

	USPSTF	American Cancer Society	American College of Radiology
Age to start screening	40	45	40
Age to stop screening	75	<10 years life expectancy	Stop when severe comorbidity
Screening interval	2 yrs	Annual 45-54 Biennial 55+	Annual

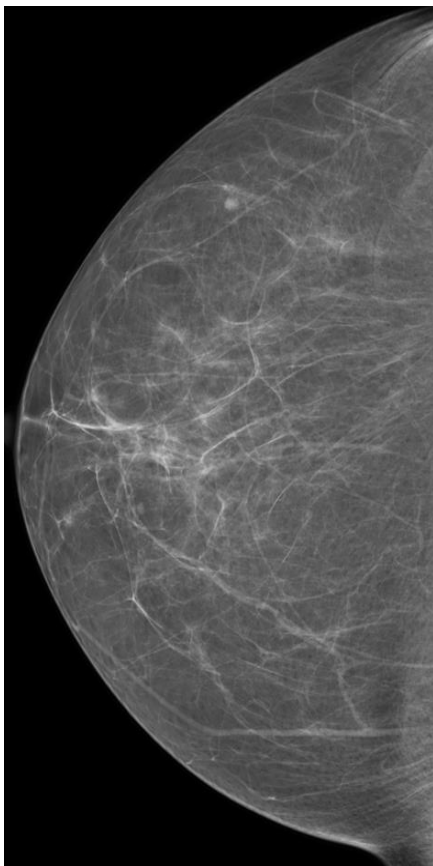
# Breast density

- **Breast density associated with ↑↑ breast cancer risk**
  - Biology unclear since breast density not correlated with known risk factors, e.g. decreases with age and higher BMI
- **Unclear what screening modality best**
  - Breast density notification now mandated by FDA
  - Ultrasound best for targeted areas, not whole breast
  - MRI high rate of false positives and not been shown to impact mortality

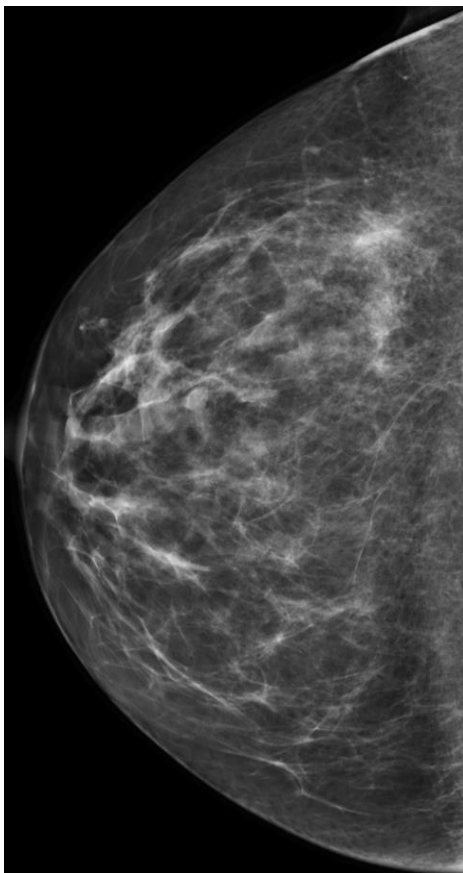


# Breast density categories

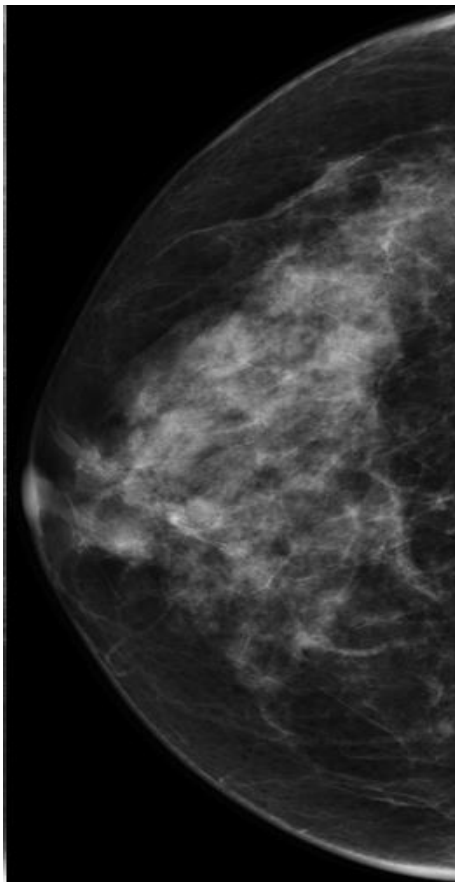
**A**



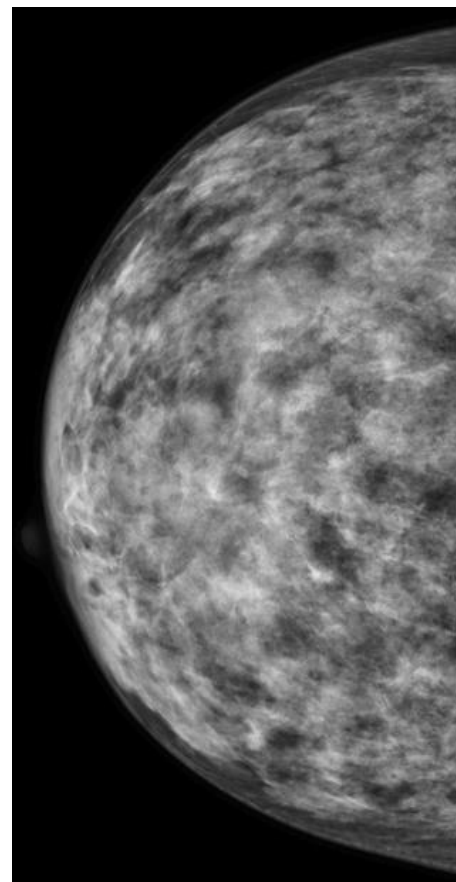
**B**



**C**



**D**



**Almost  
entirely fatty**

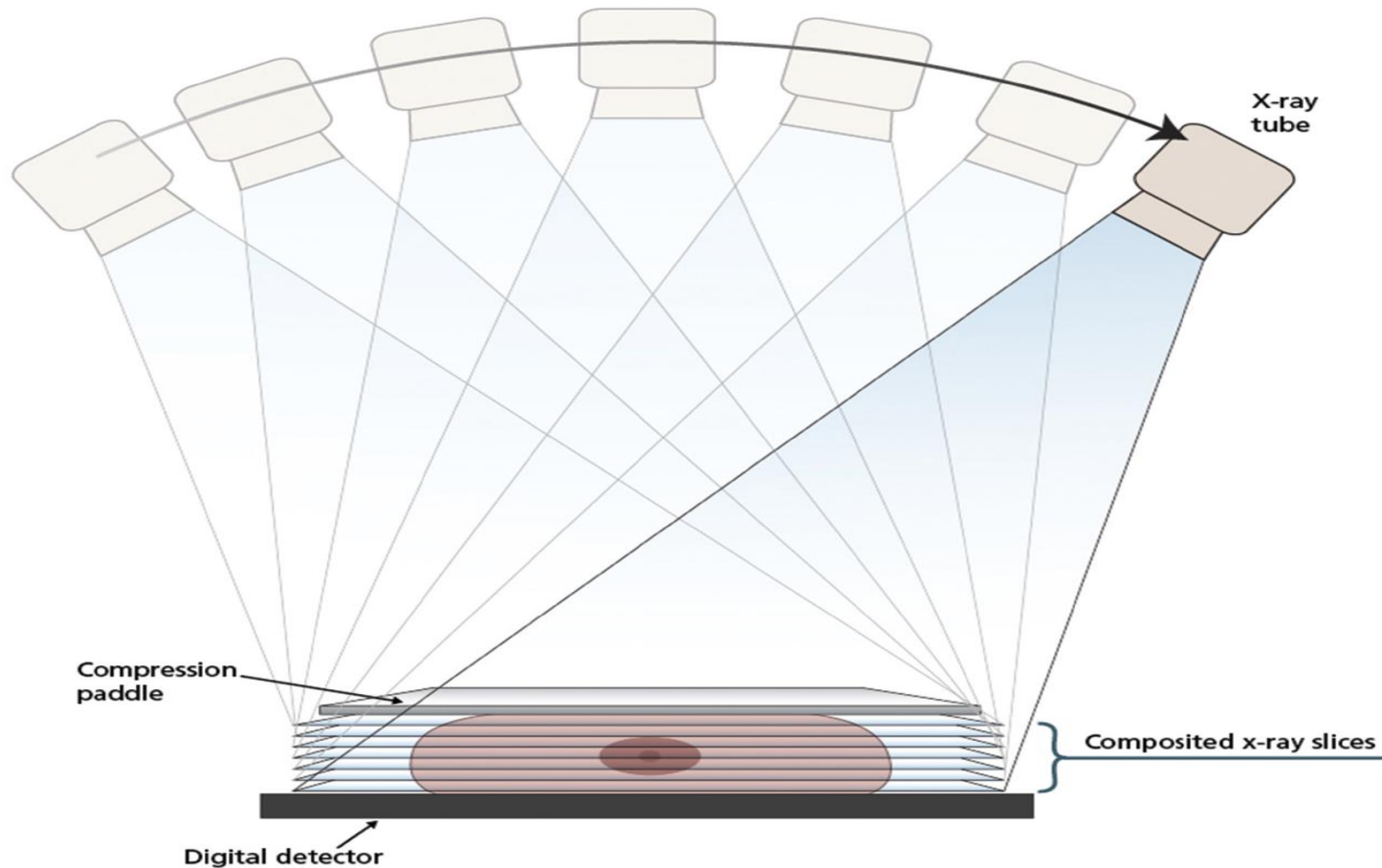
**Scattered areas of  
fibroglandular  
density**

**Heterogeneously  
dense**

**Extremely  
dense**

# Breast tomosynthesis (3-D mammo)

Breast stays in place and x-ray machine moves to take multiple images of breast



# Breast MRI

- **More sensitive – especially in young women**
    - Does not replace mammograms
    - Many more false positives
    - Requires IV gadolinium
    - Impractical as screening tool
  - **Current indications for MRI from ACS**
    - Breast cancer germline genetic mutations
    - Radiation to chest between ages 10 and 30
    - Lifetime risk of >20-25%
    - Insufficient evidence for dense breasts
- = >Never been shown to reduce mortality**

# Contrast enhanced mammo

- IV contrast prior to standard mammo
- **BRAID** randomized trial of supplemental screening for women with dense breasts and normal mammo

	Cancer detection rate per 1000 (95% CI)
Abbreviated MRI	17.4 (12.2–23.9)
Automated u/s	4.2 (1.9–8.0)
Contrast mammo	19.2 (13.7–26.1)

- **Current FDA approval for diagnostic imaging**
  - Availability limited and reimbursement still unclear



# Established breast cancer risk factors

- Age
- Overweight
- Alcohol use
- Physical activity
- Menopausal hormone use
- Late age at first birth (> 30 y.o.)
- Early age at menarche
- Late age at menopause
- *BRCA1/2*, *genetics*, and Family history

# Established breast cancer risk factors

- Age
- **Overweight**
- **Alcohol use**
- **Physical activity**
- Menopausal hormone use
- Late age at first birth (> 30 y.o.)
- Early age at menarche
- Late age at menopause
- ***BRCA1/2, genetics, and Family history***

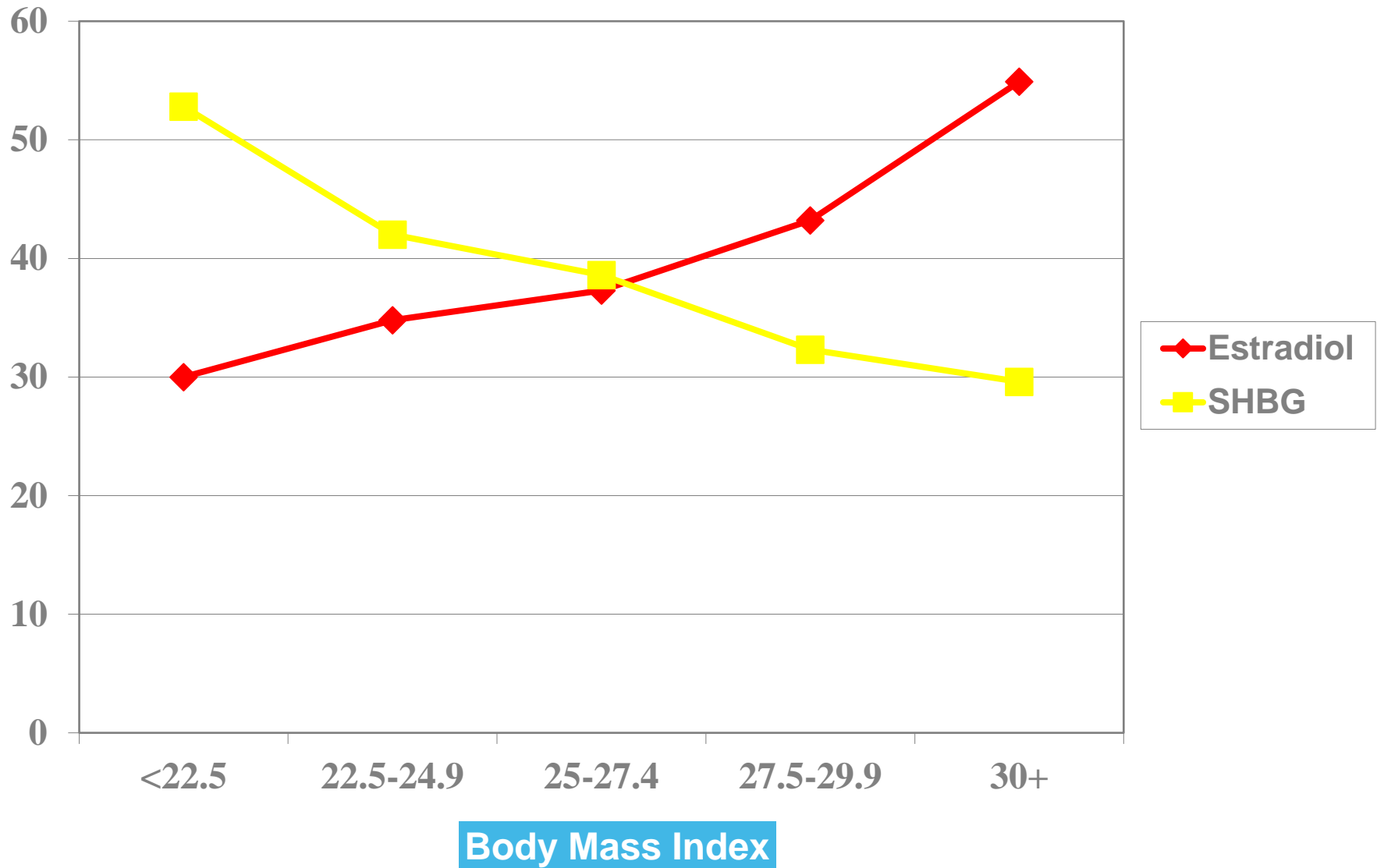
# Body mass index and breast cancer



# Body Mass Index

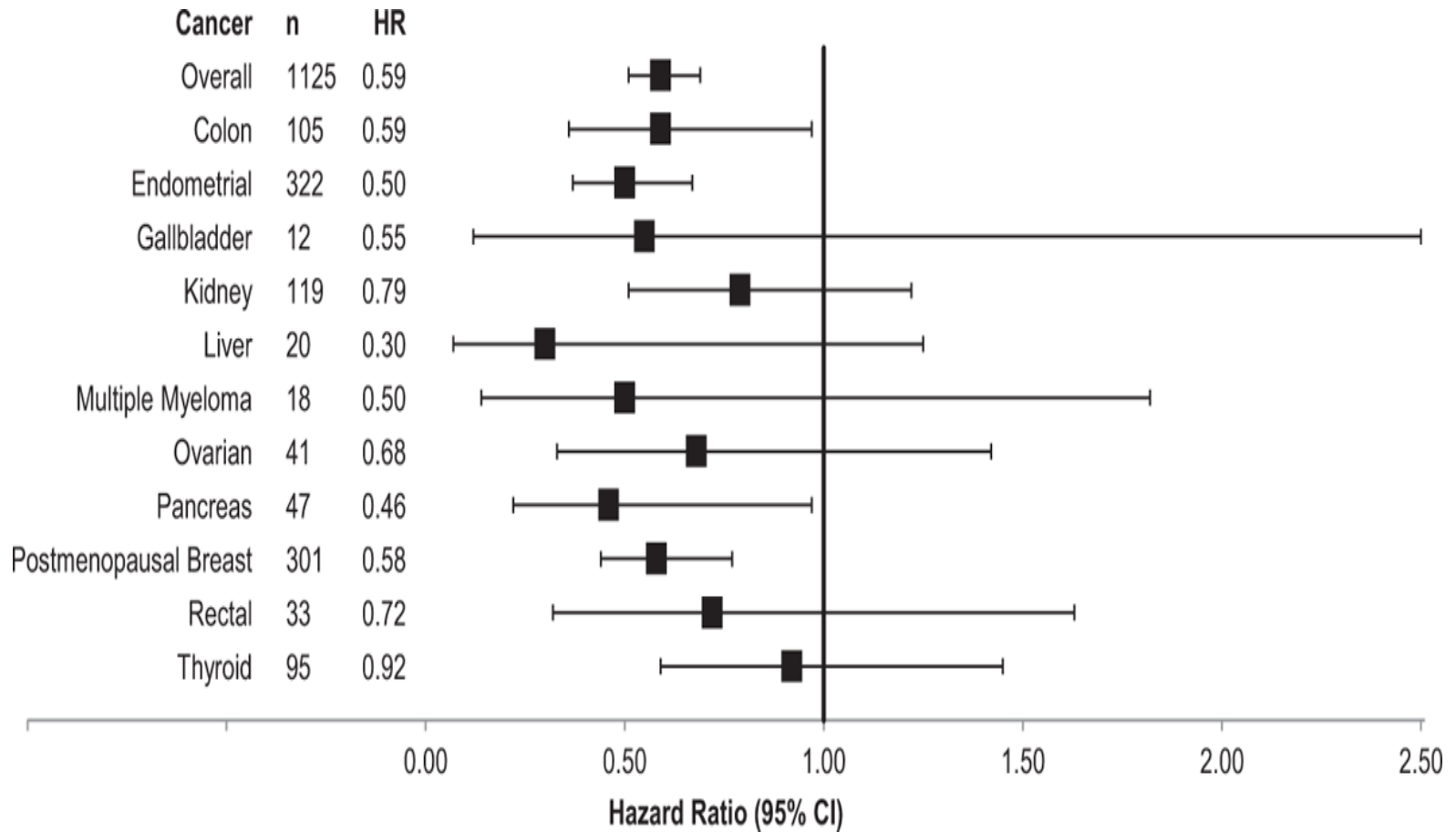
- **↑↑ Postmenopausal breast cancer risk**
  - 20-30% with ↑↑ BMI > 30
  - 10% ↑↑ with 5 kg/m<sup>2</sup> increase BMI
- *Main source of estrogen after menopause = peripheral conversion of androgens into estrogens by aromatase in adipose tissue*

# Body Mass Index & Sex Steroid Levels



# Weight Loss Lowers Cancer Risk

## Bariatric surgery – 22,198 pts and 66,427 controls



# Physical activity



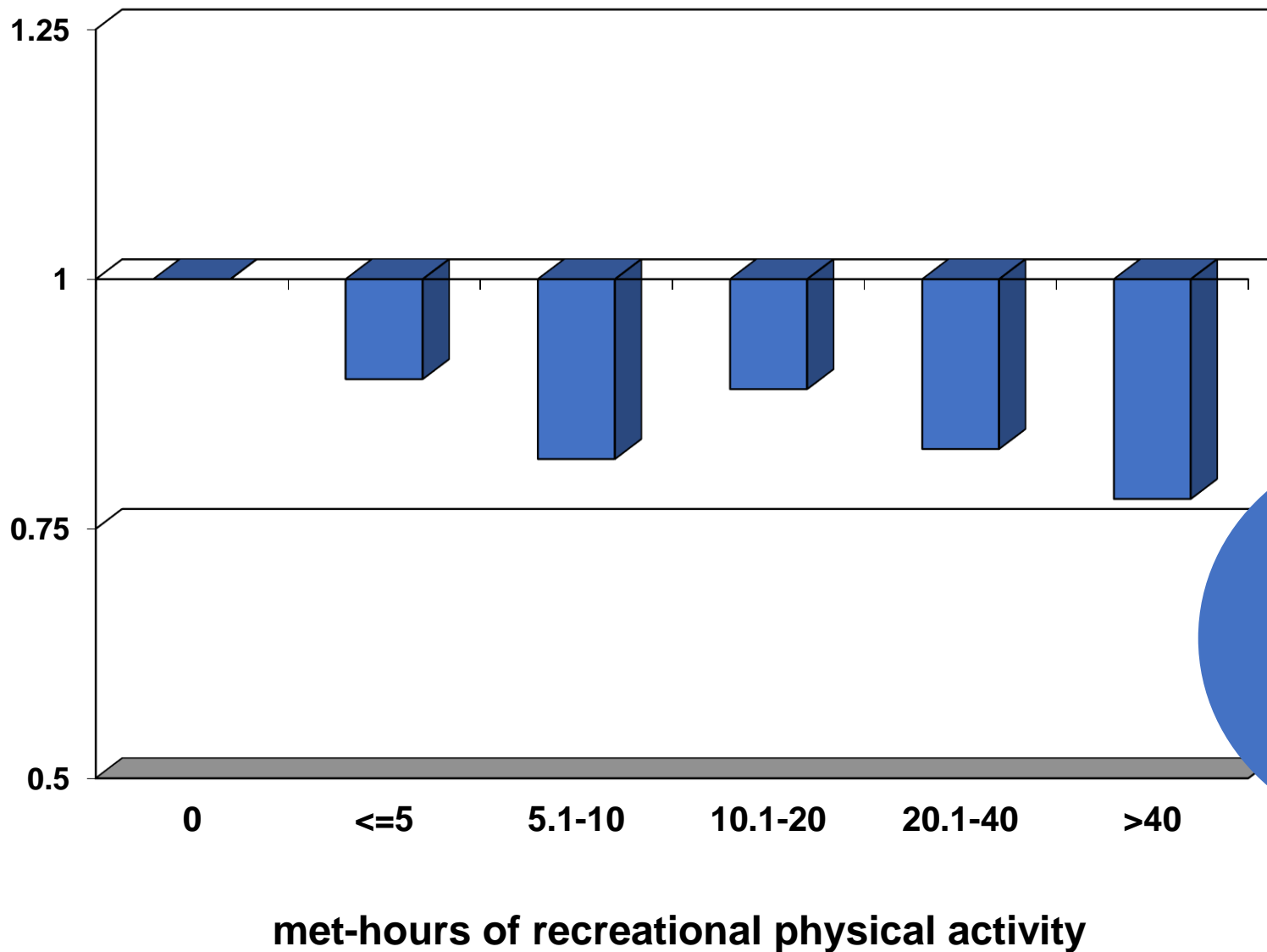
# Physical activity and breast cancer

- ↓↓ **Breast cancer risk with physical activity**
  - Prevent weight gain and ↓ body fat
  - ↓ estradiol, estrone, and free estradiol and  
↑ sex hormone binding globulin
  - ↓ insulin levels





# Exercise and postmenopausal breast ca



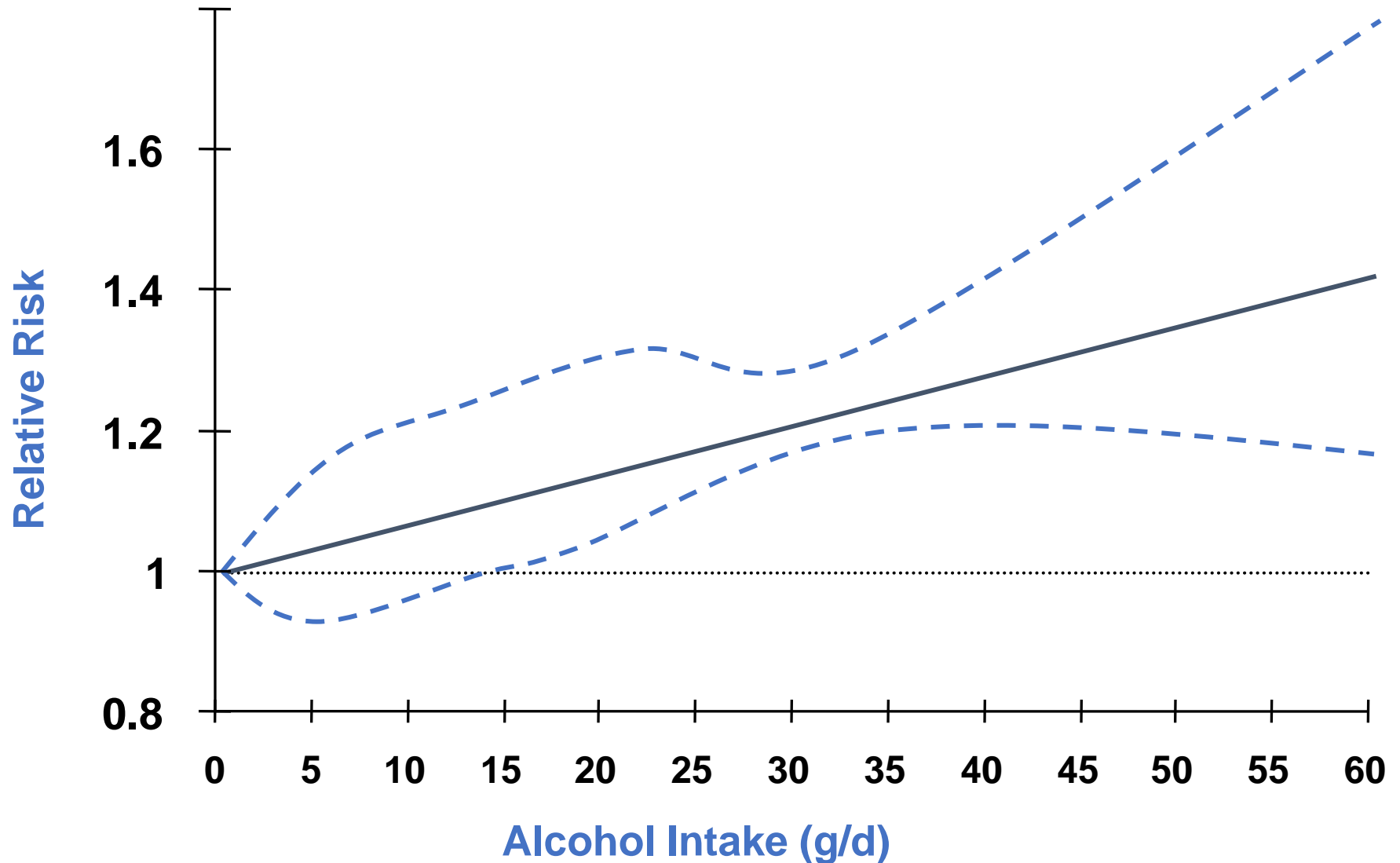
*=> No strong association with moderate or strenuous activity*

# Alcohol

**Multiple studies show association between alcohol and breast cancer**

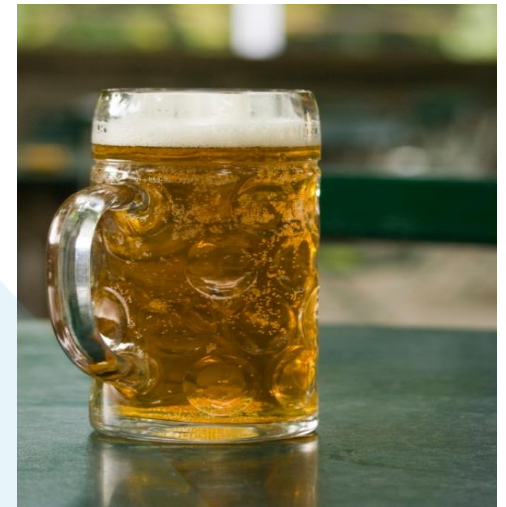


# Alcohol Intake and Breast Cancer



# Alcohol and breast cancer

- **No difference by type of alcoholic beverage**
  - Wine vs. beer. vs. liquor
- **Cumulative intake best measure**
- **2-3 servings per week OK**



# Nutrition and Breast Cancer



# Challenges to studying nutrition and cancer

- **Many food items inter-related**
  - People who eat more meat, eat less vegetables
- **Nutrition related to other health behaviors**
  - People who eat healthier often thinner and more physically active
- **Long-term trends more important than short-term**



**=> Beware of findings from small individual studies!**

# Nutrition and breast cancer risk



- **Modest benefit of fruit and vegetable intake on breast cancer**
  - ✓ Results stronger for estrogen negative cancers



- **Modest increased risk with red meat and breast cancer**

**No strong associations between breast cancer and fish, fiber, or caffeine intake**

# Why the interest in soy

- **Soy high in isoflavones – phytoestrogens**
  - Structurally similar to estradiol and bind ER
- **Modest ↓↓ breast cancer risk with soy**
  - Meta-analysis: OR 0.78 (highest vs lowest intake)
  - Asian studies show strongest effect
- **Asian and western soy intake differ**
  - Types of soy – whole vs processed soy
  - Timing of soy exposure – early vs late life





# Family History/Genetics



# Who should get BRCA1/2 testing?

**Risk for BRCA1/2 mutation is greater if:**

Age  $\leq$  50 at diagnosis

Bilateral breast cancer

Male breast cancer

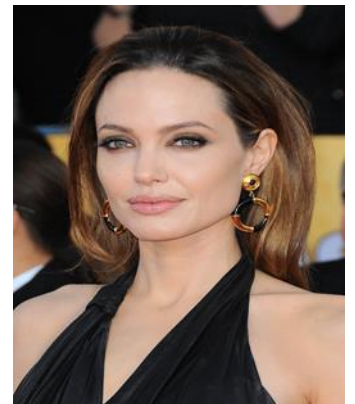
Ovarian or pancreatic or met prostate cancer

Triple negative breast cancer

**=> *Person with cancer should be tested first***

# BRCA 1 & 2

- ↑↑ lifetime risk of breast/ovarian cancer
- **BRCA1**
  - >60% breast , 40-60% ovarian ca
  - ↑ prostate and pancreatic cancer
- **BRCA2**
  - >60% breast , 10-25% ovarian ca
  - ↑↑ male breast, pancreatic, prostate, melanoma
- Explains 5-10% of breast cancers
  - More common in Ashkenazi Jewish



# Multigene/Expanded Panel test

- **BRCA1/2 testing alone rarely done**
- **Expanded panel testing**
  - Breast ca - ATM, BARD1, CDH1, CHEK2, NF1, PALB2, pTEN, RAD51, STK11, TP53
- **Breast ca risk vary**
  - Generally lower than BRCA1/2
  - Clinical recommendations vary depending on risk
- **Risk of other cancers vary**
  - CDH1 gastric ca



# Breast Cancer Prevention



# Prevention question

A healthy 45 y.o. premenopausal woman has a mother who was diagnosed with breast cancer at age 60 and passed away at 65 with metastatic disease. She would like to discuss breast cancer prevention. You recommend that she consider:

- A. Aromatase inhibitor
- B. Raloxifene
- C. Tamoxifen
- D. All of the above depending upon side effects

# Answer to Prevention question

A healthy 45 y.o. premenopausal woman has a mother who was diagnosed with breast cancer at age 60 and passed away at 65 with metastatic disease. She would like to discuss breast cancer prevention. You recommend that she consider:

A. Aromatase inhibitor

B. Raloxifene

C. Tamoxifen

D. All of the above depending upon side effects

# Randomized prevention trials

- **Tamoxifen, raloxifene, aromatase inhibitors ↓↓  
breast ca risk ~50% compared to placebo**
  - Only prevents ER+ breast cancer
  - No survival benefit seen
  - Raloxifene and AI's only after menopause
  - Low dose tamoxifen (5 mg daily) fewer side effects
    - Option for prevention (not breast cancer treatment)
- **Why are these drugs not used more?**
  - Absolute risk of breast cancer low
  - Side effects
  - Screening available for breast cancer



# Who should consider risk reducing meds?

- **Aged 35 and older with increased risk of breast cancer**
  - 1<sup>st</sup> degree relative with breast cancer
  - Personal history of lobular carcinoma in situ or atypical hyperplasia
  - 5 yr predicted risk of breast cancer >1.66% (Gail model)

<http://bcrisktool.cancer.gov>



# Tamoxifen vs Raloxifene vs AI

	Tamoxifen	Raloxifene	Aromatase inhibitors
Hot Flashes	Yes	Yes	No
Uterine effects	Yes	No	No
Bone Density	↑↑	↑↑	↓↓
Thrombotic risk	Yes	Yes	No
Premenopausal use	Yes	No	No

# Breast Cancer Treatment



# Treatment question

60 y.o. woman was diagnosed with a 1.5 cm grade 2, node negative, ER positive, HER2 negative breast cancer and had a mastectomy. What will have the biggest impact on 10-year breast cancer specific survival?

- A. Hormonal therapy
- B. Radiation
- C. Chemotherapy
- D. Trastuzumab

# Adjuvant hormonal therapy

- **1<sup>st</sup> targeted therapy**

- ↓↓ breast cancer mortality by 1/3
- ↓↓ contralateral breast cancer by 1/2
- 5 yrs for node negative, 8-10 yrs for node positive

- **Tamoxifen**

- Can be used for both pre and postmenopausal
- No data for raloxifene in adjuvant setting

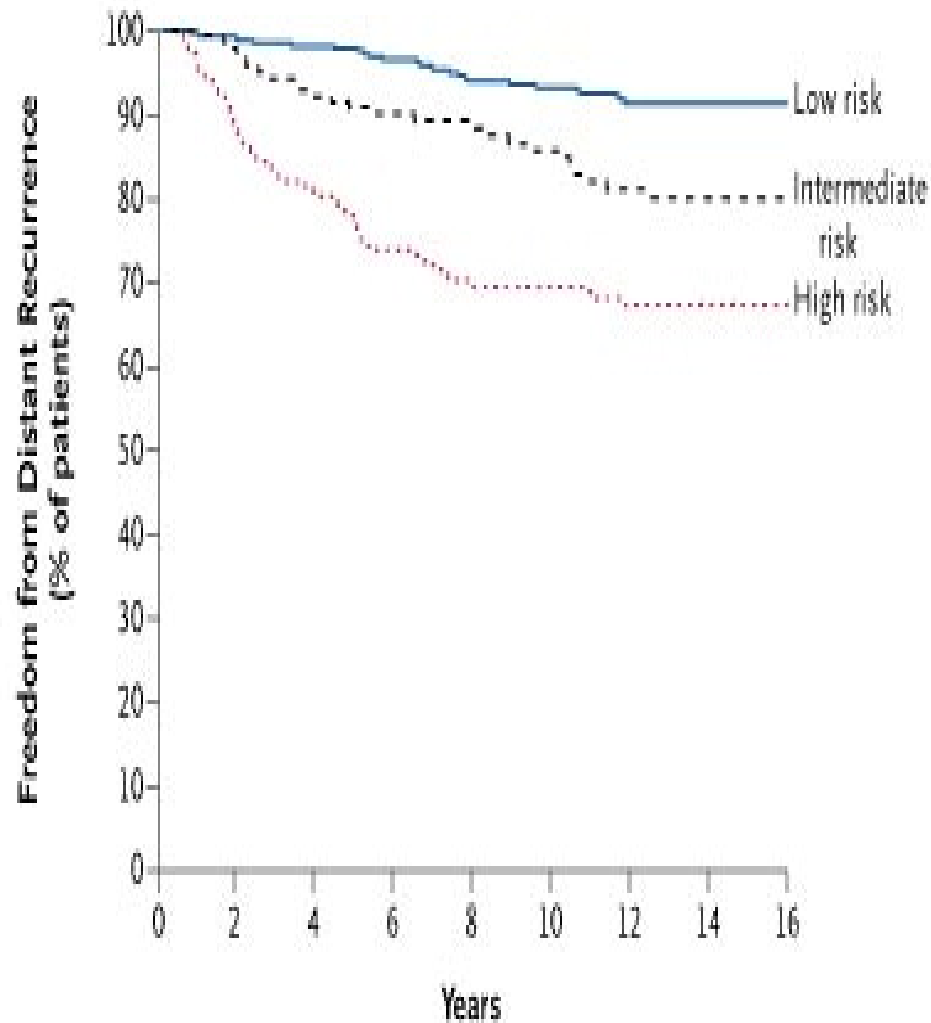
- **Aromatase inhibitor**

- Preferred for postmenopausal women

- **Ovarian suppression**

- Considered for higher risk

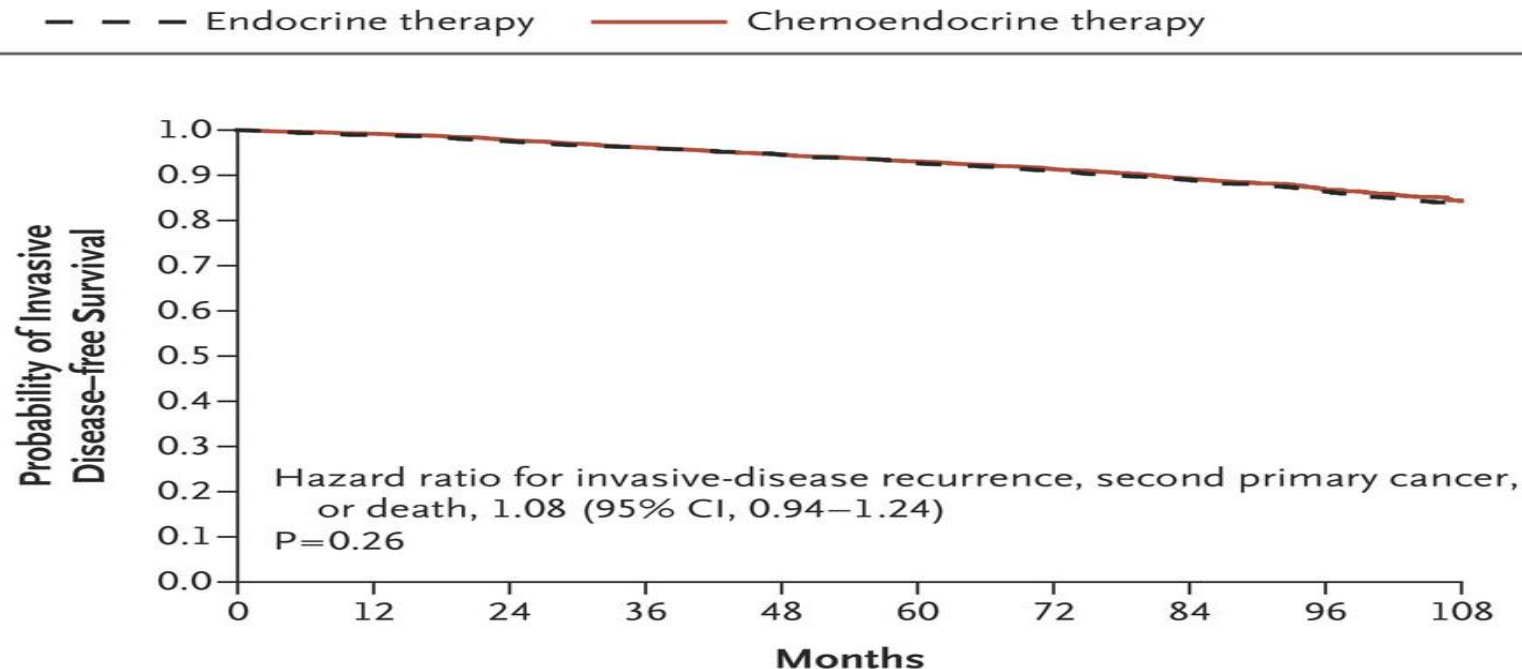
# OncotypeDX<sup>®</sup> for prognosis



- **RT-PCR gene expression array**
  - Estimate recurrence risk from clinical trial data
  - ER positive and HER2 negative
  - Node-negative and 1-3 positive lymph node
- **Low score is good!**
  - Cutoff for low varies
- **Node negative**
  - 9 yr Distant met < 1%
- **Node positive**
  - 5 yr distant mets < 5%

# OncotypeDX<sup>®</sup> for prediction

- TAILORx randomized 10,273 ER pos, node neg with OncotypeDX 11-25 to hormonal rx +/- chemo
  - Overall survival 93.9 vs 93.8% (median f/u 8 yrs)
  - No benefit to chemo for women > 50 yrs
  - ?Chemo benefit for women < 50 yrs and score 16-25 but could chemo effect be due to ovarian suppression?



# Adjuvant breast cancer chemo

- **Important trends**

- Less chemo for ER positive
- If chemo given, often before surgery to shrink tumor and assess response
  - For ER negative and HER2 positive, residual disease after chemo strongly related to prognosis

- **Biology, not stage, drive chemo recs**

- Triple negative with chemo + immunotherapy
- HER2 positive with trastuzumab
- ER positive if high risk or multiple positive lymph nodes

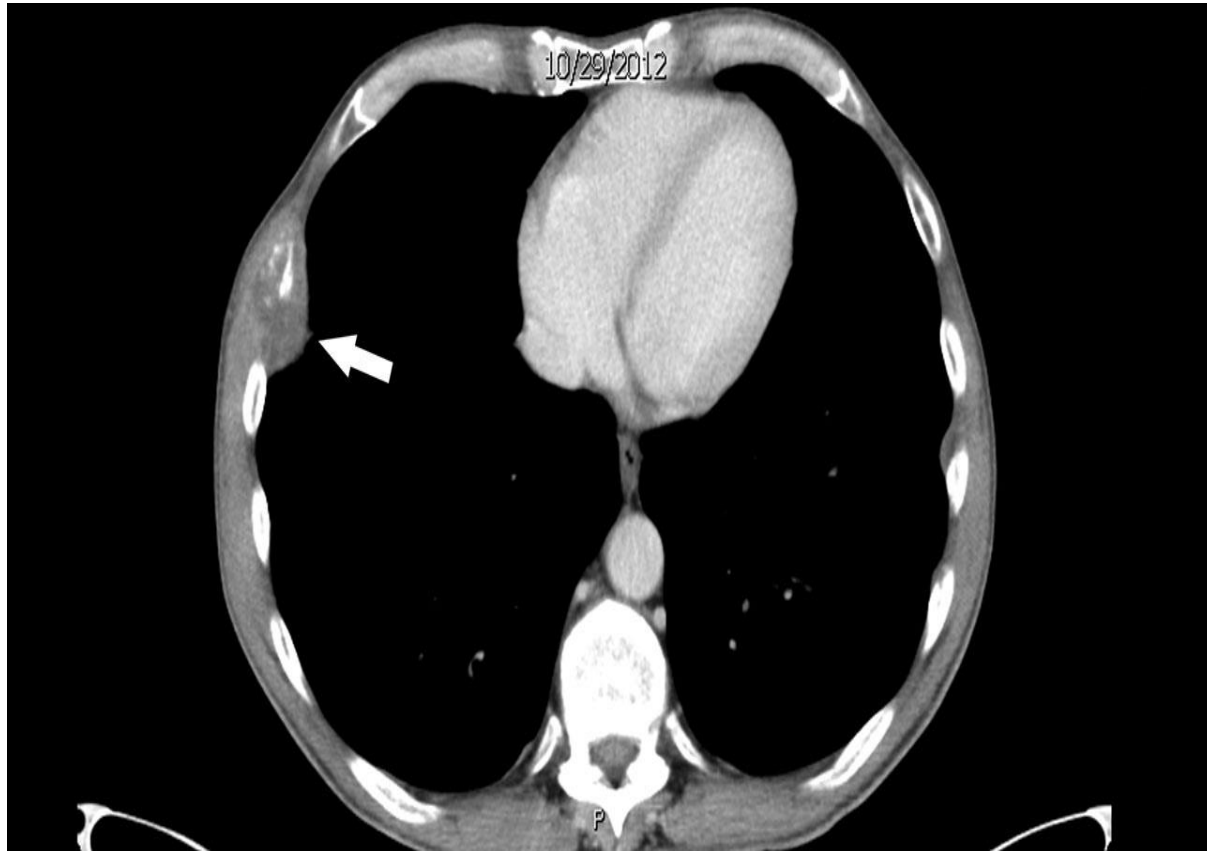




# HER2neu and trastuzumab

- **HER2/neu protein**
  - Member of EGFR family
  - 20-25% of breast cancers overexpress HER2
- **Trastuzumab - monoclonal antibody to HER2**
  - Can cause congestive heart failure
  - Most effective when given with chemo
- **HER2 positive tumors have worse prognosis, *if not treated with trastuzumab***
  - With treatment, prognosis similar or better to HER2 negative

# Metastatic Breast Cancer

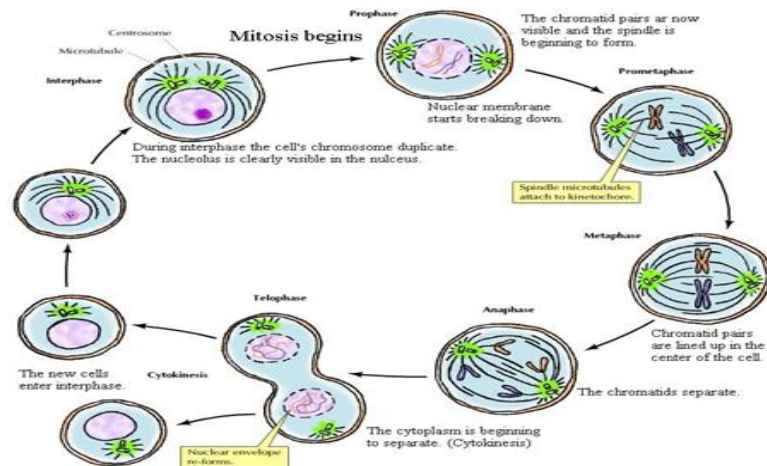


# Metastatic breast cancer overview

- **Survival continues to improve**
  - >1/3 alive at 5 yrs, but varies by subtype
- **Hormone receptor positive/HER2 negative**
  - Oral hormonal therapy first before chemo
- **Triple negative**
  - Chemo + immunotherapy first if tumor PDL1 positive
- **HER2 positive**
  - HER2 directed therapy followed by maintenance antibody therapy for responders

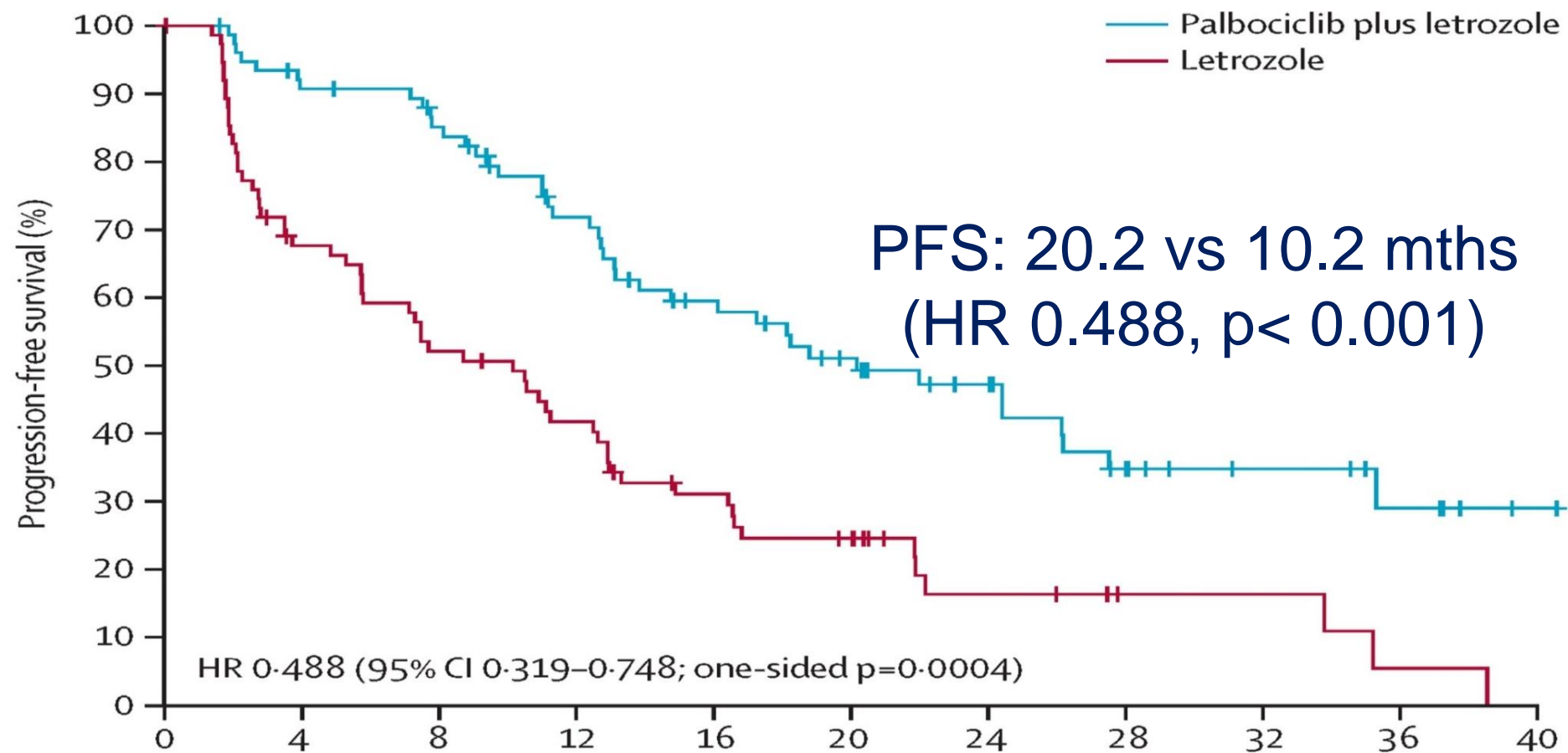
# CDK4/6 inhibitor

- **Cyclin dependent kinase (CDK) 4/6 mediates G0/G1 => S phase transition**
  - CDK4/6 overexpression common in ER+ breast cancer
  - Oral pill combined with hormonal therapy
    - Ribociclib (Kisqali), abemaciclib (Verzenio), palboclib (Ibrance)



# CDK4/6 inhibitor for metastatic breast cancer

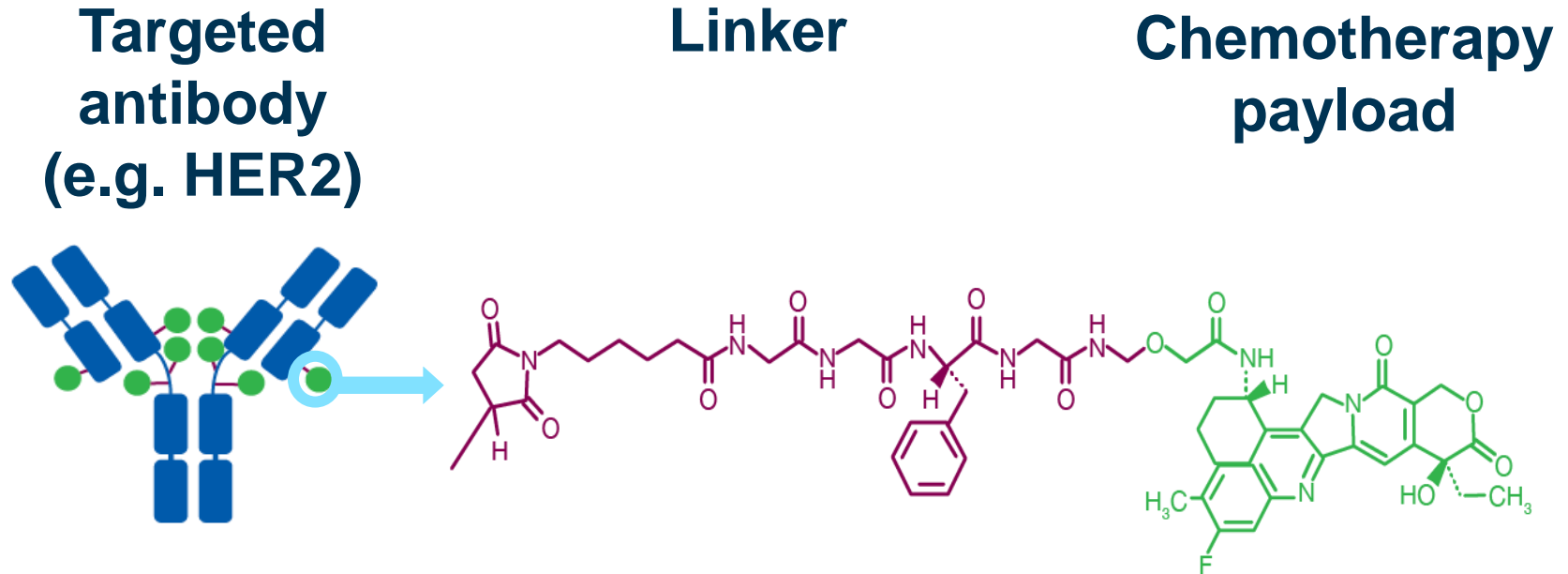
- Significantly delays time to chemo and  $\uparrow\uparrow$  survival
- Also for adjuvant high risk to prevent recurrence



# Antibody drug conjugates

**Antibody drug conjugate has 3 components:**

- 1) Antibody against tumor specific target (e.g. HER2)
- 2) Chemotherapy “payload”
- 3) Cleavable linker



# Targeted therapy

- **PI3/AKT inhibitor**

- Alpelisib, capivasertib, and inavolisib

- **PARP inhibitor**

- BRCA1/2 mutation carriers

- **Immunotherapy**

- Pembrolizumab + chemo for PDL1 positive triple negative breast cancer

- **mTOR inhibitor**

- Everolimus



# Take home points

- Epidemiology –Overweight and alcohol use ↑↑ breast ca risk, physical activity ↓↓ risk
- Prevention – Tamoxifen , raloxifene, and AI ↓↓breast ca risk, but no effect on mortality
- Screening – Mammography ↓↓ mortality ages 40-74, but should stop when life expectancy < 10 years
- Treatment – Biology not stage drives treatment



# References

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# Thank You!

