Physical Issues Cancer Survivors Face and Interventions for Improved Physical Well-Being

Kevin C. Oeffinger, MD
Director, Duke Center for Onco-Primary Care
Director, Duke Cancer Supportive Care and Survivorship Center

National Cancer Policy Forum
Long-Term Survivorship Care
July 25, 2017
Late Mortality Among 5+ Year HL Survivors
MSKCC Adult Hodgkin Lymphoma Study (1975-2000; N=747)

Cumulative Incidence by Causes of Death for Patients With Stage I Testicular Seminoma
SEER Registry: N=9193 men; Diagnosed 1973-2001

Probability of death from breast cancer or other causes among women age 50 and older with ER+ early stage breast cancer
SEER: 1988-2001

• Selected ‘physical’ issues
  – Second (and subsequent) primary cancers
  – Cardiovascular disease
  – Accelerated aging

• Interventions
  – Risk-stratified screening and surveillance
  – Management of comorbidities
  – Interception?
  – Healthy lifestyles [Wendy Demark-Wahnefried, PhD]

• Focus – survivors of adult cancers
Second Primary Cancer (SPC)

• 20% of incident cancers are a second (or subsequent) primary cancer

• Causal pathways:
  – Lifestyle habits
  – Aging
  – Genetic factors
  – Treatment exposures for the first cancer
  – All of the above (interactions)
SEER – 1992 – 2005

Cause-specific mortality among 3-year survivors of head and neck cancer

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>5-year mortality</th>
<th>10-year mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head and neck cancer</td>
<td>5.9 (5.7-6.2)</td>
<td>11.9 (11.6-12.3)</td>
</tr>
<tr>
<td>Second primary malignancy</td>
<td>3.4 (3.2-3.6)</td>
<td>9.5 (9.1-9.9)</td>
</tr>
<tr>
<td>Cardiovascular disease</td>
<td>2.7 (2.5-2.8)</td>
<td>8.4 (8.1-8.8)</td>
</tr>
<tr>
<td>Other</td>
<td>2.9 (2.7-3.1)</td>
<td>9.5 (9.1-9.9)</td>
</tr>
<tr>
<td>Cancer of unspecified site</td>
<td>0.5 (0.4-0.6)</td>
<td>1.6 (1.4-1.7)</td>
</tr>
</tbody>
</table>

### Risk prediction model – 10-year cumulative risk of SPC
Cohort of 293,435 from 12 French registries

<table>
<thead>
<tr>
<th>Age at H/N cancer</th>
<th>Calendar period</th>
<th>10-yr cumulative risk of SPC</th>
<th>Difference with general population</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 - 64 years</td>
<td>2001 - 2003</td>
<td>41.0%</td>
<td>+25.9%</td>
</tr>
<tr>
<td></td>
<td>2004 - 2006</td>
<td>40.6%</td>
<td>+25.7%</td>
</tr>
<tr>
<td></td>
<td>2007 - 2010</td>
<td>41.1%</td>
<td>+26.9%</td>
</tr>
</tbody>
</table>
### SEER – 1975 – 2006

<table>
<thead>
<tr>
<th>Treatment</th>
<th>SIR</th>
<th>95% CI</th>
<th>AER*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any solid tumor</td>
<td>2.2</td>
<td>2.1-2.2</td>
<td>167.7</td>
</tr>
<tr>
<td>Lung</td>
<td>3.7</td>
<td>3.7-3.8</td>
<td>75.2</td>
</tr>
<tr>
<td>Head / neck</td>
<td>12.4</td>
<td>12.0-12.7</td>
<td>59.8</td>
</tr>
<tr>
<td>Esophagus</td>
<td>8.3</td>
<td>7.8-8.9</td>
<td>14.2</td>
</tr>
</tbody>
</table>

*per 10,000 person-years

Risk of SPC based upon age at first cancer

<table>
<thead>
<tr>
<th>Age at first cancer</th>
<th>Females HR (95% CI)</th>
<th>Males HR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>51 – 65 years</td>
<td>4.7 (4.3-5.0)</td>
<td>8.8 (7.8-9.9)</td>
</tr>
<tr>
<td>66 - 80</td>
<td>7.1 (6.6-7.6)</td>
<td>15.1 (13.4-17.0)</td>
</tr>
<tr>
<td>&gt; 80</td>
<td>6.2 (5.7-6.7)</td>
<td>15.2 (13.5-17.2)</td>
</tr>
</tbody>
</table>
## Risk prediction model – 10-year cumulative risk of SPC

Cohort of 293,435 from 12 French registries

**FEMALES**

Calendar period for first cancer – 2007-2010

<table>
<thead>
<tr>
<th>Age at first cancer</th>
<th>First Breast Cancer</th>
<th>First Colorectal Cancer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10-yr cumulative risk</td>
<td>Difference with general population</td>
</tr>
<tr>
<td>55 - 64 yrs</td>
<td>6.8%</td>
<td>+1.5%</td>
</tr>
<tr>
<td>65 - 74</td>
<td>9.3%</td>
<td>+1.9%</td>
</tr>
<tr>
<td>≥ 75</td>
<td>10.5%</td>
<td>+2.0%</td>
</tr>
</tbody>
</table>

# SPC after Prostate or Colorectal Cancer

## Risk prediction model – 10-year cumulative risk of SPC

Cohort of 293,435 from 12 French registries

**MALES**

Calendar period for first cancer – 2007-2010

<table>
<thead>
<tr>
<th>Age at first cancer</th>
<th>First Prostate Cancer</th>
<th>10-yr cumulative risk</th>
<th>Difference with general population</th>
<th>First Colorectal Cancer</th>
<th>10-yr cumulative risk</th>
<th>Difference with general population</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 - 64 yrs</td>
<td>13.1%</td>
<td>+5.5%</td>
<td></td>
<td>19.4%</td>
<td>+6.3%</td>
<td></td>
</tr>
<tr>
<td>65 - 74</td>
<td>16.0%</td>
<td>+5.0%</td>
<td></td>
<td>21.7%</td>
<td>+3.1%</td>
<td></td>
</tr>
<tr>
<td>&gt; 75</td>
<td>16.4%</td>
<td>+2.5%</td>
<td></td>
<td>22.1%</td>
<td>+4.4%</td>
<td></td>
</tr>
</tbody>
</table>

SPC in TP53 carriers

NCI Li-Fraumeni Syndrome Cohort (N=286)
Risk of SPC by time since first cancer and by age
## Colon Cancer Family Registry (N=764)

Cumulative risk of extracolonic cancer following CRC

<table>
<thead>
<tr>
<th>Cancer site</th>
<th>10 years</th>
<th>20 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Risk, % (95% CI)</td>
<td>Risk, % (95% CI)</td>
</tr>
<tr>
<td>Both sexes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kidney etc.*</td>
<td>1.90 (0.87 to 3.17)</td>
<td>5.15 (2.86 to 7.68)</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>1.61 (0.65 to 2.75)</td>
<td>3.15 (1.37 to 5.20)</td>
</tr>
<tr>
<td>Small intestine</td>
<td>0.92 (0.28 to 1.73)</td>
<td>4.00 (1.92 to 6.41)</td>
</tr>
<tr>
<td>Stomach</td>
<td>0.66 (0.13 to 1.40)</td>
<td>1.15 (0.19 to 2.48)</td>
</tr>
<tr>
<td>Hepatobiliary tract†</td>
<td>0.83 (0.16 to 1.69)</td>
<td>1.42 (0.42 to 2.73)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cancer site</th>
<th>10 years</th>
<th>20 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Risk, % (95% CI)</td>
<td>Risk, % (95% CI)</td>
</tr>
<tr>
<td>Men</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prostate</td>
<td>2.74 (0.86 to 4.77)</td>
<td>5.90 (2.69 to 9.76)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cancer site</th>
<th>10 years</th>
<th>20 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Risk, % (95% CI)</td>
<td>Risk, % (95% CI)</td>
</tr>
<tr>
<td>Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endometrium</td>
<td>12.12 (7.66 to 17.11)</td>
<td>23.99 (16.79 to 32.84)</td>
</tr>
<tr>
<td>Breast</td>
<td>1.94 (0.58 to 3.83)</td>
<td>11.38 (0.63 to 16.69)</td>
</tr>
<tr>
<td>Ovary</td>
<td>0.94 (0.00 to 2.11)</td>
<td>2.08 (0.50 to 4.14)</td>
</tr>
</tbody>
</table>

* Kidney etc. included kidney, renal pelvis, ureter and other and unspecified urinary organs.

† Hepatobiliary tract included liver and intrahepatic bile duct, gall bladder, and other and unspecified parts of biliary tract.

Dutch HL Cohort (N=3905)
Age 15-50 at HL diagnosis, 1965-2000

Any Subsequent Solid Malignant Neoplasm

Cumulative Incidence (%)

Follow-up (yr)

- 1965–1976
- 1977–1988
- 1989–2000

Probability of a 3rd malignancy after selected 2nd malignancies (%)

Follow-up time in years since diagnosis of a 2nd malignancy

- 3rd malignancy after GI tract as 2nd
- 3rd malignancy after lung as 2nd
- 3rd malignancy after NHL as 2nd
- 3rd malignancy after urogenital tract as 2nd

Lung cancer after Hodgkin lymphoma

Case-Control study from population-based registry
Age at Hodgkin lymphoma – median 50 years

Relative Risk

Treatment Group

- N/N
- N/Alk
- RT/N
- RT/Alk

Non / Light Smoker
Moderate-Heavy Smoker

Hodgson DC, et al. Semin Radiat Oncol 2007
30 Gy Irradiation to 20 year-old with Hodgkin lymphoma

Courtesy of Constine LS.
Involved Nodal Radiation

Courtesy of Hodgson D.
Men and women treated with mediastinal radiotherapy have a substantially elevated risk of coronary artery disease.

- 20 yrs post moderate-dose RT (37.2 Gy), actuarial risk of symptomatic CAD = 21.2%
- By 30 yrs, incidence of MI = 12.9%
- Standardized Mortality Ratio with MI = 3.2
Cumulative incidence of coronary heart disease in HL survivors diagnosed prior to age 51 (1965-1995)

By age 40, 5.5% with CHD

10-yr risk = 12%

Figure 1. Implementation of Risk Assessment Work Group Recommendations

Does the patient have existing clinical ASCVD?  
Yes  
See 2011 AHA/ACC Secondary Prevention Guideline and 2013 Adult Prevention Guidelines:  
- Blood Cholesterol  
- Obesity  
- Lifestyle Management

No  
Is the patient <20 y or >79 y of age?  
Yes  
See 2012 NHLBI Pediatric CV Risk Reduction Guidelines and 2013 Adult Prevention Guidelines:  
- Blood Cholesterol  
- Obesity

No  
Assess traditional risk factors every 4-6 y in patients 20-79 y of age; estimate 10-y risk in those 40-79 y of age using Pooled Cohort Equations

Elevated 10-y risk (≥7.5%)  
Communicate risk data and refer to 2013 Adult Prevention Guidelines:  
- Blood Cholesterol  
- Obesity

Low 10-y risk (<7.5%)  
Assess 30-y or lifetime risk in those 20-59 y of age; Communicate risk data regardless of age and refer to AHA/ACC Lifestyle Guideline

americanheart.org
# Pooled Cohort Risk Assessment Equations

Predicts 10-year risk for a first atherosclerotic cardiovascular disease (ASCVD) event

## Risk Factors for ASCVD

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
</tr>
<tr>
<td>Systolic BP</td>
<td>105 mmHg</td>
</tr>
<tr>
<td>Age</td>
<td>40 years</td>
</tr>
<tr>
<td>Race</td>
<td>White or other</td>
</tr>
<tr>
<td>Receiving treatment for high blood pressure (if SBP &gt; 120 mmHg)</td>
<td>No, Yes</td>
</tr>
<tr>
<td>Diabetes</td>
<td>No, Yes</td>
</tr>
<tr>
<td>Smoker</td>
<td>No, Yes</td>
</tr>
<tr>
<td>Total Cholesterol</td>
<td>232 mg/dL</td>
</tr>
<tr>
<td>HDL Cholesterol</td>
<td>38 mg/dL</td>
</tr>
</tbody>
</table>

[Reset, Calculate]
Pooled Cohort Risk Assessment Equations
Predicts 10-year risk for a first atherosclerotic cardiovascular disease (ASCVD) event.

Risk Factors for ASCVD

- Gender: Female
- Age: 40 years
- Race: White or other
- Total Cholesterol: 232 mg/dL
- HDL Cholesterol: 38 mg/dL

10-year risk = 12%

ASCVD Risk Evaluation

- 10-year risk of atherosclerotic cardiovascular disease with current risk factors: 1.1%
- 10-year risk with optimal risk factors: 0.4%
Need for validated CAD risk prediction models for cancer survivors

Salz T, et al
MSK and Danish Cancer Institute
Caveats:

- Most women with breast cancer will not die of breast cancer
- Continued monitoring and management of common comorbidities may be as important for longevity/QoL as treatment of the breast cancer
- Lack of standardized approaches to manage HTN, DM, and lipid disorders

Hypertension (pre/during/post cancer) is a key risk factor in development of heart failure in breast cancer survivors treated with anthracyclines and/or trastuzumab

Clinical Question 3: Which preventive strategies are effective in minimizing risk during the administration of potentially cardiotoxic cancer therapy?

Recommendation 3.1. Clinicians should screen for and actively manage modifiable cardiovascular risk factors (eg, smoking, hypertension, diabetes, dyslipidemia, obesity) in all patients receiving potentially cardiotoxic treatments.
Table 4. Multivariable Cox Regression Analyses of Cardiovascular Disease Deaths in Men Diagnosed With Testicular Nonseminoma According to Baseline Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>HR</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial treatment by time since TC diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 1 year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgery (no RT)</td>
<td>—</td>
<td>—</td>
<td>Ref</td>
</tr>
<tr>
<td>Chemotherapy (no RT)</td>
<td>4.86*</td>
<td>1.25 to 32.08</td>
<td>.04</td>
</tr>
<tr>
<td>1-4 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgery (no RT)</td>
<td>—</td>
<td>—</td>
<td>Ref</td>
</tr>
<tr>
<td>Chemotherapy (no RT)</td>
<td>1.35</td>
<td>0.54 to 3.45</td>
<td>.53</td>
</tr>
<tr>
<td>≥ 5 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgery (no RT)</td>
<td>—</td>
<td>—</td>
<td>Ref</td>
</tr>
<tr>
<td>Chemotherapy (no RT)</td>
<td>0.90</td>
<td>0.51 to 1.58</td>
<td>.72</td>
</tr>
<tr>
<td>Age at diagnosis, years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 30</td>
<td>—</td>
<td>—</td>
<td>Ref</td>
</tr>
<tr>
<td>30-39</td>
<td>3.47*</td>
<td>1.99 to 6.13</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>40-49</td>
<td>8.97*</td>
<td>4.73 to 17.02</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>≥ 50</td>
<td>34.26*</td>
<td>17.81 to 66.17</td>
<td>&lt; .01</td>
</tr>
</tbody>
</table>
Deficit-Accumulation Index (DAFI):
- 51-items
- Demographics
- ADLs
- Patient-rated KPS
- Falls
- Polypharmacy
- Comorbidities
- Nutritional status
- Psychosocial status
- Social support
- Health care professional questionnaire
- Basic lab values

\[ \text{DAFI} = \frac{\text{Actual Deficit Score}}{\text{Potential Deficit Score}} \]

<table>
<thead>
<tr>
<th>Robust</th>
<th>0.0 - &lt; 0.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefrail</td>
<td>0.2 - &lt; 0.35</td>
</tr>
<tr>
<td>Frail</td>
<td>≥ 0.35</td>
</tr>
</tbody>
</table>

Figure 2. The distribution of frailty scores in the Cancer and Aging Research Group cohort is illustrated according to the frailty index (FI). DAFI indicates deficit-accumulation frailty index.
Frailty and Mortality

Older breast cancer patients: CALGB 369901 (Alliance)

St. Jude Lifetime Cohort Study

<table>
<thead>
<tr>
<th>Phenotype*</th>
<th>Total</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of Patients</td>
<td>Deaths (%)</td>
<td>HR†</td>
</tr>
<tr>
<td>Frail</td>
<td>151</td>
<td>4.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Not frail</td>
<td>1,771</td>
<td>1.4</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: HR, hazard ratio.
*Frail is defined as at least three from among low lean muscle mass, exhaustion, low energy expenditure, slowness, weakness. Not frail is defined as two or fewer from among low lean muscle mass, exhaustion, low energy expenditure, slowness, or weakness.
†HR from Cox proportional hazards model.

<table>
<thead>
<tr>
<th>System</th>
<th>Exposures</th>
<th>Potential Late Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>Radiation therapy, Anthracyclines, AntiHER2 therapy</td>
<td>Myocardial infarction, Congestive heart failure, Valvular disease, Arrhythmias</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>Radiation therapy, BCNU/CCNU, Bleomycin</td>
<td>Restrictive lung disease, Exercise intolerance</td>
</tr>
<tr>
<td>Renal/Urological</td>
<td>Radiation therapy, Platinums, Ifosfamide/Cyclophos</td>
<td>Atrophy or hypertrophy, Renal insufficiency or failure</td>
</tr>
<tr>
<td>Endocrine</td>
<td>Radiation therapy, Alkylating agents</td>
<td>Pituitary, thyroid, adrenal disease, Ovarian or testicular failure, Infertility</td>
</tr>
<tr>
<td>CNS</td>
<td>Radiation therapy, Intrathecal chemotherapy, Other systemic chemotherapy</td>
<td>Cognitive dysfunction</td>
</tr>
<tr>
<td>Psychological</td>
<td>Cancer</td>
<td>Post-traumatic stress, Employment &amp; educational problems, Insurance discrimination, Adaptation/problem solving</td>
</tr>
<tr>
<td>Second malignancies</td>
<td>Radiation therapy, Alkylating agents, Epipodophyllotoxins</td>
<td>Solid tumors, Leukemia, Lymphoma</td>
</tr>
</tbody>
</table>
Factors contributing to late effects

- Aging
- Premorbid conditions
- Genetic

  BRCA, ATM, p53 polymorphisms

- Tumor factors

  Histology
  Site
  Biology
  Response

- Treatment factors

  Surgery
  Chemotherapy
  Radiation therapy

- Host factors

  Age
  Gender
  Race

- Treatment events

- Health behaviors

  Tobacco
  Diet
  Alcohol
  Exercise
  Sun

Hudson MM. Cancer, 2005
Interventions for Improved Physical Well-Being
Risk-stratified screening for SPC

- Average-risk individuals according to existing guidelines
  - Considerations for screening interval?
- High-risk groups
  - Genetic risk (Li-Fraumeni, BRCA2)
  - Cancer therapy risk (Hodgkin lymphoma)
  - Lifestyle risk (Lung cancer)
- Interventions to increase screening rates
1. Which patients with cancer are at increased risk for developing cardiac dysfunction?

**Recommendation 1.1.** It is recommended that patients with cancer who meet any of the following criteria should be considered at increased risk for developing cardiac dysfunction.

- Treatment that includes any of the following:
  - High-dose anthracycline (eg, doxorubicin $\geq 250$ mg/m$^2$, epirubicin $\geq 600$ mg/m$^2$)
  - High-dose radiotherapy (RT; $\geq 30$ Gy) where the heart is in the treatment field
  - Lower-dose anthracycline (eg, doxorubicin $< 250$ mg/m$^2$, epirubicin $< 600$ mg/m$^2$) in combination with lower-dose RT ($< 30$ Gy) where the heart is in the treatment field
- Treatment with lower-dose anthracycline (eg, doxorubicin $< 250$ mg/m$^2$, epirubicin $< 600$ mg/m$^2$) or trastuzumab alone, and presence of any of the following risk factors:
  - Multiple cardiovascular risk factors ($\geq$ two risk factors), including smoking, hypertension, diabetes, dyslipidemia, and obesity, during or after completion of therapy
  - Older age ($\geq 60$ years) at cancer treatment
  - Compromised cardiac function (eg, borderline low left ventricular ejection fraction [50% to 55%], history of myocardial infarction, $\geq$ moderate valvular heart disease) at any time before or during treatment
- Treatment with lower-dose anthracycline (eg, doxorubicin $< 250$ mg/m$^2$, epirubicin $< 600$ mg/m$^2$) followed by trastuzumab (sequential therapy)

(Evidence based; benefits outweigh harms; Evidence quality: intermediate; Strength of recommendation: moderate)
5. What are the preferred surveillance and monitoring approaches after treatment in patients at risk for cardiac dysfunction?

Recommendation 5.2. An echocardiogram may be performed between 6 and 12 months after completion of cancer-directed therapy in asymptomatic patients considered to be at increased risk (Recommendation 1.1) of cardiac dysfunction. (Evidence based; benefits outweigh harms; Evidence quality: intermediate; Strength of recommendation: moderate)

Recommendation 5.4. No recommendations can be made regarding the frequency and duration of surveillance in patients at increased risk (Recommendation 1.1) who are asymptomatic and have no evidence of cardiac dysfunction on their 6- to 12-month post-treatment echocardiogram.

Recommendation 5.5. Clinicians should regularly evaluate and manage cardiovascular risk factors such as smoking, hypertension, diabetes, dyslipidemia, and obesity in patients previously treated with cardiotoxic cancer therapies. A heart-healthy lifestyle, including the role of diet and exercise, should be discussed as part of long-term follow-up care. (Evidence based and consensus; benefits outweigh harms; Evidence quality: intermediate; Strength of recommendation: moderate)
• Barriers to generating evidence:
  – NIH funding favors intervention > observation
  – Will early intervention improve outcomes?
    • Heart failure as an example
Heart Failure

Key points

- 5-yr survival for stage C: 75%
- Transitioning from stage B to stage C was associated with a 5-fold increased mortality risk


Heart Failure

Key points
- Meta-analysis of 39,372 patients
- Importance of 5 unit incremental changes in LVEF on survival


Can we prevent frailty?

**LIFE Study**

818 sedentary individuals age 70 – 89 years
Structured, moderate-intensity physical activity program vs health education program

• ‘Liquid biopsy’
  – circulating cell-free DNA (cfDNA)
  – circulating tumor cells (CTC)
    
    Vockley JG and Niederhuber JE. BMJ, 2015

• Epigenetic-marker based system with detection rate of breast cancer similar to mammography
  

• Cancer interception
  
  – Example: ErbB2 and lapatinib
    
    Li D, et al. Oncotarget, 2017
Summary

• Survival rates continue to improve
• Incidence and magnitude of risk of selected long-term and late effects is robust
• Evidence supporting risk-stratified surveillance and early intervention is needed
• Lifestyle modifications are evidence-based (Dr. Demark-Wahnefried’s talk)
Thank You!

kevin.oeffinger@duke.edu