SEER*Stat Technical Webinar
July 14, 2011, 1pm-2pm

Angela Mariotto
Steve Scoppa
Nadia Howlader
Hyunsoon Cho
Outline

New features in survival:

- Ederer II method to estimate expected survival in relative survival
- Improved algorithm to specify the underlying cause of death: the SEER cause-specific death classification variable

New features of SEER*Stat

- Profiles tool in SEER*Stat version 7.0.4 to customize preferences
- Sharing user-defined variables
Brief Introduction to Survival Measures
3 Measures of Cancer Survival

- **Observed survival**
  - Probability of surviving all causes of death

- **Net Survival**
  - Probability of surviving cancer in the absence of other causes of death

- **Crude Probability of death**
  - Probability of dying of cancer and other causes
Measures/Methods of Cancer Survival

<table>
<thead>
<tr>
<th>Estimation Method</th>
<th>Cause of death</th>
<th>Expected survival (life tables)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cause-specific survival</td>
<td>Net cancer survival</td>
<td>Crude probability of death using cause of death information</td>
</tr>
<tr>
<td>Relative survival</td>
<td>Crude probability of death using expected survival</td>
<td></td>
</tr>
</tbody>
</table>

- **Net cancer survival**: (Probability of surviving cancer in the absence of other cause of death)
- **Crude probability of death**: (Probability of dying of cancer in the presence of other causes of death)

Ederer II method to estimate expected survival in relative survival
# Measures/Methods of Cancer Survival

<table>
<thead>
<tr>
<th>Estimation Method</th>
<th>Cause of death</th>
<th>Cause-specific survival</th>
<th>Relative survival</th>
<th>Crude probability of death using expected survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected survival (life tables)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Net cancer survival</td>
<td></td>
<td>Crude probability of death</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Probability of surviving cancer in the absence of other cause of death)</td>
<td></td>
<td>(Probability of dying of cancer in the presence of other causes of death)</td>
</tr>
</tbody>
</table>
Relative Survival

- Does not use cause of death information
- Standard method for reporting net cancer survival from cancer registry data
- Measure of excess mortality experienced by cancer patients
- Uses expected survival to represent other-cause survival for the patient group under study
Relative Survival Method

Relative Survival

- Measure of excess mortality experienced by cancer patients

Observed survival

- Total mortality experienced by the patients

Expected Survival

- Expected mortality of a comparable group from the general population
- Matched to the patients with respect to the main factors affecting patient survival
Expected Survival

- Estimated from US life tables matched by age, sex, calendar time and race, to the cancer patient cohort
- Assumes that life tables are representative of patients other-cause survival
- Methods differ with respect to how long matched individuals are considered to be at risk
Methods to estimate expected survival

**Ederer I**
- Matched individuals are considered to be at risk indefinitely
- Previous SEER*Stat default

**Hakulinen**
- Matched individuals are considered to be at risk until the corresponding cancer patient is censored.
- If a cancer patient dies the matched individual is assumed to be at risk until the closing date of the study.
Methods to estimate expected survival

**Ederer I**
- Matched individuals are considered to be at risk indefinitely
- Previous SEER*Stat default

**Ederer II**
- Matched individuals are considered to be at risk until the corresponding cancer patient dies or is censored
- New SEER*Stat default

**Hakulinen**
- Matched individuals are considered to be at risk until the corresponding cancer patient is censored.
- If a cancer patient dies the matched individual is assumed to be at risk until the closing date of the study.
Ederer I vs. Ederer II

➢ Ederer I
  • Unbiased estimate of expected survival proportion
  • When applied to observed survival it usually overestimates relative survival

➢ Ederer II
  • Controls for heterogeneous observed follow-up time it depends on observed mortality
  • Underestimates relative survival
  • Closer to cause-specific survival
  • Being adopted in international calculations of relative survival
### 5-year relative survival estimates for selected cancer sites, SEER 17

<table>
<thead>
<tr>
<th>SEER Cancer Sites</th>
<th>5-year relative estimates (%)</th>
<th>95% confidence intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ederer I</td>
<td>Ederer II</td>
</tr>
<tr>
<td>All Sites</td>
<td>66.35</td>
<td>65.16</td>
</tr>
<tr>
<td>Prostate</td>
<td>99.23</td>
<td>99.33</td>
</tr>
<tr>
<td>Breast</td>
<td>89.13</td>
<td>89.06</td>
</tr>
<tr>
<td>Lung and Bronchus</td>
<td>16.05</td>
<td>15.47</td>
</tr>
<tr>
<td>Colon and Rectum</td>
<td>65.19</td>
<td>64.25</td>
</tr>
<tr>
<td>Melanoma of the Skin</td>
<td>91.53</td>
<td>91.15</td>
</tr>
<tr>
<td>Urinary Bladder</td>
<td>79.37</td>
<td>78.15</td>
</tr>
<tr>
<td>Corpus and Uterus, NOS</td>
<td>82.66</td>
<td>82.03</td>
</tr>
<tr>
<td>Non-Hodgkin Lymphoma</td>
<td>67.92</td>
<td>66.25</td>
</tr>
<tr>
<td>Thyroid</td>
<td>97.44</td>
<td>97.05</td>
</tr>
<tr>
<td>Pancreas</td>
<td>5.77</td>
<td>5.36</td>
</tr>
</tbody>
</table>
Relative survival for women diagnosed with thyroid cancer all ages using Ederer I, Ederer II and Hakulinen expected survival methods.
Comparison of relative survival

Female patients diagnosed with thyroid cancer at all ages in the SEER-9 areas

![Graph showing relative survival over years from diagnosis for different standards: Ederer I, Ederer II, and Hakulinen.](image)
Conclusions

- Relative survival estimates, using any of the expected survival methods available, are very similar in most situations.
- For cancer sites diagnosed at a wide range of ages, there might be small differences at longer follow-up times.
- Ederer II method is the new default for the new databases. Databases from previous versions still have Ederer I as default. Users can set default for their databases.
- Recent developments in relative survival analysis suggest other methods to estimate expected survival that might be less biased. Perme et al (2011)
Expected Survival Options in SEER*Stat

Ederer II is the default
References

- SRP technical report
  - Cho et. al Estimating relative survival for cancer patients from the SEER Program using expected rates based on Ederer I versus Ederer II method (2011)

Algorithm to specify an improved underlying cause of death: the SEER cause-specific death classification variable
The SEER cause-specific death classification variable

<table>
<thead>
<tr>
<th>Estimation Method</th>
<th>Cause of death</th>
<th>Expected survival (life tables)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cause-specific survival</strong></td>
<td><strong>Crude probability of death using cause of death information</strong></td>
<td><strong>Crude probability of death using expected survival</strong></td>
</tr>
<tr>
<td>Net cancer survival</td>
<td>Crude probability of death (Probability of dying of cancer in the presence of other causes of death)</td>
<td></td>
</tr>
<tr>
<td>(Probability of surviving cancer in the absence of other cause of death)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Why improve cause of death information?

- Population-based studies often report relative survival

- Cause of death (COD) information from death certificate
  - Not always available to cancer registries
  - Misclassification error
    - Metastatic site of the primary cancer diagnosis may be reported as the underlying COD
    - Difficult to assign CODs to a primary cancer diagnosis for people with multiple primaries
Why improve cause of death information?

- Challenging to estimate expected/relative survival for subgroups of the population
  - Lack of “appropriate” life-tables (e.g. ethnic minorities, risk factors, socioeconomic status, geographic area)
  - Patients diagnosed with screen detected cancers
- Need to develop an algorithm to identify a single, disease-specific, underlying COD
The algorithm takes into account COD in conjunction with:

- Site of original cancer diagnosis
- Tumor sequence
  - Sequence 00 (only one primary tumor) vs
  - Sequence 01 (first of more than one tumor)
- Diseases related to the cancer of diagnosis (e.g., HIV/AIDS)

COD was evaluated using respective International Classification of Disease Codes (ICD):

Overview of the algorithm used to define the SEER COD Classification Variable

<table>
<thead>
<tr>
<th>Cause of death groups</th>
<th>Sequence 00-one &amp; only one primary</th>
<th>Sequence 01 – first of more than one tumor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer of the same site</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Cancer of the same body system</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Cancer of any other site</td>
<td>Yes</td>
<td>No (in general)</td>
</tr>
<tr>
<td>AIDS and cancer (B21)</td>
<td>Yes</td>
<td>HIV/AIDS associated cancers*</td>
</tr>
<tr>
<td>HIV alone (B20)</td>
<td>HIV/AIDS associated cancers*</td>
<td>HIV/AIDS associated cancers*</td>
</tr>
<tr>
<td>Site –specific disease</td>
<td>Selective</td>
<td>Selective</td>
</tr>
</tbody>
</table>

*HIV/AIDS associated cancers= Oral Cavity and Pharynx, Cervix, Anus Cancer, Lymphomas, and Kaposi Sarcoma*
### ICD-10 SEER Cause-specific Death for Sequence 00
for SEER 1973-2008 Data (November 2010 Submission)

'Dead' coding for use with ICD-10 SEER cause-specific death with Sequence numbers 00, 60, 88, 98, or 99.

<table>
<thead>
<tr>
<th>Site Recode with Kaposi Sarcoma and Mesothelioma</th>
<th>Any Cancer</th>
<th>AIDS &amp; Cancer</th>
<th>Site-specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral Cavity and Pharynx</td>
<td>C00-D489</td>
<td>B210-B219</td>
<td>B20, B22-B24</td>
</tr>
<tr>
<td>Esophagus</td>
<td>C00-D489</td>
<td>B210-B219</td>
<td>K20-K31, K51-K57, K92</td>
</tr>
<tr>
<td>Stomach</td>
<td>C00-D489</td>
<td>B210-B219</td>
<td>K20-K31, K51-K57, K92</td>
</tr>
<tr>
<td>Small Intestine</td>
<td>C00-D489</td>
<td>B210-B219</td>
<td>K20-K31, K35-K63, K90-K93</td>
</tr>
<tr>
<td>Colon and Rectum</td>
<td>C00-D489</td>
<td>B210-B219</td>
<td>K20-K31, K35-K38, K51-K57, K62, K63, K65, K66, K92</td>
</tr>
<tr>
<td>Anus, Anal Canal and Anorectum</td>
<td>C00-D489</td>
<td>B210-B219</td>
<td>B20, B22-B24, K20-K31, K51-K57, K62, K92</td>
</tr>
</tbody>
</table>
**COD codes (Sequence 01)**


---

**ICD-10 SEER Cause-specific Death for Sequence 01**

for SEER 1973-2008 Data (November 2010 Submission)

'Dead' coding for use with ICD-10 SEER cause-specific death with Sequence numbers 01 or 61.

<table>
<thead>
<tr>
<th>Site Recode with Kaposi Sarcoma and Mesothelioma</th>
<th>Secondary Other Specified</th>
<th>Unknown Primary</th>
<th>Multiple Cancer</th>
<th>Neoplasm NOS</th>
<th>Site-specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral Cavity and Pharynx</td>
<td>C798</td>
<td>C80</td>
<td>C97</td>
<td>D489</td>
<td></td>
</tr>
<tr>
<td>Esophagus</td>
<td>C798</td>
<td>C80</td>
<td>C97</td>
<td>D489</td>
<td>B20-B24, C00-C15, C31-C32, C410-C411, C440, C443-C444, C449, C490, C499, C760, D000, D030, D033, D034, D040, D043, D044, D10-D11, D210, D310, D220, D222, D224, D230, D233, D234, D370</td>
</tr>
<tr>
<td>Stomach</td>
<td>C798</td>
<td>C80</td>
<td>C97</td>
<td>D489</td>
<td>C14-C16, C26, D002, D131, D371-D379, K20-K31, K51-K57, K92</td>
</tr>
<tr>
<td>Small Intestine</td>
<td>C798</td>
<td>C80</td>
<td>C97</td>
<td>D489</td>
<td>C17-C21, C26, C784, D014, D132, D133, D371-D379, K35-K63, K90-K93</td>
</tr>
</tbody>
</table>
Example: Cause-specific survival for patients diagnosed with Kaposi sarcoma

Comparison of cause specific survival using Kaposi sarcoma death vs. the SEER death variable
5-year net survival for patients diagnosed with only Kaposi sarcoma (KS)

Note= Five-year Kaposi sarcoma cancer survival by months since diagnosis, SEER-17, 2001-2007

Survival Probability

Year Since Diagnosis
Distribution of causes of death for patients diagnosed with only Kaposi sarcoma
Example: 5-year net survival for men diagnosed with local/regional prostate cancer

One example of the use of cause-specific survival when life tables are not representative of the other causes survival of the population under study
Cause-Specific & Relative Survival Rate For Early Stage Prostate Cancer

Note= Five-year early stage prostate cancer survival by months since diagnosis, SEER-17, 2001-2007
Cause-Specific & Relative Survival Rate For Early Stage Prostate Cancer

Note= Five-year early stage prostate cancer survival by months since diagnosis, SEER-17, 2001-2007
How to use the SEER cause-specific death classification variable in SEER*Stat
SEER*Stat: Selection Tab

Standard Case Selections

Select Only:
- Microscopically Confirmed
- Actively Followed
- Malignant Behavior
- Sex Male or Female
- Known Age
- Cases in Research Database

Exclude:
- All Death Certificate Only and Autopsy Only
- Based on Multiple Primaries:
  - Second and Later Primaries
  - All Records for Persons with Multiple Primaries
- Alive with No Survival Time
- Dead Due to Other Causes with No Survival Time

Exclusions to Match the Expected Survival Table:
- Age Values Not Found in Table
- Invalid Year
- Values Not Found for Other Variables in Table

Case Selection

\{Race, Sex, Year Dx, Registry, County, Year of diagnosis\} = '2001', '2002', '2003', '2004', '2005', '2006', '2007'
AND (Race, Sex, Year Dx, Registry, County, Sex) = 'Male'
AND (Site and Morphology, Site rec with Kaposi and mesothelioma) = 'Prostate'
AND (Stage - LRD (Summary and Historic), SEER historic stage A) = "Localized/regional (Prostate cases)"
Definition of Cause of Death

Variable:
- Cause of Death (COD) and Follow-up
  - COD to site recode
  - SEER cause-specific death classification
  - COD to site rec code KM
- Multiple Primary Fields

Operator:
- is = to
- is not

Values:
- Alive or dead of other cause
- Dead
- N/A not first tumor

Conjunction:
- New Line

Selection Statement:
(Cause of Death (COD) and Follow-up.SEER cause-specific death classification) = "Dead"

Created for use in cause-specific survival. For more information, see http://seer.cancer.gov/causespecific.
For More Information
