



SEER*Stat Technical Webinar

July 14, 2011, 1pm-2pm

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➤ 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

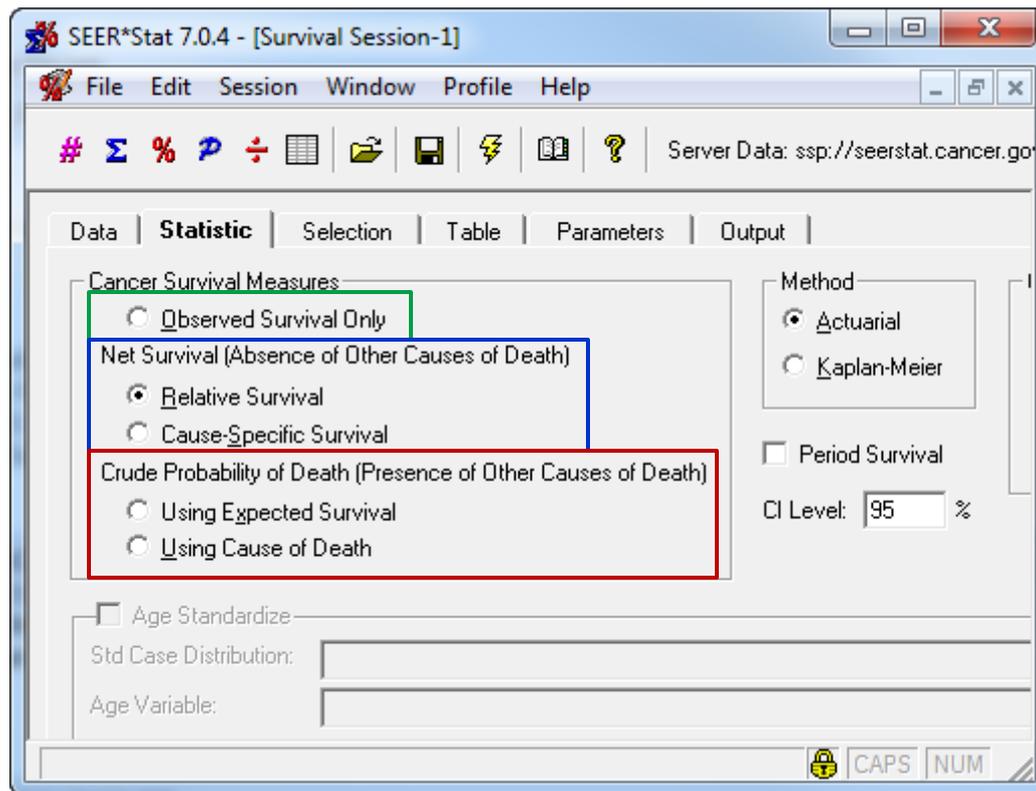
- Probability of surviving all causes of death

➤ 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



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)

Estimation Method

Cause of death	Cause-specific survival	Crude probability of death using cause of death information
Expected survival (life tables)	Relative survival	Crude probability of death using expected survival



Ederer II method to estimate expected survival in relative survival

Measures/Methods of Cancer Survival



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Relative Survival

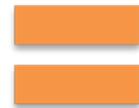


- Does not use cause of death information
- Standard method for reporting net cancer survival from cancer registry data
- Measure of excess mortality experienced by cancer patients
- Uses expected survival to represent other-cause survival for the patient group under study

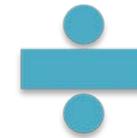
Relative Survival Method



Relative Survival



Observed survival



Expected Survival

- Measure of excess mortality experienced by cancer patients

- Total mortality experienced by the patients

- 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

Relative survival estimates using Ederer I and Ederer II



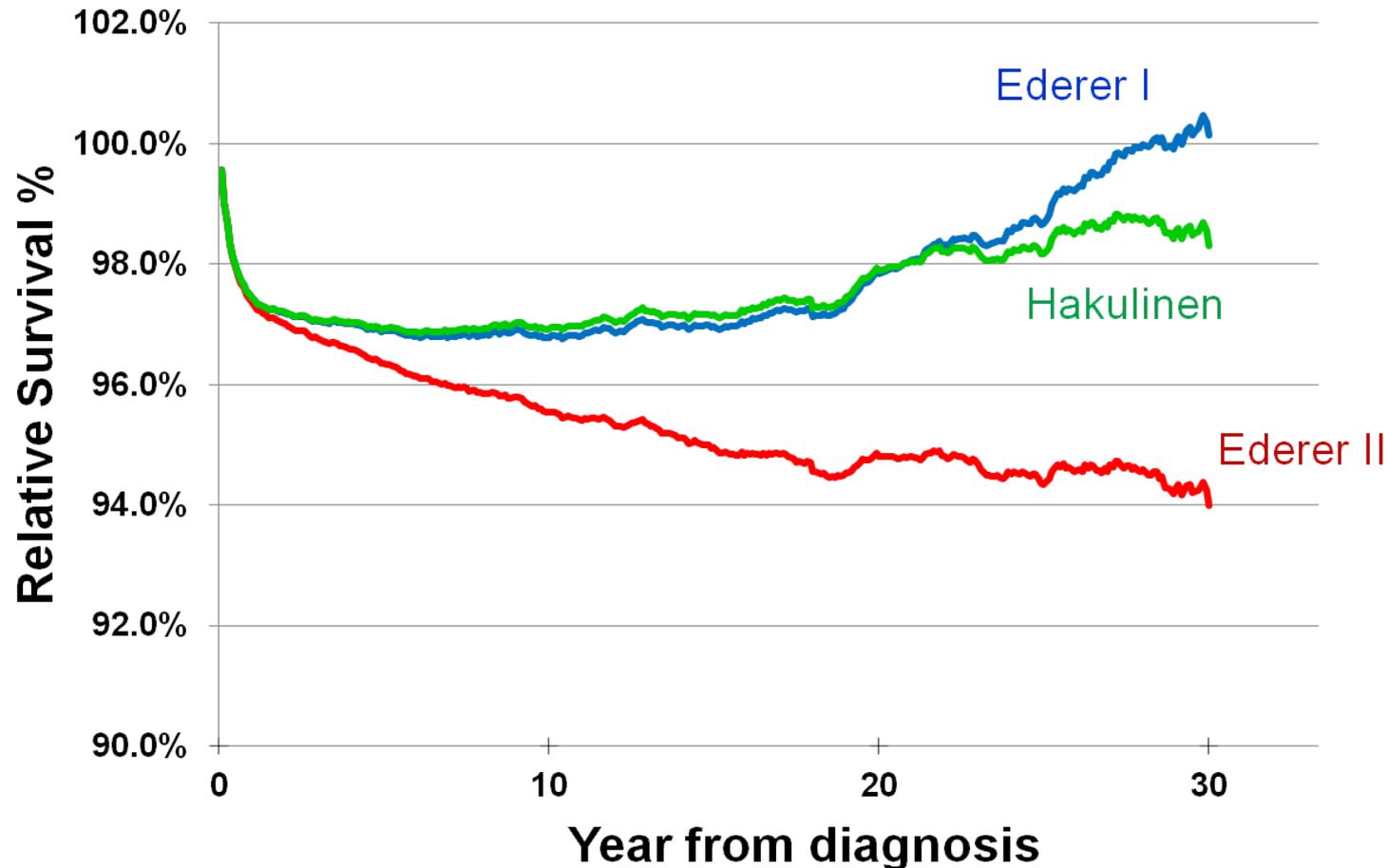
5-year relative survival estimates for selected cancer sites, SEER 17

SEER Cancer Sites	5-year relative estimates (%)			95% confidence intervals			
	Ederer I	Ederer II	Absolute difference (I-II)	Ederer I		Ederer II	
All Sites	66.35	65.16	1.19	(66.27, 66.44)	(65.08, 65.24)		
Prostate	99.23	99.33	-0.10	(99.05, 99.38)	(99.14, 99.48)		
Breast	89.13	89.06	0.07	(88.97, 89.29)	(88.89, 89.22)		
Lung and Bronchus	16.05	15.47	0.58	(15.88, 16.22)	(15.31, 15.63)		
Colon and Rectum	65.19	64.25	0.95	(64.92, 65.46)	(63.98, 64.51)		
Melanoma of the Skin	91.53	91.15	0.38	(91.21, 91.83)	(90.84, 91.45)		
Urinary Bladder	79.37	78.15	1.22	(78.93, 79.80)	(77.72, 78.57)		
Corpus and Uterus, NOS	82.66	82.03	0.63	(82.25, 83.06)	(81.62, 82.43)		
Non-Hodgkin Lymphoma	67.92	66.25	1.67	(67.52, 68.31)	(65.86, 66.64)		
Thyroid	97.44	97.05	0.40	(97.17, 97.68)	(96.78, 97.29)		
Pancreas	5.77	5.36	0.41	(5.52, 6.02)	(5.13, 5.60)		

Relative survival for women diagnosed with thyroid cancer all ages



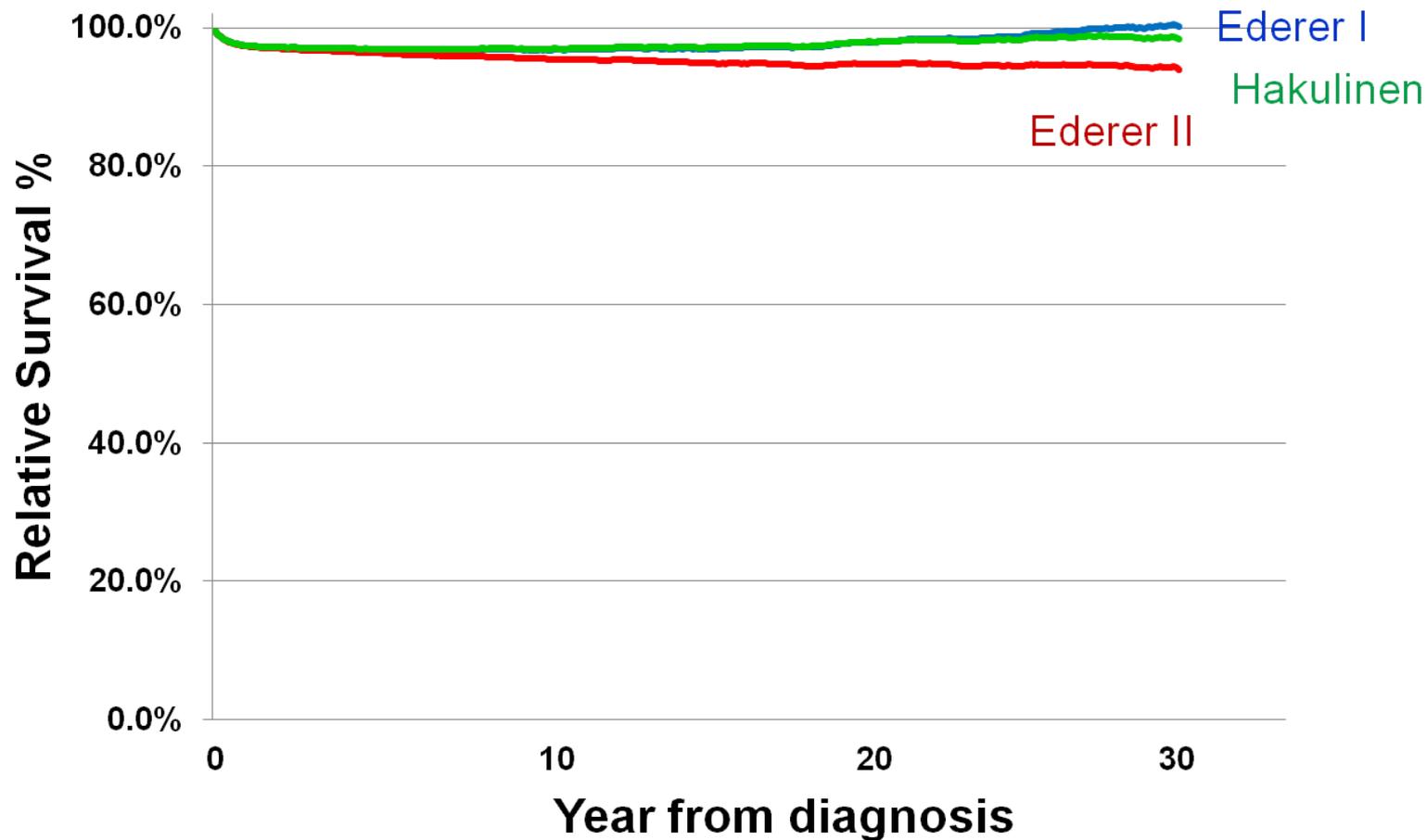
using Ederer I , Ederer II and Hakulinen expected survival methods



Comparison of relative survival



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



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



The screenshot shows the SEER*Stat 7.0.4 interface with the 'Statistic' tab selected. The 'Cum Expected Method' section is highlighted with a red box, showing the following options:

- Ederer I
- Ederer II
- Hakulinen Exact
- Hakulinen Simplified

Other visible options include:

- Cancer Survival Measures:**
 - Observed Survival Only
 - Net Survival (Absence of Other Causes of Death)
 - Relative Survival
 - Cause-Specific Survival
 - Crude Probability of Death (Presence of Other Causes of Death)
 - Using Expected Survival
 - Using Cause of Death
- Method:**
 - Actuarial
 - Kaplan-Meier
 - Period Survival
- CI Level:** 95 %
- Age Standardize:** (Std Case Distribution and Age Variable dropdowns)
- Expected Survival Table:** U.S. 1970-2006 by individual year (White, Black, Other (AI/API) All races for Other Unspec 1991+ and Unknown)
- Definition of Cause of Death:** Dead using SEER CS Death Classification (with Create, Edit, Delete buttons)
- Missing/Unknown COD:**
 - Exclude From Analysis
 - Include As Dead (Specified Cause)
 - Include As Censored
 - Include As Dead (Other Causes)

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)
<http://surveillance.cancer.gov/reports/tech2011.01.pdf>

- Perme et al. On Estimation in Relative Survival. Biometrics, 2011.



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

The SEER cause-specific death classification variable



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)

Estimation Method

Cause of death	Cause-specific survival	Crude probability of death using cause of death information
Expected survival (life tables)	Relative survival	Crude probability of death using expected survival



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

SEER Cause-Specific Death Classification Variable



- 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)
 - ICD-8 (1975-1978), ICD-9 (1979-1998), ICD-10 (1999+)

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



Cause of death groups	Death attributed to the specific cancer site	
	Sequence 00- one & only one primary	Sequence 01 – first of more than one tumor
Cancer of the same site	Yes	Yes
Cancer of the same body system	Yes	Yes
Cancer of any other site	Yes	No (in general)
AIDS and cancer (B21)	Yes	HIV/AIDS associated cancers*
HIV alone (B20)	HIV/AIDS associated cancers*	HIV/AIDS associated cancers*
Site –specific disease	Selective	Selective

*HIV/AIDS associated cancers= Oral Cavity and Pharynx, Cervix, Anus Cancer, Lymphomas, and Kaposi Sarcoma

COD codes (Sequence 00)

<http://seer.cancer.gov/causespecific/index.html>



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.

Site Recode with Kaposi Sarcoma and Mesothelioma	Any Cancer	AIDS & Cancer	Site-specific
Oral Cavity and Pharynx	C00-D489	B210-B219	B20, B22-B24
Esophagus	C00-D489	B210-B219	K20-K31, K51-K57, K92
Stomach	C00-D489	B210-B219	K20-K31, K51-K57, K92
Small Intestine	C00-D489	B210-B219	K20-K31, K35-K63, K90-K93
Colon and Rectum	C00-D489	B210-B219	K20-K31, K35-K38, K51-K57, K62, K63, K65, K66, K92
Anus, Anal Canal and Anorectum	C00-D489	B210-B219	B20, B22-B24, K20-K31, K51-K57, K62, K92

COD codes (Sequence 01)

<http://seer.cancer.gov/causespecific/index.html>



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.

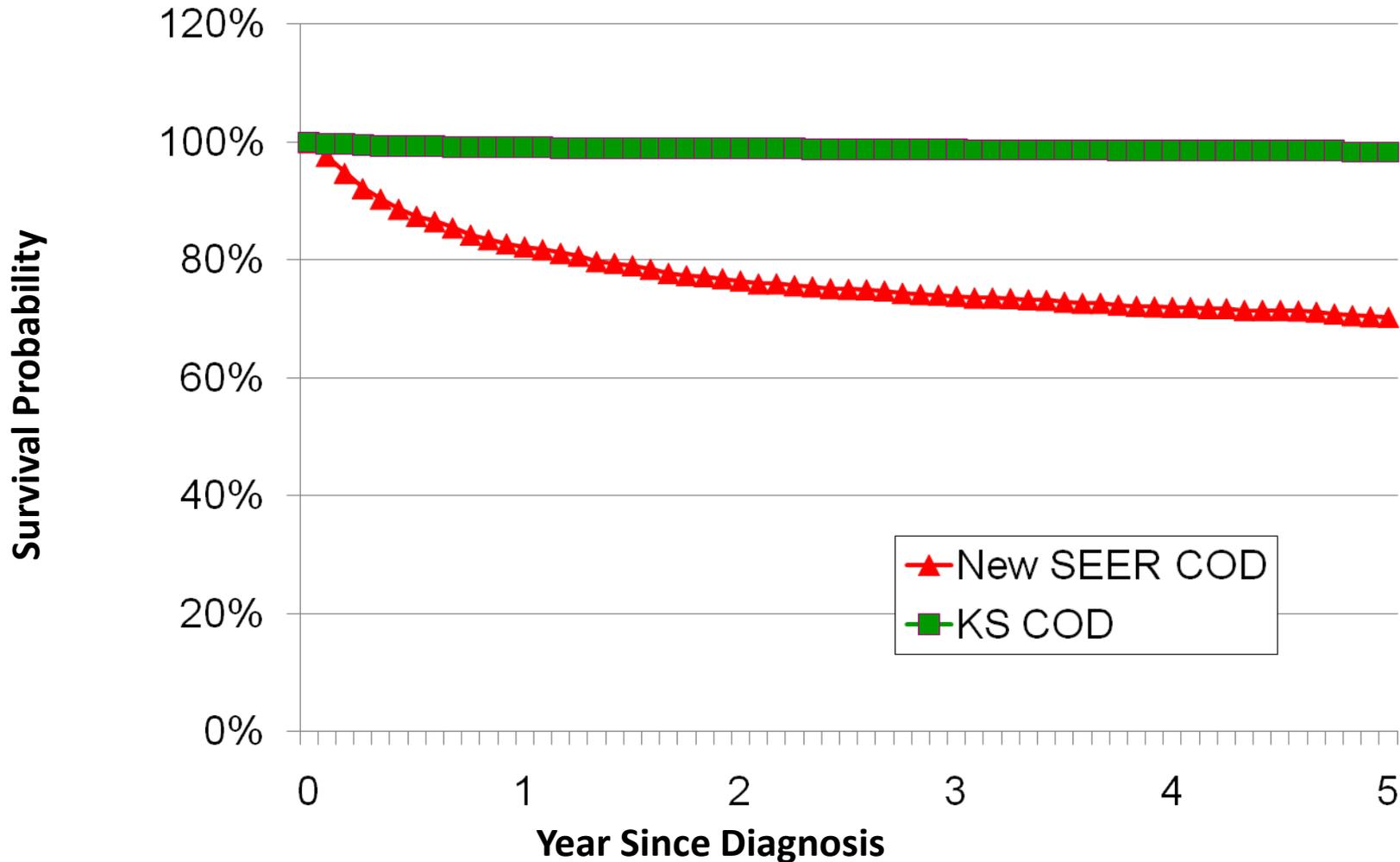
Site Recode with Kaposi Sarcoma and Mesothelioma	Secondary Other Specified	Unknown Primary	Multiple Cancer	Neoplasm NOS	Site-specific
Oral Cavity and Pharynx	C798	C80	C97	D489	B20-B24, C00-C15, C31-C32, C410-C411, C440, C443-C444, C449, C490, C499, C760, D000, D030, D033, D034, D040, D043, D044, D10-D11, D210, D220, D223, D224, D230, D233, D234, D370
Esophagus	C798	C80	C97	D489	C15-C16, C26, D001, D130, D371-D379, K20-K31, K51-K57, K92
Stomach	C798	C80	C97	D489	C14-C16, C26, D002, D131, D371-D379, K20-K31, K51-K57, K92
Small Intestine	C798	C80	C97	D489	C17-C21, C26, C784, D014, D132, D133, D371-D379, K35-K63, K90-K93
Colon and Rectum	C798	C80	C97	D489	C17-C21, C26, C785, D010-D012, D12, D371-D379, K20-K31, K35-K38, K51-K57, K62-K63, K65-K66, K92
Anus, Anal Canal and Anorectum	C798	C80	C97	D489	B21, C26, C445, C785, D013, D035, D045, D12, D225, D235, D371-D379, D485, K20-K31, K51-K57, K62, K92



Example: Cause-specific survival for patients diagnosed with Kaposi sarcoma

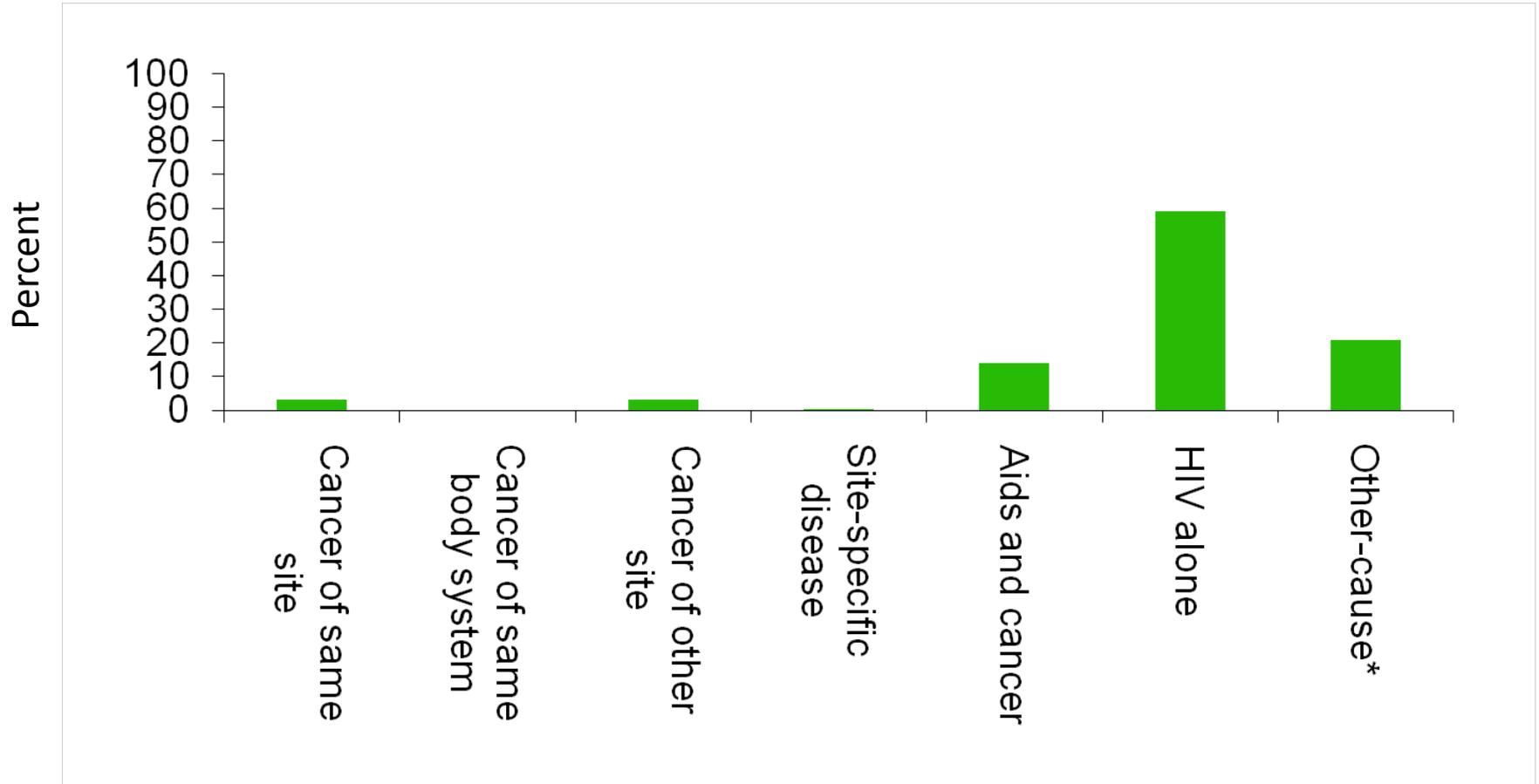
Comparison of cause specific survival using Kaposi sarcoma death vs. the SEER death variable

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

Distribution of causes of death for patients diagnosed with only Kaposi sarcoma

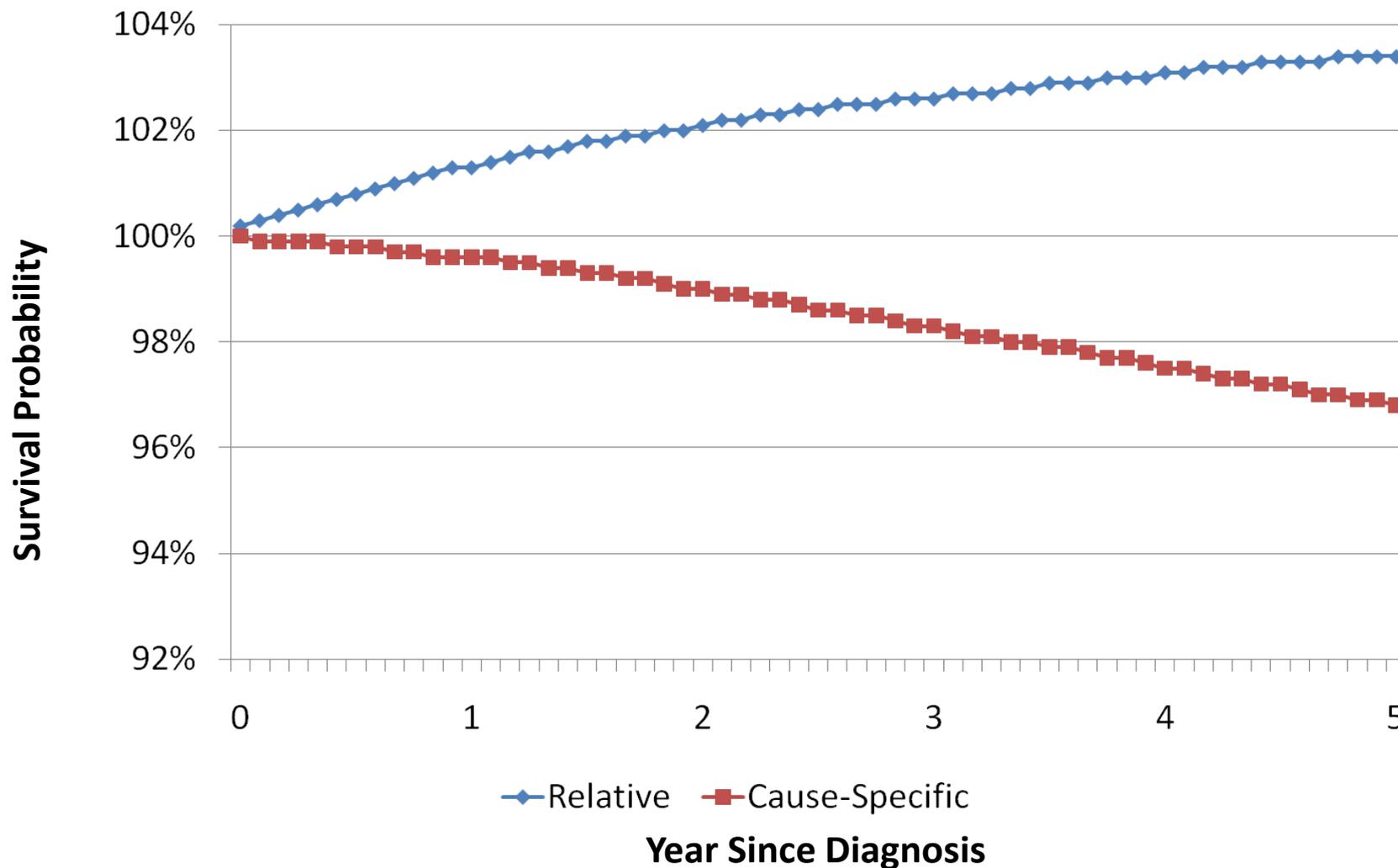




Example: 5-year net survival for men diagnosed with local/regional prostate cancer

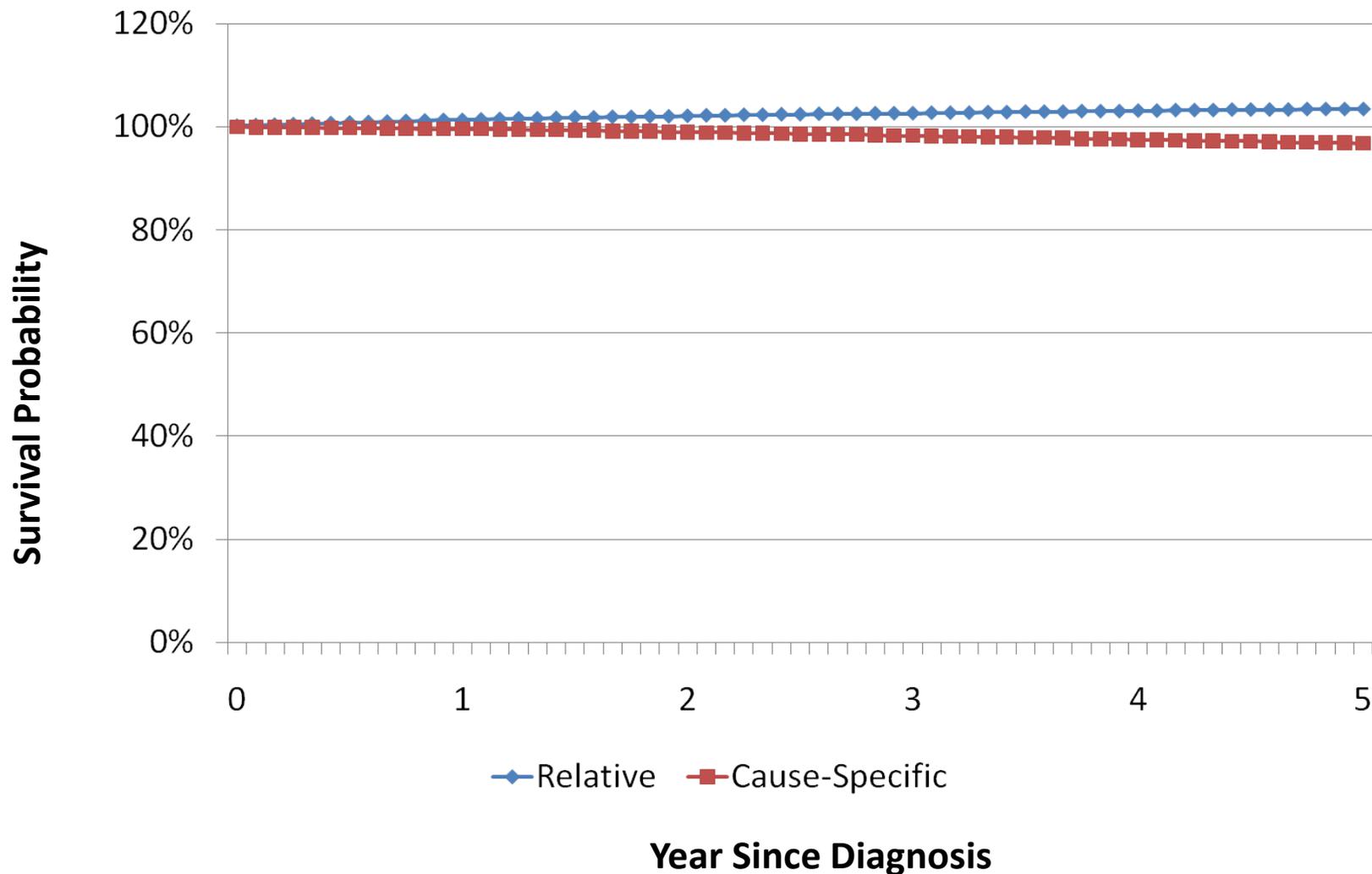
One example of the use of cause-specific survival when life tables are not representative of the other causes survival of the population under study

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





How to use the SEER cause-specific death classification variable in SEER*Stat

SEER*Stat: Selection Tab



SEER*Stat 7.0.4 - [Survival Session-1]

File Edit Session Window Profile Help

Server Data: ssp://seerstat.cancer.gov:2038

Data | Statistic | **Selection** | Table | Parameters | Output

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)'
```

Edit...
Clear

CAPS NUM



SEER*Stat 7.0.4 - [Survival Session-1]

File Edit Session Window Profile Help

Server Data: ssp://seerstat.cancer.gov:2038

Data | **Statistic** | Selection | Table | Parameters | Output

Cancer Survival Measures

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 - Relative Survival
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- Crude Probability of Death (Presence of Other Causes of Death)
 - Using Expected Survival
 - Using Cause of Death

Method

- Actuarial
- Kaplan-Meier

Period Survival

CI Level: 95 %

Cum Expected Method

- Ederer I
- Ederer II
- Hakulinen Exact
- Hakulinen Simplified

Age Standardize

Std Case Distribution: []

Age Variable: []

Expected Survival Table: U.S. 1970-2006 by individual year (White, Black, Other (AI/API) All races for Other Unspec 1991+ and Unknown)

Definition of Cause of Death

[]

Create.. Edit.. Delete

Missing/Unknown COD:

- Exclude From Analysis
- Include As Dead (Specified Cause)
- Include As Censored
- Include As Dead (Other Causes)

CAPS NUM



SEER*Stat 7.0.4 - [Survival Session-1]

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Server Data: ssp://seerstat.cancer.gov:2038

Data | **Statistic** | Selection | Table

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Age Standardize

Std Case Distribution:

Age Variable:

Expected Survival Table: U.S. 1970-2006 by

Definition of Cause of Death

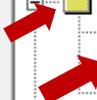
Variable	Operator	Values
<input type="checkbox"/> Cause of Death (COD) and Follow-up	is = to	Alive or dead of other cause
<input type="checkbox"/> COD to site recode	is not = to	Dead
<input checked="" type="checkbox"/> SEER cause-specific death classification		N/A not first tumor
<input type="checkbox"/> COD to site rec KM		
<input checked="" type="checkbox"/> Multiple Primary Fields		

Modify Conjunction:

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

Selection Statement

(Cause of Death (COD) and Follow-up.SEER cause-specific death classification) = 'Dead'



U.S. 1970-2006 by

Age Standardize

Std Case Distribution:

Age Variable:

Expected Survival Table: U.S. 1970-2006 by

Definition of Cause of Death

Cause of Death (COD) and Follow-up

COD to site recode

SEER cause-specific death classification

COD to site rec KM

Multiple Primary Fields

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CAPS NUM



SEER*Stat 7.0.4 - [Survival Session-1]

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Server Data: ssp://seerstat.cancer.gov:2038

Data | **Statistic** | Selection | Table

Cancer Survival Measures

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- Using Expected Survival
- Using Cause of Death

Age Standardize

Std Case Distribution:

Age Variable:

Expected Survival Table: U.S. 1970-2006 by

Definition of Cause of Death

Variable	Operator	Values
Cause of Death (COD) and Follow-up	is = to	Alive or dead of other cause
COD to site recode	is not to	Dead
SEER cause-specific death classification		N/A not first tumor
COD to site rec KM		
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CAPS NUM



SEER*Stat 7.0.4 - [Survival Session-1]

File Edit Session Window Profile Help

Σ % P ÷ [Icons] Server Data: ssp://seer

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 - Using Cause of Death

Method

- Actuarial
- Kaplan-Meier

Period Survival

CI Level: 95

Age Standardize

Std Case Distribution: []

Age Variable: []

Expected Survival Table: U.S. 1970-2006 by individual year (White, Black, Other (All Races))

Definition of Cause of Death

[]

Survival Specific Cause of Death Definition

Name: **Dead using SEER CS Death Classification**

Definition: []

Edit...

Groupings

Dead [] Edit...

Grouping Definition

{Cause of Death (COD) and Follow-up.SEER cause-specific death classificati

[]

Save to Dictionary

OK Cancel Help

CAPS NUM



SEER*Stat 7.0.4 - [Survival Session-1]

File Edit Session Window Profile Help

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Age Standardize

Std Case Distribution: [dropdown]

Age Variable: [dropdown]

Expected Survival Table: U.S. 1970-2006 by individual year (White, Black, Other (AI/API) All races for Other Unspec 1991+ and Unknown) [dropdown]

Definition of Cause of Death

- Dead using SEER CS Death Classification

Create.. Edit.. Delete

Missing/Unknown COD:

- Exclude From Analysis
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CAPS NUM

For More Information



- <http://seer.cancer.gov/causespecific/index.html>
- Howlader, N., L. Ries, A. Mariotto, M. Reichman, J. Ruhl, and K. Cronin. “Improved Estimates of Cancer-Specific Survival Rates from Population-Based Data”. *Journal of National Cancer Institute*, Vol102, Issue 20, October 2010.