

The Use of Cause-specific Survival in SEER Population-based Registries When Relative Survival Fails

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Outline

- **Background**
- **Relative survival**
- **Cause-specific survival**
- **Cause of death (COD)**
- **Development of algorithm for COD assignment**
- **Comparison of relative and cause-specific survival (using new COD variable) estimates**
- **Conclusion**

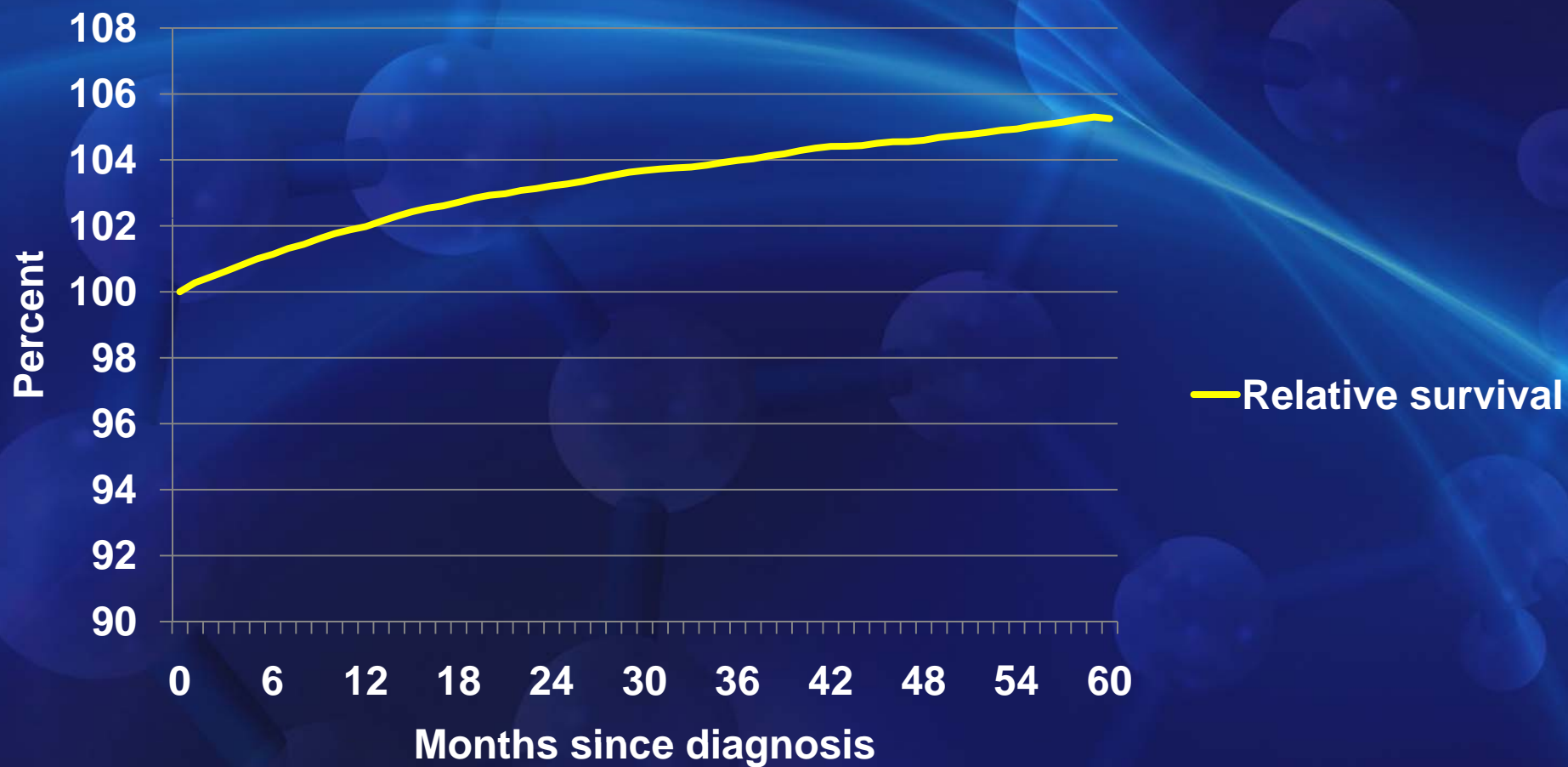
Background

- **Accurate estimates of cancer survival are important**
- **Population-based studies often use relative survival**
 - A ratio of observed to expected survival
 - Observed survival (cancer patients)
 - Expected survival (US general population life-table based on cancer cohort's age, race, sex, age, year of diagnosis, and geography)

Relative Survival

- **Challenge of “appropriate” life-tables to estimate relative survival**
 - Ethnic minorities and racial groups
 - Mortality misclassification
 - Non-cancer survival better or worse than general population
 - Risk factors & socioeconomic status
 - Screening & health status
 - Geographic area (now available)
 - Assumption that the cancer is the only difference between the cancer cohort and the general population

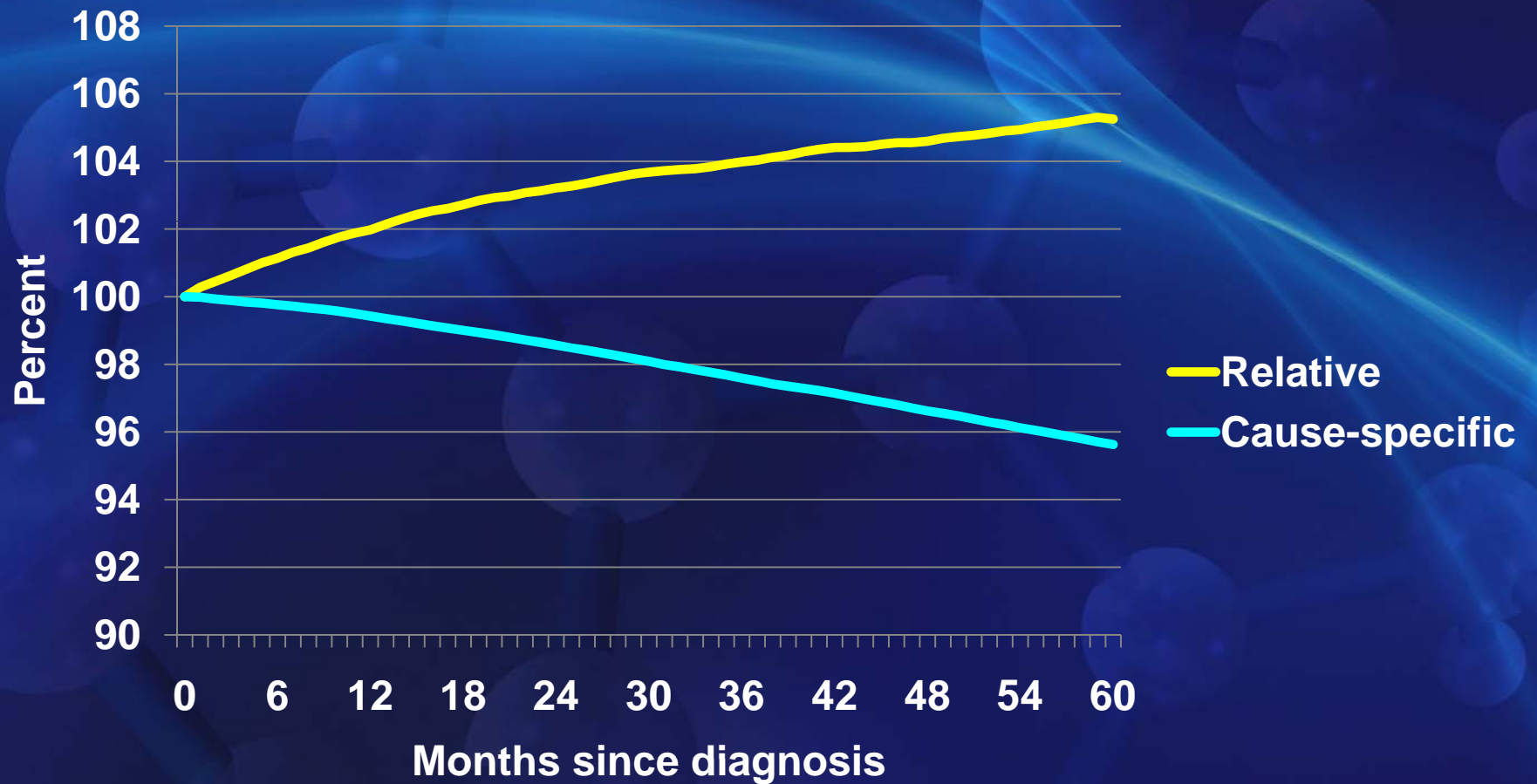
Relative Survival for Localized Prostate Cancer, Men 65+



Cause-specific Survival

- **Another approach to calculating survival is cause-specific survival**
 - Eliminates the use of life-tables especially where “appropriate” life-tables don’t exist
- **Uses the underlying cause of death (COD) to determine whether each person died of his/her cancer**

Relative & Cause-Specific Survival for Localized Prostate Cancer, Men 65+



Issues with Cause of Death (COD)

- **Death certificate errors**
 - Metastatic site of the primary cancer diagnosis may be reported as the underlying COD
- **Only the underlying cause of death is available**
- **COD may be less specific/detailed than original cancer diagnosis**
- **Priority rules in selecting underlying COD**
- **Need to develop an algorithm to identify which underlying CODs should be used as a death for each particular cancer**

SEER Cause-Specific Death Classification Variable

- Underlying CODs were evaluated for each cancer diagnosis based on ICD-10 (1999+)
- Attempt to apply same definitions to ICDA-8 (1975-1978) & ICD-9 (1979-1998)
- The algorithm takes into account COD in conjunction with
 - Site of original cancer diagnosis
 - Tumor sequence (Sequence 00 vs. 01)
 - Co-morbidities (e.g., HIV/AIDS and/or site-related non-cancer diseases)

General pattern for selecting COD as due to a specific cancer

COD Categories	Sequence 00- one & only one primary	Sequence 01 – first of more than one
Cancer of the same site	Yes	Yes
Cancer of the same body system	Yes	Yes
Cancer of any other site	Yes	Very selective
AIDS and cancer	All	AIDS associated cancers only
HIV/AIDS alone	AIDS associated cancers only	AIDS associated cancers only
Site-specific disease	Selective	Very selective

Example showing possible wrong attribution in COD: Dx of cancer of tongue by underlying COD in oral cavity

COD	Oral cavity & Pharynx	Tongue (total)
Oral Cavity (Total)	3,511	1,128
Lip	32	0
Tongue	1,017	891
Salivary gland	293	<5
Floor of Mouth	69	7
Gum and Other Mouth	503	50
Nasopharynx	348	<5
Tonsil	323	13
Oropharynx	272	75
Hypopharynx	149	<5
Other Oral Cav & Pharynx	505	80

Source: SEER Program, SEER 17 , 2000-2002 and died within 5 years of diagnosis.

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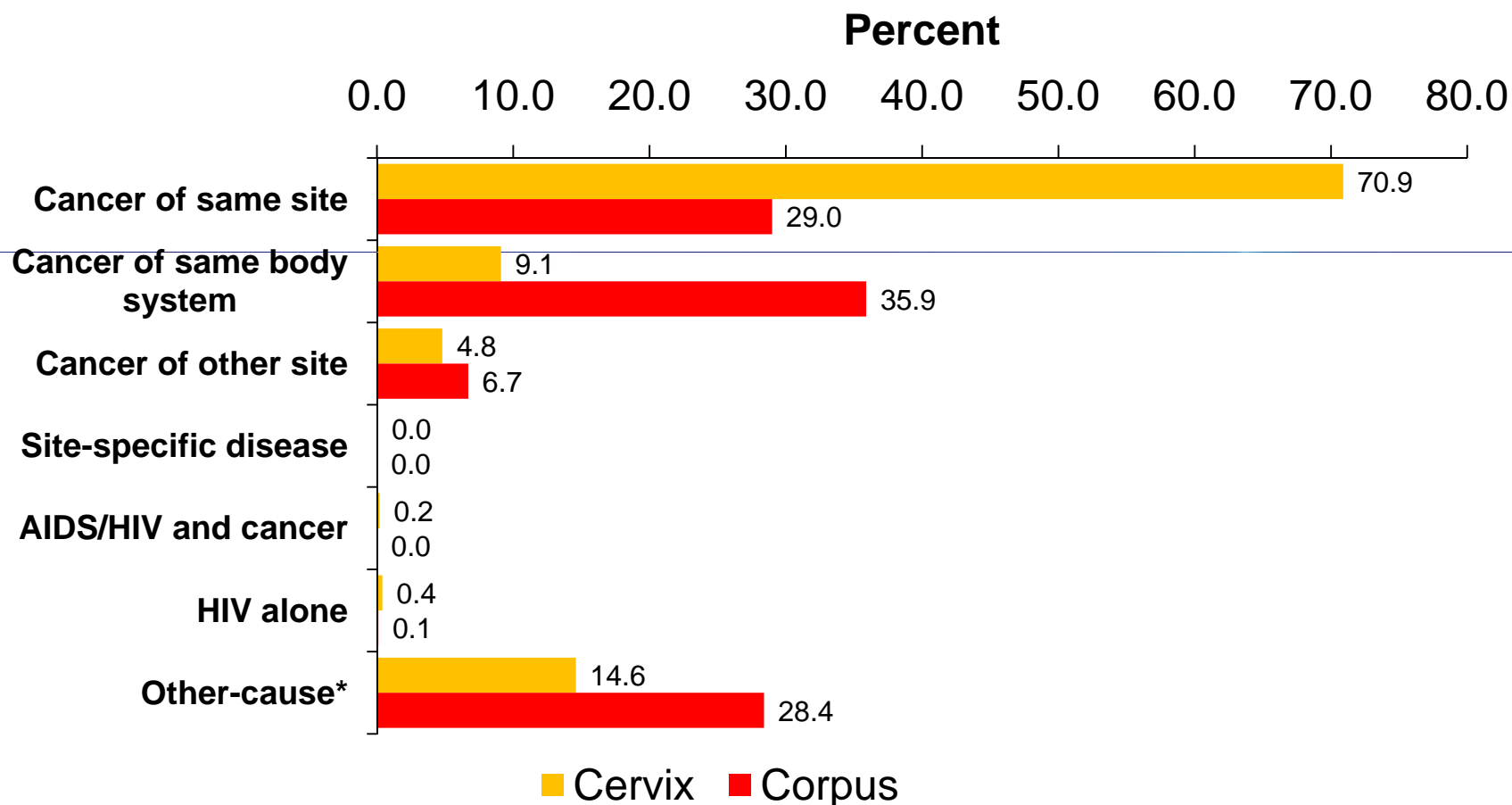
Example showing less specificity in COD: Dx of cancer of tongue by underlying COD in oral cavity

COD	Tongue (total)	Base of Tongue	Anterior 2/3 of Tongue	NOS & Other specified
Oral Cavity (Total)	1,128	497	165	466
Tongue (Total)	891	362	135	394
Base	68	61	<5	5
Anterior 2/3	0	0	0	0
NOS & Other specific	823	301	133	389
Other parts of oral cavity	237	135	30	72

Example: Deaths attributable to cervix for cases diagnosed with cancer of the cervix uteri

COD Categories	Sequence 00- one & only one primary	Sequence 01 – first of more than 1
Cancer of the same site	Cancer of the cervix uteri	Cancer of the cervix uteri
Cancer of the same body system	Cancer of the female genital system	Cancer of the female genital system
Cancer of any other site	All other cancers incl. mal, benign, in situ, unspecified	In situ cervix, leiomyoma & other benign , or uncertain neoplasms of uterus
AIDS and cancer	AIDS and any cancer	AIDS and any cancer
HIV alone	HIV	HIV
Site-specific disease	Inflammation of cervix	Inflammation of cervix

COD distribution for cases that were diagnosed with only one cancer (sequence 00): cervix & corpus uteri



*Other cause is treated as censored observation

Source: SEER Program, SEER 17, 2000-2002 and died within 5 years of diagnosis.

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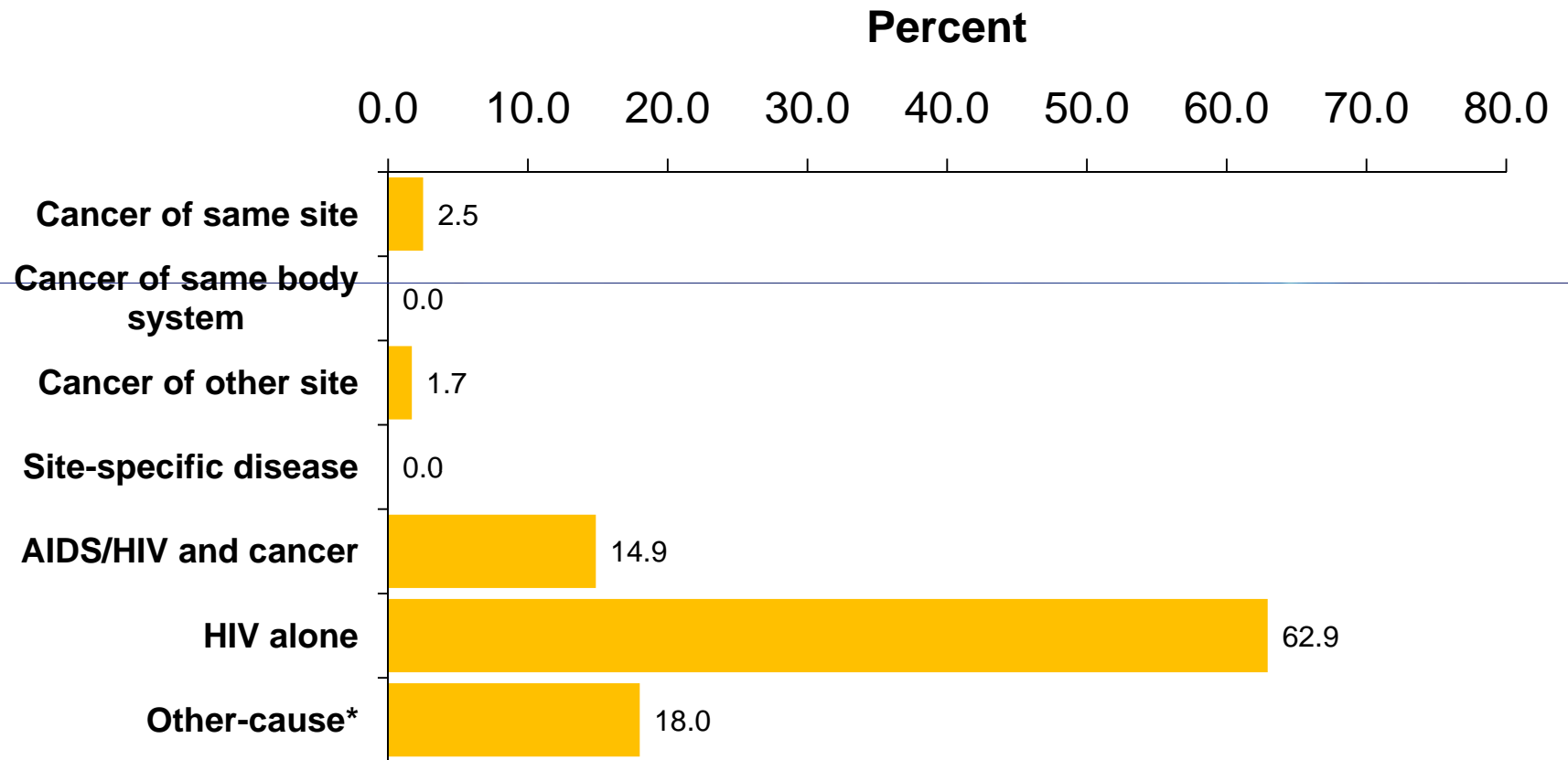
ICD-10 SEER Cause-specific Death for Sequence 00
for SEER 1973-2008 Data (November 2010 Submission)

'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

Details for the recode can be found on:
<http://www.seer.cancer.gov/causespecific/index.html>

Cases that were diagnosed with only one cancer (sequence 00): Kaposi sarcoma



*Other cause is treated as censored observation

Source: SEER Program, SEER 17, 2000-2002 and died within 5 years of diagnosis.

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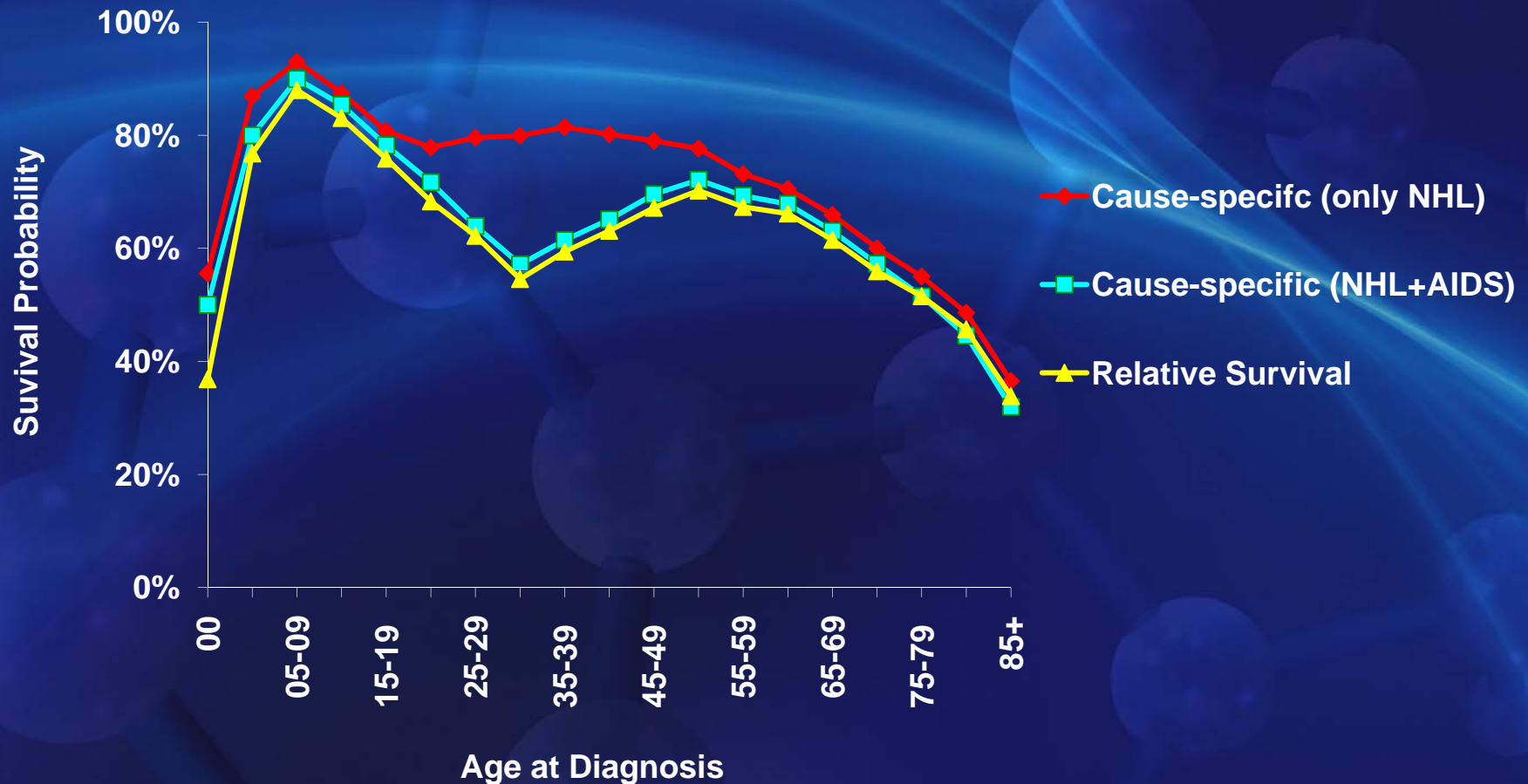
ICD-10 SEER Cause-specific Death for Sequence 01

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

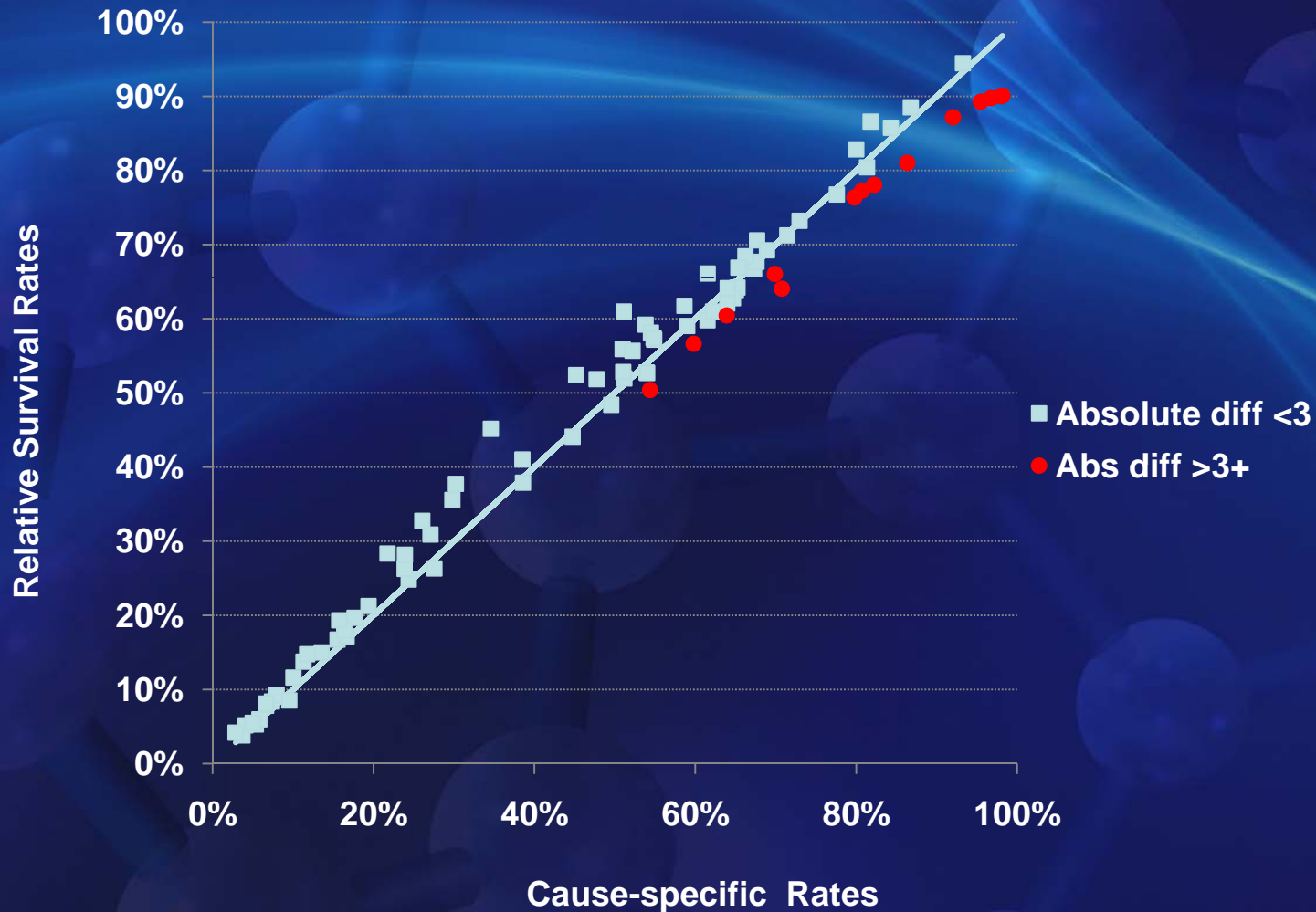
Non-Hodgkin Lymphoma, males, 5-year survival rates by age and 3 survival calculations



Source:SEER-13, 1992-2004, sequence 00

**How do cause-specific survival
using COD algorithm compare to
relative survival?**

100+ Cancer Sites in SEER, 65+ Ages



Examples When Relative Survival is Problematic: SEER-13, 1992-2004

Site, Stage & Age	White			AI/AN		
	Relative	C-S	Diff	Relative	C-S	Diff
Breast, In-situ & 65+	107.5	98.6	8.9	95.8	99.0	-3.2
Prostate, L/R & 65+	104.5	94.8	9.8	87.4	91.3	-3.8
Lung, All Stages & <65	18.7	20.5	-1.8	16.7	19.7	-3.1
Oral Cavity, All Stages & < 65	67.2	71.6	-4.4	51.6	58.0	-6.4

Note: AI/AN = American Indian/Alaska Native; C-S = Cause-specific; L/R=Localized/Regional; AI/AN uses 'other race' life table.

Absent SES-specific life tables, relative survival rates may exaggerate disparity

2000 Census Tract Poverty	Relative survival rate	Cause-Specific survival rate	Bias in expected survival rate	Bias in relative survival rate
High SES, <10.0%	86.5	84.1	Too low	Too high
Medium SES, 10.0% - 19.9%	81.6	81.2		
Low SES, 20.0%+	73.2	75.2	Too high	Too low
Difference between High and Low SES	13.3	8.8		

Note: Corpus & Uterus Cancer patients diagnosed between 1996-2004. SEER 13.

Conclusion

- **Algorithm developed for cause-specific survival by choosing specific CODs based on primary site at diagnosis**
- **In many cases, cause-specific survival estimates are in agreement with relative survival estimates**
- **Relative survival is not suitable for**
 - Heavily screened, different SES, risk factors associated with cancer & other diseases, ethnic/racial groups which don't have accurate life tables

Conclusion (Cont'd)

- **Lack of “appropriate” life-tables can lead to biased survival estimates with relative survival**
- **Cause-specific estimates are useful when the COD is available for most cases and relative survival would use inappropriate life tables**
- **New COD variable implemented in SEER*Stat software**

For More Information

- <http://seer.cancer.gov/causespecific/index.html>
- SEER*Stat software
- Howlader N, Ries L, Mariotto A, Reichman M, Ruhl J, and Cronin K. “Improved Estimates of Cancer-Specific Survival Rates from Population-Based Data”. *Journal of National Cancer Institute*, Vol 102, Issue 20, October 2010.



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