DOI:10.1093/jncimonographs/lgu024

Cancer Survival: An Overview of Measures, Uses, and Interpretation

Angela B. Mariotto, Anne-Michelle Noone, Nadia Howlader, Hyunsoon Cho, Gretchen E. Keel, Jessica Garshell, Steven Woloshin, and Lisa M. Schwartz

Correspondence to: Angela B. Mariotto, PhD, Data Modeling Branch, Surveillance Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, Bethesda, MD 20892 (e-mail: mariotta@mail.nih.gov).

Survival statistics are of great interest to patients, clinicians, researchers, and policy makers. Although seemingly simple, survival can be confusing: there are many different survival measures with a plethora of names and statistical methods developed to answer different questions. This paper aims to describe and disseminate different survival measures and their interpretation in less technical language. In addition, we introduce templates to summarize cancer survival statistic organized by their specific purpose: research and policy versus prognosis and clinical decision making.

J Natl Cancer Inst Monogr 2014;49:145–186

Survival statistics are the most used measures to estimate cancer patients' prognosis and the likely course of their disease and are of great interest to patients, clinicians, researchers, and policy makers. Although a seemingly simple concept, survival can be confusing: there are many different survival measures with a plethora of names and statistical methods developed to answer different questions. Because most of the work has been published in technical journals, clinicians and members of the public may not appreciate the many cancer survival statistics available and how to interpret them. For example, relative survival is often used to estimate a cancer patient's survival. However, relative survival—also called net survival—represents the net effect of a cancer diagnosis, that is, the chances of surviving assuming that cancer is the only possible cause of death. Because cancer patients, of course, can also die from competing causes, the patients' chance of dying from the cancer, dying from other "competing" causes, or surviving—also called crude survival measures—are more relevant survival statistics for cancer patients and the clinicians treating them.

This paper has two main objectives. The first is to describe the different survival measures, the methods and assumptions behind them and their respective interpretation in less technical language. The second is to provide a presentation template for summarizing cancer survival statistics for major cancer sites, organized by measures that answer policy and research questions and measures most useful for individual cancer patients in clinical decision making.

Cancer Survival Versus Mortality Statistics: Two Sides of Different Coins

In common usage, survival and mortality are two sides of the same coin: a person is either alive or dead. But in cancer statistics, survival and mortality are two sides of different coins. Mortality measures the number of cancer deaths among the entire population (ie, people with and without cancer). It is the chance that a person in the population will die of a cancer over a period of time, usually a year. Survival is the number alive among people *with* cancer. It is the chance that a cancer patient will be alive some years (typically five or 10 years) after diagnosis (Table 1). For clarity, the table refers to "population mortality" and "survival for cancer patients". The key difference between population mortality and cancer survival statistics is the denominator. For mortality, the denominator is the whole population, but for survival, the denominator only includes people diagnosed with cancer (in both cases, the denominator is typically measured as person-years at risk).

In the cancer registry setting, survival is sometimes called "population-based survival". This term erroneously sounds like it refers to survival for the entire population, with and without cancer. Instead, population-based survival refers to survival of *all cancer patients diagnosed in a defined population area* as opposed to survival of the usually highly selected (and often unrepresentative) cancer patients who participated in randomized trial.

Survival is sometimes used as a policy measure of cancer burden and is often used to compare cancer outcomes between different populations and time periods. However, it is well known that survival is more sensitive to biases (eg, lead time and length biases) than population mortality. For example, longer survival may reflect later deaths—but it can also reflect earlier diagnosis or over diagnosis (detecting cancer cases that progress so slowly that the person dies of other causes) with no change in death. Consequently, mortality is the preferred statistic for comparisons of cancer burden between different populations and across time. Nevertheless, mortality statistics alone cannot distinguish between the effects of primary prevention, earlier detection or better treatment. A paper in this monograph (1) discusses the use of cancer survival as a cancer burden measure, its biases and highlights the importance of interpreting survival trends in the context of incidence and mortality.

For cancer patients, the main statistic of interest is not population mortality, but individual survival. Survival, not mortality,

Table 1. Comparison of mortality rate and survival statistics. Understanding progress against cancer requires examination of mortality, survival, and incidence

	Population Mortality	Survival for Cancer Patients
Definition	**Cancer deaths over a given time frame / Entire population***	**Cancer patients alive 5 years after diagnosis / Cancer patients**
Purpose		
National Impact	**Disease burden:** Ultimate (and reliable) measure of progress against cancer	**Cancer lethality:** Burden of mortality across cancers (e.g. pancreatic cancer has a higher burden than breast cancer) **Disparities in access to care**
What is likely to happen to an individual?	**Risk:** Chance that a person in the general population will die from cancer over a specific time frame.	**Prognosis:** Chance that a cancer patient will be alive at a specific time after diagnosis
Description of statistic		
Typically reported as:	**Rate** (Number of deaths per 100 000 people*)	**Percent** (% cancer patients alive)
Typical time frame	**1 year** (or average of multiple years)	**5 or 10 years** (any length or maximum follow-up)
Data source	National Center for Health Statistics (cancer deaths in U.S. population)	Cancer registries of all cases diagnosed in geographic areas (like states) (large, nonrandom population sample, SEER covers 12-45% of U.S population)
Publication delay	2-3 years behind calendar year	Depends on time frame: 5-year survival is for patients diagnosed 9 years behind calendar year.
Cautions about interpretation	**Cannot estimate prognosis for cancer patients** **Cannot distinguish whether changes are from primary prevention, early diagnosis or better treatment**	**Better survival can be misleading because it may just reflect early diagnosis -** either through screening or incidental detection from more testing. or later death due to better treatment. Survival comparisons can be misleading because of 3 biases (lead time, length, and overdiagnosis). Increased survival can happen when mortality is increasing, unchanged or decreasing.

SEER = Surveillance, Epidemiology, and End Results.
* Mortality is a rate so the denominator is person years at risk. The mid-year population is used as a proxy for person years.

answers the question that cancer patients want to know: what is my chance of staying alive given my diagnosis? Clearly, survival is an important statistics from a clinical perspective that can provide prognosis for particular cancer types and cancer patients.

Different Measures of Survival: Dealing With Competing Causes of Death

Different survival measures answer different questions. Table 2 classifies survival into three main groups: overall survival (includes all causes of death), cancer prognosis (net survival that removes competing causes of death), and actual prognosis (crude probabilities that consider competing causes of death). We have added the terms *cancer prognosis* and *actual prognosis* to use language that is more transparent than the technical statistical terms of *net survival* and *crude survival*, respectively. Both cancer prognosis and actual prognosis are calculated differently depending on whether cause of death information is available.

Overall Survival

Overall survival—also called *all-cause*, *observed*, and *crude survival*—is the most easily understood survival measure. It estimates the chance of remaining alive some time after diagnosis. Because it uses death from all causes as the endpoint (as opposed to death from a specific cause, which can be misattributed), overall survival is the most reliable and available survival measure. However, it is not specific enough to provide information on survival associated with a cancer diagnosis. Higher survival may reflect fewer deaths from other causes or fewer deaths from the specific cancer.

Table 2. Definitions and interpretations of prognosis statistics (ie, case-based measures) using the example of prostate cancer

Statistic	Interpretation using prostate	Definition	Synonyms
Overall survival	Percent of prostate cancer patients alive 5 years after diagnosis.	Alive 5 years after prostate cancer diagnosis / Prostate cancer patients	All-cause survival; observed survival; crude survival.
Cancer prognosis (removes competing causes of death)			**Net survival**
Relative survival (Does not use cause of death data)	Percent of prostate cancer patients alive 5 years after diagnosis compared to the percent of the general population (of similar age, sex and race) alive over the same 5 years.	Overall survival for prostate cancer patients / Overall survival for similar cancer free population*	Net cancer survival; cancer-specific survival.
Cause-specific survival**†** (Uses cause of death data)	Percent of prostate cancer patients who have not died from prostate cancer 5 years after diagnosis. Patients who die of other causes are censored.	Not dead from **prostate cancer** 5 years after prostate cancer diagnosis / Prostate cancer patients	Cancer-specific survival; net cancer survival; cancer survival.
Actual prognosis (includes competing causes of death)			**Crude probabilities¶**
Chance of dying from cancer	Percent of prostate cancers patients **dead from prostate cancer** 5 years after diagnosis.	Dead from **prostate cancer** 5 years after prostate cancer diagnosis / Prostate cancer patients	Cumulative cause-specific mortality; crude probability of dying of cancer; absolute risk of dying of cancer.
Chance of dying from other causes	Percent of prostate cancers patients **dead from all other causes** 5 years after diagnosis.	Dead from **all other causes** 5 years after prostate cancer diagnosis / Prostate cancer patients	Crude probability of dying of other causes; absolute risk of dying of other causes
Overall survival **Note:** Exactly the same statistic as the first "overall survival" row.	Percent of prostate cancer patients alive 5 years after diagnosis.	100% - (% dead from prostate cancer + % dead from other causes)	All-cause survival; observed survival; crude survival¶.

* Overall survival for similar cancer free population is calculated using life tables matching by age sex and race.
** Patients dying of other causes are censored.
† Cause-specific measures can also be calculated as non-cancer survival where deaths from other causes are the outcome and cancer deaths are censored.
¶ Crude probabilities can be calculated using cause of death data or life tables.

Cancer Prognosis (Net Survival): Survival Measures That Remove Competing Causes of Death

Researchers and clinicians have long been interested in measures that isolate the effect of a cancer diagnosis on survival: to estimate the chances of surviving a cancer while removing possible distortions from competing causes of death. Such cancer prognosis measures are associated with the cancer biology, that is, what happens with the cancer or natural history of the disease in the absence of other causes of death. It also answers questions about the efficacy (in clinical settings or randomized trials) or the effectiveness (in cancer registries) of cancer interventions. In these settings, differences in cancer survival will reflect differences in cancer rather than competing causes of death. We consider *net survival*, that is, survival measuring the net effect of a cancer diagnosis after removing the effects of competing causes of death as a *cancer prognosis* measure. The two commonly used methods to estimate cancer prognosis, *relative survival* (2,3) and *cause-specific survival* (4), are described here.

Relative Survival: Relying on Life Tables to Estimate Cancer Prognosis

Relative survival is the ratio of overall survival for cancer patients to the expected survival of a comparable group of cancer-free individuals. It provides a measure of excess mortality experienced by cancer patients without requiring cause of death information. Its initial motivation was closely related to the idea of "cure". Researchers were interested in studying if and when overall survival for cancer patients returned to the same level as the general population, that is, when the excess deaths associated with a cancer diagnosis was zero, so patients no longer died from their cancer. For most cancer registries, cause of death information obtained from death certificate is either unavailable or unreliable due to misclassification errors or inherent ambiguities in determining the underlying cause of death. For example, a metastasis site might be reported as the cause of death rather than the true underlying cause, the original cancer site. Consequently, most registries have traditionally reported relative survival.

Since a comparable group of cancer-free individuals is difficult to obtain, expected survival is estimated using general population life tables.

The underlying assumptions are that cancer deaths are a negligible proportion of all deaths in the general population and that cancer and noncancer are independent competing causes of death. Expected survival is calculated from the population life tables by matching an imaginary individual from the general population whose survival is represented by the respective life table. Cancer patients are matched on age, year, sex, race, and geographic area (eg, national, state, census, and so on) if available. Expected survival using life tables can be calculated in Surveillance, Epidemiology, and End Results (SEER)*Stat using any of the following four methods: Ederer I(2), Ederer II(3) (default), Hakulinen (5,6) and Pohar–Perme (7) (soon to be implemented in SEER*Stat). The methods differ in how long the matched individuals are considered to be at risk of death (8). For five-year survival, most of the methods provide very similar relative survival estimates. The new Pohar–Perme method provides the only unbiased estimate of "net survival" (7); however, it has larger variance compared with Ederer II, which may cause estimate instability especially for long-term survival and small data (9–11).

Cause-Specific Survival: Relying on Accurate Cause of Death Information

Cause-specific (4), also denoted *cancer-specific*, survival uses cancer death as the endpoint and censors people dying of other causes of death. Clinical studies have long used cause-specific survival because cause of death is typically available and accurately ascertained from detailed review of medical records and adjudication committees (12). The recent development of an algorithm, which more accurately attributes a cause of death to cancer (13), has made it possible for cancer registries to move to reporting cause-specific survival. This algorithm (described on the SEER Web site http://seer.cancer.gov/causespecific/) uses causes of death that are likely to be related to the particular cancer or as a consequence of a cancer diagnosis. In situations where relative survival may be considered the gold standard, validation studies demonstrated that the cause-specific survival using the new cause of death variable more closely resembled relative survival than cause-specific survival using the presumably less accurate, reported cause of death (13).

Cause-specific survival is considered a "net" measure because it removes competing causes of death: people dying of competing causes are censored (ie, they are not counted as "endpoints" but just removed from the "at risk" group in the same way that people who are lost to follow-up are removed). In effect, cause-specific survival may be interpreted as cancer survival in the hypothetical situation in which the cancer of interest is the only possible cause of death.

When to Use Relative Versus Cancer-Specific Survival

Relative survival is the preferred method to compare survival between different registries and across countries because cause of death may not be available or there may be variability in the accurate determination of cause of death across countries (14). However, relative survival can only be calculated when accurate life tables are available to represent expected survival of the cohort of cancer patients. When cancer patients differ considerably from the general population with respect to important personal factors, which may affect deaths from other causes (such as socio-economic status, health status, and health behaviors like smoking), relative survival can be biased.

Relative survival is overestimated when expected survival from life tables is too low. In fact, relative survival may even exceed 100%. This scenario is best illustrated for cancers found largely by screening, such as localized prostate and breast cancers. People who are screened have higher life expectancy than the general US population, perhaps because of better overall health, greater access to health care, or healthier lifestyles. This healthy screened effect was most recently demonstrated in the Prostate, Lung, Colorectal, and Ovarian (PLCO) Cancer Screening Trial, where participants in this screening trial had 30%–50% lower mortality rates for heart disease, injury, and kidney disease than expected (15). Because the expected survival of the general population is lower than for the screened population, relative survival is inflated by a denominator that is too small.

Relative survival is underestimated (ie, the denominator is falsely high) when expected survival from life tables is too high. Patients with smoking-related cancers (eg, lung cancer) typically have lower life expectancy than the general population because they face substantially higher risks of death from many cancers and from heart disease (16). Because the expected survival for the general population is higher than for smokers, relative survival is deflated by a denominator that is too big.

When life tables are not available or are unlikely to accurately estimate expected survival for a particular group of cancer patients, cause-specific survival may be more accurate than relative survival. Thus, SEER reports cause-specific instead of relative survival for Hispanics, Asians (eg, Chinese, Japanese, Filipino, Vietnamese), Native Americans, and Alaska Natives (17). The cause-specific method should also be used to estimate survival by factors that affect deaths from competing causes that life tables do not account for, such as chronic disease comorbidity and smoking status.

Actual Prognosis (Crude Probabilities): Survival Measures That Include Competing Causes of Death

Cancer prognosis communicates the net effect of a cancer diagnosis: the chance of surviving assuming the cancer was the only possible cause of death. But patients diagnosed with cancer may be far more interested in understanding what is likely to happen to them over time, specifically, their chance of dying from the cancer, versus dying from competing causes or surviving. Actual prognosis measures provide this information and have been developed using statistical competing risk methods. These statistics, also known as *crude probability of death*, *crude survival*, *absolute risks*, *competing risks*, *cumulative incidence function*, consider two (or more) endpoints: death due to cancer and death due to competing causes. As in reality, these events are considered mutually exclusive: a person can only die from one cause. Survival is calculated as one minus the probabilities of dying of cancer *and* dying of competing causes, and is exactly the same as overall survival.

Similar to net survival, crude probabilities can be calculated using either cause of death information (18,19) or expected survival using population life tables (20). However, to be useful as prognosis measures, crude probabilities need to be tailored to individual cancer patients and their level of comorbidity. As general life tables will not represent expected survival for different levels of comorbidity,

the cause of death method is the better method to estimate individualized actual prognosis measures.

In this monograph, Howlader et al. (21) compares actual and cancer prognosis and provides actual prognosis estimates for major cancer sites by age categories and comorbidity. Because actual prognosis measures are more valuable when tailored to the individual, they are better reported in web applications, allowing the user to enter specific demographics, tumor characteristics, and comorbidity profile to obtain the respective estimated survival. The National Cancer Institute is developing the SEER Cancer Survival Calculator (22), a tool that will provide individualized actual prognosis for patients diagnosed with breast, prostate, colorectal, and head and neck cancers, accounting for many personal factors, such as stage, grade, age, sex, race, year of diagnosis, comorbidity, marital status, and socio-economic status (22). Also in this monograph, Feuer et al. (23) report the external validation of this tool using a group of patients diagnosed with colorectal and prostate cancers in a health maintenance organization.

When to Use Cancer or Actual Prognosis Measures?

Because cancer prognosis measures reflect the *hypothetical* situation where competing causes of death are removed, they are the best measures to represent trends, comparisons between different groups of cancer patients and the impact of cancer biology and other factors on cancer survival. The general idea is that changes in competing causes of death should not obscure cancer survival comparisons. As such, cancer prognosis measures are best suited to answer questions related to health policy, research, and biology.

Actual prognosis, on the other hand, better describes an individual's chance of survival because it accounts for both the chance of dying from cancer and from competing causes. Because actual prognosis most closely reflects reality, these measures are most valuable in predictive tools, clinical decision making, and cost-effectiveness analyses. For example, older patients with coexisting comorbidity may have a higher probability of dying from competing causes than of dying from their cancer; in fact, the chance of dying from competing causes may preclude the benefit of cancer treatment.

Presentation Templates for Summarizing Cancer and Actual Prognosis Measures

We developed a presentation template to summarize measures of cancer prognosis and actual prognosis. The template is designed to more efficiently and clearly present: survival trends, the effect of prognostic and demographic characteristics on cancer prognosis, and actual prognosis measures for cancer patients and clinicians. We present the templates for eight major cancer sites: prostate, female breast, lung and bronchus, colon and rectum, urinary bladder, pancreas, corpus uteri cancers, and leukemia. To represent cancer prognosis we used *five-year relative survival* or *five-year cause-specific survival*, depending on which is more appropriate. We include 95% confidence intervals whenever feasible.

Cancer Prognosis Templates

Survival trends To illustrate trends in cancer survival, we show five-year relative survival by year at diagnosis in a table format. A figure with age-adjusted incidence and mortality trends is also presented to provide interpretation of changes in survival in terms of cancer progress or burden [see Cho et al. (1) for more details on trends interpretation].

Cancer prognosis by prognostic and demographic characteristics The marginal effect of age, race and clinical characteristics on 5 year relative survival is displayed as a bar chart with 95% confidence intervals. This template can be useful to inform researchers regarding which characteristics have a bigger effect on five-year cancer survival. Five-year relative survival is also displayed as a table by age groups and clinical characteristics, which may provide information on the effect of clinical factors on cancer prognosis for different age groups.

Cancer prognosis by race/ethnicity Because life tables are not available by race and ethnicity, we used *five-year cause-specific* survival stratified by race/ethnicity and stage together in a table format, to represent cancer prognosis.

Actual Prognosis Templates

Actual prognosis by age group is shown in horizontal bar charts for different stage and levels of comorbidity. Each bar chart displays the percentage of patients dying of cancer (black area), dying of competing causes (dark grey area) and surviving (light gray area) five years after diagnosis. The percent at the end of each bar represents the percentage of patients surviving. The first column of bar charts represent actual prognosis by stage and age for all patients with the specific cancer type, irrespective of their comorbidity status. It represents survival for a patient with the average comorbidity in the cancer population. The second and third columns of graphs show these data for patients with no comorbidities and those with severe comorbidities, respectively [see Howlader et al. (21) in this monograph for more details on interpretation].

Data and Methods

Incidence and survival were calculated from the NCI SEER Program data. Registries joined the SEER program in different years. The SEER 9 registries were used for the calculation of time trends in incidence and survival from 1975 to 2010 and cover approximately 9% of the US population. SEER 18 was used for the remaining survival calculations, which include patients with a cancer diagnosis between 2004 and 2009 and study cutoff date December 31, 2010. These registries cover approximately 28% of the US population and have expanded reporting on race and ethnicity (eg, white, black, Asian/Pacific Islander, American Indian/Alaskan Native, and Hispanic). We used the derived American Joint Committee on Cancer, sixth edition, stage variable based on information collected for cancer cases diagnosed in 2004 and after under Collaborative Stage. Detailed information on staging may be found here: http://seer.cancer.gov/seerstat/variables/seer/ajcc-stage/6th/. SEER site recode variable based on the World Health Organization International Classification of Diseases for Oncology, 3rd Edition (ICD-O-3) was used. Detailed information on the SEER site

recode variable maybe found here: http://seer.cancer.gov/siterecode/index.html. Detailed information on tumor grade or differentiation may be obtained from SEER program coding and staging manual 2013 http://seer.cancer.gov/manuals/2013/SPCSM_2013_maindoc.pdf.

Mortality trends for the whole United States were estimated from deaths and causes of death data provided by the National Center for Health Statistics (www.cdc.gov/nchs) and retrieved using SEER*Stat software. The cancer sites used in these analyses were categorized according to the SEER cause of death recode. The associated ICD codes can be viewed on the SEER Web site (http://seer.cancer.gov/codrecode/1969+_d09172004/). *Population* estimates to calculate incidence and mortality rates were obtained from the US Census Bureau and available at SEER*Stat.

Incidence and mortality trends are included to provide interpretation of the changes in cancer survival trends (1). Mortality represents the whole US population, whereas incidence rates represent SEER 9 population and are adjusted to account for delay in the reporting of cases in the most recent years (delay-adjusted rates) (http://surveillance.cancer.gov/delay/). The line in Design 1 represents estimates from the Joinpoint model (24), which involves fitting a series of joined straight lines on a logarithm scale to the age-adjusted rates by calendar year.

Cancer prognosis was estimated as either relative survival or cause-specific survival. *Relative survival* was calculated by dividing all-cause (observed) survival to the expected survival. Expected survival is estimated using the Ederer II method (3) by linking cancer patients by sex, age, race, and year to the US (1970–2007) life tables available at (http://seer.cancer.gov/expsurvival/). *Cancer survival trends* is displayed as five-year relative survival by year at diagnosis estimates from a Joinpoint model on survival (25). The model fits linear segments to the hazard of dying as a function of calendar time and estimates points in which changes occurred. For patients diagnosed 2006 or later, the survival estimates reflect projected results from the model, because five-year observed is not available. *Cause-specific survival* was calculated to show cancer prognosis for specific race/ethnic groups because race/ethnicity life tables are not currently available. The SEER cause-specific death classification variable was used to identify deaths attributed to the specific cancer (13).

Actual prognosis is estimated as the five-year chance of dying from cancer, chance of dying of other causes and survival using the SEER cause-specific death classification to determine cause of death (13). *Level of comorbidity before a cancer diagnosis* for patients age 66 or older in the linked SEER-Medicare dataset were identified in previous analyses (26). Sixteen comorbid conditions identified by Charlson et al. (27) were identified from Medicare claims and summarized in an index, which was used to classify patients into comorbidity severity groups. For more information on the comorbidity index, refer to Howlader et al. (21) and Mariotto et al. (26).

All survival calculations used the complete method.

Discussion

Survival statistics are of great interest to clinicians, researchers, patients, and policy makers. Numerous methods and measures of cancer survival for cancer registry data have been developed, but not all are well known or in common use. This paper is an attempt to introduce the main cancer registry survival measures to a broad audience. To make the measures more accessible, we minimize technical language and provide explanations, suggest when to use them, and provide caveats for their interpretation. We introduce templates to summarize cancer survival statistics organized by their specific purpose: *research-policy* versus *prognosis-clinical decision making*. Although we report templates for eight major cancer sites, we plan to utilize these templates in annual reports and expand on the number of cancer types.

The other papers in this monograph complement this paper by providing applications, or describing methods and measures in more detail. Cho et al. (1) illustrate how trends in incidence and mortality can be used to interpret changes in survival. This paper also provides an explanation of the various biases that can affect survival, mostly caused by the introduction of screening or more advanced diagnostic techniques. Weir et al. (28) and Pinheiro et al. (29) study various issues with follow-up for ascertainment of vital status and how they impact survival estimates. Because life tables are an important component of relative survival estimation, Stroup et al. (30) studied the impact of national life tables versus state life tables on relative survival. Their study suggests the need to develop more appropriate life tables that better represent the varying mortality patterns in different populations for reporting of regional survival estimates. Lewis et al. (31) and Kish et al. (32) looked at cancer prognosis disparities in different populations. Lewis et al. (31) reports relative survival for adolescents and young adults diagnosed with cancer and compared with patients diagnosed at older ages. Kish et al. (32) investigates difference in five-year cause-specific survival among groups with different race, ethnicity and socioeconomic status (SES). Because life tables are not available by race/ethnicity or SES, they used cancer-specific survival. Finally, Stedman et al. (33) reports current estimates of cure fraction (the proportion of individuals that will not die of their diagnosed cancer) for selected cancers, based on SEER data, and investigates the effect of long versus short follow-up time on different types of models for estimating the cure fraction. Three monograph papers use actual prognosis measures: Howlader et al. (21), Feuer et al. (23), and Rabin et al. (34). Howlader et al. (21) compares cancer and actual prognosis measures and reports actual prognosis estimates for four leading cancers by age, comorbidity, and cancer stage. Feuer et al. (23) and Rabin et al. (34) are companion papers. They use the SEER Cancer Survival Calculator, which is being developed to be used as a web tool to provide individualized actual prognosis for prostate, female breast, colorectal and oral cancer patients. Feuer et al. (23) reports on the external validation of the tool using prostate and colorectal cancer patients' data from a health maintenance organization. Rabin et al. (34) uses health maintenance organization data to describe service utilization patterns of subgroups of prostate cancer and colorectal patients who have different relative probabilities of dying of their cancer or other conditions as estimated by the tool. We mainly focused on methods and measures implemented in SEER*Stat that could be readily used with cancer registry data. However, there are other more technical population-based cancer survival topics that have not been covered. Some examples are age-standardized survival (http://seer.cancer.gov/stdpopulations/survival.html) (35), inclusion of multiple tumors (36), cohort

definition and period survival (37) (http://surveillance.cancer.gov/survival/cohort.html), and projections of cancer survival (38).

Because different survival statistics answer different questions, both the producers and the end-users of cancer survival measures need to understand how to select and interpret the most appropriate statistic to answer the question of interest.

References

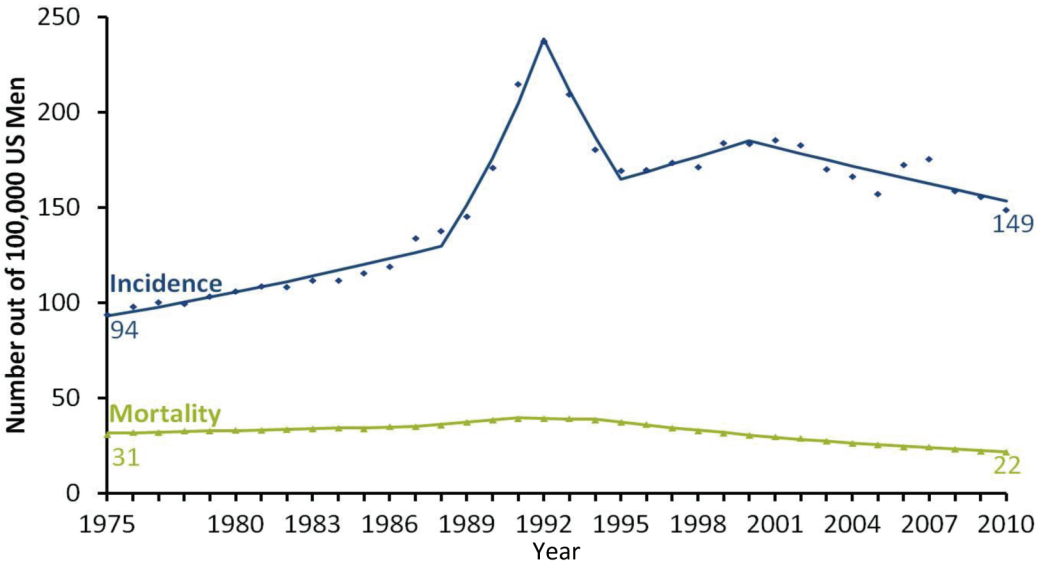
1. Cho H, Mariotto AB, Schwartz LM, Luo J, Woloshin S. When do changes in cancer survival mean progress? The insight from population incidence and mortality. *J Natl Cancer Inst Monogr*. 2014;49:187–197.
2. Ederer F, Axtell LM, Cutler SJ. The relative survival rate: a statistical methodology. *Natl Cancer Inst Monogr*. 1961;6:101–121.
3. Ederer F, Heise H. *Instructions to IBM 650 Programmers in Processing Survival Computations. Methodological Note no. 10, End Results Evaluation Section. Technical Report*. Bethesda, MD: National Cancer Insitute; 1959.
4. Marubini E, Morabito A, Valsecchi MG. Prognostic factors and risk groups: some results given by using an algorithm suitable for censored survival data. *Stat Med*. 1983;2(2):295–303.
5. Hakulinen T. Cancer survival corrected for heterogeneity in patient withdrawal. *Biometrics*. 1982;38(4):933–942.
6. Hakulinen T. On long-term relative survival rates. *J Chronic Dis*. 1977;30(7):431–443.
7. Perme MP, Stare J, Estève J. On estimation in relative survival. *Biometrics*. 2012;68(1):113–120.
8. Cho H, Howlader N, Mariotto AB, Cronin KA. Estimating relative survival for cancer patients from the SEER Program using expected rates based on Ederer I versus Ederer II method. Surveillance Research Program, NCI, Technical Report #2011-01. http://surveillance.cancer.gov/reports/tech2011.01.pdf. Published 2011. Accessed January 23, 2014.
9. Seppä K, Hakulinen T, Pokhrel A. Choosing the net survival method for cancer survival estimation [published online ahead of print]. *Eur J Cancer*. 2013;pii: S0959-8049(13)00894-0. doi: 10-1016/j.ejca.2013-03-019..
10. Roche L, Danieli C, Belot A, et al. Cancer net survival on registry data: use of the new unbiased Pohar-Perme estimator and magnitude of the bias with the classical methods. *Int J Cancer*. 2013;132(10):2359–2369.
11. Dickman PW, Lambert PC, Coviello E, Rutherford MJ. Estimating net survival in population-based cancer studies. *Int J Cancer*. 2013;133(2):519–521.
12. Marubini EV, Valsecchi MG. *Analysing Survival Data from Clinical Trials and Observational Studies*. 1st ed.West Sussex, UK: John Wiley & Sons, Inc. 2004.
13. Howlader N, Ries LA, Mariotto AB, Reichman ME, Ruhl J, Cronin KA. Improved estimates of cancer-specific survival rates from population-based data. *J Natl Cancer Inst*. 2010;102(20):1584–1598.
14. Coleman MP, Quaresma M, Berrino F, et al. Cancer survival in five continents: a worldwide population-based study (CONCORD). *Lancet Oncol*. 2008;9(8):730–756.
15. Pinsky PF, Miller A, Kramer BS, et al. Evidence of a healthy volunteer effect in the prostate, lung, colorectal, and ovarian cancer screening trial. *Am J Epidemiol*. 2007;165(8):874–881.
16. Hinchliffe SR, Rutherford MJ, Crowther MJ, Nelson CP, Lambert PC. Should relative survival be used with lung cancer data? *Br J Cancer*. 2012;106(11):1854–1859.
17. Howlader N, Noone AM, Krapcho M, et al., eds. SEER cancer statistics review, 1975-2010. SEER Web site: *SEER Cancer Statistics Review, 1975-2010*. Bethesda, MD: National Cancer Institute; 2013. http://seer.cancer.gov/archive/csr/1975_2010/ Published April 2013. Updated June 14, 2013. Accessed May 28, 2014.
18. Kalbfleisch JD, Prentice RL. *The Statistical Analysis of Failure Time Data*. 2nd ed. Hoboken, NJ: John Wiley & Sons; 2002.
19. Klein JP, Moeschberger ML. *Survival Analysis: Techniques for Censored and Truncated Data*. 2nd ed. Berlin, Germany: Springer; 2003.
20. Cronin KA, Feuer EJ. Cumulative cause-specific mortality for cancer patients in the presence of other causes: a crude analogue of relative survival. *Stat Med*. 2000;19(13):1729–1740.
21. Howlader NM, Mariotto AB, Woloshin S, Schwartz LM. Providing clinicians and patients with actual prognosis: cancer in the context of competing causes of death. *J Natl Cancer Inst Monogr*. 2014;49:255–264.
22. Feuer EJ, Lee M, Mariotto AB, et al. The Cancer Survival Query System: making survival estimates from the Surveillance, Epidemiology, and End Results program more timely and relevant for recently diagnosed patients. *Cancer*. 2012;118(22):5652–62.
23. Feuer EJ, Rabin B, Zou Z, et al. The Surveillance, Epidemiology, and End Results Cancer Survival Calculator SEER*CSC: validation in a managed care setting. *J Natl Cancer Inst Monogr*. 2014;49:265–274.
24. Kim HJ, Yu B, Feuer EJ. Selecting the number of change-points in segmented line regression. *Stat Sin*. 2009;19(2):597–609.
25. Yu B, Huang L, Tiwari RC, Feuer EJ, Johnson KA. Modelling population-based cancer survival trends using join point models for grouped survival data. *J R Stat Soc Ser A Stat Soc*. 2009;172(2):405–425.
26. Mariotto AB, Wang Z, Klabunde CN, Cho H, Das B, Feuer EJ. Life tables adjusted for comorbidity more accurately estimate noncancer survival for recently diagnosed cancer patients. *J Clin Epidemiol*. 2013;66(12):1376–1385.
27. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373–383.
28. Weir HK, Johnson CJ, Mariotto AB, et al. Evaluation of North American Association of Central Cancer Registries' (NAACCR) data for use in population-based cancer survival studies. *J Natl Cancer Inst Monogr*. 2014;49:198–209.
29. Pinheiro PS, Morris CR, Liu L, Bungum TJ, Altekruse SF. The impact of follow-up type and missed deaths on population-based cancer survival studies for Hispanics and Asians. *J Natl Cancer Inst Monogr*. 2014;49:210–217.
30. Stroup AM, Cho H, Scoppa SM, Weir HK, Mariotto AB. The impact of state-specific life tables on relative survival. *J Natl Cancer Inst Monogr*. 2014;49:218–227.
31. Lewis DR, Seibel NL, Smith AW, Stedman MR. Adolescent and young adult cancer survival. *J Natl Cancer Inst Monogr*. 2014;49:228–235.
32. Kish JK, Yu M, Percy-Laurry A, Altekruse SF. Racial and ethnic disparities in cancer survival by neighborhood socioeconomic status in Surveillance, Epidemiology, and End Results (SEER) registries. *J Natl Cancer Inst Monogr*. 2014;49:236–243.
33. Stedman MR, Feuer EJ, Mariotto AB. Current estimates of the cure fraction: a seasibility study of statistical cure for breast and colorectal cancer. *J Natl Cancer Inst Monogr*. 2014;49:244–254.
34. Rabin BA, Ellis JL, Steiner JF, et al. Health-care utilization by prognosis profile in a managed care setting: using the Surveillance, Epidemiology, and End Results Cancer Survival Calculator SEER*CSC. *J Natl Cancer Inst Monogr*. 2014;49:275–281.
35. Corazziari I, Quinn M, Capocaccia R. Standard cancer patient population for age standardising survival ratios. *Eur J Cancer*. 2004;40(15):2307–2316.
36. Weir HK, Johnson CJ, Thompson TD. The effect of multiple primary rules on population-based cancer survival. *Cancer Causes Control*. 2013;24(6):1231–1242.
37. Brenner H, Hakulinen T. Up-to-date and precise estimates of cancer patient survival: model-based period analysis. *Am J Epidemiol*. 2006;164(7):689–696.
38. Mariotto AB, Wesley MN, Cronin KA, Johnson KA, Feuer EJ. Estimates of long-term survival for newly diagnosed cancer patients - a projection approach. *Cancer*. 2006;106(9):2039–2050.

Affiliations of authors: Surveillance Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, Bethesda, MD (AM, AN, NH, HC); Division of Cancer Registration and Surveillance, National Cancer Center, Goyang-si Gyeonggi-do, Korea (HC); Information Management Services, Inc., Calverton MD (GEK, JG); Dartmouth Institute for Health Policy and Clinical Practice, Lebanon, NH, Norris Cotton Cancer Center, Dartmouth Hitchcock Medical Center, Lebanon, NH, Geisel School of Medicine at Dartmouth, Hanover, NH, Department of Veterans Affairs Medical Center, Veterans Affairs Outcomes Group, White River Junction, VT (SW, LMS).

1.1 Time trends in incidence, mortality and survival (1975-2010)

Incidence and Mortality[a,b,c]

Men



Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	67%	71%	74%	78%	85%	95%	95%	99%	100%	100%	*100%*	*100%*

a: SEER-9 **incidence** rates per 100,000 and age-adjusted to the 2000 US Standard Population. Rates are also adjusted for reporting delay. More information can be found at: http://surveillance.cancer.gov/delay/.

b: US **mortality** rates per 100,000 and age-adjusted to the 2000 US Standard Population.

c: Symbols represent observed values for **incidence** and **mortality** (observed values for 1975 and 2010 are labeled). Lines represent estimated values from the Joinpoint model.

d: 5-year **relative survival** for people diagnosed with this cancer in the SEER-9 registries by year at diagnosis. Modeled estimates using Joinpoint are shown in the table. *Italicized numbers are 5-year relative survivals* projected from the model.

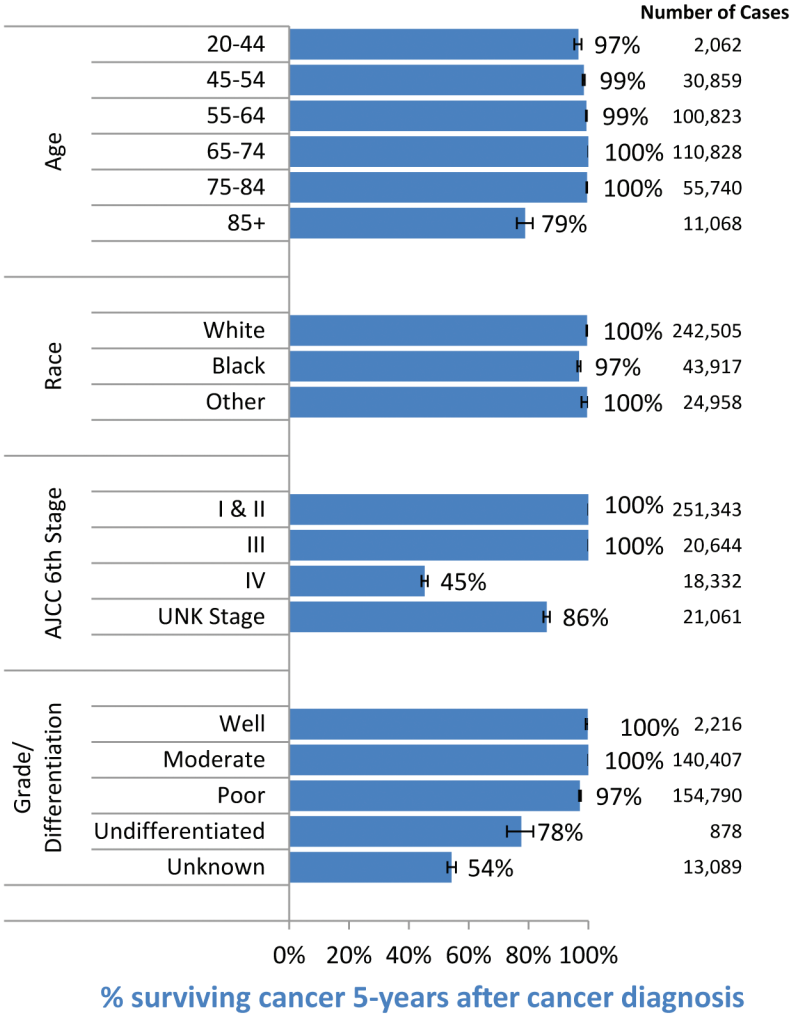
1.2 Cancer prognosis 5 years after diagnosis by prognostic characteristics and age[a] (5-Year Relative Survival)

	All ages		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All stages	96%	(80% - 99%)	+	+	100%	+	99%	(1% - 100%)	98%	(34% - 100%)	92%	(62% - 98%)
Stages I & II	100%	+	100%	+	100%	+	100%	+	100%	+	100%	+
Stage III	45%	(44% - 46%)	38%	(25% - 50%)	60%	(56% - 63%)	58%	(56% - 59%)	50%	(48% - 52%)	26%	(24% - 28%)
Stage IV	96%	(80% - 99%)	+	+	100%	+	99%	(1% - 100%)	98%	(34% - 100%)	92%	(62% - 98%)

a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each estimate.

+: Statistic could not be calculated

1.3 By prognostic characteristics[a] (5-Year Relative Survival)



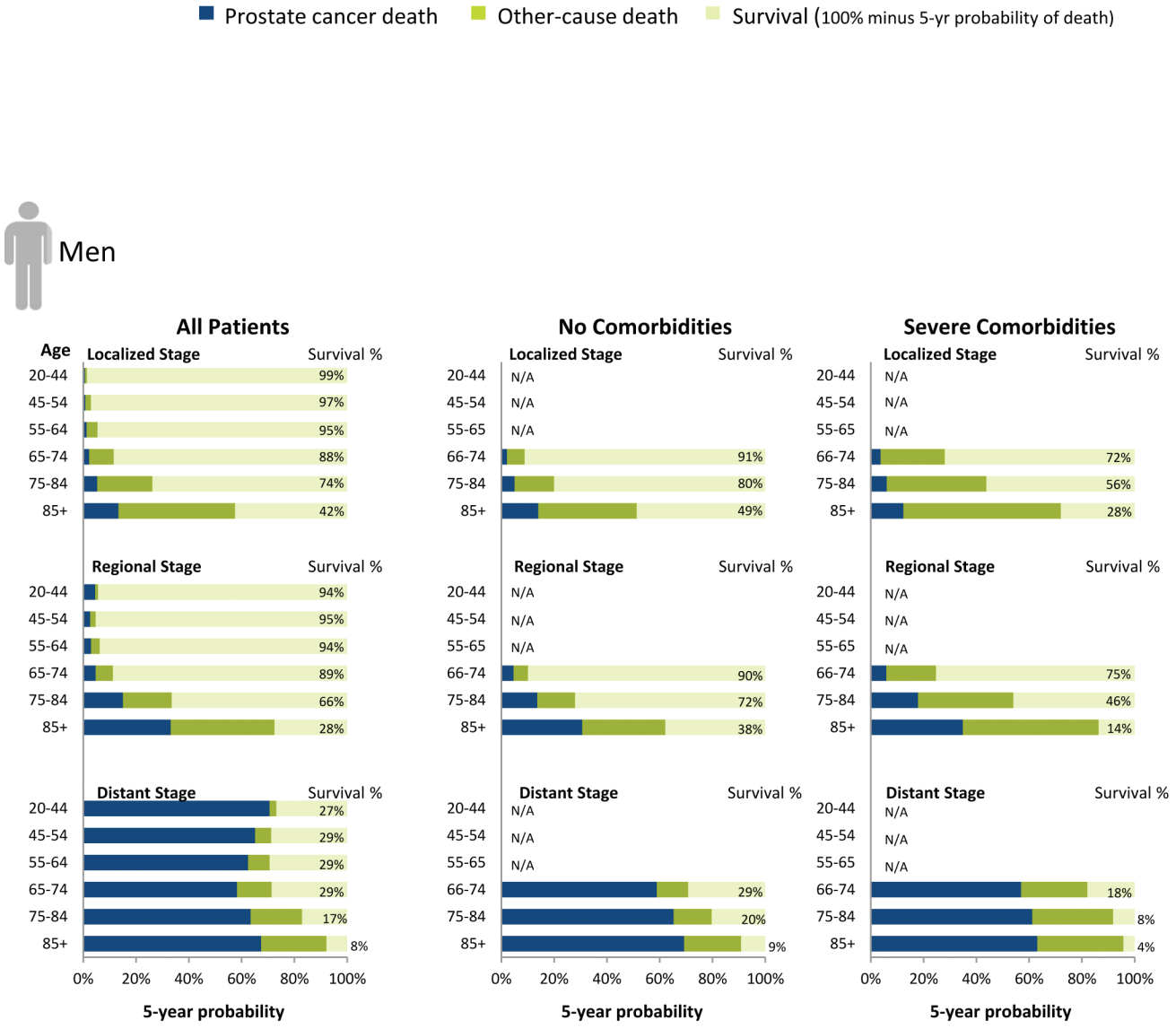
a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries. Error bars represent the 95% confidence interval for each survival estimate.

1.4 By race/ethnicity[a,b,c] (5-Year Cause-Specific Survival)

All Stages		
NH White	94%	(94%-94%)
NH Black	92%	(92%-93%)
NH API	94%	(94%-95%)
NH AI/AN	89%	(86%-92%)
Hispanic	93%	(93%-93%)
Stages I & II		
NH White	98%	(98%-98%)
NH Black	97%	(97%-97%)
NH API	98%	(98%-98%)
NH AI/AN	97%	(94%-98%)
Hispanic	98%	(97%-98%)
Stage III		
NH White	97%	(96%-97%)
NH Black	97%	(95%-97%)
NH API	98%	(96%-99%)
NH AI/AN	98%	(85%-100%)
Hispanic	96%	(95%-98%)
Stage IV		
NH White	46%	(45%-47%)
NH Black	45%	(43%-48%)
NH API	51%	(46%-55%)
NH AI/AN	43%	(28%-58%)
Hispanic	47%	(44%-50%)

a. 5-year **cause-specific survival** for people diagnosed with this cancer 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each survival estimate.
b: Cause-specific survival was used because life tables needed to calculate relative survival are not available by race/ethnicity.
c: NH: Non-Hispanic, API: Asian/Pacific Islander, AI/AN: American Indian/Alaska Native. These groups are mutually exclusive and represent 100% of the population.
+: Statistic could not be calculated.

1.5 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and stage at diagnosis[a] (5-Year Crude Probability of Death)



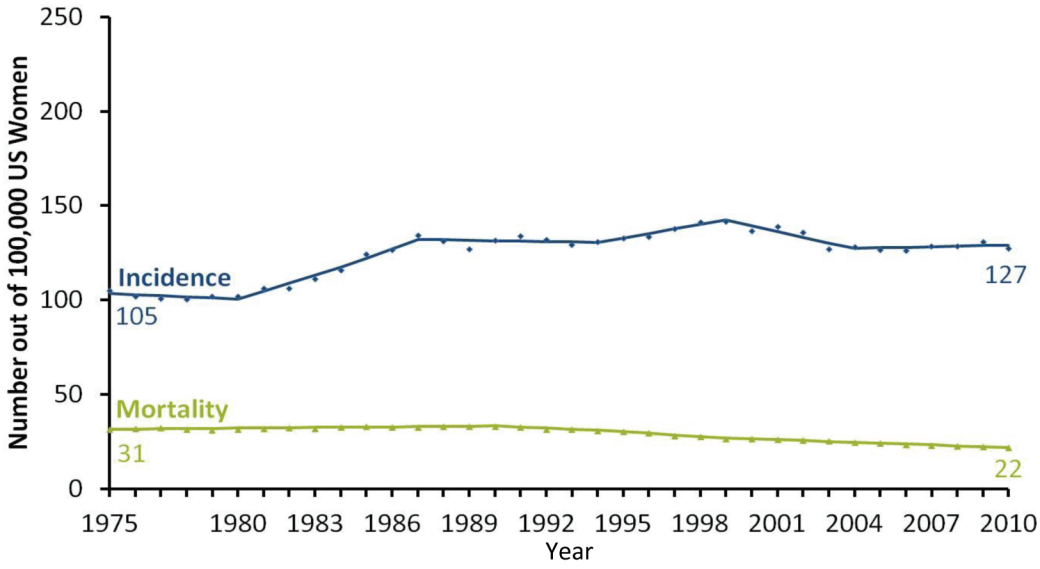
a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.

N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

2.1 Time trends in incidence, mortality and survival (1975-2010)

Incidence and Mortality[a,b,c]

Women



Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	74%	75%	76%	81%	84%	86%	87%	89%	90%	90%	*90%*	*91%*

a: SEER-9 **incidence** rates per 100,000 and age-adjusted to the 2000 US Standard Population. Rates are also adjusted for reporting delay. More information can be found at: http://surveillance.cancer.gov/delay/.

b: US **mortality** rates per 100,000 and age-adjusted to the 2000 US Standard Population.

c: Symbols represent observed values for **incidence** and **mortality** (observed values for 1975 and 2010 are labeled). Lines represent estimated values from the Joinpoint model.

d: 5-year **relative survival** for people diagnosed with this cancer in the SEER-9 registries by year at diagnosis. Modeled estimates using Joinpoint are shown in the table. *Italicized numbers are 5-year relative survivals* projected from the model.

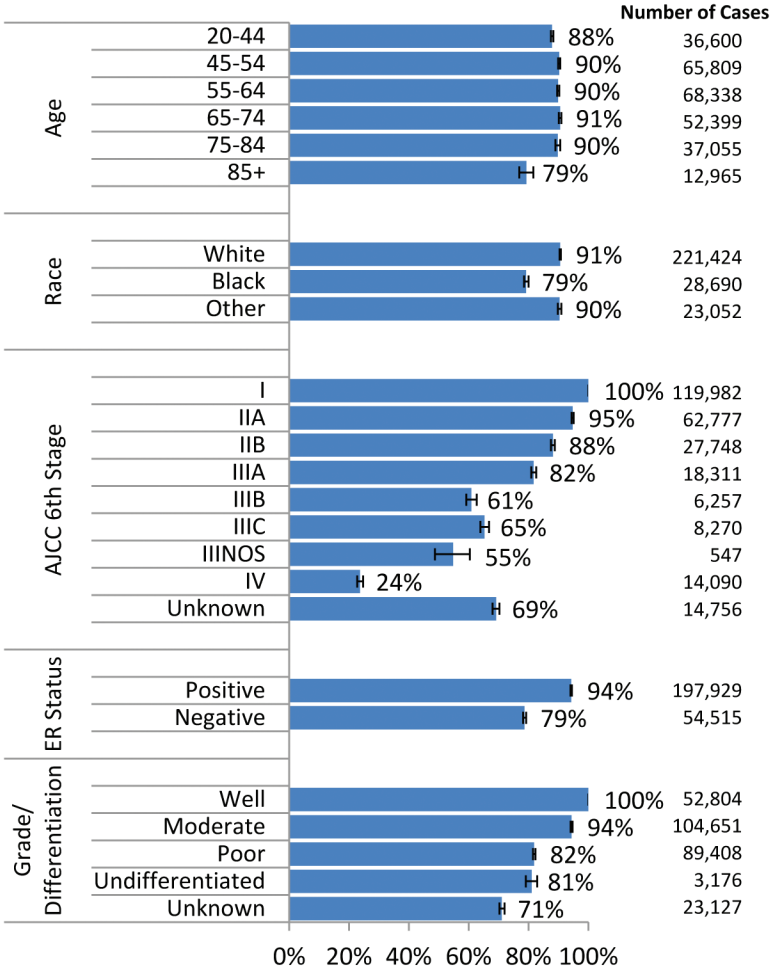
2.2 Cancer prognosis 5 years after diagnosis by prognostic characteristics and age[a] (5-Year Relative Survival)

	All ages		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All stages	**89%**	**(89%-90%)**	**88%**	**(87%-88%)**	**90%**	**(90%-91%)**	**90%**	**(90%-90%)**	**91%**	**(90%-91%)**	**87%**	**(87%-88%)**
ER positive	94%	(94%-95%)	93%	(92%-93%)	94%	(94%-95%)	94%	(94%-94%)	95%	(94%-95%)	96%	(95%-97%)
ER negative	79%	(78%-79%)	79%	(78%-79%)	80%	(79%-81%)	80%	(79%-81%)	79%	(78%-81%)	72%	(70%-74%)
Stage I	**100%**	**+**	**98%**	**(97%-98%)**	**99%**	**(99%-99%)**	**100%**	**(99%-100%)**	**100%**	**+**	**100%**	**+**
ER positive	100%	+	99%	(98%-99%)	100%	(99%-100%)	100%	+	100%	+	100%	+
ER negative	97%	(96%-97%)	94%	(93%-95%)	96%	(95%-97%)	97%	(95%-97%)	98%	(96%-99%)	100%	+
Stage II	**93%**	**(92%-93%)**	**92%**	**(91%-93%)**	**94%**	**(93%-94%)**	**94%**	**(93%-94%)**	**93%**	**(92%-93%)**	**91%**	**(89%-92%)**
ER positive	96%	(96%-97%)	96%	(95%-96%)	97%	(96%-97%)	97%	(96%-97%)	96%	(95%-96%)	96%	(94%-97%)
ER negative	84%	(83%-85%)	85%	(84%-87%)	86%	(84%-87%)	86%	(84%-87%)	83%	(80%-85%)	74%	(70%-78%)
Stage III	**73%**	**(73%-74%)**	**75%**	**(74%-77%)**	**78%**	**(77%-79%)**	**75%**	**(74%-76%)**	**73%**	**(71%-75%)**	**58%**	**(55%-61%)**
ER positive	81%	(80%-82%)	84%	(82%-86%)	85%	(84%-87%)	83%	(82%-85%)	79%	(77%-81%)	65%	(62%-68%)
ER negative	59%	(57%-60%)	59%	(57%-62%)	63%	(61%-65%)	59%	(56%-62%)	58%	(54%-62%)	45%	(41%-50%)
Stage IV	**24%**	**(23%-25%)**	**32%**	**(29%-35%)**	**28%**	**(25%-30%)**	**23%**	**(21%-25%)**	**23%**	**(21%-26%)**	**16%**	**(14%-19%)**
ER positive	31%	(29%-32%)	40%	(36%-45%)	35%	(32%-38%)	29%	(27%-32%)	31%	(28%-34%)	22%	(19%-26%)
ER negative	16%	(14%-17%)	21%	(16%-25%)	17%	(14%-20%)	16%	(13%-19%)	14%	(10%-18%)	10%	(7%-14%)

a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each estimate.

+: Statistic could not be calculated

2.3 By prognostic characteristics[a] (5-Year Relative Survival)



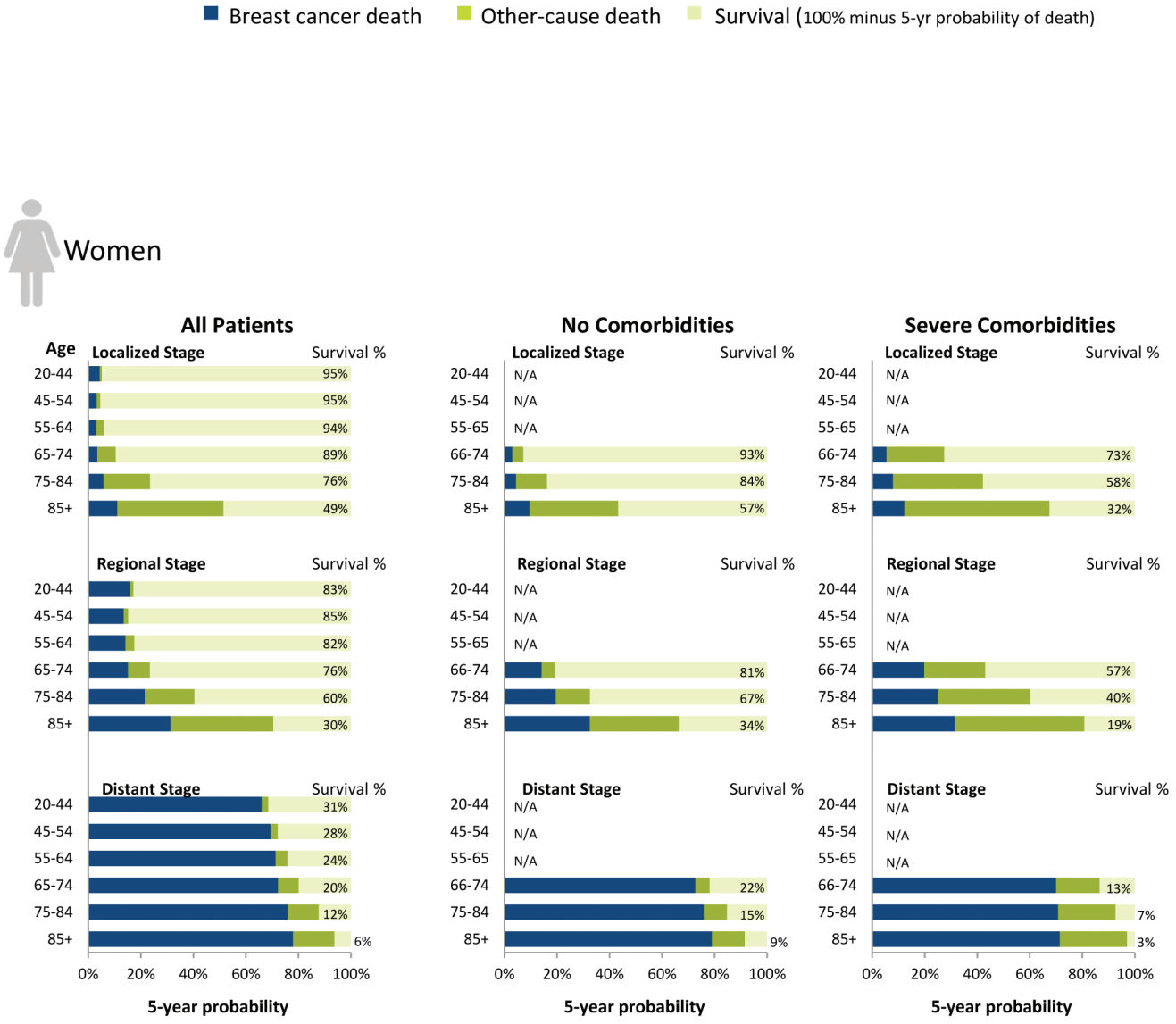
a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries. Error bars represent the 95% confidence interval for each survival estimate.

2.4 By race/ethnicity[a,b,c] (5-Year Cause-Specific Survival)

All Stages		
NH White	89%	(89%-89%)
NH Black	79%	(79%-80%)
NH API	91%	(91%-92%)
NH AI/AN	85%	(81%-88%)
Hispanic	87%	(87%-88%)
Stage I		
NH White	98%	(98%-98%)
NH Black	96%	(95%-96%)
NH API	99%	(98%-99%)
NH AI/AN	98%	(93%-99%)
Hispanic	98%	(97%-98%)
Stage II		
NH White	92%	(92%-92%)
NH Black	86%	(86%-87%)
NH API	95%	(94%-95%)
NH AI/AN	90%	(84%-94%)
Hispanic	91%	(91%-92%)
Stage III		
NH White	75%	(75%-76%)
NH Black	64%	(62%-66%)
NH API	79%	(77%-81%)
NH AI/AN	74%	(59%-84%)
Hispanic	77%	(75%-78%)
Stage IV		
NH White	26%	(24%-27%)
NH Black	16%	(13%-18%)
NH API	35%	(30%-40%)
NH AI/AN	35%	(19%-51%)
Hispanic	27%	(24%-30%)

a. 5-year **cause-specific survival** for people diagnosed with this cancer 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each survival estimate.
b: Cause-specific survival was used because life tables needed to calculate relative survival are not available by race/ethnicity.
c: NH: Non-Hispanic, API: Asian/Pacific Islander, AI/AN: American Indian/Alaska Native. These groups are mutually exclusive and represent 100% of the population.
+: Statistic could not be calculated.

2.5 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and stage at diagnosis[a] (5-Year Crude Probability of Death)



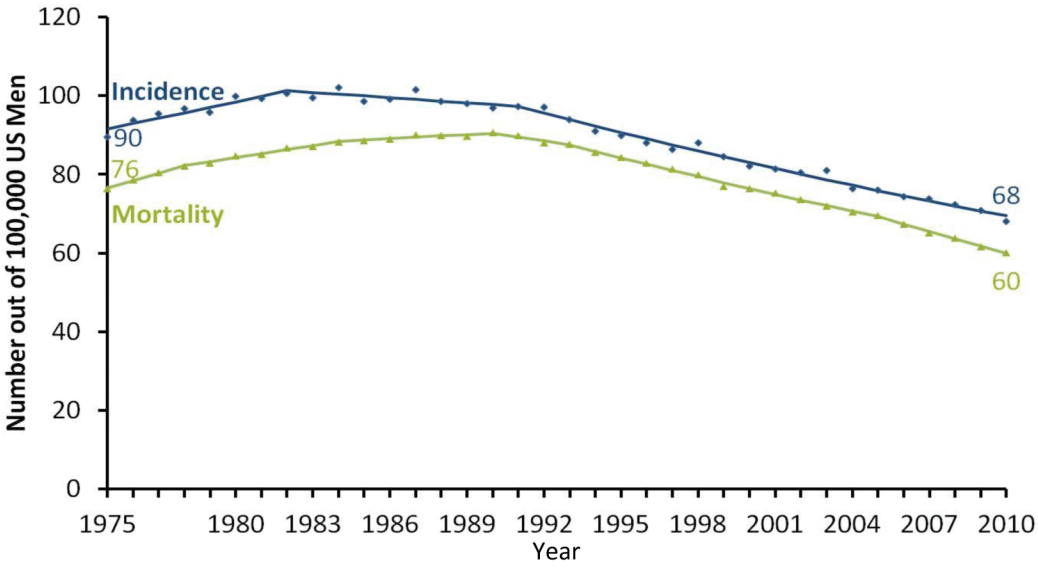
a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.

N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

3.1 Time trends in incidence, mortality and survival (1975-2010)

Incidence and Mortality[a,b,c]

Men

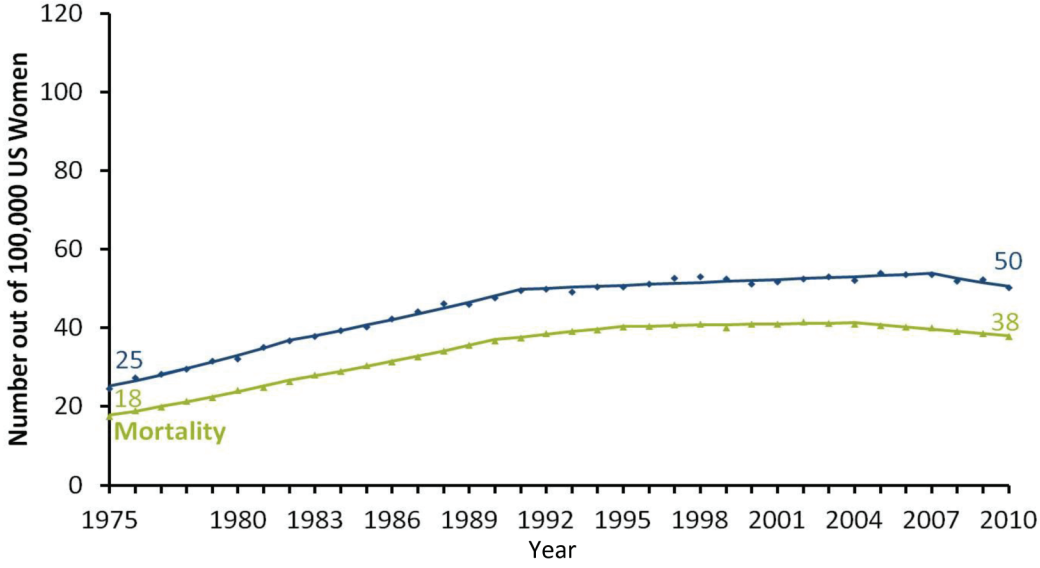


Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	11%	11%	12%	12%	12%	12%	13%	13%	13%	15%	*16%*	*18%*

Incidence and Mortality[a,b,c]

Women



Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	15%	16%	16%	16%	16%	16%	16%	17%	18%	20%	*21%*	*23%*

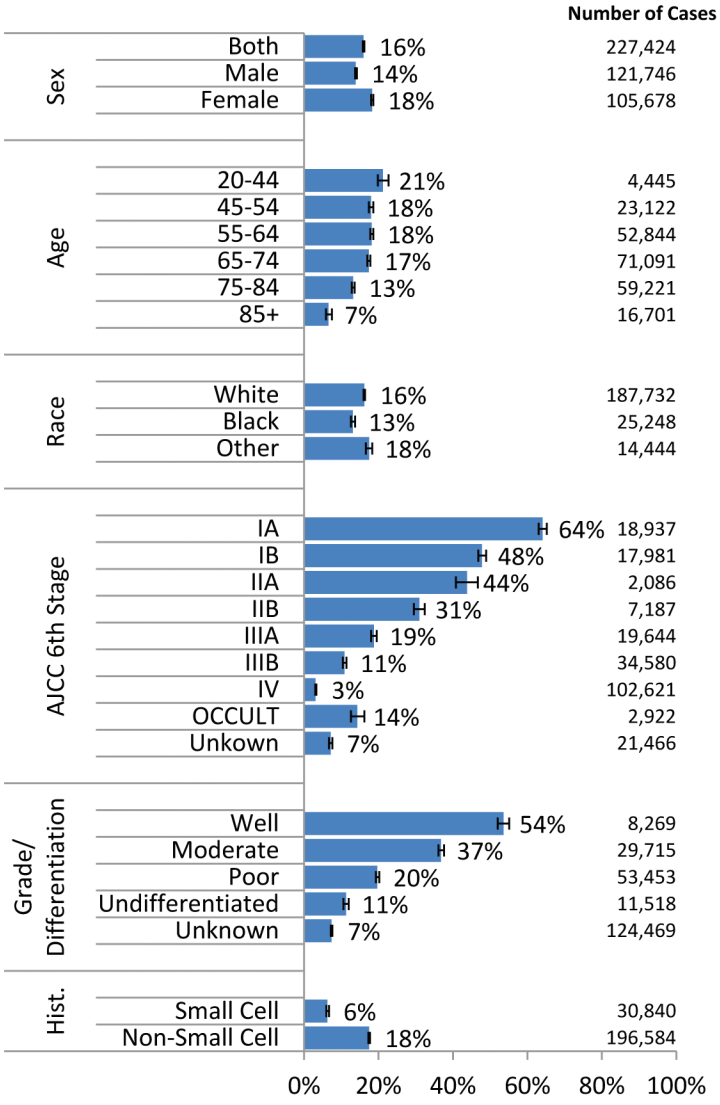
a: SEER-9 **incidence** rates per 100,000 and age-adjusted to the 2000 US Standard Population. Rates are also adjusted for reporting delay. More information can be found at: http://surveillance.cancer.gov/delay/.

b: US **mortality** rates per 100,000 and age-adjusted to the 2000 US Standard Population.

c: Symbols represent observed values for **incidence** and **mortality** (observed values for 1975 and 2010 are labeled). Lines represent estimated values from the Joinpoint model.

d: 5-year **relative survival** for people diagnosed with this cancer in the SEER-9 registries by year at diagnosis. Modeled estimates using Joinpoint are shown in the table. *Italicized numbers are 5-year relative survivals* projected from the model.

3.2 By prognostic characteristics[a] (5-Year Relative Survival)



a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries. Error bars represent the 95% confidence interval for each survival estimate.

3.3 By race/ethnicity[a,b,c] (5-Year Cause-Specific Survival)

	Male		Female	
All Stages				
NH White	16%	(16%-17%)	21%	(20%-21%)
NH Black	13%	(13%-14%)	18%	(17%-19%)
NH API	18%	(17%-19%)	23%	(22%-25%)
NH AI/AN	15%	(9%-21%)	11%	(6%-17%)
Hispanic	14%	(13%-15%)	20%	(19%-22%)
Stage I				
NH White	57%	(56%-58%)	64%	(63%-65%)
NH Black	49%	(46%-53%)	59%	(56%-62%)
NH API	63%	(59%-67%)	71%	(66%-75%)
NH AI/AN	57%	(29%-78%)	74%	(48%-89%)
Hispanic	56%	(51%-60%)	69%	(65%-73%)
Stage II				
NH White	36%	(34%-38%)	39%	(37%-41%)
NH Black	33%	(28%-38%)	38%	(32%-44%)
NH API	37%	(29%-44%)	46%	(35%-56%)
NH AI/AN	29%	(7%-56%)	+	+
Hispanic	40%	(32%-48%)	32%	(24%-42%)
Stage III				
NH White	14%	(14%-15%)	18%	(17%-18%)
NH Black	13%	(12%-15%)	16%	(14%-18%)
NH API	16%	(13%-18%)	22%	(19%-26%)
NH AI/AN	8%	(2%-19%)	14%	(6%-26%)
Hispanic	15%	(13%-18%)	18%	(15%-21%)
Stage IV				
NH White	3%	(2%-3%)	4%	(4%-4%)
NH Black	3%	(2%-3%)	4%	(4%-5%)
NH API	5%	(4%-7%)	8%	(6%-10%)
NH AI/AN	+	+	3%	(1%-8%)
Hispanic	3%	(2%-4%)	6%	(5%-7%)

a. 5-year **cause-specific survival** for people diagnosed with this cancer 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each survival estimate.
b: Cause-specific survival was used because life tables needed to calculate relative survival are not available by race/ethnicity.
c: NH: Non-Hispanic, API: Asian/Pacific Islander, AI/AN: American Indian/Alaska Native. These groups are mutually exclusive and represent 100% of the population.
+: Statistic could not be calculated.

3.4 By prognostic characteristics, age and sex[a] (5-Year Relative Survival)

Men

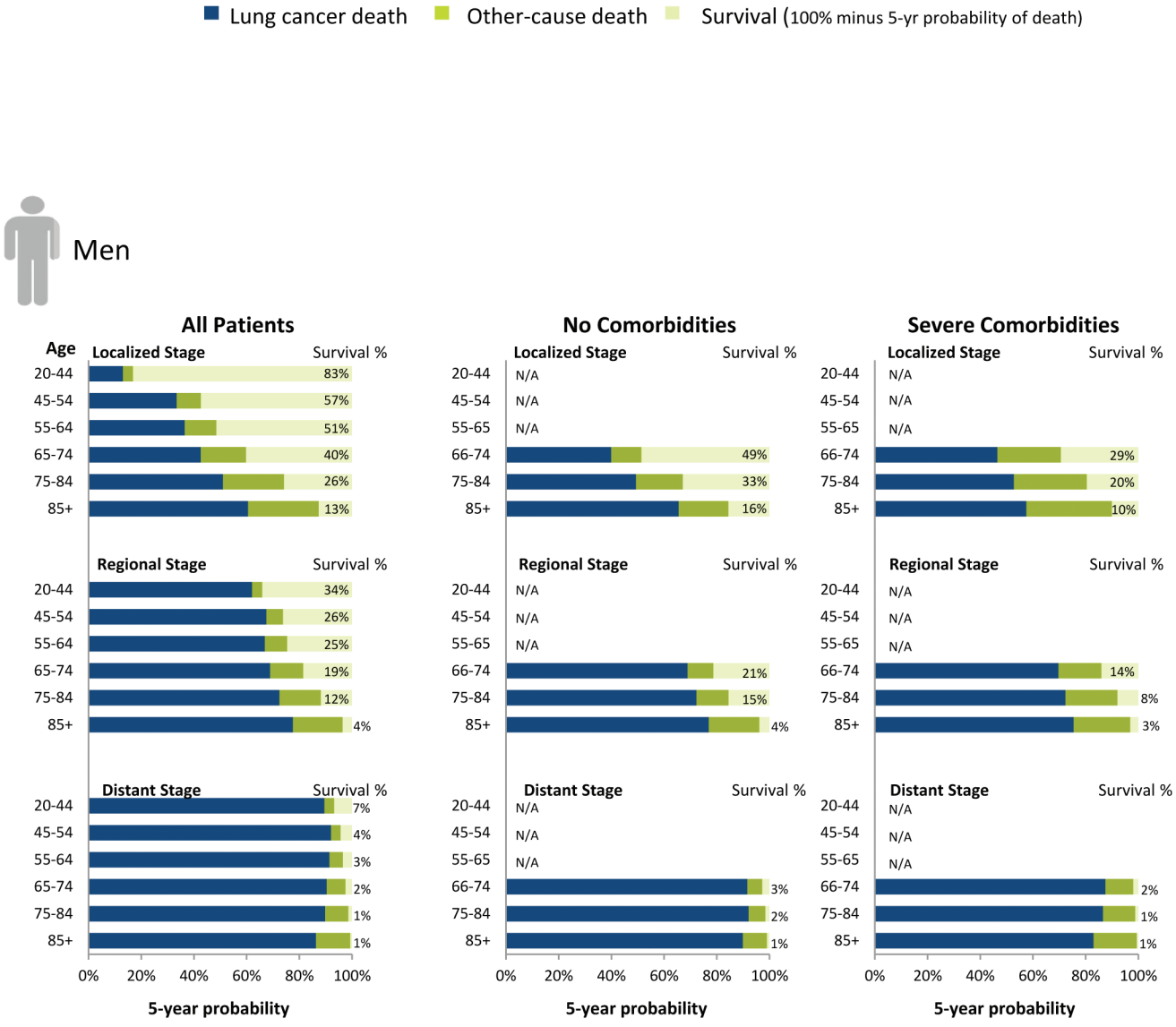
	All ages		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All Stages	**14%**	**(14% - 14%)**	**19%**	**(17% - 20%)**	**15%**	**(14% - 16%)**	**16%**	**(15% - 16%)**	**15%**	**(15% - 16%)**	**11%**	**(10% - 11%)**
Small Cell	5%	(5% - 6%)	10%	(6% - 15%)	7%	(6% - 9%)	5%	(5% - 6%)	5%	(4% - 6%)	3%	(2% - 4%)
Non-Small Cell	15%	(15% - 16%)	20%	(18% - 22%)	16%	(15% - 17%)	18%	(17% - 18%)	17%	(16% - 17%)	11%	(11% - 12%)
Stage I	**52%**	**(51% - 53%)**	**81%**	**(73% - 86%)**	**61%**	**(57% - 64%)**	**58%**	**(56% - 60%)**	**53%**	**(52% - 55%)**	**42%**	**(39% - 44%)**
Small Cell	23%	(19% - 28%)	86%	(33% - 98%)	25%	(10% - 43%)	20%	(12% - 30%)	33%	(24% - 41%)	13%	(6% - 21%)
Non-Small Cell	53%	(52% - 54%)	81%	(73% - 86%)	62%	(59% - 66%)	60%	(57% - 62%)	54%	(52% - 56%)	43%	(40% - 45%)
Stage II	**33%**	**(31% - 35%)**	**47%**	**(34% - 59%)**	**41%**	**(36% - 47%)**	**39%**	**(36% - 43%)**	**33%**	**(30% - 36%)**	**22%**	**(18% - 25%)**
Small Cell	17%	(12% - 24%)	34%	(5% - 68%)	23%	(9% - 41%)	23%	(12% - 36%)	18%	(8% - 32%)	+	+
Non-Small Cell	34%	(32% - 35%)	48%	(35% - 60%)	43%	(37% - 48%)	40%	(37% - 44%)	33%	(30% - 36%)	22%	(19% - 26%)
Stage III	**12%**	**(12% - 13%)**	**17%**	**(13% - 21%)**	**17%**	**(15% - 18%)**	**16%**	**(15% - 17%)**	**12%**	**(11% - 13%)**	**7%**	**(7% - 8%)**
Small Cell	9%	(8% - 10%)	15%	(7% - 25%)	15%	(11% - 19%)	11%	(9% - 13%)	8%	(6% - 11%)	4%	(3% - 6%)
Non-Small Cell	13%	(12% - 14%)	18%	(14% - 22%)	17%	(15% - 19%)	17%	(16% - 18%)	13%	(12% - 14%)	8%	(7% - 9%)
Stage IV	**3%**	**(2% - 3%)**	**6%**	**(5% - 8%)**	**4%**	**(3% - 4%)**	**3%**	**(2% - 3%)**	**2%**	**(2% - 3%)**	**2%**	**(1% - 2%)**
Small Cell	2%	(1% - 2%)	3%	(1% - 7%)	3%	(2% - 4%)	2%	(1% - 2%)	1%	(1% - 2%)	1%	(0% - 1%)
Non-Small Cell	3%	(3% - 3%)	7%	(5% - 9%)	4%	(3% - 4%)	3%	(3% - 3%)	3%	(2% - 3%)	2%	(2% - 2%)

Women

	All ages		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All Stages	**18%**	**(18% - 19%)**	**24%**	**(22% - 26%)**	**22%**	**(21% - 23%)**	**22%**	**(21% - 22%)**	**20%**	**(20% - 21%)**	**13%**	**(13% - 14%)**
Small Cell	8%	(7% - 8%)	10%	(6% - 15%)	11%	(9% - 13%)	11%	(10% - 12%)	7%	(6% - 8%)	4%	(3% - 5%)
Non-Small Cell	20%	(20% - 21%)	26%	(24% - 28%)	24%	(23% - 25%)	24%	(23% - 25%)	23%	(22% - 24%)	14%	(14% - 15%)
Stage I	**61%**	**(59% - 62%)**	**80%**	**(73% - 85%)**	**72%**	**(69% - 75%)**	**68%**	**(66% - 70%)**	**62%**	**(60% - 64%)**	**50%**	**(48% - 52%)**
Small Cell	31%	(27% - 36%)	63%	(14% - 90%)	36%	(22% - 49%)	36%	(27% - 45%)	35%	(27% - 44%)	18%	(11% - 27%)
Non-Small Cell	62%	(60% - 63%)	80%	(74% - 86%)	74%	(71% - 77%)	70%	(68% - 72%)	63%	(61% - 65%)	51%	(49% - 53%)
Stage II	**35%**	**(33% - 37%)**	**64%**	**(51% - 74%)**	**48%**	**(42% - 54%)**	**44%**	**(39% - 48%)**	**35%**	**(31% - 38%)**	**22%**	**(19% - 26%)**
Small Cell	23%	(17% - 29%)	54%	(7% - 87%)	28%	(11% - 47%)	29%	(19% - 40%)	25%	(14% - 37%)	10%	(4% - 20%)
Non-Small Cell	36%	(34% - 38%)	64%	(51% - 75%)	50%	(44% - 56%)	45%	(41% - 50%)	35%	(32% - 39%)	23%	(20% - 27%)
Stage III	**15%**	**(15% - 16%)**	**25%**	**(20% - 30%)**	**24%**	**(22% - 26%)**	**21%**	**(19% - 22%)**	**15%**	**(14% - 16%)**	**9%**	**(8% - 10%)**
Small Cell	13%	(12% - 14%)	12%	(4% - 24%)	19%	(15% - 24%)	20%	(17% - 22%)	10%	(8% - 12%)	6%	(4% - 9%)
Non-Small Cell	16%	(15% - 17%)	27%	(22% - 32%)	25%	(23% - 28%)	21%	(19% - 23%)	17%	(15% - 18%)	9%	(8% - 10%)
Stage IV	**4%**	**(4% - 4%)**	**8%**	**(6% - 10%)**	**5%**	**(5% - 6%)**	**4%**	**(4% - 5%)**	**4%**	**(4% - 4%)**	**3%**	**(2% - 3%)**
Small Cell	2%	(2% - 3%)	6%	(3% - 11%)	3%	(2% - 5%)	3%	(3% - 4%)	2%	(1% - 3%)	1%	(1% - 2%)
Non-Small Cell	4%	(4% - 5%)	8%	(6% - 10%)	6%	(5% - 7%)	5%	(4% - 5%)	5%	(4% - 5%)	3%	(2% - 3%)

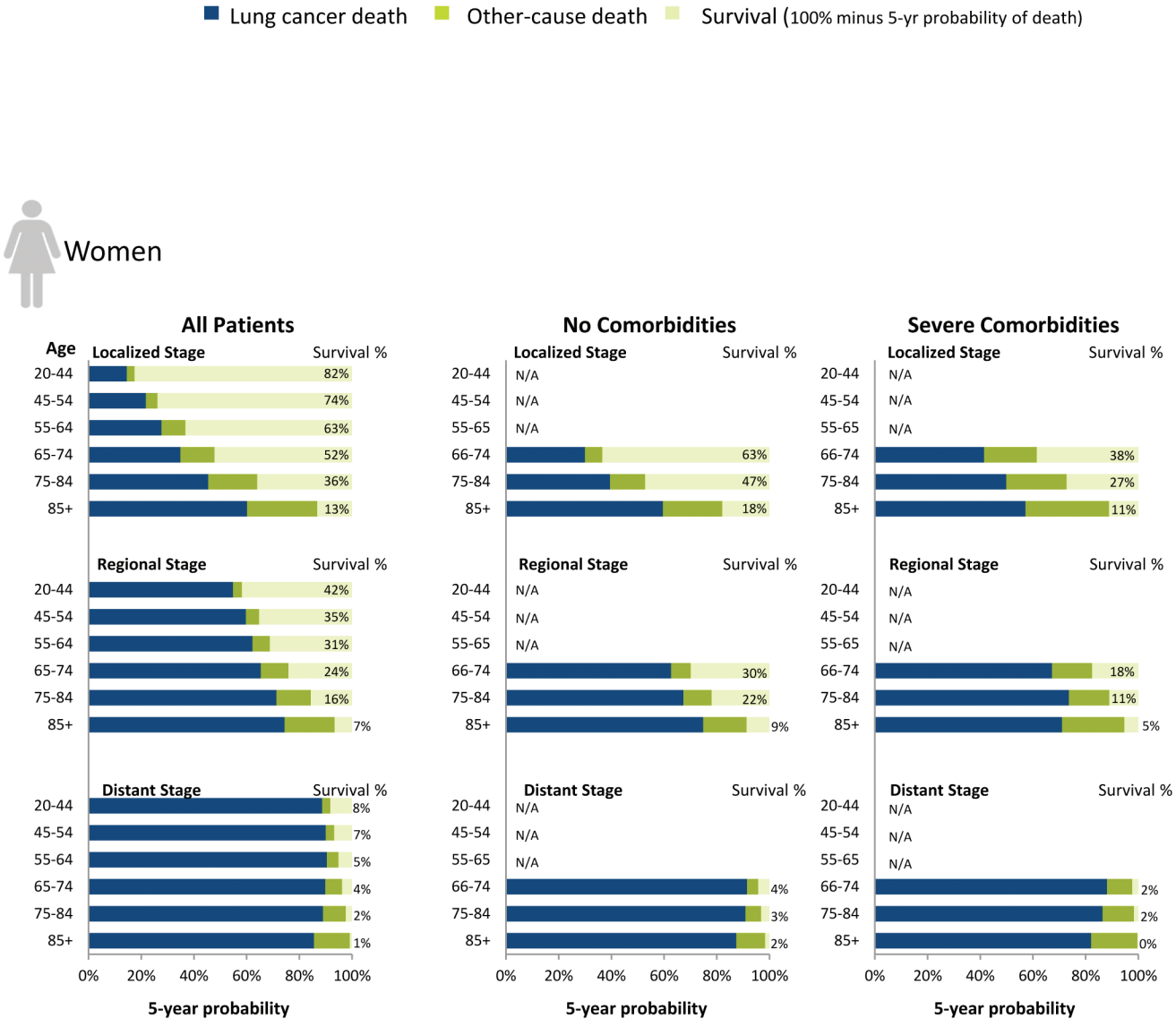
a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each estimate.
+: Statistic could not be calculated

3.5 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and stage at diagnosis[a] (5-Year Crude Probability of Death)



a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.
N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

3.6 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and stage at diagnosis[a] (5-Year Crude Probability of Death)

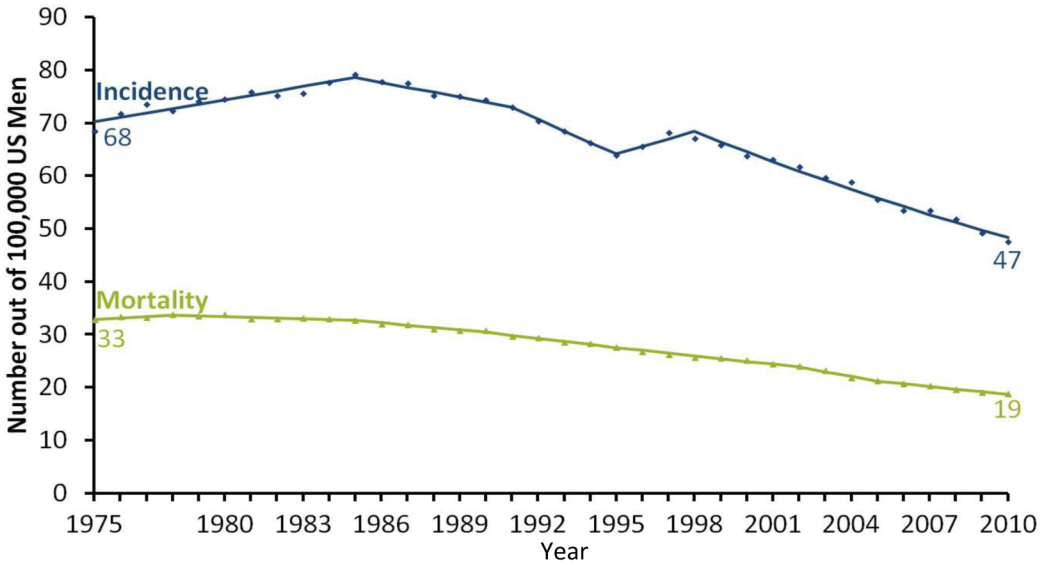


a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.
N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

4.1 Time trends in incidence, mortality and survival (1975-2010)

Incidence and Mortality[a,b,c]

Men

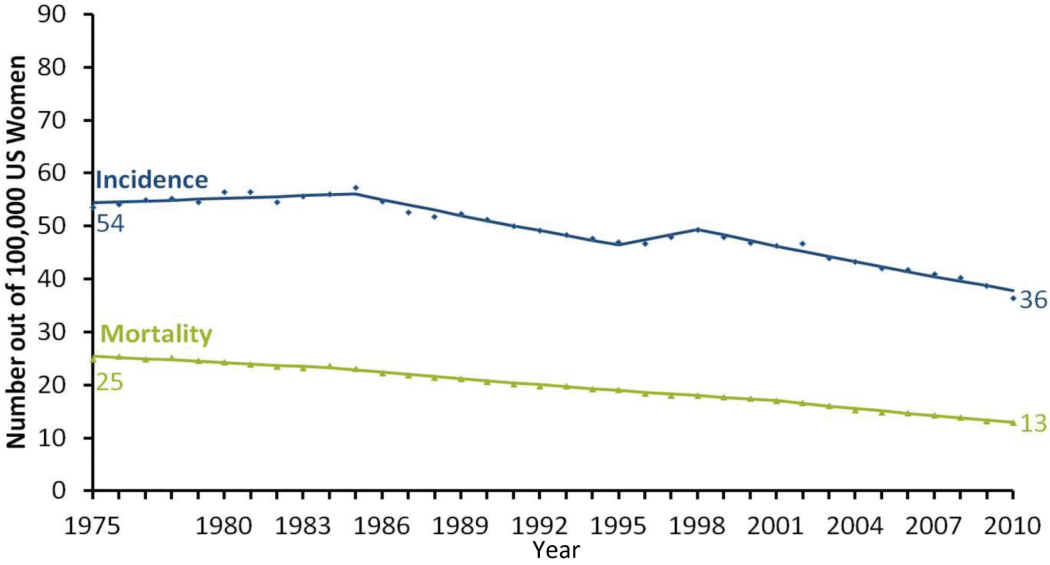


Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	47%	52%	55%	58%	61%	61%	61%	63%	65%	67%	*68%*	*70%*

Incidence and Mortality[a,b,c]

Women



Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	50%	54%	56%	58%	60%	61%	62%	63%	65%	66%	*67%*	*68%*

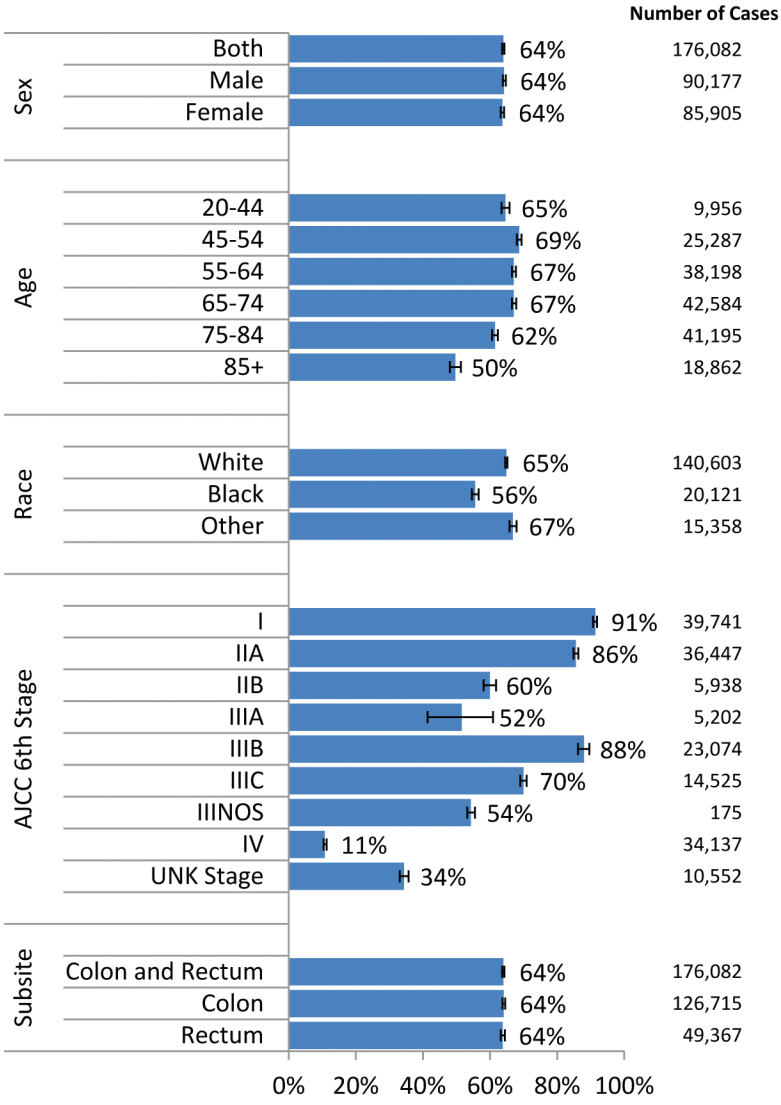
a: SEER-9 **incidence** rates per 100,000 and age-adjusted to the 2000 US Standard Population. Rates are also adjusted for reporting delay. More information can be found at: http://surveillance.cancer.gov/delay/.

b: US **mortality** rates per 100,000 and age-adjusted to the 2000 US Standard Population.

c: Symbols represent observed values for **incidence** and **mortality** (observed values for 1975 and 2010 are labeled). Lines represent estimated values from the Joinpoint model.

d: 5-year **relative survival** for people diagnosed with this cancer in the SEER-9 registries by year at diagnosis. Modeled estimates using Joinpoint are shown in the table. *Italicized numbers are 5-year relative survivals* projected from the model.

4.2 By prognostic characteristics[a] (5-Year Relative Survival)



% surviving cancer 5-years after cancer diagnosis

a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries. Error bars represent the 95% confidence interval for each survival estimate.

4.3 By race/ethnicity[a,b,c] (5-Year Cause-Specific Survival)

	Male		Female	
All Stages				
NH White	65%	(65%-66%)	64%	(64%-65%)
NH Black	56%	(55%-57%)	58%	(57%-59%)
NH API	68%	(67%-70%)	68%	(67%-70%)
NH AI/AN	61%	(53%-68%)	52%	(43%-59%)
Hispanic	63%	(62%-65%)	63%	(61%-64%)
Stage I				
NH White	91%	(90%-91%)	90%	(90%-91%)
NH Black	88%	(86%-90%)	89%	(87%-91%)
NH API	94%	(92%-95%)	94%	(92%-95%)
NH AI/AN	92%	(81%-97%)	87%	(60%-96%)
Hispanic	91%	(89%-92%)	90%	(88%-92%)
Stage II				
NH White	82%	(81%-83%)	81%	(80%-81%)
NH Black	76%	(73%-78%)	77%	(75%-79%)
NH API	83%	(80%-85%)	85%	(83%-87%)
NH AI/AN	89%	(74%-96%)	76%	(58%-87%)
Hispanic	82%	(80%-84%)	78%	(75%-81%)
Stage III				
NH White	67%	(66%-68%)	66%	(65%-67%)
NH Black	58%	(56%-61%)	63%	(60%-65%)
NH API	72%	(69%-74%)	73%	(70%-75%)
NH AI/AN	66%	(49%-78%)	53%	(35%-67%)
Hispanic	66%	(63%-68%)	65%	(62%-68%)
Stage IV				
NH White	11%	(10%-12%)	12%	(11%-13%)
NH Black	8%	(7%-10%)	9%	(7%-10%)
NH API	15%	(12%-18%)	14%	(11%-17%)
NH AI/AN	7%	(2%-19%)	3%	(0%-14%)
Hispanic	12%	(10%-14%)	14%	(11%-16%)

a. 5-year **cause-specific survival** for people diagnosed with this cancer 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each survival estimate.
b: Cause-specific survival was used because life tables needed to calculate relative survival are not available by race/ethnicity.
c: NH: Non-Hispanic, API: Asian/Pacific Islander, AI/AN: American Indian/Alaska Native. These groups are mutually exclusive and represent 100% of the population.
+: Statistic could not be calculated.

4.4 By prognostic characteristics, age and sex[a] (5-Year Relative Survival)

Men

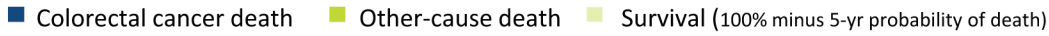
	All ages		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All Stages	**64%**	**(64% - 65%)**	**63%**	**(62% - 65%)**	**68%**	**(67% - 69%)**	**67%**	**(66% - 67%)**	**67%**	**(66% - 68%)**	**58%**	**(57% - 59%)**
0	93%	(91% - 94%)	97%	(91% - 99%)	94%	(90% - 96%)	97%	(94% - 98%)	93%	(89% - 95%)	83%	(76% - 89%)
I	92%	(91% - 92%)	94%	(91% - 96%)	94%	(93% - 95%)	93%	(92% - 94%)	93%	(91% - 94%)	87%	(85% - 89%)
IIA	85%	(84% - 86%)	89%	(86% - 91%)	89%	(87% - 91%)	88%	(87% - 90%)	85%	(83% - 87%)	82%	(79% - 84%)
IIB	60%	(57% - 63%)	68%	(58% - 77%)	75%	(69% - 79%)	59%	(54% - 64%)	58%	(53% - 63%)	51%	(45% - 57%)
IIIA	88%	(85% - 90%)	85%	(74% - 91%)	92%	(87% - 95%)	86%	(82% - 90%)	92%	(86% - 95%)	81%	(74% - 87%)
IIIB	70%	(69% - 71%)	76%	(72% - 80%)	75%	(72% - 78%)	74%	(71% - 76%)	72%	(69% - 74%)	58%	(55% - 62%)
IIIC	54%	(52% - 55%)	60%	(55% - 65%)	60%	(57% - 64%)	57%	(54% - 60%)	53%	(49% - 56%)	42%	(38% - 46%)
IIINOS	53%	(38% - 66%)	49%	(16% - 76%)	62%	(25% - 85%)	51%	(18% - 77%)	57%	(30% - 77%)	31%	(8% - 58%)
IV	11%	(10% - 11%)	15%	(12% - 18%)	14%	(13% - 16%)	12%	(11% - 14%)	10%	(8% - 11%)	5%	(4% - 7%)
Unknown	37%	(35% - 39%)	52%	(44% - 60%)	60%	(54% - 65%)	50%	(46% - 54%)	42%	(38% - 46%)	19%	(17% - 22%)
All Subsites	**64%**	**(64% - 65%)**	**63%**	**(62% - 65%)**	**68%**	**(67% - 69%)**	**67%**	**(66% - 67%)**	**67%**	**(66% - 68%)**	**58%**	**(57% - 59%)**
Colon	65%	(64% - 65%)	64%	(62% - 66%)	68%	(66% - 69%)	66%	(65% - 67%)	68%	(66% - 69%)	60%	(58% - 61%)
Rectum	64%	(63% - 64%)	62%	(59% - 65%)	68%	(66% - 69%)	67%	(66% - 69%)	65%	(63% - 66%)	53%	(51% - 56%)

Women

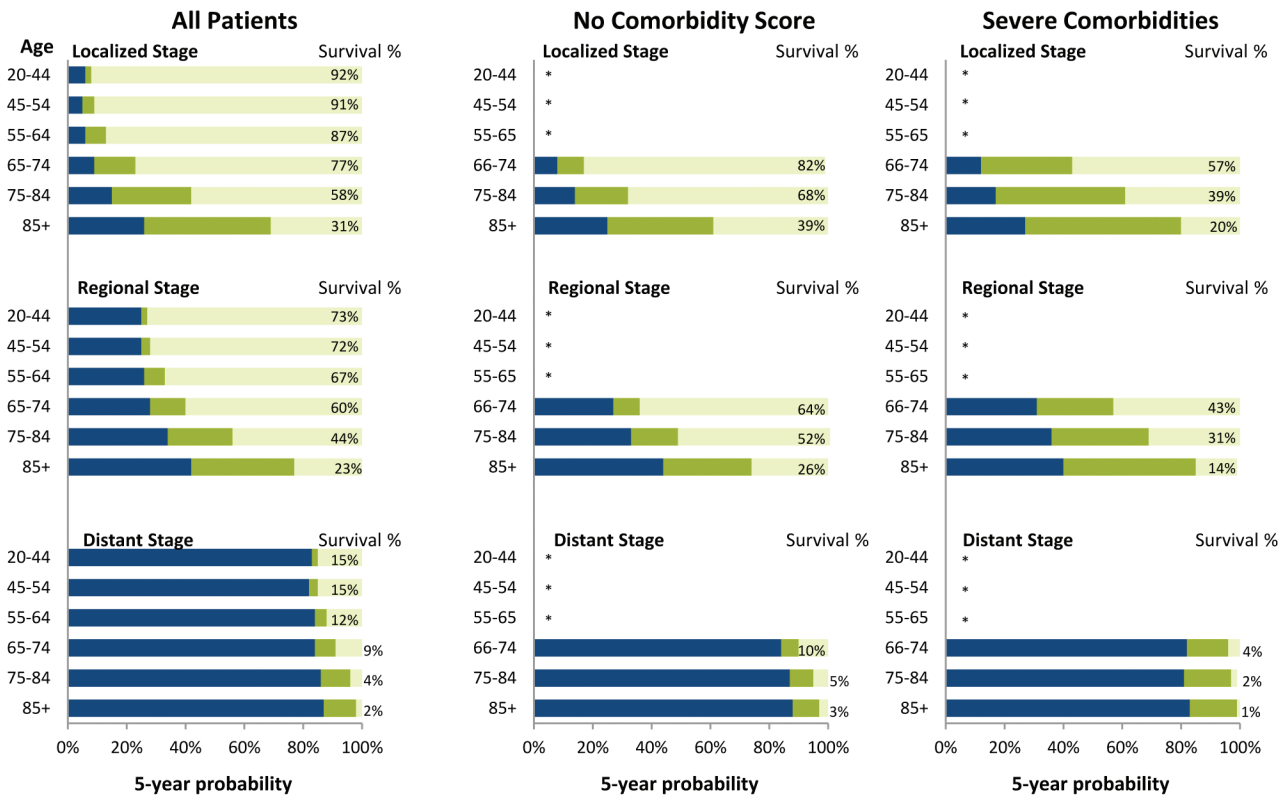
	All ages		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All Stages	**64%**	**(63% - 64%)**	**66%**	**(64% - 68%)**	**70%**	**(69% - 71%)**	**68%**	**(67% - 69%)**	**68%**	**(67% - 69%)**	**57%**	**(57% - 58%)**
0	91%	(89% - 93%)	98%	(87% - 100%)	96%	(92% - 98%)	96%	(91% - 98%)	94%	(89% - 97%)	81%	(75% - 86%)
I	91%	(90% - 92%)	97%	(94% - 98%)	96%	(94% - 97%)	94%	(93% - 96%)	92%	(91% - 94%)	87%	(84% - 88%)
IIA	86%	(85% - 87%)	91%	(89% - 94%)	91%	(89% - 92%)	89%	(87% - 90%)	86%	(85% - 88%)	83%	(81% - 85%)
IIB	60%	(57% - 62%)	72%	(62% - 80%)	71%	(64% - 77%)	65%	(60% - 70%)	64%	(58% - 69%)	52%	(47% - 56%)
IIIA	88%	(85% - 90%)	94%	(87% - 97%)	89%	(83% - 93%)	90%	(85% - 93%)	90%	(85% - 93%)	82%	(74% - 87%)
IIIB	70%	(69% - 71%)	78%	(74% - 82%)	81%	(78% - 83%)	77%	(75% - 80%)	71%	(69% - 74%)	60%	(57% - 63%)
IIIC	55%	(54% - 57%)	66%	(60% - 71%)	68%	(64% - 72%)	61%	(58% - 65%)	56%	(52% - 59%)	44%	(40% - 47%)
IIINOS	50%	(36% - 63%)	78%	(36% - 94%)	61%	(23% - 85%)	75%	(44% - 90%)	41%	(7% - 74%)	+	+
IV	11%	(10% - 12%)	18%	(15% - 21%)	16%	(14% - 18%)	13%	(11% - 14%)	12%	(11% - 13%)	6%	(5% - 7%)
Unknown	32%	(30% - 34%)	61%	(51% - 70%)	65%	(59% - 71%)	54%	(49% - 59%)	44%	(40% - 49%)	19%	(17% - 21%)
All Subsites	**64%**	**(63% - 64%)**	**66%**	**(64% - 68%)**	**70%**	**(69% - 71%)**	**68%**	**(67% - 69%)**	**68%**	**(67% - 69%)**	**57%**	**(57% - 58%)**
Colon	64%	(63% - 64%)	64%	(62% - 66%)	68%	(67% - 70%)	67%	(66% - 68%)	68%	(67% - 69%)	59%	(58% - 60%)
Rectum	64%	(63% - 65%)	69%	(66% - 72%)	73%	(71% - 75%)	70%	(68% - 72%)	67%	(65% - 69%)	52%	(50% - 54%)

a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each estimate.
+: Statistic could not be calculated

4.5 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and stage at diagnosis[a] (5-Year Crude Probability of Death)



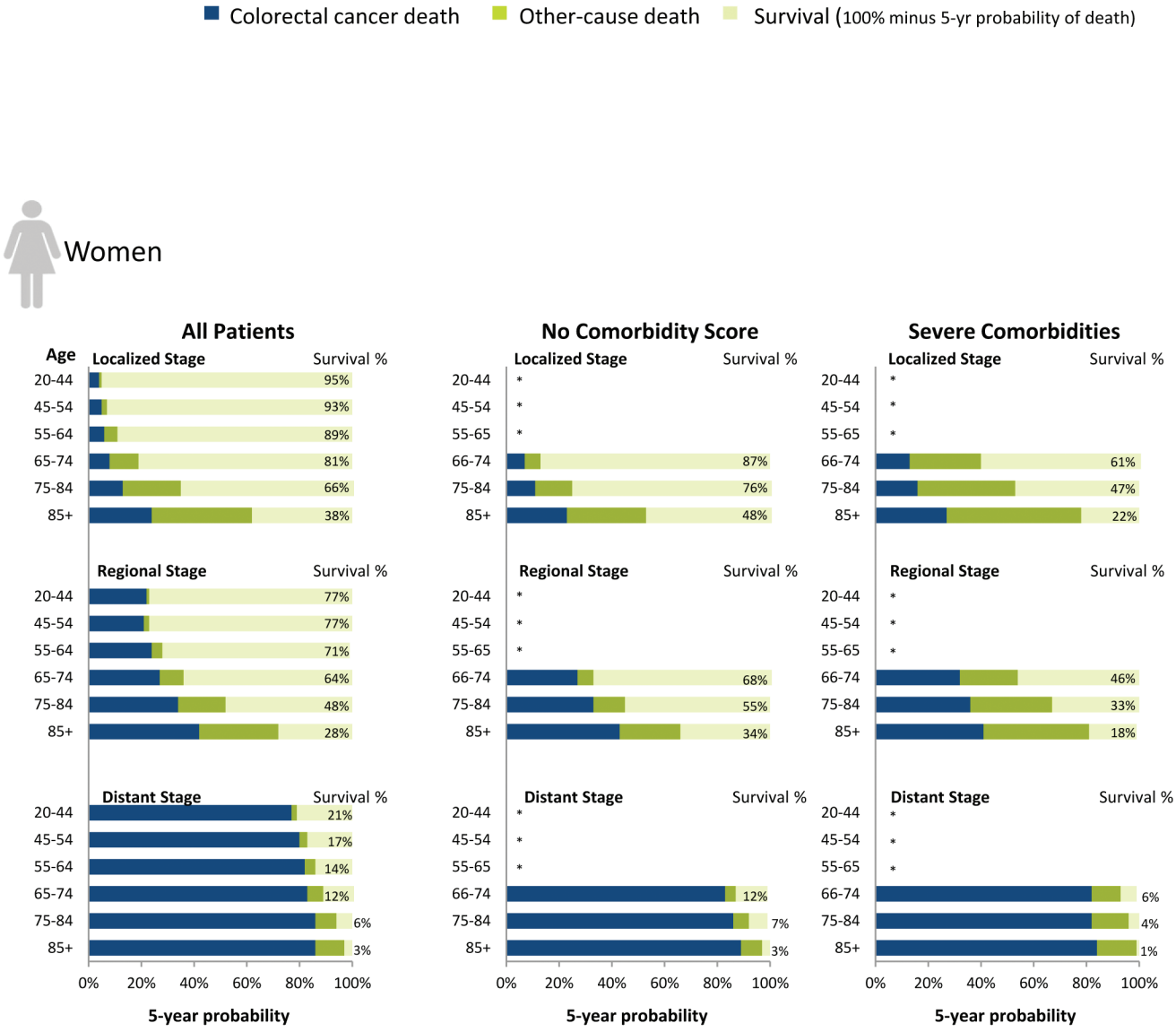
Men



a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.

N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

4.6 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and stage at diagnosis[a] (5-Year Crude Probability of Death)

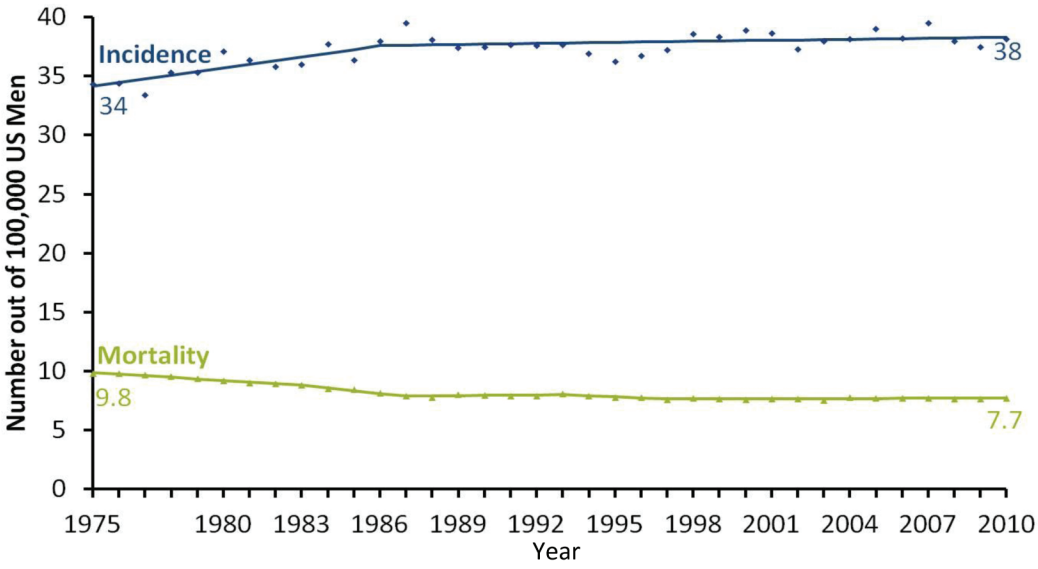


a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.

N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

5.1 Time trends in incidence, mortality and survival (1975-2010)

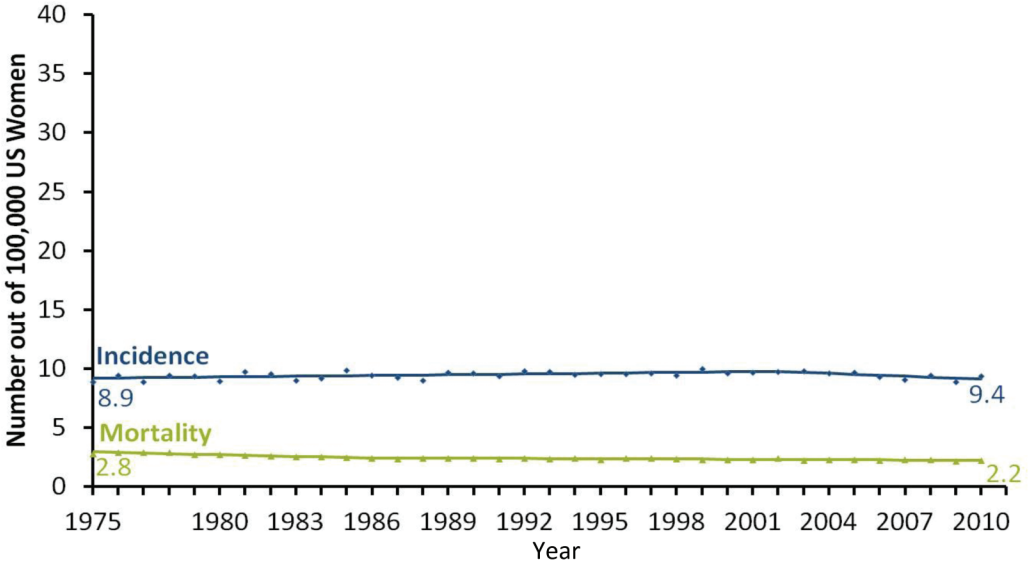
Incidence and Mortality[a,b,c]
Men



Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	74%	77%	78%	80%	81%	82%	82%	82%	81%	81%	*81%*	*81%*

Incidence and Mortality[a,b,c]
Women

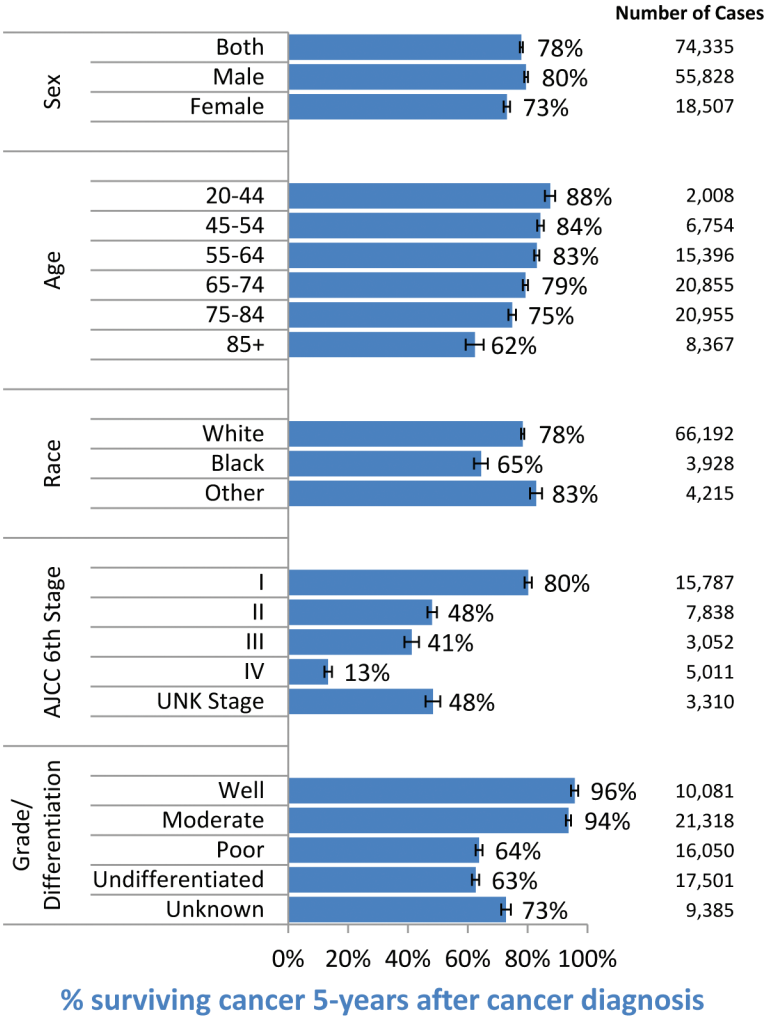


Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	70%	71%	72%	73%	73%	74%	74%	75%	75%	76%	*76%*	*77%*

a: SEER-9 **incidence** rates per 100,000 and age-adjusted to the 2000 US Standard Population. Rates are also adjusted for reporting delay. More information can be found at: http://surveillance.cancer.gov/delay/.
b: US **mortality** rates per 100,000 and age-adjusted to the 2000 US Standard Population.
c: Symbols represent observed values for **incidence** and **mortality** (observed values for 1975 and 2010 are labeled). Lines represent estimated values from the Joinpoint model.
d: 5-year **relative survival** for people diagnosed with this cancer in the SEER-9 registries by year at diagnosis. Modeled estimates using Joinpoint are shown in the table. *Italicized numbers are 5-year relative survivals* projected from the model.

5.2 By prognostic characteristics[a] (5-Year Relative Survival)



a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries. Error bars represent the 95% confidence interval for each survival estimate.

5.3 By race/ethnicity[a,b,c] (5-Year Cause-Specific Survival)

	Male		Female	
All Stages				
NH White	80%	(80%-81%)	75%	(74%-76%)
NH Black	72%	(70%-74%)	59%	(56%-62%)
NH API	81%	(79%-83%)	75%	(71%-79%)
NH AI/AN	69%	(56%-79%)	55%	(31%-74%)
Hispanic	80%	(79%-82%)	72%	(69%-75%)
Stage I				
NH White	83%	(82%-84%)	79%	(77%-81%)
NH Black	81%	(77%-85%)	71%	(64%-77%)
NH API	87%	(83%-90%)	87%	(79%-92%)
NH AI/AN	52%	(18%-78%)	75%	(13%-96%)
Hispanic	84%	(80%-87%)	78%	(70%-85%)
Stage II				
NH White	56%	(54%-58%)	45%	(42%-48%)
NH Black	43%	(36%-50%)	34%	(24%-45%)
NH API	55%	(47%-63%)	57%	(44%-69%)
NH AI/AN	+	+	+	+
Hispanic	58%	(51%-65%)	43%	(32%-53%)
Stage III				
NH White	45%	(43%-48%)	39%	(34%-43%)
NH Black	58%	(47%-68%)	26%	(16%-36%)
NH API	47%	(33%-60%)	64%	(39%-81%)
NH AI/AN	+	+	+	+
Hispanic	44%	(32%-55%)	47%	(30%-62%)
Stage IV				
NH White	16%	(14%-18%)	11%	(8%-13%)
NH Black	14%	(10%-20%)	12%	(7%-18%)
NH API	26%	(17%-36%)	21%	(11%-34%)
NH AI/AN	+	+	+	+
Hispanic	21%	(16%-28%)	12%	(5%-21%)

a. 5-year **cause-specific survival** for people diagnosed with this cancer 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each survival estimate.
b: Cause-specific survival was used because life tables needed to calculate relative survival are not available by race/ethnicity.
c: NH: Non-Hispanic, API: Asian/Pacific Islander, AI/AN: American Indian/Alaska Native. These groups are mutually exclusive and represent 100% of the population.
+: Statistic could not be calculated.

5.4 Cancer prognosis 5 years after diagnosis by prognostic characteristics, age and sex[a] (5-Year Relative Survival)

Men

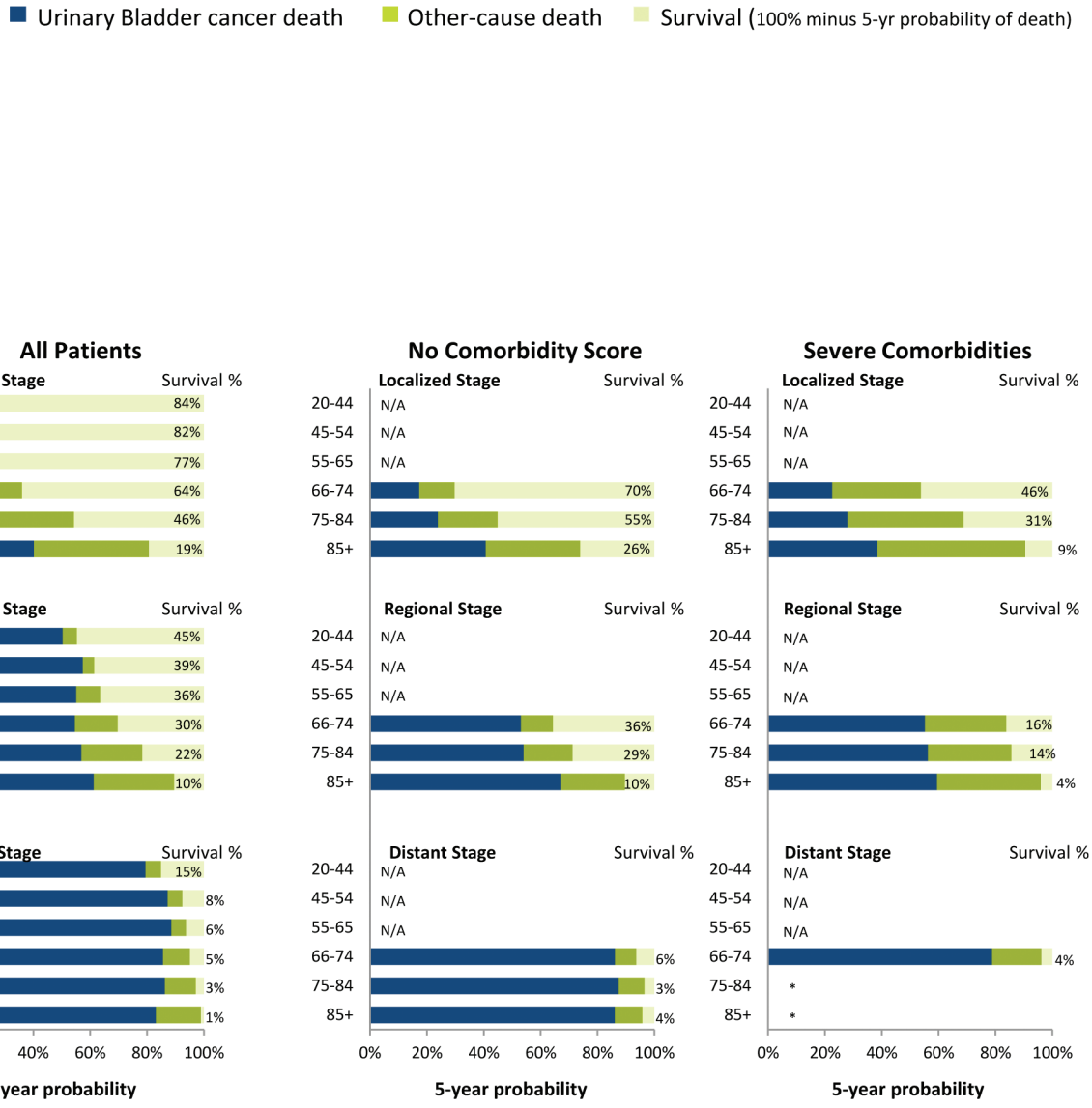
	All ages		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All Stages	79%	(79% - 80%)	89%	(87% - 91%)	85%	(83% - 86%)	83%	(82% - 84%)	80%	(79% - 81%)	74%	(73% - 76%)
Stage I	81%	(80% - 83%)	88%	(82% - 92%)	90%	(87% - 93%)	89%	(86% - 90%)	82%	(80% - 85%)	73%	(70% - 76%)
Stage II	51%	(49% - 53%)	55%	(39% - 67%)	68%	(63% - 74%)	65%	(61% - 69%)	56%	(52% - 59%)	37%	(34% - 41%)
Stage III	43%	(40% - 46%)	46%	(28% - 62%)	50%	(40% - 58%)	44%	(39% - 50%)	46%	(41% - 51%)	38%	(32% - 43%)
Stage IV	15%	(14% - 17%)	23%	(14% - 33%)	19%	(15% - 24%)	19%	(16% - 22%)	13%	(10% - 16%)	11%	(8% - 14%)

Women

	All ages		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All Stages	73%	(72% - 74%)	84%	(80% - 88%)	83%	(81% - 85%)	82%	(80% - 84%)	76%	(74% - 77%)	65%	(63% - 67%)
Stage I	76%	(74% - 78%)	84%	(70% - 92%)	90%	(84% - 94%)	84%	(80% - 88%)	78%	(73% - 81%)	70%	(66% - 75%)
Stage II	41%	(38% - 44%)	69%	(47% - 83%)	64%	(53% - 74%)	57%	(49% - 65%)	48%	(42% - 54%)	30%	(26% - 35%)
Stage III	36%	(32% - 41%)	51%	(25% - 72%)	49%	(36% - 61%)	48%	(39% - 57%)	26%	(19% - 34%)	34%	(27% - 41%)
Stage IV	9%	(8% - 12%)	13%	(4% - 26%)	10%	(5% - 18%)	14%	(9% - 20%)	11%	(8% - 15%)	7%	(4% - 10%)

a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each estimate.
+: Statistic could not be calculated

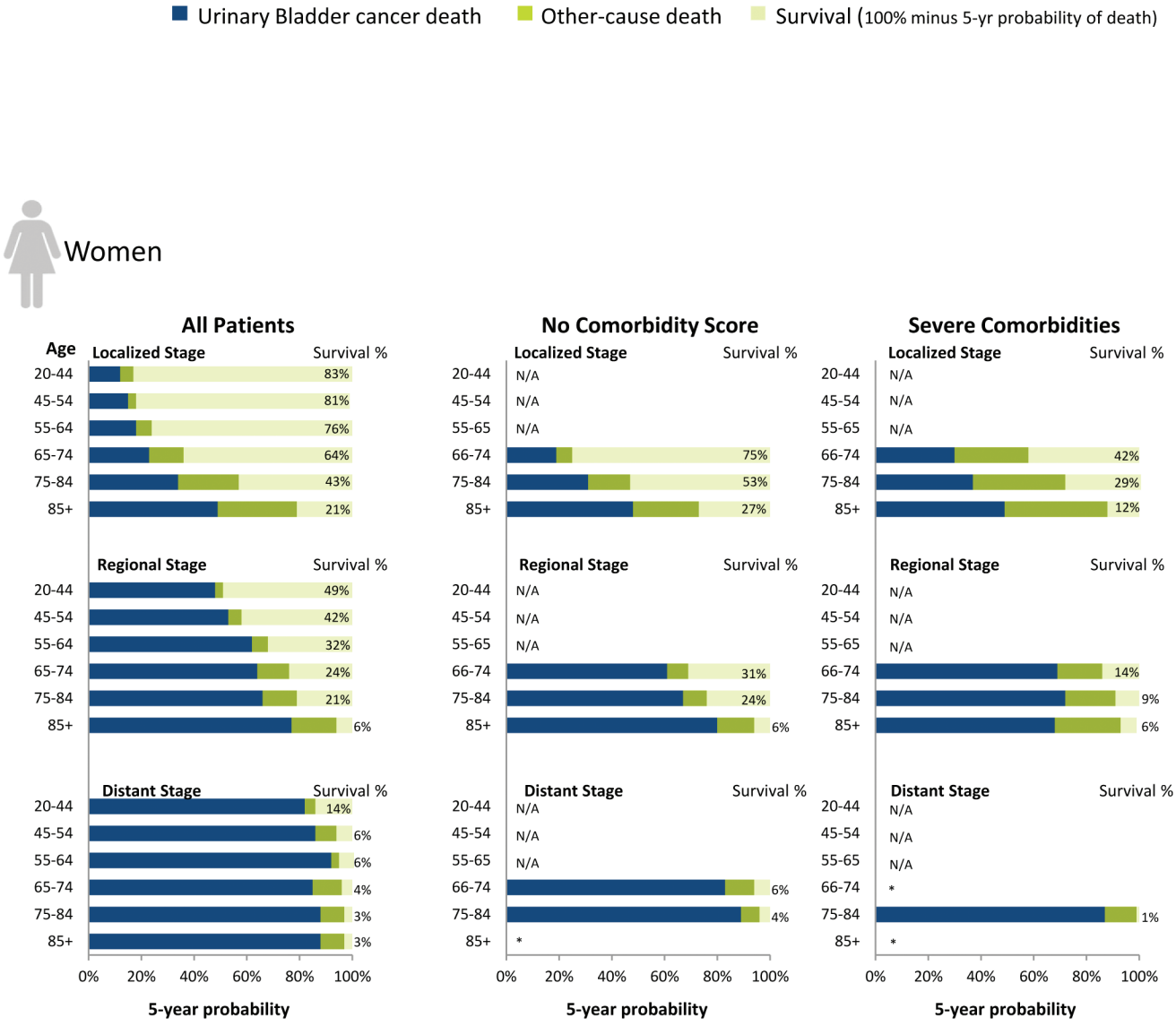
5.5 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and stage at diagnosis[a] (5-Year Crude Probability of Death)



a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.

N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

5.6 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and stage at diagnosis[a] (5-Year Crude Probability of Death)



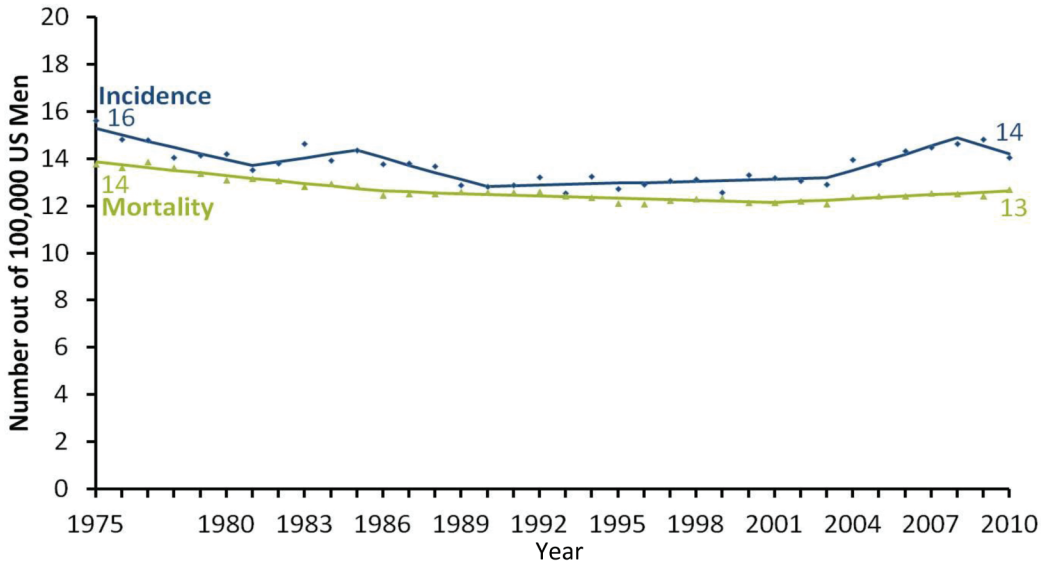
a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.

N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

6.1 Time trends in incidence, mortality and survival (1975-2010)

Incidence and Mortality[a,b,c]

Men

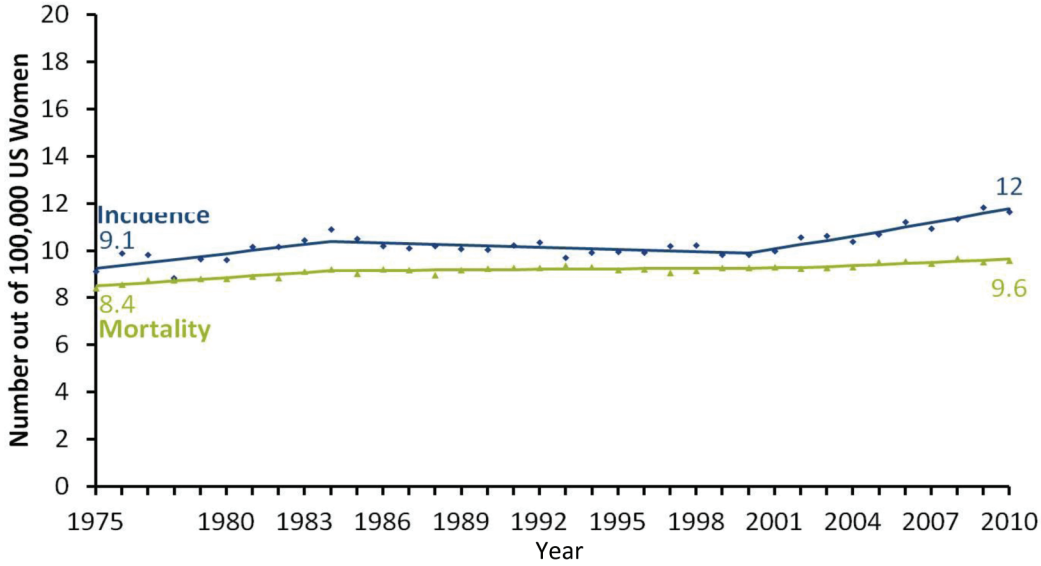


Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	2.0%	2.3%	2.6%	2.8%	3.1%	3.4%	3.7%	4.5%	5.5%	6.5%	*7.7%*	*9.1%*

Incidence and Mortality[a,b,c]

Women



Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	2.4%	2.8%	3.1%	3.4%	3.7%	4.0%	4.3%	4.7%	5.7%	6.7%	*7.9%*	*9.2%*

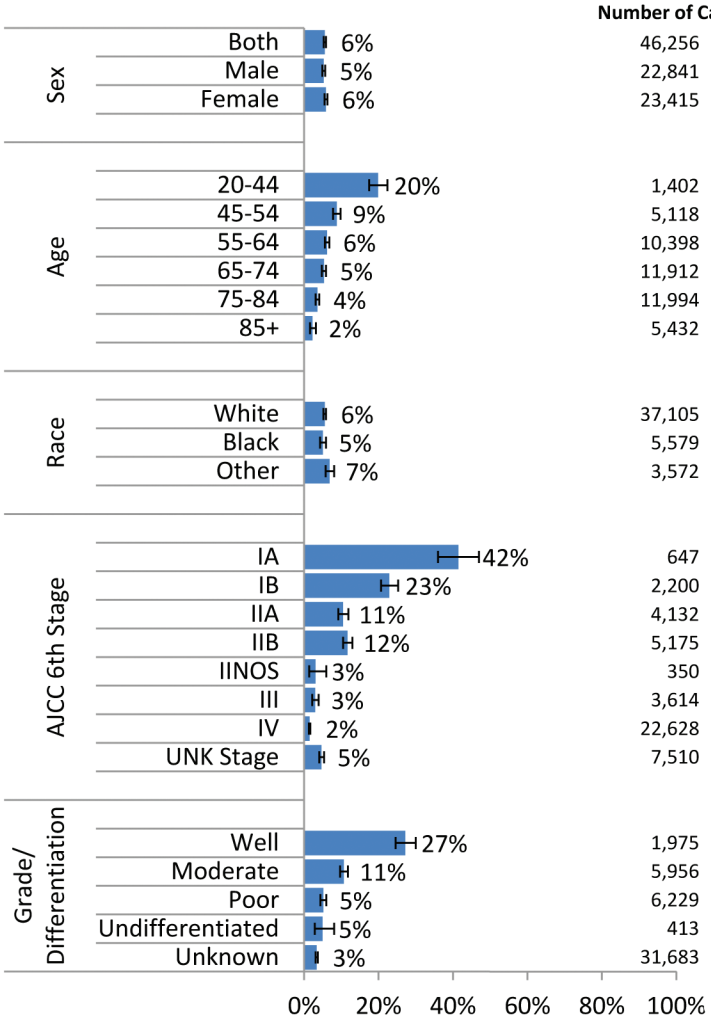
a: SEER-9 **incidence** rates per 100,000 and age-adjusted to the 2000 US Standard Population. Rates are also adjusted for reporting delay. More information can be found at: http://surveillance.cancer.gov/delay/.

b: US **mortality** rates per 100,000 and age-adjusted to the 2000 US Standard Population.

c: Symbols represent observed values for **incidence** and **mortality** (observed values for 1975 and 2010 are labeled). Lines represent estimated values from the Joinpoint model.

d: 5-year **relative survival** for people diagnosed with this cancer in the SEER-9 registries by year at diagnosis. Modeled estimates using Joinpoint are shown in the table. *Italicized numbers are 5-year relative survivals* projected from the model.

6.2 By prognostic characteristics[a] (5-Year Relative Survival)



% surviving cancer 5-years after cancer diagnosis

a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries. Error bars represent the 95% confidence interval for each survival estimate.

6.3 By race/ethnicity[a,b,c] (5-Year Cause-Specific Survival)

	Male		Female	
All Stages				
NH White	6%	(5%-6%)	6%	(5%-6%)
NH Black	6%	(4%-7%)	6%	(5%-7%)
NH API	7%	(6%-9%)	8%	(6%-9%)
NH AI/AN	+	+	6%	(2%-15%)
Hispanic	6%	(5%-7%)	7%	(6%-9%)
Stage I				
NH White	26%	(22%-30%)	27%	(24%-30%)
NH Black	19%	(11%-29%)	23%	(17%-31%)
NH API	41%	(28%-53%)	36%	(23%-50%)
NH AI/AN	+	+	+	+
Hispanic	33%	(21%-44%)	32%	(23%-41%)
Stage II				
NH White	11%	(10%-13%)	11%	(10%-13%)
NH Black	15%	(11%-19%)	12%	(8%-16%)
NH API	11%	(7%-16%)	12%	(8%-18%)
NH AI/AN	+	+	20%	(3%-48%)
Hispanic	6%	(3%-10%)	15%	(11%-19%)
Stage III				
NH White	3%	(2%-5%)	3%	(2%-4%)
NH Black	+	+	3%	(1%-7%)
NH API	3%	(1%-9%)	+	+
NH AI/AN	+	+	+	+
Hispanic	7%	(3%-13%)	6%	(3%-11%)
Stage IV				
NH White	2%	(1%-2%)	2%	(1%-2%)
NH Black	0%	(0%-2%)	1%	(1%-2%)
NH API	3%	(2%-5%)	3%	(1%-4%)
NH AI/AN	+	+	+	+
Hispanic	2%	(1%-4%)	1%	(0%-3%)

a. 5-year **cause-specific survival** for people diagnosed with this cancer 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each survival estimate.
b: Cause-specific survival was used because life tables needed to calculate relative survival are not available by race/ethnicity.
c: NH: Non-Hispanic, API: Asian/Pacific Islander, AI/AN: American Indian/Alaska Native. These groups are mutually exclusive and represent 100% of the population.
+: Statistic could not be calculated.

6.4 Cancer prognosis 5 years after diagnosis by prognostic characteristics, age and sex[a] (5-Year Relative Survival)

Men

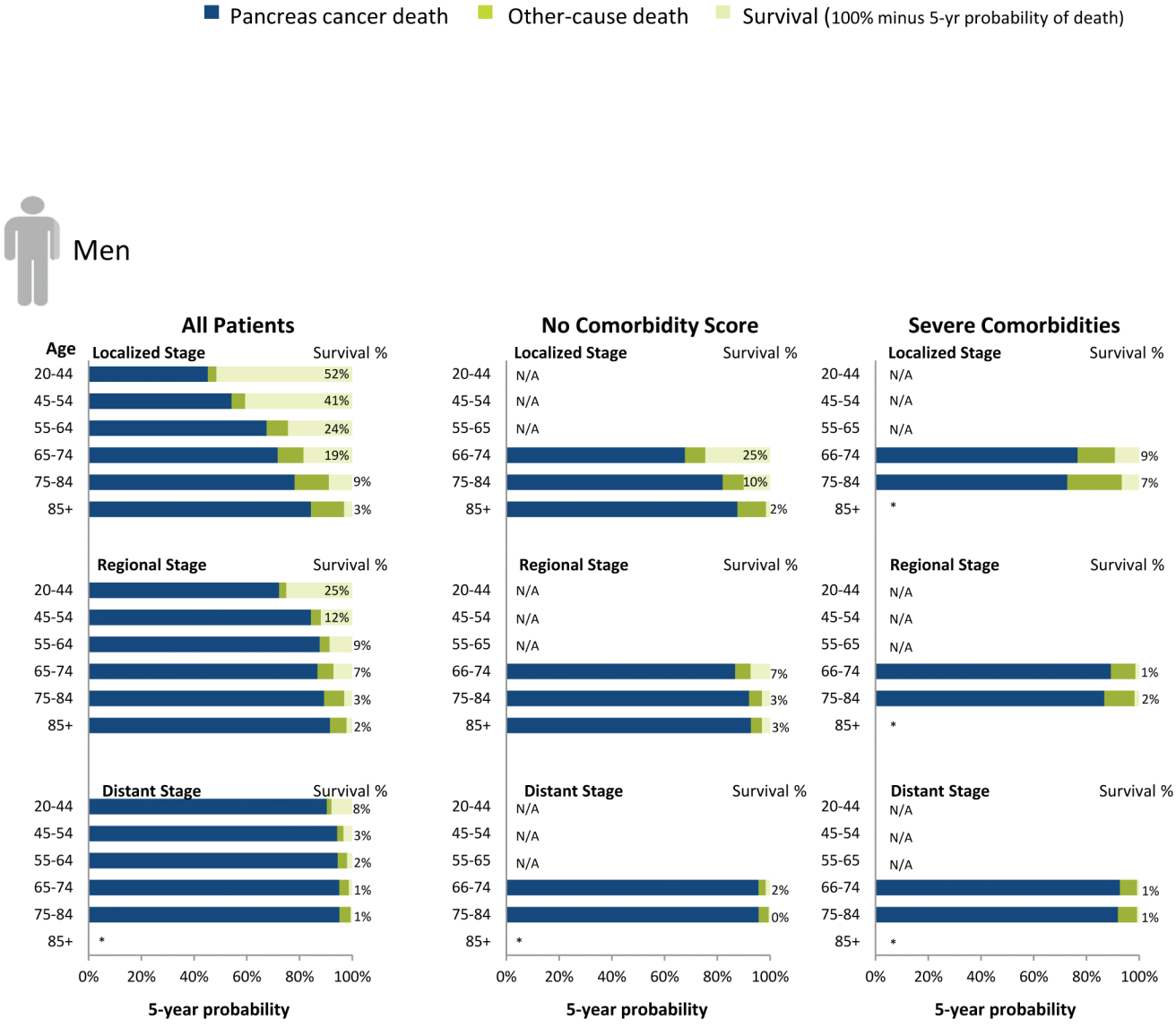
	All ages		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All Stages	5%	(5% - 6%)	18%	(15% - 21%)	8%	(7% - 9%)	5%	(4% - 6%)	5%	(4% - 6%)	3%	(2% - 4%)
Stage I	25%	(22% - 29%)	54%	(37% - 69%)	46%	(34% - 57%)	27%	(20% - 35%)	27%	(20% - 34%)	14%	(10% - 20%)
Stage II	11%	(9% - 12%)	31%	(23% - 40%)	15%	(11% - 18%)	11%	(9% - 13%)	10%	(7% - 12%)	6%	(4% - 9%)
Stage III	3%	(2% - 4%)	5%	(1% - 16%)	5%	(2% - 12%)	5%	(3% - 7%)	3%	(1% - 5%)	0%	+
Stage IV	2%	(1% - 2%)	9%	(6% - 13%)	2%	(1% - 3%)	1%	(1% - 2%)	1%	(1% - 2%)	0%	(0% - 1%)

Women

	All ages		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All Stages	6%	(5% - 6%)	23%	(19% - 27%)	10%	(9% - 12%)	8%	(7% - 9%)	6%	(5% - 7%)	3%	(3% - 4%)
Stage I	28%	(25% - 31%)	83%	(68% - 91%)	55%	(44% - 66%)	43%	(35% - 50%)	29%	(23% - 35%)	14%	(11% - 17%)
Stage II	11%	(10% - 12%)	24%	(15% - 33%)	18%	(14% - 22%)	15%	(12% - 17%)	11%	(9% - 14%)	6%	(5% - 8%)
Stage III	3%	(2% - 4%)	6%	(1% - 17%)	4%	(1% - 8%)	3%	(1% - 7%)	3%	(1% - 5%)	2%	(1% - 5%)
Stage IV	1%	(1% - 2%)	9%	(5% - 13%)	3%	(1% - 4%)	1%	(1% - 2%)	1%	(1% - 2%)	1%	(0% - 1%)

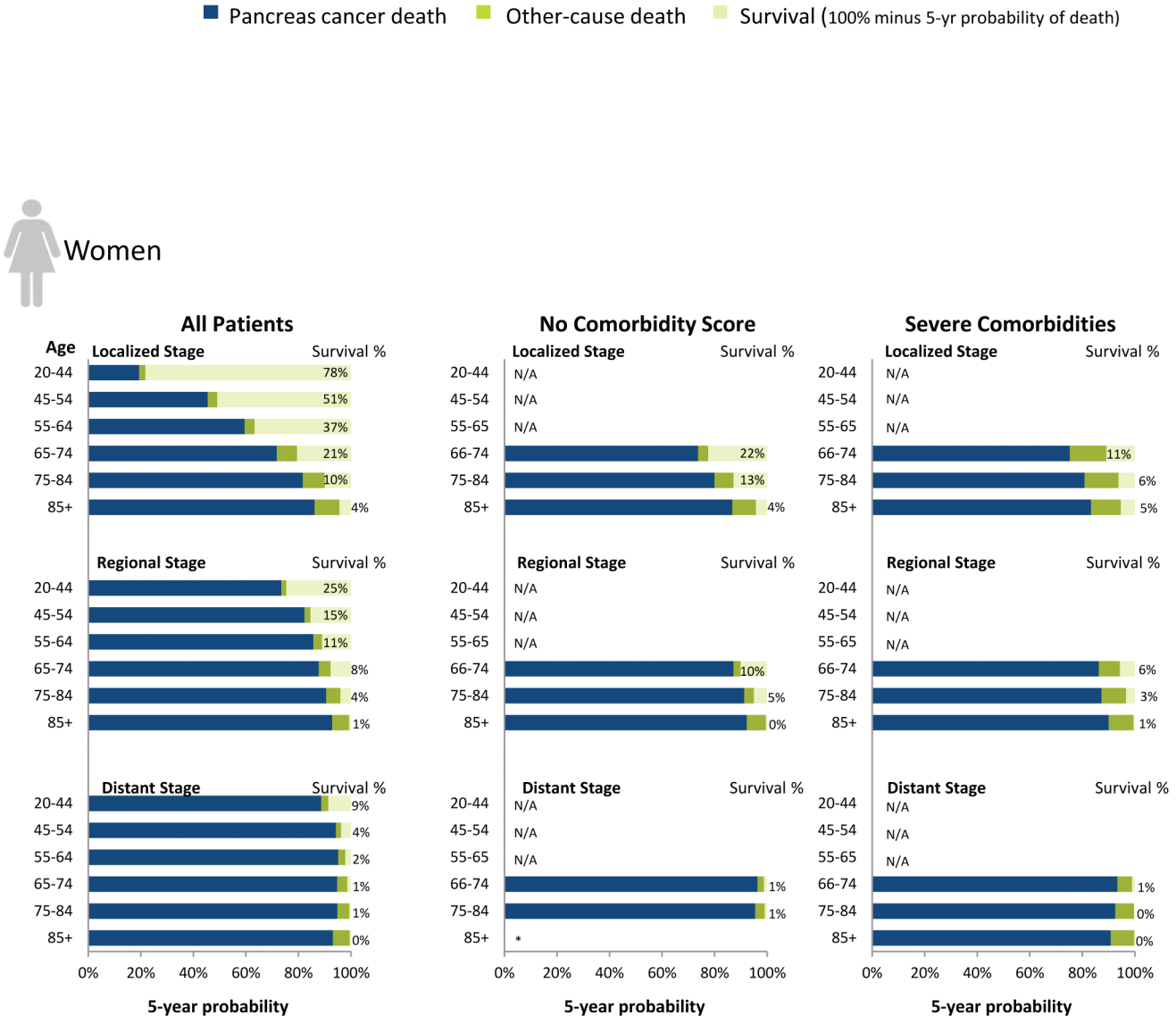
a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each estimate.
+: Statistic could not be calculated

6.5 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and stage at diagnosis[a] (5-Year Crude Probability of Death)



a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.
N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

6.6 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and stage at diagnosis[a] (5-Year Crude Probability of Death)



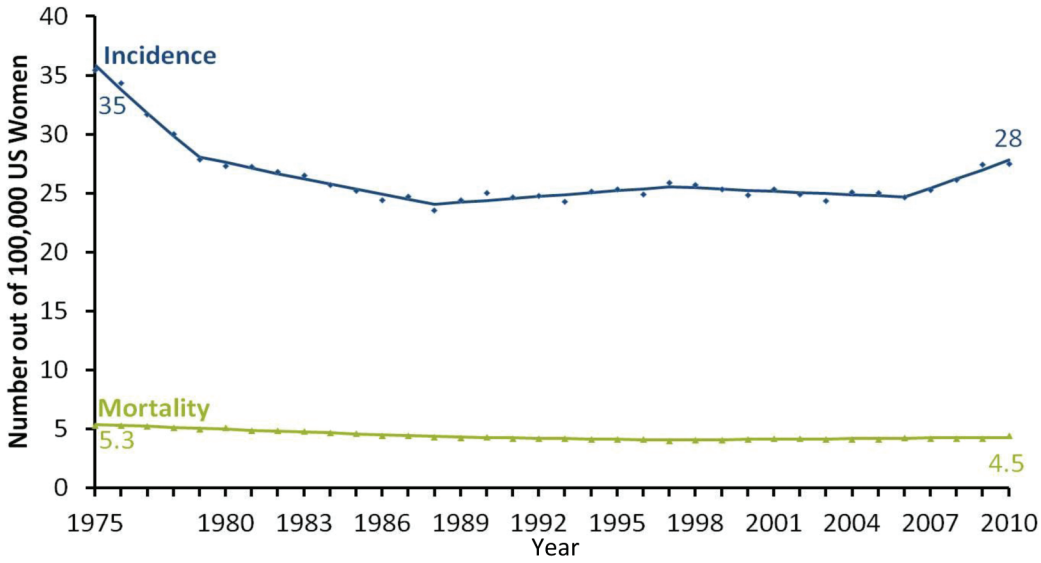
a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.

N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

7.1 Time trends in incidence, mortality and survival (1975-2010)

Incidence and Mortality[a,b,c]

Women



Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	89%	81%	82%	82%	82%	83%	83%	83%	84%	84%	*84%*	*85%*

a: SEER-9 **incidence** rates per 100,000 and age-adjusted to the 2000 US Standard Population. Rates are also adjusted for reporting delay. More information can be found at: http://surveillance.cancer.gov/delay/.

b: US **mortality** rates per 100,000 and age-adjusted to the 2000 US Standard Population.

c: Symbols represent observed values for **incidence** and **mortality** (observed values for 1975 and 2010 are labeled). Lines represent estimated values from the Joinpoint model.

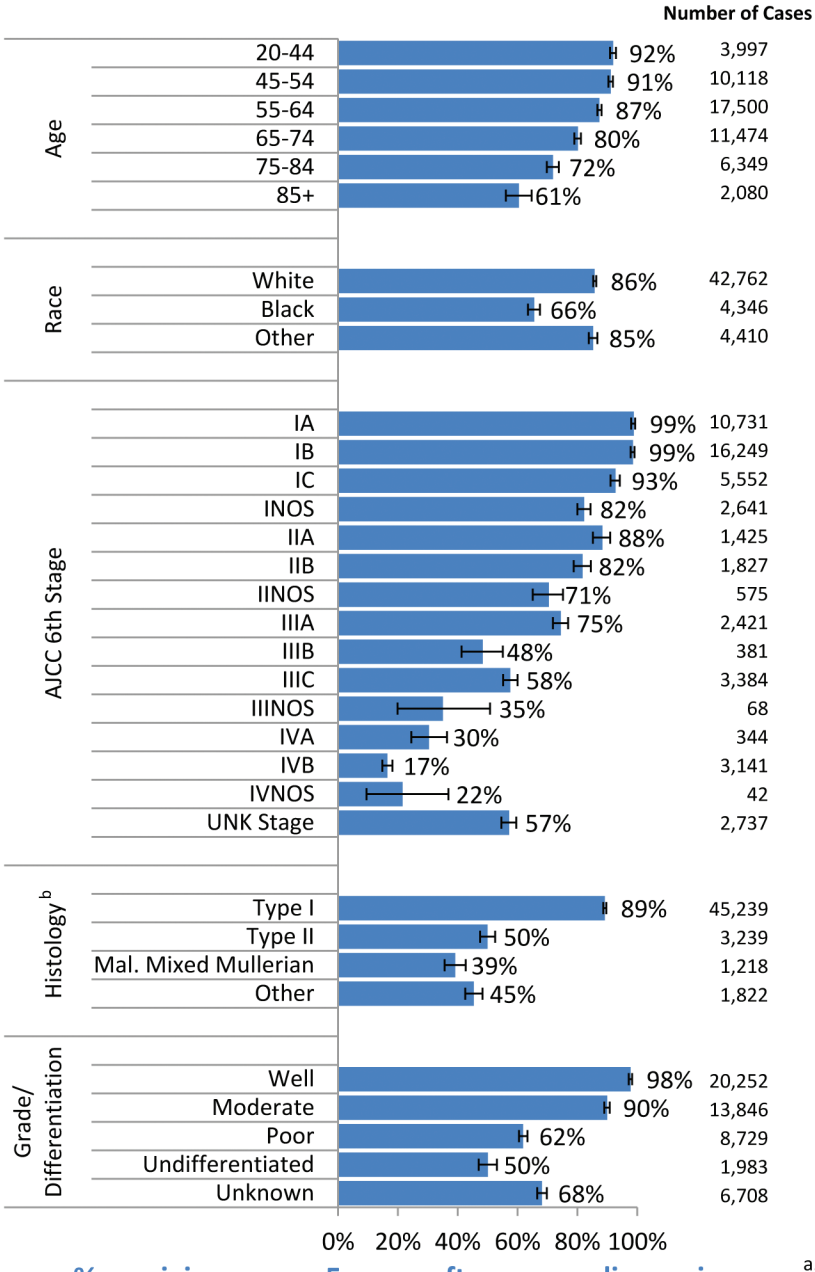
d: 5-year **relative survival** for people diagnosed with this cancer in the SEER-9 registries by year at diagnosis. Modeled estimates using Joinpoint are shown in the table. *Italicized numbers are 5-year relative survivals* projected from the model.

7.2 Cancer prognosis 5 years after diagnosis by prognostic characteristics and age[a,b] (5-Year Relative Survival)

	All ages		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All stages	**84%**	**(84% - 85%)**	**92%**	**(91% - 93%)**	**91%**	**(90% - 92%)**	**87%**	**(87% - 88%)**	**80%**	**(79% - 81%)**	**69%**	**(67% - 71%)**
Type I	89%	(89% - 90%)	93%	(92% - 94%)	93%	(93% - 94%)	91%	(90% - 92%)	87%	(86% - 88%)	79%	(77% - 81%)
Type II Malignant Mixed Mullerian	50%	(48% - 52%)	65%	(46% - 78%)	63%	(55% - 70%)	56%	(52% - 60%)	49%	(45% - 53%)	39%	(34% - 44%)
Other	45%	(42% - 48%)	76%	(67% - 83%)	65%	(58% - 71%)	59%	(53% - 64%)	40%	(34% - 47%)	23%	(18% - 28%)
Stage I	**97%**	**(96% - 97%)**	**98%**	**(97% - 98%)**	**98%**	**(97% - 98%)**	**97%**	**(96% - 98%)**	**95%**	**(94% - 96%)**	**95%**	**(92% - 97%)**
Type I	98%	(97% - 98%)	98%	(97% - 99%)	98%	(97% - 99%)	98%	(97% - 98%)	97%	(95% - 98%)	97%	(94% - 99%)
Type II Malignant Mixed Mullerian	83%	(79% - 87%)	85%	(51% - 96%)	92%	(82% - 97%)	88%	(82% - 92%)	83%	(75% - 88%)	71%	(58% - 81%)
Other	85%	(80% - 89%)	88%	(75% - 95%)	94%	(83% - 98%)	88%	(79% - 93%)	77%	(62% - 87%)	71%	(56% - 81%)
Stage II	**83%**	**(81% - 85%)**	**94%**	**(89% - 97%)**	**90%**	**(87% - 93%)**	**86%**	**(83% - 89%)**	**80%**	**(76% - 84%)**	**67%**	**(61% - 72%)**
Type I	86%	(84% - 88%)	95%	(90% - 97%)	91%	(87% - 94%)	87%	(84% - 90%)	87%	(82% - 90%)	72%	(65% - 78%)
Type II Malignant Mixed Mullerian	61%	(52% - 69%)	50%	(1% - 91%)	82%	(47% - 95%)	79%	(56% - 90%)	52%	(37% - 64%)	53%	(36% - 68%)
Other	81%	(66% - 89%)	100%	+	93%	(57% - 99%)	100%	+	75%	(45% - 91%)	49%	(18% - 74%)
Stage III	**63%**	**(62% - 65%)**	**77%**	**(71% - 82%)**	**77%**	**(73% - 80%)**	**68%**	**(65% - 71%)**	**58%**	**(54% - 61%)**	**42%**	**(38% - 47%)**
Type I	70%	(68% - 72%)	79%	(72% - 84%)	80%	(76% - 83%)	74%	(71% - 77%)	66%	(61% - 70%)	49%	(43% - 54%)
Type II Malignant Mixed Mullerian	43%	(38% - 47%)	70%	(30% - 90%)	58%	(41% - 72%)	45%	(36% - 54%)	44%	(36% - 52%)	32%	(22% - 41%)
Other	45%	(35% - 54%)	71%	(23% - 92%)	68%	(50% - 81%)	54%	(34% - 71%)	37%	(21% - 54%)	18%	(6% - 35%)
Stage IV	**18%**	**(16% - 20%)**	**29%**	**(22% - 36%)**	**29%**	**(25% - 34%)**	**21%**	**(18% - 25%)**	**14%**	**(11% - 17%)**	**8%**	**(5% - 10%)**
Type I	24%	(21% - 26%)	31%	(23% - 40%)	37%	(31% - 43%)	26%	(22% - 30%)	18%	(14% - 23%)	10%	(6% - 15%)
Type II Malignant Mixed Mullerian	13%	(10% - 17%)	37%	(11% - 63%)	12%	(4% - 25%)	18%	(12% - 26%)	13%	(8% - 18%)	8%	(4% - 14%)
Other	8%	(5% - 12%)	27%	(7% - 54%)	12%	(4% - 26%)	6%	(1% - 16%)	7%	(2% - 15%)	5%	(1% - 14%)
Other	8%	(5% - 11%)	+	+	12%	(5% - 23%)	14%	(7% - 23%)	7%	(2% - 16%)	+	+

a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each estimate.
b: Histology grouping based on: Jamison PM, Noone AM, Ries LA, Lee NC, Edwards BK. Trends in endometrial cancer incidence by race and histology with a correction for the prevalence of hysterectomy, SEER 1992 to 2008. Cancer Epidemiol Biomarkers Prev. 2013 Feb;22(2):233-41.
+: Statistic could not be calculated

7.3 By prognostic characteristics[a] (5-Year Relative Survival)



a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries. Error bars represent the 95% confidence interval for each survival estimate.

b: Histology grouping based on: Jamison PM, Noone AM, Ries LA, Lee NC, Edwards BK. Trends in endometrial cancer incidence by race and histology with a correction for the prevalence of hysterectomy, SEER 1992 to 2008. Cancer Epidemiol Biomarkers Prev. 2013 Feb;22(2):233-41.

7.4 By race/ethnicity[a,b,c] (5-Year Cause-Specific Survival)

All Stages		
NH White	86%	(85% - 86%)
NH Black	68%	(66% - 69%)
NH API	87%	(85% - 88%)
NH AI/AN	88%	(78% - 93%)
Hispanic	84%	(83% - 86%)
Stage I		
NH White	95%	(95% - 96%)
NH Black	90%	(89% - 92%)
NH API	97%	(96% - 98%)
NH AI/AN	97%	(82% - 100%)
Hispanic	96%	(95% - 97%)
Stage II		
NH White	85%	(83% - 87%)
NH Black	69%	(63% - 75%)
NH API	92%	(87% - 95%)
NH AI/AN	100%	+
Hispanic	86%	(81% - 89%)
Stage III		
NH White	67%	(65% - 69%)
NH Black	40%	(35% - 45%)
NH API	70%	(64% - 75%)
NH AI/AN	54%	(15% - 82%)
Hispanic	64%	(59% - 69%)
Stage IV		
NH White	20%	(18% - 23%)
NH Black	10%	(7% - 14%)
NH API	19%	(13% - 25%)
NH AI/AN	+	+
Hispanic	23%	(18% - 28%)

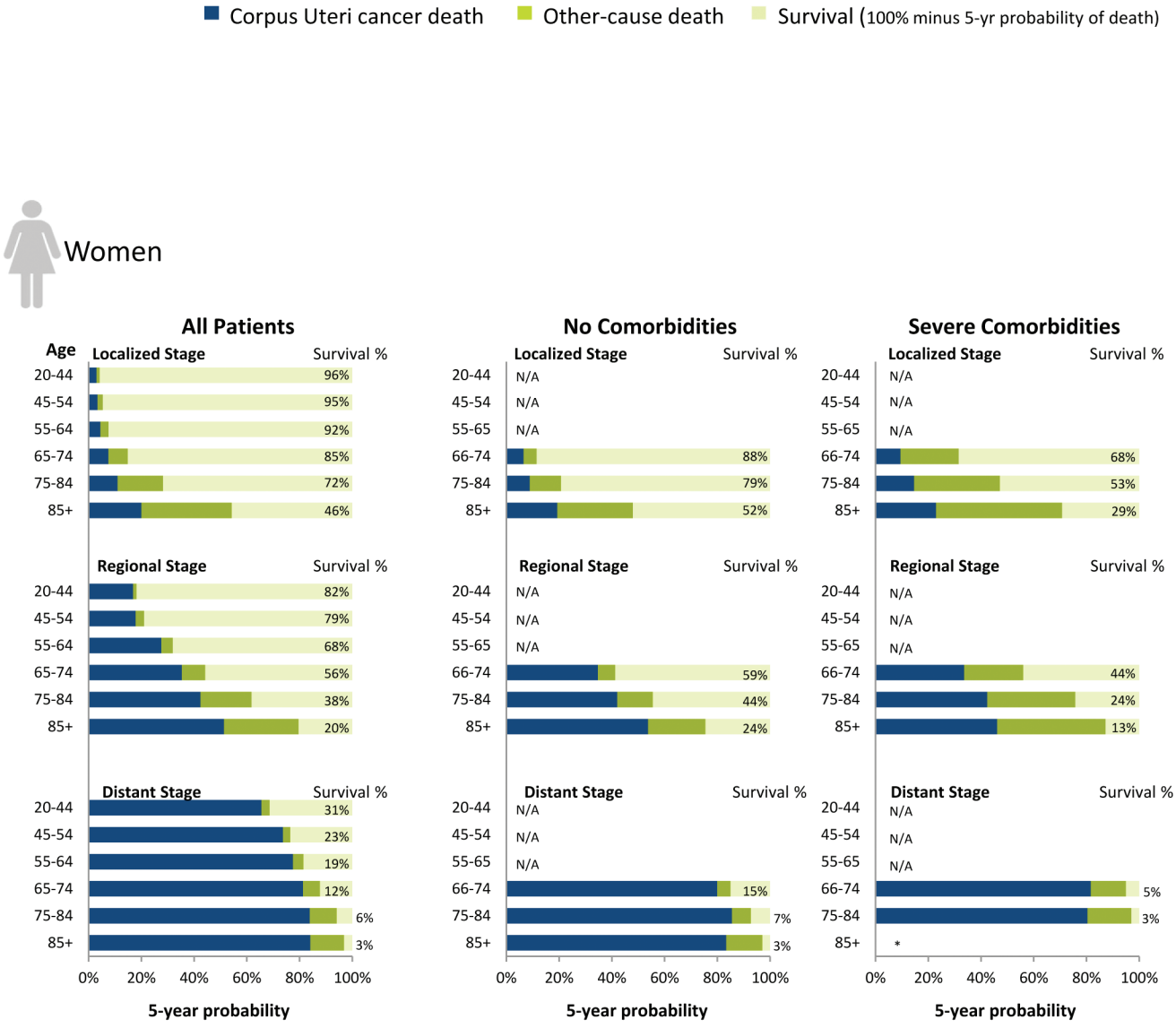
a. 5-year **cause-specific survival** for people diagnosed with this cancer 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each survival estimate.

b: Cause-specific survival was used because life tables needed to calculate relative survival are not available by race/ethnicity.

c: NH: Non-Hispanic, API: Asian/Pacific Islander, AI/AN: American Indian/Alaska Native. These groups are mutually exclusive and represent 100% of the population.

+: Statistic could not be calculated.

7.5 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and stage at diagnosis[a] (5-Year Crude Probability of Death)



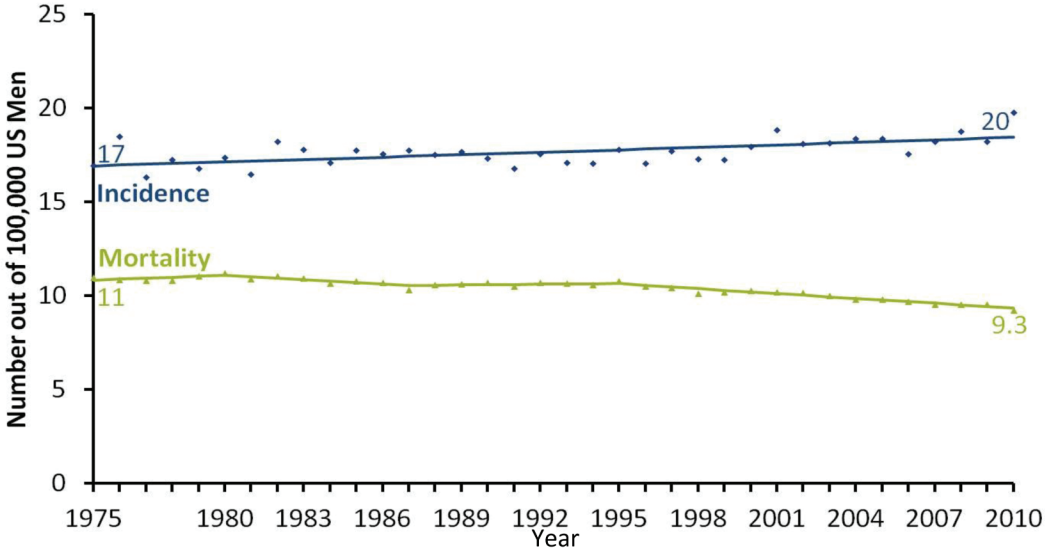
a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.

N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

8.1 Time trends in incidence, mortality and survival (1975-2010)

Incidence and Mortality[a,b,c]

Men

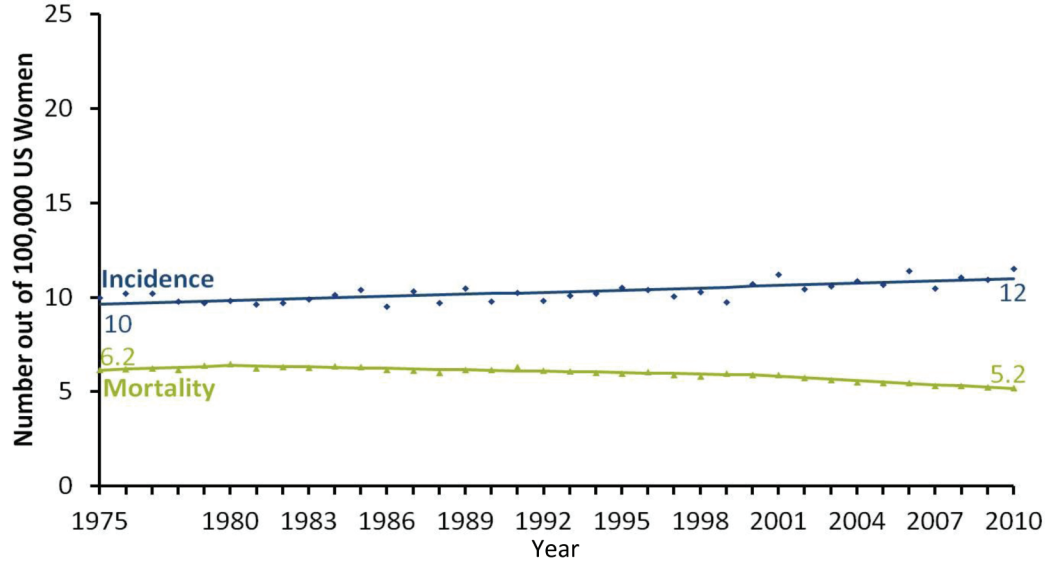


Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	33%	37%	39%	42%	44%	46%	48%	51%	54%	57%	*60%*	*64%*

Incidence and Mortality[a,b,c]

Women



Percent surviving cancer 5 years after diagnosis by year at diagnosis[d] (5-Year Relative Survival)

Year	1975	1980	1983	1986	1989	1992	1995	1998	2001	2004	2007	2010
All Stages	36%	39%	40%	42%	43%	45%	47%	48%	52%	57%	*57%*	*57%*

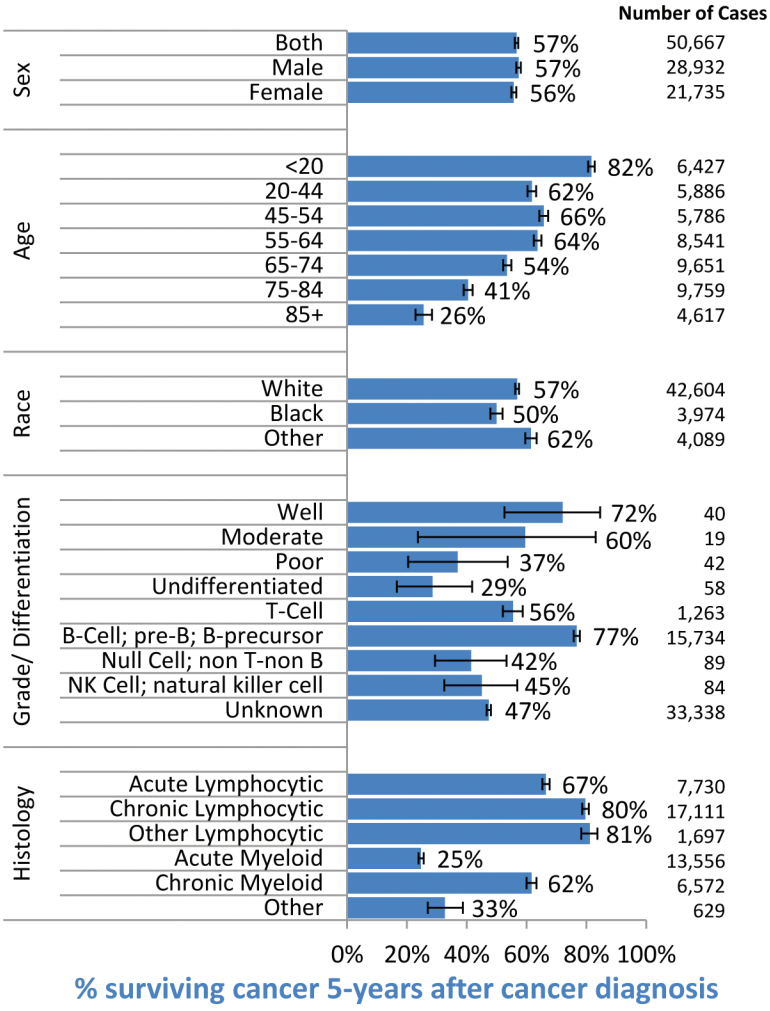
a: SEER-9 **incidence** rates per 100,000 and age-adjusted to the 2000 US Standard Population. Rates are also adjusted for reporting delay. More information can be found at: http://surveillance.cancer.gov/delay/.

b: US **mortality** rates per 100,000 and age-adjusted to the 2000 US Standard Population.

c: Symbols represent observed values for **incidence** and **mortality** (observed values for 1975 and 2010 are labeled). Lines represent estimated values from the Joinpoint model.

d: 5-year **relative survival** for people diagnosed with this cancer in the SEER-9 registries by year at diagnosis. Modeled estimates using Joinpoint are shown in the table. *Italicized numbers are 5-year relative survivals* projected from the model.

8.2 By prognostic characteristics[a] (5-Year Relative Survival)



a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries. Error bars represent the 95% confidence interval for each survival estimate.

8.3 By race/ethnicity[a,b,c] (5-Year Cause-Specific Survival)

	Male		Female	
Race				
NH White	61%	(60%-61%)	59%	(58%-60%)
NH Black	56%	(53%-58%)	54%	(51%-57%)
NH API	57%	(54%-60%)	55%	(52%-58%)
NH AI/AN	60%	(47%-70%)	60%	(45%-72%)
Hispanic	64%	(62%-65%)	60%	(58%-62%)

a. 5-year **cause-specific survival** for people diagnosed with this cancer 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each survival estimate.
b: Cause-specific survival was used because life tables needed to calculate relative survival are not available by race/ethnicity.
c: NH: Non-Hispanic, API: Asian/Pacific Islander, AI/AN: American Indian/Alaska Native. These groups are mutually exclusive and represent 100% of the population.
+: Statistic could not be calculated.

8.4 Cancer prognosis 5 years after diagnosis by prognostic characteristics, age and sex[a] (5-Year Relative Survival)

Men

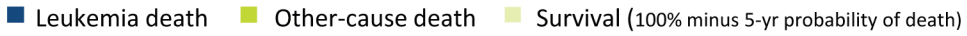
	All ages		<20 years		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All Histologies	**57%**	**(57% - 58%)**	**81%**	**(80% - 83%)**	**61%**	**(59% - 63%)**	**68%**	**(66% - 69%)**	**64%**	**(62% - 65%)**	**53%**	**(51% - 55%)**	**36%**	**(34% - 38%)**
Acute Lymphocytic	67%	(65% - 68%)	86%	(84% - 87%)	39%	(35% - 43%)	39%	(32% - 45%)	25%	(18% - 31%)	15%	(8% - 24%)	12%	(6% - 21%)
Chronic Lymphocytic	79%	(77% - 80%)	80%	(20% - 97%)	88%	(81% - 93%)	92%	(90% - 94%)	86%	(84% - 88%)	80%	(78% - 83%)	65%	(61% - 68%)
Other Lymphocytic	86%	(83% - 89%)	67%	(5% - 95%)	98%	(94% - 99%)	92%	(88% - 95%)	86%	(79% - 91%)	86%	(79% - 91%)	60%	(47% - 71%)
Acute Myeloid	23%	(22% - 24%)	64%	(59% - 68%)	49%	(45% - 52%)	36%	(32% - 40%)	24%	(21% - 27%)	10%	(8% - 12%)	2%	(1% - 3%)
Chronic Myeloid	61%	(58% - 63%)	80%	(69% - 87%)	87%	(84% - 90%)	78%	(73% - 82%)	67%	(62% - 72%)	47%	(42% - 52%)	26%	(21% - 31%)
Other	29%	(27% - 31%)	63%	(54% - 70%)	47%	(40% - 54%)	41%	(34% - 48%)	34%	(27% - 40%)	22%	(17% - 28%)	9%	(6% - 13%)

Women

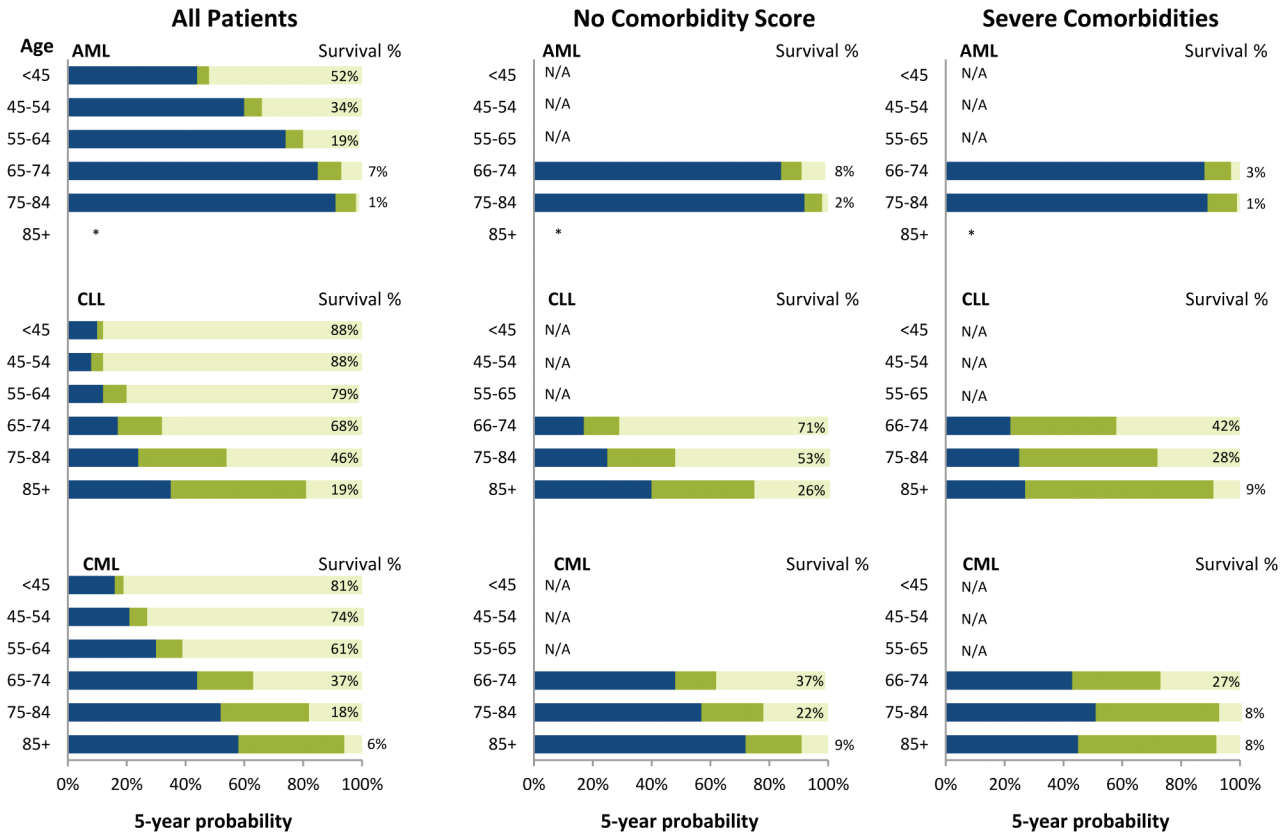
	All ages		<20 years		20-44 years		45-54 years		55-64 years		65-74 years		75+ years	
All Histologies	**56%**	**(55% - 57%)**	**82%**	**(81% - 84%)**	**62%**	**(60% - 65%)**	**63%**	**(61% - 65%)**	**64%**	**(62% - 66%)**	**54%**	**(52% - 56%)**	**37%**	**(35% - 39%)**
Acute Lymphocytic	66%	(64% - 68%)	88%	(87% - 90%)	45%	(39% - 50%)	26%	(19% - 33%)	24%	(18% - 32%)	15%	(9% - 22%)	2%	(0% - 9%)
Chronic Lymphocytic	81%	(79% - 82%)	100%	+	97%	(91% - 99%)	90%	(86% - 93%)	92%	(90% - 94%)	87%	(84% - 89%)	69%	(65% - 72%)
Other Lymphocytic	67%	(61% - 72%)	75%	(13% - 96%)	91%	(81% - 96%)	82%	(69% - 89%)	76%	(64% - 84%)	69%	(51% - 81%)	42%	(30% - 54%)
Acute Myeloid	26%	(25% - 28%)	63%	(57% - 67%)	55%	(51% - 58%)	43%	(39% - 47%)	29%	(26% - 33%)	13%	(11% - 16%)	2%	(2% - 3%)
Chronic Myeloid	63%	(61% - 66%)	82%	(70% - 89%)	88%	(84% - 91%)	85%	(80% - 89%)	72%	(66% - 77%)	58%	(52% - 64%)	29%	(24% - 34%)
Other	29%	(26% - 31%)	59%	(49% - 68%)	47%	(39% - 54%)	44%	(35% - 51%)	42%	(35% - 49%)	28%	(22% - 35%)	9%	(6% - 12%)

a: 5-year **relative survival** for people diagnosed with this cancer in 2004-2009 in the SEER-18 registries; (95% confidence intervals) follow each estimate.
+: Statistic could not be calculated

8.5 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and subtype[a] (5-Year Crude Probability of Death)

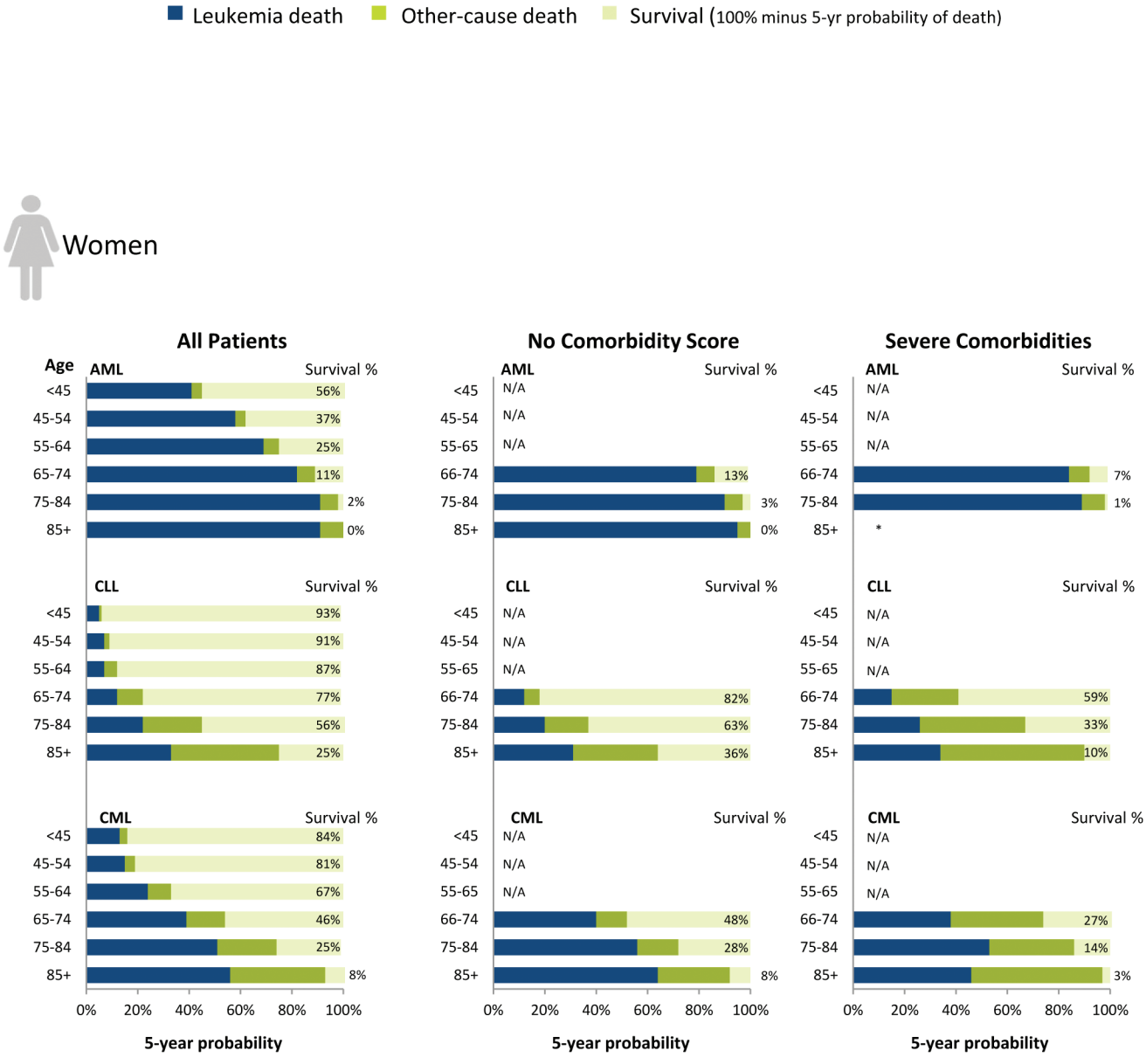


Men



a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.
N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.

8.6 5-year chance of surviving, dying from the specific cancer, or dying from competing causes by comorbidity, age, and subtype[a] (5-Year Crude Probability of Death)



a: 5-year **crude survival** for people diagnosed with this cancer in 2000-2009 in the SEER-18 registries. Numbers in light segments represent the proportion surviving 5 years.

N/A: Comorbidity score estimated from SEER-Medicare data and not available for ages less than 66.