HHS Public Access

Author manuscript

Cancer. Author manuscript; available in PMC 2015 July 20.

Published in final edited form as:

Cancer. 2015 June 1; 121(11): 1827–1837. doi:10.1002/cncr.29258.

The Past, Present, and Future of Cancer Incidence in the United States: 1975 Through 2020

Hannah K. Weir, PhD[1], **Trevor D. Thompson, BS**[1], **Ashwini Soman, MBBS, MPH**[2], **Bjørn Møller, PhD**[3], and **Steven Leadbetter, MS**[1]

[1]Division of Cancer Prevention and Control, Centers for Disease Control and Prevention, Atlanta, Georgia

[2]Northrop Grumman Corporation, Atlanta, Georgia

[3]Department of Registration, Cancer Registry of Norway, Oslo, Norway

Abstract

BACKGROUND—The overall age-standardized cancer incidence rate continues to decline whereas the number of cases diagnosed each year increases. Predicting cancer incidence can help to anticipate future resource needs, evaluate primary prevention strategies, and inform research.

METHODS—Surveillance, Epidemiology, and End Results data were used to estimate the number of cancers (all sites) resulting from changes in population risk, age, and size. The authors projected to 2020 nationwide age-standardized incidence rates and cases (including the top 23 cancers).

RESULTS—Since 1975, incident cases increased among white individuals, primarily caused by an aging white population, and among black individuals, primarily caused by an increasing black population. Between 2010 and 2020, it is expected that overall incidence rates (proxy for risk) will decrease slightly among black men and stabilize in other groups. By 2020, the authors predict annual cancer cases (all races, all sites) to increase among men by 24.1% (−3.2% risk and 27.3% age/growth) to >1 million cases, and by 20.6% among women (1.2% risk and 19.4% age/growth) to >900,000 cases. The largest increases are expected for melanoma (white individuals); cancers of the prostate, kidney, liver, and urinary bladder in males; and the lung, breast, uterus, and thyroid in females.

CONCLUSIONS—Overall, the authors predict cancer incidence rates/risk to stabilize for the majority of the population; however, they expect the number of cancer cases to increase by >20%. A greater emphasis on primary prevention and early detection is needed to counter the effect of an aging and growing population on the burden of cancer.

Corresponding author: Hannah K. Weir, PhD, Division of Cancer Prevention and Control, Centers for Disease Control and Prevention, 4770 Buford Hwy, MS-F76, Atlanta, GA 30341; Fax: 770 488-4286; hbw4@cdc.gov.

CONFLICT OF INTEREST DISCLOSURES

The authors made no disclosures.

Keywords

cancer; cancer registries; surveillance; incidence; projections; predictions

INTRODUCTION

Each year, the "Annual Report to the Nation on the Status of Cancer" documents a sustained decline in the overall age-standardized cancer incidence rate beginning in the early 1990s, largely because of a decrease in the incidence of lung and prostate cancer in men and a decrease in colorectal cancer incidence in both sexes.[1] This is a positive development because the age-standardized incidence rate approximates the population's risk of being diagnosed with cancer and is useful for comparing the cancer burden between populations or over time within a population. The declining overall incidence rate means that for the majority of the population, the overall risk of being diagnosed with cancer has declined. However, these rates do not convey the full extent of the cancer burden, because they have the effect of removing the influence of demographic changes in the population.

The number of new cancer cases diagnosed each year is a function of the population's risk of being diagnosed with cancer and the population's age structure and size. Although the incidence rate has declined, the actual number of cases diagnosed each year has increased.[2] This increase reflects the finding that the risk of being diagnosed with cancer generally increases with age,[3] and over the past several decades, the US population has grown, particularly in the older age groups.[4] These demographic changes and increasing cancer burden are forecast to continue into this century as the cohort born after World War II, with increased longevity compared with earlier generations, enters the age groups most at risk of a cancer diagnosis.[4-6] Less attention is given to the potential impact that the growing number of incident cases will have on the cancer surveillance and control community and on the health care system in the United States.

Trends in population risk, size, and age structure have been used to predict cancer incidence in several countries, including Canada,[7] England,[8,9] and the Nordic countries,[10] and for world regions.[11] In the current study, we used data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program[12] to assess the impact of changes in population risk, age structure, and growth on the cancer burden between 1975 and 2009, and to project age-standardized cancer incidence rates and case counts (all sites and the top 23 cancers) according to these changes by sex and race for the entire US population from 2010 to 2020. The year 2020 was selected to align with Healthy People 2020 (healthypeople.gov/2020/topicsobjectives2020/), which includes national goals and objectives in 42 topic areas, including cancer mortality. Herein, we discuss how these data can provide information to anticipate resource requirements to screen, diagnose, treat, and care for patients with cancer. Predictions of site-specific cancers can also help cancer control planners evaluate the effectiveness of prevention strategies[13,14] and alert researchers to early changes in population risk.

MATERIALS AND METHODS

Source of Data

We obtained data for patients diagnosed from 1975 through 2009 covering approximately 10% of the US population (SEER 9 registry [SEER 9]) from the SEER program.[15] All invasive cancers were selected and grouped according to the top 23 cancers among men and women using the SEER site groups.[3] Population estimates produced by the US Census Bureau were obtained from the SEER program.[3] Population projections of the resident population by age, sex, and race from 2010 through 2020 were obtained from the US Census Bureau's Population Projections program.[16]

Analytic Methods

Past cancer incidence: 1975 through 2009—To estimate the relative contribution to changes in the number of cancer cases diagnosed each year (1976-2009) attributed to changes in population risk, size, and age structure, we generated 3 sets of case counts by sex and race (white and black) based on a method first published in the 1999 Canadian Cancer Statistics report.[17] The baseline for this analysis was the number of cases diagnosed in 1975.

Predicting cancer incidence: 2010 through 2020—To predict cancer incidence from 2010 through 2020, we used Nordpred software,[18] which is available from the Cancer Registry of Norway Web site (kreftregisteret.no/software/nordpred). The program used an age-period-cohort (APC) regression model with input data aggregated into six 5-year calendar periods (1980-2009) and 15 age groups (15-19 years, 20-24 years …80-84 years, and ≥85 years). Separate models were fit for each cancer site by sex and race (all, black, and white): $R_{ap} = (A_a + D \bullet p + P_p + C_c)^5$ in which the dependent variable R_{ap} is the incidence rate in age group a in calendar period p. A_a is the age component for age group a, D is the drift parameter (the common linear effect of both calendar period and birth cohort), P_p is the nonlinear period component of period p, and C_c is the nonlinear cohort component of cohort. We synthetically created cohorts by subtracting the age group midpoint from the period group midpoint. To offset exponential increases or decreases in incidence rates, we used the Power-5 link function. Assuming that trends are not likely to continue indefinitely, the drift component D was reduced by 25% and 50%, respectively, in the second and third calendar periods. Both of these modifications have been shown empirically to improve predictions.[18] A chi-square goodness-of-fit test was used to choose the number of calendar periods (4-6 candidate periods) to include in the model. We based predictions on long-term trend data unless there was statistically significant curvature ($P < .05$) in the trend over time, in which case the linear drift component was based on the most recent 10-year period. Visual inspection was used to determine the starting age for each cancer site, sex, and race group such that each age group contained ≥10 cases. We age-standardized incidence rates per 100,000 using the US 2000 standard population weights.[19]

For cancer of the female breast and prostate, we used a modified approach to account for 2003 breast cancer incidence decreases attributed to a reduction in the use of hormone replacement therapy[20,21] and fluctuations in prostate cancer incidence related to the use of the prostate-specific antigen test.[22] We based predictions for these cancers on data from

2005 through 2009. This is a reasonable assumption for breast cancers, because recent incidence rates are no longer declining,[1,23] but might overestimate prostate cancers because recent rates continue to decline,[1] particularly in older age groups.[24] We based predictions for all sites combined on summed estimates among the cancer sites categories, including other cancer sites combined.

We obtained predicted cancer incidence counts for the entire US population by multiplying the age-specific rates to the 2010 through 2020 population projections. We apportioned cancer cases into the contribution from the change in population risk and changes in population size and age structure combined (denoted as the demographic component) according to methods described by Moller et al,[10] using 2020 as the baseline.

RESULTS

Figure 1 and Table 1 show the contribution to the changes in the total number of cases by diagnosis year that we can attribute to changes in population risk, size, and age by sex and race. Between 1975 and 2009, the number of cases diagnosed increased by 95.3% among white males, 76.6% among white females, 183.4% among black males, and 192.9% among black females. Among white men, 17.3% of the increase (16.5%/95.3%) was because of a change in risk, 33.2% (31.6%/95.3%) was because of population growth, and 49.5% (47.2%/95.3%) was because of an aging population. Among white females, 21.1% of the increase was because of a change in risk, 34.2% was because of growth, and 44.7% was because of aging. Among black males, 13.0% of the increase was because of a change in risk, 62.5% was because of growth, and 24.4% was because of aging. Among black females, 8.3% of the increase was because of a change in risk, 56.3% was because of growth, and 35.4% was because of aging.

Table 2 shows the predicted cases for 2010 and 2020 for the entire US population by sex and race, with the total percentage difference in the cases apportioned to the change due to risk and demographics. A percentage change of ≥5% was noted as an increase or decrease; otherwise cases were considered stable. Between 2010 and 2020, total cases are predicted to increase by 24.1% (−3.2% risk and 27.3% demographics) to >1 million annual cases in men, and by 20.6% (1.2% risk and 19.4% demographics) to >900,000 annual cases in women. Risk is predicted to stabilize for white individuals of both sexes and black women, and decline (7.9%) in black men. Results varied by cancer site. Figure 2 shows age-adjusted incidence rates from 1975 through 2009 (observed) and from 2010 through 2020 (predicted) for all sites combined and the top 10 cancers in men and women, with the largest predicted increase in incident cases between 2010 and 2020. Note that the scale on the y-axis varies according to cancer site.

Figure 3 shows the rank order of cases predicted to be diagnosed in 2010 by sex, for all races combined. The number of cases predicted to have been diagnosed in 2010 is shown in dark shading and the addition of cases predicted to be diagnosed in 2020 is shown in light shading. The largest increases in incident cases are expected in melanoma (among white individuals) and cancers of the prostate, kidney, liver, and urinary bladder in males and of the lung, breast, uterus, and thyroid in females.

DISCUSSION

Over the next decade, we predict cancer incidence rates/risk to stabilize for much of the population. However, we expect the number of cancer cases to increase by >20% because of demographic changes in the US population. An increase in the number of incident cases of cancer has implications for the cancer surveillance and control community and for the health care system. A greater emphasis on primary prevention and early detection is needed to counter the effect of an aging and growing population on the burden of cancer.

Between 1975 and 2009, incident cases increased among white individuals, due primarily to an aging white population, and among black individuals, primarily because of a growing black population. Of particular note was the observation that population aging had little influence on cancer incidence in black men until the beginning of the 21st century. This is explained by the finding that compared with white individuals, life expectancy among black individuals in general, and black men in particular, was lower because of higher death rates from heart disease, cancer, homicide, diabetes, and perinatal conditions.[25] Compared with white individuals, a higher percentage of black individuals spend more of their lives uninsured and in a state of poorer health.[26] Racial disparities in life expectancy appear to be increasing in the US whereas overall life expectancy is increasing.[27]

The demographic components underlying the increasing cancer burden are likely to continue as the US population is expected to increase, with the largest increases expected in minority populations and in individuals aged >65 years.[4] Between 2010 and 2020, the overall US population is expected to increase by 10%, with the percentage of those aged ≥65 years increasing from 13% to 16%. Changes in population risk (approxi-mated by the age-standardized incidence rate) can exacerbate or attenuate the impact of these demographic trends.

Predicting future incident cases helps health planners and policy makers anticipate the resources needed to screen, diagnose, and treat patients newly diagnosed with cancer while providing ongoing care to cancer survivors. According to the results of the current study, between 2010 and 2020, total incident cases are predicted to increase by >20% to approximately 1.9 million cases diagnosed each year. During this time period, the overall cancer risk is predicted to stabilize in white individuals and black women and decline slightly among black men. Thus, the increase will be due primarily to demographic changes in the population. The largest increases will occur in prostate cancers in men and breast cancers in women.

In addition to an increase in the number of incident cases, there will be an accompanying increase in the number of cancer survivors, as patients with cancer overall are living longer after their diagnosis.[3] In 2007, the number of cancer survivors was estimated to be 11.7 million.[28] It is projected to increase to 18 million by 2020.[29] These increases have profound implications for the health care system in the United States. Over the past 2 decades, the financial cost of treating the most common cancers has nearly doubled,[29,30] and these costs are expected to continue to increase.[29,31] A projected shortage of oncologists is anticipated to strain the ability of the health care system to provide quality cancer care.[32] In addition,

the increasing number of cases is expected to impact cancer registries as the workforce and resources required to register and follow patients with cancer will also increase.[33]

Cancer predictions also can help the cancer control community to target and evaluate prevention strategies by forecasting the cancer burden under various exposures to etiologic factors (eg, diet, physical activity, and tobacco use), screening and diagnostic procedures, and health care interventions.[13,14] Apportioning the changing cancer burden into risk and demographic components helps put into perspective the effectiveness of these prevention strategies. Tobacco control efforts are a good example. Tobacco use, particularly cigarette smoking, is associated with several cancers, including those of the respiratory system (lung and bronchus), urogenital system (kidney and renal pelvis, urinary bladder, and cervix uteri), digestive system (colorectum, esophagus [squamous cell], liver, pancreas, and stomach), and head and neck (oral cavity, pharynx, and larynx).[34] The connection between tobacco use and cancer risk is strongest for lung cancer. In the United States, cigarette use has declined since the release of the first US Surgeon General's report on smoking and health in 1964.[34] Accounting for the long latency period between exposure and disease occurrence, incidence rates for lung cancer have decreased since the mid-1980s among men and the late 1990s among women, in parallel with decreases in tobacco use.[35] The incidence of lung cancer has declined more rapidly among men than women.[1,35]

As shown in Figure 2, these trends are expected to continue as sex-specific and race-specific rates begin to converge.[36] According to the results of the current study, the accelerated reduction in risk among men is expected to nearly offset the increase in the number of new incident cases expected in 2020 due to demographic changes. As a result, the number of new lung cancer cases in men is expected to stabilize between 2010 and 2020. However, lung cancer risk reductions in women will only partially offset the increase in the number of incident cases due to demographic changes and, as a result, >10,000 additional new lung cancer cases are expected to be diagnosed annually in women by 2020. Other tobacco-related cancers demonstrate similar patterns of risk and case count reduction.

Cancer predictions can also alert researchers to the impact of changes in population risk before the full extent of the cancer burden manifests and thus suggest the need for new and enhanced prevention strategies or areas of etiologic research. The current study identified several cancers for which increasing risk is exacerbating demographic trends. Consider the obesity epidemic. Excess weight is associated with an increased risk of cancers of the female breast, colon and rectum, esophagus (adenocarcinomas), corpus uteri, pancreas, and kidney and renal pelvis.[37] The rate of overweight and obesity has increased over the past several decades, and approximately two-thirds of adults and one-third of children currently are considered over-weight or obese.[37] With the exception of breast and colorectal cancers, case counts for weight-related cancers are predicted to increase between 30% and 40% between 2010 and 2020. Risk is also increasing for cancers with an infectious etiology. Cases of liver cancer are predicted to increase by >50%, most likely as the result of the epidemic increase in hepatitis infections, particularly among cohorts born between 1945 through 1965,[38] and by approximately 30% for oral cancers in white men, likely the result of an increase in human papillomavirus infections.[39] Thyroid and melanoma cancers have increased over the past several decades,[40-43] and are predicted to continue to increase between 50% and 60%.

Although the reasons for these increases are not completely understood, they may relate in part to improved surveillance and access to care.

Strengths and Limitations

APC models identify trends in younger birth cohorts and extrapolate these trends to future older cohorts.[10] These models have been validated in studies using long-term cancer incidence data.[18] Although based on the best available information, predictions should be viewed with caution. For example, colorectal cancer was the site that most frequently demonstrated a poor fit using APC models for 5 of the 6 combinations of sex and race. APC models might not adequately reflect period effects related to screening.[44,45] Other possible limitations include the following. First, the SEER 9 data, which cover only10% of the US population, are not representative of the entire US population. SEER 9 areas tend to be more urban and to have more foreign-born individuals compared with other parts of the United States.[46] Recent data from the Centers for Disease Control and Prevention's National Program of Cancer Registries (NPCR) covers 96% of the US population,[2] but is only available from 1999 onward. In a comparison of SEER and NPCR data, incidence rates of colorectal cancer and tobacco-related cancers were higher in the NPCR, whereas rates of screen-detected cancers and cancers diagnosed in physician offices (such as breast cancer, prostate cancer, and melanoma) were higher in SEER.[47] As such, the magnitude of the increase in case counts for certain cancers might be impacted by using SEER 9 data. For example, melanoma cases were lower in the predictions for all races combined compared with the predictions for white individuals for males and females.

This is because the percentage of white males and females was lower overall in the SEER 9 areas compared with the US population. When NPCR data become available for a sufficient period of time, SEER and NPCR data combined should be used to predict future cancer incidence rates and counts. Second, population projections are themselves forecasts based on assumptions regarding future births, deaths, and migration and can therefore impact projections of incident counts and rates. Third, the change in the number of cases between time periods has been divided into changes due to risk, age structure, and population size. The decomposition is arbitrary because the 3 components mutually affect each other. For example, if the population size increases, the effect of higher incidence rates (risk) will be larger than if the population size does not change. In the analysis of past time trends, the base year (1975) was used as the reference year, following the Canadian approach.[17] For future trends, we used the final year (2020) as the reference year following the method described in Moller et al.[10] The consequence of using the final year as a reference rate is that the change in the number of cases because of the combined effect of risk, age structure, and population size is attributed to risk, not demographics. For future trends, we preferred this approach from a preventive prospective: if a future increase in risk can be prevented to maintain risk at the current level, the number of cases from the combined effect of risk and demographics can be avoided.

Acknowledgments

FUNDING SUPPORT

No specific funding was disclosed.

REFERENCES

1. Edwards BK, Noone AM, Mariotto AB, et al. Annual report to the nation on the status of cancer, 1975-2010, featuring prevalence of comorbidity and impact on survival among persons with lung, colorectal, breast, or prostate cancer. Cancer. 2014; 120:1290–1314. [PubMed: 24343171]
2. US Cancer Statistics Working Group. United States Cancer Statistics: 1999-2010 Incidence and Mortality Web-based Report. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Cancer Institute; Atlanta: 2013.
3. Howlader, N.; Noone, AM.; Krapcho, M., et al., editors. SEER Cancer Statistics Review, 1975-2010. National Cancer Institute; Bethesda, MD: 2013. Available at: http://seer.cancer.gov/archive/csr/1975_2010/ [Accessed January 16, 2015]
4. Vincent, GK.; Velkoff, VA. Current Population Reports P25-1138. US Census Bureau; Washington, DC: 2010. The Next Four Decades, The Older Population in the United States: 2010 to 2050.
5. Smith BD, Smith GL, Hurria A, Hortobagyi GN, Buchholz TA. Future of cancer incidence in the United States: burdens upon an aging, changing nation. J Clin Oncol. 2009; 27:2758–2765. [PubMed: 19403886]
6. Edwards BK, Howe HL, Ries LA, et al. Annual report to the nation on the status of cancer, 1973-1999, featuring implications of age and aging on U.S. cancer burden. Cancer. 2002; 94:2766–2792. [PubMed: 12173348]
7. Nowatzki J, Moller B, Demers A. Projection of future cancer incidence and new cancer cases in Manitoba, 2006-2025. Chronic Dis Can. 2011; 31:71–78. [PubMed: 21466757]
8. Mistry M, Parkin DM, Ahmad AS, Sasieni P. Cancer incidence in the United Kingdom: projections to the year 2030. Br J Cancer. 2011; 105:1795–1803. [PubMed: 22033277]
9. Moller H, Fairley L, Coupland V, et al. The future burden of cancer in England: incidence and numbers of new patients in 2020. Br J Cancer. 2007; 96:1484–1488. [PubMed: 17473821]
10. Moller B, Fekjaer H, Hakulinen T, et al. Prediction of cancer incidence in the Nordic countries up to the year 2020. Eur J Cancer Prev. 2002; 11(suppl 1):S1–S96. [PubMed: 12442806]
11. Bray F, Moller B. Predicting the future burden of cancer. Nat Rev Cancer. 2006; 6:63–74. [PubMed: 16372017]
12. Hankey BF, Ries LA, Edwards BK. The surveillance, epidemiology, and end results program: a national resource. Cancer Epidemiol Biomarkers Prev. 1999; 8:1117–1121. [PubMed: 10613347]
13. Parkin DM. The role of cancer registries in cancer control. Int J Clin Oncol. 2008; 13:102–111. [PubMed: 18463952]
14. Lousdal ML, Kristiansen IS, Moller B, Stovring H. Trends in breast cancer stage distribution before, during and after introduction of a screening programme in Norway. Eur J Public Health. 2014; 24:1016–1021.
15. Howlader, N.; Noone, AM.; Krapcho, M., et al., editors. SEER Cancer Statistics Review, 1975-2009 (Vintage 2009 Populations). National Cancer Institute; Bethesda, MD: 2012. Available at: http://seer.cancer.gov/archive/csr/1975_2009_pops09/index.html [Accessed January 16, 2015]
16. United States Census Bureau. [Accessed May 15, 2014] 2008 National Population Projections: Downloadable Files [Internet]. Available at: census.gov/population/projections/data/national/2008/downloadablefiles.html
17. Canadian Cancer Society. Canadian Cancer Statistics 1999. Canadian Cancer Society; Toronto, Ontario, Canada: 2014. http://www.cancer.ca/~/media/cancer.ca/CW/cancer%20information/cancer%20101/Canadian%20cancer%20statistics/Canadian-Cancer-Statistics-1999-EN.pdf [Accessed January 16, 2015]
18. Moller B, Fekjaer H, Hakulinen T, et al. Prediction of cancer incidence in the Nordic countries: empirical comparison of different approaches. Stat Med. 2003; 22:2751–2766. [PubMed: 12939784]
19. National Center for Health Statistics, Centers for Disease Control and Prevention. Age Adjustment Using the 2000 Projected U.S. Population. National Center for Health Statistics, Centers for

Disease Control and Prevention; Atlanta, GA: 2001. Available at: cdc.gov/nchs/data/statnt/statnt20.pdf [Accessed May 15, 2014]

20. Centers for Disease Control and Prevention (CDC). Decline in breast cancer incidence-United States, 1999-2003. MMWR Morb Mortal Wkly Rep. 2007; 56:549–553. [PubMed: 17557070]
21. Ravdin PM, Cronin KA, Howlader N, et al. The decrease in breast cancer incidence in 2003 in the United States. N Eng J Med. 2007; 356:1670–1674.
22. Hankey BF, Feuer EJ, Clegg LX, et al. Cancer surveillance series: interpreting trends in prostate cancer-part I: evidence of the effects of screening in recent prostate cancer incidence, mortality, and survival rates. J Natl Cancer Inst. 1999; 91:1017–1024. [PubMed: 10379964]
23. DeSantis C, Howlader N, Cronin KA, Jemal A. Breast cancer incidence rates in U.S. women are no longer declining. Cancer Epidemiol Biomarkers Prev. 2011; 20:733–739. [PubMed: 21357727]
24. Li J, Djenaba JA, Soman A, Rim SH, Master VA. Recent trends in prostate cancer incidence by age, cancer stage, and grade, the United States, 2001-2007. Prostate Cancer. 2012; 2012:691380. [PubMed: 23251806]
25. Kochanek KD, Arias E, Anderson RN. How did cause of death contribute to racial differences in life expectancy in the United States in 2010? NCHS Data Brief. 2013; (125):1–8. [PubMed: 24152376]
26. Kirby JB, Kaneda T. "Double jeopardy" measure suggests blacks and Hispanics face more severe disparities than previously indicated. Health Aff (Millwood). 2013; 32:1766–1772. [PubMed: 24101067]
27. Olshansky SJ, Antonucci T, Berkman L, et al. Differences in life expectancy due to race and educational differences are widening, and many may not catch up. Health Aff (Millwood). 2012; 31:1803–1813. [PubMed: 22869659]
28. Centers for Disease Control and Prevention (CDC). Cancer survivors-United States 2007. MMWR Morb Mortal Wkly Rep. 2011; 60:269–272. [PubMed: 21389929]
29. Mariotto AB, Yabroff KR, Shao Y, Feuer EJ, Brown ML. Projections of the cost of cancer care in the United States: 2010-2020. J Natl Cancer Inst. 2011; 103:117–128. [PubMed: 21228314]
30. Tangka FK, Trogdon JG, Richardson LC, Howard D, Sabatino SA, Finkelstein EA. Cancer treatment cost in the United States: has the burden shifted over time? Cancer. 2010; 116:3477–3484. [PubMed: 20564103]
31. Trogdon JG, Tangka FK, Ekwueme DU, Guy GP Jr, Nwaise I, Orenstein D. State-level projections of cancer-related medical care costs: 2010 to 2020. Am J Manag Care. 2012; 18:525–532. [PubMed: 23009303]
32. Yang W, Williams JH, Hogan PF, et al. Projected supply of and demand for oncologists and radiation oncologists through 2025: an aging, better-insured population will result in shortage. J Oncol Pract. 2014; 10:39–45. [PubMed: 24443733]
33. Chapman SA, Mulvihill L, Herrera C. Workload and time management in central cancer registries: baseline data and implication for registry staffing. J Registry Manag. 2012; 39:178–184. [PubMed: 23493024]
34. US Department of Health and Human Services. The Health Consequences of Smoking–50 Years of Progress: A Report of the Surgeon General. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; Atlanta, GA: 2014.
35. Jemal A, Thun MJ, Ries LA, et al. Annual report to the nation on the status of cancer, 1975-2005, featuring trends in lung cancer, tobacco use, and tobacco control. J Natl Cancer Inst. 2008; 100:1672–1694. [PubMed: 19033571]
36. Jemal A, Travis WD, Tarone RE, Travis L, Devesa SS. Lung cancer rates convergence in young men and women in the United States: analysis by birth cohort and histologic type. Int J Cancer. 2003; 105:101–107. [PubMed: 12672038]
37. Eheman C, Henley SJ, Ballard-Barbash R, et al. Annual Report to the Nation on the status of cancer, 1975-2008, featuring cancers associated with excess weight and lack of sufficient physical activity. Cancer. 2012; 118:2338–2366. [PubMed: 22460733]

38. Polednak AP. Surveillance and interpretation of trends in US age-specific incidence rates for primary liver cancer, in relation to the epidemic of hepatitis C infection. J Registry Manag. 2013; 40:115–121. quiz 144-145. [PubMed: 24643213]

39. Jemal A, Simard EP, Dorell C, et al. Annual Report to the Nation on the Status of Cancer, 1975-2009, featuring the burden and trends in human papillomavirus (HPV)-associated cancers and HPV vaccination coverage levels. J Natl Cancer Inst. 2013; 105:175–201. [PubMed: 23297039]

40. Holman DM, Soman A, Watson M, Weir HK, Trivers KF, White MC. Examination of the increase in thyroid cancer incidence among younger women in the United States by age, race, geography, and tumor size, 1999-2007. J Adolesc Young Adult Oncol. 2011; 1:95–102.

41. Morris LG, Sikora AG, Tosteson TD, Davies L. The increasing incidence of thyroid cancer: the influence of access to care. Thyroid. 2013; 23:885–891. [PubMed: 23517343]

42. Linos E, Swetter SM, Cockburn MG, Colditz GA, Clarke CA. Increasing burden of melanoma in the United States. J Invest Dermatol. 2009; 129:1666–1674. [PubMed: 19131946]

43. Jemal A, Saraiya M, Patel P, et al. Recent trends in cutaneous melanoma incidence and death rates in the United States, 1992-2006. J Am Acad Dermatol. 2011; 65(5 suppl 1):S17–S25. e1–e3. [PubMed: 22018063]

44. Edwards BK, Ward E, Kohler BA, et al. Annual report to the nation on the status of cancer, 1975-2006, featuring colorectal cancer trends and impact of interventions (risk factors, screening, and treatment) to reduce future rates. Cancer. 2010; 116:544–573. [PubMed: 19998273]

45. Moller B, Weedon-Fekjaer H, Hakulinen T, et al. The influence of mammographic screening on national trends in breast cancer incidence. Eur J Cancer Prev. 2005; 14:117–128. [PubMed: 15785315]

46. Merrill RM, Dearden KA. How representative are the surveillance, epidemiology, and end results (SEER) program cancer data of the United States? Cancer Causes Control. 2004; 15:1027–1034. [PubMed: 15801487]

47. Wingo PA, Jamison PM, Hiatt RA, et al. Building the infrastructure for nationwide cancer surveillance and control–a comparison between the National Program of Cancer Registries (NPCR) and the Surveillance, Epidemiology, and End Results (SEER) Program (United States). Cancer Causes Control. 2003; 14:175–193. [PubMed: 12749723]

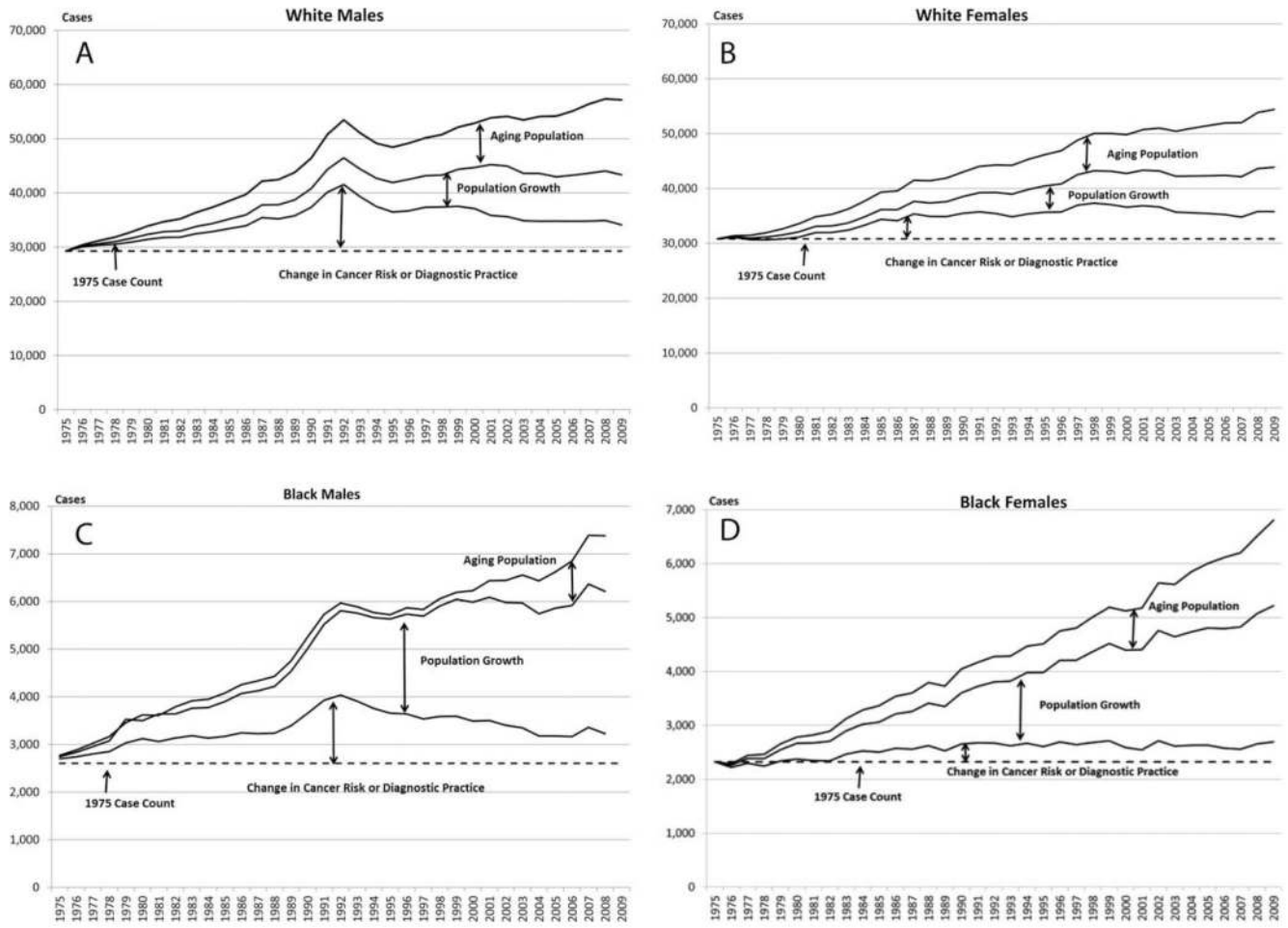
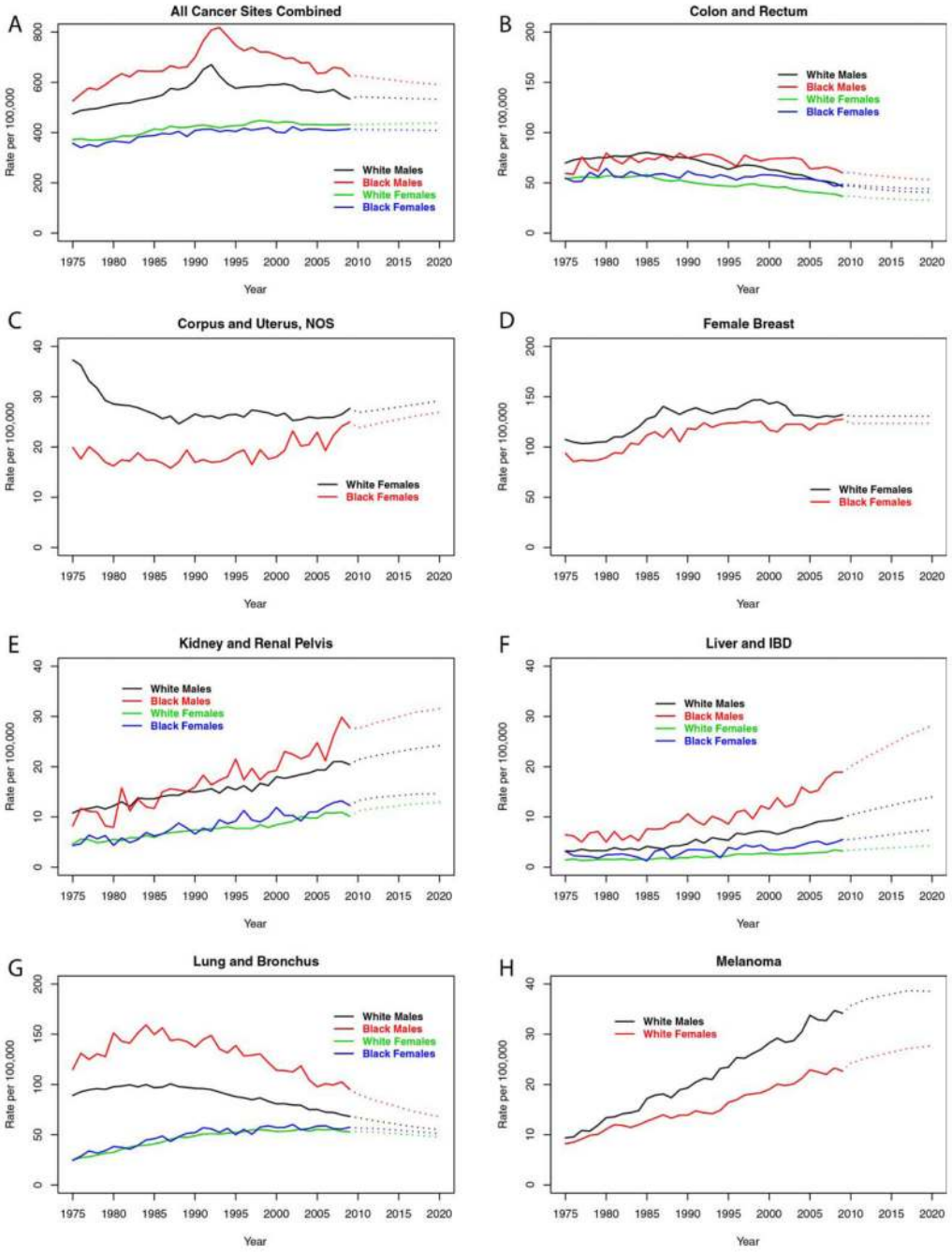


Figure 1.

(a-d) Trends in incident cases for all cancers and ages combined attributed to population risk and diagnostic practices, growth, and aging are shown. Surveillance, Epidemiology, and End Results SEER 9 registry data (1975-2009) are shown by sex and race (white vs black) in (a) white males, (b) white females, (c) black males, and (d) black females.



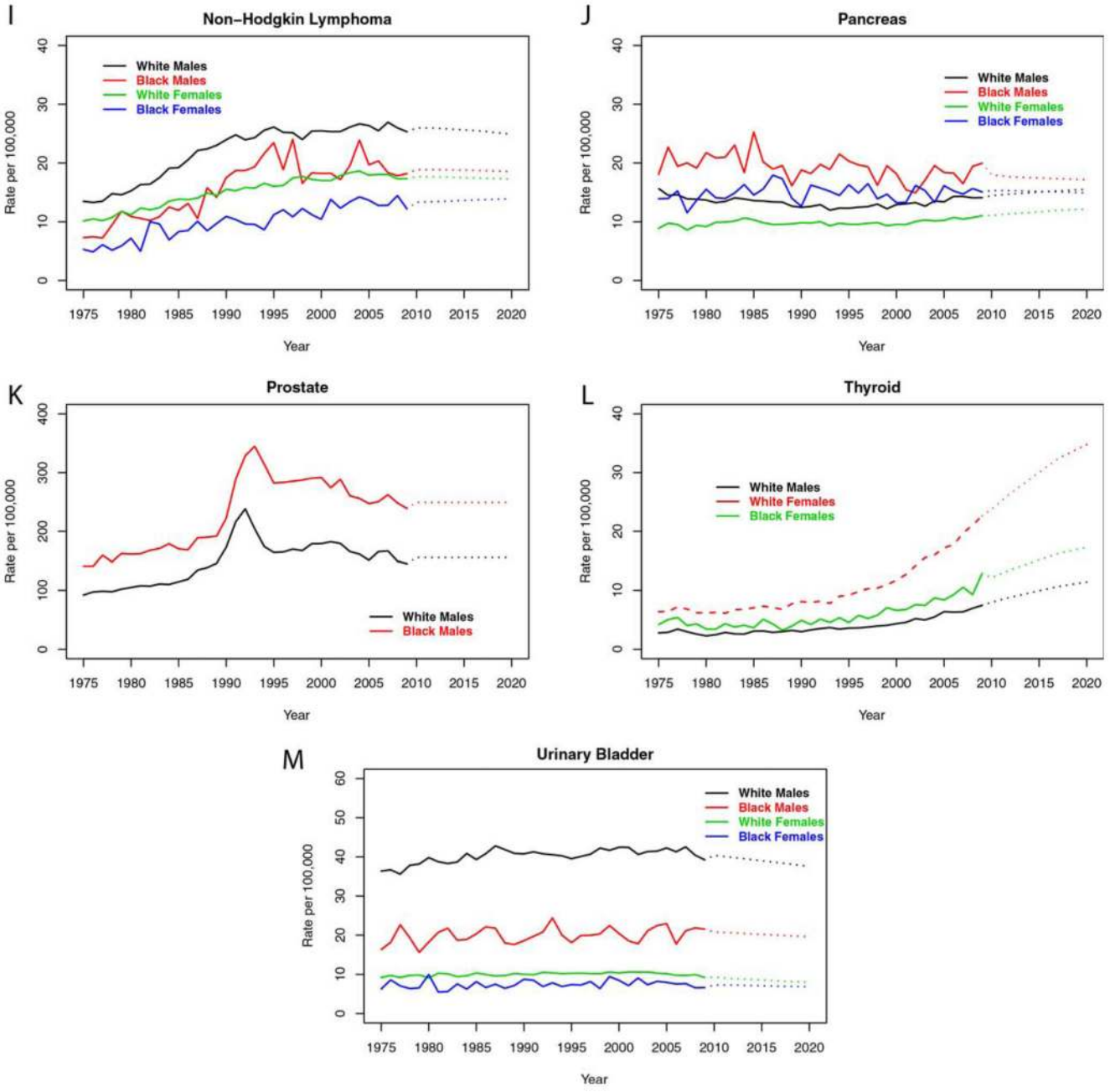


Figure 2.

(a-m) Trends in observed (solid line) and predicted (dotted line) age-standardized incidence rates are shown for all sites combined and the top 10 cancers in men and women with the largest predicted increase in incident cases (white and black individuals), 1975 through 2020. NOS indicates not otherwise specified; IBD, inflammatory bowel disease.

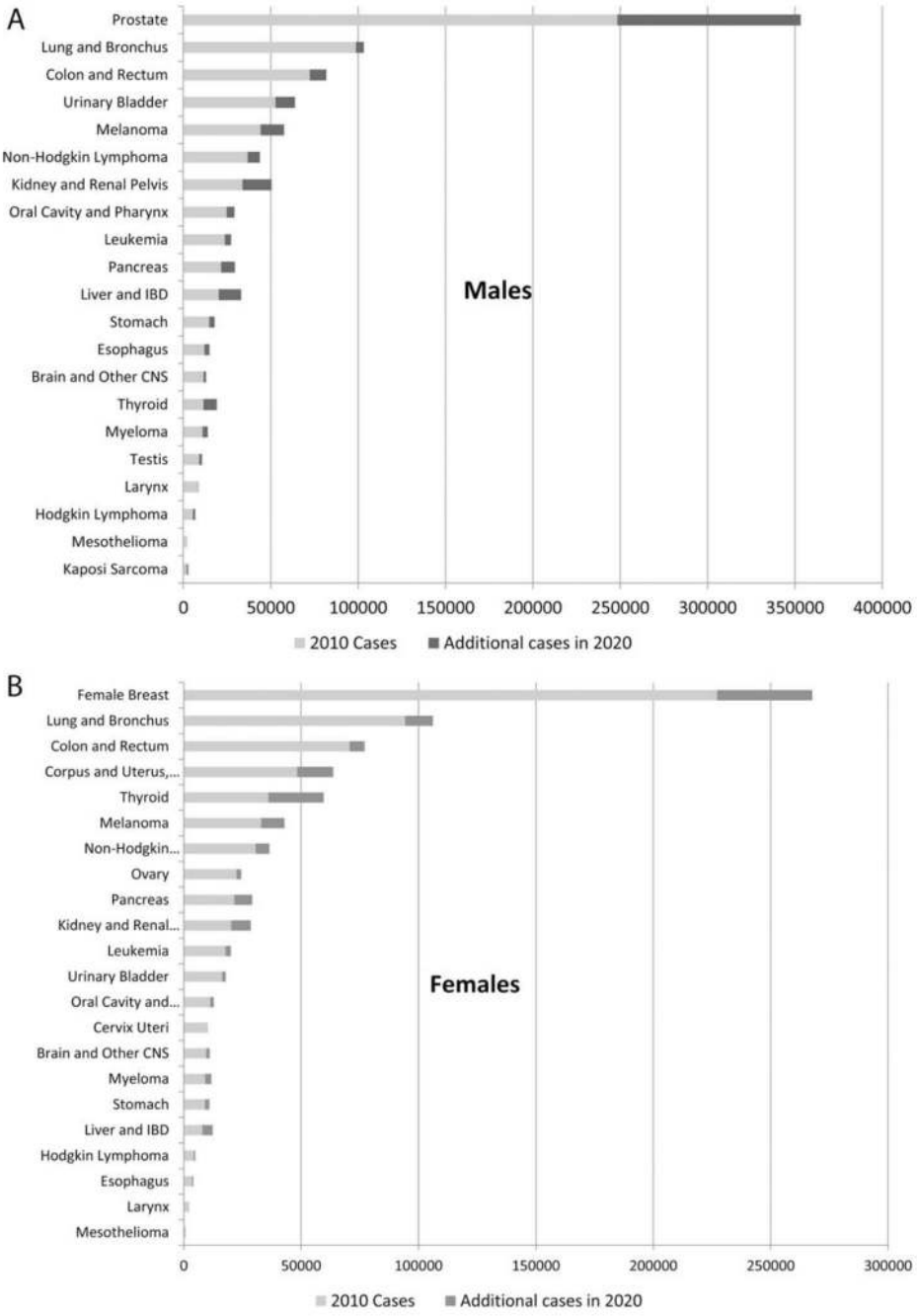


Figure 3.

(a and b) Cancer site-specific incident cases predicted to be diagnosed in 2010 (dark shading) and additional cases predicted to be diagnosed in 2020 (lighter shading) are shown ranked by 2010 case counts by sex. CNS indicates central nervous system; IBD, inflammatory bowel disease.

TABLE 1

Observed Case Counts and Percent Changes in Invasive Cancers (All Sites Combined) Because of Population Risk, Growth, and Aging by Sex and Race (White and Black)

	White Males				White Females				Black Males				Black Females			
Year of Diagnosis	**Total**	**Risk**	**Growth**	**Aging**	**Total**	**Risk**	**Growth**	**Aging**	**Total**	**Risk**	**Growth**	**Aging**	**Total**	**Risk**	**Growth**	**Aging**
1975 (baseline)	29,270	29,270	29,270	29,270	30,808	30,808	30,808	30,808	2604	2604	2604	2604	2323	2323	2323	2323
1990	46,391	8066	3437	5618	43,016	4668	3062	4478	4752	786	1145	217	4044	329	949	443
2000	52,874	7860	7566	8178	49,829	5782	6159	7080	6191	987	2453	147	5125	265	1809	728
2009	57,161	4835	9248	13,808	54,409	4988	8069	10,544	7379	622	2986	1167	6805	371	2524	1587
% Change for 1975 through 2009(% relative contribution)	95.3%	16.5% (17.3%)	31.6% (33.2%)	47.2% (49.5%)	76.6%	16.2% (21.1%)	26.2% (34.2%)	34.2% (44.7%)	183.4%	23.9% (13.0%)	114.7% (62.5%)	44.8% (24.4%)	192.9%	16.0% (8.3%)	108.7% (56.3%)	68.3% (35.4%)

TABLE 2

Predicted Cancer Incident Counts (2010 and 2020) For All Sites Combined and For the Leading 23 Cancers by Race (All, White, and Black) and Sex Apportioned into Changes Because of Risk and Demographics

	All Races					White					Black				
	2010	2020	Change			2010	2020	Change			2010	2020	Change		
Cancer Site	No.	No.	%	Risk	Demographics	No.	No.	%	Risk	Demographics	No.	No.	%	Risk	Demographics
Male															
All cancer sites	813,566	1,009,416	24.1[a]	−3.2	27.3	702,312	857,531	22.1[a]	−2.5	24.6	88,455	113,965	28.8[b]	−7.9	36.7
Brain and other CNS	11,711	13,431	14.7[a]	−4.2	18.9	10,953	12,496	14.1[a]	−2.6	16.6	741	777	4.8[c]	−17.7	22.6
Colon and rectum	72,275	81,318	12.5[b]	−13.3	25.8	60,166	64,623	7.4[b]	−15.9	23.3	8063	9648	19.7[b]	−15.4	35.0
Esophagus	12,106	15,009	24.0[a]	−3.9	27.9	10,896	13,340	22.4[a]	−2.9	25.3	962	764	−20.6[d]	−57.8	37.2
Adenocarcinoma	7580	10,122	33.5[e]	5.6	28.0	7668	10,051	31.1[e]	5.9	25.2	-	-	-	-	-
Squamous cell	2914	2717	−6.8[d]	−35.6	28.8	1902	1918	0.9[c]	−25.8	26.7	-	-	-	-	-
Hodgkin lymphoma	5338	6597	23.6[e]	11.8	11.8	4574	5505	20.4[e]	10.5	9.9	673	823	22.3[e]	5.3	17.0
Kidney and renal pelvis	32,998	46,330	40.4[e]	16.1	24.3	27,995	38,198	36.4[e]	14.7	21.8	4019	5988	49.0[e]	16.3	32.7
Larynx	8298	8657	4.3[c]	−22.5	26.8	7048	7227	2.5[c]	−21.5	24.1	1275	1275	0.0[c]	−37.9	37.9
Leukemia	23,615	26,971	14.2[b]	−10.4	24.6	21,372	24,152	13.0[b]	−9.6	22.6	1854	2263	22.1[b]	−7.6	29.7
Liver and IBD	20,269	32,781	61.7[e]	38.4	23.3	14,256[f]	23,701	66.3[e]	45.5	20.7	3301	5996	81.6[e]	50.3	31.3
Lung and bronchus	98,785	103,636	4.9[c]	−25.4	30.3	84,666	88,330	4.3[c]	−23.4	27.7	11,794	12,095	2.6[c]	−37.4	39.9
Melanoma	44,301	57,594	30.0[e]	6.5	23.5	45,652	59,033	29.3[e]	8.7	20.6	-	-	-	-	-
Myeloma	10,992	13,848	26.0[a]	−2.2	28.2	8905	10,865	22.0[a]	−3.7	25.7	1987	2749	38.4[a]	1.1	37.3
Non-Hodgkin lymphoma	36,714	43,654	18.9[b]	−6.1	25.0	32,769	38,343	17.0[b]	−5.8	22.8	2881	3533	22.6[a]	−4.7	27.3
Oral cavity and pharynx	24,752	29,357	18.6[a]	−2.9	21.5	22,134	27,905	26.1[e]	7.3	18.8	2227	2279	2.3[c]	−27.4	29.7
Pancreas	21,619	29,637	37.1[e]	9.2	27.9	18,466	24,840	34.5[e]	9.2	25.3	2376	3081	29.6[b]	−8.0	37.6
Prostate[f]	251,933	329,901	30.9[a]	0.0	30.9	208,795	267,888	28.3[a]	0.0	28.3	35,901	50,381	40.3[a]	0.0	40.3
Stomach	14,786	17,902	21.1[b]	−5.7	26.8	11,142	13,355	19.9[a]	−4.2	24.1	2066	2508	21.4[b]	−13.9	35.3

Cancer Site	All Races					White					Black				
	2010 No.	2020 No.	Change			2010 No.	2020 No.	Change			2010 No.	2020 No.	Change		
			%	Risk	Demographics			%	Risk	Demographics			%	Risk	Demographics
Testis	9021	10,468	16.0[e]	9.9	6.1	8526	9801	15.0[e]	11.4	3.6	-	-	-	-	-
Thyroid	11,476	19,073	66.2[e]	49.6	16.6	10,345	17,049	64.8[e]	51.0	13.8	-	-	-	-	-
Urinary bladder	52,769	63,787	20.9[b]	−8.9	29.8	50,147	59,081	17.8[b]	−9.3	27.1	2505	3199	27.7[b]	−12.1	39.9
Female															
All cancer sites combined	755,671	911,584	20.6[a]	1.2	19.4	646,909	758,070	17.2[a]	0.8	16.4	81,138	103,394	27.4[a]	−0.8	28.3
Brain and other CNS	9418	10,799	14.7[a]	−2.0	16.6	8435	9460	12.1[a]	−1.9	14.0	825	991	20.1[a]	−1.0	21.2
Cervix uteri	10,253	10,041	−2.1[c]	−13.4	11.4	7979	7790	−2.4[c]	−10.3	7.9	1546	1393	−9.9[d]	−30.8	20.9
Colon and rectum	70,568	76,880	8.9[b]	−11.7	20.7	57,956	59,813	3.2[c]	−14.2	17.4	9295	11,199	20.5[b]	−10.0	30.5
Corpus and uterus, NOS	48,301	63,119	30.7[e]	10.3	20.4	41,141	51,765	25.8[e]	8.7	17.1	4783	7144	49.4[e]	15.9	33.4
Esophagus	3495	3917	12.1[b]	−10.2	22.2	3017	3657	21.2[a]	2.3	19.0	491	431	−12.3d	−44.1	31.8
Female breast[f]	227,267	267,693	17.8[a]	0.0	17.8	193,397	222,139	14.9[a]	0.0	14.9	24,899	31,138	25.1[a]	0.0	25.1
Hodgkin lymphoma	4143	4534	9.4[a]	−1.4	10.9	3550	3785	6.6[a]	−2.3	8.9	-	-	-	-	-
Kidney and renal pelvis	20,162	28,154	39.6[e]	18.7	20.9	16,954	23,036	35.9[e]	18.1	17.8	2579	3655	41.7[e]	11.4	30.3
Larynx	2068	2181	5.5[b]	−16.1	21.6	1781	1873	5.1[b]	−13.5	18.7	372	442	18.8[b]	−10.1	28.9
Leukemia	17,706	19,962	12.7[b]	−6.7	19.5	15,461	16,751	8.3[b]	−8.4	16.7	1574	1879	19.3[b]	−8.3	27.6
Liver and IBD	7884	12,180	54.5[e]	32.4	22.1	5271	8004	51.9[e]	33.1	18.7	1129	2027	79.5[e]	49.2	30.3
Lung and bronchus	94,330	106,067	12.4[b]	−13.0	25.4	83,025	90,793	9.4[b]	−13.0	22.3	10,816	13,012	20.3[b]	−13.7	34.0
Melanoma	32,984	43,008	30.4[e]	15.7	14.7	33,663	43,508	29.2[e]	17.7	11.6	-	-	-	-	-
Myeloma	9083	11,581	27.5[a]	4.6	22.9	6725	8103	20.5[a]	0.9	19.6	2168	3047	40.5[e]	8.5	32.1
Non-Hodgkin lymphoma	30,598	36,310	18.7[a]	−2.0	20.7	26,988	31,073	15.1[a]	−2.8	17.9	2666	3516	31.9[e]	6.4	25.5
Oral cavity and pharynx	11,227	12,692	13.1[b]	−5.8	18.9	9510	10,539	10.8[b]	−5.5	16.4	1082	1139	5.2[b]	−19.5	24.7
Ovary	22,363	24,393	9.1[b]	−9.6	18.7	19,492	20,442	4.9[c]	−11.0	15.8	1933	2303	19.1[b]	−8.7	27.8

Cancer Site	All Races					White					Black				
	2010 No.	2020 No.	Change			2010 No.	2020 No.	Change			2010 No.	2020 No.	Change		
			%	Risk	Demographics			%	Risk	Demographics			%	Risk	Demographics
Pancreas	21,540	29,035	34.8[e]	11.9	22.9	17,733	23,251	31.1[e]	11.6	19.5	2875	3757	30.7[a]	−2.6	33.3
Stomach	9001	10,708	19.0[a]	−1.2	20.2	6063	6960	14.8[a]	−2.2	17.0	1608	2099	30.5[a]	1.6	28.9
Thyroid	36,151	60,015	66.0[e]	54.9	11.1	30,983	50,586	63.3[a]	55.3	8.0	2521	4288	70.1[e]	51.0	19.2
Urinary bladder	16,384	18,009	9.9[b]	−13.3	23.2	14,802	15,439	4.3[c]	−15.8	20.1	1338	1685	25.9[b]	−6.8	32.7

Abbreviations: CNS, central nervous system; IBD, inflammatory bowel disease; NOS, not otherwise specified.

[a] Case counts increased because of demographic changes only.

[b] Attenuated increase in case counts: the decrease in case counts because of risk reductions partially offset the increase in case counts because of demographic changes.

[c] Case counts stable: the reduction in case counts because of a decrease in risk approximated the increase in case counts because of demographic changes.

[d] Case counts decrease: the reduction in case counts because of a decrease in risk exceeded the increase in case counts because of demographic changes.

[e] Case counts increased because of increases in risk and demographic changes.

[f] Female breast and prostate predictions were based on data from 2005 through 2009.