

Cancer treatment and survivorship statistics, 2022

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Abstract: The number of cancer survivors continues to increase in the United States due to the growth and aging of the population as well as advances in early detection and treatment. To assist the public health community in better serving these individuals, the American Cancer Society and the National Cancer Institute collaborate triennially to estimate cancer prevalence in the United States using incidence and survival data from the Surveillance, Epidemiology, and End Results cancer registries, vital statistics from the Centers for Disease Control and Prevention's National Center for Health Statistics, and population projections from the US Census Bureau. Current treatment patterns based on information in the National Cancer Database are presented for the most prevalent cancer types by race, and cancer-related and treatment-related side-effects are also briefly described. More than 18 million Americans (8.3 million males and 9.7 million females) with a history of cancer were alive on January 1, 2022. The 3 most prevalent cancers are prostate (3,523,230), melanoma of the skin (760,640), and colon and rectum (726,450) among males and breast (4,055,770), uterine corpus (891,560), and thyroid (823,800) among females. More than one-half (53%) of survivors were diagnosed within the past 10 years, and two-thirds (67%) were aged 65 years or older. One of the largest racial disparities in treatment is for rectal cancer, for which 41% of Black patients with stage I disease receive proctectomy or proctocolectomy compared to 66% of White patients. Surgical receipt is also substantially lower among Black patients with non-small cell lung cancer, 49% for stages I-II and 16% for stage III versus 55% and 22% for White patients, respectively. These treatment disparities are exacerbated by the fact that Black patients continue to be less likely to be diagnosed with stage I disease than White patients for most cancers, with some of the largest disparities for female breast (53% vs 68%) and endometrial (59% vs 73%). Although there are a growing number of tools that can assist patients, caregivers, and clinicians in navigating the various phases of cancer survivorship, further evidence-based strategies and equitable access to available resources are needed to mitigate disparities for communities of color and optimize care for people with a history of cancer. *CA Cancer J Clin.* 2022;72:409–436.

Keywords: prevalence, statistics, survivorship, treatment patterns

Introduction

The number of cancer survivors continues to grow in the United States, primarily as a result of the combined effects of a growing and aging population as well as increases in cancer survival due to advances in early detection and treatment. Many cancer survivors must cope with the physical effects of cancer and its treatment, potentially leading to functional and cognitive impairments as well as other psychological and economic sequelae.¹ To help the public health community better serve this unique population, the American Cancer Society collaborates triennially with the National Cancer Institute to estimate complete cancer prevalence in the United States for the most common cancers in the current year. Statistics on contemporary treatment patterns and survival as well as information about issues related to survivorship, including challenges caused by the coronavirus disease 2019 (COVID-19)

pandemic, are also presented. For the first time, we also present treatment data by race/ethnicity for selected cancers (female breast, colon, rectum, lung, and uterine corpus). Although racial classification is a social construct without biological meaning, it remains useful for describing health patterns in the United States because long-standing structural racism has contributed to inequalities in social determinants of health and access to care. Herein, *cancer survivor* refers to any person who has been diagnosed with cancer, although not all people with a history of cancer identify as survivors,² and *cancer prevalence* refers to the prevalence of cancer survivors regardless of disease status.

Materials and Methods

Prevalence Estimates

National cancer survivor prevalence as of January 1, 2022 was estimated using the Prevalence Incidence Approach Model (PIAMOD) with incidence and survival data from the Surveillance, Epidemiology, and End Results (SEER) Program, US all-cause mortality data from the National Center for Health Statistics, and US Census Bureau population estimates.³ Incidence rates from 1975 to 1999 (using SEER's 9 oldest registries) and from 2000 to 2018 (using SEER's 18 oldest registries) were applied to the US population estimates to obtain US incidence counts by single calendar year, age (single-year and age ≥ 90 years), and cancer type. Counts were confined to the first primary invasive case diagnosed in a person (except urinary bladder, which included *in situ* cases) by cancer site. Relative survival was obtained from the 9 oldest SEER registries by sex, age group (birth to 54, 55–64, 65–74, 75–84, 85–99 years), and year of diagnosis (1975–1984, 1985–1989, ..., 2005–2009, 2010–2017), excluding patients diagnosed through death certificate or autopsy and those who were lost to follow-up at the month of diagnosis. The 2017 US Census Bureau National Population Projections, which are based on the 2010 Census, were used to project US incidence and mortality for 2019 to 2022 by applying the 2016 to 2018 average rates to the respective US population projections; survival for 2010 to 2017 was also assumed to be constant for the projections. The prevalence proportions for ages 85 to 89 years were used to estimate prevalence counts for the population aged 90 years and older. Finally, a cancer-specific and sex-specific adjustment factor was used to align the 2022 projections with 2018 complete prevalence estimates.^{4,5}

2022 Case Estimates

The method for estimating the number of new US cancer cases in 2022 is described in detail elsewhere.⁶ Briefly, the total number of cases in each state is estimated using a spatiotemporal model based on high-quality incidence data from 50 states and the District of Columbia for the years 2004 to 2018 from the North American Association of Central Cancer Registries and sociodemographic and lifestyle

cofactors.^{7,8} Then, the number of new cases nationally and in each state is temporally projected 4 years ahead using the most recent 4-year average annual percent change in counts, as estimated using a novel Joinpoint regression.⁹

Stage at Diagnosis and Survival

The American Joint Committee on Cancer (AJCC)¹⁰ is the most common staging system in clinical settings, and its 7th and 8th editions (in use during most of the years of data collection for this article) are used herein to describe stage distribution, treatment patterns, and 5-year relative with the exception of prostate cancer, for which SEER Summary Stage is used to describe survival for patients with metastatic disease.

Survival information is presented in terms of relative survival, which adjusts for normal life expectancy by comparing survival among patients who have cancer with that of the general population, controlling for age, race/ethnicity, sex, geography, and year. The SEER 18 registries were the source for contemporary 5-year survival (diagnosis years 2011–2017), whereas historical 5-year survival rates are based on data from the 9 oldest SEER registries. Many of these statistics were originally published in the *SEER Cancer Statistics Review, 1975–2018* or are available from the SEER Explorer website.¹¹ All additional survival analyses were conducted using the National Cancer Institute's SEER*Stat software version 8.3.9.⁴ Stage distribution and 5-year colorectal cancer survival by insurance status are based on the corresponding National Cancer Database (NCDB) patient populations described below. Survival and distribution data by race are exclusive of Hispanic ethnicity.

Treatment

Information on the first course of treatment was obtained from the NCDB for cases diagnosed in 2018, the latest year for which complete data are available, except diffuse B-cell non-Hodgkin lymphoma and testicular cancer, for which aggregated cases diagnosed from 2014 to 2018 were used because of sparse data. The NCDB is a hospital-based cancer registry jointly sponsored by the American Cancer Society and the American College of Surgeons that includes >70% of all invasive cancers in the United States from more than 1500 facilities accredited by the American College of Surgeons' Commission on Cancer (CoC).^{12,13} NCDB treatment data are incomplete for cancers often diagnosed in the outpatient setting, such as prostate cancer, melanoma, and leukemia, and thus were supplemented with information from the scientific literature, and there may also be some delay in reporting.

Cancer treatment modalities reported are surgery, radiation therapy, and systemic therapy, including chemotherapy, targeted therapy, hormonal therapy, and immunotherapy. Many common targeted therapies are classified as chemotherapy in the NCDB. For consistency and comparability, chemotherapy in this report includes targeted therapy and immunotherapies, except for diffuse large B-cell lymphoma

(DLBCL) and nonsmall cell lung and urinary bladder cancers, for which immunotherapy has been examined separately. Treatment data presented by race are exclusive of Hispanic ethnicity. For more information regarding the prescription drug classification system used for the NCDB and other cancer registries, visit seer.cancer.gov/tools/seerrx. For more information on the NCDB, visit facs.org/ncdb.

Selected Findings

Overall Cancer Prevalence

More than 18 million Americans with a history of cancer were alive on January 1, 2022. These estimates do not include carcinoma in situ of any site except urinary bladder or basal cell and squamous cell skin cancers. They also do not reflect the impact of diagnostic and treatment delays related to the COVID-19 pandemic because they are based on available prepandemic, observed cancer incidence, mortality, and survival data through 2018.

The 3 most prevalent cancers in 2022 are prostate (3,523,230), melanoma of the skin (760,640), and colon and rectum (726,450) among males and breast (4,055,770), uterine corpus (891,560), and thyroid (823,800) among females (Fig. 1). The distribution of prevalent cancers differs from that of incident cancers because prevalent cancers reflect survival and median age at diagnosis as well as cancer occurrence.

More than one-half (53%) of survivors were diagnosed within the past 10 years; 18% were diagnosed \geq 20 years ago (Table 1). About two-thirds (67%) are aged 65 years or older (Table 2), although age distributions vary by cancer type (Fig. 2). For example, the majority of prostate cancer survivors (85%) are aged 65 years or older compared with slightly less than one-half (47%) of cervical cancer survivors (Fig. 2).

Breast (Female)

It is estimated that there are more than 4 million women living in the United States with a history of invasive breast

cancer as of January 1, 2022, and an additional 287,850 women will be newly diagnosed in 2022. More than 150,000 breast cancer survivors are living with metastatic disease, three-fourths of whom were originally diagnosed with stage I, II, or III cancer.¹⁴ Two-thirds of breast cancer survivors (>2.7 million women) are aged 65 years and older, whereas 6% are younger than 50 years (Fig. 2). The age distribution of breast cancer survivors is younger than that for survivors of other common cancers in the United States (lung, colon, and prostate), largely because the median age at diagnosis is younger (eg, 63 vs 71 years for lung cancer).¹¹

Treatment and survival

One-half of women with early stage (I or II) breast cancer undergo breast-conserving surgery (BCS) with adjuvant radiotherapy, whereas one-third (34%) undergo mastectomy, often without chemotherapy or radiation (Fig. 3). By comparison, 65% of patients with stage III breast cancer undergo mastectomy, most of whom also receive chemotherapy. Black women are less likely than White women to receive BCS (with or without adjuvant radiotherapy) for stage I and II disease (60% vs 64%, respectively). For stage III disease, Black women are less likely to receive mastectomy (57% vs 66%) and more likely to receive only chemotherapy and/or radiation (9% vs 6%). Women diagnosed with metastatic disease (stage IV) most often receive radiation and/or chemotherapy alone (60%). At least one-half of patients with metastatic breast cancer who have hormone receptor-positive tumors and who do not receive cancer-directed surgery, chemotherapy, or radiation receive adjuvant hormonal therapy.¹² Among all patients with female breast cancer who have hormone receptor-positive tumors, 84% receive hormonal therapy, although the percentage is lower for metastatic disease (76%), especially among Black women (69% vs 77% in White women).¹²

When BCS followed by radiation to the breast is appropriately used for localized or regional cancers, long-term survival

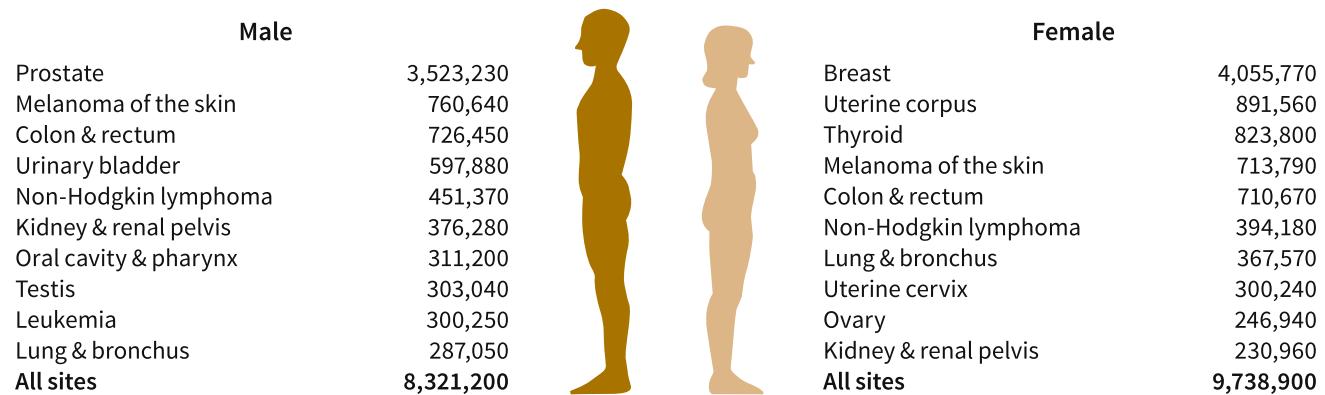


FIGURE 1. Estimated Number of US Cancer Survivors by Site as of January 1, 2022. Estimates do not include in situ carcinoma of any site except urinary bladder and do not include basal cell or squamous cell skin cancers.

TABLE 1. Estimated Number of US Cancer Survivors by Sex and Years Since Diagnosis as of January 1, 2022

YEARS SINCE DIAGNOSIS	MALE AND FEMALE			MALE			FEMALE		
	NUMBER	PERCENT	CUMULATIVE PERCENT	NUMBER	PERCENT	CUMULATIVE PERCENT	NUMBER	PERCENT	CUMULATIVE PERCENT
0 to <5	5,540,240	31%	31%	2,737,850	33%	33%	2,802,390	29%	29%
5 to <10	3,996,380	22%	53%	1,932,820	23%	56%	2,063,560	21%	50%
10 to <15	3,045,330	17%	70%	1,446,540	17%	74%	1,598,790	16%	66%
15 to <20	2,170,060	12%	82%	996,590	12%	85%	1,173,480	12%	78%
20 to <25	1,405,250	8%	89%	598,880	7%	93%	806,370	8%	87%
25 to <30	841,830	5%	94%	314,560	4%	96%	527,280	5%	92%
30+	1,061,010	6%	100%	293,970	4%	100%	767,040	8%	100%

Note: Percentages do not sum to 100% due to rounding.

TABLE 2. Estimated Number of US Cancer Survivors by Sex and Age at Prevalence as of January 1, 2022

AGE, YEARS	MALE AND FEMALE			MALE			FEMALE		
	NUMBER	PERCENT	CUMULATIVE PERCENT	NUMBER	PERCENT	CUMULATIVE PERCENT	NUMBER	PERCENT	CUMULATIVE PERCENT
All ages	18,060,100	100%		8,321,200	100%		9,738,900	100%	
0-14	69,920	<1%	<1%	35,060	<1%	<1%	34,870	<1%	<1%
15-19	49,120	<1%	1%	24,580	<1%	1%	24,540	<1%	1%
20-29	193,220	1%	2%	93,510	1%	2%	99,700	1%	2%
30-39	443,750	2%	4%	184,050	2%	4%	259,700	3%	4%
40-49	930,710	5%	9%	334,080	4%	8%	596,630	6%	10%
50-59	2,290,540	13%	22%	894,990	11%	19%	1,395,550	14%	25%
60-69	4,576,230	25%	47%	2,116,080	25%	44%	2,460,150	25%	50%
70-79	5,263,910	29%	77%	2,669,340	32%	76%	2,594,570	27%	77%
80+	4,242,690	24%	100%	1,969,520	24%	100%	2,273,180	23%	100%
0-19	119,040	<1%	<1%	59,640	<1%	<1%	59,410	<1%	<1%
20-64	5,902,960	33%	33%	2,413,690	29%	30%	3,489,260	36%	36%
65+	12,038,100	67%	100%	5,847,870	70%	100%	6,190,230	64%	100%

is the same as that with mastectomy.^{15,16} However, evidence from randomized controlled trials have suggested that adjuvant radiation may be omitted without affecting survival in certain subsets of patients receiving BCS, such as women aged 70 years or older with small, localized, estrogen receptor (ER)-positive tumors.^{17,18} Some BCS-eligible women elect mastectomy because of reluctance to undergo radiation therapy, fear of recurrence, or a contraindication to receiving radiation (eg, prior ipsilateral radiation).¹⁹⁻²¹ Structural obstacles to receiving radiation therapy, such as distance to treatment and/or transportation availability, also play a role.²² Younger women (aged <40 years) and patients with larger and/or more aggressive tumors are more likely to be treated with mastectomy^{23,24} and to have a contralateral prophylactic mastectomy (CPM).²⁵ Among women with early stage disease who choose mastectomy, the percentage who also underwent CPM increased from <2% in 1998 to 28% to 30% during 2010

through 2012,²⁴ but it appears to have leveled off in recent years.²⁶ A proportion of this increase may be because of the broader availability of genetic testing and increased awareness among women at high risk of contralateral disease;²⁷ however, CPM rates in Europe are remarkably lower than those in the United States.²⁸ Within the United States, CPM receipt among women with early stage, unilateral breast cancer is highest in the Midwest and lowest in the Northeast and West, which may reflect differences in physician beliefs and practices as well as patient-related factors.²⁵

Clinical factors that influence breast cancer survival include stage, tumor grade, ER and progesterone receptor (PR) status, and human epidermal growth factor receptor 2 (HER2) status. Treatment advances for triple-negative tumors (ER-negative, and PR-negative, and HER2 receptor-negative) have lagged behind those for other molecular subtypes (eg, aromatase inhibitors for ER-positive/

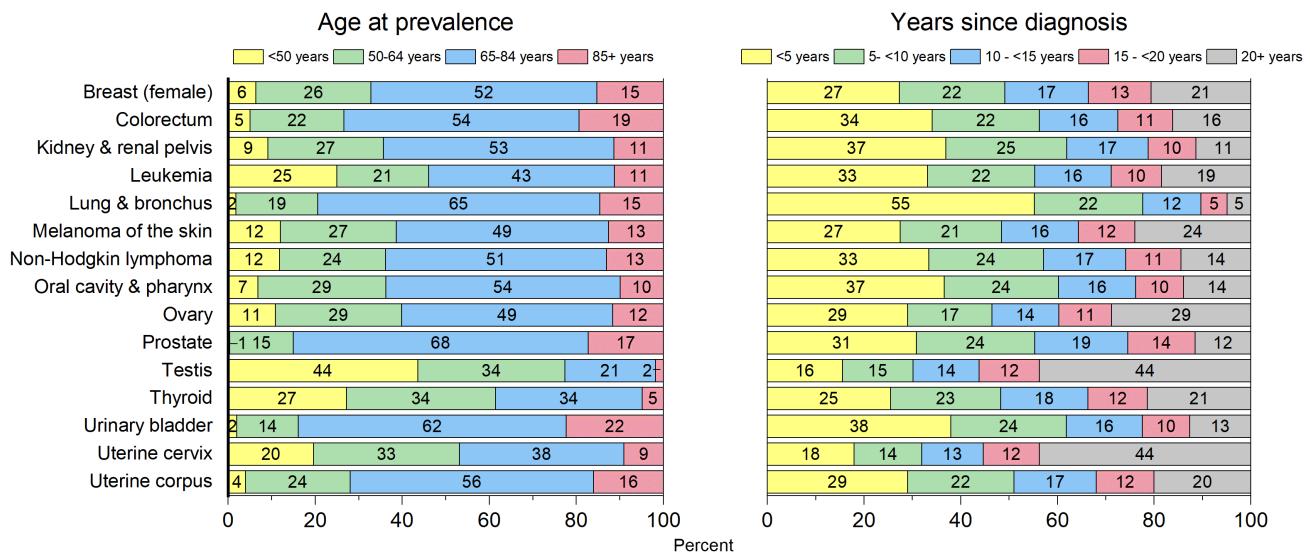


FIGURE 2. Prevalence by Cancer Type, Years Since Diagnosis, and Age at Prevalence as of January 1, 2022, United States. Estimates do not include in situ carcinoma of any site except urinary bladder and do not include basal cell or squamous cell skin cancers. ^aCancer prevalence for survivors of prostate cancer <50 years of age is <1%.

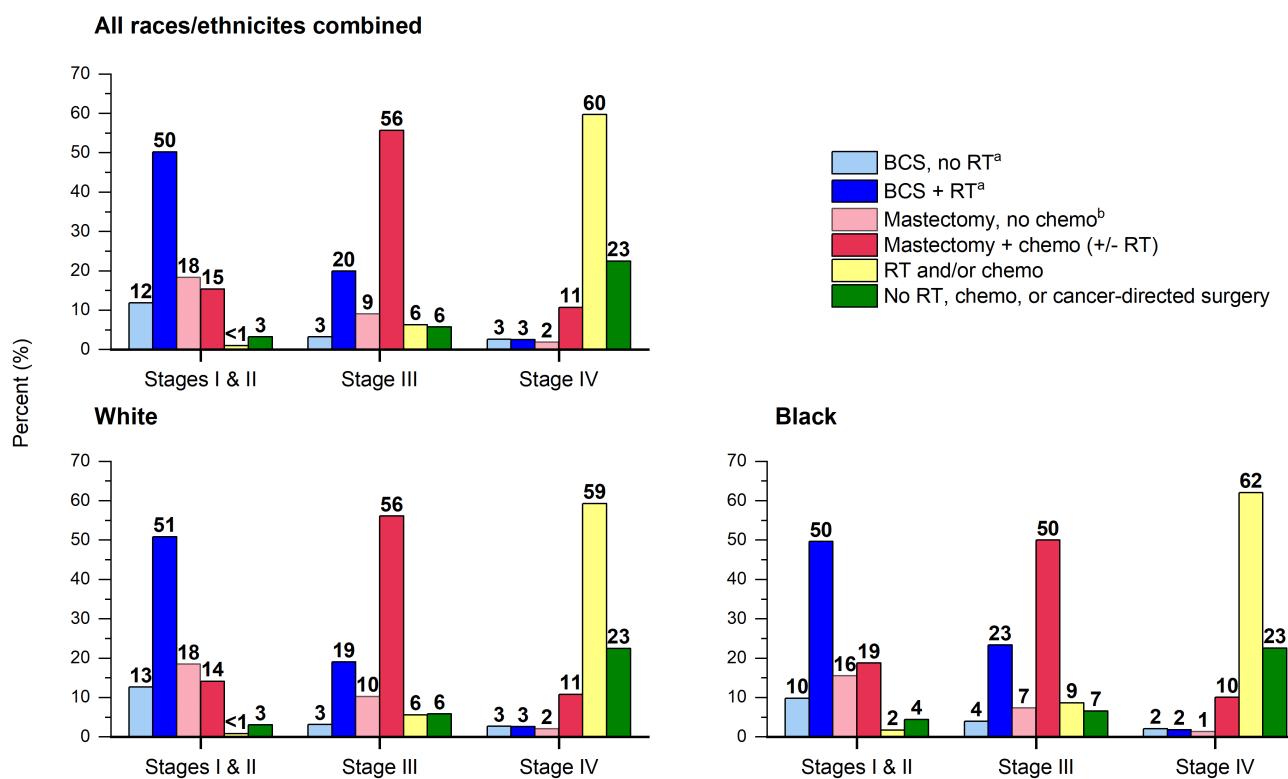


FIGURE 3. Female Breast Cancer Treatment Patterns (%) by Stage, 2018. Categories for White and Black race exclude persons of Hispanic ethnicity. ^aA small number of these patients receive chemotherapy. ^bA small number of these patients receive radiation therapy (RT). +/- Indicates with or without; BCS, breast-conserving surgery; chemo, chemotherapy (includes targeted therapy and immunotherapy).

PR-positive tumors; trastuzumab for HER2-positive tumors) and are largely limited to cytotoxic chemotherapy. However, recent advances for the treatment of triple-negative disease include a immune checkpoint inhibitor in combination with chemotherapy for early stage and metastatic disease,²⁹ an antibody-drug conjugate for metastatic disease,³⁰ and targeted drugs for tumors with germline *BRCA* mutations.^{31,32}

Although several other immunotherapy and targeted therapy treatments are currently under investigation, these treatments may only be effective for a subset of patients because triple-negative cancers encompass a heterogeneous range of molecular profiles.

The 5-year relative survival rate has increased from 75% for patients diagnosed in the mid-1970s to 90% for those

diagnosed during 2011 through 2017,^{11,33} largely because of advances in hormonal treatments and earlier detection as a result of increased mammography screening prevalence.³⁴ The 5-year relative survival rate approaches 100% for patients with breast cancer who are diagnosed at stage I but declines to 28% for those diagnosed with stage IV breast cancer.³⁵ Black women are less likely than White women to be diagnosed with stage I breast cancer (53% vs 68% of cases) (Fig. 4) and have lower survival for every stage, with the largest disparity for advanced disease (stage III, 65% vs 77%; stage IV, 19% vs 30%).³⁵ In one study, health insurance coverage status accounted for more than one-third of the Black-White disparity in breast cancer survival among nonelderly patients after adjusting for patient demographics, treatment differences, and other clinical factors (eg, tumor characteristics).³⁶ Because of structural racism, Black women face barriers in access to socioeconomic and health care resources, leading to higher exposure to health hazards and

prevalence of comorbidities and unfavorable tumor characteristics (eg, higher incidence of triple-negative tumors), which also contribute to the survival disparity.^{36,37} Notably, however, Black women have lower survival for every molecular subtype.^{38,39}

Short-term and long-term health effects

The precise incidence of breast cancer-related arm lymphedema is difficult to determine because of the condition's long latency, with incidence generally peaking 12 to 30 months after initial treatment.⁴⁰ It has been estimated that the condition occurs in at least one-fifth of patients after axillary lymph node dissection (ALND) and in approximately 6% of patients after sentinel lymph node biopsy.⁴¹ However, the risk of chronic arm lymphedema may be greatly reduced through prospective surveillance and early management of the condition; in one meta-analysis that examined the efficacy of this approach, the cumulative incidence of chronic arm lymphedema among

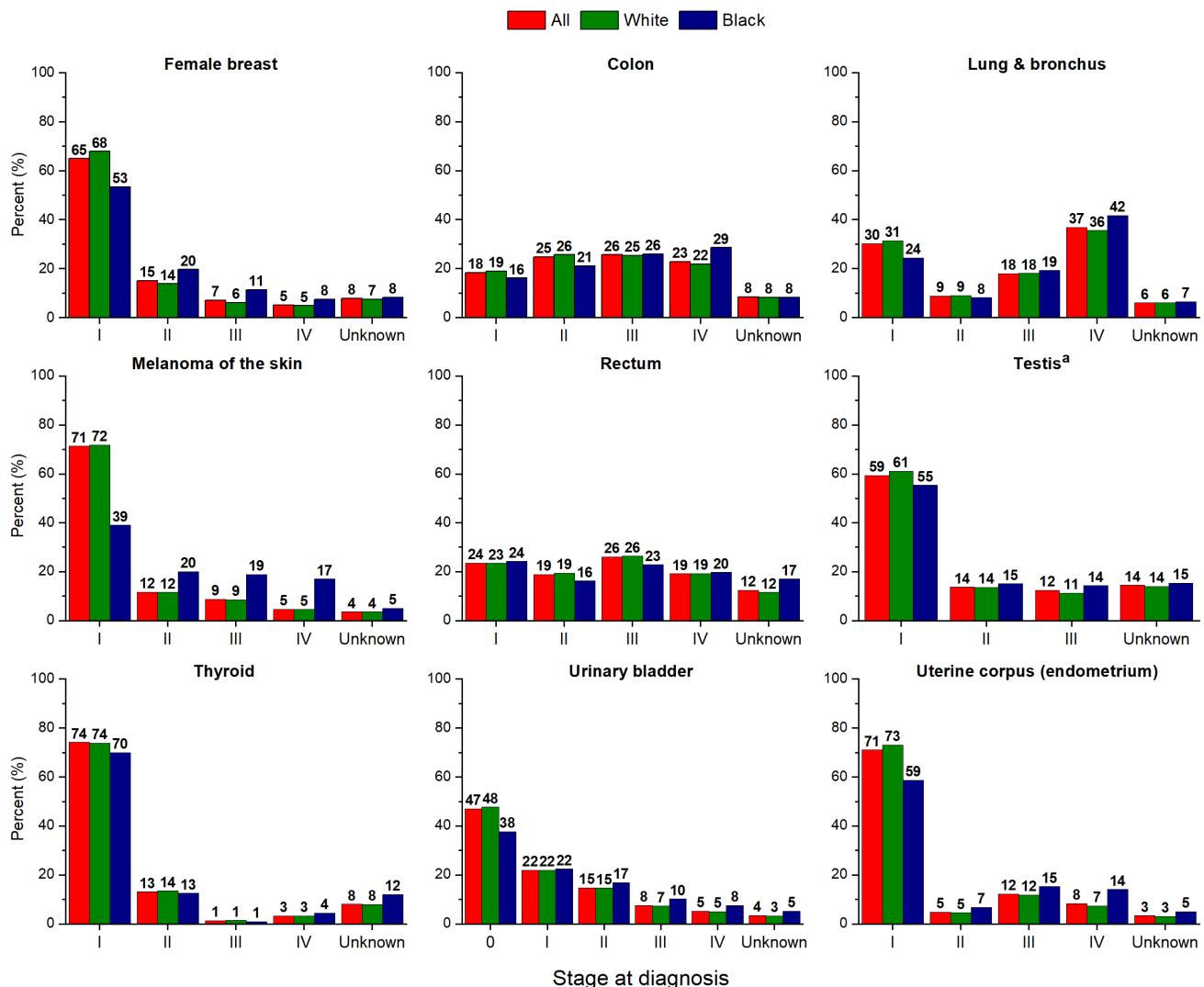


FIGURE 4. Stage Distribution (%) by Race and Cancer Type, 2018. Categories for White and Black race exclude persons of Hispanic ethnicity. Stage is based on the American Joint Committee on Cancer's (AJCC's) Staging Manual. *Testicular cancer does not have a stage IV classification according to the AJCC 7th and 8th editions, and data are for the years 2014 through 2018.

women who underwent ALND was only 6%.⁴² Cancer rehabilitation can reduce the risk and lessen the severity of the chronic condition.^{43,44} In large part because of limited access to these services, women of lower socioeconomic status are disproportionately burdened by the condition.⁴⁵ Other long-term effects of surgical and radiation treatment include numbness, tingling, or tightness in the chest wall, arms, or shoulders. Recent studies suggest that approximately one-third of women develop persistent pain after breast cancer surgery or radiation therapy,⁴⁶ with younger women and those who undergo ALND having the highest risk.⁴⁷

Sexual dysfunction and fertility concerns are common in breast cancer survivors.^{48,49} In particular, hormonal treatments for breast cancer can cause menopausal symptoms, such as hot flashes, night sweats, and atrophic vaginitis, which can lead to dyspareunia.⁵⁰ Poor body image after surgery may also lower sexual health.⁴⁹ Furthermore, some chemotherapeutic agents are gonadotoxic and can lead to premature menopause.^{51,52} As such, fertility counseling is recommended for all premenopausal patients with breast cancer.⁵¹ Recent studies have suggested that modest breast cancer treatment delays for fertility preservation do not significantly increase all-cause or breast cancer-specific mortality or recurrence.^{53–55}

Breast cancer survivors may also experience cognitive impairment and fatigue, which may become chronic.^{43,56} Several chemotherapeutic agents are associated with long-term adverse outcomes, such as persistent neuropathy after treatment with taxanes.⁵⁷ Importantly, anthracyclines and HER-2-targeted drugs can lead to cardiomyopathy and congestive heart failure.⁵⁸ The American Society for Clinical Oncology has issued guidelines for the prevention and monitoring of cardiomyopathies and other cardiovascular irregularities associated with these treatments.⁵⁹ Ovarian suppression in younger women and treatment with aromatase inhibitors, which are generally reserved for postmenopausal women, can cause osteoporosis, and may also cause myalgia and arthralgia.^{60,61} Tamoxifen treatment can slightly increase the risk of endometrial cancer and thromboembolic disease in women older than 55 years.^{62,63}

Colon and Rectum (Colorectum)

It is estimated that, as of January 1, 2022, there were more than 1.4 million men and women living in the United States with a previous colorectal cancer diagnosis, and 151,030 new cases will be diagnosed with the disease in 2022. Three-quarters (73%) of colorectal cancer survivors—more than 1 million men and women—are aged 65 years and older, although there are 72,660 survivors (5%) younger than 50 years (Fig. 2). The median age at diagnosis for colorectal cancer is 65 years for males and 68 years for females¹¹ and has rapidly shifted younger since the early 2000s because of incidence rising in adults younger than 50 years while declining in older age groups.⁶⁴ Reasons for the increase in

young adults remain unknown but may be related to changes in diet, physical inactivity, and the obesity epidemic.

Treatment and survival

The majority of patients with stage I and II colon cancer undergo colectomy without chemotherapy (84%), whereas approximately two-thirds of patients with stage III colon cancer (as well as some patients with high-risk stage II disease)⁶⁵ receive adjuvant chemotherapy to lower the risk of recurrence (Fig. 5). For patients with rectal cancer, proctectomy or proctocolectomy is the most common treatment (61%) for those who have stage I disease, with approximately one-half also receiving neoadjuvant radiation or chemotherapy (Fig. 6). Stage II and III rectal cancers are usually treated with neoadjuvant chemoradiotherapy and surgery. About one-half (49%) of patients with stage IV colon cancer and 29% of those with stage IV rectal cancer receive surgical treatment, usually with chemotherapy and/or radiotherapy. For unresectable stage IV disease, treatment may include an initial induction chemotherapy regimen followed by observation, maintenance, or continuation of the induction regimen.⁶⁶ More than one-half of patients who have metastatic colorectal cancer have tumors with specific molecular profiles (eg, KRAS/NRAS/BRAF wild-type tumors or those with BRAF V600E sequence variations; microsatellite instability), for which several targeted drugs or immunotherapies are also available.⁶⁷

Racial disparities in treatment are much greater for rectal cancer than for colon cancer, likely reflecting, at least in part, greater complexity in the management of care. Black patients are less likely than White patients to receive surgery for early stage colon and rectal cancers, with the disparity much wider for rectal cancer than that previously observed for colon cancer.^{68,69} Black patients who have stage I rectal cancer are substantially less likely than White patients to receive proctectomy or proctocolectomy (41% vs 66%, respectively), and 7% receive no treatment at all compared with 3% of White patients (Fig. 6). Furthermore, 57% of Black individuals with stage II/III disease receive neoadjuvant chemoradiotherapy before proctectomy or proctocolectomy compared with 60% of White individuals. Sphincter-preserving surgery for patients with rectal cancer has been associated with improved outcomes and higher quality of life; however, patients who are male, aged 70 years or older, uninsured, or Black are less likely to receive this procedure.^{70,71}

The 5-year relative survival rate for colorectal cancer has improved from 50% during the mid-1970s to 65% for patients diagnosed during 2011 through 2017, reflecting both earlier diagnosis through screening and advances in surgical techniques and novel systemic therapies. The 5-year survival rate is slightly higher for patients who have rectal cancer (67%) than for those who have colon cancer (64%), reflecting the higher proportion of patients with rectal

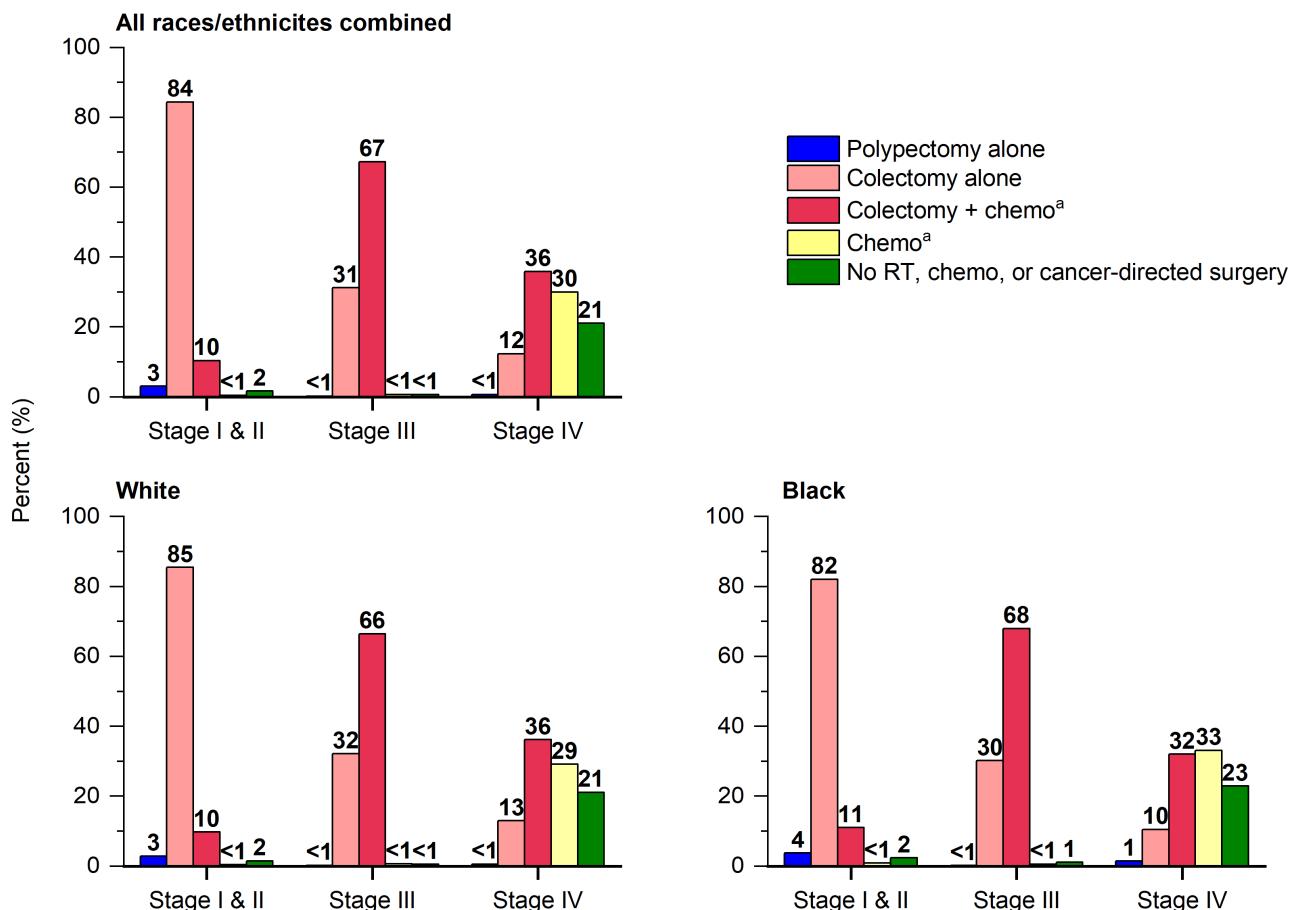


FIGURE 5. Colon Cancer Treatment Patterns (%) by Stage, 2018. Categories for White and Black race exclude persons of Hispanic ethnicity. ^aA small number of these patients also receive radiation therapy (RT). ^bOnly a very small proportion of patients receive RT alone. Chemo indicates chemotherapy (includes targeted therapy and immunotherapy).

cancer who are diagnosed with stage I disease (Fig. 4). The 5-year survival rate is >90% for stage I colon and rectal cancers but declines to 11% and 15%, respectively, for stage IV disease.

Health insurance coverage is strongly linked to the quality of care, with privately insured patients who have colon cancer more than twice as likely as uninsured patients to receive either surgical resection for stage I/II disease or adjuvant chemotherapy for stage III disease in one nationwide study.⁶⁸ As a result of these types of disparities, patients with stage II colorectal cancer who have private insurance have higher 5-year observed survival than those with stage I disease who are uninsured (Fig. 7). Disparities in access to health insurance coverage have been estimated to account for about one-half of the Black-White survival disparity for patients with colorectal cancer aged 18 to 64 years.⁷²

Short-term and long-term health effects

Neuropathy is a common side effect of the chemotherapy regimens typically used for colorectal cancer that contain oxaliplatin.⁷³ Recent pooled analyses have demonstrated the

safety of reducing the duration of oxaliplatin-based regimens to lower the risk of persistent neurotoxicity among appropriately selected patients.^{74,75} Chemotherapy-related diarrhea occurs in many patients treated for colorectal cancer but usually resolves.^{76,77} Other bowel dysfunction, including increased stool frequency, incontinence, radiation proctitis, and perianal irritation, is common among rectal cancer survivors, especially those treated with pelvic radiation.^{78,79}

Survivors may also suffer from bladder dysfunction, sexual dysfunction, infertility, and negative body image.^{50,80,81} Studies suggest that survivors of colorectal cancer have a higher prevalence of sexual dysfunction than survivors of other cancers,⁸² especially among patients with a permanent ostomy.⁸³ Patients with a colostomy require a referral to a trained ostomy therapist or nurse.⁸⁴ Reproductive-aged patients treated with pelvic radiation may suffer from impairment of the ovaries or testes as a result of exposure.⁸⁵ For women treated with pelvic radiation who are interested in fertility preservation, ovarian transposition is an option in addition to other fertility-preservation strategies (eg, egg cryopreservation).⁵¹

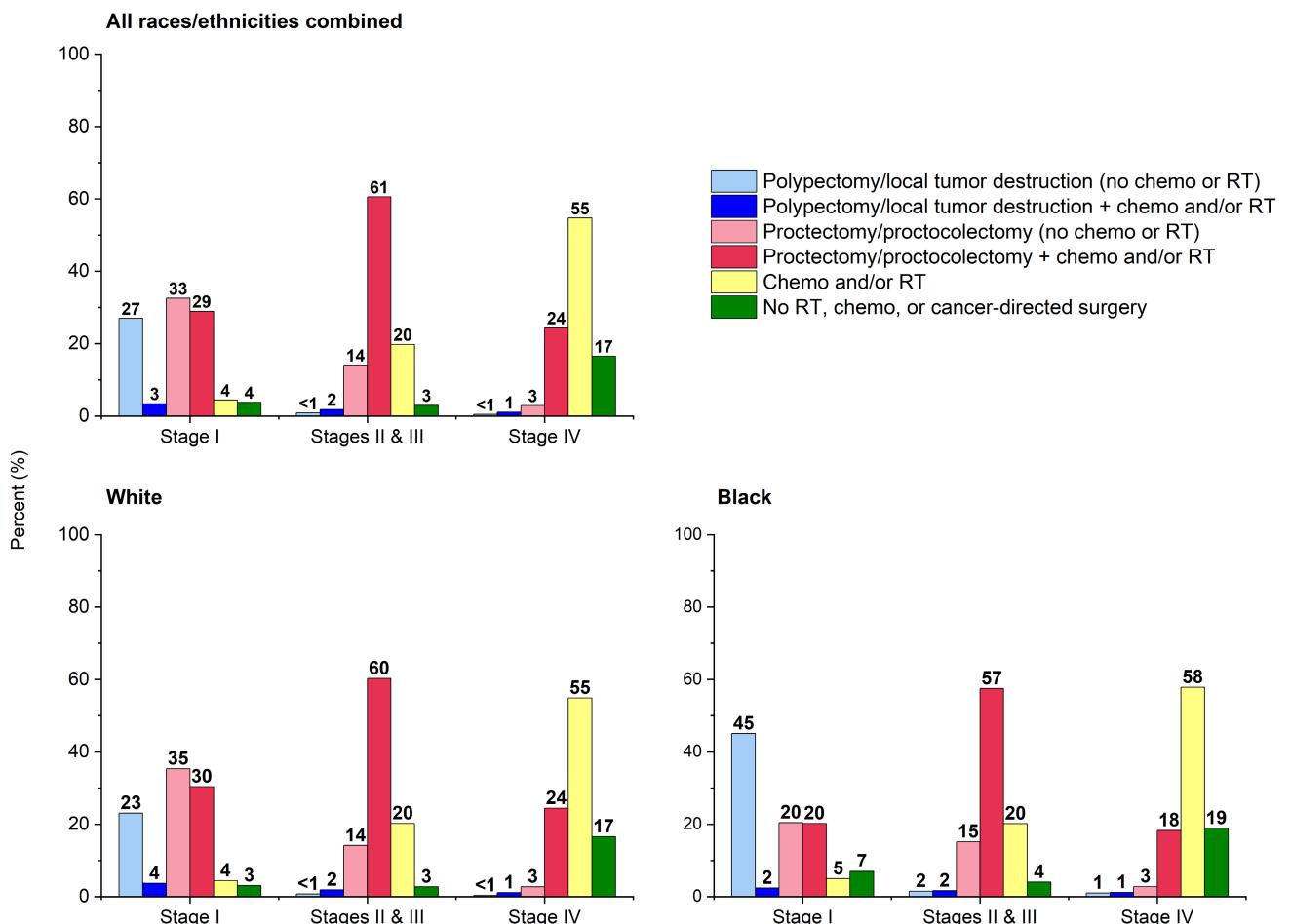


FIGURE 6. Rectal Cancer Treatment Patterns (%) by Stage, 2018. Categories for White and Black race exclude persons of Hispanic ethnicity. Chemo indicates chemotherapy (includes targeted therapy and immunotherapy); RT, radiation therapy.

Leukemias and Lymphomas

There are an estimated 526,730 leukemia survivors living in the United States, and 60,650 people will be newly diagnosed with the disease in 2022. Although leukemia is the most common type of cancer diagnosed among children aged birth to 14 years, the majority (93%) of patients with leukemia are diagnosed at age 20 years or older.⁷ Acute lymphocytic leukemia (ALL) is most common among children and teens, whereas acute myeloid leukemia (AML), chronic lymphocytic leukemia/small lymphocytic leukemia (CLL/SLL [hereinafter CLL]), and chronic myeloid leukemia (CML) are most common among adults. CLL is included among leukemias for the purpose of reporting trends, although it is now recognized as a type of lymphoma. The median age at diagnosis is 17 years for ALL, 65 years for CML, 68 years for AML, and 70 years for CLL.¹¹

There are 2 major types of lymphoma: Hodgkin lymphoma (HL) and non-Hodgkin lymphoma (NHL). It is estimated that, as of January 1, 2022, there were 229,040 HL survivors and 845,550 NHL survivors. In addition, approximately

8,540 new cases of HL and 80,470 new cases of NHL will be diagnosed in 2022. Nearly half (49%) of HL cases occur in ages <40 years, whereas the vast majority of NHL cases (87%) are in adults aged 50 years or older,⁷ with the median age at diagnosis of 39 versus 67 years.¹¹

Treatment and survival for the most common types of leukemia and lymphoma

Acute myeloid leukemia. AML is often divided into acute promyelocytic leukemia (APL) and non-APL for treatment. APL, a rare subtype of AML (approximately 10%–15% of new cases), has a much better prognosis and can be treated with arsenic trioxide and all-trans retinoic acid (as induction therapy).⁸⁶ Chemotherapy is the standard treatment for most patients with AML, although many older adults are not able to tolerate the most aggressive and potentially curative protocols.⁸⁷ In addition to standard regimens, non-APL AML may be treated with an antibody-drug conjugate⁸⁸ as well as targeted therapy drugs.⁸⁹ Although complete remission is achieved in many patients (60%–85% of adults aged 60 years or younger and 40%–60% of those

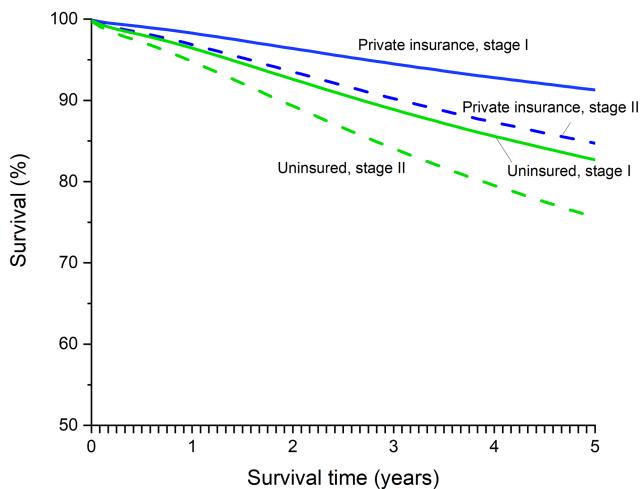


FIGURE 7. Disparities in Observed Colorectal Cancer Survival by Health Insurance Coverage and Stage, Ages 45 to 64 Years. Patients were diagnosed from 2013 to 2017 and followed through 2019.

older than 60 years), approximately one-half of these patients relapse.⁸⁷ The prognosis is substantially better for children and adolescents, for whom the 5-year relative survival rate is 69%. Five-year survival declines to 58%, 35%, and 9% for patients aged 20 to 49, 50 to 64, and 65 years and older, respectively.³³

Chronic myeloid leukemia. Modern treatment of CML was transformed by tyrosine kinase inhibitors (TKIs) aimed at the BCR-ABL protein, which induce remission in most patients. Recent studies have found that these drugs can be safely discontinued after the initial course in a subset of patients,⁹⁰ which can substantially improve quality of life.⁹¹ Stem cell transplantation may be used in younger patients and in those who become resistant to TKIs, whereas chemotherapy is only used in TKI-resistant cases. Primarily because of the development and widespread use of the BCR-ABL TKIs, the 5-year survival rate for CML doubled from 34% for patients diagnosed during 1994 through 1996 to 71% for those diagnosed during 2011 through 2017.^{11,33}

Acute lymphocytic leukemia. Chemotherapy is the standard treatment for ALL, with typically more aggressive protocols used in children than in adults, including more intensive central nervous system therapy.⁹² Patients with Philadelphia-chromosome positive ALL, which accounts for up to 30% of adult cases but is relatively rare (<5%) in children,⁹³ may benefit from the addition of a BCR-ABL TKI to chemotherapy. More than 95% of children and from 78% to 92% of adults with ALL attain remission.⁹⁴ Allogeneic stem cell transplantation is recommended for some patients who have high-risk disease characteristics and for those who relapse after remission or who fail to achieve remission after successive courses of induction chemotherapy. Chimeric

antigen receptor (CAR) T-cell therapy is also an option for patients with a specific subtype of ALL who have relapsed or have not responded to other treatments.⁹⁵

Survival rates for ALL have increased steadily since the mid-1970s, from 7% to 40% among adults aged 20 years and older and from 54% to 89% in children and adolescents, largely reflecting the optimization of chemotherapeutic regimens by age.^{33,35} Although there is some evidence that adults younger than 50 years may have a survival benefit with limited toxicity when treated with a more aggressive regimen akin to pediatric protocols,⁹² research is still ongoing.

Chronic lymphocytic leukemia/small lymphocytic leukemia. CLL is the most common type of leukemia in adults, with 95% of cases diagnosed in individuals aged 50 years and older.⁷ The disease is slow-growing, and treatment is generally reserved for symptomatic patients or for those who have cytopenia or other complications because it is unlikely to result in a cure and may not prolong survival.^{96–98} Available treatments include chemotherapy, immunotherapy, targeted therapy, radiation therapy, and splenectomy. CAR T-cell immunotherapy has also been used in patients with disease that has relapsed or has not responded to other treatments.⁹⁵ The overall 5-year relative survival rate for CLL is 87%; however, there is large variation in survival among individual patients, ranging from several months to a normal life expectancy. Approximately 5% to 10% of patients with CLL also develop diffuse large B-cell lymphoma (DLBCL), a process known as *Richter transformation*.⁹⁹

Hodgkin lymphoma. Of the 2 major types of HL, classical HL is the most common and is characterized by the presence of Reed-Sternberg cells. Nodular lymphocyte-predominant HL (NLPHL) comprises only about 5% of cases⁷ and is a more indolent disease with a generally favorable prognosis.¹⁰⁰

Classical HL is generally treated with multiagent chemotherapy, sometimes in combination with radiation therapy, although the use of radiotherapy is declining.¹² Stem cell transplantation or treatment with the targeted antibody-drug conjugate brentuximab vedotin may be options for refractory disease.¹⁰¹ For patients with NLPHL, radiation alone may be appropriate for early stage disease,¹⁰² whereas chemotherapy plus radiation, as well as the monoclonal antibody rituximab, may be recommended for those with more advanced disease. The 5-year survival rates for HL are 88% overall, 87% for classical HL, and 96% for NLPHL.

Non-Hodgkin lymphoma. The most common types of NHL are DLBCL, representing about 4 in 10 cases, and follicular lymphoma, representing about 1 in 5 cases.⁷ Although DLBCLs grow quickly, most patients with localized disease and approximately 50% with advanced-

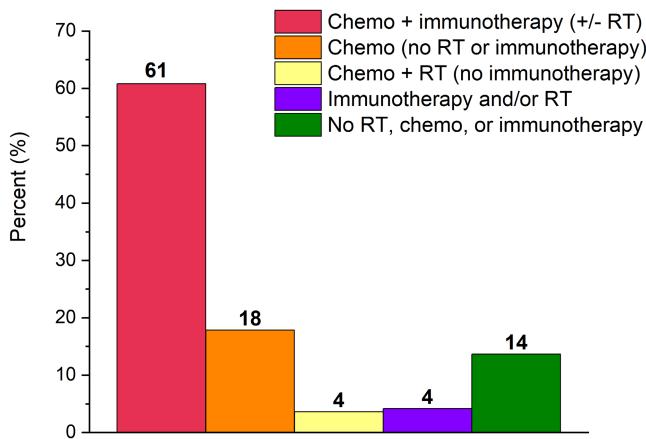


FIGURE 8. Diffuse Large B-Cell Treatment Patterns (%), 2014 to 2018. Chemo indicates chemotherapy (includes targeted therapy); RT, radiation therapy.

stage disease are cured.^{103,104} Overall, most patients (61%) with DLBCL receive chemotherapy plus immunotherapy (such as rituximab), with or without radiation (Fig. 8). Less frequently, chemotherapy may also be used alone (18%) or with radiation therapy (4%), without immunotherapy.¹⁰⁵ Approximately 14% of patients with DLBCL receive no initial treatment, although the percentage is higher for early stage disease.¹² In contrast, follicular lymphomas tend to grow slowly and often do not require treatment until symptoms develop, although most are not considered curable.¹⁰⁶ For NHL that persists or recurs after standard treatment, stem cell transplantation or CAR T-cell therapy may be an option. The 5-year relative survival rate is 90% for follicular lymphoma and 64% for DLBCL.³⁵

Short-term and long-term health effects

People treated for leukemia and lymphoma can experience several significant late effects. Some leukemia and lymphoma survivors, such as those treated with stem cell transplantation, have problems with recurrent infections and anemia, which may require blood transfusions. Certain chemotherapy drugs, as well as high dose chemotherapy used for stem cell transplantation, can lead to infertility. Allogeneic transplantation, which is used most often to treat acute leukemias (and sometimes CML), can lead to chronic graft-versus-host disease, which can cause skin changes, dry mucous membranes (eyes, mouth, vaginal), joint pain, weight loss, shortness of breath, and fatigue.¹⁰⁷

Chest radiation for HL increases the risk for cardiac dysfunction as well as breast cancer among patients who were treated in childhood and adolescence.^{108,109} Patients who have HL, NHL, and ALL are commonly treated with anthracyclines, which can also be cardiotoxic. Some children with ALL who are at increased risk for central nervous system relapse receive cranial radiation therapy, which can cause long-term cognitive deficits.¹¹⁰

Lung and Bronchus

It is estimated that there are 654,620 men and women living in the United States with a history of lung cancer, and an additional 236,740 cases will be diagnosed in 2022. About three-fourths of lung cancer survivors were aged 65 years or older as of January 1, 2022 (Fig. 2), reflecting the older median age at diagnosis (71 years).¹¹ In part because of the low overall 5-year relative survival for the disease, more than half of lung cancer survivors (55%) were diagnosed within the past 5 years.

Treatment and survival

Lung cancer is classified as small cell lung cancer (SCLC) (14% of cases) or nonsmall cell lung cancer (NSCLC) (82% of cases) for the purposes of treatment, with approximately 3% of cases with unspecified histology.⁷ More than one-half (55%) of patients with stage I or II NSCLC undergo surgery with either wedge resection (partial removal of a lobe of the lung), sleeve resection (removal of the tumor and a portion of the affected airways), lobectomy (entire removal of an affected lobe), or pneumonectomy (removal of one lung) (Fig. 9). In contrast, only 21% of patients with stage III NSCLC undergo surgery, whereas most (61%) are treated with chemotherapy and/or radiation. Black individuals are much less likely to receive surgery than White individuals—49% versus 55% for stage I/II and 16% versus 22% for stage III. Black patients who receive treatment at academic centers and from surgeons who specialize in thoracic care are more likely to receive surgery and have higher survival than those who receive care at community centers, although large disparities in receipt of surgery compared with White individuals remain.^{111,112} Nearly 1 in 7 Black patients (15%) with stage I/II disease receive no treatment, compared to 10% of White patients (Fig. 9).

Recent advances in surgical treatment, such as improved staging and video-assisted thoracic surgery,¹¹³ have improved survival for every stage of NSCLC.¹¹⁴ There are also several targeted and immunotherapy drugs available to treat NSCLC, such as angiogenesis inhibitors, epidermal growth factor receptor (EGFR) inhibitors, and anaplastic lymphoma kinase (ALK) inhibitors. Recently, immunotherapy drugs that act by targeting the programmed cell death receptors on T cells (programmed death-ligand 1 and programmed cell death protein 1 inhibitors) have been approved to treat some types of NSCLC as well as in combination with chemotherapy for SCLC.¹¹⁵ Uptake of immunotherapy, which was only approved by the US Food and Drug Administration in 2015, has been rapid; in 2018, approximately 33% of patients with newly diagnosed, stage IV NSCLC received immunotherapy, up from 12% in 2016.^{12,116}

Advances in early detection and improved treatment options have nearly doubled 5-year relative survival since the early 1990s, from 13% for patients diagnosed during

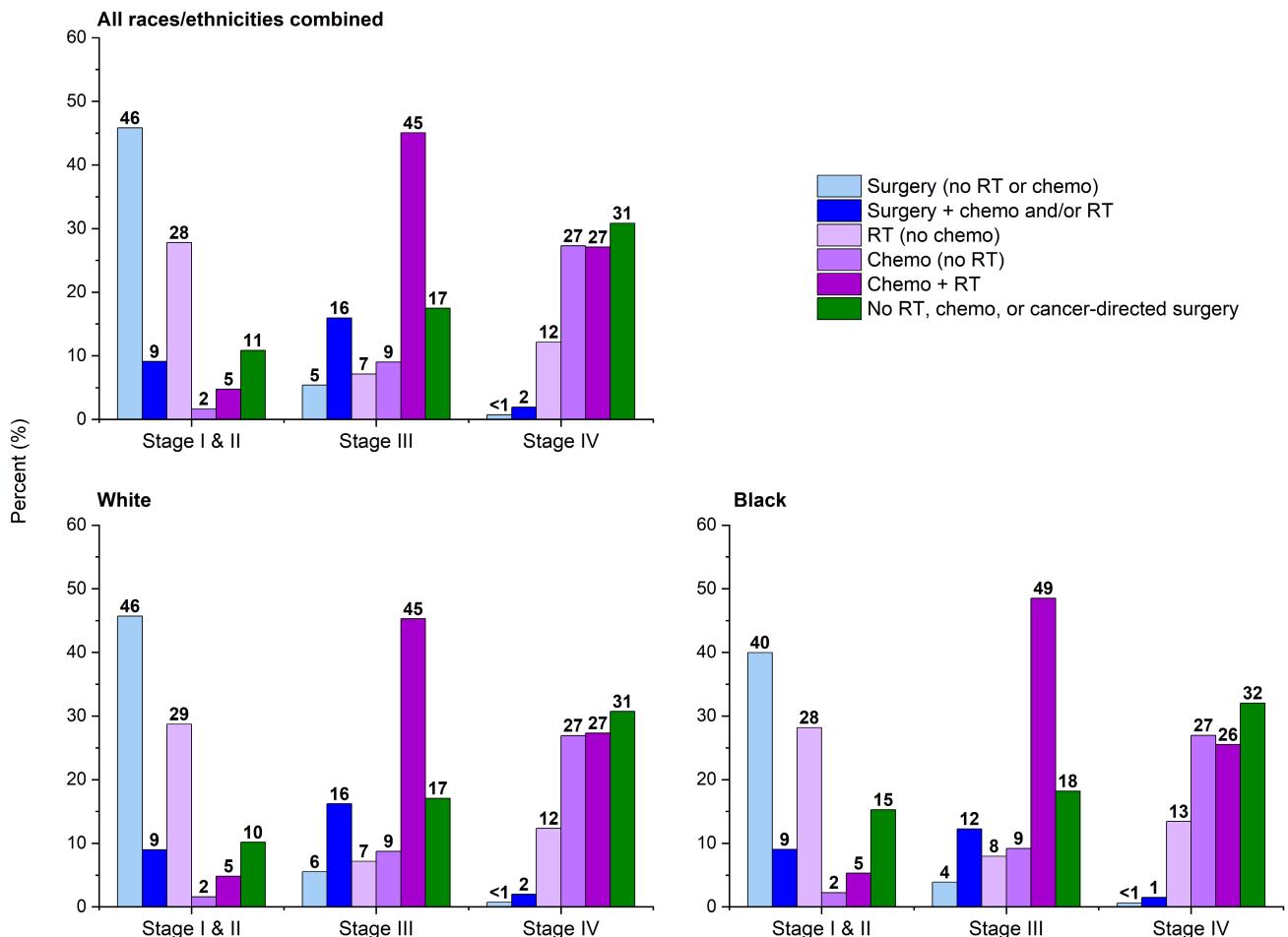


FIGURE 9. Non-small Cell Lung Cancer Treatment Patterns (%) by Stage, 2018. Categories for White and Black race exclude persons of Hispanic ethnicity. Chemo indicates chemotherapy (includes targeted therapy); RT, radiation therapy.

1989 through 1991 to 22% for those diagnosed during 2011 through 2017 (White patients, 22%; Black patients, 20%).^{33,35} However, most cases are advanced at diagnosis because early disease is typically asymptomatic. Only 30% of cases are diagnosed at stage I (Fig. 4), for which the 5-year survival rate is 65%, declining to 5% for stage IV.³⁵ The 5-year survival rate for SCLC (7%) is lower than that for NSCLC (26%) overall and for every stage.

Short-term and long-term health effects

Many lung cancer survivors have impaired pulmonary function before treatment that can be exacerbated by surgery and/or radiation and may be a contraindication to treatment.¹¹⁷ In some cases, respiratory therapy and medications can improve fitness and allow survivors to resume normal daily activities. Treatment with EGFR inhibitors can lead to a severe acneiform rash. Immunotherapy drugs used in lung cancer treatment can lead to several immune-mediated toxicities, including pneumonitis, colitis, nephritis, and endocrinopathy.

Lung cancer survivors who smoke or used to smoke are at increased risk for additional smoking-related cancers,

especially in the head and neck and urinary tract, as well as second lung cancers and other smoking-related health problems. Survivors may feel stigmatized because of the social perception that lung cancer is a self-inflicted disease, which can be particularly difficult for those who never smoked.¹¹⁸ Data suggest that smoking cessation after lung cancer diagnosis reduces the risk of subsequent cancer and improves prognosis,^{119,120} highlighting the importance of patient and clinician discussions about smoking status and improving access to cessation resources.¹²¹

Melanoma of the Skin

It is estimated that there are nearly 1.5 million skin melanoma survivors living in the United States, and 99,780 people will be newly diagnosed with invasive disease in 2022. About 4 in 10 melanoma survivors (569,900 men and women) are younger than 65 years, including 177,310 survivors who are younger than 50 years (Fig. 2). Women tend to be diagnosed at a younger age than men (median age, 61 vs 67 years, respectively),¹¹ reflecting differences in occupational and recreational exposure to ultraviolet radiation.

Treatment and survival

Surgery is the primary treatment for most melanomas. Patients with stage III disease may be offered adjuvant immunotherapy (nivolumab or pembrolizumab).^{122–124} Treatment for patients with stage IV melanoma has changed in recent years and typically includes immunotherapy (ipilimumab, pembrolizumab, nivolumab, and relatlimab with nivolumab) or targeted therapy.^{125–128} Receipt of BRAF/MEK inhibitors improves survival for the 1 in 2 patients who have melanoma with a *BRAF* mutation.¹²⁹ Almost one-half of patients with metastatic disease who receive systemic therapy also receive radiation therapy.¹²

The 5-year relative survival rate for melanoma is 93% for patients who were diagnosed during 2011 through 2017, up from 82% for patients who were diagnosed in the mid-1970s, largely because of increased detection of early stage disease throughout the 1980s and 1990s.^{11,33,130} Most patients with melanoma are diagnosed at stage I (71%; Fig. 4), for which the 5-year relative survival rate approaches 100%.³⁵ For the small proportion of patients diagnosed with stage IV melanoma, relative survival has increased in recent years because of advances in systemic therapy with BRAF/MEK inhibitors and immunotherapy,¹³¹ with the 3-year relative survival rate rising from 22% for patients diagnosed during 2010 through 2012 to 34% for those diagnosed during 2015 through 2017.³⁵

Short-term and long-term health effects

Depending on the size and location of the melanoma, removal of these cancers can be disfiguring. Male and female melanoma survivors are nearly 13 and 16 times, respectively, more likely than the general population to develop additional melanomas because of skin type and other genetic or behavioral risk factors.¹³² From 10% to 15% of patients who are treated with ipilimumab experience potentially fatal autoimmune-related side effects,¹³³ which occur less often with single-agent pembrolizumab or nivolumab.¹³⁴ Patients who are treated with BRAF inhibitors have an increased risk of developing squamous cell skin cancers¹³⁵ that is attenuated with the addition of an MEK inhibitor.¹³⁶

Prostate

It is estimated that there are more than 3.5 million men with a past diagnosis of prostate cancer in the United States, and 268,490 cases will be newly diagnosed in 2022. The majority (85%) of prostate cancer survivors are older than 65 years, whereas <1% (12,630) are younger than 50 years (Fig. 2). The median age at diagnosis is 67 years.¹¹

Treatment and survival

Treatment options vary, depending on stage and grade of the tumor as well as patient characteristics, such as age, comorbidity, and personal preferences. Active surveillance rather than immediate treatment is commonly recommended for

low-risk, localized cancer or for patients who are older and/or have other serious health conditions.^{137–139} After publication of the 2010 National Comprehensive Cancer Network guideline to minimize overtreatment,¹⁴⁰ active surveillance of low-risk disease increased from 15% in 2010 to 42% in 2015, whereas radical prostatectomy declined from 47% to 31%.¹⁴¹ Previous studies have suggested that the increase in active surveillance is most pronounced among men with low-risk disease aged 75 years and older,¹⁴² but it does not appear to vary substantially by race/ethnicity after accounting for tumor differences.^{143–145} Racial disparities in treatment are largest among men with early stage, high-risk disease.¹⁴⁶

For advanced disease, androgen-deprivation therapy (ADT), chemotherapy, bone-directed therapy (such as zoledronic acid or denosumab), radiation, or a combination of these treatments may be used. Radioligand therapy was also recently approved in the United States for use in individuals with metastatic, castration-resistant prostate cancer in combination with standard regimens.¹⁴⁷ Additional forms of hormone therapy, such as abiraterone and enzalutamide, are also available to treat advanced prostate cancer that is no longer responding to traditional hormone therapy^{148,149} and are now also used in castration-sensitive disease.

The 5-year relative survival rate for all stages combined increased from 68% in the mid-1970s to 98% in the most recent period (2011–2017),¹¹ primarily reflecting lead time bias and overdiagnosis associated with prostate-specific antigen screening uptake in the late 1980s and 1990s. Most (84%) prostate cancers are discovered in the local or regional stages, for which the 5-year relative survival rate approaches 100%. The 5-year survival rate declines to 31% for patients with metastatic disease. (Survival is presented by SEER Summary stage because TNM stage IV disease also includes high-risk patients without metastasis.)

Short-term and long-term health effects

Surgery and radiotherapy for prostate cancer are associated with the risk of substantial physical impairments, including urinary incontinence, erectile dysfunction, and bowel complications.^{150–153} In one long-term follow-up study, >95% of patients with prostate cancer who were treated with surgery or radiation experienced some sexual dysfunction, and approximately 50% reported urinary or bowel dysfunction; patients who received radiation alone generally reported better outcomes than those who underwent radical prostatectomy.¹⁵⁴ Patients receiving hormonal treatment may experience loss of libido, hot flashes, night sweats, irritability, and gynecomastia. Sexual counseling in this population can be helpful in restoring comfort with intimacy.⁴⁸

In the long term, ADT also increases the risk of osteoporosis, obesity, and diabetes.¹⁵⁵ Certain bone-targeted therapies can reduce skeletal morbidity, including bone pain, in patients with metastatic, castration-resistant disease.¹⁵⁶ Careful

monitoring of cardiovascular risk factors is recommended in men who have received ADT^{157,158} because data are conflicting regarding whether there is an increased risk of cardiovascular disease or death associated with the use of hormone therapy.¹⁵⁹

Testis

It is estimated that there are 303,040 testicular cancer survivors in the United States, and an additional 9,910 men will be diagnosed in 2022. Testicular germ cell tumors (TGCTs) account for approximately 96% of all testicular cancers.⁷ The 2 main types of TGCTs are seminomas (15%) and nonseminomas (56%), with an additional 29% of mixed histology.⁷ Nonseminomas generally occur in men in their late teens to early 40s and tend to be more aggressive, whereas seminomas are generally diagnosed in men in their late 30s to early 50s and are slow-growing.

Treatment and survival

The most common treatment for stage I seminomas is inguinal orchectomy without chemotherapy or radiation (78%), whereas most patients with stage II disease receive chemotherapy (66%), radiation (19%), or both (<1%) in addition to surgery (Fig. 10). Over the last decade, postsurgical active surveillance has become an increasingly preferred management option for patients with stage I seminomas, as supported by long-term studies.¹⁶⁰ Late-stage seminomas are generally treated with surgery and chemotherapy without radiation (68%) (Fig. 10). For men with stage I nonseminomas, more than one-half are treated with orchietomy alone, whereas the majority of patients with stage II tumors receive further treatment in addition to the initial surgical procedure, including chemotherapy (49%), retroperitoneal lymph

node dissection (RPLND) (11%), or both (31%) (Fig. 10). Men with metastatic nonseminomas are usually treated with chemotherapy in addition to orchietomy, with or without RPLND.

Testicular cancer survival has increased from 83% in patients who were diagnosed during the mid-1970s to 95% in the most recent time period, largely because of the success of chemotherapy regimens for advanced disease. Five-year relative survival is lower for nonseminomas (90%) than for mixed TGCTs (94%) and seminomas (98%), regardless of age.³⁵ More than one-half (59%) of patients are diagnosed at stage I, for which the 5-year relative survival rate is 99%. The prognosis for metastatic testicular cancer is favorable compared with that for most other metastatic cancers, with a 5-year survival rate of 75%.

Short-term and long-term health effects

Many men with testicular cancer have impaired fertility before treatment.¹⁶¹ Consultation about fertility status and risks before treatment and referral for sperm banking, as appropriate, is important in efforts to promote quality-of-life outcomes.⁵¹ RPLND can lead to retrograde ejaculation, making unassisted reproduction impossible.

Men treated with chemotherapy have increased risks of coronary artery disease as they age, so these patients and their physicians should be particularly mindful of risk factors such as hyperlipidemia, hypertension, obesity, and smoking.¹⁶² Cisplatin-based chemotherapy causes ototoxicity in approximately one-fifth of recipients and causes neuropathy in 20% to 40%.¹⁶³ Men who have bilateral tumors have both testes removed and require lifelong testosterone supplementation.

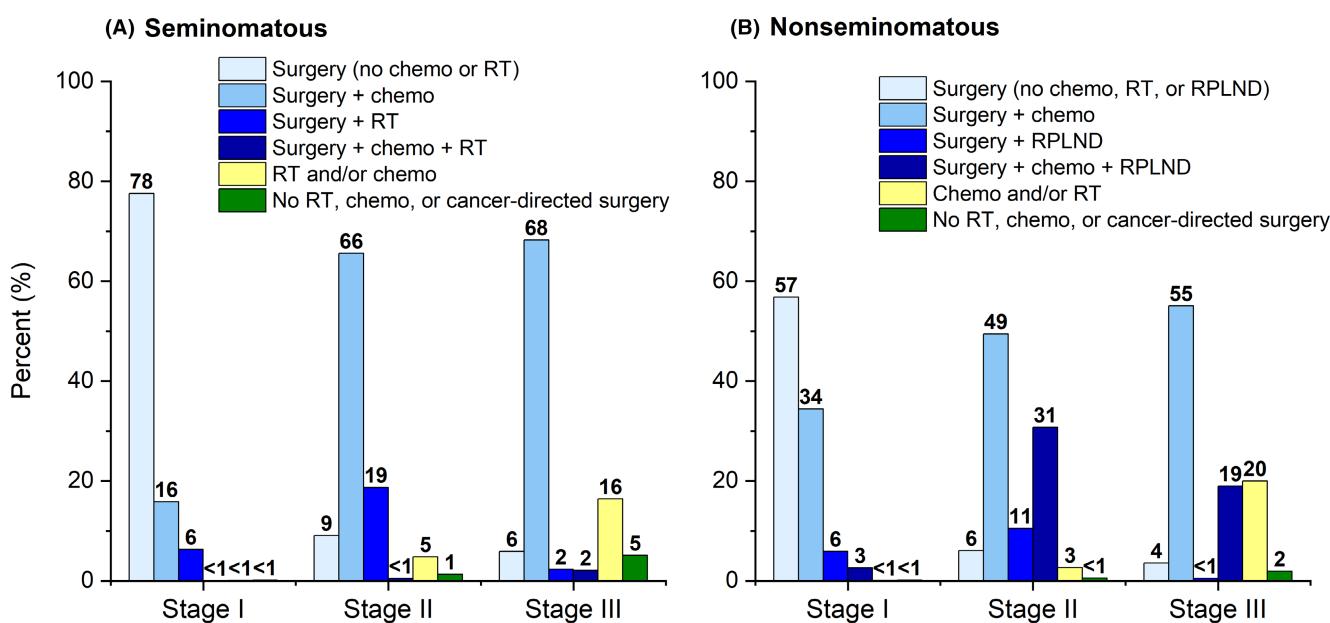


FIGURE 10. Treatment Patterns (%) for Testicular Germ Cell Tumors, 2014 to 2018. The tumors did not include mixed cell types. Note that surgery includes orchietomy and other local excision and tumor destruction procedures but does not include retroperitoneal lymph node dissection (RPLND). Chemo indicates chemotherapy (includes targeted therapy and immunotherapy drugs); RT, radiation therapy.

Thyroid

It is estimated that there are nearly 1.1 million people living with a previous thyroid cancer diagnosis in the United States, and an additional 43,800 will be diagnosed in 2022. The majority of thyroid cancer survivors are women (77%), with an incidence more than double that in men.⁶ The median age at diagnosis—55 years for males and 50 years for females—is younger than that for most other adult cancers.¹¹

Treatment and survival

Most thyroid cancers are highly curable papillary or follicular carcinomas, but approximately 3% are medullary or anaplastic carcinomas,⁶ which are more difficult to treat because they do not respond to radioactive iodine treatment.¹⁶⁴ These types of thyroid cancers also grow more quickly and often have metastasized at diagnosis.

Initial treatment in nearly all cases of thyroid cancer is surgery, with most patients receiving total or partial thyroidectomy.¹² Approximately one-half of surgically treated patients with papillary or follicular thyroid cancer receive radioactive iodine (I-131) after surgery to destroy any remaining thyroid tissue and cancer.¹⁶⁵ However, a recent clinical trial of low-risk thyroid cancer found no benefit of adjuvant radioiodine at 3 years of follow-up.¹⁶⁶ After total thyroidectomy, thyroid hormone therapy is required and is often prescribed in a dosage sufficient to inhibit pituitary production of thyroid-stimulating hormone to decrease the risk of recurrence.

Total thyroidectomy is the primary treatment for patients with medullary thyroid cancer. Radiation therapy may be given after surgery to reduce the risk of local recurrence for high-risk patients.¹⁶⁷ Targeted drugs can be useful in treating metastatic disease. Although anaplastic thyroid cancers are often resistant to treatment, those with BRAF V600E mutations respond to BRAF/MEK inhibitors.¹⁶⁸ In selected cases, radiation therapy alone or in combination with chemotherapy may be used.

The 5-year relative survival rate for patients with thyroid cancer has exceeded 90% since at least the mid-1970s; for patients who were diagnosed during 2011 through 2017, the overall 5-year survival rate was 98%. However, the 5-year survival for medullary and anaplastic carcinomas is 90% and 7%, respectively.³⁵

Short-term and long-term health effects

Patients who have undergone total thyroidectomy require thyroid hormone-replacement therapy, and thyroid hormone levels must be monitored to prevent hypothyroidism, which can cause cold intolerance and weight gain. Surgical removal of the thyroid gland can damage the underlying parathyroid glands, leading to problems with calcium metabolism. Surgery can also damage nerves to the larynx and lead to voice changes.¹⁶⁹ For those treated with I-131, there is a low risk of temporary loss of or change in taste as well

as damage to the salivary glands, such as dry mouth, dental caries, and dysphagia, that may have delayed onset.¹⁷⁰ Treatment with I-131 has also been found to increase the risk of subsequent cancers, particularly those of the salivary glands.¹⁷¹ Approximately 25% of medullary thyroid cancers occur as part of a genetic syndrome, such as multiple endocrine neoplasia type 2, so these patients should be screened for other syndromic cancers and referred for genetic counseling and possible testing.¹⁷²

Urinary Bladder

It is estimated that there are 789,730 urinary bladder cancer survivors living in the United States, with an additional 81,180 cases expected to be diagnosed in 2022. The vast majority of bladder cancer survivors are men (76%), reflecting the 3-fold higher incidence than in women. The median age at diagnosis is 73 years.¹¹

Treatment and survival

For the 70% of patients diagnosed with nonmuscle-invasive cancers (patients with Ta, Tis, or T1 tumors), most patients are diagnosed and treated with transurethral resection of the bladder tumor (TURBT), which may be followed by intravesical chemotherapy or biological therapy with *bacille Calmette–Guerin*.¹² Among patients with stage 0 disease, flat carcinoma in situ (CIS) is more likely to be high-grade and treated with bacille Calmette–Guerin than noninvasive papillary tumors.¹⁷³ (The NCDB does not distinguish between systemic and intravesical chemotherapy, but, based on treatment guidelines, it is likely that virtually all chemotherapy for bladder cancer is intravesical.)

Among appropriately selected patients with nonmetastatic disease, TURBT followed by combined chemotherapy and radiation therapy is as effective as cystectomy at preventing recurrence.^{174–176} The vast majority (91%) of patients with stage I bladder cancer and 62% of those with stage II disease are diagnosed and treated with TURBT, with or without chemotherapy and/or radiation (Fig. 11). In contrast, 61% of patients with stage III bladder cancer receive cystectomy, with or without chemotherapy and/or radiation (Fig. 12). Chemotherapy is usually the first treatment for cancers that have metastasized, but other treatments, such as immunotherapy (eg, checkpoint inhibitors) or TURBT, might be used as well. Previous studies have documented substantial disparities in the receipt of guideline-concordant care among Black patients with nonmetastatic, muscle-invasive disease, with patients in one study up to 85% less likely to receive optimal treatment.¹⁷⁷

For all stages combined, the 5-year relative survival rate is 77%,¹¹ which is up from 72% for patients who were diagnosed in the mid-1970s, but it is much lower among Black patients (65%) compared with White patients (78%). Stage 0 urinary bladder cancer is diagnosed in 47% of cases, for

which the 5-year relative survival rate is 96%.³⁵ The 5-year relative survival rate is 80% for the 1 in 5 patients diagnosed with stage I disease and declines to 14% for those diagnosed with stage IV disease.

Short-term and long-term health effects

Posttreatment surveillance is crucial given the high rate of recurrence.^{178,179} In one study, the 10-year prevalence of recurrence among patients with high-risk, nonmuscle-invasive

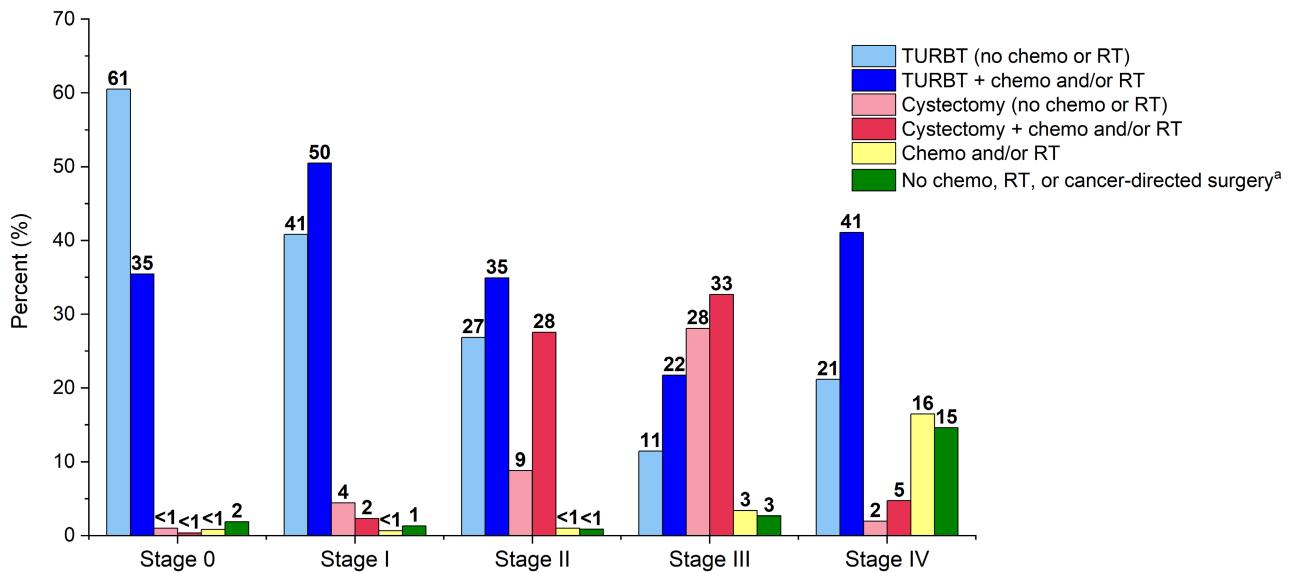


FIGURE 11. Urinary Bladder Cancer Treatment Patterns (%), 2018.^aThese patients may have received a surgical diagnostic procedure to determine staging. Chemo indicates chemotherapy (includes targeted therapy but does not include immunotherapy, which is shown in the inset); cystectomy, surgery that removes all or part of the bladder as well as the surrounding fatty tissue and lymph nodes; RT, radiation therapy; TURBT, transurethral resection of the bladder tumor.

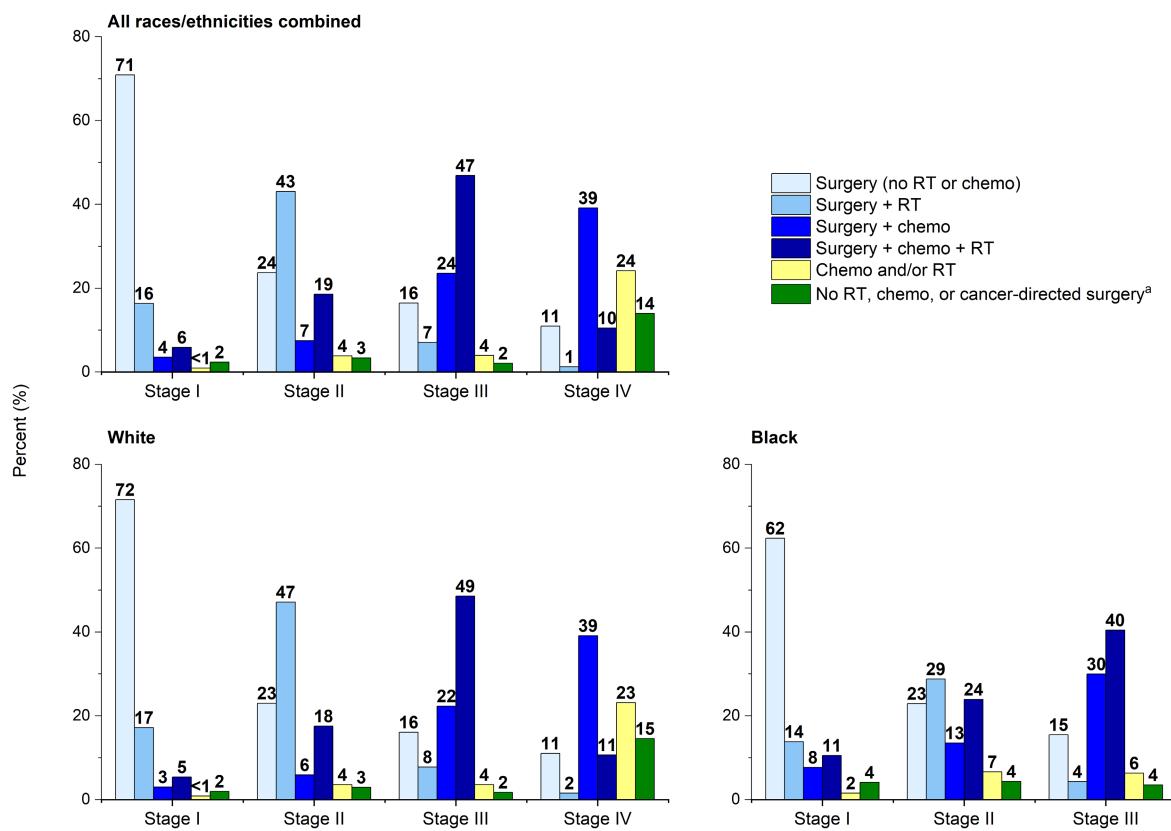


FIGURE 12. Endometrial Cancer Treatment Patterns (%) by Stage, 2018. Categories for White and Black race exclude persons of Hispanic ethnicity.^aSome of these patients may have received hormonal therapy. Chemo indicates chemotherapy (includes targeted therapy and immunotherapy drugs); RT, radiation therapy.

bladder cancer was 74%.¹⁸⁰ Surveillance can include urine biomarker assays, urine cytology, and/or cystoscopy. Patients requiring repeated bladder surgeries can end up with a small or scarred bladder, which may lead to urinary frequency or incontinence. Partial cystectomy results in a smaller bladder, sometimes causing more frequent urination. Patients undergoing total cystectomy require urinary diversion with construction of either a neobladder with urethral anastomosis or a urostomy. Those with a neobladder can retain most of their urinary continence after appropriate rehabilitation.¹⁸¹ However, creation of a neobladder remains much less common than urostomy (9% vs 91%), largely because of the complexity of the procedure; utilization is substantially higher at larger, higher volume hospitals.¹⁸²

Uterine Corpus (Endometrium)

There are an estimated 891,560 women living in the United States with a previous diagnosis of uterine corpus cancer, and 65,950 cases will be newly diagnosed in 2022. Cancer of the uterine corpus is often referred to as endometrial cancer because >90% of cases arise in the endometrium.⁷ It is the second most prevalent cancer among women after breast cancer and has a median age at diagnosis of 63 years.¹¹

Treatment and survival

Surgery without chemotherapy or radiation, consisting of hysterectomy often along with bilateral salpingo-oophorectomy, is used to treat 71% of patients with early stage (stage I) disease. Most patients with stage II endometrial cancer (67%) receive surgery alone or with radiation, whereas the majority of those with stage III disease (70%) receive surgery and chemotherapy with or without radiation (Fig. 12). One-half of patients with metastatic disease receive surgery followed by chemotherapy, with or without radiation. Clinical trials are currently assessing the most appropriate regimen of radiation and chemotherapy for women with metastatic or recurrent cancers.

Black patients are more likely to receive chemotherapy after surgery, with or without radiation, for both stage I and stage II endometrial cancer (Fig. 12), reflecting the higher proportion of Black women diagnosed with nonendometrioid, high-risk disease. When stratified by disease subtype, receipt of guideline-concordant therapy in hospital-based studies was lower among Black women than among White women for endometrioid subtypes,¹⁸³ but it was similar for nonendometrioid cancers.^{184,185} However, population-based studies of patients aged 65 years or older have reported that Black patients are more likely than White patients to have treatment delays and are less likely to receive adjuvant therapy regardless of histology.^{186,187}

Uterine corpus cancer is one of the few cancers for which survival has not substantially improved since the mid-1970s, reflecting few advances in treatment. However,

more than two-thirds of patients with uterine corpus cancer are diagnosed at stage I (usually because of postmenopausal bleeding), for which the 5-year survival rate is 95%.³⁵ The 5-year relative survival rate for all stages combined is 81%, but ranges from 84% for White women to 63% for Black women. Black women have a higher burden of aggressive tumor subtypes¹⁸⁸ and are substantially less likely to be diagnosed with stage I disease (59% vs 73%); however, survival in Black women is lower regardless of histology or stage,^{35,189} pointing to pervasive disparities in access to treatment.

Short-term and long-term health effects

Any hysterectomy causes infertility. Younger women with low-risk disease may elect to receive conservative surgical treatment.^{51,190} Bilateral oophorectomy causes menopause in premenopausal women, which can lead to symptoms such as hot flashes, night sweats, atrophic vaginitis, and osteoporosis. Long-term side effects of radiation therapy for uterine cancer can include bladder and bowel dysfunction as well as atrophic vaginitis and vaginal stenosis. Sexual problems are commonly reported among uterine cancer survivors.^{48,191} Approximately one-half of patients who have pelvic lymph nodes removed develop leg lymphedema compared with approximately one-third of those treated with hysterectomy alone.¹⁹²

Cancers in Children and Adolescents

It is estimated that there were 69,920 cancer survivors aged birth to 14 years (children) and 49,120 survivors aged 15 to 19 years (adolescents) living in the United States as of January 1, 2022, and an additional 10,470 children and 5,480 adolescents will be newly diagnosed in 2022. Leukemia survivors account for approximately one-third of all cancer survivors younger than 20 years.¹¹ Previously published complete prevalence estimates of all individuals with a history of childhood or adolescent cancer approach 400,000.¹⁹³

Treatment and survival

Pediatric cancers are treated with a combination of therapies chosen based on the type and stage of cancer, often by a coordinated, multidisciplinary team that includes pediatric oncologists, surgeons, nurses, social workers, child-life specialists, psychologists, and others in specialized centers. Adolescents (aged 15–19 years) diagnosed with cancers that are more common in childhood are usually most appropriately treated at pediatric facilities or by pediatric specialists. For example, studies have shown that pediatric protocols result in better outcomes for adolescent patients with ALL than adult protocols.¹⁹⁴ Childhood cancer centers are also more likely to offer adolescent patients the opportunity to participate in clinical trials.¹⁹⁵ For adolescent patients with cancers that are more common among adults, such as melanoma, testicular cancer, and thyroid cancer, treatment by adult care specialists is considered more appropriate.¹⁹⁶

For all childhood and adolescent cancers combined (excluding benign and borderline brain tumors), the 5-year relative survival rate increased from 58% during 1975 through 1977 to 85% during 2011 through 2017 among children and from 68% to 86% among adolescents because of the optimization of treatment regimens.^{11,33} However, survival varies considerably, depending on cancer type, patient age, and other characteristics. The overall survival rate among adolescents is heavily influenced by high survival rates for thyroid cancer (>99%) and HL (97%), masking lower survival in adolescents than in children for several cancers, including ALL (76% vs 92%, respectively) and Ewing sarcoma (59% vs 76%).

Short-term and long-term health effects

Aggressive treatments used for childhood cancers, especially in the 1970s and 1980s, resulted in several late effects, including increased risk of subsequent neoplasms and cardiomyopathies.¹⁹⁷ A large follow-up study of pediatric cancer survivors found that almost 10% developed a second cancer (most commonly, female breast, thyroid, and bone) over the 30-year period after initial diagnosis.¹⁹⁸ In addition, a subsequent study of the same childhood cancer survivor cohort found that 54% had developed a severe or life-threatening chronic health condition by age 50 years, compared with 20% of cancer-free siblings.¹⁹⁹ A recent study showed that even childhood cancer survivors exposed to low doses of radiation treatment had a 1.6-fold risk of developing cardiac disease over the next 30 years if the area of exposure included more than one-half of the heart.²⁰⁰

Recent declines in late morbidity and mortality among childhood cancer survivors are due in part to reduced use of certain treatments, such as cranial radiation for ALL and abdominal radiation for Wilms tumor.²⁰¹ However, even many newer, less toxic therapies increase the risk of serious health conditions.²⁰² Cognitive impairment affects up to one-third of childhood cancer survivors.²⁰³ In addition, some chemotherapies and surgery and radiation affecting the reproductive organs may cause infertility in male and female patients.^{204,205}

Sexual and psychosocial long-term and late effects are also important concerns for childhood and adolescent cancer survivors. High doses of chemotherapy have been associated with lower fertility, especially in male survivors,²⁰⁶ and pelvic radiation increases the risk for premature menopause among female survivors.²⁰⁷ Compared with women without a history of cancer, female survivors of childhood cancer are also more likely to experience serious cardiac problems during pregnancy as well as preterm birth.²⁰⁸ Some treatments may result in developmental delays and negatively affect mental health and the achievement of social and professional goals.^{209,210} For example, one long-term study of individuals with a history of childhood cancer who had impaired central

nervous system or sensory functioning found slightly lower educational attainment and higher unemployment and likelihood of being unmarried compared with individuals without a cancer history.²¹¹

Access to Care in Treatment and Survivorship

Racial Disparities

Because of longstanding, persistent structural racism that has limited access to education, employment opportunities, intergenerational transfer of wealth, and economic mobility for Black individuals in the United States, many of the most important social determinants of health continue to be closely associated with race.²¹² Similarly, because the Social Security Act of 1935 created a system of employment-based health insurance coverage that interacts with discriminatory hiring practices and systemic barriers to employment opportunities, health insurance coverage status also continues to be closely associated with race in the United States. Even after accounting for differences in stage at diagnosis, 5-year relative survival is lower for Black patients compared with White patients for most cancers,⁶ largely driven by differences in access to care.^{36,37} Because of barriers in access to education; biases in recruitment, retention, and promotion; and exclusionary professional networks, Black individuals are underrepresented in the medical workforce, especially in leadership positions. This lack of diversity leads to low cultural competence among health care professionals and contributes to the inability of the health care system to demonstrate trustworthiness. Lack of diversity in large clinical trials has also been identified as a major barrier to health equity in cancer treatment,²¹³ with Black patients who have pediatric cancer less likely to be treated with potentially superior cancer treatment modalities than White patients, even when both were enrolled in clinical trials.²¹⁴ In the posttreatment phase, Black cancer survivors report poorer physical functioning and less access to culturally appropriate support services compared with White survivors, and they also receive inadequate disease surveillance.²¹⁵⁻²¹⁸

COVID-19 and Cancer Care

The COVID-19 pandemic has exacerbated existing challenges in access to care across the cancer spectrum. In one meta-analysis, approximately one-fourth of patients with cancer experienced treatment delays as a result of the pandemic, largely due to causes such as reduced provider availability and supply chain issues (eg, drug shortages because of manufacturing or shipping issues).²¹⁸ Although many delays are related to radiotherapy or chemotherapy, one study of Medicare recipients reported that surgical procedures likewise declined in the first few months of the pandemic.²¹⁹ Although some data are available, it is still too early to know the extent to which COVID-19-related treatment delays will influence cancer survival.²²⁰⁻²²²

For those transitioning to long-term care in the COVID-19 era, the pandemic has substantially impeded the process of finding a *new normal* as a cancer survivor. Similar to the general population, posttreatment survivors have experienced reduced contact with health care providers; increased financial concerns; a rise in unhealthy behaviors associated with increased cancer risk, such as physical inactivity, smoking, and alcohol use; and elevated anxiety and depression.^{223–225} In one study of older breast cancer survivors and individuals without a history of cancer, loneliness increased similarly in both groups from before to during the first wave of the pandemic and was associated with similar degrees of worsening depression and anxiety in both groups.²²⁶ However, cross-sectional studies have reported that survivors are substantially more likely to report feeling anxious, lonely, or depressed during the pandemic compared with individuals without a history of cancer, especially those who are younger, highlighting the need for further longitudinal studies among broader groups of survivors.²²⁷ In addition, whereas some survivors have cited fears of contracting the virus as a reason for delaying medical care during the pandemic, a substantial proportion—especially those who are younger—have deferred care to cope with pandemic-related financial setbacks.²²⁸

In response to some of these challenges, several organizations have released recommendations regarding the appropriate triaging and treatment of patients with cancer during the pandemic.^{229,230} In addition, telehealth has expanded rapidly in response to the demand for socially distanced, limited exposure care.²³¹ Although one meta-analysis found that telehealth has been used successfully in improving cognitive function and fatigue among survivors, evidence is more limited for its use for the surveillance of recurrence or new cancers.²³² In the same study, general feasibility and patient adherence to telehealth interventions were high, but some people experienced barriers, such as low technology literacy, lack of broadband access, lack of trust in technology, and perceived ethical or security concerns.

Quality of Life and Other Concerns in Survivorship

Supportive care, including psychosocial and palliative care and cancer rehabilitation, can improve pain, functioning, and overall quality of life throughout every stage of survivorship.²³³ Although side effects and impairments are often acute, some may become chronic or emerge months or even years after the completion of primary cancer treatment, often referred to as *late effects*.^{1,234} The most common side effects of cancer and its treatment are pain, fatigue, and emotional distress.^{235–237} Other important long-term and late effects include subsequent cancers, neurologic sequelae, cardiomyopathies, sexual development and/or dysfunction, and impaired fertility. However, population-based surveillance

of these types of long-term and late effects is limited, although efforts to link information on health-related quality of life, patient-reported outcomes, and care experience to cancer registry data are ongoing.²³⁸ In general, survivors report similar mental and physical quality of life as the general population, especially survivors ≥5 years postdiagnosis and those with higher socioeconomic status.²³⁹

Many late and long-term effects of cancer and its treatment may be ameliorated by cancer rehabilitation, so patient referral services should be offered as early as possible.²⁴⁰ Similarly, palliative care improves the quality of life for patients who have cancer and their families and has also been shown to improve survival when combined with other treatments.²⁴¹ However, palliative care remains substantially underused in the United States and was received by only 10% of patients with solid tumors in one large study.²⁴²

In total, the national patient economic burden associated with cancer care was estimated to be over \$21 billion in 2019.²⁴³ Cancer survivors are vulnerable to medical financial hardship, which may manifest as material (eg, problems paying medical bills, medical debt, and bankruptcy), psychological (eg, stress or worry about paying medical bills), or behavioral (eg, delaying or forgoing necessary medical care because of cost) aspects. Survivors who are younger, underinsured or uninsured, and/or have lower income are more likely to experience financial hardship, as are long-term survivors of childhood cancer.^{244,245}

Healthy behaviors can improve functioning and quality of life among survivors, as well as reduce the risk of cancer recurrence/progression or subsequent cancers.²⁴⁶ As such, the American Cancer Society has developed guidelines for healthy behaviors related to diet, weight, and physical activity among cancer survivors.²⁴⁰ Smoking prevalence among cancer survivors overall has declined from 20% in 1992 to 13% in 2019, similar to trends in the general population. However, smoking prevalence is higher among survivors aged 18 to 44 years (25% vs 16% for that age group in the general US population in 2019).²⁴⁷ Support for smoking cessation and increased access to cessation aids is essential because approximately 10% of cancer survivors continue to smoke even up to 9 years after diagnosis.²⁴⁸

Quality-of-life issues also encompass the concerns of informal caregivers (ie, family members or friends), who provide substantial emotional and physical support to survivors. Caregivers frequently report having unmet psychosocial and medical needs and are vulnerable to depression, anxiety, and psychological distress. In one study, approximately 40% of caregivers reported that they found caregiving emotionally difficult, and 12% reported experiencing depression.²⁴⁹ Social support programs for caregivers that teach coping skills have been shown to diminish the negative impact of caregiver stress.^{250–252}

Limitations

Cancer prevalence estimates cannot be compared with previously published estimates because they are model-based projections based on currently available population-based incidence, mortality, and survival data through 2018. As a result, these estimates do not account for the impact of COVID-19 on cancer survivorship. In addition, these prevalence estimates do not distinguish disease status and thus include both individuals living disease-free as well as those in active treatment.

The NCDB is a hospital-based cancer registry and may be less complete for treatment commonly administered in the outpatient setting. Furthermore, data are collected for patients diagnosed or treated at CoC-accredited facilities, which are more likely to be located in larger urban areas compared with non-CoC-accredited facilities, and may not be representative of all patients in the United States.²⁵³ Despite these limitations, studies have shown that disease severity and treatment patterns in the NCDB stratified by clinical and sociodemographic factors for common cancer sites are remarkably similar to those found in population-based registries.^{254,255}

Conclusion

Despite increasing awareness of survivorship issues and the resilience of cancer survivors, many challenges remain. These include a fractured health care system, poor integration of survivorship care between oncology and primary care settings, clinician workforce shortages, lack of diversity in the medical workforce, knowledge gaps about the needs of cancer survivors, and lack of strong evidence-based guidelines for posttreatment care. These challenges are exacerbated by financial and other barriers to quality care, particularly for communities of color and low-income and rural neighborhoods, who continue to experience substantial gaps in early detection and access to high-quality treatment. To address these disparities and further progress in cancer survivorship, ongoing efforts to identify best practices for the equitable delivery of quality cancer treatment, rehabilitation and posttreatment cancer care are needed. As the evidence-base grows, efforts at the individual, provider, medical institution, health care system, and policy levels will help cancer survivors live longer and healthier lives. ■

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