

Cancer Incidence Among Patients of the U.S. Veterans Affairs Health Care System

Leah L. Zullig, MPH*†; George L. Jackson, PhD*‡; Raye Anne Dorn, MPH§;
Dawn T. Provenzale, MD*¶¶; Rebecca McNeil, PhD||; Catherine M. Thomas, ScM||;
Michael J. Kelley, MD**††‡‡

ABSTRACT Objective: Approximately 40,000 incident cancer cases are reported in the Veterans Affairs Central Cancer Registry (VACCR) annually (approximately 3% of U.S. cancer cases). Our objective was to provide the first comprehensive description of cancer incidence as reported in VACCR. Methods: Data were obtained from VACCR for incident cancers diagnosed in VA. Analyses focused on 2007 data. Cancer incidence among VA patients was compared to the general U.S. cancer population. Results: In 2007, 97.5% of VA cancers were diagnosed among men. Approximately 78.5% of newly diagnosed patients were White, 19.0% Black, and 2.5% were another race. Median age at diagnosis was 66 years. The geographic distribution of cancer patients in VA aligns that of VA users. The most commonly diagnosed cancers were similar between VA and the U.S. male cancer population. The five most frequently diagnosed cancers among VA cancer patients were: prostate (31.8%), lung/bronchus (18.8%), colon/rectum (8.6%), urinary bladder (3.6%), and skin melanomas (3.4%). VA patients were diagnosed at an earlier stage of disease for the three most commonly diagnosed cancers—lung/bronchus, colon/rectum, and prostate—compared to the U.S. male cancer population. Conclusions: Registry data indicate that incident cancers in VA in 2007 approximately mirrored those observed among U.S. men.

INTRODUCTION

In 2007, approximately five million Veterans received care in the Veterans Affairs (VA) health care system, making it one of the leading U.S. providers of health care.^{1,2} Moreover, approximately 3% of U.S. cancer diagnoses are made in VA annually. This equates to approximately 40,000 incidence cancer cases reported in the VA Central Cancer Registry (VACCR) each year. Although state and national cancer statistics are routinely reported,^{3,4} there has been no public reporting of cancer incidence from the VACCR. The objective of this article is to provide the first-ever comprehensive description of cancer incidence as reported in the VACCR in 2007. To achieve this objective, we present

cancer frequencies within the VA population in 2007 and provide comparisons with the larger U.S. cancer population based on incidence estimates developed annually by the American Cancer Society.⁴

The VA patient population is unique. In order to qualify to receive VA health care, patients must have served in the U.S. armed forces. VA users must undergo a financial needs assessment and may receive care at a reduced cost because of financial need or because of a service-related injury or disease.⁵ As a result of this qualification process, users of VA health care are more likely to have poor health status, have lower levels of education and income, and be of minority race.⁶

To provide health care for this distinct patient population, the VA currently operates a network of approximately 153 hospital facilities (at least one in each state, the District of Columbia, and Puerto Rico) and 788 community-based outpatient clinics focusing on primary care.⁷ Approximately 143 VA hospitals have cancer diagnostic and treating capabilities. These facilities share a national electronic health record (EHR) system.⁸ This EHR provides the basic information to equip registry activities. One hundred thirty-two VA facilities have some level of cancer registry activity. There are full cancer registry programs at 129 hospitals, covering the spectrum of the VA system. The VACCR has maintained a comprehensive database containing records of cancer cases treated in the VA system retrospectively to 1995. We report VACCR cancer incidence information from 2007, which is the most current, complete year of data.

METHODS

The analyses for this report were conducted as part of a VA data quality improvement project approved by the

*Center for Health Services Research in Primary Care, Durham Veterans Affairs Medical Center, 508 Fulton Street, Durham, NC 27705.

†Department of Health Policy and Management, University of North Carolina at Chapel Hill, 1101 McGavran-Greenberg Hall, Chapel Hill, NC 27599.

‡Division of General Internal Medicine, Duke University Medical Center, 2301 Erwin Road, Durham, NC 27710.

§Washington Veterans Affairs Medical Center, 50 Irving Street, Northwest Washington, DC 20422.

||Epidemiologic Research and Information Center, Durham Veterans Affairs Medical Center, Durham, NC, 508 Fulton Street, Durham, NC 27705.

¶¶Division of Gastroenterology, Duke University Medical Center, 2301 Erwin Road, Durham, NC 27710.

**Office of Patient Care Services, Department of Veterans Affairs, 810 Vermont Avenue, Washington, DC 20420.

††Hematology-Oncology Service, Durham Veterans Affairs Medical Center, Durham, NC, 508 Fulton Street, Durham, NC 27705.

‡‡Division of Medical Oncology, Duke University Medical Center, 2301 Erwin Road, Durham, NC 27710.

The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the U.S. Government.

Chief Officer of Patient Care Services. The goal of the project was to provide a descriptive analysis of cancer incidence in the VA.

The VA Central Cancer Registry

In response to a national directive in 1998, many VA facilities began local cancer registry operations. Additional VA facilities became operational until all facilities were accruing data in 2001 (Table I). The VACCR was formally recognized in 2003.⁹ After reaching national participation, the number of new cases reported through the VA registry system has remained stable at approximately 40,000 new cases annually.

The VACCR retrospectively abstracted incident cases diagnosed on or after January 1, 1995. VACCR continues to abstract prospectively, striving to capture all cancer cases occurring within the VA system. It has been estimated that VACCR captures nearly 90% of cancer cases treated in VA.^{9,10} To achieve this level of case identification and abstraction, cancer registrars in VA use custom software, called OncoTraX, which is directly integrated with the VA EHR system. Cancer registrars manually abstract case data, conforming to standards set by the North American Association of Central Cancer Registries (NAACCR). In keeping with the NAACCR criteria for reportable cases, the VACCR includes cases that are diagnosed outside of the VA health care system if they subsequently receive care within VA. Data are then aggregated into the national cancer registry located in Washington, DC. Once the data are centralized, cases are merged and quality assurance checks are conducted. Data in the registry are retrospectively updated as new information is obtained by VACCR.

TABLE I. Number of Cases Reported Annually to VACCR, 1995–2007^a

Year	Number of Reporting Facilities ^b	Number of Cases	Average Number of Cases Per Facility
1995	99	31,291	316
1996	100	31,173	312
1997	104	31,111	299
1998	105	33,440	318
1999	110	34,877	317
2000	112	36,941	330
2001	114	38,835	341
2002	115	39,725	345
2003	116	38,802	335
2004	117	39,621	339
2005	121	38,788	321
2006	123	40,085	326
2007	129	39,505	306
Total	—	474,194	—

^aCases with a SEER summary stage of 0 have been excluded. ^bA facility is defined as a VA medical center (primary, secondary, or tertiary) that has the capacity to diagnosis and treat cancer. The number of reporting facilities for each year and definition of “facility” were provided by the National Program Director of VACCR.

All VA medical centers diagnosing and treating Veterans with reportable malignancies are required to collect and submit patient-level data to the VACCR biannually. To ensure data integrity, local registry data files must meet the NAACCR electronic quality standards before being consolidated into the national master file.¹¹ As a result of this process, VACCR incurs reporting delays slightly in excess of 1 year. By comparison, other national cancer registries generally lag by 2 years postdiagnosis.¹²

For this analysis, data were obtained from VACCR for all incident cases diagnosed in the VA population from 1995 through 2007, the most current year that has been internally validated.

This report describes cancer incidence using VACCR data from 2007. In situ cancers ($n = 3,684$) were excluded from analysis unless otherwise noted; these were identified by a Surveillance, Epidemiology and End Results (SEER) summary stage of 0. SEER is a constellation of geographically based cancer registries that collect information on incidence, prevalence, and survival from approximately one-fourth of the nation. This exclusion primarily affected the reported frequency of urinary bladder cancer ($n = 1,252$) and melanoma of the skin ($n = 1,178$). No other exclusions were made.

Descriptive Variables

Within the VA, geographic location is described by Veterans Integrated Service Networks (VISN). To simplify analysis, each case’s VISN of origin was subgrouped into geographic regions. These regions were defined as follows: (1) Northeastern region, defined as VISNs 1, 2, 3, and 4; (2) Southern region, defined as VISNs 5, 6, 7, 8, 9, 16, and 17; (3) Midwestern region, defined as VISNs 10, 11, 12, and 15; and (4) Western region, defined as VISNs 18, 19, 20, 21, and 22. Because of VHA reorganization, VISNs 13 and 14 were merged to create VISN 22. The regions described here are not equally distributed based on landmass or patient population, but approximate standard geographical divisions of the United States.¹³

Primary anatomic site was defined according to International Classification of Diseases for Oncology (ICD-O-3) site and histology (i.e., type) codes.¹⁴ ICD-O-3 codes are commonly used in pathology reports and cancer registries to capture information about the topography and morphology of neoplasms. The unit of analysis throughout this report is the specific cancer diagnosis and not unique patient. Therefore, patients with multiple cancer diagnoses have multiple records in the database and may be included in the analysis several times. A recurrence of an existing cancer diagnosis would not be coded separately.

Statistical Analysis

Frequency distributions of incident cancer diagnoses were evaluated by primary anatomical site, sex, race, and geographic region. Cancer frequency trends within the VA population

were examined descriptively and comparisons were made with the larger U.S. cancer population. Because of the categorical nature of these data, the characteristics of cancer cases were summarized using frequencies and proportions. These were compared by sex and race at the organ system level using a χ^2 test when a minimum of 25 cases occurred in each comparison group. Standard methods of age-adjustment to the 2000 projected U.S. population¹⁵ were used in support of comparisons with the general U.S. population, as follows: (1) within each age category, calculated the crude cancer incidence within the VA based on the 2007 VA population; (2) within each age category, calculated the expected cancer frequency for the 2000 Standard Population as (crude incidence in VA) \times (2000 Standard Population); (3) summed the expected cancer frequencies over age categories; and (4) estimated the age-adjusted cancer incidence by dividing the summed frequencies by the 2000 Standard Population total. Statistical analyses were performed using Stata 10 (StataCorp LP, College Station, TX) and SAS 9.2 (SAS Institute, Cary, NC).

RESULTS

Mirroring the format of other reports on cancer incidence in the United States, we have provided a summary of key characteristics of patients with incident cancer among VA patients.⁴ In addition to descriptive text and tables, we provide a brief interpretation of our findings, which are categorized by: (1) overall incidence, (2) sex, (3) race, (4) age, (5) geographic distribution, (6) stage at diagnosis, and (7) change in number of incident cases.

Demographic Characteristics

In fiscal year 2007 (October 1, 2006 through September 30, 2007), approximately 5 million patients received care in VA.¹ Approximately 39,505 of these patients were diagnosed with cancer. Among these cancer diagnoses, 97.5% occurred in men (38,513/39,505), whereas 2.5% were in women (989/39,505). To mitigate the potential impact of outlying patients who were diagnosed at very young or very old ages, the median age at diagnosis was examined rather than the mathematical mean. The median age of VA patients newly diagnosed with cancer in 2007 was 66 years (minimum = 15 years, maximum = 100 years). Approximately 78.5% of cancer occurred among White patients (31,010/39,505), compared to approximately 19% among Black patients (7,523/39,505).

Incidence of Common Cancers

The number of incident cancer cases by anatomic site is described in Table II. Within the VA, the most common cancers are prostate, lung and bronchus, colon and rectum, urinary bladder, melanomas of the skin, kidney, liver, non-Hodgkin's lymphoma, leukemia, and larynx (Table II).

Sex Differences in Incidence

The most frequently diagnosed cancer among Veteran men was prostate cancer, accounting for about 33% (12,543/38,513) of male cancer diagnoses. Among women Veterans, breast cancer was the most commonly diagnosed, accounting for about 30% (292/989) of female cancers. For both sexes, cancers of the lung and bronchus, and colon and rectum, occur second and third most frequently, respectively. Urinary bladder is fourth in ranking for men both nationally and within VA (1,397/38,513), comprising 4% of VA male cancer diagnoses. For women in the VA, the fourth ranked cancer is corpus uteri (49/989), accounting for 5% of female cancers.

Racial Differences in Incidence

Table III provides a tabulation of incident cases by cancer site and racial group. Moderate differences between White and Black Veterans are apparent, such as for lung and bronchus (19.7% vs. 15.5%) and melanoma (4.2% vs. 0.1%). The most striking difference is in prostate cancer, which accounted for 28.9% of cancers in White Veterans but 42.7% of cancers in Black Veterans.

Age Distribution

The median age of Veterans enrolled in VA is approximately 57 years,¹⁶ compared to the median age of the general population of approximately 38 years.¹⁷ However, the median age at diagnosis for VA cancers in both sexes in 2007 was 66 years, exactly the same as the median age at diagnosis for all SEER cancer sites.¹⁸ The most cancers occurred in Veterans aged 55 to 64 years, accounting for approximately 37% of cancer diagnoses (Table IV). Those aged 65 to 74 years were the second most frequently diagnosed group, with 28% of cancer diagnoses. These age categories also had the highest number of incident cases after age-adjustment. After adjusting the age structure of the VA population to that of the 2000 U.S. Standard Population, we estimated that the age-adjusted cancer incidence is 426 cases per 100,000 person-years.

The median age at diagnosis differed between men and women. Among male Veterans with cancer, the median age at diagnosis was 66 years, whereas it was 58 years among females. Age at diagnosis in women in VA is nearly 10 years younger than among all women with cancer. National SEER estimates from 2003 to 2007 depict an overall median age at diagnosis of 65 years for women diagnosed with any type of cancer.¹⁸ In addition, median age at diagnosis within sexes has remained relatively consistent over time within the VA cancer patient population. For women, the median age at diagnosis has ranged from 58 to 61 years over the span of 2000 to 2007. Similarly, men's median age at diagnosis has been approximately 67 years over the same 7-year span. The median age at diagnosis varied slightly according to anatomic site. For prostate cancer, the median age at diagnosis was 66 years. This is similar to the SEER national estimate, which is 67 years.¹⁸ For VA colorectal

TABLE II. Incident Cancer Cases by Sex in Veteran Affairs Patients, 2007^a

	Incident Cases, 2007			<i>p</i> -Value ^c
	All Sexes, <i>n</i> (% total cancers)	Male, <i>n</i> (% male cancers)	Female, <i>n</i> (% female cancers)	
All Sites	39,505	38,513	989	
Head and Neck	1,712 (4.3)	1,689 (4.4)	23 (2.3)	—
Tongue	452 (1.1)	443 (1.2)	9 (0.9)	
Lip	101 (0.3)	101 (0.3)	0 (0)	
Mouth	746 (1.9)	739 (1.9)	7 (0.7)	
Pharynx	357 (0.9)	350 (0.9)	7 (0.7)	
Nasal Cavity and Sinuses	56 (0.1)	56 (0.1)	0 (0)	
Digestive System	6,965 (17.6)	6,827 (17.7)	137 (13.9)	0.0016
Esophagus	804 (2.0)	798 (2.1)	6 (0.6)	
Stomach	548 (1.4)	543 (1.4)	5 (0.5)	
Small Intestine	127 (0.3)	124 (0.3)	3 (0.3)	
Colon	2,384 (6.0)	2,329 (6.1)	55 (5.6)	
Rectum ^b	1,037 (2.6)	1,015 (2.6)	21 (2.1)	
Anus	137 (0.4)	122 (0.3)	15 (1.5)	
Liver and Intrahepatic Bile Duct	1,054 (2.7)	1,039 (2.7)	15 (1.5)	
Gallbladder	18 (<0.1%)	16 (<0.1%)	2 (0.2%)	
Pancreas	727 (1.8%)	713 (1.9%)	14 (1.4%)	
Other Digestive Organs	129 (0.3)	128 (0.3)	1 (0.1)	
Respiratory System	8,254 (20.9)	8,090 (21.0)	164 (16.6)	0.0007
Larynx	807 (2.0)	800 (2.1)	7 (0.7)	
Lung and Bronchus	7,437 (18.8)	7,280 (18.9)	157 (15.9)	
Other Respiratory Organs	10 (<0.1)	10 (<0.1)	0 (0)	
Bones and Joints	25 (<0.1)	23 (<0.1)	2 (0.2)	—
Bone Marrow	484 (1.2)	471 (1.2)	13 (1.3)	—
Soft Tissue (Including Heart)	175 (0.4)	168 (0.4)	7 (0.7)	—
Melanoma	1,327 (3.4)	1,289 (3.4)	38 (3.8)	0.39
Breast	358 (0.9)	66 (0.2)	292 (29.5)	—
Genital System	12,812 (32.4)	12,701 (33.0)	110 (11.1)	—
Uterine Cervix	32 (<0.1)	N/A	32 (3.2)	
Uterine Corpus	49 (0.1)	N/A	49 (5.0)	
Ovary	15 (<0.1)	N/A	15 (1.5)	
Vulva	9 (<0.1)	N/A	9 (0.9)	
Vagina and Other Genital Female	5 (<0.1)	N/A	5 (0.5)	
Prostate ^b	12,544 (31.8)	12,543 (32.6)	N/A	
Testis	77 (0.2)	77 (0.2)	N/A	
Penis and Other Genital Male	81 (0.2)	81 (0.2)	N/A	
Urinary System	2,804 (7.1)	2,756 (7.2)	48 (4.9)	0.0054
Urinary Bladder	1,417 (3.6)	1,397 (3.6)	20 (2.0)	
Kidney and Renal Pelvis	1,307 (3.3)	1,279 (3.3)	28 (2.8)	
Ureter and Other Urinary Organs	80 (0.2)	80 (0.2)	0 (0)	
Eye and Orbit	24 (0.1)	24 (0.1)	0 (0)	—
Central Nervous System	370 (0.9)	350 (0.9)	20 (2.0)	—
Brain	264 (0.7)	257 (0.7)	7 (0.7)	
Other Central Nervous System	106 (0.3)	93 (0.2)	13 (1.3)	
Endocrine System	458 (1.2)	408 (1.1)	50 (5.1)	<0.0001
Thyroid	373 (0.9)	329 (0.9)	44 (4.5)	
Other Endocrine	85 (0.2)	79 (0.2)	6 (0.6)	
Lymphoma	1,244 (3.2)	1,207 (3.1)	37 (3.7)	0.28
Hodgkin Lymphoma	92 (0.2)	89 (0.2)	3 (0.3)	
Non-Hodgkin Lymphoma	1,152 (2.9)	1,118 (2.9)	34 (3.4)	
Myeloma	449 (1.1)	441 (1.2)	8 (0.8)	—
Leukemia	901 (2.3)	883 (2.3)	18 (1.8)	—
Other and Unspecified Primary Sites ^b	1143 (2.9)	1120 (2.9)	22 (2.2)	—

^aCases with a SEER summary stage of 0 have been excluded. ^bColumns may not sum to All Sexes because of presence of Other/Not stated sex. ^c*p*-Values are presented for male–female comparison within organ systems with a minimum of 25 cases in each category.

TABLE III. Incident Cancers by Site and Race in Veteran Affairs Patients, 2007^a

	White, N = 31,010	Black, N = 7,523	Other, N = 972	p-Value ^b
Head and Neck	1408 (4.5%)	260 (3.5%)	44 (4.5%)	<0.0001
Tongue	392 (1.3%)	51 (0.7%)	9 (0.9%)	
Lip	100 (0.3%)	0 (0%)	1 (0.1%)	
Mouth	613 (2.0%)	114 (1.5%)	19 (2.0%)	
Pharynx	258 (0.8%)	88 (1.2%)	11 (1.1%)	
Nasal Cavity and Sinuses	45 (0.2%)	7 (<0.1%)	4 (0.4%)	
Digestive System	5381 (17.4%)	1418 (18.9%)	166 (17.1%)	0.0023
Esophagus	647 (2.1%)	140 (1.9%)	17 (1.8%)	
Stomach	366 (1.2%)	157 (2.1%)	25 (2.6%)	
Small intestine	95 (0.3%)	30 (0.4%)	2 (0.2%)	
Colon	1878 (6.1%)	459 (6.1%)	47 (4.8%)	
Rectum	832 (2.7%)	183 (2.4%)	22 (2.3%)	
Anus	106 (0.3%)	28 (0.4%)	3 (0.3%)	
Liver and Intrahepatic Bile Duct	766 (2.5%)	260 (3.5%)	28 (2.9%)	
Gallbladder	16 (<0.1%)	2 (<0.1%)	0 (0%)	
Pancreas	574 (1.9%)	136 (1.8%)	17 (1.8%)	
Other Digestive Organs	101 (0.3%)	23 (0.3%)	5 (0.5%)	
Respiratory System	6763 (21.8%)	1327 (17.6%)	164 (16.9%)	<0.0001
Larynx	635 (2.1%)	158 (2.1%)	14 (1.4%)	
Lung and Bronchus	6118 (19.7%)	1169 (15.5%)	150 (15.4%)	
Other Respiratory Organs	10 (<0.1%)	0 (0%)	0 (0%)	
Bones and Joints	24 (<0.1%)	1 (<0.1%)	0 (0%)	—
Bone Marrow	414 (1.3%)	65 (0.9%)	5 (0.5%)	—
Soft Tissue (Including Heart)	136 (0.4%)	33 (0.4%)	6 (0.6%)	—
Melanoma	1301 (4.2%)	10 (0.1%)	16 (1.7%)	—
Breast	274 (0.9%)	74 (1.0%)	10 (1.0%)	—
Genital System	9179 (29.6%)	3248 (43.2%)	385 (39.6%)	<0.0001
Uterine Cervix	16 (<0.1%)	11 (0.1%)	5 (0.5%)	
Uterine Corpus	42 (0.1%)	6 (<0.1%)	1 (0.1%)	
Ovary	14 (<0.1%)	1 (<0.1%)	0 (0%)	
Vulva	6 (<0.1%)	2 (<0.1%)	1 (0.1%)	
Vagina and Other Genital Female	5 (<0.1%)	0 (0%)	0 (0%)	
Prostate	8963 (28.9%)	3210 (42.7%)	371 (38.2%)	
Testis	65 (0.2%)	8 (0.1%)	4 (0.4%)	
Penis and Other Genital Male	68 (0.2%)	10 (0.1%)	3 (0.3%)	
Urinary System	2340 (7.6%)	404 (5.4%)	60 (6.2%)	<0.0001
Urinary Bladder	1247 (4.0%)	134 (1.8%)	36 (3.7%)	
Kidney and Renal Pelvis	1024 (3.3%)	260 (3.5%)	23 (2.4%)	
Ureter and Other Urinary Organs	69 (0.2%)	10 (0.1%)	1 (0.1%)	
Eye and Orbit	23 (<0.1%)	1 (<0.01%)	0 (0%)	—
Central Nervous System	318 (1.0%)	45 (0.6%)	7 (0.7%)	—
Brain	236 (0.8%)	23 (0.3%)	5 (0.5%)	
Other Central Nervous System	82 (0.3%)	22 (0.3%)	2 (0.2%)	
Endocrine System	359 (1.2%)	71 (0.9%)	28 (2.9%)	0.11
Thyroid	303 (1.0%)	46 (0.6%)	24 (2.5%)	
Other Endocrine	56 (0.2%)	25 (0.3%)	4 (0.4%)	
Lymphoma	1057 (3.4%)	167 (2.2%)	20 (2.1%)	—
Hodgkin Lymphoma	70 (0.2%)	21 (0.3%)	1 (0.1%)	
Non-Hodgkin Lymphoma	987 (3.2%)	146 (1.9%)	19 (2%)	
Myeloma	304 (1.0%)	131 (1.7%)	14 (1.4%)	—
Leukemia	783 (2.5%)	94 (1.3%)	24 (2.5%)	—
Other & Unspecified Primary Sites	946 (3.1%)	174 (2.3%)	23 (2.4%)	—

^aCases with a SEER summary stage of 0 have been excluded. ^bp-Values are presented for black-white comparison within organ systems with a minimum of 25 cases in each category.

cancer patients, median age at diagnosis was 68 years, identical to the SEER estimate. However, VA lung cancer patients are slightly younger at diagnosis than those in the United States as a whole. Within VA, the median age at lung cancer diagnosis is 68 years; the SEER median age at diagnosis for men is 70 years.¹⁸

Geographic Distribution

The geographic distribution of cancer patients in VA generally mirrors the geographic distribution of VA users. Among Veterans enrolled in VA, more live in the South, approximately 41%, compared to other regions. The Midwest and

TABLE IV. Age-adjusted Cancer Incidence in Veterans Affairs Patients, 2007^a

Age at Diagnosis	2007 VA Population	Cancers	Crude Incidence ^{b,c}	2000 Std. Population	Age-adjusted Cancers ^d	Age-adjusted Incidence ^{b,e}
All Ages	4,875,740	39,505	810	203,851,000	869,415	426
<25	44,581	27	61	26,258,000	15,903	
25–34	199,848	110	55	37,233,000	20,494	
35–44	287,333	358	125	44,659,000	55,642	
45–54	619,643	3,189	515	37,030,000	190,575	
55–64	1,342,466	14,703	1095	23,961,000	262,426	
65–74	966,561	11,032	1141	18,136,000	206,998	
75–84	1,077,278	8,308	771	12,315,000	94,974	
≥85	338,030	1,778	526	4,259,000	22,402	

^aCases with a SEER summary stage of 0 have been excluded. ^bIncidence per 100,000 person-years. ^cCrude cancer incidence is calculated as (Cancers/2007 VA Population) × 100,000. ^dAge-adjusted cancer frequency is calculated as (2000 Std. Population) × (Cancers/2007 VA Population). ^eAge-adjusted cancer incidence is calculated as [sum(Age-adjusted Cancers)]/[sum(2000 Std. Population)]. That is, sum the age-adjusted cancer frequencies, and divide this total by the total 2000 Std. Population.

West each contain about 20% of the VA population. Slightly fewer (17%) live in the Northeast. The South has approximately 42% (16,738/39,505), Midwest 22% (8,869/39,505), West 21% (8,295/39,505), and Northeast 14% (5,603/39,505) of VA cancer patients.

Distribution of Stage at Diagnosis

Stage at diagnosis is an important predictor of prognosis and 5-year survival rates.⁴ Stage at diagnosis was examined for the three most commonly occurring cancer sites: lung and bronchus, colon and rectum, and prostate. The distribution of stage at diagnosis in VA differs from that in the general population for these cancers.

In 2007, approximately 23% (1,699/7,437) of lung cancer diagnoses made in VA were localized. In contrast, only 15% of the SEER lung cancer population was diagnosed with localized disease.¹⁸ Similarly, approximately 46% of lung cancers (3,431/7,437) in VA were metastatic at time of diagnosis, compared with 56% in the broader population.¹⁸ Colon and rectal cancer rates follow a similar pattern of earlier stage at diagnosis within VA. In VA, approximately 42% (1,441/3,421) of colorectal cancers are localized at diagnosis, compared with about 39% in the SEER population. The rate of diagnosis of metastatic colorectal cancer is similar with about 18% (614/3,421) in VA and 19% in the SEER populations.¹⁸ Likewise, prostate cancers are diagnosed earlier among Veterans. Approximately 89% (11,117/12,544) of VA prostate cancers are localized when diagnosed, compared with 80% in the broader population. Rates of metastatic prostate cancer diagnosis are the same in VA and outside at approximately 4%.¹⁸

Changes in the Number of VA Incident Cancers

As the number of VA patients has grown, there has been a commensurate increase in the number of incident cancer cases in the VA from 2001 to 2007. Breast and lung cancer incidence remained stable. However, liver and prostate cancers are on an upward trend. Incident prostate cancer cases rose from 11,603 to 12,544 per year over this 6-year span—an

increase of 941 cases, representing an absolute 2% increase in prostate cancer's fraction of overall VA cancer cases. During this timeframe, the number of new liver cancer cases increased from 570 to 1,054 cases—an increase of 484 cases, which represents a near-doubling of crude frequency of liver cancer over 6 years. Conversely, colorectal cancer experienced a slight decline in both incidence and rate. There was a decrease of 351 colorectal cancer patients between 2001 (3,865) and 2007 (3,421). This equates to a 1.2% decrease in colorectal cancer's fraction of total cancer cases. Given the small number of incident cases, breast cancer remains a small fraction of cancers in VA (0.9%); this fraction has remained constant from 2001 to 2007.

DISCUSSION

Data from the VACCR in 2007 suggest that cancer incidence in the VA is similar to that which is seen in the general male U.S. cancer patient population. Over 45,000 new cases of cancer were diagnosed in VA, approximately 40,000 of which were invasive. It is estimated that VA cares for 175,000 Veteran cancer patients annually, with over 3% of all U.S. cancer diagnoses made in VA each year.⁴

The VA patient population is a unique subset of the American population, with a distinct demographic distribution.⁶ Following the historical composition of the U.S. military, VA serves a predominately male population. However, the composition of the Nation's military is evolving—transforming the future Veteran population. Women comprise a small, but increasing portion of VA patients. Of those who have served in the military since 1990, approximately 15% are women.¹⁹ In addition, Veteran patients are older than the general U.S. population. Most health care systems have a more expansive distribution of age groups; however, the requirement for prior military service limits the number of VA patients under the age of 20. Most are considerably older—the median age of Veterans is approximately 57 years compared to the median age of the general population of approximately 38 years.¹⁷ As the sex and age distribution of the overall Veteran population shifts, the cancer

composition will also change. These demographic differences between Veterans and the overall U.S. population result in differences in the cancers identified and treated in VA.

Moreover, when compared with nationally published cancer statistics, the most commonly diagnosed cancers for Veterans are similar to those of the male U.S. population.^{3,4} However, the frequency of these cancers as a fraction of all cancers in VA varies somewhat from national percentages. For example, approximately 25% of cancer diagnoses in men nationally are prostate,^{3,4} whereas within VA, prostate cancer accounts for approximately 33% of male cancer diagnoses. These differences may be a reflection of the older age of the VA population relative to the general U.S. population.⁶ Similarly, younger age and earlier stage at diagnosis have been associated with better prognosis and increased survival rates,⁴ but patients qualifying for and using VA health care tend to be older. As a result of this changing demographic, interpretation of age and sex differences is complex. The overall age of female Veterans treated within VA is younger than that of their male counterparts. This is as a result of the changing sex composition of military service members.^{20,21} As a result, the difference in median age at diagnosis between men and women may reflect the fact that female VA patients tend to be younger than male VA patients.

Several studies have noted racial variations in cancer incidence and treatment.⁴ The U.S. Census Bureau (which surveys all Veterans, not just those using the VA health care system) estimates that 83% of Veterans are White and under 10% of Veterans are African American.¹⁶ There is evidence that users of the VA health care system are more likely to be African American, are less likely to be employed, and likely have a lower annual income.²² The observed racial distribution of cancer in VA (78.5% among White and 19% among Black) reflects a similar burden of illness among Black Veterans.

We found that patients in VA are diagnosed with commonly occurring cancers at earlier stages, relative to the general population. This finding is consistent with evidence from the Government Performance Review Act Report on Oncology (2010).²³ Intensive screening directives and an electronic clinical reminder system may be responsible for earlier detection. However, VA has no screening program for lung cancer, which had the largest shift toward earlier stage at diagnosis in VA relative to the U.S. population. VA patients diagnosed with lung cancer have more frequent and more severe lung disease,²³ which may prompt more frequent diagnostic evaluation that may incidentally result in diagnosis of asymptomatic lung cancer.

This analysis provides anecdotal evidence of VACCR's utility as an epidemiological tracking and research tool. This finding has important implications. VACCR has a myriad of potential future uses. VACCR data could be used to assemble and report measurements of incident cancers among Veterans; to provide information on changes over time in extent of disease at diagnosis and treatment; to promote and conduct studies designed to identify factors relating to cancer etiol-

ogy, prevention, and control; to respond to requests from individuals and organizations in the Department of Veterans Affairs for cancer data and analysis; and to provide data and expertise for cancer research activities and educational opportunities. These possible uses of VACCR could aid decision making for resource allocation and to provide a data source for research.

VACCR data have served an integral role in informing numerous VA quality improvement and research initiatives. Specifically, VACCR data have been used as a basis for cancer case identification and patient tracking for a number of studies examining colorectal cancer screening, diagnosis, receipt of guideline-concordant cancer care, and timeliness of treatment.^{10,24-26} VACCR data have also been examined to assess possible changes in the composition of VA cancer cases and related diseases over time.^{24,25} Data from the VACCR have also been utilized to make comparisons between VA cancer care and care delivered in the private sector. It has been determined that cancer care for older Americans is generally equivalent in both settings.²³ Furthermore, data have been used to identify cancer patients that may be eligible for research initiatives or may be experiencing barriers to cancer care.²⁷

Limitations

Despite the utility of VACCR data, this analysis has important limitations. Previous studies have indicated that that VACCR captures an estimated 87% to nearly 90% or better of cancer patients treated by the VA.^{9,10} Like most registries, VACCR is tasked with systematic collection of data about cancer incidence. By design, VACCR does not currently contain timely mortality data; for example, only 7% of patients diagnosed with lung cancer in 2001 are recorded as deceased in VACCR. This makes calculating survival rates and outcomes based solely on VACCR data difficult. A positive difference between the VA cancer registry and other cancer registries is that VA has access to system-wide integrated electronic medical record and supporting administrative data. Furthermore, the quality of VACCR is currently unknown, but there is an ongoing validation project comparing VACCR data with manually abstracted data from the electronic medical record for a sample of lung cancer cases. VACCR data can be supplemented with administrative vital status information. These resources also better equip VA to accurately measure its registry capture rate, whereas other registries must rely upon population predictions.

A second limitation of this analysis is that the estimated annual incidence rates should not be generalized to all Veterans in the United States. Veterans have a choice in where they receive their health care. Patients may receive all or part of their care in the private sector. Some Veterans may begin using VA health care services upon receiving a diagnosis of cancer elsewhere. This leads to health care system overlap. For example, patients may be counted both in a SEER registry and

in the VACCR.²⁸ This could result in duplication bias. The SEER summary data is a historical data comparison; therefore, caution should be exercised in interpreting this comparison.

It should be noted that patients using the VA tend to be older, sicker, and of lower socioeconomic status than the overall U.S. and Veteran populations as a whole.²⁹ As a result, estimates presented in this report apply only to patients receiving care in the VA health care system, not all Veterans in the United States. Furthermore, these underlying differences in the VA patient population and the general U.S. result in limited generalizability of study findings to a broader national context.

Third, the age-adjusted incidence rates should be interpreted with caution. The “population” of VA patients is dependent on definitions of who uses the health care system. Population figures were obtained from the VA Office of Policy and Planning. In addition, information was not available to subtract individuals with prevalent cancer from the VA population denominator, which could lead to an underestimate of incidence rate. However, this may be offset by the fact that the VA cancer registry does not capture all incident cases. As a result, the numbers should be interpreted as the best available approximation of the age-adjusted incidence rate available, but not exact numbers.

Similarly, we were unable to obtain information about the underlying racial distribution of patients using the VA health care system. As a result, we were unable to produce race-adjusted statistics. Future analyses would be strengthened by adjusting for both age and race.

CONCLUSION

VACCR data indicate that incident cancers in VA in 2007 approximately mirrored those observed among U.S. men. Furthermore, data from the VACCR are pivotal to provide accurate estimates of VA cancer incidence. This information can be used to plan efforts to improve quality of cancer care and access to services. These registry data indicate that incident cancers in VA in 2007 approximately mirrored those observed among U.S. men.

ACKNOWLEDGMENTS

This work was conducted as part of a quality improvement effort of the Veterans Health Administration Office of Patient Care Services. L.L.Z. was supported by funding from the National Cancer Institute (5R25CA116339).

REFERENCES

- Selected VHA Health Statistics FY 2006–2007. Washington, DC, U.S. Department of Veterans Affairs, Office of the Assistant Deputy Under Secretary for Health for Policy and Planning. Available at <http://vaww4.va.gov/VHAOPP/index.asp>, October 5, 2011; accessed November 23, 2011.
- National Survey of Veterans, Active Duty Service Members, Demobilized National Guard and Reserve Members, Family Members, and Surviving Spouses. Rockville, Westat. Available at <http://www.va.gov/vetdata/docs/SurveysAndStudies/NVSSurveyFinalWeightedReport.pdf>, October 18, 2010; accessed November 23, 2011.
- Jemal A, Siegel R, Ward E, Hao Y, Xu J, Thun MJ: Cancer statistics, 2009. *CA Cancer J Clin* 2009; 59(4): 225–49.
- Jemal A, Siegel R, Ward E, Murray T, Xu J, Thun MJ: Cancer statistics, 2007. *CA Cancer J Clin* 2007; 57(1): 43–66.
- VA Health Care Eligibility & Enrollment Ratings and Evaluations. Service Connection 3.303-1. Washington, DC, U.S. Department of Veterans Affairs. Available at <http://www.va.gov/healtheligibility/library/pubs/healthcareoverview/>, September 15, 2009; accessed November 12, 2011.
- Agha Z, Lofgren RP, VanRuiswyk JV, Layde PM: Are patients at Veterans Affairs medical centers sicker? A comparative analysis of health status and medical resource use. *Arch Intern Med* 2000; 160(21): 3252–7.
- VA Benefits & Health Care Utilization. Washington, DC, National Center for Veterans Analysis and Statistics. Available at http://www.va.gov/VETDATA/Pocket-Card/4X6_spring10_sharepoint.pdf, April 28, 2010; accessed November 12, 2011.
- Jackson GL, Krein SL, Alverson DC, et al: Defining core issues in utilizing information technology to improve access: evaluation and research agenda. *J Gen Intern Med* 2011; 26 Suppl 2: 623–7.
- VHA Directive 2003-034 National Cancer Strategy. Washington, DC, U.S. Department of Veterans Affairs. Available at http://vaww1.va.gov/vhapublications/ViewPublication.asp?pub_ID=261, June 20, 2003; accessed November 20, 2011.
- Jackson GL, Melton LD, Abbott DH, et al: Quality of nonmetastatic colorectal cancer care in the Department of Veterans Affairs. *J Clin Oncol* 2010; 28(19): 3176–81.
- Facility Oncology Registry Data Standards. Chicago, American College of Surgeons. Available at <http://www.facs.org/cancer/coc/fordsmanual.html>, December 21, 2010; accessed November 3, 2011.
- Clegg LX, Feuer EJ, Midthune DN, Fay MP, Hankey BF: Impact of reporting delay and reporting error on cancer incidence rates and trends. *J Natl Cancer Inst* 2002; 94(20): 1537–45.
- Veterans Health Administration Locations. Washington, DC, U.S. Department of Veterans Affairs. Available at <http://www2.va.gov/directory/guide/division.asp?dnum=1>, July 23, 2010; accessed November 1, 2011.
- SEER Site Recode ICD-O-3 (1/27/2003) Definition. Washington, DC, Surveillance Epidemiology and End Results. Available at http://seer.cancer.gov/siterecode/icdo3_d01272003/, January 27, 2003; accessed October 30, 2011.
- Klein RJ, Schoenborn CA: Age adjustment using the 2000 projected U.S. population. *Healthy People 2010 Stat Notes* 2001; (20): 1–10.
- Veterans 2000 Census Brief. Washington, DC, U.S. Census Bureau. Available at <http://www.census.gov/prod/2003pubs/c2kbr-22.pdf>, May 2003; accessed November 13, 2011.
- Age and Sex Composition 2010. Washington, DC, U.S. Census Bureau. Available at <http://www.census.gov/prod/cen2010/briefs/c2010br-03.pdf>, May 2011; accessed November 12, 2011.
- Altekruse SF, Kosary CL, Krapcho M, et al (editors): SEER Cancer Statistics Review, 1975–2007, Bethesda, National Cancer Institute. Available at http://seer.cancer.gov/csr/1975_2007/, 2010; accessed November 23, 2011.
- American FactFinder Veterans. Washington, DC, U.S. Census Bureau. Available at http://fastfacts.census.gov/servlet/ACSSAFFPeople?_event=&geo_id=01000US&_geoContext=01000US&_street=&_county=&_cityTown=&_state=&_zip=&_lang=en&_sse=on&ActiveGeoDiv=&_useEV=&_pctxt=fph&pgsl=010&_submenuId=people_12&ds_name=null&_ci_nbr=&qr_name=®=%3A&_keyword=&_industry=, October 27, 2009; accessed October 30, 2011.
- Kimerling R, Pavao J, Valdez C, Mark H, Hyun JK, Saweikis M: Military sexual trauma and patient perceptions of Veteran Health Administration health care quality. *Womens Health Issues* 2011; 21(4 Suppl): S145–151.
- Murdoch M, Bradley A, Mather SH, Klein RE, Turner CL, Yano EM: Women and war. What physicians should know. *J Gen Intern Med* 2006; 21 Suppl 3: S5–10.

22. Agha Z, Lofgren RP, VanRuiswyk JV, Layde PM: Are patients at Veterans Affairs medical centers sicker? A comparative analysis of health status and medical resource use. *Arch Intern Med* 2000; 160(21): 3252–7.
 23. Keating NL, Landrum MB, Lamont EB, et al: Quality of care for older patients with cancer in the Veterans Health Administration versus the private sector: a cohort study. *Ann Intern Med* 2011; 154(11): 727–36.
 24. Chao HH, Schwartz AR, Hersh J, et al: Improving colorectal cancer screening and care in the Veterans Affairs Healthcare system. *Clin Colorectal Cancer* 2009; 8(1): 22–8.
 25. Powell AA, Nugent S, Ordin DL, Noorbaloochi S, Partin MR: Evaluation of a VHA collaborative to improve follow-up after a positive colorectal cancer screening test. *Med Care* 2011; 49: 897–903.
 26. Jackson GL, Powell AA, Ordin DL, et al: Developing and sustaining quality improvement partnerships in the VA: the Colorectal Cancer Care Collaborative. *J Gen Intern Med* 2010; 25 Suppl 1: 38–43.
 27. Zullig LL, Jackson GL, Provenzale D, Griffin JM, Phelan S, van Ryn M. Transportation: a vehicle or roadblock to cancer care for VA patients with colorectal cancer? *Clin Colorectal Cancer* 2012; 11: 60–5.
 28. Howlader N, Ries LA, Stinchcomb DG, Edwards BK: The impact of underreported Veterans Affairs data on national cancer statistics: analysis using population-based SEER registries. *J Natl Cancer Inst* 2009; 101(7): 533–6.
 29. Morgan RO, Teal CR, Reddy SG, Ford ME, Ashton CM: Measurement in Veterans Affairs Health Services Research: veterans as a special population. *Health Serv Res* 2005; 40(5 Pt 2): 1573–83.
-