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An Update on Cancer in American Indians and Alaska Natives, 1999-2004

Supplement to ***Cancer***

Cancer Among American Indians and Alaska Natives in the United States, 1999–2004

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BACKGROUND. Cancer incidence rates vary among American Indian and Alaska Native (AI/AN) populations and often differ from rates among non-Hispanic whites (NHWs). However, the misclassification of race for AI/AN cancer cases in central cancer registries may have led to underestimates of the AI/AN cancer burden in previous reports.

METHODS. Cases diagnosed during 1999 through 2004 were identified from population-based cancer registries in the United States. Age-adjusted rates were calculated for the 25 most common sites for AI/ANs and NHWs. To minimize the misclassification of race, cancer registry records were linked with patient registration files from the Indian Health Service (IHS). Analyses were restricted to Contract Health Service Delivery Area (CHSDA) counties and were stratified by IHS region.

RESULTS. In CHSDA counties, cancer incidence rates among AI/ANs varied widely by region, whereas rates among NHWs did not. For all cancer sites combined, AI/AN rates were higher than NHW rates among both males and females in the Northern and Southern Plains, and among Alaska Native Females; AI/AN rates were lower than NHW rates in the Southwest, the Pacific Coast, and the East. Lung cancer and colorectal cancer rates for AI/ANs exceeded rates for NHWs in Alaska and the Northern Plains. Rates for stomach, gallbladder, kidney, and liver cancer were higher among AI/ANs than among NHWs overall, in Alaska, in the Plains regions, and in the Southwest.

CONCLUSIONS. Regional differences in cancer incidence rates among AI/AN populations were not obvious from nationwide data and highlighted opportunities for cancer control and prevention. It is unlikely that such differences are explained by race misclassification. ***Cancer* 2008;113(5 suppl):1142–52.** *Published 2008 by the American Cancer Society.**

KEYWORDS: cancer, incidence, American Indian, Alaska Native, misclassification, National Program of Cancer Registries, Surveillance, Epidemiology, End Results, United States, health disparity.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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There is wide variation in cancer incidence and mortality rates worldwide.[1-3] Historically, systematic examination of differences in cancer occurrence by geographic region and among different cultures has yielded important clues about etiology.[4] Such differences may also point to opportunities for cancer prevention and control.

Cancer incidence rates for American Indian and Alaska Native (AI/AN) populations vary by geographic region in the United States and often differ from those of non-Hispanic whites (NHWs).[5-7] However, the misclassification of AI/AN cancer cases as other races in central cancer registries often has distorted the true burden of disease in these populations.[8-12] Systematic linkage of records from central cancer registries with patient registration records from the Indian Health Service (IHS) has been suggested to address this problem.[13]

The articles assembled in this *Cancer* supplement provide a comprehensive overview of the burden of cancer among AI/AN populations in the United States at the beginning of the 21st century. The objective of this report is to present incidence rates for the most common types of cancer among AI/ANs, by region and sex, in a format that enables the reader to assess the relative contribution of each type of cancer to the overall burden of the disease both within and between geographic regions. Region-specific rates for NHW populations are presented for comparison.

MATERIALS AND METHODS

Data Sources

Incident cancer cases that were diagnosed during the period from 1999 through 2004 were identified from population-based registries that participate in the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program[14] and/or the Centers for Disease Control and Prevention's National Program of Cancer Registries (NPCR).[15] For this study, participating registries classified tumor histology, tumor behavior, and primary cancer site according to the 3rd edition of the International Classification of Diseases for Oncology (ICD-O).[16] Detailed descriptions of the data sources and methods used for this analysis are provided in another article in this supplement.[17]

Incidence rates are presented for all cancer sites combined and for the most common 25 cancer sites among AI/AN populations nationwide; site categories are consistent with prevailing reporting standards.[15] Lymphomas (ICD-O histology codes 9590-9729) are presented as 2 separate categories (ie, Hodgkin and non-Hodgkin lymphoma) and are not included with other tumors of specific anatomic sites. Mesothelioma (ICD-O histology codes 9050-9055) and Kaposi sarcoma (ICD-O histology code 9140) are not included with other tumors of specific anatomic sites. In situ and invasive bladder tumors are combined in a single category.[18] All other benign and in situ tumors (ICD-O behavior codes 0 and 2, respectively) are excluded from the analysis, as are tumors of uncertain or unknown behavior (ICD-O behavior code 1).

To identify AI/AN cancer cases that were misclassified as other races, states worked with the IHS to link cancer registry records with IHS patient registration files. AI/AN individuals must provide proof of membership in a federally recognized tribe to receive healthcare from the IHS. The provision of healthcare to AI/AN populations by the IHS is greatest in Contract Health Service Delivery Area (CHSDA) counties, which generally are defined as counties that contain or are adjacent to federally recognized tribal reservations and/or trust lands.[19] There also is evidence that misclassification of AI/AN race occurs less often in CHSDA counties.[20] For this reason, 1 set of incidence rates was calculated for residents of all United States counties, and a second set of rates was calculated for residents of CHSDA counties.

Incidence rates also were calculated for each of 6 IHS regions (Alaska, Pacific Coast, Northern Plains, Southern Plains, Southwest, and East) and for all regions combined (Fig. 1). These IHS regions were chosen because they are consistent with previous reports of regional patterns of specific health outcomes and disease risk factors for AI/ANs.[21-23] Rank order of cancer sites by IHS region was based on the value of the respective site-specific incidence rates.

Statistical Analyses

Incidence rates were expressed per 100,000 population and were age-adjusted by the direct method[24] using the 2000 United States standard population.[25] The annual percentage change (APC) was used to describe fixed interval trends from 1999 to 2004. Incidence rates, rate ratios, APC, and 95% confidence limits were calculated with version 6.3 of SEER*Stat software.[26] Denominators for rate calculations were derived from population estimates from the U.S. Bureau of the Census.[27] Incidence counts were suppressed when fewer than 6 cases were observed to protect confidentiality. The APC was suppressed if it was based on fewer than 10 cases for at least 1 year within the time interval.

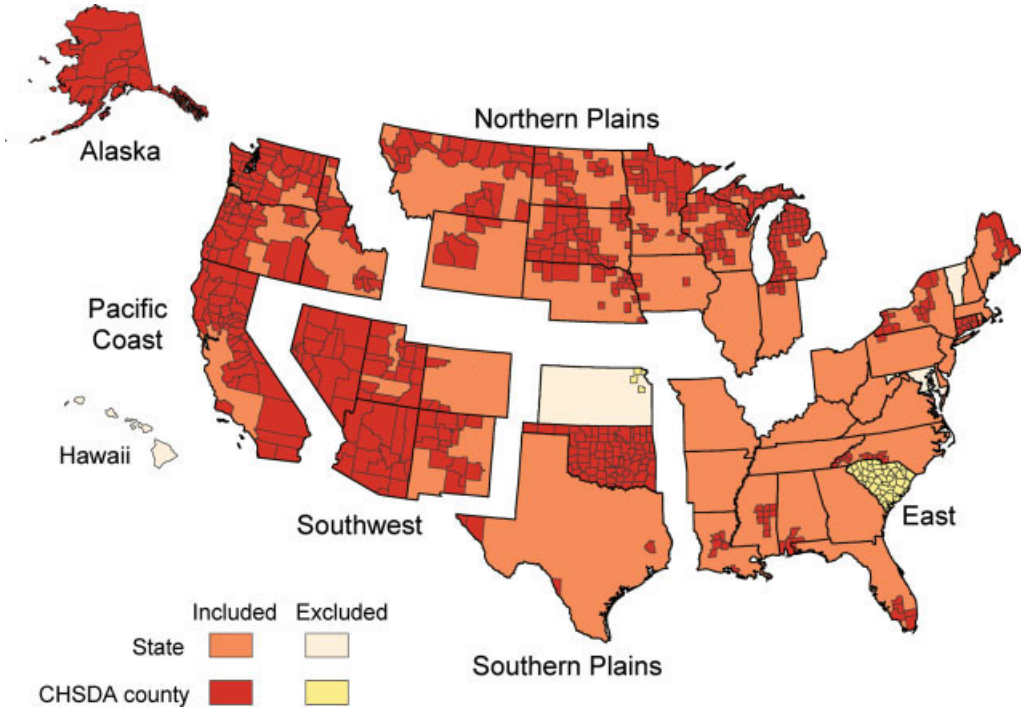

FIGURE 1. States and Contract Health Service Delivery Area (CHSDA) counties by Indian Health Service region are illustrated.

RESULTS

Incidence rates for AI/AN populations residing in CHSDA counties were higher than rates for AI/AN residents in all counties combined (Table 1). In contrast, NHW rates did not differ appreciably between CHSDA counties and all counties. These findings are consistent with improved classification of AI/AN cancer cases within CHSDA counties; therefore, the remaining portion of this report will focus on rates calculated for residents of CHSDA counties.

In CHSDA counties, incidence rates for all cancer sites combined among AI/AN males ranged from 256.2 in the Southwest to 636.1 in the Northern Plains (Table 2). Rates for NHW males ranged from 505.0 in the Southwest to 574.4 in the East. Among AI/AN males, the top 5 incident cancers were prostate, lung and bronchus (lung), colon and rectum (colorectal), kidney and renal pelvis (kidney), and urinary bladder (bladder) for all regions except Alaska and the Southwest, although the rankings varied. In Alaska and the Southwest, stomach replaced bladder cancer in the top 5 cancer sites (Table 2). AI/AN prostate cancer rates were highest in the Northern and Southern Plains and were similar to rates for NHW males. Lung and colorectal cancer rates among AI/AN males were highest in the Northern Plains and Alaska, and were significantly higher than those for NHW males. In the Southern Plains, AI/AN males also had high rates of lung cancer that were similar to the rates for NHW males, and colorectal cancer rates among AI/AN males in this region were significantly higher than for NHW males. AI/AN males in the Southwest had the lowest rates for the top 3 sites. AI/AN rates for cancers of the kidney, stomach, and liver/intrahepatic bile ducts (liver) generally were higher than those in NHW males in most regions. Gallbladder cancer rates for AI/AN males were nearly 4-fold greater than for NHW males for all regions combined and were more than 6 times greater in the Southwest and Alaska.

Among AI/AN females in CHSDA counties, incidence rates for all sites combined ranged from 218.3 in the Southwest to 500.7 in Alaska (Table 3). Rates for NHW females ranged from 398.9 in the Southwest to 437.9 in both the Pacific Coast and the East. Breast was the most common site among AI/AN females and NHW females in all regions. Breast, colorectal, and uterine cancer were among the top 5 cancers among AI/AN females in all regions. Lung cancer was among the top 5 in all regions except the Southwest. Non-Hodgkin lymphoma was in the top 5 among AI/AN females in the Plains and Pacific Coast; kidney cancer was in the top 5 among AI/AN females in Alaska, the East, and the Southwest; and ovarian cancer was in the top 5 among AI/AN females in the Southwest. Breast cancer was signifi-

TABLE 1
Incidence Rates and Annual Percentage Change, Both Sexes Combined, Contract Health Service Delivery Area Counties and All Counties: United States, 1999-2004

	AI/AN[a]			NHW			AI/AN:NHW[a]	
Type of Cancer	Rate[b]	Count	APC[c]	Rate[b]	Count	APC[c]	RR	95% CI
CHSDA Counties								
All sites	368.4	22,165	−1.14	475.9	1,311,488	−1.32[c]	0.77[d]	0.76–0.78
Prostate	105.6	2475	−1.93	154.4	194,792	−2.62	0.68[d]	0.66–0.71
Breast	85.3	3041	−1.83	134.4	195,290	−3.03[c]	0.63[d]	0.61–0.66
Lung and bronchus	57.4	3165	−0.22	70.3	197,074	−1.18[c]	0.82[d]	0.79–0.85
Colon and rectum	46.3	2621	−3.02	50.8	143,160	−3.03[c]	0.91[d]	0.87–0.95
Corpus and uterus, NOS	18.1	650	0.37	23.6	34,780	−1.21	0.77[d]	0.71–0.83
Kidney and renal pelvis	18.2	1152	3.31	12.6	34,648	3.09[c]	1.45[d]	1.36–1.54
NHL	14.1	845	−0.13	19.4	53,309	−0.06	0.73[d]	0.67–0.78
Ovary	11.5	405	−5.32	14.4	21,224	−3.02[c]	0.80[d]	0.72–0.88
Urinary bladder	9.6	518	−2.11	23.9	67,366	−0.72[c]	0.40[d]	0.37–0.44
Pancreas	9.9	540	−0.06	10.8	30,562	0.00	0.91[d]	0.83–1.00
Stomach	10.8	606	−1.49	5.8	16,258	−1.70[c]	1.88[d]	1.72–2.05
Cervix uteri	9.4	381	−6.82[c]	7.4	9374	−4.50[c]	1.28[d]	1.15–1.42
Leukemia	9.4	673	−0.70	12.6	34,025	−2.07[c]	0.75[d]	0.69–0.81
Liver and intrahepatic bile duct	9.0	529	4.04	4.3	11,805	2.64[c]	2.11[d]	1.92–2.32
Oral cavity and pharynx	8.5	548	−1.62	11.0	30,245	−0.74[c]	0.77[d]	0.70–0.84
Myeloma	6.2	355	−2.51	4.9	13,656	−0.29	1.27[d]	1.14–1.42
Thyroid	5.6	452	5.24	8.3	20,567	7.15[c]	0.67[d]	0.61–0.74
Melanoma of the skin	4.8	314	1.45	21.7	57,228	2.04	0.22[d]	0.20–0.25
Esophagus	4.4	248	−3.65	5.1	14,166	0.12	0.87[d]	0.76–0.99
Brain	3.6	299	−4.77	6.9	17,897	−0.02	0.53[d]	0.46–0.59
Testis	4.1	204	−2.95	6.7	7643	−0.04	0.61[d]	0.53–0.70
Larynx	3.1	189	−6.11	3.8	10,522	−4.12[c]	0.81[d]	0.69–0.94
Gallbladder	3.3	170	−0.55	0.9	2618	−2.69[c]	3.59[d]	3.04–4.22
Soft tissue including heart	2.1	157	−2.60	2.9	7707	0.83	0.70[d]	0.59–0.84
Other biliary	2.2	114	4.12	1.5	4177	4.82[c]	1.48[d]	1.21–1.80
All Counties								
All sites	275.5	28,874	−1.92	479.0	6,010,914	−1.21[c]	0.58[d]	0.57–0.58
Prostate	83.5	3429	−3.21	153.4	865,550	−3.27[c]	0.54[d]	0.52–0.56
Breast	65.5	4090	−2.34	131.7	879,456	−2.78[c]	0.50[d]	0.48–0.51
Lung and bronchus	43.8	4166	−0.89	72.4	921,867	−0.64[c]	0.61[d]	0.59–0.62
Colon and rectum	33.9	3316	−4.04[c]	53.2	681,745	−2.72[c]	0.64[d]	0.61–0.66
Corpus and uterus, NOS	13.3	829	1.31	24.6	166,098	−1.25[c]	0.54[d]	0.50–0.58
Kidney and renal pelvis	12.6	1393	3.07	13.4	167,890	3.29[c]	0.94[d]	0.89–0.99
NHL	10.5	1100	−0.27	19.7	246,109	−0.04	0.53[d]	0.50–0.57
Ovary	8.3	505	−5.10	14.3	96,461	−2.82[c]	0.58[d]	0.53–0.64
Urinary bladder	7.6	693	−4.18	23.7	304,365	−0.43[c]	0.32[d]	0.29–0.34
Pancreas	7.3	691	−0.25	10.9	140,444	0.26	0.67[d]	0.62–0.73
Stomach	7.2	701	−2.55	6.1	77,735	−2.18[c]	1.19[d]	1.10–1.29
Cervix uteri	6.9	502	−6.89[c]	7.7	45,935	−4.15[c]	0.90[d]	0.82–0.99
Leukemia	6.8	846	−2.10	12.7	156,354	−1.48	0.54[d]	0.50–0.58
Liver and intrahepatic bile duct	6.5	681	2.83	4.3	54,317	2.03[c]	1.52[d]	1.40–1.64
Oral cavity and pharynx	6.4	718	−1.22	10.9	135,624	−0.25	0.59[d]	0.54–0.63
Myeloma	4.6	451	−5.00	4.9	63,283	−0.83	0.93	0.84–1.02
Thyroid	4.0	595	6.92	8.5	98,144	6.67[c]	0.47[d]	0.43–0.52
Melanoma of the skin	3.6	424	0.08	19.6	236,723	2.67[c]	0.18[d]	0.16–0.20
Esophagus	3.2	309	−5.61	5.0	63,176	0.66[c]	0.63[d]	0.56–0.71
Brain	2.9	406	−7.13[c]	6.9	81,271	−0.61	0.42[d]	0.38–0.47
Testis	2.8	260	−1.86	6.5	34,389	0.39	0.43[d]	0.38–0.49
Larynx	2.3	246	−8.56	4.2	52,828	−2.74[c]	0.54[d]	0.47–0.61
Gallbladder	2.1	189	−0.72	1.0	13,123	−2.54[c]	2.11[d]	1.80–2.44

(*continued*)

TABLE 1
(*continued*)

	AI/AN[a]			NHW			AI/AN:NHW[a]	
Type of Cancer	Rate[b]	Count	APC[c]	Rate[b]	Count	APC[c]	RR	95% CI
Soft tissue including heart	1.6	207	−1.84	3.0	35,240	0.97[c]	0.53[d]	0.45–0.62
Other biliary	1.5	137	2.73	1.5	19,031	4.49[c]	1.04	0.87–1.24

Source: Cancer registries in Centers for Disease Control and Prevention's National Program of Cancer Registries (NPCR) and/or the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program.

CHSDA indicates Contract Health Service Delivery Area; AI/AN, American Indians/Alaska Natives; NHW, non-Hispanic whites; APC, annual percentage change; RR, rate ratio; CI, confidence interval; NOS, not otherwise specified; NHL, non-Hodgkin lymphoma.

[a]AI/AN race is reported by NPCR and SEER registries or through linkage with the IHS patient registration database. AI/AN persons of Hispanic origin are included.

[b]Rates are per 100,000 persons and are age-adjusted to the 2000 U.S. standard population (19 age groups).

[c] The APC is statistically significant ($P < .05$).

[d] The RR is statistically significant ($P < .05$). Counts <6 are suppressed; if no were cases reported, then rates and RRs could not be calculated.

Years of data and registries used: 1999-2004 (41 states and the District of Columbia): Alaska,* Alabama,* Arkansas, Arizona,* California,* Colorado,* Connecticut,* the District of Columbia, Delaware, Florida,* Georgia, Hawaii, Iowa,* Idaho,* Illinois, Indiana,* Kentucky, Louisiana,* Massachusetts,* Maine,* Michigan,* Minnesota,* Missouri, Montana,* North Carolina,* Nebraska,* New Hampshire, New Jersey, New Mexico,* Nevada,* New York,* Ohio, Oklahoma,* Oregon,* Pennsylvania,* Rhode Island,* Texas,* Utah,* Washington,* Wisconsin,* West Virginia, and Wyoming*; 1999 and 2002-2004: North Dakota*; 2001-2004: South Dakota*; 2003-2004: Mississippi* and Virginia; 2004: Tennessee (asterisks indicate states with at least 1 county designated as a CHSDA).

Percentage regional coverage of AI/AN in CHSDA counties to AI/AN in all counties: Alaska, 100%; East, 13.1%; Northern Plains, 59.0%; Southern Plains, 64.1%; Pacific Coast, 55.6%; Southwest, 87.5%.

cantly lower among AI/AN females than among NHW females in all regions except Alaska, where the rates were similar. Lung and colorectal cancer rates for AI/AN females were highest in Alaska and the Plains regions and exceeded the rates for NHW females in those areas. Lung cancer rates for AI/AN females were lowest in the Southwest (20% of the rate for NHW females). Cervical cancer was significantly higher among AI/AN than among NHW females in the Plains. Cancers of the kidney, stomach, liver, and gallbladder generally were higher among AI/AN females than among NHW females with some regional variation. Incidence rate tables combining data from males and females for the top 25 cancers and for all cancers collectively, by IHS region, are available at http://www.cdc.gov/cancer/healthdisparities/what_cdc_is_doing/aiansupplement.htm accessed on July 15, 2008.

DISCUSSION

Results from this report are consistent with previous accounts of AI/AN cancer incidence[6,7] and mortality.[21,23,28] Regional differences in cancer incidence rates may reflect geographic variation in population screening and/or in risk factors, including tobacco abuse, obesity, physical inactivity, heavy alcohol consumption, dietary factors, and prevalence of infectious agents that are believed to cause cancer. In some instances, there is compelling evidence to link such risk factors with observed cancer rates. For example, high rates of lung cancer in Alaska and in the Northern and Southern Plains regions generally are consistent with high rates of tobacco abuse in these areas.[7,29] For other cancers, additional research is needed to 1) elucidate risk factors and determinants for the regional variations, and 2) develop new approaches for implementing culturally appropriate cancer prevention and control strategies. Risk factors for specific cancers are addressed in detail in other articles included in this supplement.

AI/AN populations generally have a lower prevalence of screening for colorectal, breast, and cervical cancer, which can affect stage at diagnosis, clinical outcomes, and, in some cases, incidence, as reported by Steele et al[29] in this supplement and previously. It has been demonstrated that cervical cancer screening programs, coupled with adequate diagnostic follow-up and treatment, clearly benefit AI/AN populations.[30] The success of such screening programs underscores the potential for expanding other recommended cancer screening modalities in these communities. Cancer control only recently has become an important concern for many AI/AN communities, because cancer surveillance has revealed substantial increases in cancers that once were rare in this population.[31-34] Several governmental, public, and private organizations are collaborating to foster the establishment of comprehensive cancer control programs within tribes and other communities.[35]

This study also has identified several cancers for which AI/AN incidence rates consistently exceeded the rates in NHW populations. The incidence of kidney cancer was nearly 50% greater for AI/AN populations than for NHW populations in all regions combined and was elevated in 4 of 6 regions exam-

TABLE 2
Incidence Rates, Ranks, and Rate Ratios of the Top 25 Cancers for American Indian/Alaska Native Males Compared With Non-Hispanic White Males by Indian Health Service Region in Contract Health Service Delivery Area Counties: United States, 1999-2004

	All Regions Combined					Northern Plains					Alaska				
	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW
Type of Cancer	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR
All sites/types	—	414.6	—	549.2	0.75[b]	—	636.1	—	541.8	1.17[b]	—	538.7	—	569.8	0.95
Prostate	1	105.6	1	154.4	0.68[b]	1	174.6	1	162.2	1.08	3	78.3	1	180.7	0.43[b]
Lung and bronchus	2	69.6	2	85.9	0.81[b]	2	119.8	2	84.6	1.42[b]	1	115.3	2	85.0	1.36[b]
Colon and rectum	3	52.6	3	59.8	0.88[b]	3	88.9	3	61.3	1.45[b]	2	98.5	3	61.4	1.60[b]
Kidney/renal pelvis	4	23.2	7	17.2	1.35[b]	4	29.2	7	17.2	1.70[b]	5	28.6	6	18.7	1.53[b]
Urinary bladder	5	16.5	4	41.5	0.40[b]	5	26.8	4	39.4	0.68[b]	6	23.0	4	47.3	0.49[b]
NHL	6	15.2	6	23.1	0.65[b]	7	19.2	5	22.8	0.84	11	13.2	5	26.3	0.50[b]
Stomach	7	14.7	12	8.5	1.74[b]	8	18.7	12	8.5	2.21[b]	4	34.6	14	7.8	4.46[b]
Oral cavity/pharynx	8	13.1	8	16.4	0.80[b]	6	22.6	9	15.5	1.45[b]	8	20.5	8	15.4	1.33
Liver/IHBD	9	12.7	16	6.4	2.00[b]	10	16.0	17	5.4	2.98[b]	9	17.2	12	8.2	2.09[b]
Leukemia	10	11.5	9	16.3	0.71[b]	9	17.6	8	16.3	1.08	12	8.4	9	15.2	0.55[b]
Pancreas	11	9.8	10	12.5	0.78[b]	13	9.0	10	11.6	0.78	7	21.4	10	9.6	2.22[b]
Esophagus	12	8.1	11	8.7	0.93	11	15.2	11	9.3	1.64[b]	10	13.3	11	9.3	1.43
Myeloma	13	6.7	17	6.3	1.06	14	8.9	14	6.6	1.35	19	2.7	16	6.1	0.44
Melanoma, skin	14	5.8	5	26.6	0.22[b]	18	3.5	6	18.8	0.18[b]	25	1.6	7	16.4	0.10[b]
Larynx	15	5.5	15	6.6	0.84[b]	12	9.3	16	6.5	1.43	15	5.4	17	5.2	1.04
Brain	16	4.5	13	8.3	0.54[b]	16	4.7	13	8.0	0.58[b]	17	3.3	13	7.8	0.42[b]
Testis	17	4.1	14	6.7	0.61[b]	15	5.1	14	6.6	0.77	14	6.2	15	7.1	0.86
Gallbladder	18	2.5	33	0.7	3.69[b]	20	2.7	33	0.7	3.97[b]	16	4.6	33	0.6	7.38[b]
Thyroid	19	2.4	18	4.4	0.55[b]	17	4.6	18	3.9	1.17	21	2.4	18	5.1	0.47
Other biliary	20	2.4	24	1.9	1.26	27	1.2	23	1.8	0.64	13	6.5	25	1.4	4.81[b]
Soft tissue including heart	21	2.1	19	3.5	0.59[b]	23	2.0	20	3.2	0.63	28	0.9	20	3.9	0.24[b]
Hodgkin lymphoma	22	1.7	20	3.3	0.51[b]	19	2.9	19	3.3	0.8	30	0.9	21	3.6	0.24
Penis	23	1.3	31	0.8	1.69[b]	21	2.4	29	0.8	2.90[b]	26	1.1	31	0.8	1.53
Bones and joints	24	1.1	27	1.1	1.00	28	1.0	26	1.1	0.89	24	2.1	27	0.9	2.34
Anorectum	25	1.1	26	1.3	0.84	24	1.8	28	0.9	2.09	18	3.0	26	1.2	2.56

	Southern Plains					Pacific Coast					East				
	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW
Type of Cancer	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR
All sites/types	—	573.4	—	547.5	1.05[b]	—	338.0	—	557.8	0.61[b]	—	308.9	—	574.4	0.54[b]
Prostate	1	156.7	1	146.5	1.07	1	83.2	1	160.8	0.52[b]	1	83.9	1	155.9	0.54[b]
Lung and bronchus	2	111.0	2	108.5	1.02	2	57.7	2	82.5	0.70[b]	2	51.0	2	91.5	0.56[b]
Colon and rectum	3	70.3	3	63.2	1.11	3	44.0	3	56.5	0.78[b]	3	31.1	3	65.8	0.47[b]
Kidney/renal pelvis	4	25.1	8	17.8	1.41[b]	4	15.2	8	16.8	0.90	5	15.3	7	18.7	0.82
Urinary bladder	5	25.0	4	35.0	0.71[b]	5	14.1	4	42.0	0.34[b]	4	22.8	4	44.8	0.51[b]
NHL	6	24.2	5	22.1	1.10	7	12.5	6	24.2	0.52[b]	13	5.5	6	24.0	0.23[b]
Stomach	12	10.5	14	7.2	1.46[b]	8	12.2	13	8.3	1.48[b]	10	7.9	11	10.1	0.79
Oral cavity/pharynx	7	18.4	7	18.3	1.00	9	12.2	7	17.1	0.71[b]	6	11.3	9	16.3	0.69
Liver/IHBD	11	11.1	15	6.1	1.81[b]	6	12.8	15	6.6	1.95[b]	12	7.3	15	6.8	1.06
Leukemia	8	17.6	9	16.3	1.08	10	9.7	9	16.7	0.58[b]	7	9.0	8	17.1	0.53[b]
Pancreas	9	12.1	10	13.0	0.94	12	6.8	10	12.8	0.53[b]	11	7.9	10	13.4	0.59
Esophagus	14	8.4	13	7.7	1.09	11	7.4	12	8.8	0.84	8	8.9	12	8.9	1.00
Myeloma	15	8.3	16	5.8	1.43[b]	14	5.0	16	6.5	0.77	15	3.8	16	6.6	0.57
Melanoma, skin	10	11.9	6	20.3	0.58[b]	13	6.3	5	32.0	0.20[b]	16	3.4	5	25.8	0.13[b]
Larynx	13	9.0	12	7.7	1.16	16	3.8	17	5.8	0.65[b]	9	8.0	14	7.8	1.02
Brain	16	7.6	11	8.4	0.90	17	3.4	11	8.8	0.38[b]	14	4.7	13	8.1	0.57
Testis	17	3.4	17	5.6	0.62[b]	15	3.8	14	7.2	0.53[b]	20	1.5	17	6.5	0.23[b]

(*continued*)

TABLE 2
(*continued*)

	Southern Plains					Pacific Coast					East				
	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW
Type of Cancer	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR
Gallbladder	23	1.5	33	0.7	2.29	25	0.8	35	0.6	1.43	21	1.3	33	0.8	1.64
Thyroid	24	1.5	19	3.1	0.48[b]	18	2.3	18	4.1	0.56[b]	19	1.7	18	4.9	0.35
Other biliary	20	2.9	22	1.7	1.65	19	2.3	24	1.9	1.18	25	0.9	23	2.0	0.45
Soft tissue including heart	18	3.3	20	2.9	1.14	20	2.2	19	3.8	0.58[b]	26	0.8	19	3.6	0.22[b]
Hodgkin lymphoma	19	3.1	18	3.3	0.93	21	1.4	20	3.3	0.41[b]	23	1.2	20	3.5	0.34
Penis	27	1.4	29	1.0	1.42	26	0.8	34	0.7	1.12	32	0.0	31	0.8	—
Bones and joints	26	1.4	26	1.2	1.24	28	0.7	27	1.1	0.58	18	2.0	27	1.1	1.83
Anorectum	25	1.5	28	1.1	1.32	23	0.8	25	1.6	0.53	32	0.0	26	1.3	—

	Southwest				
	AI/AN		NHW		AI/AN:NHW
Type of Cancer	Rank	Rate[a]	Rank	Rate[a]	RR
All sites/types	0	256.2	0	505.0	0.51[b]
Prostate	1	65.7	1	133.8	0.49[b]
Lung and bronchus	4	21.2	2	77.3	0.27[b]
Colon and rectum	2	25.7	3	55.1	0.47[b]
Kidney/renal pelvis	3	25.2	7	15.7	1.60[b]
Urinary bladder	11	5.7	4	40.7	0.14[b]
NHL	7	10.9	6	20.4	0.54[b]
Stomach	5	15.3	13	7.1	2.17[b]
Oral cavity/pharynx	12	4.7	8	15.3	0.30[b]
Liver/IHBD	6	12.3	15	6.3	1.95[b]
Leukemia	9	7.0	9	14.2	0.49[b]
Pancreas	8	7.9	10	11.4	0.69[b]
Esophagus	13	4.6	11	8.0	0.58[b]
Myeloma	9	7.0	17	5.3	1.32
Melanoma, skin	17	3.3	5	28.6	0.11[b]
Larynx	19	2.1	16	5.9	0.35[b]
Brain	16	3.3	12	7.6	0.44[b]
Testis	14	4.3	14	6.3	0.68[b]
Gallbladder	15	4.1	32	0.7	6.21[b]
Thyroid	18	2.5	18	5.2	0.48[b]
Other biliary	20	2.0	23	1.8	1.12
Soft tissue including heart	21	1.7	19	3.5	0.48[b]
Hodgkin lymphoma	26	0.8	20	2.8	0.27[b]
Penis	23	1.3	33	0.6	2.10
Bones and joints	24	0.9	27	1.0	0.84
Anorectum	28	0.5	26	1.2	0.43

Source: Cancer registries in the Centers for Disease Control and Prevention's National Program of Cancer Registries and/or the National Cancer Institute's Surveillance, Epidemiology and End Results Program (for the states included, see Table 1).

AI/AN indicates American Indians/Alaska Natives; NHW, non-Hispanic whites; RR, rate ratio; NHL, non-Hodgkin lymphoma; IHBD, intrahepatic bile ducts.

[a] Rates are per 100,000 persons and are age-adjusted to the 2000 U.S. standard population (19 age groups).

[b] The RR is statistically significant ($P < .05$).

ined.[36] Stomach and liver cancer incidence rates were higher among AI/ANs than among NHWs in most regions.[37,38] Finally, gallbladder incidence rates were 4 times greater among AI/AN populations than among NHW populations in all regions combined and in 4 of 6 IHS regions.[39] Possible contributors to the regional patterns in AI/AN populations for these cancers are explored in separate articles of this supplement.[36-39]

Similar methods and findings were described recently in the 2007 *Annual Report to the Nation on the Status of Cancer*[7] (ARN); however, the current

TABLE 3
Incidence Rates, Ranks, and Rate Ratios of the Top 25 Cancers for American Indian/Alaska Native Females Compared With Non-Hispanic White Females, by Indian Health Service Region, CHSDA Counties: United States, 1999-2004

	All Regions Combined					Northern Plains					Alaska				
	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW
Type of Cancer	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR
All sites/types	0	337.6	0	424.0	0.80[b]	0	471.1	0	410.7	1.15[b]	0	500.7	0	417.2	1.20[b]
Breast	1	85.3	1	134.4	0.63[b]	1	115.9	1	130.3	0.89[b]	1	134.9	1	136.5	0.99
Lung and bronchus	2	48.5	2	58.6	0.83[b]	2	93.8	2	51.1	1.83[b]	3	75.4	2	60.7	1.24[b]
Colon and rectum	3	41.6	3	43.6	0.95	3	59.8	3	45.1	1.33[b]	2	106.2	3	40.6	2.62[b]
Corpus/uterus, NOS	4	18.1	4	23.6	0.77[b]	4	19.5	4	26.6	0.74[b]	5	13.6	4	22.8	0.60[b]
Kidney/renal pelvis	5	14.2	12	8.7	1.62[b]	5	19.3	11	9.2	2.10[b]	8	12.0	11	8.6	1.39
NHL	6	13.1	6	16.4	0.80[b]	6	18.0	5	16.6	1.08	10	9.9	5	17.9	0.55[b]
Ovary	7	11.5	7	14.4	0.80[b]	9	11.0	6	14.0	0.79	13	7.3	6	13.5	0.54[b]
Pancreas	8	9.8	11	9.4	1.04	8	12.5	12	8.9	1.40[b]	9	11.9	10	10.7	1.12
Cervix uteri	9	9.4	13	7.4	1.28[b]	7	12.5	13	7.4	1.69[b]	11	8.5	13	6.2	1.37
Thyroid	10	8.5	8	12.1	0.70[b]	10	9.7	8	11.8	0.83	6	12.3	8	12.4	0.99
Stomach	11	7.9	17	3.6	2.18[b]	12	9.2	17	3.4	2.69[b]	4	17.7	18	3.0	5.90[b]
Leukemia	12	7.6	10	9.7	0.78[b]	11	9.6	10	9.9	0.97	18	5.7	9	10.9	0.52[b]
Liver/IHBD	13	5.8	20	2.5	2.36[b]	14	6.5	21	2.2	2.89[b]	15	6.9	19	2.7	2.51[b]
Myeloma	14	5.8	16	3.7	1.56[b]	16	5.9	16	4.0	1.49	12	7.5	16	4.0	1.88
Oral cavity/pharynx	15	4.8	14	6.3	0.75[b]	13	7.6	14	6.2	1.23	7	12.3	15	5.8	2.12[b]
Urinary bladder	16	4.5	9	10.5	0.43[b]	15	6.4	9	10.4	0.62[b]	16	6.4	12	8.6	0.74
Melanoma, skin	17	4.0	5	18.0	0.22[b]	17	5.3	7	13.8	0.38[b]	29	1.1+	7	12.7	0.08[b]
Gallbladder	18	3.9	28	1.1	3.50[b]	22	2.5	26	1.3	1.89	14	6.9	32	0.9	7.91[b]
Brain	19	3.0	15	5.7	0.52[b]	20	2.8	15	5.4	0.53[b]	22	2.6	14	6.0	0.43[b]
Other biliary	20	2.1	27	1.2	1.77[b]	29	1.0+	27	1.2	0.83	19	3.6	24	1.5	2.42
Soft tissue including heart	21	2.0	19	2.5	0.82	18	3.4	20	2.4	1.42	23	2.4	21	2.4	0.99
Vulva	22	1.6	21	2.4	0.67[b]	21	2.8	19	2.4	1.17	28	1.1+	17	3.4	0.32
Esophagus	23	1.6	22	2.1	0.76	19	3.1	22	2.0	1.55	17	6.2	23	2.1	2.98[b]
Larynx	24	1.2	24	1.5	0.80	24	2.1	23	1.5	1.39	24	1.7+	26	1.3	1.39
Anorectum	25	1.2	23	1.8	0.68[b]	27	1.8	25	1.3	1.38	20	3.0	20	2.5	1.21

	Southern Plains					Pacific Coast					East				
	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW
Type of Cancer	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR
All sites/types	0	440.9	0	402.1	1.10[b]	0	295.1	0	437.9	0.67[b]	0	272.0	0	437.9	0.62[b]
Breast	1	115.7	1	129.7	0.89[b]	1	74.7	1	142.6	0.52[b]	1	71.4	1	133.6	0.53[b]
Lung and bronchus	2	69.9	2	62.6	1.12[b]	2	48.0	2	60.9	0.79[b]	2	43.5	2	61.7	0.71[b]
Colon and rectum	3	53.8	3	43.2	1.25[b]	3	35.0	3	42.1	0.83[b]	3	39.7	3	47.1	0.84
Corpus/uterus, NOS	4	22.4	4	19.4	1.16	4	16.7	4	23.6	0.71[b]	4	15.2	4	25.4	0.60[b]
Kidney/renal pelvis	6	18.1	10	9.1	1.99[b]	7	10.2	12	8.3	1.23	5	14.0	12	9.2	1.53
NHL	5	18.5	5	15.6	1.18	5	12.5	6	16.8	0.74[b]	6	8.8	5	16.9	0.52[b]
Ovary	7	14.7	6	14.0	1.05	8	10.0	7	14.9	0.67[b]	11	5.9	7	14.8	0.40[b]
Pancreas	9	10.1	11	8.7	1.16	6	11.1	10	9.7	1.15	9	7.0	10	10.2	0.69
Cervix uteri	8	14.1	9	9.2	1.54[b]	10	6.9	13	7.0	0.98	8	7.1	13	7.3	0.97
Thyroid	11	9.2	13	8.1	1.13	11	6.3	8	11.0	0.57[b]	10	6.6	8	13.6	0.49[b]
Stomach	13	7.6	17	3.4	2.23[b]	13	4.7	17	3.5	1.34	13	4.8	16	4.4	1.09
Leukemia	10	9.6	8	9.7	1.00	9	7.5	11	9.7	0.77	7	7.5	11	9.8	0.77
Liver/IHBD	17	5.1	18	2.8	1.84[b]	12	5.8	20	2.6	2.24[b]	15	3.8	21	2.5	1.55
Myeloma	15	6.6	16	3.7	1.79[b]	15	4.1	16	3.8	1.08	12	4.9	17	3.9	1.25
Oral cavity/pharynx	16	6.0	14	6.0	1.00	17	3.8	14	6.7	0.57[b]	16	3.7	14	6.5	0.58
Urinary bladder	14	7.3	12	8.5	0.85	14	4.3	9	10.1	0.42[b]	14	4.4	9	12.0	0.37[b]
Melanoma, skin	12	7.8	7	12.4	0.63[b]	16	4.0	5	22.6	0.18[b]	19	1.9+	6	16.7	0.12[b]

(*continued*

TABLE 3
(*continued*)

	Southern Plains					Pacific Coast					East				
	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW	AI/AN		NHW		AI/AN:NHW
Type of Cancer	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR	Rank	Rate[a]	Rank	Rate[a]	RR
Gallbladder	20	2.6	27	1.0	2.65[b]	19	2.0	29	1.1	1.80	21	1.8+	27	1.1	1.61
Brain	18	4.8	15	5.7	0.84	18	3.1	15	5.9	0.52[b]	18	2.4	15	5.8	0.42[b]
Other biliary	24	1.6	26	1.1	1.49	23	1.1	28	1.1	0.98	31	0.4+	26	1.3	0.31
Soft tissue including heart	19	2.8	21	2.1	1.36	27	0.8	19	2.6	0.32[b]	27	0.7+	20	2.6	0.26
Vulva	23	1.8	19	2.6	0.69	20	1.8	22	2.2	0.81	17	2.6+	19	2.7	0.97
Esophagus	27	1.5	24	1.5	0.96	22	1.1	21	2.2	0.51	24	1.1+	22	2.2	0.48
Larynx	22	2.0	23	1.8	1.10	21	1.4	27	1.3	1.11	25	0.9+	23	1.8	0.49
Anorectum	21	2.1	22	1.8	1.14	25	0.9	23	2.1	0.41[b]	26	0.8+	24	1.6	0.48

	Southwest				
	AI/AN		NHW		AI/AN:NHW
Type of Cancer	Rank	Rate[a]	Rank	Rate[a]	RR
All sites/types	0	218.3	0	398.9	0.55[b]
Breast	1	50.8	1	125.2	0.41[b]
Lung and bronchus	6	10.4	2	56.3	0.18[b]
Colon and rectum	2	17.3	3	39.7	0.44[b]
Corpus/uterus, NOS	3	16.7	4	19.6	0.86[b]
Kidney/renal pelvis	5	12.4	12	8.2	1.51[b]
NHL	8	8.8	7	14.7	0.60[b]
Ovary	4	12.5	8	13.6	0.92
Pancreas	11	7.7	11	8.4	0.92
Cervix uteri	10	7.8	13	7.3	1.07
Thyroid	7	8.9	6	14.8	0.60[b]
Stomach	9	8.6	17	3.0	2.86[b]
Leukemia	15	5.8	10	9.1	0.63[b]
Liver/IHBD	13	6.3	19	2.3	2.71[b]
Myeloma	14	6.2	16	3.1	2.04[b]
Oral cavity/pharynx	17	2.1	14	5.9	0.37[b]
Urinary bladder	21	1.4	9	10.1	0.14[b]
Melanoma, skin	19	1.8	5	17.8	0.10[b]
Gallbladder	12	6.6	29	0.9	7.20[b]
Brain	20	1.8	15	5.6	0.32[b]
Other biliary	16	3.6	27	1.0	3.64[b]
Soft tissue including heart	18	2.0	18	2.5	0.83
Vulva	23	0.8	21	2.2	0.37[b]
Esophagus	26	0.6+	23	1.7	0.35[b]
Larynx	39	0.2+	24	1.4	0.11[b]

Source: Cancer registries in the Centers for Disease Control and Prevention's National Program of Cancer Registries and/or the National Cancer Institute's Surveillance, Epidemiology, and End Results Program (for the states included, see Table 1).

AI/AN indicates American Indians/Alaska Natives; NHW, non-Hispanic whites; RR, rate ratio; NOS, not otherwise specified; NHL, non-Hodgkin lymphoma; IHBD, intrahepatic bile ducts.

[a] Rates are per 100,000 persons and are age-adjusted to the 2000 U.S. standard population (19 age groups).

[b] The RR is statistically significant ($P < .05$).

report differs from the ARN in several respects. First, this report includes rates for 25 of the most common cancer sites, whereas the ARN was restricted to 15 sites. Second, the ARN suppressed publication of rates based on fewer than 16 cases, whereas the current report applied a less restrictive suppression rule to present rates for more cancer sites among AI/AN populations. Finally, for this supplement, the investigators analyzed data from additional states with significant AI/AN populations (Minnesota, North Carolina, and South Dakota) that were not included in the ARN analysis.

Results from this report must be interpreted in the context of the following limitations. The record-linkage methodology used to reduce AI/AN misclassification relied on records of individuals who received healthcare from the IHS; this method does not address misclassification among AI/ANs who were not listed in IHS files. Furthermore, the current analysis was restricted to residents of CHSDA counties, where it is believed that this methodology is most efficacious. The cancer burden among AI/ANs who do not receive healthcare from the IHS and among AI/AN residents of non-CHSDA counties has not been well characterized. For this reason, the direction or extent of possible bias that may have been introduced by the current methodology is not known.

Despite limitations of the data, this and other reports in the supplement offer the most comprehensive examination to date of cancer incidence in AI/AN populations. The inclusion of data from most central cancer registries in the United States strengthens the stability of regional estimates of AI/AN cancer incidence, whereas data linkages and the focus on CHSDA counties improves on the race classification and, thus, on the accuracy of the estimates.

In conclusion, the quality and scope of cancer surveillance in AI/AN populations has been strengthened. Our report and the other reports in this supplement describe disparities in cancer incidence, risk factors, and screening prevalence that provide a clear, albeit challenging, course of action for cancer control partners. Future progress in decreasing the cancer burden in AI/AN populations is necessary and achievable with the implementation of comprehensive cancer control programs. Ideally, these programs would provide direction and would motivate and actively engage partners across the spectrum of cancer control advocates, healthcare providers, policymakers, tribal leaders, and funding agencies.

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