REPORT OF THE

Navajo Epidemiology Center

October 31, 2023

By Navajo Cancer Workgroup

Cancer Among the Navajo

Incidence, Mortality, Stage of Diagnosis & Screening

2014 - 2018

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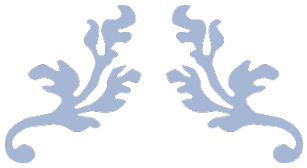

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2014 - 2018

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NAVAJO EPIDEMIOLOGY CENTER
The Navajo Nation

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Navajo Cancer Workgroup

The Navajo Cancer Workgroup was formed in 1999 to support the efforts of Navajo Nation leaders to improve cancer prevention and care by utilizing and improving cancer data. The workgroup aims to:

1. Evaluate and improve cancer data quality and monitoring.
2. Empower and engage communities around cancer prevention.
3. Support and improve Navajo Area health programs.
4. Produce Navajo specific cancer reports to inform and educate public health professionals, medical providers, Navajo Nation health programs, and local, state, and federal agencies.
5. Produce Navajo specific cancer reports to inform tribal leaders and community members.

Representatives (listed below) from these organizations make up the Navajo Cancer Workgroup and are recognized and commended for their contribution to this report.

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Preface

In response to professional and community concerns about cancer being a major health issue among Navajo residents of the Navajo Nation, the Navajo Cancer Workgroup presents *Cancer Among the Navajo, 2014-2018*. This report was produced to update the findings of previous reports, *Cancer Among the Navajo, 2005-2013*,[1] and *Cancer Among the Navajo, 1995-2004,*[2] and to increase our current understanding of cancer among the Navajo people. Patients, family members, medical and public health professionals, educators, community members, policy makers, tribal program administrators and staff are encouraged to use all of the reports to improve cancer prevention, education, and treatment.
This latest report presents cancer data among people of the Navajo Nation, a large tribal nation both geographically and by population in the United States. It examines cancer incidence (new cases), stage of diagnosis, mortality, trends and cancer screening behaviors among the Navajo people for the years 2014-2018. In addition, the report provides recommendations and resources to improve cancer prevention and care on the Navajo Nation.

Acknowledgment

We would like to acknowledge all former members of the Navajo Cancer Workgroup. We express our gratitude for their unwavering support, commitment, expertise, and guidance over the years. Such reports would have not been possible without them. Thank you!

Dedication

Cancer has greatly impacted the lives of the Navajo people over the years. Therefore, we would like to dedicate this report to cancer survivors, those who have lost their lives to cancer, and their loved ones who cared for them. The amount of courage, determination and resilience of cancer survivors is immeasurable, and we send them continuous strength and support. May they be a symbol of hope for all who have been affected by cancer. As for those who have lost their battle to cancer, their families and friends are in our prayers. We hope this report will provide the Navajo people with the information, awareness and resources needed to decrease the burden of cancer.

Executive Summary

Background

Cancer is currently the third leading cause of death among the Navajo people, representing 11.5 percent of all deaths.[3] American Indian and Alaska Native people (AI/AN) are often diagnosed at relatively advanced stages of cancer compared to non-Hispanic white people.[4-9] For instance, despite having lower incidence of breast cancer compared to non-Hispanic white women, Navajo women are more likely to be diagnosed at later stages.[1,2] This higher burden of cancer outcomes in Navajo people is considered a cancer disparity. Historical and cultural factors, such as the detrimental effects of uranium exposure and post-colonial changes in the food environment, in combination with social determinants of health (e.g., unemployment, food insecurity, lower access to affordable quality healthcare services) are major contributors to cancer in the Navajo people.[10-14] Therefore, continued cancer surveillance is important for research, targeted screening and education to help reduce cancer disparities on the Navajo Nation.[15]

Methodology

The Navajo Cancer Workgroup, a workgroup of health and public health professionals, utilized high-quality, population-based cancer surveillance, cancer incidence, mortality, and stage at diagnosis data reported to the Arizona Cancer Registry, New Mexico Tumor Registry and Utah Cancer Registry. The Navajo cancer incidence and mortality rates were based on data from American Indians and Alaska Natives (AI/AN) who resided in a six-county region that comprise the Navajo Nation. The counties are Coconino, Navajo and Apache Counties in Arizona; San Juan and McKinley counties in New Mexico; and San Juan County in Utah. In these six counties, Navajo people represent about 80% of the total AI/AN population;[16] therefore, cancer data for AI/AN serves as a proxy for Navajo people. To examine trends, the average annual percent change in the age-adjusted mortality and incidence rates were calculated from 1990 to 2018. For cancer screening behaviors, data were used from the Indian Health Service (IHS), federal and tribal clinical outcome measures reported as part of the Government Performance and Results Act (GPRA),[17] and the Behavioral Risk Factor Surveillance Survey (BRFSS),[18] a well-established national, telephone-based health survey by the Centers for Disease Control and Prevention (CDC).

Key Findings

Incidence: Findings show that from 2014-2018, the ten most commonly diagnosed cancers (by counts) among the Navajo people were female breast, colorectal, kidney, prostate, uterine, stomach, thyroid, non-Hodgkin lymphoma, liver, and pancreas. Prostate cancer was the most commonly diagnosed cancer among Navajo males (222 new cases, 50.4 cases per 100,000 males), followed by colorectal cancer and kidney cancer. Among Navajo females, breast cancer was the most commonly diagnosed cancer (384 new cases, 60.9 per 100,000 females), followed by uterine cancer and colorectal cancer. Compared to the non-Hispanic white (NHW) population in Arizona and New Mexico, Navajo adults had a significantly lower incidence of prostate, female breast, non-Hodgkin lymphoma, lung, and pancreatic cancers, but significantly higher incidence of liver, kidney, stomach, myeloma, and gallbladder cancers.

Trends over time: From 1998 to 2018, there was an increasing trend in the incidence rates for colorectal (Annual Percent Change (APC): 3.6%), breast (APC: 1.7%) and all cancer sites (APC: 0.8%), and a decreasing trend for prostate cancer (-4.6%) among Navajo people. Whereas for Non-Hispanic White (NHW) people in Arizona and New Mexico, the trends in the incidence rates for prostate (APC: -2.8%), colorectal (APC: -2.2%), breast (APC:-0.6%) and all cancer sites (APC: -0.9%) decreased significantly.

Stage of diagnosis: Compared to AZ/NM non-Hispanic white people, Navajo people were less likely to be diagnosed in the local stage, a critical window of time where cancer is more treatable. For breast cancer, 67.1% of AZ/NM non-Hispanic white women were diagnosed in the local stage vs. 59.7% of Navajo women, for cervical cancer 45.1% AZ/NM non-Hispanic white women were diagnosed in local stage vs. 41.2% for Navajo women and for colorectal cancers 35.5% for AZ/NM non-Hispanic white people vs. 32.5% among Navajo.

Mortality: The most common causes of cancer mortality among Navajo males were from prostate, colorectal, kidney, and stomach cancers, and among Navajo females were breast, colorectal, pancreatic and ovarian cancers. In contrast, for AZ/NM non-Hispanic white people, the leading cause of cancer death was from lung cancer, at a rate 5.1 times higher than the Navajo people. Trends in cancer mortality rates between 1998 and 2018 increased among Navajo people for colorectal (APC: 2.6%), female breast (APC: 2.2%), pancreatic (APC: 1.1%), kidney and renal pelvis (APC: 0.7%) and prostate cancer (APC: 0.6%); and decreased trends in cancer mortality rates were found for for stomach (APC: -2.0%), lung (APC: -1.1%), leukemia (APC: -1.0%), ovary (APC: -0.5%), and liver cancer (APC: -0.5%). For AZ/NM non-Hispanic white people, mortality rates showed a significantly downward trend for stomach, colorectal, lung, female breast, ovarian, prostate, and leukemia, but not liver (significant upward trend) and pancreatic cancer.

Screening: Cancer screening among the Navajo people is low, particularly for colorectal cancer. However, there are substantial differences in breast cancer screening based on data sources, with Navajo area-wide GPRA (clinic-reported) suggesting lower proportions than the self-reported BRFSS data. The BRFSS data suggests that non-Hispanic white females receive mammography and pap test screenings at almost the same proportions as AI/AN females in the counties for which recent data was available (San Juan and McKinley counties), but the proportions of colorectal cancer screening were much lower in AI/AN females (61.8% non-Hispanic white vs. 46.4% AI/AN). The most recent years' screening proportions (2021) were lower due to the COVID-19 pandemic, but similar to other IHS areas.

Conclusion and Recommendations

Cancer among the Navajo people remains a substantial public health challenge on the Navajo Nation. The most common cancers in the Navajo people are prostate, breast, kidney and colorectal cancers. Although the incidence and mortality of the most common cancers (prostate, breast, colorectal) remain lower than the non-Hispanic white population in Arizona and New Mexico, Navajo people suffer from comparatively higher rates of kidney, liver, stomach and gallbladder cancers. In addition, Navajo people continue to be diagnosed at late disease stages (regional and distant), despite a notable 6% increase from the 2005-2013 report for Navajo women being diagnosed in local stages for breast and cervical cancer. In the context of the COVID-19 pandemic, recent clinic-reported cancer screening estimates were lower than in the report from 2005-2013, but comparable to other Indian Health Service areas.

The workgroup recommends continuing the partnership with state cancer registries and cancer control planners to maintain and improve ongoing surveillance of cancer among the Navajo people, and to promote research that examines risk factors and causes, as well as support appropriate approaches to promote screening, early detection, and treatment. In addition, the workgroup recommends increasing education and training for health care providers regarding current cancer screening practices and guidelines, and expanding collaboration between Navajo tribal health programs, Indian Health Service and Tribal Health Organizations, and local communities to translate these data into targeted and culturally appropriate strategies to reduce the cancer burden in the Navajo people.

Introduction

Until the advent of population-based cancer surveillance in the 1970s, reports of cancer among the Navajo people were based on case studies of patients from individual physicians or organizations that served Navajo communities, and on data using vital records. Reports of cancer among the Navajo people were published in the medical literature as early as the 1930s.[19-21] A common finding in these reports was the relatively low number of cancers observed among the Navajo people. For example, in 1956 C.G. Salsbury, M.D., a physician who worked among the Navajo people, wrote that cancer rates were lower among the Navajo people compared to white people and questioned whether the Navajo people were protected from diabetes and cancer because of their diet and nutrient intake.[22]

Following World War II, uranium mining settled within uranium-rich regions across the United States including Navajo Nation communities of Cove, Monument Valley, Sanostee, and Church Rock. Decades later and after the uranium mining boom, increased rates of lung cancer in Navajo uranium workers were discovered and linked to working in the uranium mines without protective equipment. Much of the uranium tailings and toxic waste from the milling process were left abandoned in Shiprock, NM, Tuba City, AZ, and Kayenta, AZ, resulting in an additional environmental risk to the health of Navajo people even to today.[12-14]

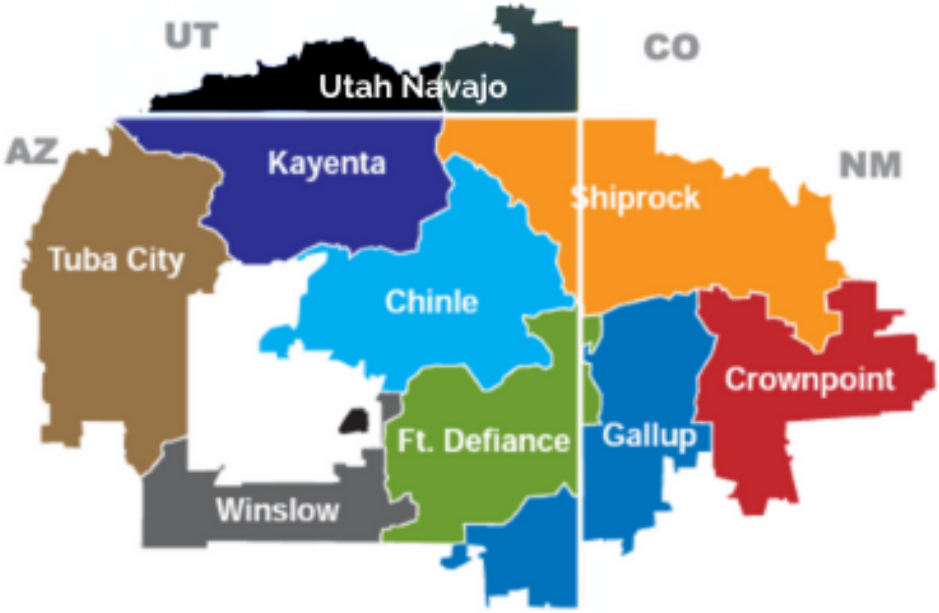
Today, cancer has become one of the leading causes of disease and death for the Navajo people. The Indian Health Service estimated that 7.3 percent of all deaths in the Navajo Area Indian Health Service region were due to cancer from 1999 to 2001.[23] In the current report, data from the Arizona Cancer Registry, New Mexico Tumor Registry, and Utah Cancer Registry were used to provide Navajo proxy cancer incidence and stage of diagnosis. The cancer mortality data were provided by the National Center for Health Statistics. These data focus on the contiguous Navajo Nation and exclude the three satellite communities of Ramah, Alamo, and Tohajiilee in New Mexico. These satellite communities are served by the Albuquerque Area Indian Health Service in New Mexico and were excluded because the Navajo Cancer Workgroup did not have access to Albuquerque Area Indian Health Service Resource Patient Management System (RPMS), a health care information system for population estimate data.

Health Care on the Navajo Nation

The Navajo Nation is a large tribal nation in the United States (U.S.), both geographically and by population. It spans over 27,000 square miles across Arizona, Colorado, New Mexico, and Utah, and there are more than 400,000 tribally enrolled individuals. Based on the U.S. 2010 Census, over 407,000 individuals living in the U.S. claimed to have Navajo ancestry with approximately one-half living on the Navajo Nation and the other half in border towns or metropolitan areas. The Navajo population's median age of 25 years old is much younger when compared to the U.S. general population of 35 years old.[24-25]

According to Navajo culture, Navajo people believe that the Holy People bestowed special teachings upon them.[26] These teachings tell one how to live in balance with nature and all of Mother Earth's inhabitants; this balance is known as *K'e*. When out of balance, Navajo people seek traditional healing from Navajo healers or traditional practitioners for mental, spiritual, and physical well-being. These practitioners specialize in specific areas for diagnosis and care that range from hand tremblers and crystal gazers to individuals who perform healing ceremonies involving songs, prayers, and herbal medicines.[26,27]

Figure 1. Map of Navajo Nation by IHS/638 health care service areas.



Parallel to Navajo healing practices and medicines is the Western medicine system. The Indian Health Service (IHS), an agency within the U.S. Department of Health and Human Services, is responsible for providing health-care services to AI/ANs. Within the Navajo Area IHS (NAIHS) there are five hospitals, seven health centers, 15 health stations, and 22 dental clinics, including 5 contract (or "638") facilities that are administered by Navajo organizations. These facilities are geographically divided into eight NAIHS service areas called service units.[28] The NAIHS primarily serves people from the Navajo Nation, the Southern Band of San Juan Paiute, Hopi, and Zuni. Their services include inpatient care, ambulatory care, contract health, and public health programs. Additional health, education, and prevention services to the Navajo People are provided by the Navajo Department of Health (NDOH). In 1977, the NDOH was established within the Navajo government system to promote and protect the overall health of the Navajo people by developing tribal health programs that focus on health promotion and disease prevention. The NDOH programs include:

Table 1: Navajo Department of Health Programs

Office of the Executive Director	Navajo Epidemiology Center
Division of Behavioral & Mental Health Services	Environmental Health & Protection Program
Division of Aging & Long-Term Care Support	Public Health Emergency Preparedness Program
Navajo Research Program	Diabetes Prevention Program
Community Health Representative Program	Uranium Workers Program
Food Distribution Program	Cancer Prevention Program
Health Education & HIV Prevention Program	Women, Infants and Children Program
Kayenta Public Health Nursing	Information Technology
Infectious Disease Prevention & Control Program	Non-Emergency Medical Transport Program

Specific to cancer services, the Navajo Nation has a breast and cervical cancer screening program, founded in 1996. Furthermore, in 2019, a cancer treatment center opened on the Navajo Nation under the Tuba City Regional Health Care Corporation. The center was the first cancer treatment center in the U.S. on any Tribal lands, allowing for reduced travel time for Navajo people diagnosed with cancer.

Cancer Incidence & Trends

Cancer incidence refers to new cancers, a measure that informs us about the burden of cancer within a population. The terms cancer incidence and cancer incidence rate are often used interchangeably, however, there is a difference. Cancer incidence (synonymous with incident number) is defined as the number of new cancers of a specific site or type diagnosed in a specified period of time. Cancer incidence rate is the number of new cancers of a specific site or type diagnosed in a specified period of time among a defined population. In other words, it is the cancer incidence count divided by the number of people in the entire population at risk. The numerator is the number of new cancers; the denominator is the population size.

Incidence Rate = Number of new cancers diagnosed / Population at risk X 100,000

In this report, the incidence rates were age-adjusted. It is known that older people are more likely to have cancer than younger people and the age-distribution of different populations often differs. For example, group A may tend to be older on average than group B because they are at higher risk simply because they represent an older population. Therefore, to accurately compare rates of two populations with differing age distributions, the age groups of one population need to be weighted to the age distribution of the comparison population. This technique is called age standardization. Age standardization results in a weighted average of the age-specific rates. The standardization produces the rate expected if the populations being compared had identical age distributions. In this report, the rates were age standardized to the 2000 U.S. standard population.

Methodology

Population-based cancer incidence data were obtained from New Mexico Tumor Registry, Arizona Cancer Registry, and Utah Cancer Registry which jointly cover the geographic area of the Navajo Nation. The New Mexico Tumor Registry and Utah Cancer Registry participate in the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program. The Arizona Cancer Registry participates in the Center for Disease Control and Prevention's National Program of Cancer Registries (NPCR). All three state cancer registries met the same high standards for complete, accurate, and timely data collection.[29] Data from these registries are routinely linked with the Indian Health Service (IHS) patient records to identify cases as Navajo. These data are used as numerators for the cancer incidence rate calculations. Cancers were coded and classified according to the International Classification of Diseases – Oncology (ICD-1O).[30] The site recode as defined by the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program was used.[31] Unless otherwise specified, all ages are included in the analyses.

The comparison group used in this report were non-Hispanic white (NHW) people living in States and Contract Health Service Delivery Area (CHSDA) counties of Arizona and New Mexico. We used county-level population estimates produced by the U.S. Census Bureau as denominators in the rate calculations. We calculated standardized rate ratios for Navajo people using NHW rates as comparisons (Appendix A). We tested if rates between Navajo and NHW people were statistically different using a p-value <0.05.

Table 2: Data sources and notes for Figures 2-16, Tables 3-5	
Data Source	• National Program of Cancer Registries and Surveillance, Epidemiology, and End Results SEER*Stat Database: U.S. Cancer Statistics American Indian and Alaska Native Incidence Analytic Database - 1998-2018. United States Department of Health and Human Services, Centers for Disease Control and Prevention. • Mortality data provided by National Center for Health Statistics.
Counties included in data	• American Indian/ Alaskan Native cancer data in the six counties that comprise of most of Navajo Nation were used as a proxy for Navajo cancer rates; the six counties include: Apache

	County (AZ), Coconino County (AZ), Navajo County (AZ), McKinley County (NM), San Juan County (NM) and San Juan County (UT).
Comparison group	• AZ/NM non-Hispanic White; non-Hispanic white (NHW) people living in States and Contract Health Service Delivery Area (CHSDA) counties of Arizona and New Mexico
Statistical Notes	• Rates are per 100,000 persons and are age-adjusted to the 2000 U.S. standard population (19 age groups - Census P25-1130). • Rate ratios (RR) were calculated in SEER*Stat prior to rounding of rates and may not equal RR calculated from rates. • * Indicates RR is statistically significant ($p<0.05$).
Abbreviations	• NHW indicates non-Hispanic White

Data Summary Incidence (Figures 2-5, Appendix A)

- The most common cancers among the Navajo people by count were female breast, colorectal, kidney, prostate and uterine cancers (Figure 2).
  - Prostate cancer was the most commonly diagnosed cancer among Navajo males, followed by colorectal cancer, kidney cancer, and stomach cancer.
  - Among Navajo females, breast cancer was the most commonly diagnosed cancer, followed by uterine cancer, colorectal cancer, and kidney cancer.
- Navajo people were significantly less likely to be diagnosed with certain cancers compared to NHW people (Figure 3, Table 3 and Appendix A).
  - Eighty-four percent less likely to be diagnosed with lung cancer
  - Fifty-one percent less likely to be diagnosed with breast cancer
  - Fifty-one percent less likely to be diagnosed with leukemia
  - Thirty-eight percent less likely to be diagnosed with prostate cancer
  - Twenty-one percent less likely to be diagnosed with non-Hodgkin lymphoma
  - Twenty-one percent less likely to be diagnosed with pancreatic cancer
  - Navajo had lower rates than NHW of oral cancer, esophageal cancer, brain cancer, melanoma, esophagus, and urinary bladder cancer, although the number of cases were relatively small.
- In contrast, Navajo people were 6.3 times more likely to be diagnosed with gallbladder cancer, 3.2 times more likely for stomach cancer, 1.9 times more likely for kidney cancer, 1.8 times more likely for liver cancer, and 1.8 times more likely to be diagnosed with myeloma than NHW people.

Figure 2. Total counts of most commonly diagnosed cancers among Navajo 2014-2018 males and females combined

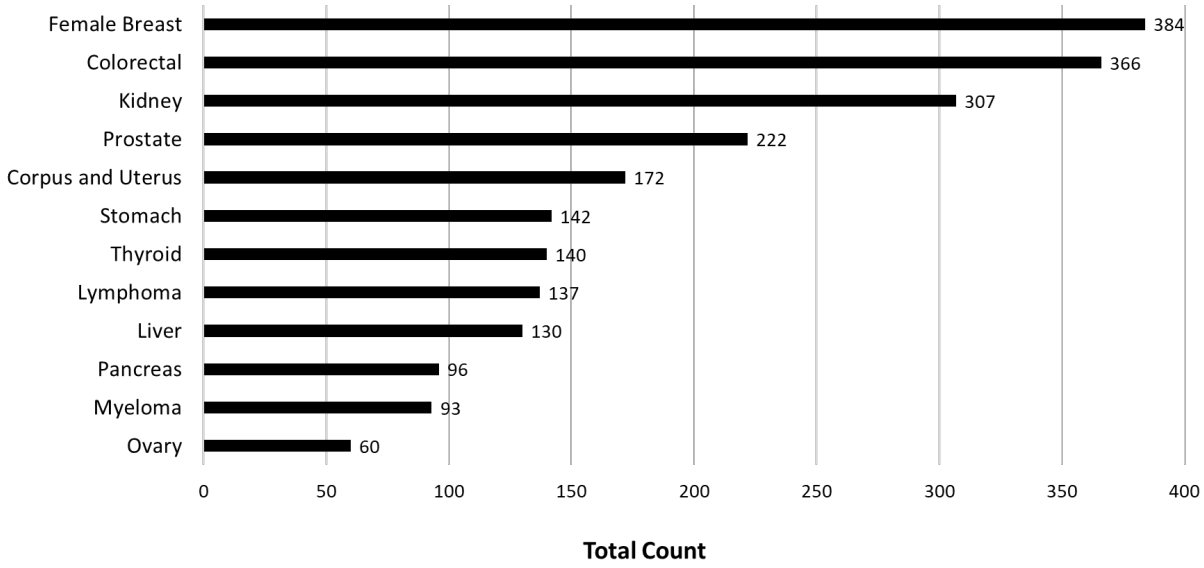


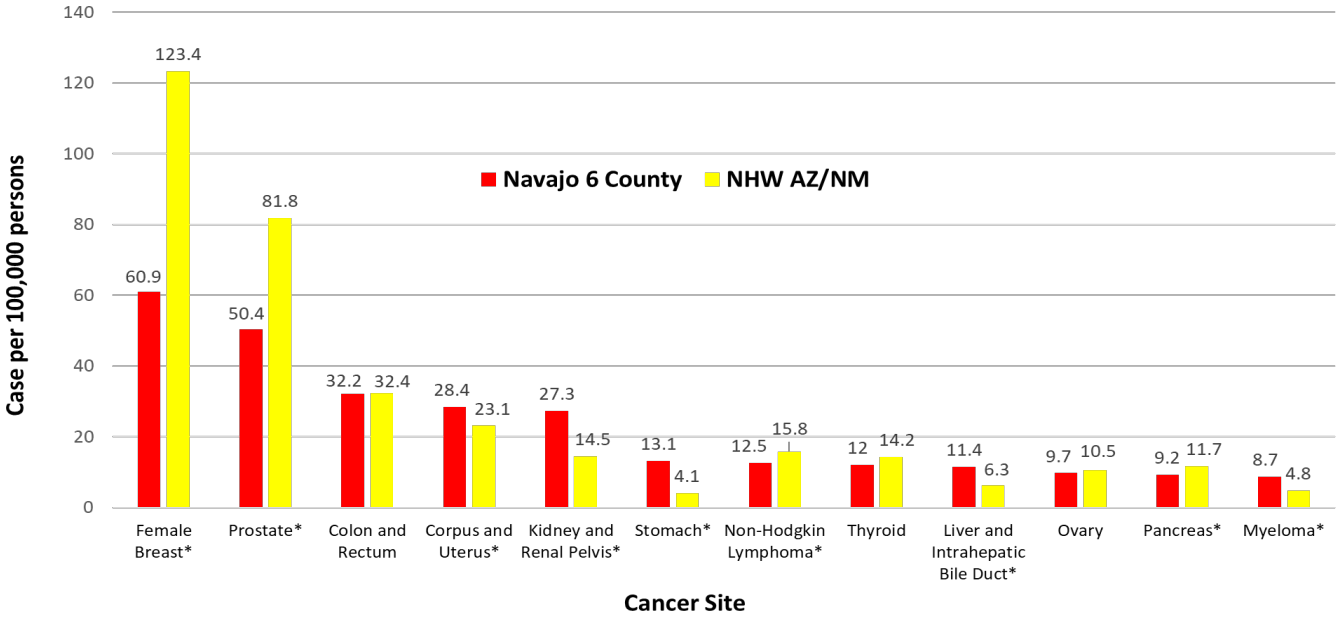
Figure 2. From 2014-2018, the highest cancer incidence counts among Navajo people were for female breast, colorectal, kidney, prostate, uterine, stomach, thyroid, non-Hodgkin lymphoma, liver, pancreas, myeloma, and ovarian cancer.

Table 3: Significant differences in cancer incidence comparing Navajo males and females to AZ/NM NHW

Navajo Males Significantly Lower rates ↓		**Navajo Males Significantly Higher rates ↑**	
Lung cancer	77% ↓	Stomach cancer	3.2 times ↑
Oral cancer	66% ↓	Kidney cancer	2.0 times ↑
Brain cancer	57% ↓	Liver cancer	1.7 times ↑
Leukemia	50% ↓	Myeloma	1.6 times ↑
Prostate cancer	38% ↓		
Non-Hodgkin lymphoma	37% ↓		
Navajo Females Significantly Lower rates ↓		**Navajo Females Significantly Higher rates ↑**	
Lung cancer	88% ↓	Gallbladder cancer	6.2 times ↑
Leukemia	53% ↓	Stomach cancer	3.5 times ↑
Brain cancer	52% ↓	Liver cancer	2.2 times ↑
Breast cancer	51% ↓	Myeloma	2.1 times ↑
Pancreatic cancer	27% ↓	Kidney cancer	1.9 times ↑
		Uterine cancer	1.2 times ↑

Table 3. Compared to NHW males, rates of six cancers were significantly lower among Navajo males, whereas four cancers had higher rates. Compared to NHW females, rates of five cancers were significantly lower among Navajo females, whereas six cancers had higher rates (Table 3).

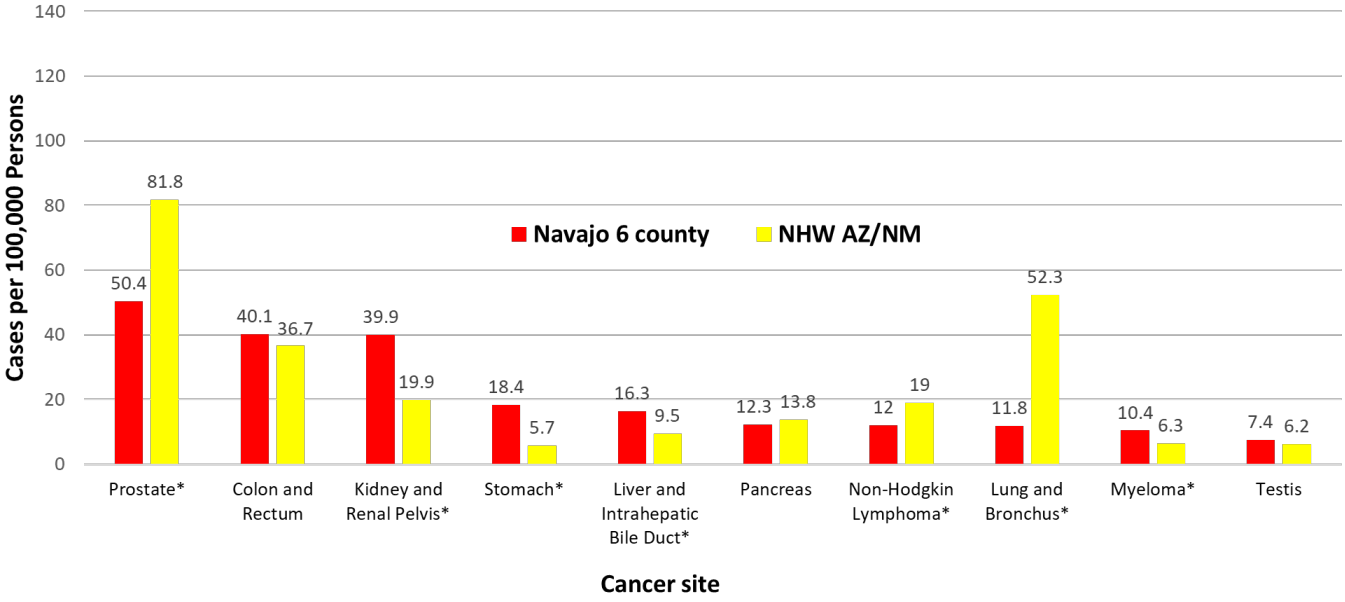
Figure 3. Most commonly diagnosed cancers among Navajo compared to non-Hispanic Whites (NHW): incidence rates 2014-2018, males and females combined



*= Significantly different between Navajo and NHW, p-value <0.05

Figure 3. The leading cancer incidence for Navajo people compared to NHW people of Arizona and New Mexico, among males and females combined, are shown above (Figure 3). Significantly lower incidence among the Navajo people compared to NHW as indicated by a Rate Ratio smaller than 1.0 were found for female breast cancer (Rate Ratio (RR)=0.49), prostate cancer (RR=0.62), non-Hodgkin lymphoma (RR=0.79), pancreatic cancer (RR=0.79), and lung cancer (RR=0.16). Significantly higher incidence among Navajo people compared to NHW people was found for kidney cancer (RR=1.89), stomach cancer (RR=3.19), liver cancer (RR=1.79) and myeloma (RR= 1.80). The incidence of colorectal, thyroid, and ovarian cancers were similar for both Navajo people and NHW people.

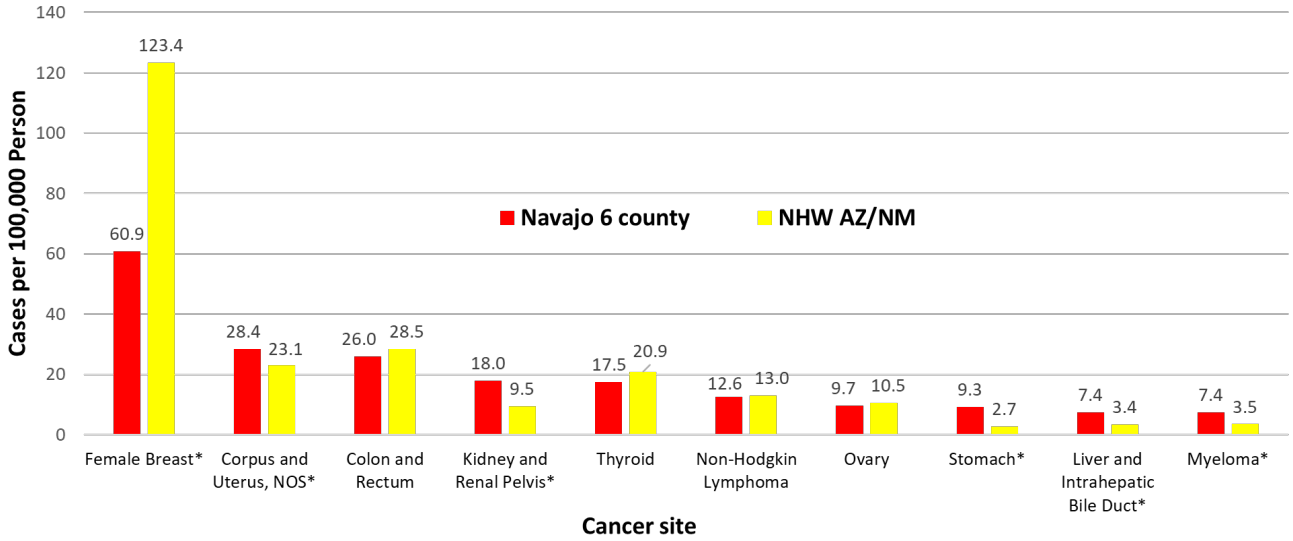
Figure 4. Most commonly diagnosed cancers among Navajo compared to non-Hispanic Whites (NHW): incidence rates 2014-2018, males only



*= Significantly different between Navajo and NHW, p-value <0.05

Figure 4. The leading cancer incidence for Navajo males and how they compare to NHW males of Arizona and New Mexico are shown above. Prostate cancer is the most commonly diagnosed cancer among Navajo males. Compared to NHW males, Navajo males had significantly higher incidence of kidney cancer (RR=2.01), stomach cancer (RR=3.23), liver cancer (RR=1.71), and myeloma (RR=1.64) cancers. Navajo males had significantly lower incidence of prostate cancer (RR=0.62), non-Hodgkin lymphoma (RR=0.63), and lung cancer (RR=0.23) compared to NHW males. The incidence rates of colorectal, pancreas, and testicular cancers were similar for Navajo and NHW males.

Figure 5. Most commonly diagnosed cancers among Navajo compared to non-Hispanic Whites (NHW): incidence rates 2014-2018, females only



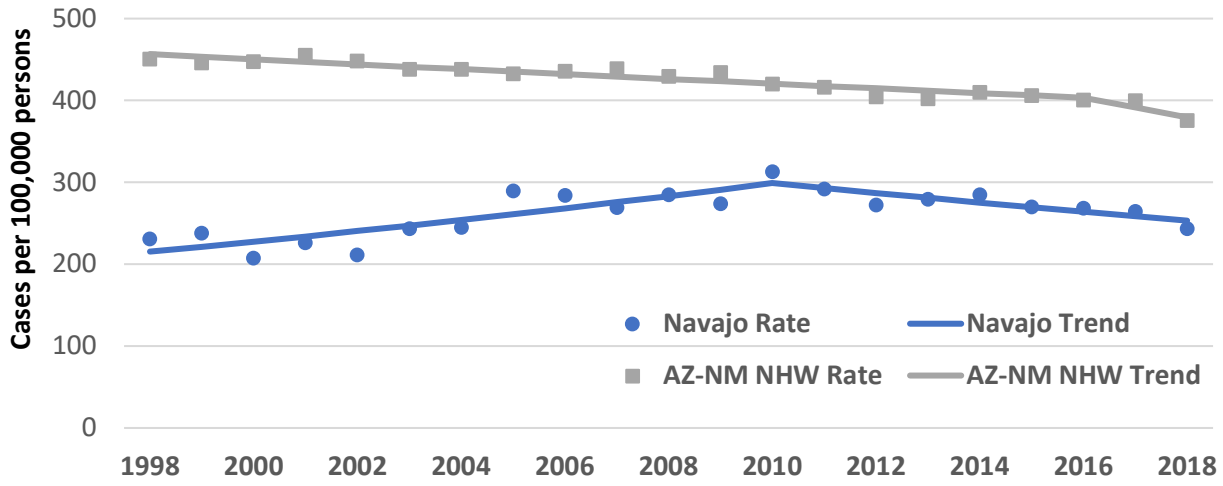
*= Significantly different between Navajo and NHW, p-value <0.05

Figure 5. Among Navajo females, the incidence of uterine (RR=1.23), kidney (RR=1.89), stomach (RR=3.47), liver (RR=2.15), gallbladder (RR=6.24), and myeloma (RR=2.13) cancers were significantly higher than NHW females. For breast cancer (RR=0.49), the incidence was significantly lower compared to NHW females. The incidence of colorectal, thyroid, non-Hodgkin lymphoma, and ovarian cancers were not significantly different between Navajo and NHW females.

Data Summary Incidence Trends (Table 4, Figures 6-9)

- *All cancers:* The incidence rates for all cancer sites combined increased annually between 1998 to 2010 among Navajo females and males (2.8% Annual Percent Change). However, between 2010 and 2018, there was a downward trend (-2.1% Annual Percent Change). There was a fairly consistent downward trend for all cancer sites combined incidence rates among NHW between 1998-2018 (-0.9% Average Annual Percent Change).
    - *Breast cancer:* There was an upward trend in female breast cancer incidence from 1998 to 2005 (6.2% Annual Percent Change). Between 2005 and 2018 there was a downward trend in Navajo female breast cancer rates (-0.7% Annual Percent Change), which was similarly observed in NHW females from 2009-2018 (-0.4 Annual Percent Change).
    - *Colorectal cancer:* There was a significant upward trend for colorectal cancer incidence rates among Navajo people between 1998 and 2018 (3.6% Average Annual Percent Change), with a sharp increase between 1998 to 2006 (9.5% Annual Percent Change). Between 2006-2018, trends remained mostly flat among Navajo (-0.2% Annual Percent Change). Among NHW people, there was a consistent downward trend from 1998 to 2018 (-2.2% Average Annual Percent Change).
    - *Prostate cancer:* The trend of prostate cancer incidence rates among Navajo males fluctuated from 1998 to 2018. Prostate cancer incidence rates decreased between 1998 to 2000, then rapidly increased between 2000 and 2009 (7.4% Annual Percent Change), and then significantly decreased again between 2009 and 2018 (-10.8 Annual Percent Change). There was a downward trend in prostate cancer rates among NHW males between 1998 to 2012 and no significant change in rates between 2012 to 2018.

Figure 6. Trend Lines for All Cancer Sites Combined, Males and Females 1998-2018



- **Figure 6.** There was an upward trend in all cancer sites from 1998 to 2010 for Navajo females and males, followed by a downward trend from 2010 to 2018.

Figure 7. Trend Lines for Female Breast Cancer 1998-2018

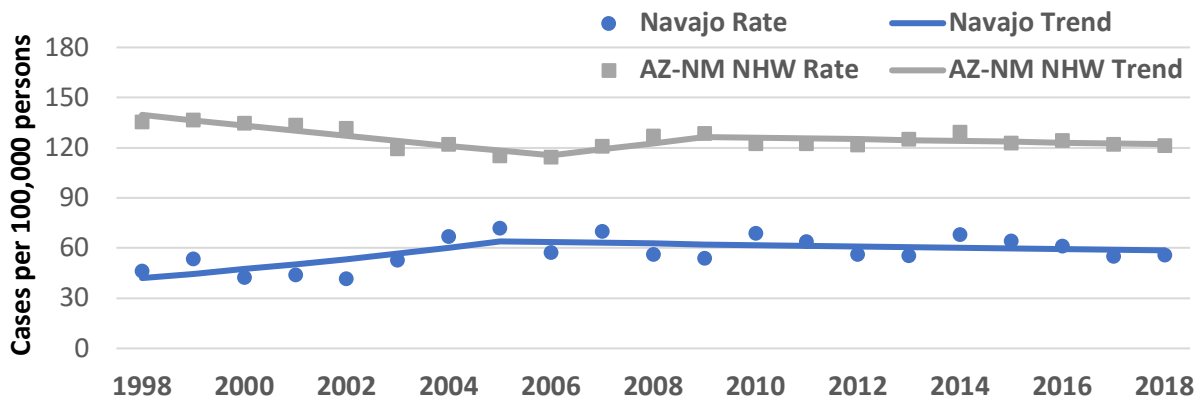


Figure 7. Between 1998 to 2005, there was an upward trend among Navajo women, followed by a slight downward trend from 2005 to 2018.

Figure 8. Trend Lines for Colorectal Cancer 1998-2018, males and females combined

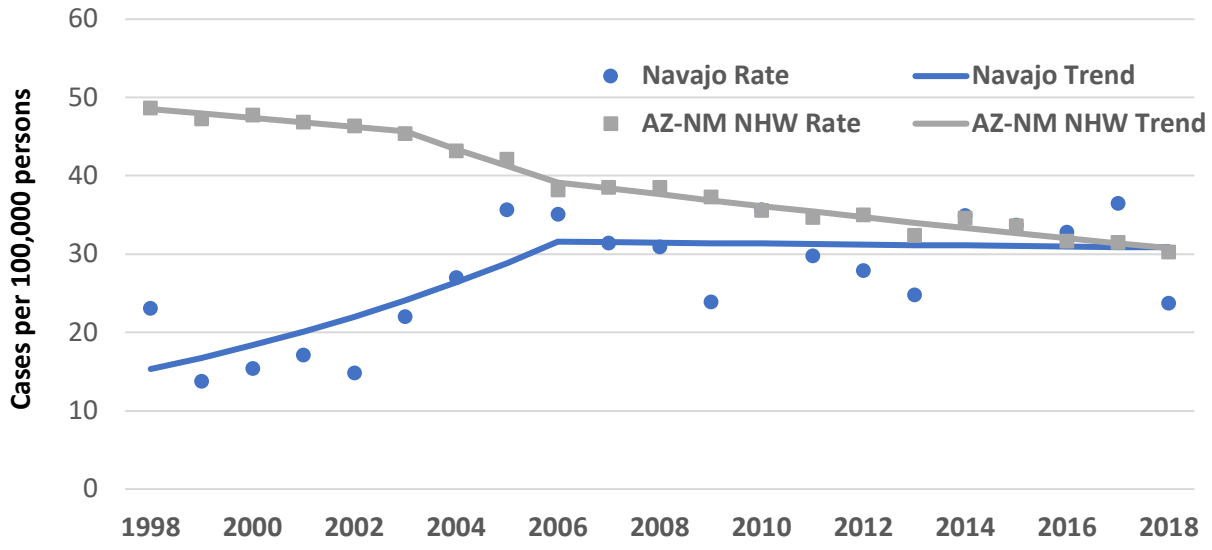


Figure 8. There was a sharp upward trend in colorectal cancer rates among Navajo men and women between 1998 to 2006. From 2006 to 2018 the annual average colorectal cancer rates among Navajo stayed fairly consistent. Rates of NHW and Navajo people were highly similar by 2018.

Figure 9. Trend Lines for Prostate Cancer, Males 1998-2018

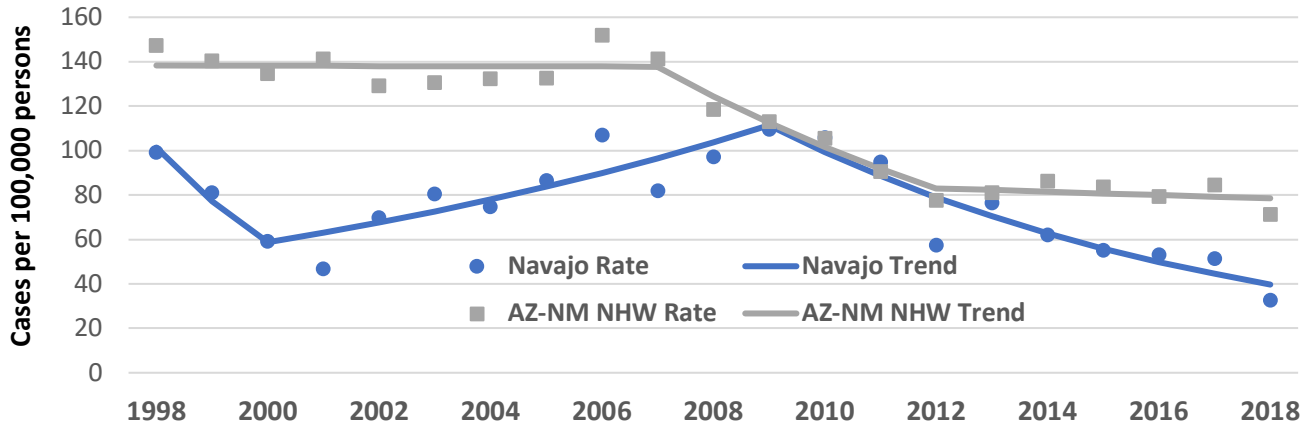


Figure 9. Prostate cancer rates among Navajo males varied between 1998 to 2018. Prostate cancer rates decreased between 1998 and 2000, climbed from 2000 to 2009, and then consistently dropped between 2009 to 2018.

Table 4. Cancer incidence trends, Average annual percent change, 1998–2018

	Average Annual Percent Change	95% Confidence Interval		P-Value
		Lower	Upper	
All Cancers				
Navajo Six Counties	0.8	-0.1	1.7	0.10
Non-Hispanic Whites AZ/NM	-0.9	-1.3	-0.5	<0.01*
Female Breast				
Navajo Six Counties	1.7	-0.4	3.7	0.10
Non-Hispanic Whites AZ/NM	-0.6	-1.8	0.5	0.20
Colorectal				
Navajo Six Counties	3.6	0.3	7.0	<0.01*
Non-Hispanic Whites AZ/NM	-2.2	-3.2	-1.3	<0.01*
Prostate				
Navajo Six Counties	-4.6	-9.3	0.4	0.10
Non-Hispanic Whites AZ/NM	-2.8	-4.4	-1.1	<0.01*

STAGE OF DIAGNOSIS

Cancer staging describes the extent to which the patient's cancer has spread. Doctors design a treatment plan that is best for addressing a patient's disease stage and identify clinical trials, which are research studies that test new medical treatments and behavioral treatments. Staging can also be used to estimate a person's prognosis or likely outcome from cancer disease or treatment.

Staging is based on knowledge of the way cancer develops. Cancer cells divide and grow without control or order. They can break away from the primary site of growth and enter the bloodstream or lymphatic

system to form new tumors in other organs of the body. This spread of cancer is called metastasis. As we learn more about cancer, different staging systems have evolved over time.

Staging systems doctors use are generally more detailed and complex than those used by cancer registries. In this report, we used a cancer registry summary staging system that can be expressed in the following categories:

- **Early Stage:**
  - ***Localized*** or ***early***, is cancer limited to the organ in which it began, without evidence of spread.
- **Late Stage:**
  - ***Regional*** is cancer that has spread beyond the original (primary) growth site to nearing lymph nodes or organs and tissues.
  - ***Distant*** is cancer that has spread from the primary growth site to distant organs or distant lymph nodes.
- ***Unknown*** or ***unstaged*** is used to describe cases for which there is not enough information to indicate a stage.

Methodology

We examined summary stage 2000 cancer staging data obtained from the New Mexico Tumor Registry (SEER), Arizona Cancer Registry (NPCR), and Utah Cancer Registry (SEER) for cases that were diagnosed from 2014-2018.[18] Data for NHW in Arizona and New Mexico are presented in this report for comparison. Cancer staging data are presented in proportions: the number of cases diagnosed in a particular stage category divided by the total cases diagnosed for that particular cancer. The categories of stages were localized, regional, distant and unknown. We limited some cancer sites to certain age groups corresponding to standard cancer screening recommendations by the U.S. Preventive Services Task Force (USPSTF) and supported by the CDC. For example, female breast cancer stage data was limited to cases diagnosed in women 40 years and older because USPSTF recommends mammography screening in average-risk women in this age group. Racial differences between stages were tested using Chi-square statistics (Appendix B). Statistical significance was set at $p<0.05$.

Data Summary Stage of Diagnosis (Figures 10-12)

- Colorectal cancer cases among Navajo males and females ages 50+ were mostly diagnosed in the late stages (regional and distant), which was similar for non-Hispanic whites ages 50+ (Figure 10).
- Among Navajo females ages 40 years or older, over half of breast cancer cases were diagnosed in the early stage. However, Navajo females (59.7%) were significantly less likely to be diagnosed at the early stage of breast cancer than non-Hispanic white females (67.1%) (Figure 11).
- Cervical cancer cases among Navajo females ages 20+ were frequently diagnosed in the later stages (regional or distant). Navajo women had about a 4% lower prevalence of diagnosis in the localized stage compared to NHW (41.2% vs. 45.1%), although the different was not statistically significant (Figure 12).

Figure 10. Colorectal cancer (age 50+) stage at diagnosis for Navajo people compared to non-Hispanic Whites (NHW) 2014-2018

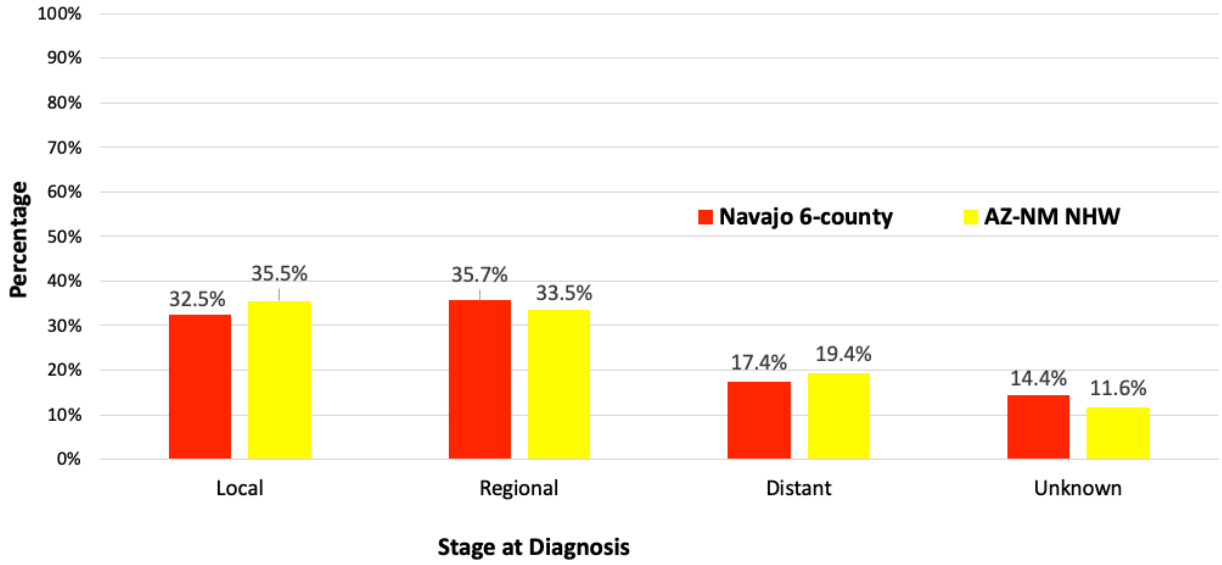


Figure 10. Cancer diagnosed in the early stage is easier to treat and has better survival than late-stage cancer. Navajo people age 50+ years old diagnosed with colorectal cancer at the early stage was 3% lower compared to NHW people age 50+ years old in Arizona and New Mexico (32.5% vs. 35.5%), but the difference was not statistically significant. About 52% of Navajo and NHW people (age 50+) were diagnosed in late stages (regional or distant) for colorectal cancer.

Figure 11. Female breast cancer (age 40+) stage at diagnosis for Navajo people compared to non-Hispanic Whites (NHW) 2014-2018

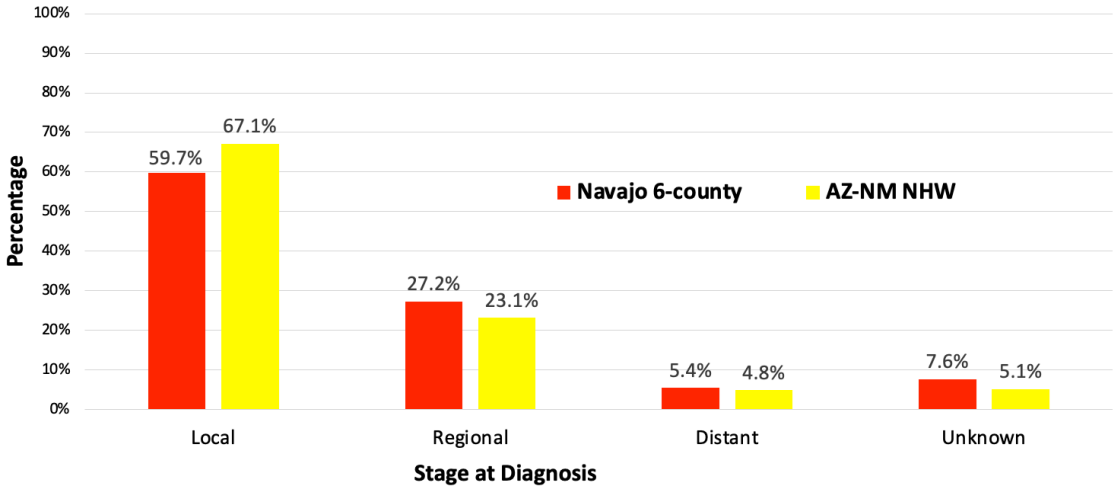


Figure 11 A large proportion of breast cancer cases were diagnosed in the local stage among Navajo females age 40+ (59.7%), which was significantly lower than NHW females age 40+ of Arizona and New Mexico (67.1%). The proportion of breast cancer cases diagnosed at the late stages were higher for Navajo females (Regional: 27.2%, Distant: 5.4%) compared to NHW females of Arizona and New Mexico

(Regional: 23.1%, Distant: 4.8%). There was also a higher proportion of breast cancer cases diagnosed at the unknown stage in Navajo females (7.6%) than NHW females of Arizona and New Mexico (5.1%).

Figure 12. Cervical cancer stage at diagnosis for Navajo females compared to non-Hispanic Whites (NHW) 2014-2018

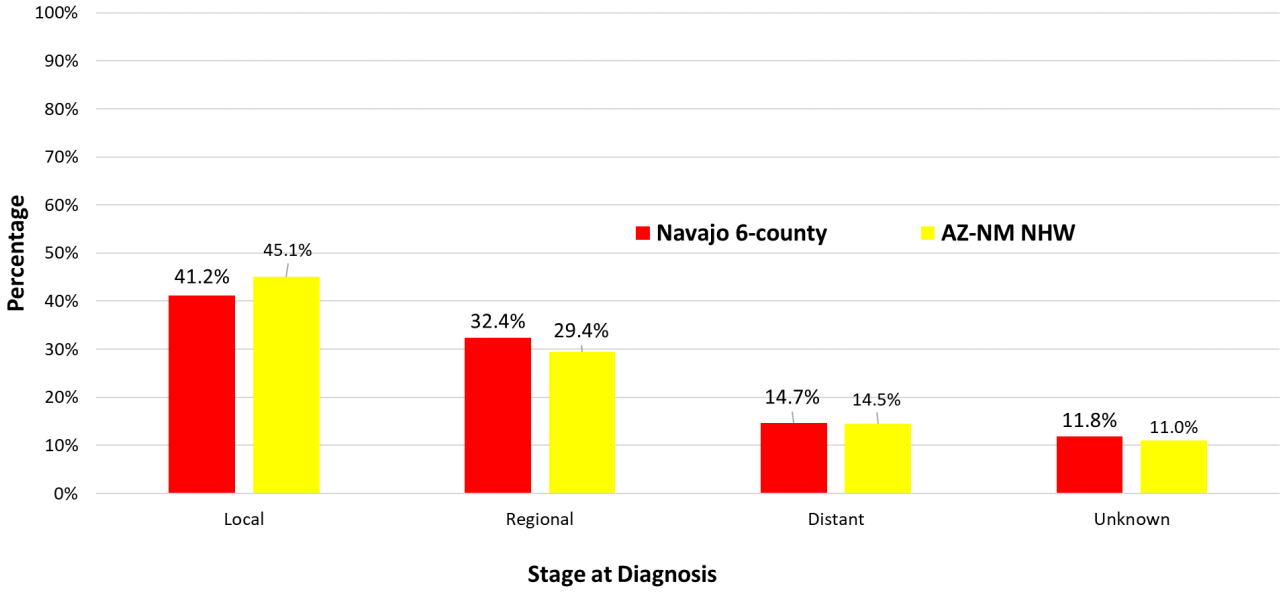


Figure 12. A large proportion of cervical cancer cases were diagnosed within the late stages (regional and distant) among Navajo females ≥ 20 years of age (Regional: 32.4%, Distant: 14.7%). The percentage of Navajo females diagnosed with cervical cancer was not substantially different from NHW females across all stages.

Cancer Mortality & Trends

Cancer mortality rates measure, at the population level, either the risk of dying from a specific type of cancer or from all cancers. These rates are important indicators of the burden of cancer and are the preferred measure for evaluating secondary prevention programs. Reduction in cancer mortality is the standard measure for evaluating cancer control efforts.[32]

The definition of cancer mortality rate is the number of persons who died from cancer during a specified period divided by the population at risk. The cancer mortality rate is expressed as cancer deaths per 100,000 population.

Mortality Rate = Number of cancer deaths / Population at risk X 100,000

Given that the AI/AN population was younger than the U.S. NHW population, and for reasons of comparability with recent analyses and publications, mortality rates presented in this report have been age-adjusted by the direct method (or age standardization) with the U.S. 2000 standard population.

Methodology

The AI/AN vital events data were collected from data furnished by National Centers for Health Statistics (NCHS) to the IHS. NCHS obtains birth and death records for all U.S. residents from the state health departments based on information reported on official state birth and death certificates. The records

received from NCHS by IHS do not contain names, addresses, tribal identity, or medical record identification numbers. Each vital record includes the single underlying cause of death and this is determined by following a standard criteria and data listed on the death certificate. The records also contain county of residence, which allowed the selection of deaths of residents in the six counties that comprise the Navajo Nation. For this report, we examined only those AI/AN deaths for which the underlying cause of death was cancer, as determined by International Classification of Diseases, (ICD-10) codes. The cause of death record as defined by the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program was used.[33] These data were used as numerators in the cancer mortality rate calculations. The AI/AN population counts (i.e., the denominator in the mortality rate calculations) were based on 2000 U.S. Census Bureau County population estimates. During the decennial census, the U.S. Census Bureau counts those persons who identify themselves as AI/AN.

The Arizona and New Mexico NHW mortality and population data were derived from the National Cancer Institute's SEER database.[34] We calculated standardized rate ratios for Navajo people using NHW rates as comparisons (Appendix C). P-values were also calculated and were used to determine whether rate differences between Navajo people and NHW were statistically different. Statistical significance was set at $p<0.05$.

Data Summary Mortality (Table 5, Figures 13-16)

- The most common causes of cancer deaths (by counts) among the Navajo people were from colon and rectum (colorectal) cancer, followed by prostate, pancreas, stomach, kidney and renal pelvis (kidney), female breast, lung and bronchus (lung), liver and intrahepatic bile duct (liver), ovary, and gallbladder cancers (Figure 13).
  - Navajo people are 80% less likely to die from lung cancer and 39% less likely to pass away from female breast cancer than NHW people (Appendix C).
  - Navajo people are 7.6 times more likely to pass away from gallbladder cancer, 4.4 times more likely to pass away from stomach cancer, 2.3 times more likely to pass away from kidney cancer, 1.6 times more likely to pass away from prostate cancer, and 1.4 times more likely to pass away from liver cancer than NHW people (Appendix C).
- Among Navajo males, the leading causes of death from cancer were prostate cancer, followed by colorectal, kidney, stomach, pancreas, liver, esophageal cancer, lymphoma and leukemia (Figure 14).
- Among Navajo females the leading causes of death from cancer were from breast cancer followed by colorectal, pancreas, ovary, stomach, liver, lung, lymphoma, gallbladder, and kidney cancers (Figure 15). Significant differences between Navajo and NHW males and females are highlighted in Table 5 (see also Appendix C).

Table 5: Significant differences in cancer mortality comparing Navajo males and females to AZ/NM NHW

Navajo Males Significantly Lower rates ↓		**Navajo Males Significantly Higher rates ↑**	
Leukemia	60% ↓	Stomach cancer	5.0 times ↑
Esophageal cancer	41% ↓	Kidney cancer	2.7 times ↑
Lymphoma	38% ↓	Prostate cancer	1.6 times ↑
Navajo Females Significantly Lower rates ↓		**Navajo Females Significantly Higher rates ↑**	
Lung cancer	85% ↓	Gallbladder cancer	8.1 times ↑
Breast cancer	39% ↓	Stomach cancer	3.8 times ↑
		Liver cancer	2.0 times ↑
		Kidney cancer	1.8 times ↑

Mortality Trends (See Table 6 below)

- *Stomach cancer* mortality rates decreased among Navajo people (-2.0% Average Annual Percent Change) however, this decrease is not significant. Whereas the decrease in NHW people (-3.0% Average Annual Percent Change between 1990 to 2018) is significant.
- *Colorectal cancer:* Among Navajo females and males, colon and rectum cancer mortality rates significantly increased (2.6% Average Annual Percent Change) each year between 1990 to 2018, while NHW females and males significantly decreased 2.0% Annual Percent Change each year between 1990 to 2018.
- *Liver cancer:* There was a slight decrease in liver cancer mortality rates between 1990 to 2018 among Navajo females and males. On average, the Navajo population experienced a 0.5% decrease, while the NHW population experienced a 2.2% significant increase in liver cancer mortality rates.
- *Pancreatic cancer:* There was a suggestive upward trend in pancreas cancer mortality rates among Navajo people (1.1% Annual Percent Change) and NHW people (0.3% Annual Percent Change) between 1990 to 2018; however, these upward trends were not significant.
- *Lung cancer:* There was a suggestive downward trend for lung and bronchus cancer mortality rates among Navajo people between 1990 to 2018 (-1.1% Annual Percent Change), but this was not significant; however, the downward trend among NHW people (-2.0% Annual Percent Change) was significant.
- *Female breast cancer*: Mortality rates increased among Navajo females (2.2% Annual Percent Change) and decreased significantly among NHW females (-1.8% Annual Percent Change) from 1990 to 2018.
- *Ovarian cancer*: Mortality rates slightly decreased among Navajo females (-0.5% Annual Percent Change), whereas mortality rates decreased significantly in NHW (-0.9% Annual Percent Change) females between 1990 to 2018.
- *Prostate cancer:* There was a slight upward trend in prostate cancer mortality rates among Navajo males (0.6% Annual Percent Change) and a significant decrease in prostate cancer mortality rates among NHW males (-3.1% Annual Percent Change) between 1990 to 2018.
- *Kidney cancer:* Navajo people experienced a slight increase in kidney and renal pelvis cancer mortality rates (0.7% Annual Percent Change), while kidney and renal pelvis cancer mortality rates decreased significantly among NHW people (-0.3% Annual Percent Change).
- *Leukemia:* There was a downward trend in leukemia mortality rates among Navajo people (-1.0% Annual Percent Change) and NHW people (-1.1% Annual Percent Change; significant change).

Figure 13. Leading causes of death by cancer site among the Navajo 2014-2018 (counts)

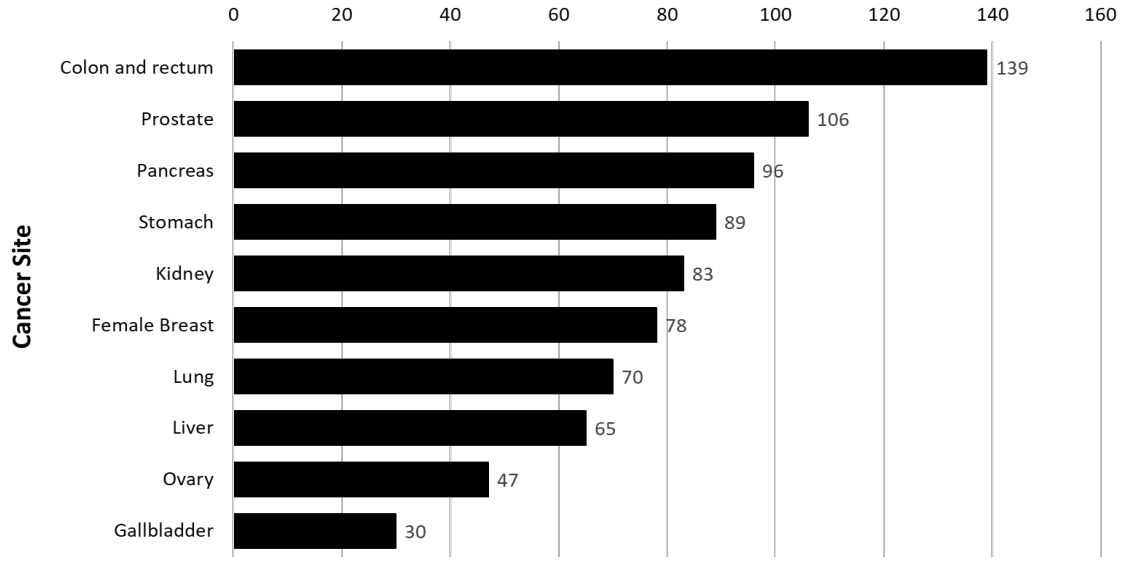


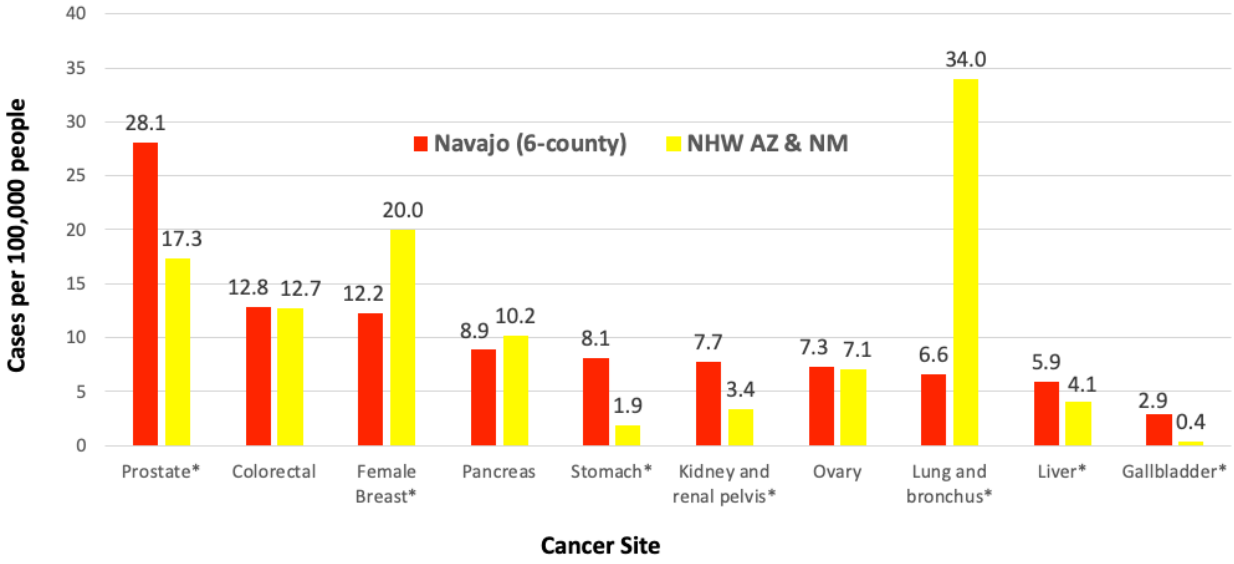
Figure 13. The most common causes of cancer deaths (by counts) among the Navajo people were from colorectal cancer, followed by prostate, pancreatic, stomach, kidney, female breast, lung, liver, ovarian, and gallbladder cancers.

Table 6. Cancer mortality trends in age-adjusted mortality rates 1990 – 2018.

Cancer type	Average Annual Percent Change	95% Confidence Interval		P-Value
		Lower	Upper	
Stomach				
Navajo Six Counties	-1.96	-3.89	0.01	0.05
Non-Hispanic Whites AZ/NM	-3.03	-3.36	-2.71	<0.05*
Colon and Rectum				
Navajo Six Counties	2.58	1.24	3.94	<0.05*
Non-Hispanic Whites AZ/NM	-1.97	-2.25	-1.69	<0.05*
Liver				
Navajo Six Counties	-0.45	-1.96	1.08	0.51
Non-Hispanic Whites AZ/NM	2.18	1.57	2.80	<0.05*
Pancreas				
Navajo Six Counties	1.09	-0.42	2.62	0.13
Non-Hispanic Whites AZ/NM	0.33	-0.10	0.75	0.11
Lung and Bronchus				
Navajo Six Counties	-1.12	-2.90	0.71	0.19
Non-Hispanic Whites AZ/NM	-1.99	-2.41	-1.57	<0.05*
Female Breast				
Navajo Six Counties	2.16	-2.02	6.52	0.31
Non-Hispanic Whites AZ/NM	-1.75	-2.26	-1.23	<0.05*

Ovary				
Navajo Six Counties	-0.52	-2.01	0.99	0.44
Non-Hispanic Whites AZ/NM	-0.86	-1.52	-0.21	<0.05*
Prostate				
Navajo Six Counties	0.55	-1.33	2.46	0.57
Non-Hispanic Whites AZ/NM	-3.08	-3.38	-2.79	<0.05*
Kidney and Renal Pelvis				
Navajo Six Counties	0.72	-0.21	1.65	0.11
Non-Hispanic Whites AZ/NM	-0.34	-0.93	0.26	0.27
Leukemia				
Navajo Six Counties	-1.00	-3.19	1.24	0.32
Non-Hispanic Whites AZ/NM	-1.08	-1.60	-0.56	<0.05*

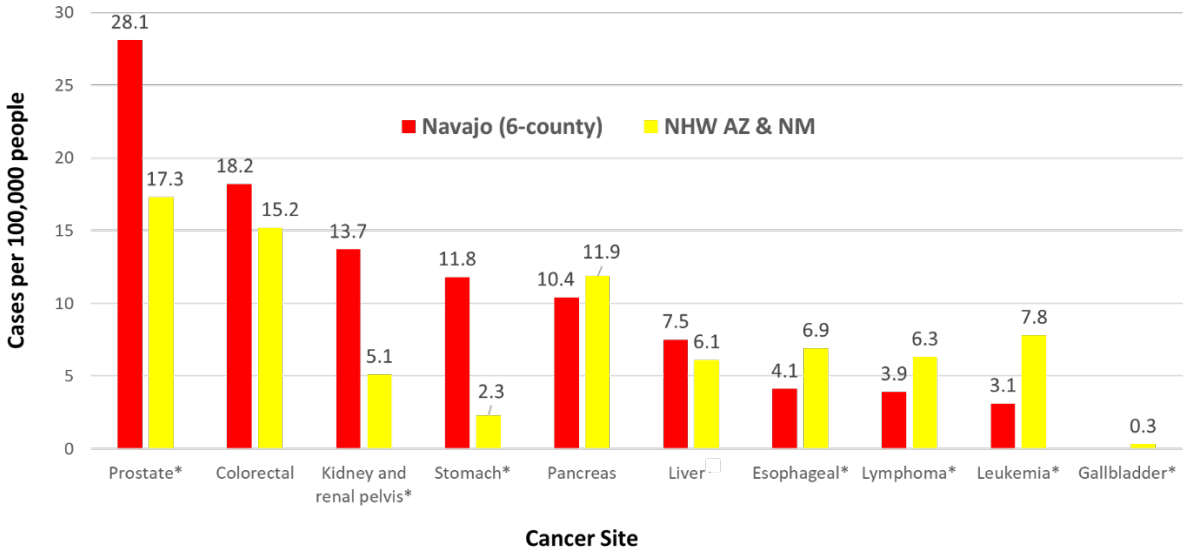
Figure 14. Cancer mortality rates comparing Navajo to non-Hispanic Whites (NHW) 2014-2018, males and females combined



*= Significantly different between Navajo and NHW, p-value <0.05

Figure 14. Death rates from cancers of the stomach (RR=4.36), liver (RR=1.44), kidney (RR=2.26), prostate (RR=1.62) and gallbladder (7.61) were significantly higher among the Navajo people compared to NHW people. Conversely, death rates of female breast (RR=0.61), and lung (RR=0.20) cancers among Navajo people were significantly lower than NHW people. Navajo cancer death rates of colorectal, pancreatic, and ovarian cancers were similar to NHW people.

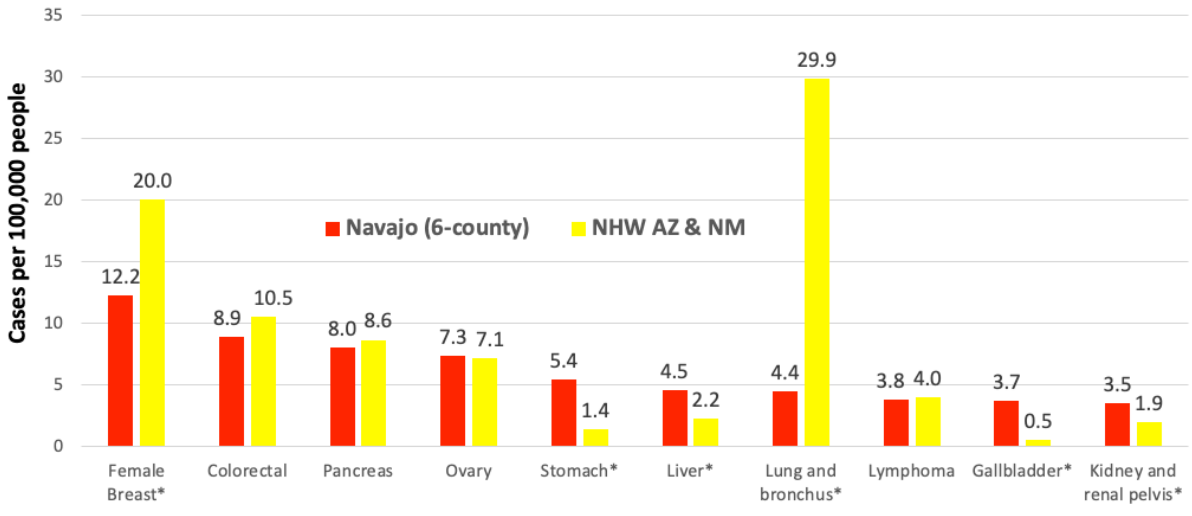
Figure 15. Cancer mortality rates comparing Navajo to non-Hispanic Whites (NHW) 2014-2018, males only



*= Significantly different between Navajo and NHW, p-value <0.05

Figure 15. For Navajo males, the mortality rates for prostate (RR=1.62), stomach (RR=5.02), and kidney (RR=2.68) cancers were significantly higher compared to NHW males. Significantly lower mortality rates for Navajo males were observed for lymphoma (RR=0.62), leukemia (RR=0.40), and esophageal (RR=0.59) cancers than NHW males. No differences were for colorectal, pancreatic, and liver.

Figure 16. Cancer mortality rates comparing Navajo to non-Hispanic Whites (NHW) 2014-2018, females only



*= Significantly different between Navajo and NHW, p-value <0.05

Figure 16. Compared to NHW females, Navajo females had significantly lower mortality rates for breast (RR=0.61) and lung (RR=0.15) cancers. Navajo females had significantly higher rates for liver (RR=2.04), stomach (RR=3.80), kidney (RR=1.82) and gallbladder (RR=8.11) cancers. Colorectal, ovarian, pancreatic, and lymphoma cancer mortality rates were similar for both Navajo and NHW females.

SCREENING

Cancer screening tests are designed to clinically test asymptomatic or symptomatic individuals that may be at average risk for a particular type of cancer. The main purpose of screening is to detect cancers early in their development and start a treatment plan to improve survival outcomes. In this chapter , we focused on three common cancer screening tests – Papanicolaou (Pap) test for cervical cancer, mammography for breast cancer, and fecal occult blood test, sigmoidoscopy, or colonoscopy for colorectal cancer. The screening test for lung cancer was not available during the time period of this report (2014-2018).

Methodology

Navajo-specific screening estimates were selected from the Navajo Area IHS Government Performance and Results Act (GPRA) measures.[17] The GPRA is a federal reporting system that evaluates the performance of the healthcare system of the Navajo Area IHS by monitoring key health measurements using clinical data from the IHS Resource and Patient Management System (RPMS). Within the panel of IHS GPRA health measures are the cancer screening measurements, which report annual screening rates for pap test, mammogram, and colorectal screening. Pap test, mammography, and colorectal screening rates have specific numerator and denominator definitions and are age specific to the standard cancer screening recommendations by the U.S. Preventive Services Task Force (USPSTF). In general, the numerators are the number of patients with documented screening tests and patients who refused the test in the past year of the reporting period; and the denominators are the number of patients who were seen in the Navajo Area IHS during the reporting period.

Table 7: Screening data sources and notes

Data Sources	• Clinical: National Government Performance and Results Act (GPRA) Prevention: https://www.ihs.gov/quality/government-performance-and-results-act-gpra/ • Self-reported: the Centers for Disease Control and Prevention Behavioral Risk Factor Surveillance System; http://www.cdc.gov/brfss/index.html • Self-reported: Navajo Nation Health Survey (NNHS): Navajo-adapted version of BRFSS: https://nec.navajo-nsn.gov/Projects/Navajo-Nation-Health-Survey • Healthy People National targets: https://health.gov/healthypeople
Data notes	Screening definitions: • Pap test in the past 3 years for females ages 24-64 or Pap test in the past 3 years for females aged 30-64; or either a Pap test in the past 3 years and HPV DNA in past 5 years; Includes active clinical patients in IHS facilities only (Chinle, Crownpoint, Gallup, Kayenta, Shiprock). • Mammography among females 50-74 years old. • Colorectal cancer: Fecal occult blood or endoscopy in past 5 years, adults 50 to 74 years old. Inclusion definitions: • Counties included for BRFSS data are McKinley County (NM) and San Juan County (NM).
Abbreviations	• NHW indicates non-Hispanic White. • GPRA is Government Performance and Results Act (GPRA). • CDC is Centers for Disease Control and Prevention. • BRFSS is the Behavioral Risk Factor Surveillance System.

Additionally, screening estimates for AI/AN and NHW were collected from the CDC Behavioral Risk Factor Surveillance System (BRFSS) [20] for the six counties of the Navajo Nation. The CDC BRFSS is a well-established telephone-based health survey that collects self-reported data on U.S. residents regarding their health-related risk behaviors, chronic health conditions, and use of preventive services. Included in

the survey are questions about cancer screening related to Pap test, mammography, and colorectal screening tests.

The Healthy People 2030 target measurement for screening was also used to show established benchmarks for improving the health of all U.S. residents. The U.S. Department of Health and Human Services provides the benchmarks for the U.S. with regard to health promotion and disease prevention.

Data Summary Screening (Table 8, Figures 17, 18)

- Screening prevalence based on Navajo Area GPRA data in 2021 were low, but slightly above (pap test and colorectal cancer screening) or just below (mammography) the national average. Notably, these rates were impacted by the COVID-19 pandemic. Screening prevalence were below national IHS GPRA targets, although only slightly for pap test and colorectal cancer screening.
- Based on 2016-2020 self-reported survey data in New Mexico, Navajo people reported lower recommended colorectal screenings than the non-Hispanic white population (46.4% of AI/AN people vs. 61.8% of NHW people in BRFSS), but similar rates of pap test and mammography.
- All rates for Navajo people are below the recommended Healthy People 2030 targets.

Figure 17. Clinical measures of cancer screening 2021: Navajo Area IHS, National GPRA average and target

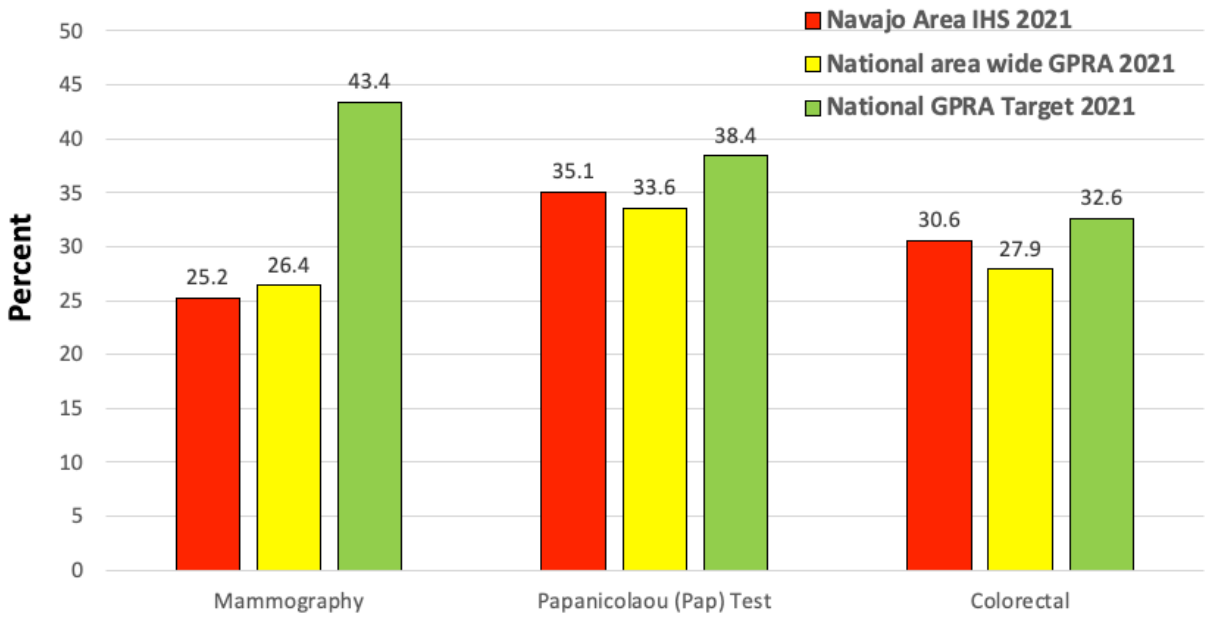


Figure 17. Compared to national GPRA averages, Navajo Area IHS facilities have similar screening prevalence for mammography, pap test and colorectal cancer screening. The percentage of people screened was close to national targets for pap test and colorectal cancer screening, but lower for mammography.

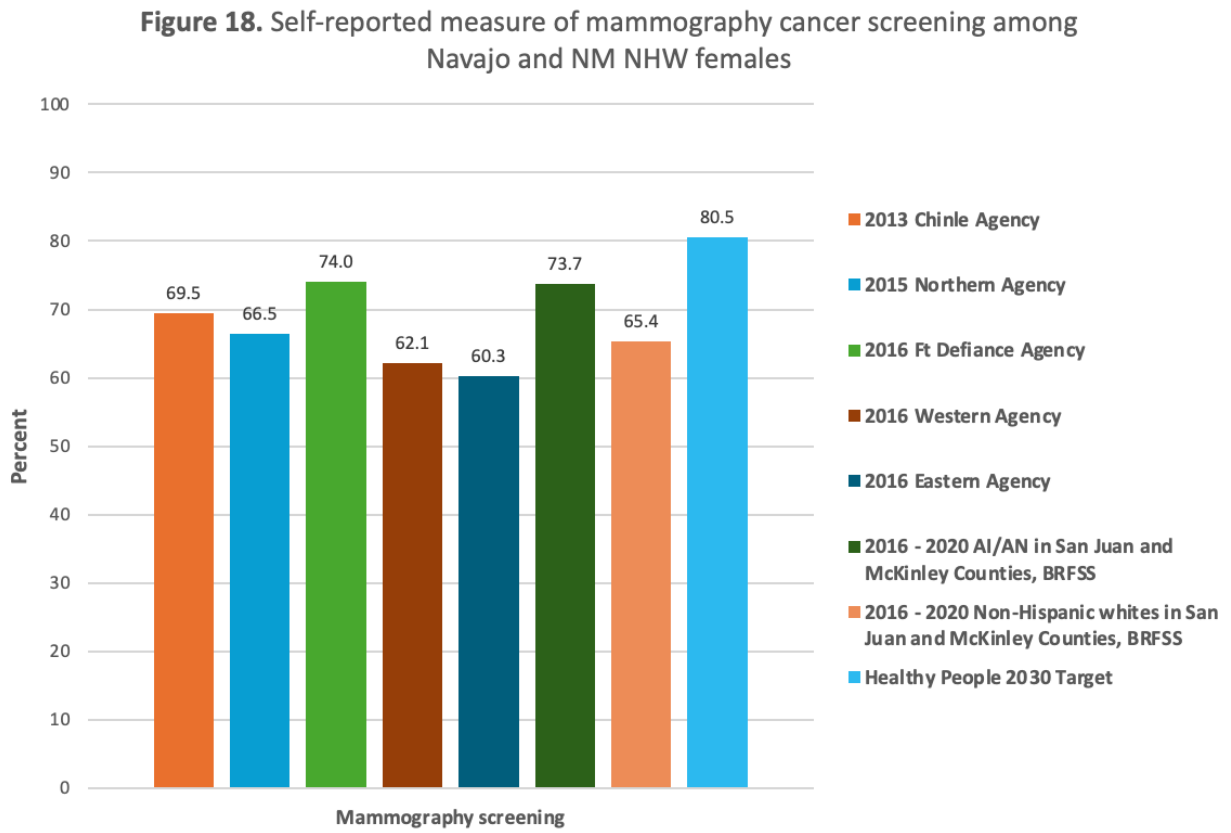


Figure 18. Self-reported mammography screening prevalence was variably high across Navajo Nation agencies for Navajo females. 2016-2020 mammography prevalence in AI/AN females in two New Mexico counties (San Juan & McKinley) compared to NHW females was 9% higher but 7% lower than the healthy People 2030 Target.

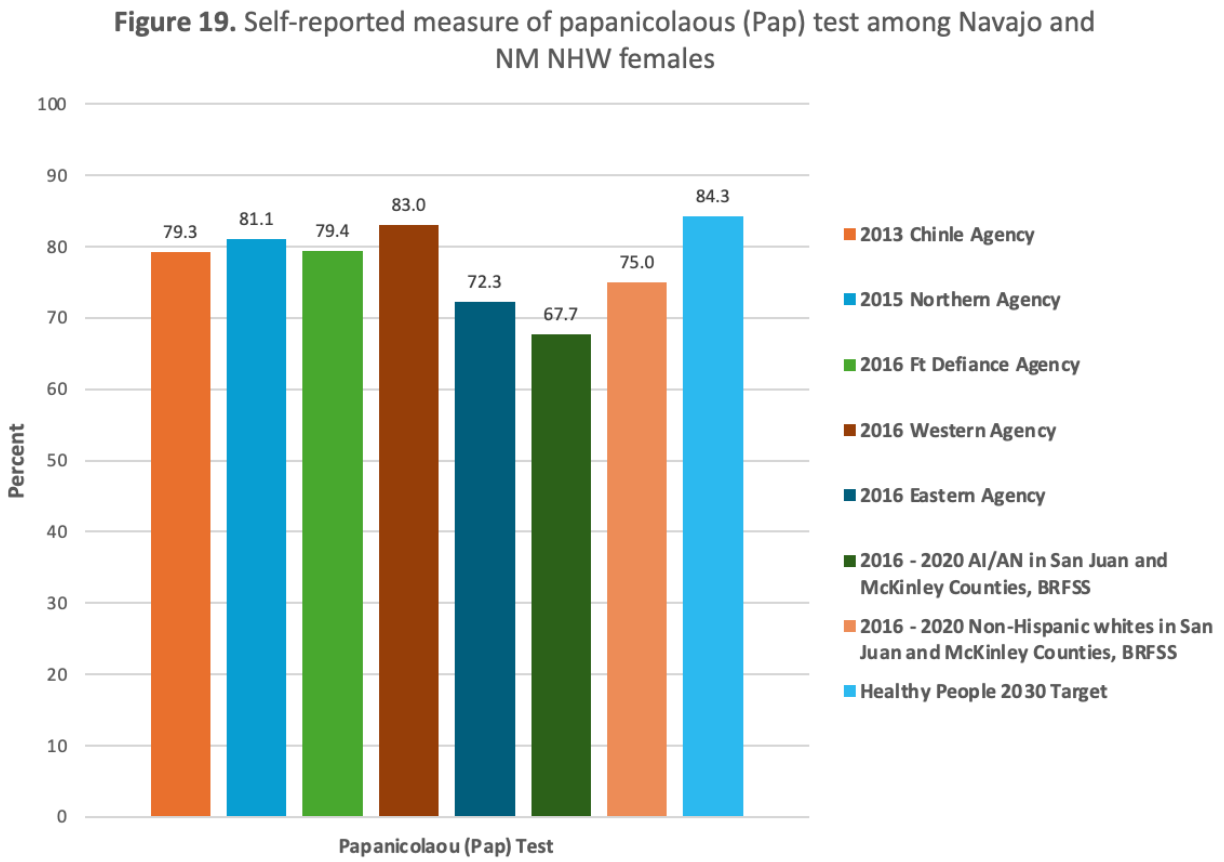


Figure 19. Self-reported pap test screening prevalence was variable yet high across Navajo Nation agencies for Navajo females. However, the prevalence of Pap tests in AI/AN females in two New Mexico counties (San Juan & McKinley) compared to NHW females of the same counties and the Healthy People 2030 Target was much lower.

Figure 20. Self-reported measure of colorectal cancer screening among Navajo and NM NHW people

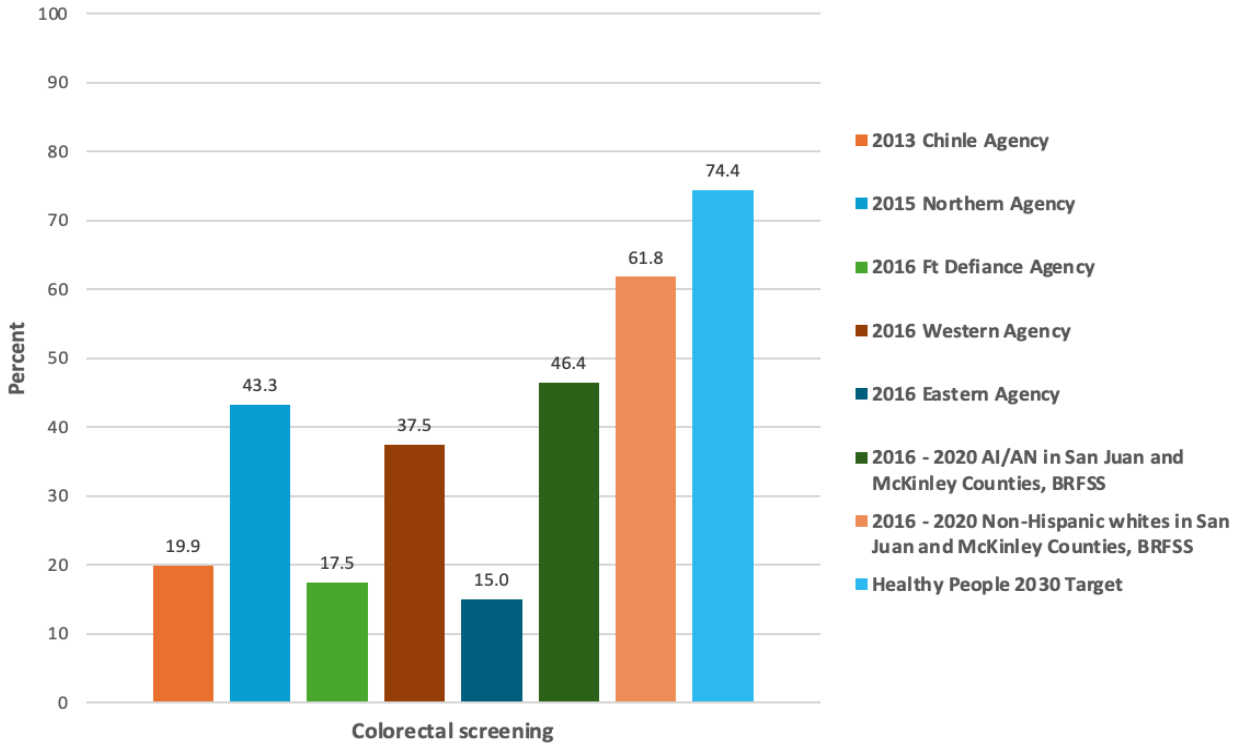


Figure 20. Self-reported colorectal screening prevalence was much lower among Navajo people across Navajo Nation agencies compared to NHW people in two New Mexico counties (San Juan & McKinley) and compared to the Healthy People 2030 Target.

Table 8. Cancer screening prevalence for Navajo, American Indians/Alaska Natives, and non-Hispanic white adults from multiple data sources.

Data Source	Year	Mammo-graphy	Papanicolaou (Pap) Test	Colorectal
		Percent (%)	Percent (%)	Percent (%)
National Targets				
Healthy People 2030 Target[6]	**N/A**	80.5	84.3	74.4
National IHS GPRA target[3]	2021	43.4	38.4	32.6
Clinical Measures				
Navajo Area IHS GPRA[1]	2021	25.2	35.1	30.6
Area-Wide GPRA (federal & tribal)[1,2]	2021	26.4	33.6	27.9
Self-Reported				
Navajo Nation Health Survey[4]				
Chinle Agency	2013	69.5	79.3	19.9
Northern Agency	2015	66.5	81.1	43.3
Ft Defiance Agency	2016	74.0	79.4	17.5
Western Agency	2016	62.1	83.0	37.5
Eastern Agency	2016	60.3	72.3	15.0
AI/AN in San Juan and McKinley Counties, BRFSS	2016-2020	73.7	67.7	46.4
Non-Hispanic whites in San Juan and McKinley Counties, BRFSS	2016-2020	65.4	75.0	61.8

DISCUSSION

As the leading cause of death among Navajo females, and the third leading cause of death regardless of sex,[1-3] cancer is a major public health concern for the Navajo Nation. This report includes the latest information on cancer epidemiology for Navajo residents of the Navajo Nation served by the Navajo Area IHS.

Incidence and Mortality

As mentioned, it is notable that this report (consistent with other reports[2,35]) found elevated rates of stomach, kidney, liver and gallbladder cancers. The reasons for a higher burden of stomach, liver, and kidney in the Navajo people are not fully understood, but potential environmental (e.g., diet[38], cancer-causing contaminants), behavioral (e.g., smoking, substance use, physical inactivity[39]), pathogenic (e.g., *Helicobacter pylori* infections), or genetic risk factors are likely contributing factors. For example, exposure to arsenic in drinking water has been associated with a higher risk of liver, kidney and bladder cancers,[36] and one study that tested wells in the Navajo Nation found elevated uranium, arsenic, and bicarbonate concentrations in several wells used for drinking water.[37] In addition, a lack of available nutritious foods may lead to eating unhealthy foods, large portion meals, consuming red meat and processed food, preparing food under intense heat, and not eating enough fruits and vegetables. Similarly, safety concerns discourage physical activity and include the lack of or not properly maintained sidewalks and streetlights, bicycle paths, drinking fountains, walkways, and parks. These issues may be particularly relevant for vulnerable populations such as children, youth, women, pregnant women, the elderly, and individuals with disabilities living in rural and remote areas of the Navajo Nation. Additionally, recent research shows that type 2 diabetes is an independent risk factor for certain cancers.[40-42] Because AI/AN populations are disproportionately affected by type 2 diabetes, cancer screening and prevention should be addressed by diabetes educators. Further research into these exposures may lead to greater insight into potential underlying causes of cancer and inform prevention efforts.

Differences in cancer types and burdens by gender/sex is also not fully understood, however, biological (e.g., hormone and immune function), occupational (e.g., environmental exposures), and behavioral factors (smoking, alcohol use, physical activity) may play a role. Overall, this information is important for prioritizing high-impact research to reduce the burden of the top cancers (female breast, prostate, colorectal, uterine, kidney, and stomach cancers). By better understanding the occurrence and patterns of cancer among Navajo people, the Navajo Nation will be better positioned to develop culturally relevant solutions, interventions, and education for the Navajo people.

Trends in incidence and mortality

For the Navajo people, overall cancer incidence trended up through 2010, but downwards since then. This may reflect changes in behaviors associated with cancer risk as well as changes in medical practice such as the guidelines and use of cancer screening tests. For example, the decrease in prostate cancer (from 2009-2018) may reflect changes in the use of prostate-specific antigen (PSA) tests due to recommendations to decrease and target PSA testing for men.

For mortality, the trend data showed an increase in colorectal cancer and slight increases in female breast, kidney, and prostate cancer, whereas NHW in the same counties saw significant decreases. However, overall mortality for breast cancer among Navajo females was still lower than for NHW females. Conversely, data suggested a small reduction in liver cancer mortality, compared to an increase among NHW. The increase in colorectal and breast cancers could be attributed to late-stage diagnosis due to challenges accessing and utilizing preventive screening and a lack of quality treatment options.

Stage at Diagnosis
The stage at diagnosis data tells us that there is an opportunity to address late stage (regional and distant) cancers through increased screening among Navajo Nation people, especially for colorectal cancer and cervical cancer, which were most commonly diagnosed in the regional and distant stages.

Screening
The available sources of cancer screening data suggest that cancer screening among the Navajo is low, particularly for cervical and colorectal cancer. Further comprehensive and culturally appropriate education and awareness around screening and additional research to identify barriers to cancer screening in different regions of the Navajo Nation are needed.

Changes from the previous report '2005-2013 Cancer Among the Navajo' to the current report
Interpretation of any comparisons between the previous reports in incidence, stage of diagnosis and mortality must be interpreted with caution, given the use of different data, methodologies and population numbers used in the reports.

- Of the most commonly diagnosed cancers among the Navajo, age adjusted incidence rates were lower for prostate cancer (50.4 vs 85.0 (2005-2013 report)) and similar for female breast cancer (60.9 vs 64.4 (2005-2013 report)), colorectal cancer (32.2 vs. 32.7 (2005-2013 report)) and kidney cancer 27.3 per 100,000 people vs 25.6 in the 2005-2013 report)).
- Increases in patients being diagnosed in the early stage of cervical cancer (5% increase) and breast cancer (7% increase) were observed in this report.
- The mortality rate was the highest for prostate cancer at 28.1 per 100,000 people in this report, compared to 23.3 in the 2005-2013 report. Mortality rates of stomach, kidney and liver cancer remain higher in Navajo people than AZ/NM NHW populations.

Data Limitations
Several limitations should be considered when interpreting the results presented in this report including racial misclassifications, migration in and out of the reservation, and limited capture of all Navajo data.[43,44] Cancer incidence, mortality and stage of diagnosis data was limited to Navajo people residing in the six county regions and captured in the New Mexico Tumor Registry, Arizona Cancer Registry and Utah Cancer Registry. Therefore, the report excluded Navajos who resided outside the six county regions. These cancer data focused on the contiguous Navajo Nation, excluding the three Navajo satellite communities of Ramah, Alamo and Tohajiilee in New Mexico. They are non-contiguous with the larger Navajo Nation land base. Moreover, these satellite communities are served by the Albuquerque Area Indian Health Service (IHS) and were excluded because the Navajo Cancer Workgroup did not have access to the Albuquerque Area IHS clinical data in the RPMS data system.

For this report, the cancer incidence and mortality rates among AI/AN who resided in a six-county region that comprised the Navajo Nation were used to serve as a proxy for estimating the Navajo cancer incidence and mortality rates. Navajos residing in these six counties represent about 80% of the total AI/AN population in these counties. For screening, BRFSS data was only available for New Mexico counties at the time of this report.

Finally, racial misclassification is a common issue regarding AI/AN cancer data, which leads to an underestimation of the true burden of cancer.[45] To decrease misclassification, cancer registry data were linked with IHS data. Some cases with race coded as AI/AN were not able to be linked to IHS data while many cases which are not coded as AI/AN were able to be linked to IHS data and were reclassified as AI/AN. However, such data linkage did not completely resolve all misclassification issues. This method of correcting misclassification did not address AI/AN who did not receive health care within IHS.

RECOMMENDATIONS

Using cancer data from the Arizona Cancer Registry (NPCR), New Mexico Tumor Registry (SEER), Utah Cancer Registry (SEER), and the NCHS Vital Statistics Data, the Navajo Cancer Workgroup was able to identify the leading cancers that impact the health of the Navajo people. The data showed differences in cancer burden between the Navajo and NHW of Arizona and New Mexico and indicated that both Navajo males and females have different cancer experiences. In view of these results, the following recommendations constitute a framework that public health professionals, healthcare providers, and communities can use to reduce the cancer burden of the Navajo people:

1. Expand collaboration among Navajo tribal health programs, Navajo Senior Centers, Indian Health Service, and tribally operated facilities and local communities in order to translate these data into targeted and culturally appropriate cancer prevention and intervention programs and development of a Navajo Cancer Control and Prevention plan.
2. Continue meaningful partnerships with state cancer registries to further improve population-based cancer surveillance data and maintain ongoing surveillance of cancer among the Navajo people.
3. Promote research that examines risk factors for many of these cancers, potential causes behind late diagnoses for screenable cancers, and research on culturally appropriate and effective approaches to improve screening. Continue to support Navajo-specific screening efforts, building on successes in increased screening and early diagnosis for breast and cervical cancer.
4. Promote research on possible causes of cancers that have higher incidence and mortality among Navajo people compared to NHW populations (stomach, kidney, and liver cancer), and approaches to promote early detection and treatment in these populations.
5. Promote research on barriers to preventative screening and cancer care delivery in Navajo communities and in rural areas. Continue to support telehealth infrastructure and rideshare/hospital-based transportation to promote equal access to high-quality cancer care and reduce geographic disparities in screening and cancer care.
6. Increase targeted and culturally appropriate education and awareness, screening and prevention, especially among those geographic areas within the Navajo Nation with the lowest screening rates and highest incidence and mortality rates. Enhance dissemination of data in accessible formats.
7. Increase education and training for health care providers regarding current cancer screening practices and guidelines. Offer Continuing Medical Education (CME) for medical health care professionals.
8. Develop a Comprehensive Navajo Cancer Plan to address cancer disparities, screening, treatment options, and overall collaboration with a focus to decrease cancer mortality in Navajo Nation.
9. Build relationships with healthcare facilities that were not able to add cancer data at this time, including those serving Navajo satellite communities.

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Definitions

Term	Definition
RPMS	The Resource and Patient Management System (RPMS) is a decentralized automated information system of over 50 integrated software applications. RPMS software modules fall into three major categories: clinical, administrative, and infrastructure applications.
GPRA	Government Performance Results Act mandates federal measures to monitor the performance of federal agencies according to specific health and treatment guidelines. Meeting these target measures demonstrates the effectiveness of the federal agency to comply with identified strategic and annual performance goals.
Derived Summary Stage 2000	Derived Summary Stage 2000 is a one-digit code which summarizes the stage of disease at time of initial diagnosis and/or treatment that is derived from Collaborative Stage. The derived stage codes are ideally suited for data analysis because of the consistency that can be obtained with objectively-recorded, identically-processed data items.
Local Stage	Also known as *early*, is cancer that is limited to the organ of origin; it has spread no farther than the organ in which it started.
Regional Stage	Cancer that has spread beyond the original (primary) growth site to nearing lymph nodes or organs and tissues.
Distant Stage	Cancer cells have broken away from the primary cancer, have traveled to other parts of the body, and have begun to grow at the new location(s); distant stage is also called remote, diffuse, disseminated, metastatic, or secondary disease. **NOTE*** *Regional* and *distant* stages are considered to be *late* stages of cancer.
Unknown Stage	Not enough information exists to categorize a case; it must be recorded as un-staged.
Incidence Rate	The number of new cancer cases occurring in a population during a specified period in time.
Mortality Rate	The number of persons dying during a specified period of time within a population.
Age-standardization	A procedure for adjusting rates (e.g., death rates) designed to minimize the effects of differences in age composition when comparing rates for different populations.
Population-based	A registry that includes all persons inhabiting a country, city, or other specified place or area.
Rate Ratio	The ratio of the incidence of disease in one group divided by the corresponding incidence of disease in another group.
Statistical difference or Statistical significance	A way to quantify the degree to which chance variability may account for the results. A measure often reported from all tests of statistical significance is the P-value. A p-value less than or equal to 0.05 indicates that there is no more than a 5%, or 1 in 20, probability of observing a result as extreme as that observed due solely to chance and is considered statistically significant.

RESOURCES

Organization	Contact information
American Cancer Society	www.cancer.org
Arizona Cancer Registry, Arizona Department of Health Services	www.azdhs.gov/phs/phstats/acr/index.htm
Cancer Control P.L.A.N.E.T.	Cancercontrolplanet.cancer.gov
Centers for Disease Control and Prevention (CDC) Cancer Prevention and Control	www.cdc.gov/cancer
Community Outreach and Patient Empowerment (COPE) Project	www.copeprogram.org
Indian Health Service	www.ihs.gov/epi/index.cfm?module=epi_cancer_main
National Cancer Institute	www.cancer.gov
Partnership for Native American Cancer Prevention (NACP) – Northern Arizona University and University of Arizona	Tel: 928-523-8593; Nau.edu/NACP
Native American Cancer Research	natamcancer.org/index.html
Navajo Epidemiology Center	Tel: (928) 871-6359; www.nec.navajo-nsn.gov
Navajo Nation Breast and Cervical Cancer Screening Program	Tel: (928) 871-6348; www.nndoh.org/bccp
New Mexico Cancer Center, Gallup, NM	Tel: 505-726-2400; www.nmcancercenter.org/about/locations/gallup
New Mexico Department of Health	nmhealth.org
New Mexico Tumor Registry	Nmtrweb.unm.edu
San Juan Regional Cancer Center	Tel: (505) 609-6259; www.ourcancercenter.com
Tribal Epidemiology Centers	Tribalepicenters.org
University of New Mexico Comprehensive Cancer Center	cancer.unm.edu
University of Utah, Huntsman Cancer Institute	www.huntsmancancer.org
Fred Hutchinson Cancer Center	www.fredhutch.org

Appendix A

Cancer incidence rates and rate ratios for the top cancers among Navajos compared to NHWs 2014-2018, All Ages, Males and Females

MALES AND FEMALES COMBINED								
	Navajo 6-county			AZ-NM NHW			Navajo: AZ-NM NHW	
Site	Count	Rate[b]	95% CI	Count	Rate[b]	95% CI	Rate Ratio[c]	95% CI
All Cancer Sites Combined	2,981	268.2	258.4-278.2	152,243	404.2	402.0-406.4	0.66*	0.64-0.69
Female Breast	384	60.9	54.8-67.5	22,768	123.4	121.6-125.1	0.49*	0.44-0.55
Prostate	222	50.4	43.7-57.7	16,454	81.8	80.5-83.1	0.62*	0.53-0.71
Colon and Rectum	366	32.2	28.9-35.7	12,083	32.4	31.8-33.0	0.99	0.89-1.10
Corpus and Uterus, NOS	172	28.4	24.2-33.1	4,528	23.1	22.4-23.9	1.23*	1.04-1.44
Kidney and Renal Pelvis	307	27.3	24.3-30.6	5,333	14.5	14.1-14.9	1.89*	1.67-2.12
Stomach	142	13.1	10.9-15.4	1,598	4.1	3.9-4.3	3.19*	2.66-3.81
Non-Hodgkin Lymphoma	137	12.5	10.5-14.8	5,956	15.8	15.4-16.3	0.79*	0.66-0.94
Thyroid	140	12.0	10.1-14.2	3,814	14.2	13.7-14.7	0.84	0.70-1.00
Liver and Intrahepatic Bile Duct	130	11.4	9.5-13.6	2,548	6.3	6.1-6.6	1.79*	1.48-2.15
Ovary	60	9.7	7.3-12.5	1,961	10.5	10.0-11.1	0.92	0.69-1.19
Pancreas	96	9.2	7.4-11.3	4,779	11.7	11.3-12.0	0.79*	0.63-0.97
Myeloma	93	8.7	7.0-10.7	1,946	4.8	4.6-5.1	1.80*	1.44-2.22
Lung and Bronchus	84	7.9	6.3-9.8	20,234	48.3	47.7-49.0	0.16*	0.13-0.20
Testis	43	7.4	5.3-10.1	644	6.2	5.8-6.8	1.18	0.84-1.63
Leukemias	68	5.7	4.4-7.3	4,126	11.8	11.4-12.2	0.49*	0.37-0.62
Cervix	34	5.6	3.8-7.9	780	6.1	5.6-6.6	0.92	0.63-1.31
Gallbladder	41	4.1	2.9-5.5	266	0.6	0.6-0.7	6.25*	4.34-8.73
Oral Cavity and Pharynx	38	3.4	2.4-4.8	3,989	10.6	10.2-10.9	0.33*	0.23-0.45
Brain and Other Nervous System	34	3.0	2.0-4.2	2,127	6.7	6.4-7.0	0.44*	0.30-0.63
Melanomas of the Skin	30	2.9	1.9-4.2	11,695	32.8	32.2-33.5	0.09*	0.06-0.13
Esophagus	28	2.7	1.8-4.0	1,877	4.6	4.4-4.8	0.60*	0.39-0.87
Urinary Bladder	25	2.4	1.5-3.5	8,363	20.1	19.6-20.5	0.12*	0.08-0.18

*=significant on $p<0.05$

MALES								
	Navajo 6-county			AZ-NM NHW			Navajo: AZ-NM NHW	
Site	Count	Rate	95% CI	Count	Rate	95% CI	Rate Ratio	95% CI
All Cancer Sites Combined	1,361	286.0	270.3-302.2	79,180	428.2	425.1-431.4	0.67*	0.63-0.71
Prostate	222	50.4	43.7-57.7	16,454	81.8	80.5-83.1	0.62*	0.53-0.71
Colon and Rectum	201	40.1	34.6-46.3	6,512	36.7	35.7-37.6	1.09	0.94-1.27
Kidney and Renal Pelvis	194	39.9	34.3-46.1	3,532	19.9	19.2-20.6	2.01*	1.72-2.33
Stomach	85	18.4	14.5-22.9	1,058	5.7	5.3-6.1	3.23*	2.53-4.06
Liver and Intrahepatic Bile Duct	83	16.3	12.9-20.4	1,837	9.5	9.1-10.0	1.71*	1.34-2.15
Pancreas	53	12.3	9.1-16.3	2,658	13.8	13.3-14.4	0.89	0.66-1.18
Non-Hodgkin Lymphoma	58	12.0	9.0-15.6	3,365	19.0	18.3-19.7	0.63*	0.47-0.83
Lung and Bronchus	51	11.8	8.7-15.6	10,315	52.3	51.2-53.3	0.23*	0.17-0.30
Myeloma	48	10.4	7.5-13.9	1,200	6.3	6.0-6.7	1.64*	1.18-2.20
Testis	43	7.4	5.3-10.1	644	6.2	5.8-6.8	1.18	0.84-1.63
Leukemias	39	7.3	5.1-10.2	2,460	14.5	13.9-15.2	0.50*	0.35-0.70
Thyroid	33	5.9	4.1-8.4	1,116	7.7	7.2-8.2	0.77	0.52-1.10
Oral Cavity and Pharynx	27	5.7	3.7-8.4	3,012	16.7	16.1-17.3	0.34*	0.22-0.51
Esophagus	23	5.2	3.3-7.9	1,535	7.9	7.5-8.3	0.67	0.41-1.01
Brain and Other Nervous System	17	3.4	1.9-5.4	1,217	7.9	7.4-8.4	0.43*	0.24-0.69

*=significant on $p<0.05$

FEMALES								
	Navajo 6-county			AZ-NM NHW			Navajo: AZ-NM NHW	
Site	Count	Rate[b]	95% CI	Count	Rate[b]	95% CI	Rate Ratio[c]	95% CI
All Cancer Sites Combined	1,620	260.5	247.7-273.8	73,063	387.0	383.9-390.1	0.67*	0.64-0.71
Female Breast	384	60.9	54.8-67.5	22,768	123.4	121.6-125.1	0.49*	0.44-0.55
Corpus and Uterus, NOS	172	28.4	24.2-33.1	4,528	23.1	22.4-23.9	1.23*	1.04-1.44
Colon and Rectum	165	26.0	22.1-30.3	5,571	28.5	27.7-29.3	0.91	0.77-1.07
Kidney and Renal Pelvis	113	18.0	14.7-21.7	1,801	9.5	9.0-10.0	1.89*	1.54-2.29
Thyroid	107	17.5	14.2-21.2	2,698	20.9	20.0-21.7	0.84	0.68-1.02
Non-Hodgkin Lymphoma	79	12.6	9.9-15.7	2,591	13.0	12.4-13.5	0.97	0.76-1.22
Ovary	60	9.7	7.3-12.5	1,961	10.5	10.0-11.1	0.92	0.69-1.19
Stomach	57	9.3	7.0-12.0	540	2.7	2.4-2.9	3.47*	2.57-4.59
Liver and Intrahepatic Bile Duct	47	7.4	5.4-9.9	711	3.4	3.2-3.7	2.15*	1.56-2.91
Myeloma	45	7.4	5.4-9.9	746	3.5	3.2-3.8	2.13*	1.53-2.89
Pancreas	43	7.1	5.1-9.6	2,121	9.7	9.3-10.2	0.73*	0.52-0.99
Cervix	34	5.6	3.8-7.9	780	6.1	5.6-6.6	0.92	0.63-1.31
Lung and Bronchus	33	5.3	3.6-7.4	9,919	45.1	44.2-46.0	0.12*	0.08-0.16
Gallbladder	30	5.0	3.4-7.2	173	0.8	0.7-0.9	6.24*	4.04-9.27
Leukemias	29	4.4	2.9-6.4	1,666	9.3	8.8-9.9	0.47*	0.31-0.69
Brain and Other Nervous System	17	2.7	1.5-4.3	910	5.6	5.2-6.0	0.48*	0.27-0.78

*=significant on $p<0.05$

Appendix B

Cancer stage at diagnosis for Navajo and NHWs in Arizona and New Mexico, 2014-2018, All Ages

Cervical Cancer (ages 20+)										
Location	**Local**		**Regional**		**Distant**		**Unknown**		**Total**	
	Count	**Row %**	**Count**	**Row %**	**Count**	**Row %**	**Count**	**Row %**	**Count**	**Row %**
Navajo 6-county	14	41.2%	11	32.4%	5	14.7%	4	11.8%	34	100%
AZ-NM NHW	352	45.1%	229	29.4%	113	14.5%	86	11.0%	780	100%
						Statistic		**DF**	**Value**	**P-value**
						Chi-Square		3	0.229	0.973
Female Breast Cancer (ages 40+)										
Location	**Local**		**Regional**		**Distant**		**Unknown**		**Total**	
	Count	**Row %**	**Count**	**Row %**	**Count**	**Row %**	**Count**	**Row %**	**Count**	**Row %**
Navajo 6-county	219	59.7%	100	27.2%	20	5.4%	28	7.6%	367	100%
AZ-NM NHW	14830	67.1%	5099	23.1%	1051	4.8%	1133	5.1%	22,113	100%
						Statistic		**DF**	**Value**	**P-value**
						Chi-Square		3	10.442	0.015*
Colorectal Cancer (ages 50+)										
Location	**Local**		**Regional**		**Distant**		**Unknown**		**Total**	
	Count	**Row %**	**Count**	**Row %**	**Count**	**Row %**	**Count**	**Row %**	**Count**	**Row %**
Navajo 6-county	99	32.5%	109	35.7%	53	17.4%	44	14.4%	305	100%
AZ-NM NHW	3948	35.5%	3725	33.5%	2151	19.4%	1284	11.6%	11108	100%
						Statistic		**DF**	**Value**	**P-value**
						Chi-Square		3	3.929	0.269

Appendix C

Death rates and rate ratios for the leading cancer causes of death among Navajos compared to NHWs, All Ages, 2014-2018.

MALES AND FEMALES COMBINED										
	Navajo 6-county				AZ-NM NHW				Navajo: AZ-NM NHW	
Site	Count	Average Count	Rate[b]	95% CI	Count	Average Count	Rate[b]	95% CI	Rate Ratio[c]	95% CI
Prostate*	106	21	28.1	22.9-34.0	3,300	660	17.3	16.7-17.9	1.62	1.32-1.97
CRC	139	28	12.8	10.7-15.2	5,000	1,000	12.7	12.3-13.1	1.01	0.84-1.20
Female Breast*	78	16	12.2	9.6-15.2	4,049	810	20.0	19.4-20.7	0.61	0.48-0.76
Pancreas	96	19	8.9	7.2-10.9	4,246	849	10.2	9.9-10.5	0.88	0.70-1.08
Stomach*	89	18	8.1	6.5-10.0	725	145	1.9	1.7-2.0	4.36	3.44-5.46
Kidney*	83	17	7.7	6.1-9.6	1,378	276	3.4	3.2-3.6	2.26	1.78-2.83
Ovary	47	9	7.3	5.3-9.7	1,492	298	7.1	6.7-7.5	1.03	0.75-1.38
Lung*	70	14	6.6	5.1-8.4	14,274	2,855	34.0	33.4-34.5	0.20	0.15-0.25
Liver*	65	13	5.9	4.5-7.5	1,692	338	4.1	3.9-4.3	1.44	1.10-1.86
Gallbladder*	30	6	2.9	1.9-4.1	153	31	0.4	0.3-0.4	7.61	4.89-11.36

*=significant on $p<0.05$

Mortality rates are per 100,000 and are age-adjusted to the 2000 US standard population

MALES										
Site	Count	Average Count	Rate[b]	95% CI	Count	Average Count	Rate[b]	95% CI	Rate Ratio[c]	95% CI
Prostate*	106	21	28.1	22.9-34.0	3,300	660	17.3	16.7-17.9	1.62	1.32-1.97
CRC	86	17	18.2	14.4-22.7	2,769	554	15.2	14.6-15.8	1.20	0.94-1.50
Kidney*	61	12	13.7	10.3-17.7	955	191	5.1	4.8-5.4	2.68	2.01-3.50
Stomach*	56	11	11.8	8.8-15.4	427	85	2.3	2.1-2.6	5.02	3.68-6.69
Pancreas	46	9	10.4	7.5-13.9	2,314	463	11.9	11.4-12.4	0.87	0.62-1.17
Liver	37	7	7.5	5.2-10.4	1,199	240	6.1	5.7-6.5	1.23	0.85-1.72
Esophageal	17	3	4.1	2.3-6.5	1,348	270	6.9	6.6-7.3	0.59	0.33-0.94
Lymphoma*	17	3	3.9	2.2-6.2	1,178	236	6.3	5.9-6.6	0.62	0.35-1.00
Leukemia*	15	3	3.1	1.7-5.2	1,424	285	7.8	7.4-8.2	0.40	0.22-0.68
Gallbladder	-	-	-	-	52	10	0.3	0.2-0.4	-	-
FEMALES										
Site	Count	Average Count	Rate[b]	95% CI	Count	Average Count	Rate[b]	95% CI	Rate Ratio[c]	95% CI
Female Breast*	78	16	12.2	9.6-15.2	4,049	810	20.0	19.4-20.7	0.61	0.48-0.76
Colorectal	53	11	8.9	6.6-11.6	2,231	446	10.5	10.0-10.9	0.85	0.63-1.12
Pancreas	50	10	8.0	5.9-10.5	1,932	386	8.6	8.2-9.0	0.93	0.68-1.24
Ovary	47	9	7.3	5.3-9.7	1,492	298	7.1	6.7-7.5	1.03	0.75-1.38
Stomach*	33	7	5.4	3.7-7.7	298	60	1.4	1.3-1.6	3.80	2.53-5.49
Liver*	28	6	4.5	3.0-6.6	493	99	2.2	2.0-2.4	2.04	1.33-3.00
Lung*	27	5	4.4	2.9-6.3	6,672	1,334	29.9	29.2-30.7	0.15	0.10-0.21
Lymphoma	23	5	3.8	2.4-5.8	899	180	4.0	3.7-4.3	0.96	0.60-1.45
Gallbladder*	23	5	3.7	2.3-5.6	101	20	0.5	0.4-0.6	8.11	4.83-12.96
Kidney*	22	4	3.5	2.2-5.4	423	85	1.9	1.7-2.1	1.82	1.12-2.81

*=significant on $p<0.05$

Mortality rates are per 100,000 and are age-adjusted to the 2000 US standard population