Cancer Mortality in the US-Affiliated Pacific Islands, 2008–2013

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Abstract

*Cancer-related mortality in the US-Affiliated Pacific Island (USAPI) jurisdictions is unknown. This is the first ever reporting of cancer-related mortality in the USAPI using cancer registry data. The individual USAPI jurisdictions collected incident cancer data and submitted it to the Pacific Regional Central Cancer Registry (PRCCR). All cases reported to PRCCR (n = 3,118) with vital status of dead (n = 1,323) during 2008–2013 were examined. Cause of death was coded based on clinical information provided in the cancer registry. Incidence-based mortality (IBM) rates were calculated using SEER*Stat software and age adjusted to the US standard population. Total cancer IBM rates among males were highest in Palau (151.5 per 100,000), Republic of the Marshall Islands (RMI, 142.0), and Guam (133.2); rates were lowest in American Samoa (21.7), the Commonwealth of the Northern Mariana Islands (CNMI, 22.7), and the Federated States of Micronesia (FSM, 28.9). Total cancer IBM rates among females were highest in RMI (120.3 per 100,000), Palau (107.7), and Guam (72.2); rates were lowest in CNMI (19.0), FSM (23.2), and American Samoa (42.8). The median time from cancer diagnosis to death was 8–28 days in the Freely Associated States and 102–128 days in the Flag Territories. IBM rates were higher among individuals in USAPI jurisdictions than among Asian/Pacific Islanders in Hawai'i for many cancers preventable through vaccination, smoking cessation, overweight and obesity prevention, and cancer screening. Geographic remoteness, underreporting, delay in reporting, and challenges with accurate death registration and certification led to lower IBM rates for some jurisdictions. These mortality data can help prioritize evidence-based interventions to reduce cancer-related deaths through risk factor reduction, early detection, and improved quality of life after a cancer diagnosis through palliative care.*

Background

In 2010, a state of health emergency due to an epidemic of non-communicable diseases (NCD) was declared in the six US-Affiliated Pacific Island (USAPI) jurisdictions.[1,2] The USAPI are politically linked to the US as "Flag Territories" (Guam, American Samoa and the Commonwealth of the Northern Mariana Islands [CNMI]) or as "Freely Associated States" (Federated States of Micronesia [FSM, grouped into four states: Chuuk, Kosrae, Pohnpei, and Yap], Republic of the Marshall Islands [RMI], and Republic of Palau, Figure 1) through the Compacts of Free Association.[3] USAPI jurisdictions have among the highest prevalence of obesity and tobacco use in the world and insufficient resources to prevent and control cancers.[4-9] Despite substantial under-diagnosis and under-reporting for many areas of the USAPI, the age-adjusted incidence of some cancers are still high.[10] High cancer incidence rates in the USAPI are due to lack of preventive health services and high prevalence of cancer risk factors, such as alcohol, tobacco, betel nut use, and chronic hepatitis B.[6,7,11,12]

Cancer is now the second most common cause of death in nearly all USAPI jurisdictions.[5] The USAPI healthcare systems have numerous challenges that influence cancer registration and cancer mortality reporting. Per capita health care expenditures, including health prevention (vaccines), public health, and medical care, range from $500–$1,310, in comparison to $10,348 spent in the US (Table 1). The populations in most jurisdictions are scattered among multiple islands and atolls across thousands of square miles of ocean. Geographic isolation creates limitations not only for preventive health care, but also for cancer diagnosis and treatment, which requires a subspecialized and multidisciplinary team not available in most jurisdictions. Most jurisdictions do not have computerized tomography (CT) or other advanced radiology service, endoscopy, or on-island pathology, causing delays in tissue diagnosis (Table 2).[13,14] Patients are often sent off-island for staging and treatment, but in the FSM, patients with a less than 50% five-year survival are not referred due to severe financial limitations.[15]

Due to limited health information systems, difficulty obtaining reports from off-island medical treatment referrals, and incomplete reporting of cause of death certifications, there is a paucity of cancer mortality data.[16-19] To address these issues systematically, all jurisdictions participate in the Centers for Disease Control and Prevention (CDC) National Program of Cancer Registries (NPCR) as the Pacific Regional Central Cancer Registry (PRCCR). The University of Hawai'i, John A. Burns School of Medicine's Department of Family Medicine and Community Health (UH) is the bona fide agent for the PRCCR, providing salary and training support for registry personnel in each jurisdiction and for the regional cancer registrar.

Like other US cancer registries, the USAPI cancer registries obtain mortality information from medical records, off-island referrals, insurance offices, and in some jurisdictions, death certificates from local vital statistics offices. All cancer registries compare their database with local vital statistics records and update vital status in the cancer registry. However, not all jurisdictions require death certifications. For those that do, many death certificates are improperly or not coded, or there are significant delays in receiving the coded death certificates to vital statistics offices.[20] Despite lacking the cause of death codes from death certificates, in most jurisdictions, the cancer registry contains sufficient text information recorded directly from medical records to determine if cancer was an attributable cause of death.[21] In order to identify high-need health

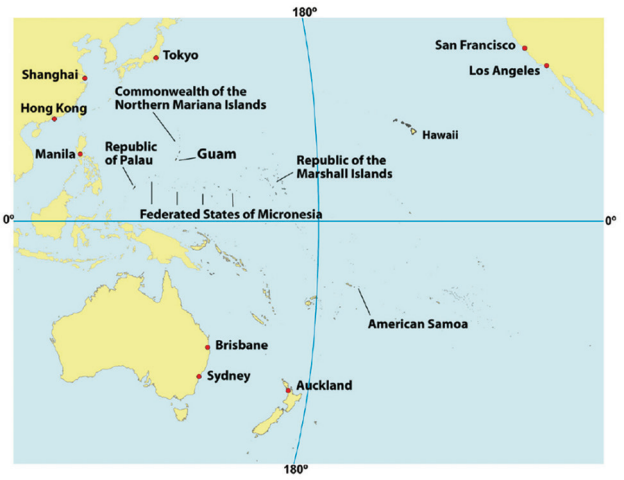

Figure 1. Map of the US-Affiliated Pacific Island Jurisdictions

Table 1. US-Affiliated Pacific Islands Demographics and Selected Indicators

	American Samoa	Commonwealth of the Northern Mariana Islands	Guam	Federated States of Micronesia	Palau	Republic of the Marshall Islands	United States
Population (midyear estimates, 2014)[a,b]	53,426	53,021	165,864	105,681	21,186	70,983	318,857,056
Number of Islands[c]	7	14 (most residents live on 3 islands)	1	4 major island groups; 607 islands total	340 (9 inhabited)	1,225 remote islands (29 atolls and 5 major islands)	—
Land surface area (sq. km)	199	464	544	702	459	181	9,826,675
Political status with US	Territory	Commonwealth	Territory	Freely Associated	Freely Associated	Freely Associated	—
Median age (years)[d]	25.5	33.6	29.0	25.1	33.4	22.9	38.1
Birth rate (births/1,000 population, 2017 est.)[d]	19.6	15.0	19.7	20.0	11.3	24.4	12.5
Death rate (deaths/1,000 population)[d]	5.9	4.8	6.0	4.2	8.1	4.2	8.2
Life expectancy (years)[d]	73.4	75.4	76.0	73.1	73.4	73.4	80.0
Health expenditures per capita (US$)[e,f,g,h,i]	$500	$723	$1,032	$447	$1,310	$651	$10,348
Hospitals	1	1	2	5	1	2	5,534[j]

[a] US Census Bureau, International Programs, International Data Base [internet], Revised:December 22, 2017; [cited 2018 April 2]. Available from: https://www.census.gov/data-tools/demo/idb/informationGateway.php.
[b] US Census Bureau, Population Division, Annual Estimates of the Resident Population for Selected Age Groups by Sex for the United States, States, Counties, and Puerto Rico Commonwealth and Municipios: April 1, 2010 to July 1, 2014 [internet], Released: June 2015; [cited 2018 April 2]. Available from: https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk.
[c] Townsend JS, Stormo AR, Roland KB, Buenconsejo-Lum L, White S, Saraiya M. Current cervical cancer screening knowledge, awareness, and practices among US affiliated pacific island providers: opportunities and challenges, supplemental table 1. *Oncologist*. 2014;19(4):383-393.
[d] Central Intelligence Agency. The World Factbook. Washington, DC: Central Intelligence Agency, 2012; [cited 2018 April 3]. Available at: https://www.cia.gov/library/publications/the-world-factbook/.
[e] World Health Statistics 2015 (Federated States of Micronesia, Palau (unadjusted), and the Marshall Islands)
[f] World Health Organization Country Profiles, 2011 (American Samoa, Guam, health expenditures in year 2000)
[g] For CNMI 39 million 2009 FY budget/53,883 population in 2010 (unadjusted)
[h] Centers for Medicare & Medicaid Services. [internet], 2016; [cited 2018 June 1]. Available from: https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.html.
[i] Includes all vaccines, public health and medical.
[j] American Hospital Association (AHA) [internet], 2018; [cited 2018 April 3], Available from: https://www.aha.org/statistics/fast-facts-us-hospitals. Registered hospitals are those hospitals that meet AHA's criteria for registration as a hospital facility. Registered hospitals include AHA member hospitals as well as nonmember hospitals.

Table 2. US-Affiliated Pacific Islands Cancer Screening, Diagnosis, and Treatment Availability[a,b]									
	American Samoa	**Common-wealth of the Northern Mariana Islands**	**Guam**	**Federated States of Micronesia**	**Palau**	**Republic of the Marshall Islands**	**Number of territories/ freely associated states where available**	**Percent of territories/ freely associated states where available (%)**	**United States**
Cancer screening or diagnosis									
Mammography	X	X	X		X	X	5	83	X
Ultrasound	X	X	X	X	X	X	6	100	X
Cervical screening	X	X	X	X	X	X	6	100	X
Cytology specimens collected (smear/ liquid-based)	X	X	X	X	X	X	6	100	X
On-island processing of cytology	X						1	17	X
Human papillomavirus DNA co-testing	X	X					2	33	X
Visual inspection with acetic acid				X		X	2	33	
Colonoscopy	X	X	X	X (Pohnpei only)		X	4	67	X
Fecal occult blood test	X	X	X	X (Yap only)	X	X	6	100	X
National Breast and Cervical Cancer Early Detection Program	X	X	X		X		4	67	X
On-island cancer diagnosis and treatment									
Pathologist	X		X				2	33	X
Histopathology	X		X				2	33	X
Oncologist			X				1	17	X
Obstetrician-Gynecologist	X	X	X	X	X	X	6	100	X
Radiologist	X	X	X				3	50	X
General surgeon	X	X	X	X	X	X	6	100	X
Dental	X	X	X	X	X	X	6	100	X
Chemotherapy		X[c]	X	X (Pohnpei only)			3	50	X
Radiation therapy			X				1	17	X
Palliative care	X	X	X	X	X	X	6	100	X
Off-island treatment when on-island treatment or diagnosis unavailable									
Off-island treatment restricted based on expected cost of treatment	X	X	X	X	X	X	6	100	N/A
Referred to Hawai'i	X	X	X	X			4	67	N/A
Referred to New Zealand	X						1	17	N/A
Referred to Philippines		X	X	X	X	X	5	83	N/A

[a] Pacific Regional Central Cancer Registry Cancer Council of the Pacific Islands. Cancer in the US Affiliated Pacific Islands 2007–2012 [Internet]. May 2015 [cited 2018 April 2]. Available from: http://www.pacificcancer.org/site-media/docpdfonwebpage/2015/PIJ%20Cancer%20Facts&%20Figures%202007-2012%20060115.pdf.

[b] X = available screening, diagnosis, or treatment. In many cases, these are only available at the main island hospital and not available on other islands.

[c] Maintenance chemotherapy only

system strengthening efforts to reduce the burden of cancer, UH requested CDC's assistance in determining USAPI cancer mortality statistics.

Methods

The individual USAPI jurisdictions collect incident cancer data starting with the cancer diagnosis date of January 1, 2007. After abstracting information from multiple data sources, the registrars send the completed abstracts to the PRCCR registrar for quality control and preparation for data submission to CDC. UH staff performs detailed analyses and provides technical assistance. Per the CDC NPCR standards, cases are classified by anatomic site and cell type using the *International Classification of Diseases for Oncology, 3rd Edition.*[22] Based on a data quality evaluation re-abstracting audit done by the CDC NPCR, the 2013 registry data were 96% concordant. The protocol was reviewed by human subjects' research advisors at the CDC and was deemed to be public health practice, not research. As such, IRB review was not required.

During the study period of January 1, 2008–December 31, 2013, all 3,118 cases reported a vital status (alive/deceased). All cases reported as deceased during the study period were included in the analysis. Two study clinicians (EAV, oncologist and LB, family medicine) and a fourth-year medical student (DN) conducted a review of cases using available information in the database's text fields (text from clinical progress notes, pathology reports, imaging results, and discharge and death summaries). Cases were coded for cause of death using the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) version[23] and also coded with Surveillance, Epidemiology, and End Results (SEER) cause-specific death classification (of death attributable to cancer diagnosis). Date of cancer diagnosis was previously coded by the registrar. Date of death was obtained from the date on the death certificate or death summary; if not available, the last clinical date entered in the cancer registry was used for the data of death. Coding disagreements were resolved by a review by the second clinician.

Incidence-based mortality (IBM) rates were obtained by dividing the number of deaths among incident cases (primary site diagnosis code) by the population. IBM rates were calculated by primary cancer site.[24] Only cases that were malignant and had cause-specific death classification of death attributable to cancer diagnosis were included in IBM rates. Cases in which cause of death was unknown or not cancer-related were excluded. IBM rates were chosen due to the limited mortality information and the availability of incident data. As IBM is likely underestimated in the early years of registry operations, deaths in 2007 were excluded. IBM rates were calculated using year of death 2008–2013; rates were adjusted to the 2000 US standard population. The analysis was performed using Microsoft Excel and software from the National Cancer Institute's SEER cancer registry program: SEER*Prep and SEER*Stat. SEER registry data (year of death 2008–2013) for Asian/Pacific Islanders in Hawai'i (malignant, cause-specific death classification of death attributable to cancer diagnosis) are presented for contrast.

All-cause one-year case fatality ratios were the proportion of people diagnosed with cancer with vital status of deceased within 365 days from the date of diagnosis (January 1, 2008–December 31, 2013, including all deaths even if cancer was not the attributable cause of death). All-cause one-year case fatality ratios were used to determine condition severity when the cause of death information was not available in the text fields. All other cancer-related outcomes were among persons who died of cancer. Cancer-related case fatality ratios were the proportion of people diagnosed with cancer during the study period who had vital status deceased and cause-specific death classification of death attributable to cancer diagnosis. Also analyzed were other cancer and care usage outcomes among those who were diagnosed during the study period and died of cancer: (1) median time from diagnosis to death (days), (2) median age of death (years), (3) access to palliative care (%), and (4) documented off-island treatment. Documented off-island treatment was based on cancer registry information that indicated cancer treatment took place outside the island jurisdiction.

Results

During the six-year period of 2008–2013, 1,323 out of 3,118 people (42.4%) diagnosed with cancer in the USAPI died. Of the 1,323 deaths, 79.3% (n = 1,045) of deaths were cancer-related. Total cancer IBM rates among males were highest in Palau (151.5 per 100,000), RMI (142.0), and Guam (133.2, Table 3). Rates were lower in American Samoa (21.7), CNMI (22.7), and FSM (28.9). For comparison, the IBM rate of cancer among Asian/Pacific Islanders in Hawai'i was 136.9. Lung cancer and liver cancer were among the most common causes of mortality among men in the USAPI. IBM rates for liver cancer among men were 28.0 in Palau, 24.5 in the RMI, and 20.7 in Guam; among Asian/Pacific Islanders in Hawai'i IBM rates of liver cancer was less than half that (9.9). IBM rates for lung cancer among men were 50.0 in Guam, 35.6 in Palau, and 35.0 in RMI; the rate was 37.3 among Asian/Pacific Islanders in Hawai'i. Prostate cancer was the third most common cause of death in half of the jurisdictions (RMI, Palau, and American Samoa); in Palau the rate was 26.9 compared to the rate of 9.7 among Asian/Pacific Islanders in Hawai'i. IBM rates for cancer of the oral cavity and pharynx among men were 16.8 in Palau, 9.3 in RMI, 5.0 in FSM, and 4.6 in Guam; among Asian/Pacific Islanders in Hawai'i, the IBM rate was 4.3.

Total cancer IBM rates among women were highest in RMI (120.3 per 100,000), Palau (107.7), and Guam (72.2). Rates were lower in CNMI (19.0), FSM (23.2), and American Samoa (42.8). The IBM rate of total cancer among female Asian/Pacific Islanders in Hawai'i was 88.6. The most common cause of mortality varied among women by jurisdiction and included

Table 3. Cancer Age-adjusted Incidence Based-mortality (IBM) by Site and Sex — US-Affiliated Pacific Islands, 2008–2013[a,b]

	American Samoa		Guam		Commonwealth of the Northern Mariana Islands		Federated States of Micronesia		Marshall Islands		Palau		Hawai'i Asian/Pacific Islander[c]	
	Rank	Rate	Rank	Rate	Rank	Rate	Rank	Rate	Rank	Rate	Rank	Rate	Rank	Rate
Males														
Total		21.7 (11.9–35.6)		133.2 (119.2–148.3)		22.7 (9.7–42.4)		28.9 (20.4–39.7)		142.0 (101.5–191)		151.5 (108.7–203.4)		136.9 (132.7–141.2)
Colon & rectum	4	2.4 (0.5–7.8)	3	12.3 (8.2–17.5)		0[d]	4	3.6 (0.6–10.1)	5	2.7 (0.5–11.9)	6	11.4 (1.7–32.7)	2	15.8 (14.4–17.3)
Esophagus		0[d]	8	3.4 (1.4–6.5)		0[d]		0[d]		0[d]	8	5.8 (1.1–17.9)	9	3.7 (3–4.4)
Leukemia	7	0.7 (0.1–5.0)	9	1.7 (0.5–3.9)	3	2.1 (0.1–10.0)	6	1.0 (0.1–4.1)	8	1.0 (0–10.1)	7	6.1 (1.2–18.4)	8	4.9 (4.1–5.7)
Liver	5	2.0 (0.2–7.6)	2	20.7 (15.9–26.5)	1	5.7 (0.3–20.8)	2	5.1 (2–10.4)	2	24.5 (8.5–50.8)	2	28.0 (13–51.1)	4	9.9 (8.8–11.1)
Lung & bronchus	1	4.4 (1.1–11.4)	1	50.0 (41.3–59.6)	2	4.8 (1.7–11.8)	1	6.0 (2.8–11.4)	1	35.0 (17.1–61.5)	1	35.6 (17.9–61.7)	1	37.3 (35.2–39.6)
Oral cavity & pharynx		0[d]	6	4.6 (2.5–7.5)		0[d]	3	5.0 (2–10.2)	4	9.3 (4.4–19.8)	4	16.8 (4.6–39.4)	7	4.3 (3.6–5.1)
Pancreas	6	1.2 (0–6.4)	5	5.6 (3.1–9.2)	5	0.7 (0–6.4)	8	0.5 (0–3.4)	6	1.5 (0.2–10.5)		0[d]	3	11 (9.8–12.2)
Prostate	3	3.7 (0.1–14.8)	4	8.5 (5.2–13.0)		0[d]	6	1.0 (0.1–4.2)	3	9.4 (1.6–26.8)	3	26.9 (8.8–57.3)	5	9.7 (8.6–10.8)
Stomach	2	4.1 (0.7–11.6)	7	4.5 (2.2–7.9)	4	1.0 (0.1–6.5)	5	1.4 (0.3–4.6)	7	1.1 (0–10.3)	5	11.6 (2.1–31.7)	6	7.8 (6.8–8.8)
Thyroid		0[d]	10	1.2 (0.1–3.7)		0[d]		0[d]		0[d]	9	2.6 (0.1–13.7)	10	0.6 (0.3–0.9)
Females														
Total		42.8 (28.1–61.4)		72.2 (62.7–82.7)		19.0 (7.4–37.5)		23.2 (15.7–32.7)		120.3 (87.2–160.2)		107.7 (77.5–145.0)		88.6 (85.6–91.7)
Breast	1	11.2 (5.3–20.3)	2	7.6 (4.8–11.3)	4	0.6 (0–6.0)	1	4.1 (1.6–8.6)	3	12.9 (5.9–24.9)	7	5.8 (0.6–19.3)	2	10.8 (9.7–11.9)
Cervix	5	4.2 (0.6–12.6)	9	1.9 (0.8–3.7)		0[d]	3	3.2 (1.3–6.8)	1	34.0 (18.4–56)	3	11.7 (4.7–24.8)	10	1.7 (1.2–2.2)
Colon & Rectum		0[d]	3	5.2 (2.9–8.5)		0[d]	6	1.9 (0.2–6.1)		0[d]	9	4.7 (0.5–16.6)	3	9.8 (8.9–10.9)
Esophagus		0[d]	13	0.3 (0–1.5)		0[d]		0[d]		0[d]	10	3.1 (0.1–14.6)	13	0.3 (0.2–0.6)
Leukemia	7	0.3 (0–4.0)	9	1.9 (0.7–4.0)		0[d]	7	0.5 (0–2.8)	10	3.9 (1.3–11.7)	12	2.0 (0.1–11.3)	8	3.1 (2.6–3.8)
Liver		0[d]	5	3.9 (1.9–6.8)		0[d]	5	2.2 (0.3–6.6)	4	6.9 (2–17.6)	2	15.2 (5.6–31.9)	8	3.1 (2.6–3.7)

Table 3. Cancer Age-adjusted Incidence Based-mortality (IBM) by Site and Sex — US-Affiliated Pacific Islands, 2008–2013[a,b] (Continued)

Lung & bronchus		0[d]	1	22.5 (17.2–28.7)		0[d]	3	3.2 (0.8–8.1)	2	23 (7.7–48.2)	1	19.4 (7.8–38.6)	1	19.8 (18.4–21.3)
Oral cavity & pharynx	6	2.7 (0.1–10.9)	9	1.9 (0.6–4.2)	3	3.2 (0.5–10.7)	7	0.5 (0–2.9)	7	5.0 (0.2–19.2)	8	5.2 (1.0–15.8)	11	1.2 (0.9–1.6)
Ovary	4	4.7 (0.8–13.0)	8	2.7 (1.2–5.2)		0[d]	7	0.5 (0–2.8)	7	5.0 (1.7–13.4)	5	7.3 (1.3–21.2)	6	3.7 (3.1–4.4)
Pancreas		0[d]	7	3.2 (1.5–5.8)		0[d]	7	0.5 (0–2.9)	5	6.8 (0.4–24.1)	6	6.3 (0.7–20.4)	4	8.1 (7.3–9.1)
Stomach	3	4.9 (1.2–12.4)	4	4.0 (1.9–7.1)	1	8.9 (1.1–26.0)	7	0.5 (0–2.9)	6	5.6 (0.4–19.8)	12	2.0 (0.1–11.3)	7	3.4 (2.9–4.1)
Thyroid	8	0.9 (0–5.3)	12	1.0 (0.2–2.8)		0[d]		0[d]	9	4.5 (0.1–18.8)	10	3.1 (0.1–14.6)	12	0.7 (0.5–1)
Uterus	2	8.8 (2.9–19.0)	6	3.4 (1.7–5.8)	2	4.8 (0.7–14.5)	2	3.6 (0.9–8.8)	11	3.5 (0.7–12.1)	4	8.9 (1.7–24.4)	5	4.8 (4.1–5.5)

[a] Data from Pacific Regional Central Cancer Registry Cancer Council of the Pacific Islands, based on vital status deceased was reported with a cause-specific death classification attributable to cancer diagnosis, year of death January 1, 2008–December 30, 2013. IBM rates are per 100,000 persons and age-adjusted to 2000 US Standard population.
[b] Based on chart review using available clinical information from clinical notes, death summaries, pathology notes, and imaging results in cancer registry, cases were coded with cause of death using the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) 2016 version. World Health Organization. International Classification of Diseases for Oncology, Third Edition, First Revision. [Internet]. Geneva: World Health Organization, 2013 [cited 2018 April 2]. Available from: http://codes.iarc.fr/.
[c] Surveillance, Epidemiology, and End Results (SEER) registry data (2000–2015), with a cause-specific death classification attributable to cancer diagnosis, among Asian or Pacific Islander, diagnosed in Hawai'i 2008–2013.
[d] Rate was not calculated as case count was zero.

breast, cervical, lung, and stomach cancer. IBM rates for cervical cancer among women were 34.0 in RMI and 11.7 in Palau; the IBM rate of cervical cancer among Asian/Pacific Islanders in Hawai'i (1.7) was 20 times lower than in RMI. IBM rates for liver cancer among women were 15.2 in Palau and 6.9 in RMI; the IBM rate of liver cancer among Asian/Pacific Islanders in Hawai'i (3.1) was less than half of the rates in Palau and RMI. Stomach cancer IBM rates were 8.9 in CNMI, 5.6 in RMI, and 4.9 in American Samoa; among Asian/Pacific Islanders in Hawai'i the rate was 3.4. Oral cavity and pharynx cancer were approximately four times higher in Palau (5.2) and RMI (5.0) than among Hawai'i Asian/Pacific Islanders (1.2).

In the Freely Associated States (FSM, RMI, and Palau), 58%–67% of those diagnosed with cancer died within a year of diagnosis, compared to 27%–28% in the Flag Territories (Table 4). In the Freely Associated States, 24%–64% of those diagnosed with cancer died of cancer, compared to 20%–31% in the Flag Territories. In the Freely Associated States, the median time from cancer diagnosis to death was 8–28 days; in the Flag Territories, the median time was 102–128 days. Among Asian/Pacific Islanders in Hawai'i, the median time from diagnosis to death was 270 days, over 8 months greater than in the Freely Associated States. The median age of death was 54–62 years in the Freely Associated States and 58–64 years in the Flag Territories. Palliative care was documented in the cancer registry in 9%–16% of cases. Off-island treatment was reported in 27%–48% among persons who were unable to initiate chemotherapy or radiation therapy on-island; in Guam, where most cancer treatment modalities are available, only 10% were referred off-island for treatment.

Discussion

This is the first cancer mortality study done across USAPI jurisdictions. This study found that IBM rates in USAPI jurisdictions were higher than rates among Asian/Pacific Islanders in Hawai'i for many cancers that could be prevented through vaccination, smoking cessation, overweight and obesity prevention, and cancer screening. Resource-limited or geographically dispersed populations throughout the South Pacific also face similar high mortality in cervical and liver cancers where vaccination and/or screening are routinely recommended.[25-30]

Cancer outcome data can be used to inform outreach, vaccination programs (human papillomavirus and hepatitis B), and education to clinical providers. Implementing recommended clinical preventive services for prevention and early detection may improve cancer outcomes. USAPI jurisdictions have breast cancer screening by mammography in five of six jurisdictions and cervical cancer screening by cytology in all jurisdictions (Table 2). Limited mammography is available only on the main islands. In all jurisdictions, cytology tests may only be performed in central locations on the main island and are not available at rural sites, especially in the outer islands. In addition, cytology

Table 4. Cancer-related Outcomes Among Persons Who Died of Cancer[a] — US-Affiliated Pacific Islands, 2008–2013						
	All-cause case fatality within 1-year[b] (%)	**Cancer-related case fatality[c] (%)**	**Median time diagnosis to death[d] (days)**	**Median age of death (years)**	**Access to palliative care[e] (%)**	**Documented off-island treatment[e] (%)**
Flag Territories						
American Samoa	27	29	110 (0–1,054)	60 (3–82)	10	27
Guam	27	31	128 (0–2,002)	64 (11–97)	16	10
Commonwealth of the Northern Mariana Islands	28	20	102 (0–1,299)	58 (31–84)	13	48
Freely Associated States						
Federated States of Micronesia	67	24	8 (0–844)	54 (4–81)	9	36
Marshall Islands	58	54	28 (0–1,215)	53 (1–100)	13	35
Palau	67	64	18.5 (0–452)	62 (10–90)	14	32
Asian/Pacific Islander, Hawai'i	—	—	270[f]	—	—	—

[a] Data from Pacific Regional Central Cancer Registry Cancer Council of the Pacific Islands, based on vital status deceased was reported, year of diagnosis January 1, 2008–December 30, 2013. Based on chart review using available clinical information from clinical notes, death summaries, pathology notes, and imaging results in cancer registry, cases were coded with cause of death using the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) 2016 version. World Health Organization. International Classification of Diseases for Oncology, Third Edition, First Revision. [Internet]. Geneva: World Health Organization, 2013 [cited 2018 April 2]. Available from: http://codes.iarc.fr/.

[b] Number of persons diagnosed with cancer that had vital status deceased in cancer registry and date of death ≤365 days from date of diagnosis (even when cancer may not have been the coded cause of death) divided by the incident cases.

[c] Number of persons diagnosed with cancer that had vital status deceased and coded with cause-specific death classification of death attributable to cancer diagnosis divided by the incident cases.

[d] Date of cancer diagnosis based on date recorded in cancer registry, many times based on date of pathology review of cancer tissue. Date of death based on date on death certificate or last clinical date entered in the cancer registry if date of death not recorded.

[e] Based on clinical information included in cancer registry.

[f] Median number of days calculated using Surveillance, Epidemiology, and End Results (SEER) registry data (2000–2015), Kaplan-Meier survival analysis with a cause-specific death classification attributable to cancer diagnosis, among Asian or Pacific Islander, diagnosed in Hawai'i 2008–2013.

testing is processed off-island in five of six jurisdictions.[21] This can delay diagnosis of pre-cancers and cancers, leading to loss to follow-up and later stage presentation, consistent with IBM rates in the USAPI.[31]

Women in the RMI have eight times the US incidence of invasive cervical cancer (70.0 per 100,000),[16] making this the highest incidence of cervical cancer in the world.[10] Mortality due to cervical cancer is over 20 times higher in RMI than in Hawai'i among Asian/Pacific Islanders. This may be due to differences in screening access, follow-up, later stage presentation, and inadequate on-island treatment.

In FSM, RMI, and Palau, travel from the outer islands to the only hospital can take several hours to days by small motor boats. In the most remote areas, large government cargo ships travel a few times a year with health teams and supplies and are subject to frequent delays and cancellation. In most jurisdictions, when cancer is a suspected diagnosis, clinicians have only basic x-ray and ultrasound to supplement their clinical skills. Due to the remoteness and limited clinical on-island resources, cancer may be diagnosed at later stages, demonstrated by higher all-cause case fatality ratios and shorter times from diagnosis to death in the Freely Associated States. Women in Pohnpei State, FSM are often diagnosed with late-stage cervical cancer, and the median survival from diagnosis to death for all types of cancer diagnosed in FSM is eight days. Because of the high numbers of cancers diagnosed at late stage and lack of on-island treatment for advanced cancers, all USAPI jurisdictions have also been focused on improving access to palliative care.[32]

Palliative care is an approach that improves the quality of life of patients and their families facing a life-threatening illness through the prevention and relief of suffering by means of early identification and treatment of pain, and supportive services for physical, psychosocial and spiritual problems.[33] Well-integrated palliative care not only reduces unnecessary hospital admissions but improves quality of life in geographically remote places where there are barriers to screening, diagnosis, and curative treatment.[34,35] Palliative care was documented in only 9%–16% of cancer-related deaths. As part of the requirements for CDC's National Comprehensive Cancer Control (CCC) Program, all USAPI jurisdictions have coalitions that have developed objectives to increase access to palliative care for patients with cancer through provider education and expanding some existing home-based care programs.

This study has some limitations. Not all cases were reported from Chuuk State in FSM and American Samoa due to lack of staff capacity. Guam and CNMI are working on backlogged cases that have not yet been reported to the PRCCR. This may be the reason why IBM rates are lower for these jurisdictions. Geographic remoteness and challenges with accurate death registration and certification may have resulted in under-reporting of mortality. Due to limitations on data available in the cancer registry text field or to poor documentation in the original medical record, it was sometimes difficult to determine cancer-related mortality based on the information provided. The proportion of deaths that could not be coded due to limited text field information varied by jurisdiction: 2% in American Samoa, 4% in Guam, 45% in CNMI, 67% in FSM, 8% in RMI, and 7% in Palau. Those diagnosed with cancer during the study period and who died after 2013 (due to longer survival times or diagnosis near the end of the study period) were excluded; this could lead to an underestimation of IBM rates and an underreporting of case fatality. Lastly, since the combined population of USAPI islands is relatively small (450,000 people total, with populations ranging from 7,000–20,000 in some FSM states and in Palau), the sample size for this study was small and made it challenging to calculate detailed stratified estimates for cancer mortality.

A key strength of this study is that the available PRCCR data are accurate and of high quality for the initial diagnostic information. Based on available information from multiple data sources, the cancer registrars are abstracting the information with 96% concordance on re-abstraction by CDC contractors. There are many active partnerships working to ensure all cancers in the jurisdictions are reported. Widespread health system strengthening efforts spearheaded by the Pacific Island Health Officers' Association started in 2015 in the areas of health information systems (medical records) and in civil registration, vital statistics, and death certifications. Over time, these larger efforts will positively influence the quality and quantity of accurate mortality data reported to cancer registries.

Some of the highest IBM rates in the USAPI were for cancers (lung, liver, cervical, oral cavity, and pharynx) where there are opportunities for prevention through a reduction in risk factors or early detection when treatment is more effective. The CCC coalitions in all jurisdictions place public education, outreach, and health provider education among the highest priorities. The CCC coalitions work closely with their local cervical cancer screening teams and other primary care providers, with technical assistance and health provider education done by partners at UH. Four of the six USAPI jurisdictions participate in the CDC's National Breast and Cervical Cancer Early Detection Program and all have limited cervical cancer screening through other US federally funded programs. Even with these programs the financial and human resource capacity are presently inadequate to achieve high cancer screening uptake. A population-wide colorectal cancer screening program does not exist due to lack of financial and staff resources. USAPI focus has been on risk-factor reduction, early detection of cervical and breast cancers, and increasing access to palliative care for the numerous patients diagnosed at late stage. This cancer mortality analysis supports ongoing multi-pronged approaches to prioritize, implement, and evaluate evidence-based interventions that could reduce cancer-related deaths through health promotion, early detection, and adoption of policies aimed at protecting youth from uptake of risk factors. The Affordable Care Act and certain aspects of Medicare and Medicaid are relevant only to those insured in the Flag Territories. With the scheduled cessation of US Compact sector grant funding in 2023 and transition to uncertain income from compact trust funds, the Freely Associated States may need substantial assistance and other sources of income that increase cancer screening capacity in order to decrease premature deaths from cervical, breast and colorectal cancers.[36]

Disclaimer

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.

Conflict of Interest Disclosure Statement

Dr. Buenconsejo-Lum (University of Hawai'i) received CDC cooperative agreements for the USAPI cancer registry program. Otherwise, all authors declare that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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