Cancer in Micronesia

Abstract: Between November 1998 and December 1999, trained medical record abstractors visited the Micronesian jurisdictions of Chuuk, Kosrae, Pohnpei, and Yap (the four states of the Federated States of Micronesia), as well as the Republic of Palau (Belau), the Republic of Kiribati, the Republic of the Marshall Islands (RMI), and the Republic of Nauru to review all available medical records in order to describe the epidemiology of cancer in Micronesia. Annualized age-adjusted, site-specific cancer period prevalence rates for individual jurisdictions were calculated. Site-specific cancer occurrence in Micronesia follows a pattern characteristic of developing nations. At the same time, cancers associated with developed countries are also impacting these populations. Recommended are jurisdiction-specific plans that outline the steps and resources needed to establish or improve local cancer registries; expand cancer awareness and screening activities; and improve diagnostic and treatment capacity. *Key Words:* Medically underserved area, needs assessment, oncology services, Pacific Islanders, quality of health care, health services research

PACIFIC CANCER AND HEALTH STUDIES

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Introduction

Medical practitioners throughout Micronesia believe that the rates of cancer are high, an impression supported by the fact that malignant neoplasms are the second or third-ranked cause of death in the Federated States of Micronesia (FSM), Nauru, Republic of Palau (Belau), and the Republic of the Marshall Islands (RMI)[1]. Although the site-specific incidence of cancer has been characterized for Micronesia as a whole[2,3], incidence rates for individual jurisdictions have been characterized only for Belau and Guam in recent years.

To further examine the extent of the cancer burden in Micronesia, we conducted a retrospective review of medical records in a majority of the Micronesian jurisdictions in 1998 and 1999.

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Methods

Between November 1998 and December 1999, trained medical record abstractors visited the Micronesian jurisdictions of Chuuk, Kosrae, Pohnpei, and Yap (the four states of the Federated States of Micronesia), the Republic of Palau (Belau), the Republic of Kiribati (Kiribati), the Marshall Islands, and the Republic of Nauru (Nauru) to collect data on cancer cases. Where hospital discharges and death certificates were coded using ICD-9 (all the states except Nauru), computerized records were searched for codes for neoplasm (140-239.9, exclusive of benign neoplasms). In addition, death certificates and laboratory logbooks were searched manually for cancer diagnoses. The proportion of cases identified through death certificate data only was lowest in Kiribati (17 of 276 cases; 6%) and highest in Chuuk (227 of 284 cases; 80%). In Belau, the personal cancer logbook of a physician aided in case-finding. In Nauru, where hospital discharges and death certificates are not coded and computerized records are not kept, cases were found by manual search of pathology reports, review of the Papanicolau smear logbook, search of the overseas referral database, and review of death certificates.

Cancer cases in the Marshall Islands were collected through medical records archived by the Nuclear Claims Tribunal (NCT), which renders determination on claims based on the nuclear testing program in the Marshall Islands (1947-1957)[4]. Cases were initially collected in 1996 via a review of NCT records of decedents awarded compensation. Additional cases were collected in November through December 1999 via a review of all claims submitted to the NCT.

Where available, medical records from the incident cancer cases diagnosed in the years 1985-1998 were reviewed for information on cancer type, sex, age at diagnosis, and basis of diagnosis (histological verification or clinical presentation without tissue confirmation). Clinical diagnoses without histological verification were included in the present analysis. For patients for whom only death certificate data were available, the age at death was used as a proxy

Table 1. Cancer prevalence by site, by Northern Pacific Area, c.1985-1998 (adjusted to world standard population)

	Area							
Cancer site	**Chuuk**	**Kosrae**	**Pohnpei**	**Yap**	**Belau**	**Kiribati**	**Marshall Islands**	**Nauru**
Breast	7.9	11.5	10.7	15.6	17.1	8.0	**36.0**	15.4
Cervix	4.8	33.4	24.8	13.1	37.5	4.5	**60.5**	55.0
Gastric	3.0	**17.6**	7.7	1.1	1.6	2.2	2.9	10.7
Hematologic	2.2	2.6	4.7	2.7	**6.0**	2.9	4.7	3.2
Liver	5.2	4.1	11.9	**24.4**	19.4	0.5	10.2	5.7
Lung	24.6	8.7	21.3	39.6	34.6	4.4	41.1	**42.8**
Oral	3.8	7.9	6.2	**22.1**	12.4	2.4	12.6	3.6
Other/GI	3.6	30.9	5.9	15.6	12.8	5.0	20.1	**33.4**
Other/GU	6.0	*	8.2	5.8	13.8	5.9	**21.8**	10.3
Other/Unk	13.7	13.5	11.9	33.2	26.4	14.0	22.2	**48.9**
Prostate	2.5	10.9	4.9	14.0	**74.9**	1.3	9.3	2.9
Thyroid	2.6	1.6	3.0	2.6	4.2	1.2	**28.6**	*
Years	1985-1997	1990-1998	1985-1997	1985-1998	1985-1998	1989-1998	1985-1998	1985-1998

Note: Number of cases per 100,000 population, age-adjusted to WHO world standard population, annualized. The highest cancer prevalence by cancer site is indicated in bold-face print

**No cases reported*

measure of the age at diagnosis. Where neither the date of death nor the date of diagnosis was available, the year 1990 was assigned as the year of diagnosis. Where the patient's age was not available, the patient was excluded.

The measurements reported are annualized site-specific, period prevalence for existing cancer cases documented during the period of concern for each jurisdiction. The period is defined as the years during which data were available for a given jurisdiction. Included in the numerator were, (1) persons diagnosed with cancer during the period (incident cases), and (2) persons who were diagnosed with cancer prior to the period who either died during the period or who were still alive at the end of the period (prevalent cases at the start of the period). The denominator included the total population from census data available for a year close to the mid-point of the period. Site-specific prevalence measurements were age-adjusted to the World Health Organization world standard population[5] using the direct method. The period prevalence measurements were annualized by dividing by the number of years for which data were collected. A companion article in this journal provides greater detail on this method of estimating prevalence[6].

Results

A total of 284 cases of cancer in Chuuk (1985-1997), 48 cases in Kosrae (1990-1998), 236 cases in Pohnpei (1985-1997), 169 cases in Yap (1985-1998), 370 cases in Belau (1985-1998), 276 cases in Kiribati (1989-1998), 886 cases in the Marshall Islands (1985-1998), and 115 cases in Nauru (1985-1998) are included in the present analysis.

Annualized age-adjusted site-specific cancer period prevalence data for individual jurisdictions are shown in Table 1. The data suggest that Micronesia cancer patterns have characteristics of both the developing world (given high rates of gastric, cervical, and liver cancer) and the developed world (given high rates of lung, colorectal, breast, and prostate cancers) [7].

Discussion

Cancers characteristic of the developing world

In that cancers such as gastric cancer (in Kosrae, Pohnpei, and Nauru), cervical cancer, and liver cancer are prominent, the pattern in Micronesia is similar to that of the developing world. It is estimated that a quarter of cancers in the developing world are associated with infectious agents such as *Helicobacter pylori* (gastric), human papilloma virus (cervical), and hepatitis B (liver) [8].

Gastric cancer. Helicobacter pylori (*H. pylori*), associated with gastric cancer and gastric lymphomas, is associated with low socioeconomic status. High rates of gastric cancer also are related to dietary practices such as smoking and pickling of foods[9,10]. The prevalence of gastric cancers can be much reduced by eradicating *H. pylori* and reducing tobacco use.

Cervical cancer. The biological causative agent of cervical cancer is human papilloma virus (HPV) infection. The high prevalence of cervical cancer in many of the Micronesian districts probably reflects high rates of HPV infection. Many districts do not have comprehensive screening programs. Many women, therefore, present with late stage cervical cancer. The highest prevalence is found in the Marshall Islands where high rates of sexually transmitted disease, including syphilis, have been documented[11]. Smoking has been associated with cervical cancer also. Primary prevention of cervical cancer would entail increased safe sex practices to prevent the transmission of HPV. Programs that help prevent smoking and help women quit may also decrease cervical cancer rates.

Secondary prevention after HPV infection has occurred involves recognition and treatment of cervical dysplasia. The lack of cultural acceptance of Pap smear screening remains a barrier to cervical cancer control in Micronesia. Visual inspection with acetic acid and immediate treatment with loop electrocautery has been recommended in areas with limited resources as a low technology alternative to Papanicolau screening (dependent upon expert interpretation) and colposcopy[12].

High costs are associated with the treatment of advanced cervical cancer (hospital admission for palliative management and pain control, off-island referrals for specific cancer treatment). More widespread cervical cancer screening and treatment may be cost-effective. This would entail systematization of screening, record-keeping, and follow-up efforts.

Liver cancer. Prevalence of liver cancer is highest in Yap. As liver cancer is associated with viral hepatitis and alcohol consumption, rates of hepatitis B (and possibly C) and drinking behaviors should be investigated in Yap. Seroprevalence rates for hepatitis B are high in Micronesia, with a 14% carrier rate in some jurisdictions. The occurrence of liver cancer in young people probably indicates that they were infected at birth or in early childhood. Sexual transmission in the generation of child-bearing age increases perinatal transmission of hepatitis B. Primary prevention of hepatitis B infection would entail increased safe sex practices and immunization[13]. A program of routine infant vaccination and catch-up vaccination for children up to 6 years of age began in the Federated States of Micronesia in 1988-89[14]. Alcohol intake may account for the generally higher rates of liver cancer in males. A decrease in alcohol abuse will lead to a decrease in cirrhosis and cancer of the liver.

Cancers characteristic of the developed world

Cancer in the developed world follows a different pattern from that of the developing world. In the continental U.S. for example, the cancers of highest incidence are breast, lung, and colorectal for women and prostate, lung, and colorectal for men[15]. These cancers also are prevalent in Micronesia.

Prostate cancer. Every population can be expected to have high rates of asymptomatic prostate cancer. In this study, prostate cancer prevalence was highest in Belau. Screening for prostate cancer (whether by prostate-specific antigen, digital rectal examination, or trans-rectal ultrasound) reveals many cases that would otherwise not come to clinical attention[16]. As case-finding in prostate cancer is highly dependent on the availability of screening and urological services, high rates in Belau may reflect vigorous case-finding.

Breast cancer. Breast cancer prevalence is high in the Marshall Islands. Similarly to prostate cancer, case-finding in breast cancer is dependent on the availability of screening and surgical services. Thus, high breast cancer rates may reflect differences in case-finding strategies.

Lung cancer. The Micronesian entities of Nauru, the Marshall Islands, and Yap have high period prevalence of lung cancer. The correlation with rates of tobacco smoking needs to be delineated.

Oral cancer. Prevalence of oral cancer is highest in Yap. Oral cancer has been linked to betel nut chewing, particularly if the betel nut is combined with slaked lime[17]. Betel nut chewing is commonly practiced throughout Micronesia, particularly in Belau, the Mariana Islands, and the FSM states of Yap and Chuuk.

Radiation-associated cancers. The unique history of U.S. nuclear thermo-weapons testing in the Marshall Islands between 1946 and 1957, and the release of deleterious amounts of ionizing radiation into the environment, has great significance with regard to cancer rates in the Pacific and the Marshall Islands in particular. Did the U.S. nuclear testing program cause an excess burden of cancers? If so, does it continue to cause an excess burden of cancers? While this discussion is beyond the scope of this paper several relevant issues became clear during this study.

Cancers associated with exposure to ionizing radiation can be categorized as those cancers which are induced by acute radiation exposure (caused in months to a few years from time of exposure) and those which may be induced many years following exposure (r 20-30 years or more) i.e., are latent.

Thyroid cancers and particular hematologic cancers can both be induced by acute exposure. Both hematologic and thyroid cancer rates were associated with the Nuclear Testing Program. Various groups have conducted screening for thyroid cancer in the Marshall Islands. Data collected by a Japanese group and by Dr. Thomas Hamilton of the Fred Hutchinson Cancer Institute suggests that the prevalence of thyroid cancer in the Marshall Islands correlates with the

received dose of radiation[18]. Enhanced case finding may uncover more thyroid malignancies than would otherwise come to clinical attention. Population studies have documented ultrasound-detected thyroid nodules in 20 to 45% of normal women and 17 to 25% of normal men[19].

Although some hematologic malignancies are also associated with radiation exposure, most of the excess incidence occurs within five to ten years of exposure[20]. There were documented hematologic cancers found in the post testing era, however these rates were not thought to be excessive in the Marshall Islands during the period studied.

The effect of the U.S. Nuclear testing program on latent cancers requires a more extensive comment and study that is beyond the scope of this article. Most malignancies including lung, breast, gastrointestinal, genitourinary, hematologic, neurologic, oral cancers, and thyroid can be a latent effect of exposure to deleterious doses of ionizing radiation. These cancers are prevalent in the Marshall Islands and other parts in the U.S. Associated Pacific. The development of these cancers is mutifactoral, therefore establishing cause and effect from exposure to nuclear testing in small populations poses a challenge.

The lack of a comprehensive cancer surveillance system in the Marshall Islands before and around the time of the nuclear testing means there is no knowledge of the pre-nuclear and post-nuclear testing rates of the aforementioned cancers. A comparative study, comparing cancer rates of surrounding Micronesian areas to the Marshall Islands, in an attempt to examine if ionizing radiation from the nuclear testing influenced an excess of radiogenic cancers in Marshall Islands, is fraught with difficulties in data comparisons. None of the cancer information systems in surrounding Micronesian areas were robust at the time of the nuclear testing, and no cancer registries existed in the post-nuclear testing era. The necessary historical cancer data, which would allow valid comparisons are lacking. It is tragic that these crucial cancer information systems were not put in place.

It is clear that thyroid cancer, a very sensitive cancer to ionizing radiation, affected a large portion of the Marshallese population as mentioned earlier. A more comprehensive look at the issue of whether or not there are an excessive burden of r latent cancers generated from the U.S. Nuclear Testing Program in the Marshall Islands and the surrounding Pacific is needed. Whereas, the present cancer data information systems were not operational over the last 50 years, the question of excess rates of latent cancers associated with the ionizing radiation from nuclear testing remains difficult.

Other methods of projecting excess cancer rates can be utilized to answer this question. These methods involve studying the doses of ionizing radiation that were placed into the environment through the testing era, and projecting the expected excess rates of cancers that may be attributable to that exposure.

Limitations of the study

Use of clinical diagnoses. For patients with death certificate data only, we estimated the age at diagnosis from the age at death. This may overestimate the age at diagnosis for indolent cancers (e.g. thyroid), though it may be accurate in late-presenting, aggressive cancers.

The health facilities of many Micronesian jurisdictions are not comparable to those of the U.S. Diagnostic Laboratory and imaging capabilities are rudimentary. The lack of resources precludes in-country tissue diagnosis of most cancers. Patients with cancer often present for medical care in the late stages of their disease. In settings with limited resources, the expenditure of health personnel time, equipment, and effort cannot be justified for patients with limited life expectancy. The logistical difficulties of evacuating patients, sending laboratory specimens overseas, and receiving timely reports also make tissue diagnosis difficult.

Many patients thus receive clinical diagnoses of cancer. Some clinical diagnoses, e.g., breast or cervical cancers, are made more easily than others, such as gastric or lung cancers. Limiting case ascertainment to histologically confirmed cases would have greatly underestimated true cancer rates. Conversely, by including cancers without tissue diagnoses, we may have overestimated true cancer occurrence.

Ascertainment biases. The completeness of case finding varies according to the geographic makeup of each jurisdiction. For example, the Republic of Nauru is a single island of four miles by six miles, and illnesses are likely to come to medical attention. In contrast, the islands of the Republic of Kiribati are spread across an area as large as the continental US. Hence, a significant amount of morbidity and mortality remains unrecognized and unreported.

Further, the availability of records was limited in many jurisdictions. For example, the records at the Ministry of Health and the Registrar in Nauru were lost when the records building was destroyed by fire in 1990. Ascertainment also was incomplete in Kiribati, Chuuk, and Belau.

Case finding was facilitated in the Republic of the Marshall Islands by the archives of the Nuclear Claims Tribunal. Patients in the Marshall Islands who are able to demonstrate that they have one of the compensable conditions caused by nuclear testing can receive compensation for personal injury and death through the NCT[21]. For example, the NCT compensates people with non-recurrent thyroid cancer $50,000, and people with cancer of the stomach are compensated $125,000. There is thus a financial incentive for

patients to receive diagnoses of cancer.

Factors in the etiology of cancer and its control

The prevalence of cancer is associated with many risk factors. The risk factors can be categorized into several models including: a biomedical model (carcinogens, genetics, ionizing radiation), psychosocial model (cultural factors, dietary patterns, health seeking behaviors), and politico-economic model (effect of poverty, disparities in the distribution of health resources, political policies). Each model is not exclusive, and each has a role in the prevalence of cancer and cancer outcomes in Micronesia.

The conventional public health view of the emergence of cancer as a significant cause of morbidity and mortality in developing nations is part of the so-called "epidemiological transition," by which degenerative diseases come to the fore as infectious diseases come under control[22,23].

For the Pacific Islands, continued low levels of economic development result in a persistence of cancers characteristic of developing countries, particularly those caused by infectious agents. Meanwhile, cancers associated with developed countries are increasing in prevalence as a result of increased use of tobacco and alcohol; increased intake of low-fiber and high-fat foods; decreased physical activity; and increased prevalence of overweight and obesity[24].

The abandonment of a sustainable, self-sufficient, social lifestyle in favor of integration into the globalized, cosmopolitan economy has additional consequences. The past decades have seen an influx of tobacco in the Pacific. Indigenous food production has diminished, and Pacific Islanders are more dependent on processed foods, produced and imported through a globalized economy[25]. The Pacific Islands have witnessed a breakdown of traditional cultural values and increased rates of obesity and alcohol and tobacco use.[26,28] Sexual freedoms leading to increased sexual contacts within populations, and with other populations have contributed to the spread of pathogens such as HPV and HBV.

International socio-economic policies also have adversely affected Pacific Islander populations. Exposure of the indigenous people to ionizing radiation from the US nuclear weapons testing program in the Pacific and aggressive US tobacco industry advertising and marketing are practices that stem from policy decisions.

Unfortunately, the health care infrastructure in much of the region has been neglected. None of the jurisdictions surveyed in this study has a comprehensive cancer control program. Additionally, jurisdictions have little or no capacity to collect cancer data, promote cancer awareness, expand screening and case-finding, diagnose cancer, and provide timely treatment.

Conclusions

Micronesia finds itself in a curious situation in which diseases of the developing world co-exist with diseases of the developed world. A strategic plan is needed to accurately characterize the cancer burden, identify causal factors, and develop appropriate and sustainable prevention and treatment strategies in each jurisdiction of Micronesia. There is a need for robust cancer registries because accurate ascertainment of cancer rates is necessary to properly guide cancer control[29]. Additionally, cancer awareness programs, cancer screening, and cancer treatment programs are needed in all the Micronesian jurisdictions. Such infrastructure development will require systematic capacity building. Leadership to develop necessary cancer policies, acquire financial resources, and develop health manpower is essential.

Cancer control public health measures should be instituted. These include:

1. Prevent smoking in youth, and expand smoking cessation efforts.
2. Promote healthy dietary and exercise practices, and prevent obesity.
3. Promote safe sexual practices.
4. Expand efforts to decrease the abuse of alcohol.
5. Improve cervical dysplasia screening and treatment. If cultural resistance to pelvic examination among women is a barrier to the expansion of cervical dysplasia screening, institute a campaign to increase its acceptance.
6. Develop a cancer information system, including cancer registries.
7. Develop a comprehensive cancer control program in each jurisdiction.

Finally, the social forces that contribute to cancer in Micronesia need to be addressed through effective awareness programs and policy development. The campaign against cancer in Micronesia will need to be part of a larger campaign for economic, social, and cultural renewal.

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