

Epidemiology of cancer in the Republic of Nauru

Abstract: Between November 1998 and December 1999, the Republic of Nauru was one of 8 Micronesian jurisdictions visited by trained medical record abstractors to review all available medical records in order to describe the epidemiology of cancer in Micronesia and to better understand the cancer data and control systems in each entity. There is likely incomplete ascertainment of cancer cases in the Republic of Nauru because of historical events, and the lack of a robust cancer registry and a systematic cancer surveillance system. A national comprehensive cancer control strategic plan and the implementation of that plan would facilitate greater prevention, treatment and control of cancer. The government of Nauru is working towards this end. *Key Words:* Medically underserved area, needs assessment, oncology services, Pacific Islanders, quality of health care, health services research

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Introduction

The Republic of Nauru is a limestone island located 41 kilometers south of the Equator at 0 32' South and 166 56' East where the indigenous Nauruan people have lived for an estimated 3,000 years. The Nauruans, ethnically Micronesian, are composed of 12 tribes. Nauru achieved independence in 1968, was admitted to the United Nations in 1999, and is presently the world's smallest republic, with a land mass of 21 square kilometers¹.

The island consists of a narrow coastal plain 100-300 meters wide, referred to as "Bottomside," which rises 30 meters off a limestone escarpment to a central plateau, referred to as "Topside." Rainfall is variable in Nauru and prolonged droughts are common², making access to safe drinking water a major health and environmental concern in Nauru³.

A German-British consortium aggressively mined Nauru's phosphate deposits since the 1900's, which has led to

environmental degradation. More than 70% of the once arable land has become barren and uninhabitable. Rapid changes to the environment, a high population growth rate, and drought have been associated with deforestation, soil erosion, loss of natural habitats, and a limited potable water supply³. There are health concerns attributed to the phosphate dust and cadmium generated from the many years of mining^{3,4}.

The 1995 Nauruan census described a population of 9,919 inhabitants⁵. The July 2003 population estimate was 12,570¹, composed of 58% Nauruans, 26% other Pacific Islanders, 8% Chinese, and 8% Europeans. In 2003, the gender ratio was 1.01 males to females^{1,5}. The mean age of the population was 19.6 years, infant mortality was 10.33 per 100,000 live births, and life expectancy was 62 years. Approximately 1.9% of the population was 65 years or older, and 38.9% was between the ages of 0 and 14 years¹.

Government-subsidized health care was 2.5% of the total government budget in 1991-1992 and 8.9% in 1995-1996. In 2002, the GDP (Gross Domestic Product) per capita in 2001 international dollars was \$14,083 with a total health expenditure per capita of \$1,015⁶. In comparison, the United States GDP per capita in 2001 international dollars was \$35,182, the total health expenditure per capita was \$4,887, and the total health expenditure as a percentage of GDP was 13.9%⁷.

Nauru is served by two hospitals, Nauru General Hospital (NGH) and Nauru Phosphate Corporation Hospital (NPCH). NGH is the national hospital, which serves largely Nauruan nationals. NPCH treats employees of the Nauru Phosphate Corporation. Complicated cases from NGH are referred overseas. Restricted sub-specialty medical treatment is usually obtained in Australia. Costs from the very high demand for overseas referrals for medical care far exceeded the annual \$2.5 million (Australian) budgeted for out-of-county, tertiary referrals⁸. The professional health staff is composed of nearly 95% expatriates on contract to the government^{9,10}.

Communicable diseases remain a threat to the people of the Republic of Nauru. The Ministry of Health is focusing its efforts on primary health care, particularly targeting acute

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respiratory infections, diarrheal diseases and the expanded program of immunization diseases⁹. With the increasing life expectancy of Nauruans^{9, 11}, chronic diseases are also a concern. The data on chronic diseases are difficult to access^{12, 13}. Changes in culture, such as the adoption of a more westernized diet and a more sedentary lifestyle, along with the environmental effects related to mining may also exacerbate the proliferation of chronic diseases¹⁴. In 1994, the five leading causes of mortality were cardiovascular disease/hypertension (236.85 per 100,000), respiratory infection/pneumonia (198.11 per 100,000), malignant neoplasms (169.81 per 100,000), stillbirths (122.64 per 100,000), and end-stage diabetic renal failure (103.77 per 100,000)⁹. Little detail is available on the cancer deaths. A report filed with the World Health Organization from the Director of Medical Services in 1996 listed 18 deaths from cancer in 1994; however, the report did not specify the primary sites or types of cancer¹³.

Little information is available on cancer in Nauru, therefore authors collected data from primary sources to better understand: 1) the existing cancer data and epidemiology of cancer in the Republic of Nauru, 2) Nauru's cancer data system, and 3) Nauru's cancer control network. This study was conducted in March 1999 and funded by the Nuclear Claims Tribunal in the Republic of the Marshall Islands with the cooperation of the Republic of Nauru Department of Health.

Methods

For this project, we reviewed a variety of records, including death records, hospital medical records, pathology reports, and logbooks. For cases of cancer, available data were abstracted. Specifically, we gathered data on demographics (place of residence, date of birth, age, sex, occupation, country of birth, race), psychosocial behaviors (smoking, beetle nut chewing, alcohol use, kava use), cancer data (date of diagnosis, date of admission, interval between symptoms and treatment, histology, body site, stage of cancer, aim of treatment, type of treatment), mortality data (date, age and cause of death), and whether the case was referred to Australia.

Data were collected from the NGH and the NPCH in March 1999. In March 1999, computerized records of admissions and discharges were incomplete at both hospitals. Codes of the Ninth Revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-9) were not utilized by either hospital; therefore, it was not possible to link cancer cases to particular ICD-9 codes.

At NGH, pathology reports from January 1987 through

December 1998 were reviewed, and data from all specimens with a diagnosis of cancer were recorded. These included pathology reports from out-of-country medical sites and laboratories, primarily in Australia.

Prior to 1997, Pap smear reports were filed directly into patient's charts, and no log was kept. Out-of-country Pap smear reports from November 1997 through March 1999 were logged by an obstetrician in a Pap smear logbook. This logbook was reviewed for diagnosis of cervical intraepithelial neoplasia (CIN) I, CIN II, CIN III, atypical squamous cells of undetermined significance (ASCUS), and malignancies. These cases were cross-referenced with the NGH medical charts. If the CIN developed into *carcinoma in situ* or cancer, then these records were included in the database. Individual patient charts prior to 1997 were not pulled for review.

A NGH computerized database from 1994 through 1999 was reviewed for patients who were referred overseas for medical care. The database was found to be incomplete. The overseas referral database was reviewed for diagnoses of dysplasia, carcinoma, cancer, sarcoma, lymphoma, leukemia, myeloma, malignancy, neoplasm, and blastoma. The Ministry of Health's medical charts of cases referred overseas were then cross-referenced with the overseas referrals database for additional

cancer cases. Records for overseas referrals were only available from 1990 to March 1999. Records prior to 1990 were stored at the parliament buildings (Ministry of Health, Registrar), but the "bureaucracy was burned down, and all records were lost¹⁵" during a period of civil strife.

Existing death certificates at NGH from January 1985 to October 1986, and November 1987 through March 1999 were collected and reviewed for diagnoses of cancer. Death certificates from January 1986 to March 1999 at the Office of the Registrar of Births, Deaths, & Marriages were also reviewed. Available charts at NGH of deceased cancer patients also were retrieved and reviewed for cancer-related information.

The NPCH is an acute care hospital for employees of the Nauru Phosphate Corporation, and approximately 60% of the patients at the time of this review were foreign contract workers. Foreigners with complicated medical problems, such as cancer, were usually repatriated to his/her home country for further medical management. Complicated cases at NPCH who were Nauruan citizens were referred to NGH for further management. Until 1992, Pap smear reports performed on Nauruans were sent to the NGH, although foreigners' reports were kept at NPCH. After 1992, Nauruan patients who needed Pap smears were referred to NGH. At NPCH, death certificates and hospital

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Table 1. Description of cancer patient population in Nauru

Characteristic	% of population
Sex (n=124)	
Male	37.1
Female	62.9
10-year age groups (n=57)	
0-10	3.5
11-20	1.8
21-30	10.5
31-40	28.1
41-50	21.1
51-60	15.8
61-70	8.8
71-86	10.5
Time between symptoms and treatment (n=37)	
0-30 days	40.5
31-60 days	21.6
61-120 days	13.5
121-365 days	5.4
>1 year	18.9
Ethnicity (n=120)	
Chinese	0.8
Filipino	0.8
Nauruan	90.0
Mixed Nauruan	2.5
Other Pacific Islander	5.8

discharge summaries from January 1988 to January 1998 were available and reviewed for cases of malignancy.

Data were entered into a Microsoft Excel database, and duplicates were eliminated. Data on cancer cases were entered into a Microsoft Excel database and analyzed with SPSS 11.5 for Windows.

The measurements reported are annualized site-specific, period prevalence for existing cancer cases documented during the period of concern for Nauru. 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.

The period prevalence measurements were annualized by dividing by the number of years for which data were collected. This method was used because of the small numbers of cases in any single year and the necessary

Table 2. Unadjusted cancer Period Prevalence for Nauru (n=127)

Body site	Number cases	prev/yr/100,000
Total	n=127	
Cervix	29	55.0
Gastrointestinal	23	n/a
Lung	19	42.8
Uncertain benign or malignant	11	n/a
Unknown primary site	8	52.8
ENT	5	n/a
Lymph	4	n/a
Breast	4	15.4
Brain	4	n/a
Urinary tract	3	n/a
Liver	3	5.7
MSK	2	n/a
Oral	2	n/a
Skin	2	n/a
Uterus	2	n/a
Vagina	2	n/a
Prostate	1	2.9
Eye	1	n/a
Hematological	1	3.2

Note: Rates per 100,000 population, age adjusted to WHO world standard population, annualized

information needed to calculate incidence was not available. Period prevalence was deemed to be the best descriptive form for the data in this situation.

Results

Existing data and epidemiology

From the period of 1985 to 1999, there were 127 cases of cancer; 116 cases were treated at NGH, 8 cases were treated at NPCH, 2 cases were treated at both hospitals, and 1 case did not have documentation as to where that person was treated. Data were incomplete, e.g., age was available for only 57 of the 127 cases. Among the 120 cases who listed a race, the majority were Nauruans (Table 1). Most of the cancer cases occurred among females and, based on the subset that reported age, a peak in cancer cases was seen among people aged 31 to 40 years old. Among the 61 cases for which the basis of diagnosis was documented, 39.3% was by histology, 26.2% by cytology or hematology, 13.1% by radiology, 9.8% by clinical impression only, 9.8% by exploratory surgery, and 1.6% by history only. Two patients had 2 types of primary cancers, and the remainder had only one primary cancer site. Death certificate data were found for 67.7% of all the cancer cases although death was docu-

Table 3: Cancer cases in Nauru, stratified by age group

	Age group (years)							
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-84
Total cases	2	1	6	16	12	9	5	6
Body site								
Musculoskeletal	0	0	0	0	0	1	0	0
Breast	0	0	0	1	1	0	0	0
Cervix	0	1	4	10	4	2	2	0
Ear, Nose, Throat	0	0	0	1	0	0	0	0
Gastrointestinal	0	0	0	1	1	2	2	3
Lung	0	0	0	0	2	0	1	2
Lymph	1	0	0	1	1	0	0	0
Oral	0	0	0	0	0	1	0	0
Urinary tract	0	0	0	0	1	0	0	0
Uncertain benign or Malignant	1	0	1	1	0	3	0	0
Brain	0	0	1	0	1	0	0	0
Vagina	0	0	0	0	0	0	0	1

mented in some record for 75.2% of all cases.

Among the 124 cases with documentation of the primary site of cancer, the most common primary sites were: cervix (22.8%), gastrointestinal (18.1%), and lung (15%). For another 6.3%, the primary source was unknown. Among 78 female cases with information on primary site, the most common cancers also were: cervix (37.2%), gastrointestinal (17.9%), and lung (11.5%). Among 46 male cases with information on primary site, the most common cancers were: lung (21.7%), gastrointestinal (19.6%), ears/nose/throat (13%), and brain (6.5%).

Unadjusted period prevalence, the number of cases of a site specific cancer existing during the reference period (not adjusted to a standardized population), are listed in Table 2. Types of cancers stratified by age are presented for the entire population in Table 3. The low numbers of cases in a small population were deemed unstable and incomplete, therefore further statistical analysis was not performed.

Among the 88 cases that had a documented place of residence, the highest percentages were from Meneng (17.8%), Yaren (12.2%), Aiwo (8.9%), Anetan (8.9%), and Buada (8.9%); 22.2% were from the North, 43.3% were from the West, 31.1% were from the South, and 3.3% were from the East. With respect to other risk factors among all the cases of cancer, 10 cases (7.9%) had documented status of alcohol use, and 17 cases (13.4%) had documented status of tobacco use. At the time of data collection, kava and betel nut were not in common use among the Nauruans, and no use of these substances was documented in the medical charts of cancer patients. Of the 44 cases that had documentation of occupation, 30.4% were homemakers, 21.7% were phosphate workers, 21.7% were professional or government

related, and 26.1% were some other occupation.

Among the 48 biopsied specimens positive for malignancy, 61.2% were from the primary site of cancer, 8.2% were from a site of metastasis, and in 4.1% it was uncertain whether the specimen was from a primary or metastatic site. In 8.2% of the specimens it was not clear if the lesion was benign or malignant, and in 18.4% the specimens were simply labeled malignant. Of the 44 cases that had a histological assessment, 6.8% were moderately differentiated, 15.9% were poorly differentiated, 2.3% were undifferentiated or anaplastic, 75% did not have grade or differentiation determined, and there were none that was well differentiated. Among the 36 cases that had stage of disease documented, 13.9% had carcinoma in situ, 25% were localized, 38.9% had regional or lymph node involvement, and 22.2% had remote or diffuse metastasis.

More than one third (36.2%) of all cases were referred to Australia for further treatment. Among the 55 cases that listed a type of treatment, 9.1% had chemotherapy, 3.6% were only treated for tuberculosis, 10.9% had no treatment, 40% had surgery, 12.7% had radiotherapy, and 23.6% had a combination of surgery, chemotherapy, and/or radiotherapy. Of the 58 cases that had a documented age of death in years, 5.2% were 0 to 30 years old; 15.5% were 31 to 40 years old; 19% were 41 to 50 years old; 20.7% were 51 to 60 years old; 24.1% were 61 to 70 years old; and 15.5% were over 70 years old.

Cancer data systems

Because all medical records prior to 1990 were burned during civil strife, a retrospective study of cancer data from medical records was limited to a 9-year period, and solely

from death certificates from the reference period. There was no defined cancer registry functioning at the time of this review. Particular cancer data were gathered from non-linked medical record systems of two hospitals, national death certificates, a single Pap smear logbook, and overseas medical records. The computerized system and the medical record systems in both NGH and NPCH hospitals did not utilize ICD-9 codes. Each of the sources of cancer information had limitations and the fields under study were either not recorded or contradictory between sources.

In the hospital medical charts, many cases were missing basic demographic information and information on cancer risk factors, such as whether the person used tobacco or alcohol. For example, out of all 127 cases of cancer, 76.4% had a full birth date documented while 4.7% of the records only had a birth year documented. Basic information was missing from 18.9% of the records. Age information is often crucial when deciding when to initiate or end cancer screenings, as well as for statistical analysis of data.

Cancer control network

Records from the Health Statistics Office and Medical Records were instructive about the nature of the cancer control system in Nauru. A robust system for screening common cancers was not available. There were no programs in place for mammograms or regular colon cancer screenings. Assessing the extent of the screening and diagnostic capacity was limited because only 68 of 127 cancer cases had documentation as to how the cancer was diagnosed. Cervical cancer screening was being done and the Pap results were logged since 1997. Diagnostic modalities such as biopsies and CT scans were only available from referral facilities outside of Nauru. Palliative and definitive cancer treatment for Nauruans were usually done in Australia, and for expatriates, services were received in their native country. Notably, less than 5% of cancer cases in the study period that documented how the cancer was diagnosed relied on clinical impressions alone compared with 79% in Kiribati (see companion article in this issue).

Discussion

It was the conclusion of the authors that ascertainment of cancer cases was incomplete. It is of note that breast cancer was conspicuously absent as a cancer diagnosis. There were only 4 cases of breast cancer documented in the period under examination. Lack of patient access to levels of health care where a correct and timely diagnosis could be made is an issue being addressed by the Nauruan Government and Health Ministry.

Development of a systematic cancer registry and data collection system, with the use of standardized coding of diseases, would facilitate the generation of statistics on various indicators of health. A complete history and physi-

cal exam upon admission to the hospital are also important. All relevant information about the patient should be recorded in the chart so that future medical workers looking at the chart will be able to provide quality care more efficiently.

Although Nauru had one of the highest per capita incomes in the world at one time¹⁶, medical diagnostic tools and technology are limited in its local medical facilities. In addition, patients generally wanted to be referred overseas for complicated medical care⁸, such as cancer.

It appears that off-island treatment is obtained when the cases are identified. Perhaps the biggest hurdle is to develop the comprehensive cancer education, prevention, screening, and data systems to identify the existing cancers earlier and to deal effectively with preventable cancers. The types of cancer that were prevalent, such as, gastrointestinal, breast, cervical and lung, are often preventable cancers. Gastrointestinal, colorectal, breast and cervical cancers are also treatable in their early stages.

The purpose of this study was to better understand the cancer epidemiology and the comprehensive cancer control system in Nauru. The officials at the Ministry of Health and Family Planning are already working with this information in a descriptive and comparative fashion to advocate for the development of their cancer databases and cancer control efforts. Improvements in cancer education, screening, diagnosis, and treatment will require planning and resource allocation. Additionally, stakeholders, including political, administrative, health care providers, and community members will need to work together to insure a practical and sustainable system. A National Comprehensive Cancer Control Strategic Planning initiative would be a key initiative towards cancer control in Nauru. The Nauru Health services and government are working toward this end.

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Just because the taro is big,
doesn't mean that it is mature.

Yapese proverb