

An Assessment of Non-Communicable Diseases, Diabetes, and Related Risk Factors in the Republic of the Marshall Islands, Kwajalein Atoll, Ebeye Island: A Systems Perspective

Henry M. Ichiho MD, MPH; Johannes Seremai AS; Richard Trinidad MD; Irene Paul BA; Justina Langidrik MPH; and Nia Aitaoto MPH, MS

Abstract

Non-communicable diseases (NCD) have been declared a health emergency in the US-affiliated Pacific Islands (USAPI).¹ This assessment, funded by the National Institutes of Health, was conducted on Ebeye Island of Kwajalein Atoll, Republic of the Marshall Islands (RMI) to describe the burdens due to selected NCD (diabetes, heart disease, hypertension, stroke, chronic kidney disease); assess the system of service capacity and activities for service delivery, data collection, and reporting; and identify the key issues that need to be addressed. Findings reveal that the risk factors of poor diet, lack of physical activity, and lifestyle behaviors lead to overweight and obesity and subsequent NCD that impact the morbidity and mortality of the population. Population survey of the RMI show that 62.5% of the total population is overweight or obese with a dramatic increase from the 15-24 year old (10.6%) and the 25-64 year old (41.9%) age groups. The leading causes of death were septicemia, renal failure, pneumonia, cancer, and myocardial infarction. Other findings show gaps in the system of administrative, clinical, and support services to address these NCD. All health care in Ebeye is provided in one setting and there is collaboration, coordination, and communication among medical and health care providers. The Book of Protocols for the Kwajalein Atoll Health Care Bureau provides the guidelines, standards, and policy and procedures for the screening, diagnosis, and management of diabetes and other NCDs. Based on these findings, priority issues and problems to be addressed for the administrative, clinical, and data systems were identified.

Introduction

This paper presents findings from an assessment of the capacity of the administrative, clinical, support, and data systems to address the problems of non-communicable diseases (NCD) including diabetes and its risk factors in the Republic of the Marshall Islands, Ebeye Island conducted on November 1-5, 2011. When available, reports and data specific to Ebeye were used. However, several of the available reports, plans, and documents included data that encompassed the entire RMI. Data and information were obtained through review of existing plans, reports, and documents; interviews were conducted with selected key informants; issues and needs were identified and groups of administrators and clinicians were used to define the priorities. (See article in this issue: *Assessing the System of Services for Chronic Disease Prevention and Control in the US-affiliated Pacific Islands: Introduction and Methods*).² This work was funded by the National Institutes of Health, Institute on Minority Health and Health Disparities.

Geography of the Republic of the Marshall Islands and Ebeye Island

The Republic of Marshall Islands (RMI) is an island nation situated in the Central Pacific Ocean between 4 degrees and 14 degrees North latitude and 160 degrees and 173 degrees East longitude. The country lies in two parallel chains of 29 low-lying atolls and islands: the Eastern Ratak (Sunrise) and the Western

Ralik (Sunset) chains of atolls and islands. The total number of islands and islets is about 1,225. The total land area of the RMI is 70 square miles scattered over the country's Exclusive Economic Zone of over 750,000 square miles, which means that the total land area is less than 0.01% of this total surface area. The RMI is divided into 24 municipalities, and Majuro, Ebeye, Wotje and Jaluit are the major district centers. Majuro and Kwajalein are served by international airlines; Air Marshall Islands airline has numerous flights between the islands of Majuro, Kwajalein and the outer islands, 23 of which have airstrips.

Kwajalein is one of the world's largest coral atolls as measured by area of enclosed water. Comprising 97 islands and islets, it has a land area of 6.33 square miles, and surrounds one of the largest lagoons in the world, with an area of 839 square miles. Ebeye is the most populous island of Kwajalein Atoll as well as the center for Marshallese culture in the Ralik Chain of the archipelago. Settled on only 78 acres of land, Ebeye Island had an estimated population of more than 10,000 residents in 2006 making it one of the most densely populated places in the world. Ebeye also has a young population with over 50% of the residents estimated to be under the age of 18 years. Ebeye is challenged with crowded living conditions, an inadequate school system, and scarce clean water in contrast with the nearby Kwajalein Island three miles south of Ebeye--home to the United States Army Kwajalein Atoll (USAKA) Reagan Missile Test Site. With a population of only about 1,500 individuals living on an atoll 1.5 square miles (960 acres), those living on the army base enjoy a relatively affluent and luxurious (US government subsidized) lifestyle. The base employs 1,300 Marshallese workers, who are not allowed to reside on Kwajalein, and must travel daily by ferry or boat between Ebeye and Kwajalein islands to work in support of their families and dependents residing on Ebeye. Despite this, for many who reside on Ebeye, though crowded, this tightly-knit and very diverse community from all over the Marshall Islands is considered an urban melting pot.³⁻⁹

Population and Characteristics of the Population

The projected population for RMI in 2009 was estimated to be 54,065. In 1999 the population of the Marshall Islands was 50,848 persons. This number has more than doubled in 26 years from 24,135 persons according to the 1973 census. Based on the 1999 census, 23,682 (47%) residents live on Majuro Atoll and another 10,903 (21%) reside on Kwajalein Atoll, and the remaining 16,263 (32%) in the outer islands. Based on these data, 68% of the residents on Majuro Atoll and Kwajalein Atoll are considered to live in urban areas; and the remaining population

Age	Male	Female	Total	Percent
<5	882	870	1752	16.1
5-14	1547	1465	3012	27.6
15-24	1111	1137	2248	20.6
25-34	796	762	1558	14.3
35-44	583	563	1146	10.5
45-54	401	365	766	7.0
55-64	143	115	258	2.4
65-74	56	60	116	1.1
75-84	18	24	42	0.4
85+	3	2	5	0.0
Total	5540	5363	10903	100

Data source: Economic Policy, Planning and Statistics Office, Statistical Yearbook, 2002¹⁰

lives in rural areas. The population of the country is still young with 43% being under 14 years of age and 64.3% below 25 years of age. The data from the 1988 and 1999 censuses show the life expectancy of males has increased from 59.6 to 65.7 years and for females from 62.6 years to 69.4 years.¹⁰

Based on the 1999 census, the population of Kwajalein Atoll including Ebeye is 10,903 residents with a median age of 17.6 years. The population by age (Table 1), shows that 16.0% are young children less than 5 years of age; 27.6% are older children between 5 and 14 years of age; while 20.6% are adolescents and young adults ages 15 to 24 years. The working population (25-64 years) represents 34.2% of the total population and elderly residents 65 years and older comprise 1.5% of the population.

The RMI Economic Policy, Planning and Statistics Office (EPPSO) published the *Summary of Key Findings, RMI 2006 Community and Socio-Economic Survey, 2006*. The summary of findings showed that Ebeye's population saw a dramatic decrease in growth between 1988 and 1999 adding only 1,000 more people; nevertheless, despite the slowdown, the estimated population in 2006 was over 10,000 residents. The slowdown is most likely the result of crowded housing conditions and lack of space for new homes. Ebeye had the highest percentage of persons living in multiple unit households, many of which share common sanitation facilities. Ebeye residents had the highest median household income when compared to all the surveyed sites, \$17,321 and \$12,603, respectively. Food sources for Ebeye showed that when compared to the rest of the RMI, it had the lowest prevalence of crops and livestock grown on household premises with only 10% of Ebeye households relying on local sources of protein and 9% on local fruits and vegetables—Ebeye residents are the most dependent on imported food sources in all of the RMI.¹¹

The Marshallese are a matrilineal society where family ties and mutual reciprocity remain integral features of Marshallese culture despite modern influences. The extended family infrastructure is a common fixture and provides a foundation for the strong family ties that are seen in the area. With the

Cause of Death	2007	2008	2009	2007-2009	Rate ^a
Septicemia	7	5	5	17	52.0
Pneumonia	0	5	9	14	42.8
MI ^b	5	6	2	13	39.7
Renal failure	7	0	5	12	36.7
Cancer	0	6	0	6	18.3
CVA ^c	3	0	2	5	15.3
Prematurity	5	0	0	5	15.3
Heart disease	0	3	0	3	9.2
Diabetes related ^d	12	5	10	27	82.5
Other	5	13	16	34	103.9
Total	44	43	49	136	415.8

^aCrude mortality rate/100,000 population. ^bMI – Myocardial infarct. ^cCVA – Cerebrovascular accident. ^dDiabetes related – Contributing secondary and tertiary cause of death. Data source: Personal communication, G. Beio (November 2, 2010)

arrival of missionaries in the 1830s, organized religion has played a significant role in shaping the attitude and behavior of the people. Shifts to non-traditional occupations, the development of a cash-based economy, and the availability of imported modern western food have negatively impacted food habits among the residents of the Marshall Islands. The traditional, nutritionally rich diet consisting primarily of breadfruit, coconut, pandanus, taro, fish, chicken, and pork has been replaced by imported, canned, and processed food. Alcohol, smoking, and substance abuse are on the rise particularly among the young. The change in the way of life in the Marshall Islands that has led to changes in dietary and physical activity behavior, has led to an alarming increase in the prevalence of diabetes and the secondary complications associated with diabetes and other chronic diseases.

Morbidity and Mortality Data

Leading Causes of Death

Death certificate data were obtained from G. Beio, (November 2, 2010) Vital Statistician for Ebeye Hospital. Mortality data reveal that there were 44 total deaths in 2007, 43 deaths in 2008, and 49 deaths in 2009. Mortality data were aggregated for 2007-2009 and crude mortality rates per 100,000 population were calculated based on the 1990 census for Kwajalein of 10,903 residents. The overall crude mortality rate for 2007-2009 was 415.8/100,000 population. The leading causes of death (Table 2), based on the primary cause were septicemia (52.0), pneumonia (42.8), myocardial infarct (39.7), renal failure (36.7), cancer (18.3), and cerebrovascular accident (15.3). Diabetes-related deaths, listed as the secondary or tertiary contributing cause of death was (82.5). When the proportions of the deaths due to chronic diseases or related conditions (primary diagnosis of heart disease, MI, cancer, CVA, renal failure) are aggregated for each year, these conditions accounted for 34.1% of the deaths in 2007, 34.9% in 2008, 18.4% of the deaths in 2009 (data not shown).

Medical Referrals

Data on medical referrals were obtained in a conversation with B.R. Laik, Medical Referral Coordinator (November 3, 2010). Patients who were not able to receive the necessary medical care in Ebeye were referred to medical facilities in Honolulu or the Philippine Islands for care. In 2007, there were 11 referrals and in 2008, there were 18 medical referrals and the most common diagnoses included four patients with cancer, two patients with heart disease, and two patients with cleft-lip and palate. There were 14 referrals in 2009 for a variety of medical conditions including five patients with cancer, and one each for heart disease, tuberculosis, brain abscess, hydrocephaly, and kidney stone. There were no medical referrals for patients with diabetes for complications of diabetes or diabetes related complications.

Population-Based Surveillance Data NCD Risk Factors STEPS Report

The data for the RMI NCD Risk Factor STEPS survey were obtained during August to October 2002.¹² Because of the wide and complex distribution of the population within the nation, the survey population (3045 individuals 15-64 years of age) was stratified into urban and rural with further sub-stratification of the urban population into Majuro (50.9% of the survey population) and Ebeye (20.7%) and the rural population into outer islands (21.5%) and the nuclear exposed islands of Bikini, Enewetak, and Rongelap atolls (6.8%). The results are only available for the RMI as a whole (Table 3).

Data for health behaviors showed that 23.1% of the respondents reported current smoking and 19.8% reporting current alcohol use. Overall, 91.0% of the survey respondents reported consuming fewer than 5 servings of fruits and vegetables per day. For physical activity, the data show that 66.1% of the respondents had low physical activity with a higher proportion of women (70.3%) when compared to men (61.3%). The data also show that 11.5% of the respondents engaged in moderate-intensity physical activity, while 22.5% engaged in high-intensity physical activity (data not shown).

Overall, 62.5% of the survey population was overweight or obese, with the proportions increasing with age, and with a higher prevalence among females (65.4%) as compared to males (59.9%). The data among the obese population showed a four-fold increase in obesity among 25-34 year olds (41.9%) when compared to the 15-24 year olds (10.6%). Central obesity, measured as waist circumference, has been shown to correlate well with visceral fat and in association with a BMI greater than 25 in adults is a risk factor for NCDs. The data show that 35.4% of the population is centrally obese with a significantly higher proportion of females (54.2%) affected compared to males (18.4%) data not shown. Based on measurements on venous samples, the prevalence of diabetes among 15-64 year old adults in the RMI is 19.6% with a slightly higher proportion among women (20.5%) as compared to men (18.9%).

Five critical risk factors for NCD, including daily smoking, overweight or obese, raised blood pressure, consuming fewer than 5 servings of fruits and vegetables, and low level of physi-

Table 3. NCD Risk Factors by Gender, NCD Risk Factors STEPS Report, Republic of the Marshall Islands Residents Age 15-64, 2002

Risk Factor	% Total (n=3045)	% Male (n=1234)	% Female (n=1811)
Current smoker	23.1	39.5	6.0
Current alcohol use	19.8	33.5	4.5
Binge drinking (of current alcohol users)	65.7	67.1	55.0
Consume <5 servings	91.0	91.9	90.1
Low activity	66.1	61.3	70.3
Overweight (BMI 25-29.9)	30.9	33.3	28.3
Obese (BMI ≥30)	31.6	26.6	37.1
Overweight + Obese	62.5	59.9	65.4
Central obesity	35.4	18.4	54.2
Hypertension (≥140/90)	10.5	11.6	9.3
Elevated cholesterol (≥200mg/dl)	21.6	20.3	22.9
Low HDL (≤35mg/dl)	39.1	48.8	29.1
Elevated triglyceride (≥151mg/dl)	7.8	9.5	6.0
Elevated FBS (≥126 mg/dl)	19.3	18.6	20.1
Diabetes	19.6	18.9	20.5

Data source: WHO, NCD Risk Factors STEPS Report¹²

cal activity, were aggregated to examine the risk of NCD in the study population. Participants were divided into three groups: high (3-5 risk factors), moderate (1-2 risk factors) and low (no risk factors). Using this stratification, 60.2% of the study population was at high risk, 39.1% at moderate risk and only 0.7% at low risk for developing a chronic disease (Table 4). These population health findings indicate the risk for developing NCDs is very high among the residents of the RMI and every effort should be made to address these risk factors at the individual, community, and national levels.

RMI High Schools Youth Risk Behavior Survey

The results of the YRBS survey (Table 5), showed that between 2003 and 2007, the proportion of students who were overweight or obese decreased from 42.6% to 40.6%. When the data are disaggregated into overweight students and obese students, there is an overall decline in the proportion of overweight students between 2003 and 2007 (23.7% to 15.0%); whereas students who were obese steadily increased in the same period from 18.9% to 25.6%.¹³ The significance of these data is the possible implication that more of the students are gaining weight and becoming obese, rather than remaining in the overweight category. The data also show that almost one third of the students are trying to lose weight through exercise and food restriction. Paradoxically, fruit and green salad consumption at least 1 time in the past seven days decreased from 2003 to 2007.

Diabetes Specific and Related Data Patient Electronic Care System (PECS)

The Ebeye Diabetes Prevention and Control Program (DPCP) maintains the PECS diabetes registry as part of the Health

Disparities Collaborative. Data were obtained from J. Seremai, (November 2, 2010) the Ebeye Diabetes Prevention and Control Coordinator (Table 6). The summary report for FY 2010 shows that there are 446 patients in the PECS registry and of these patients, 292 (65.5%) are female and 154 (34.5%) are male. The age distribution of the patients show that 1.6% are between 15-29 years, 26.7% are 30-49 years, 58.3% are 50-64 years, and 15.0% are 65 years and over; additionally, over 99.1% are uninsured.

Data for 2010 showed that 325 patients (72.9%) had a BMI measurement and of those patients, 81.8% are overweight or obese: with 36.6% overweight (BMI of 25-29.9), and 45.2% obese (28.6% had BMI of 30-34.9, 12.3% had BMI of 35-39.9 and 4.3% had BMI \geq 40). The data also revealed that 74.4% of the patients had blood pressure measured and of those patients, 58.7% had elevated blood pressure measurements (\geq 130/80 mmHg). The data for services received during 2010 revealed that 17.0% set self-management goals, 16.1% received a dental examination, 13.5% received a retinal examination, and 9.4% received a foot examination. Testing data revealed that 36.8% of the patients in the registry had a HgBA_{1c} test performed during the year and of those tested, 5.5% were $<$ 7.0, 22.6% were between 7.0-7.9, 15.2% were between 8.0-8.9, 16.5% were between 9.0-9.9, and 40.2% were \geq 10.0.

The health profile of all 446 patients with diabetes in the registry shows that 37.4% of the patients had hypertension, 14.1% had dyslipidemia, 12.1% had retinopathy, 3.4% with neuropathy, and 2.0% with nephropathy. The data for specialty services show that 51.1% of the patients received diabetes education, 16.4% received nutrition education, and 1.1% received pneumonia vaccination.

Diabetes and Tuberculosis

M. Hauma, (November 3, 2010) TB Program Coordinator provided data on the status of patients with tuberculosis. In FY 2010, there were a total of 41 patients with active tuberculosis and 25 patients with latent tuberculosis infection (LTBI) registered in the Ebeye Public Health Tuberculosis Program. Of the patients with active tuberculosis, 13 (32%) were diagnosed with diabetes. Previously in Ebeye, there were six patients with multiple-drug-resistant tuberculosis (MDR-TB); of these patients, two were treated and are no longer infected, two patients died, and two patients moved from Ebeye. There continues to be at least 13 patients who are the contacts of the patients with MDR-TB who were assessed to have latent TB infection (LTBI) and are currently under prophylactic treatment.

Description of the Administrative System Legislation and Regulations

RMI has legislation that provides the Ministry of Health the overall authority to provide for the health, safety, and welfare of the residents of RMI and laws on tobacco control and food safety. These laws include:

Table 4. Combined Critical Risk Factors^a for NCD, Republic of the Marshall Islands Residents Age 15-64, 2002

Combined Risk	% Total (n=3045)	% Male (n=1234)	% Female (n=1811)
High Risk	60.2	62.1	58.4
Moderate Risk	39.1	37.1	41.0
No risk	0.7	0.8	0.6

^aRisk factors - daily smoking, overweight or obese, raised blood pressure, consuming fewer than 5 servings of fruits and vegetables, and low level of physical activity. Data source: WHO, NCD Risk Factors STEPS Report¹²

Table 5. Youth Risk Behavior Survey, High School Students, Republic of the Marshall Islands, 2003 and 2007

Weight and Weight Management	2003	2007
Overweight (BMI \geq 85% and $<$ 95%)	23.7	15.0
Obese (BMI \geq 95%)	18.9	25.6
Overweight + Obese	42.6	40.6
Trying to lose weight	34.8	37.1
Exercised to lose weight	60.8	61.3
Ate less food to lose weight	56.5	52.5
Dietary Behavior	2003	2007
Ate fruit 1+ times in past 7 days	80.7	77.0
Ate green salad 1+ times in past 7 days	65.4	59.9
Physical Activity	2003	2007
Attended PE 1+ days	57.9	55.9
Attended PE class daily	14.9	14.7
Watched TV 3+ hours per day	24.0	19.3
Played on team sports past 12 months	65.5	63.3

Data source: High School YRBS, Marshall Islands, 2003-2007¹³

(1) *Title 7 Public Health, Safety and Welfare, Chapter 1 Public Health and Sanitation* is an Act to provide for the health, safety and welfare of the people of the Republic through the establishment of health services, and control of sanitation, and related matters.

(2) *Title 7 Public Health, Safety, and Welfare, Chapter 17 Tobacco Control* to reduce tobacco use and its consequent harm by: (a) Protecting children and other nonsmokers from inducements to use tobacco; (b) protecting nonsmokers from exposure to tobacco smoke; (c) ensuring that the population is adequately informed about the risks of tobacco use and exposure to second hand tobacco smoke and about the benefits of quitting smoking; (d) promoting a climate where nonsmoking and the absence of tobacco promotion is the norm. (3) *Title 7 Public Health, Safety, and Welfare, Chapter 8 Prohibition of Smoking* to prohibit smoking in public premises and public vehicles. (4) *Public Law 2010-37, Food Safety Act 2010* authorizes the RMI government to provide for the health, safety and welfare of the people by prohibiting the importation, production, processing, handling, distribution, and domestic trade of unsafe, unwholesome and poor quality food.

Planning Documents

KUMIT (*Komaron Ukot Mour Ilo Tomak – You can change life based on belief*) is the RMI NCD/Nutrition Strategy for 2008-2013. KUMIT was based on the results of the 2002 NCD

Table 6. Diabetes Registry Summary Report – Patient Electronic Care System, Ebeye Island, 2010

Indicator		n	Percent
Gender (n=446)	Male	154	34.5
	Female	292	65.5
Age Group (n=444)	15-29	7	1.6
	30-49	119	26.7
	50-64	251	56.3
	65+	67	15.0
Insurance Status (n=443)	Uninsured	442	99.1
BMI (n=325)	<25	59	18.2
	25-29.9	119	36.6
	30-34.9	93	28.6
	35-39.9	40	12.3
	≥40	14	4.3
Blood Pressure (n=332)	<130/80	137	41.3
	≥130/80	195	58.7
HgbA _{1c} (n=164)	<7.0	9	5.5
	7.0-7.9	37	22.6
	8.0-8.9	25	15.2
	9.0-9.9	27	16.5
	≥10	66	40.2
Service (n=446)	Goal setting	76	17.0
	Dental Exam	72	16.1
	Eye Exam	60	13.5
	Foot Exam	42	9.4
	Diabetes Educ	228	51.1
	Nutrition Educ	73	15.4
	Pneumo Vac	5	1.1
Health Profile (n=446)	Hypertension	167	37.4
	Dyslipidemia	63	14.1
	Retinopathy	54	12.1
	Neuropathy	15	3.4
	Nephropathy	9	2.0

Data source: Personal communication, J. Seremai (November 2, 2010)

Risk Factors STEPwise survey that revealed significant risk factors that contributed to the increasing rates of morbidity and mortality due to chronic illnesses among RMI residents. The KUMIT will be used to guide the planning and implementation of policy, programs, services, and activities to address non-communicable diseases and nutrition issues in the RMI. The plan is based on the Ministry of Health’s theme that “health is a shared responsibility” and involves government agencies, community groups, and non-governmental organizations in the implementation of the activities.

The NCD/Nutrition planning framework of the KUMIT is built around six components: (1) NCD/Nutrition organization;

(2) Tobacco and betel nut control; (3) Alcohol control; (4) Physical activity; (5) Healthy eating; and (6) Monitoring, evaluation, and surveillance. Strategies and activities were developed to meet the 2012 national targets through the implementation of the plan. These targets include: (1) Reduce the prevalence of risk factors (tobacco smoking, physical inactivity, consumption of fruits and vegetables, and alcohol use) by 10%; (2) Reduce the prevalence of iron deficiency anemia by 10%; (3) Increase exclusive breastfeeding by 10%; (4) Reduce the prevalence of diabetes by 10%; (5) Reduce hospital admission rates attributable to NCD by 10%; (6) Reduce the rate of amputation by 50%; and (7) Reduce cardiovascular mortality by 10%.¹⁴

Policy and Procedure Manual

The Medical Director of the Division of Primary Health Care Services, has developed *The Book of Protocols for the Kwajalein Atoll Health Care Bureau (KAHCB)* (see *Description of Clinical Services* below) that provides policies and procedures, standards and guidelines for Out-Patient Services, one of the five main subdivisions of the KAHCB Division of Primary Health Care Services. The objectives of the Out-Patient Services are to: (1) Provide efficient, affordable, and high quality health care services in an outpatient setting, including both primary health and specialty services; (2) Assist the different public health programs in conducting their clinics; (3) Provide minor surgical services (ambulatory surgery); (4) Provide assistance to the DOH staff as a satellite clinic; and (5) Coordinate special activities of the Bureau such as the Canvasback Team medical missions, screening activities, and others.

The *Book of Protocols* establishes operational guidelines in the Out-Patient Services and includes all public health services. The Diabetes Program Protocol establishes the operational guidelines for the diabetes clinics; guidelines for annual referrals for eye clinic, foot clinic, dental clinic self-management goal setting sessions, diabetes education, exercise education, and depression screening; and standards for laboratory monitoring. The protocol also establishes the diagnostic criteria, metabolic goals, and treatment guidelines. There are also operational guidelines for the Diabetes Eye Clinic and the Diabetic Foot Clinic. (Described in *Description of the Clinical System* below).

Health Insurance

In the Marshall Islands, benefits under the Basic Health Plan include all health care provided at an approved Provider Facility. Outside of the Marshall Islands, benefits under the Basic Health Plan include health care approved by the National Medical Referral Committee and emergency care when traveling and provided within 30 days of departure. The Republic of the Marshall Islands, Ministry of Health, Supplemental Health Plan enables subscribing members to access approved medical facilities in Hawai‘i and obtain services such as routine doctor visits not covered under the Basic Health Plan. The Supplemental Health Plan is open to all residents of the Marshall Islands, Marshallese working as Foreign Mission employees and full-time students studying overseas. The Supplement Health Plan

pays for services according to the schedule of benefits (80% of approved services with 20% co-pay) up to an annual maximum of \$100,000 per person after an annual deduction of \$200. The monthly premium for a single resident is \$60, whereas the premium for a family up to five members is \$180, and \$240 for a family of 6-10 members.

Partnerships and Collaborations

The Ebeye Diabetes Prevention and Control Program has established two working partnerships with local community groups. One of the community partnerships is with the Ebeye Diabetes Task Force that promotes good nutrition and works with church groups. The other is with the Youth-to-Youth group that works with the youths in Ebeye to promote healthy eating and physical activities.

Research

A research project, *Marshallese Diabetic Health Improvement Pilot Project in Ebeye*, was published in the Californian Journal of Health Promotion, 2009. In this project, a diabetes education curriculum, focused on diet, exercise, medications, and insulin administration, was implemented with 17 Marshallese participants. Baseline and 6 months measurements were conducted and statistically significant improvements were seen in lowered blood pressure and weight loss. Minor improvement trends were observed in statin treatment, self-monitoring of blood glucose goals set, and nutritional counseling.¹⁵

Description of Clinical Services System

Medical and Health Professionals

In the Republic of the Marshall Islands, direct health care services are provided by three bureaus: The Bureau of Majuro Atoll Health Care Services (BMAHCS), the Bureau of Kwajalein Atoll Health Care Services (BKAHCS), and the Bureau of Outer Islands Health Care Services (BOIHCS). The health and medical care providers in these bureaus (Table 7), provide: (1) Clinical care services in the hospitals, health care centers, and as outreach activities; (2) Primary health care and preventive services in the hospital and in health care settings, schools, communities, and house-to-house outreach; (3) Health promotion and education activities and special projects with community groups; and (4) Data collection to monitor health indicators, health care provision, and assessment of the health care system.

Under the Bureau of Kwajalein Atoll Health Care Services (BKAHCS), there are two primary facilities – the Leroij Kitlang Kabua Memorial Hospital with 45 beds, and the Santo Health Center. There are no private clinics or providers in the community. Table 6 lists the medical and allied health personnel for each of the three bureaus.¹⁶

The Health Disparities Collaborative

The Diabetes Program Clinic in Ebeye is based on the Health Disparities Collaborative (HDC) model to provide services to patients with diabetes and its secondary complications. The HDC model includes the Care Model and the Improvement Model.

Position	BMAHCS ^a	BKAHCS ^b	BOIHCS ^c	Total
PHYSICIANS				
Family Practitioner	9	2	1	12
General Practitioner	0	0	1	1
Internist	1	1	0	2
Pediatrician	2	1	0	3
Ob-Gynecologist	2	2	0	4
Ophthalmologist	1	0	0	1
Psychiatrist	1	0	0	1
Orthopedic surgeon	1	1	0	2
General surgeon	1	2	0	3
Urologist	0	1	0	1
Radiologist	1	0	0	1
Pathologist	1	0	0	1
Anesthesiologist	1	2	0	3
SUBTOTAL	21	12	2	35
ALLIED HEALTH				
Medical Assistant	3	0	0	3
Health Assistant	5	0	56	61
Dentist	5	2	0	7
Graduate Nurse – PH	26	8	-	34
Graduate Nurse – Clinical	72	22	-	94
Practical Nurse – PH	12	10	-	22
Practical Nurse - Clinical	18	0	-	18
Nurse Aide – PH	4	0	-	4
Nurse Aide - Clinical	23	0	-	23
SUBTOTAL	168	42	56	243
GRAND TOTAL	189	54	58	278

^aBureau Majuro Atoll Health Care Services. ^bBureau Kwajalein Atoll Health Care Services. ^cBureau Outer Islands Health Care Services. Data source: "Kumiti Ejmuur" RMI Annual Report, FY 2009¹³

The Care Model assures that patients receive evidence-based care and that they actively participate in their own care. The Care Model has six components: (1) Self-management support that empowers and prepares patients to manage their health and health care; (2) Delivery system design to assure the delivery of effective, efficient clinical care and self-management support; (3) Decision support to promote clinical care that is consistent with scientific evidence and patient preferences; (4) A clinical information system to organize patient and population data to facilitate efficient and effective care; (5) A health care organization that creates a culture, organization, and mechanisms that promote safe, high quality care; and (6) Mobilize community resources to meet the needs of patients.

The Improvement Model, when used in conjunction with the Care Model, provides a process to improve the quality of care at an accelerated pace and is based on three fundamental questions: (1) What are we trying to accomplish? This question

is meant to establish an AIM STATEMENT for improvement that focuses the organization's effort; (2) How will we know that a change is an improvement? Data is needed to assess and understand the impact of changes designed to meet an AIM; (3) What changes can we make that will result in an improvement? The PDSA Cycle (PDSA stands for Plan, Do, Study, Act) is a trial and learning method to discover an effective and efficient way to change a process.

The HDC model uses the team approach of health professionals to provide comprehensive care to patients with diabetes. Other important factors in the care of the patients include the principles of self-management in combination with community resources to meet the needs of the patients. Team members report that this model provides comprehensive and effective care to improve the health of patients with diabetes and other NCDs.

Outreach and Prevention

The DPCPCoordinator in collaboration with the Health Educator provides outreach services on the prevention of diabetes and other NCDs. These services include community presentations and providing educational brochures and materials, school presentations and activities with students around nutrition and physical activity, and health fairs and other community events.

Screening and Diagnosis

Screening and diagnostic services are described in the Diabetes Program section of the *Book of Protocols for the Kwajalein Atoll Health Care Bureau* (KAHCB). The risk factors for screening include: obesity (BMI>25), hypertension, positive family history, and pregnant women with a strong family history of diabetes. Individuals presenting with risk factors for diabetes will be screened and referred to the clinic if they meet the criteria for diagnosis and the use of mass screening will not be part of the diabetes prevention and control program.

The Book of Protocols defines criteria for the diagnosis of diabetes to include: Blood sugar measurement of >126 mg/dl on two separate determinations, a random blood sugar measurement of >200 mg/dl and symptoms of diabetes mellitus, or a postprandial glucose (post 75g load) measurement of >200 mg/dl.

Treatment and Management

The *Book of Protocols for KAHCB* describes the treatment guidelines and the management goals and includes the following directives: (1) The patient should receive culturally effective education on lifestyle changes such as diet and exercise as an integral components of their diabetes management plan; (2) Staging and treatment guidelines to assist clinicians in the long term management of patients and the stages of diabetes are defined with specific recommendations for treatment and management of the diabetes; (3) Metformin (Glucophage) should be the initial drug of choice; (4) Description of other treatments that include: (a) Patients with vascular risk factors should receive aspirin therapy or anti-platelet aggregation therapy; (b)

Patients with hypertension should receive anti-hypertensive medication; (c) Patients with dyslipidemia should receive statin medication; (d) Patients should receive Flu vaccine annually and Pneumococcal vaccine when available; (e) Patients with cardiovascular complications should be managed based on the Cardiovascular Disease treatment protocol included in the Book of Protocols; (5) Patients with major complications should be admitted to the hospital for intensive work-up and follow-up management in a multi-disciplinary approach.

The Diabetes Eye Clinic

The *Book of Protocols for KAHCB* describes the Diabetes Eye Clinic operational guidelines, the procedures for examination of the eye and retina, and the treatment guidelines. The Diabetes Eye Clinic is operational at the same time as the Diabetes Program Clinic and patients seen in the diabetes clinic are referred to the eye clinic for examination and treatment. There are specific policies and procedures for the eye examination and treatment.

The Diabetic Foot Clinic

The *Book of Protocols for KAHCB* describes the Diabetic Foot Clinic operational guidelines, procedures for classifying diabetic foot based on the examination, and comprehensive treatment guidelines. The Diabetic Foot Clinic operates at the same time at the Diabetes Program Clinic and all patients seen at the clinic are referred for a comprehensive examination by the orthopedist or the general surgeon on the Health Disparities Collaborative Team.

Data on limb amputations were provided by J. Seremai, (November 3, 2010) by reviewing the surgical logbook. Table 8 reveals the number of patients with lower limb amputations or gangrene for 2003 to 2009. It is important to note that the total number of patients affected peaked in 2005 and since that time there has been a gradual decline in the number of patients with lower limb amputations while the number of patients with gangrene appears to remain the same. This may be an indication that the foot amputation prevention education and the Diabetic Foot Clinic are having a positive impact on the number of lower limb amputations. Since most of the measures to prevent lower limb amputations among diabetic patients are implemented in Ebeye, it would be important to identify the residence of the patients and stratify the data based on whether the patient lives on Ebeye or on an outer island of Kwajalein Atoll where these services are limited.

Procedure	2003	2004	2005	2006	2007	2008	2009
Major amputation	7	5	8	5	2	5	2
Partial Foot	4	7	7	3	4	3	7
Gangrene	3	3	3	2	4	3	2
Total	14	15	18	16	10	11	11

Data source: Personal communication, J. Seremai (November 3, 2010)

Description of the Support Services System Quality Assurance Program

There is an overall Quality Assurance (QA) Program conducted in all parts of the Ebeye health system including the hospital and public health programs. The survey for the public health section focuses on two standards: Staff exhibits professional conduct, and Service delivery is efficient and effective. Some examples of QA survey items specific for the Diabetes-NCD program include: (1) Preventive education has been planned and implemented in the community in the past 3 months; (2) All diabetic patients are screened for weight, BP, and FBS at each clinic visit; (3) All results for NCD clients are documented on a Clinic Appointment Card and the OPD Record; (4) The Diabetic Flip Chart and other prepared educational material is utilized during counseling; (5) There are copies of Diabetes and Hypertension Treatment Protocols available in clinic exam rooms; (6) Computer Registry is updated at the end of each day and Registry is accurate and up to date; and (7) Registry record shows that outreach attempts for clients were made in the past month.

Diabetes Health Education Materials

The Diabetes Prevention and Control Program is currently using culturally appropriate diabetes and other NCD educational materials and brochures in Ebeye. Examples of these materials include: How Do You Get Diabetes? (*Kwjela ke owi wawein?*) You Should Stop Eating Fatty Food (*Kwon kadiklok am mōñā mōñā ko rokuriij*), Youth - Health Guide (*Jodrikdrik Ran, Reitok Mōk*), Control Your Diabetes For Life (*Kejbarok Naninmej In Tonal Eo Ibbam Toon Wot Am Mour*), Small Steps Big Rewards, 10,000 Steps, You May Have Diabetes and Not Know It (Papa Ola Lokahi, Pacific Diabetes Education Program);¹⁷ Diabetes is Everyone's Business (SPC);^{18,19} and locally produced materials in the Marshallese language, You Can Control Your Diabetes: Health Passport from (Taiwan Health Center and the RMI Ministry of Health).²⁰

Pharmacy Services

The medications available for the control of diabetes include: Metformin, Glyburide, and insulin. Other medications commonly used by patients with diabetes with co-morbid conditions include: statin medications and anti-hypertensives (ACE inhibitors, Angiotensin II receptor blockers, beta-blocker, calcium channel blocker, and diuretics). There are no major problems reported by the pharmacy.

Laboratory Services

All of the basic laboratory tests are available for diagnosing and monitoring the treatment and management of patients with diabetes. These laboratory tests include: blood sugar, total cholesterol, HDL, LDL, triglycerides, and renal function tests. HgbA_{1c} and microalbuminuria determinations are done on a portable analyzer in the Diabetes Program Clinic. A major problem with the laboratory is that the ordering of supplies and reagents is cumbersome and complicated. At times there is a

2-3 month lag between ordering supplies and actually receiving them – and in the meantime, supplies and reagents have run out.

Description of the Data System

The Patient Electronic Care System (PECS) is a software program specifically aimed at supporting the adoption of the Care Model as the clinical information system for the Health Disparities Collaborative. The DPCP Coordinator has been entering data and maintaining the PECS registry. The PECS data system is able to generate the Diabetes Registry Summary Report that provides summary data including demographic data, clinic visit information, and test/data information. The Diabetes Registry Summary Report is generated quarterly and sent to the Medical Director, Dr. Richard Trinidad.

Although PECS is a useful registry for diabetes, the data system is limited in that additional indicators cannot be added to system because of the coding that is embedded into the software program. Other indicators that would be helpful to integrate into the system would be for data related to homebound patients who are unable to attend the clinics, data on patients with diabetes who are hospitalized, and mortality data on patients who are known to be diagnosed with diabetes. There are plans to migrate to a new data system – the Chronic Disease Electronic Management System (CDEMS), an Access-based software program that allows more flexibility for upgrades and to be able to import and export data files to other statistical software for statistical data analysis.

Conclusions: Prioritized Issues and Needs

Some of the highest rates of diabetes and other chronic diseases are experienced by Pacific Islanders. To begin to address this situation, the first step is to identify and describe the burden of chronic diseases and diabetes, describe the programs and agencies responsible for providing the health and medical care to patients, and assess the capacity of the administrative and clinical system of services to provide the infrastructure to address the problems. This report presents the issues and problems that need to be addressed to make a positive impact on the disparities in health caused by NCDs.

Mortality data show that the leading causes of death were septicemia, renal failure, pneumonia, cancer, and myocardial infarction. Findings from RMINCD-STEPS surveys reveal that low consumption of fruits and vegetables and lack of physical activity are prevalent. Overall, 62.5% of the population is overweight or obese starting with 34.5% of the 15-24 year olds and dramatically increasing to 74.2% of the 25-34 year olds. These data suggest that there is a trend of significant weight gain between the late adolescent years and early adulthood and identifies a prime intervention period to implement health campaigns aimed at preventing obesity. Data on the overall prevalence of diabetes for Ebeye are not available. However, the Ebeye DPCP registry in 2010 identified 446 patients diagnosed with diabetes and of these patients, 81.8% were overweight or obese, 58.7% were hypertensive, and 40.2% had a HgbA_{1c} ≥10.0.

Although chronic disease surveillance system data, local

Table 9. Administrative Issues Priority Ranking		
Priority Rank	Administrative Issue/Need	Average Score ^a
1	Need to develop an overall DPCP plan for Ebeye	20.4
2	Need to increase awareness of the KUMIT plan in Ebeye (include all Ministries and community)	23.4
3	Need a new computer and printer for the DPCP Program - converting to CDEMS data system	26.5
4	Need more community collaboration in addressing the issues of diabetes, nutrition, and physical activities	28.0
5	Need for training of staff on how to analyze and use data and information	29.6
6	Need to enforce current laws regarding smoking in public areas and vehicles	30.9
7	Need for more research on issues related to prevention and interventions of diabetes and its complications	34.0
8	Need to improve the medical records system for chronic care	34.4
9	Need for more resources for staffing and supplies	39.0

^aLower the average score, higher the priority

Table 10. Clinical Issues Priority Ranking		
Priority Rank	Clinical Issue/Need	Average Score ^a
1	Need for CONSISTENT supply of HgbA _{1c} test kits	21.9
2	Need for a copy machine to produce educational materials and posters	24.6
3	Need for CONSISTENT supply of reagents in the laboratory for testing	24.7
4	Need for more staff to conduct diabetes, nutrition, and physical activity outreach and prevention activities in the community	24.9
5	Need for more educational videos and CDs related to diabetes and NCD	26.1
6	Need for nutritionist/dietitian	30.6
7	Need for Certified Diabetes Educator	31.0
8	Need for an ophthalmologist	32.4

^aLower the average score, higher the priority

population survey data, vital statistics, and program data exist,²¹ there continues to be limited availability of these data and a paucity of published data. Often mortality, morbidity, and risk behavior data across the Pacific jurisdictions cannot be compared because of differences in defining the data elements, data collection methods, and timeliness of reporting.

The description of the system of services reveals that there is one major planning document – the RMI NCD/Nutrition Strategy for 2008-2013 (known as the KUMIT) which is based on the findings of the NCD-STEPs Survey. This document will guide the planning and implementation of policies, programs, services, and activities to address NCD and nutrition issues. An extensive policy and procedure manual, *The Book of Protocols for the Kwajalein Atoll Health Care Bureau*, provides the guidelines, standards, policy and procedures for the screening, diagnosis, treatment, and management of patients with diabetes and other NCDs. All health and medical care in Ebeye is provided within one setting, there is coordination, collaboration, and communication among the medical providers and the public health programs. The pharmacy does not report any problems, however, ordering of supplies for the laboratory is cumbersome and causes a lag time between ordering and receiving laboratory supplies.

Based on these findings and the rankings by the participants in the Administrative and the Clinic Groups, the top three

administrative priority needs identified included: (1) Need to develop an overall DPCP plan for Ebeye; (2) Need to increase awareness of the KUMIT plan in Ebeye (including all ministries and community); and (3) Need for equipment for the DPCP to convert to the Chronic Disease Electronic Management System (CDEMS) data system. The top four clinical priority needs identified included: (1) Need for consistent supply of Hgb A_{1c} test kits; (2) Need for a copy machine to produce educational materials and posters; (3) Need for consistent supply of reagents in the laboratory for testing; and (4) Need for more staff to conduct community outreach and prevention activities. Tables 9 and 10 list the priority ranking of the issues and needs.

Disclosure Statement

The authors report no conflict of interest.

Acknowledgements

Funded by the National Institute on Minority Health and Health Disparities (NIMHD) of the National Institutes of Health (NIH) (Grant 3R24MD001660). The content is solely the responsibility of the author and does not necessarily represent the official views of the NIMHD or the NIH. A special thank you to Justina Langidrik, Secretary of Health, Republic of the Marshall Islands and Irene Paul, Assistant Secretary, Bureau of Kwajalein Atoll Health Services for their administrative support; the key informants and the participants of the priority setting groups for their expertise; and the Ebeye Needs Assessment Team Johannes Seremai (Team Leader), Alusiana Abner, George Beio, Joe Bejang, Rose Bobo, Rose H Dribo, and Calvin Juda for their participation.

Authors' Affiliation:

- Pacific Chronic Disease Coalition, Atlanta, GA (HMI)
- Ebeye Public Health Center, Republic of the Marshall Islands Ministry of Health (JS, RT)
- Republic of the Marshall Islands Ministry of Health (JL, IP)
- College of Public Health, University of Iowa, Iowa City, IA (NA)

Correspondence to:

Henry M. Ichiho MD, MPH; c/o Augusta Rengiil, Executive Director, Pacific Chronic Disease Coalition; Ph: (680) 587-2010; Email: pcdc10@gmail.com

References

1. Pacific Islands Health Officers Association. Board Resolution #48-01: Declaring a Regional State of Health Emergency Due to the Epidemic of Non-Communicable Diseases in the United States-Affiliated Pacific Islands. May 24, 2010. http://www.palau-health.net/images/NCD_Declaration.pdf. Accessed October 31, 2012.
2. Ichiho H, Aitaoto N. Assessing the system of services for chronic diseases prevention and control in the US-affiliated Pacific Islands: Introduction and methods. *Hawaii J Med Public Health*. 2013;72(5 Suppl 1):5-9.
3. Embassy of the Republic of the Marshall Islands, Washington D.C. Geography Web site. <http://www.rmiembassyus.org/Geography.htm> Web site. Accessed October 5, 2010.
4. Embassy of the Republic of the Marshall Islands, Washington D.C. Culture Web site. <http://www.rmiembassyus.org/Culture.htm>. Accessed October 5, 2010.
5. Infoplease: Part of the Family Education Network. Marshall Islands Web site. <http://www.infoplease.com/ipa/A0107767.html>. Accessed September 20, 2010.
6. Marshall Islands Visitors Authority. Iokwe Web site. <http://www.visitmarshallislands.com>. Accessed September 5, 2010.
7. Kroon E, Ravi R, Gunawardane K, Briand K, Riklon S, Soe T, Diaz Balaoing GA. Cancer in the Republic of the Marshall Islands. *Pacific Health Dialog*. 2004;11(2):70-77.
8. Central Intelligence Agency. The World Factbook. Australia-Oceania: Marshall Islands Web site. <https://www.cia.gov/library/publications/the-world-factbook/geos/rm.html>. Accessed April 25, 2012.
9. U.S. Department of State. Background Notes: Marshall Islands Web site. <http://www.state.gov/r/pa/ei/bgn/26551.htm#>. Accessed March 15, 2012.
10. Economic Policy, Planning and Statistics Office. *Statistical Yearbook, 2002*. Majuro, Republic of the Marshall Islands: Economic Policy, Planning and Statistics Office; 2002.
11. Economic Policy, Planning and Statistics Office. *Summary of Key Findings, RMI 2006 Community and Socio-Economic Survey*. Majuro, Republic of the Marshall Islands: Economic Policy, Planning and Statistics Office; No date.
12. World Health Organization, Western Pacific Region and the Ministry of Health, Republic of the Marshall Islands. *NCD Risk Factors STEPS Report: Ministry of Health, Republic of the Marshall Islands, 2002*. Suva Fiji: World Health Organization; 2007.
13. Centers for Disease Control and Prevention (CDC). Youth Online: High School YRBS, Marshall Islands 2003-2007 Results Web site. <http://apps.nccd.cdc.gov/YouthOnline/App/Results.aspx>. Accessed March 12, 2011.
14. Ministry of Health. *KUMIT (Komaron Ukot Mour Ilo Tomak), Republic of the Marshall Islands Noncommunicable Disease (NCD)/Nutrition Strategy 2008-2012*. Majuro, Republic of the Marshall Islands: Ministry of Health; No date.
15. Ravi R, Trinidad R, Seremai J, Nasa J. Marshallese diabetic health improvement pilot project in Ebeye. *Californian Journal of Health Promotion*, 2009;7(Special Issue-Obesity Prevention):125-130.
16. Ministry of Health. "Kumiti Ejmuur" Annual Report, FY 2009. Majuro, Republic of the Marshall Islands: Ministry of Health; No date.
17. Papa Ola Lokahi, Pacific Diabetes Education Program Website. <http://www.pdep.org>. Accessed September 5, 2012.
18. Secretariat of the Pacific Community. Featured publications Web site. <http://www.spc.int/en/featured-publications.html>. Accessed September 5, 2012.
19. Secretariat of the Pacific Community. Healthy Pacific Lifestyles Web site. http://www.spc.int/hpl/index.php?option=com_docman&Itemid=5. Accessed September 5, 2012.
20. Taiwan Health Center in the Republic of the Marshall Islands, Taipei Hospital, Department of health, Ministry of Health, Republic of the Marshall Islands. *You can control your diabetes: Health passport*; No date.
21. Hosey G, Ichiho H, Satterfield D, Dankwa-Mullan I, Kuartei S, Rhee K, et al. Chronic disease surveillance systems within the US associated Pacific Island jurisdictions. *Preventing Chronic Disease* 2011; 8(4):A86. http://www.cdc.gov/pccd/issues/2011/jul/10_0148.htm.