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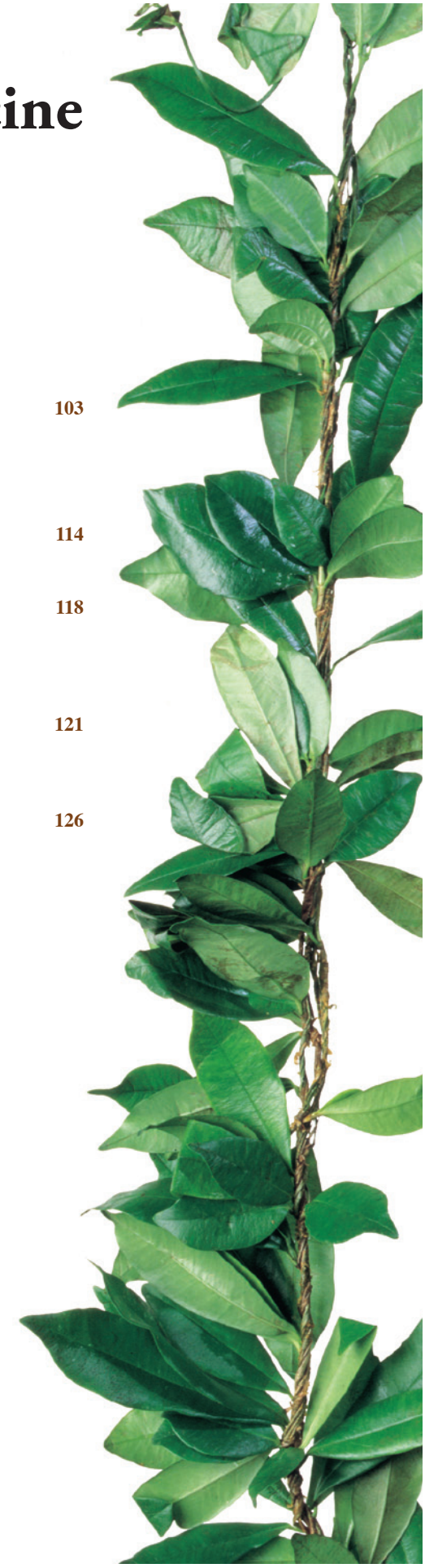

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D. Varez

Racial/Ethnic and County-level Disparity in Inpatient Utilization among Hawai'i Medicaid Population

Chathura Siriwardhana PhD; Eunjung Lim PhD; Lovedhi Aggarwal MD; James Davis PhD; Allen Hixon MD; and John J. Chen PhD

Abstract

We investigated racial/ethnic and county-level disparities in inpatient utilization for 15 clinical conditions among Hawaii's Medicaid population. The study was conducted using inpatient claims data from more than 200,000 Hawai'i Medicaid beneficiaries, reported in the year 2010. The analysis was performed by stratifying the Medicaid population into three age groups: children and adolescent group (1–20 years), adult group (21–64 years), and elderly group (65 years and above). Among the differences found, Asians had a low probability of inpatient admissions compared to Whites for many disease categories, while Native Hawaiian/Pacific Islanders had higher probabilities than Whites, across all age groups. Pediatric and adult groups from Hawai'i County (Big Island) had lower probabilities for inpatient admissions compared to Honolulu County (O'ahu) for most disease conditions, but higher probabilities were observed for several conditions in the elderly group. Notably, the elderly population residing on Kaua'i County (Kaua'i and Ni'ihau islands) had substantially increased odds of hospital admissions for several disease conditions, compared to Honolulu.

Keywords

Ethnicity, Medicaid, Multi-level CCS conditions, Race, Utilization

Abbreviations and Acronyms

CCS = Clinical Classification Software
CI = Confidence Intervals
ICD-9 = International Classification of Diseases 9th revision
NHPI = Native Hawaiian/Pacific Islanders

Introduction

The Medicaid Program plays an important role in providing health coverage to Americans including eligible low-income adults, children, pregnant women, elderly adults, and people with disabilities. In 2015, the program covered more than 70 million beneficiaries, with more than 9 million newly eligible individuals under the Medicaid expansion.[1] Although the program supports people with limited resources, disparities in access to health care among Medicaid beneficiaries still exist.[2] With an increasing role of individual states in regulating Medicaid expansion programs,[3] it is essential for state governments to examine how health services are utilized among their Medicaid beneficiaries. Identifying the patterns and sources of disparities would help state governments improve their Medicaid programs by targeting expenditures.

As for sources of health disparity, race/ethnicity has been widely investigated in health care access. Race/ethnicity is associated with socio-economic status, culture, and health literacy.[4-7] However, most health service studies conducted in the US population have mainly focused on several major racial/ethnic groups: Whites, African Americans or Latinos.[8,9] Asians and Native Hawaiian/Pacific Islanders (NHPI) have often been ignored or lumped into broad racial/ethnic groups. Only a few studies have addressed disparities in access to health services among these racial/ethnic groups.[10-13] Asians and NHPIs are the fastest growing racial/ethnic subpopulations in the US and projected to increase 143% and 101%, respectively, from their current sizes by 2060.[14] Assessing and comparing access to health services among these minority racial/ethnic groups can provide significant clinical and public health insights, especially for a state like Hawai'i, which has the largest population of these racial/ethnic groups (ie, in the state of Hawai'i: single-race White 24.7%, single-race Asian 38.6%, and single-race NHPI 10.0% versus US: 72.4%, 4.8%, and 0.2%, respectively).[15]

Rurality has also been explored as a source of disparity in health care access among Medicaid beneficiaries.[16-18] Most of the studies using Medicaid data have focused on the comparison between urban and rural areas among pediatric populations[19-22] or for specific diseases or conditions.[23-27] Utilization by different age groups or for general disease conditions has not been extensively studied. In the state of Hawai'i, to our knowledge, there have not been any studies addressing county-level disparities in health care utilization among the Medicaid population. Counties in Hawai'i are specified by a single or a cluster of islands. Because of the complex geographical diversity of this state, it is anticipated that, due to logistic reasons, health care disparities among different islands may exist, even among people who have the same Medicaid insurance coverage. On the other hand, previous studies/reports that described this gap on access to care among different geographical areas in Hawai'i physician shortage and geographical maldistribution of physicians.[28,29]

The purpose of this study was to examine racial/ethnic and county-level disparities in inpatient utilization for a set of 15 broad clinical conditions,[30] to understand the burden in Hawaii's Medicaid population, while accounting for age and gender effects. The study was conducted by stratifying the population into three main age groups to accommodate the utilization heterogeneity by stages of life. The identification of vulnerable subpopulations may help the state government and health care professionals scrutinize the specific barriers in access to health care in the state and develop integrated interventions or adjust health care policies specific to these disadvantaged racial/ethnic groups or regions.

Methods

Study Data

In this retrospective study, we utilized Hawai'i Medicaid health insurance claims inpatient data, reported from 01/01/2010 to 12/31/2010, to investigate relationships between patients' characteristics and the incidence of inpatient claims for a set of major disease types. The study was conducted using individuals who enrolled in Medicaid consistently from 01/01/2010 to 12/31/2010 or those who had a consistent enrolment from 01/01/2010 until death that occurred during the year. The final dataset included a set of unique 201,562 subjects. Since overall inpatient utilization patterns could vary by age group, we focused our study on three primary age categories: children and adolescents (1–20 years), adults (21–64 years), and the elderly (65 years and above). There were 108,553, 74,364, and 18,645 patients in each age category, respectively

Demographic information was extracted from the Medicaid Personal Summary File. These included race/ethnicity, residential zip code, age, and gender. Race/ethnicity was categorized as White, Asian, Hispanic, and Native Hawaiian/Pacific Islander (NHPI). Beneficiary's county was identified as Hawai'i, Honolulu, Kaua'i, and Maui counties based on his/her residential zip code. Each age group was further classified into smaller age subgroups: 1–5, 6–14, and 15–20 years for the pediatric group; 21–44 and 45–64 years for the adult group; and 65–74, 75–84, and 85 years or above for the elderly group. We utilized International Classification of Diseases 9th revision (ICD-9) codes to specify Multi-level Clinical Classification Software (CCS) Category and Diagnoses,[30] which results in 18 aggregated disease conditions: (i) infectious and parasitic diseases, (ii) neoplasms, (iii) endocrine, nutritional, and metabolic diseases and immunity disorders, (iv) diseases of the blood and blood-forming organs, (v) mental illness, (vi) diseases of the nervous system and sense organs, (vii) diseases of the circulatory system, (viii) diseases of the respiratory system, (ix) diseases of the digestive system, (x) diseases of the genitourinary system, (xi) complications of pregnancy, childbirth, and the puerperium, (xii) diseases of the skin and subcutaneous tissue, (xiii) diseases of the musculoskeletal system and connective tissue, (xiv) congenital anomalies, (xv) certain conditions originating in the perinatal period, (xvi) injury and poisoning, (xvii) symptoms, signs, and ill-defined conditions and factors influencing health status, and (xviii) residual codes, unclassified, all E codes. The above disease categorization has been frequently applied in health care research studies focused on overall diagnostic patterns.[31-36] We limited our current investigation to 15 conditions, removing three conditions related to pregnancy (xi), birth (xv), and unclassified cases (xviii). Inpatient utilization was defined as having one or more inpatient claims for a given disease condition at least one time during the 12-month study period, coded as a binary outcome (yes/no). The proposed study was approved by the University of Hawai'i Institutional Review Board (CHS #23362).

Statistical Analysis

The analysis was conducted for each of the 15 conditions, stratified by three different age groups: children and adolescents (ages 1–20 years), adults (21–64 years), the elderly (65 years and above). Frequencies were computed to summarize inpatient utilization for each disease condition. Multiple logistic regression models were used to determine the effects of race/ethnicity and county on inpatient utilization for each given condition, controlling for age and gender. Adjusted odds ratios and their 95% confidence intervals (CI) were estimated. The data analysis was conducted using R software version 3.2.0.

Results

Tables 1(A – C) provide frequencies of inpatient claims for 15 major disease categories stratified by the three age groups. Tables 2(A – C) summarize odds ratios and 95% CI estimated for the aforementioned claims with respect to the county of residence, gender, and race/ethnicity, stratified by the three broad age groups. Each table lists disease categories based on the observed overall counts (from high to low). In Table-1, the row named "Group Sizes" provides the size of the subgroup defined by each column. For a given Multi-level CCS Category the total observed count is provided in the column given by "Total". We did not report subgroup specific results for cells with fewer than 11 counts, and indicated those with NAs.

Age 1–20 Years

The top five disease categories of inpatient utilization for the children and adolescent group (n=108,553) were: (i) diseases of the respiratory system, (ii) infectious and parasitic diseases, (iii) endocrine, nutritional, and metabolic diseases and immunity disorders, (iv) diseases of the digestive system, and (v) diseases of the nervous system and sense organs, with 439 (0.40%), 396 (0.36%), 329 (0.30%), 271 (0.25%), and 263 (0.24%) cases, respectively (Table 1A). Compared to Honolulu, beneficiaries from Hawai'i County had significantly lower odds for 11 out of 15 diseases categories (Table 2A). Additionally, Maui County had lower odds for three conditions: diseases of the respiratory system; endocrine, nutritional, and metabolic diseases and immunity disorders; and diseases of the digestive system. No significant differences between Honolulu and Kaua'i counties were found. Compared to Whites, Asians had significantly lower odds for injury and poisoning and mental illness. NHPIs had significantly higher odds for seven categories compared to Whites, including diseases of the respiratory system; infectious and parasitic diseases; endocrine, nutritional, and metabolic diseases and immunity disorders. The odds ratio of infectious and parasitic diseases was greater than 2.0 for NHPIs compared to Whites. Males had significantly higher odds than females for five categories. Significant age-related differences were observed for 12 disease categories. Mental illness significantly increased with respect to increased age in this young group of patients.

Age 21–64 Years

The top five disease categories of inpatient utilization for the age group 22–64 years (n=74,364) were: (i) endocrine, nutritional, and metabolic immunity disorders, (ii) diseases of the circulatory system, (iii) mental illness, (iv) diseases of the respiratory system, and (v) diseases of the genitourinary system, with 2,177 (2.93%), 1,924 (2.59%), 1,651 (2.22%), 1,202 (1.62%), and 1,177 (1.58%) cases, respectively (Table 1B). Hawai'i County had significantly lower odds for 12 of the 15 disease conditions compared to Honolulu County (Table 2B). Maui County had significantly lower odds ratios for six disease categories, but higher odds rations for injury and poisoning. Kaua'i County had significantly lower odds ratios in three conditions: diseases of the circulatory system; diseases of the respiratory system conditions, and symptoms, signs, and ill-defined conditions, while higher odds ratios for diseases of the nervous system and sense organs. Among Asians and Hispanics groups, probabilities for mental illness and injury and poisoning were both lower than Whites. Additionally, the odds for six other disease groups were significantly lower among Asians compared to Whites. Compared with Whites, NHPIs had significantly lower odds for mental illness, but higher odds for seven other conditions. Out of the seven categories that showed significant gender differences, males had higher odds in five cases. Significantly increased odds ratios were also observed for increased age for all conditions, except for congenital anomalies.

Age 65 Years or Above

The top five disease categories for the age group 65 years or above (n=18,645) were: (i) diseases of the circulatory system, (ii) endocrine, nutritional, and metabolic diseases and immunity disorders, (iii) mental illness, (iv) diseases of the musculoskeletal system and connective tissue, and (v) diseases of the genitourinary system, with 2,607 (13.98%), 2,151 (11.54%), 1,534 (8.23%), 1,399 (7.50%), and 1,354 (7.26%) cases, respectively (Table 1C). Overall, individuals from Kaua'i County had significantly higher odds of having inpatient claims for nine out of 15 disease categories, compared to Honolulu County (Table 2C). Hawai'i County had three categories with significantly higher odds ratios, while Maui County showed lower odds for three disease conditions, compared with Honolulu. Asians had significantly lower odds compared to Whites for 11 conditions. On the other hand, NHPIs had higher odds in all six conditions that showed significant differences compared to Whites. Males had higher odds for diseases of the genitourinary system and diseases of the respiratory system, but lower odds for diseases of the musculoskeletal system and connective tissue, and injury and poisoning categories. Increased odds ratios were also observed for higher age subgroups, in 14 of the 15 conditions. As one may expect, the analysis showed increased rates of inpatient visit probabilities for elderly population compared to the other two age groups, in general.

Discussion

In this study, we investigated the inpatient utilization of 15 major aggregated clinical conditions in Hawaii's Medicaid population to assess health disparities among different counties and racial/ethnic groups in three age categories, adjusting for age (ie, pertaining to a given main age category) and gender. Based on Hawai'i Medicaid year 2010 inpatient claims data, more than 200,000 individual records were used to analyze the utilization pattern of inpatient health care for 15 multi-level CCS disease categories.

Across all age groups, Asians have a lower probability of being admitted to the hospital compared to Whites, while NHPIs tend to have a higher probability of inpatient admissions than Whites. Some other studies have also shown that Asian Americans are less likely to make inpatient and emergency visits, while NHPIs are more prone to making such visits, in comparison to Whites for conditions such as mental illnesses.[37] Evidence shows that communication with their care providers might be an issue among some Asian groups.[38] The high rate of inpatient visits among NHPIs could be due to the high prevalence of diabetes,[39] hyperglycemia,[40] heart-related disease,[41] drug addiction,[42] coupled with the severity of illness and the lack of utilization of the health system in general or preventive healthcare visits. This study indicates a higher incidence rate of inpatient admissions for this population even among the younger age group. Also of interest, we found that infectious and parasitic diseases were higher across all age groups among NHPIs. Further research should be conducted to confirm this finding. Rates for mental illness were higher among Whites. However, it is important to note that racial/ethnic groups such as Asians and Native Hawaiians are less likely to be assessed and counseled for mental illness.[43] Also, there is a shortage of mental health professionals taking Medicaid in the outpatient setting which may lead to more inpatient visits. The driving factor that makes disease of the respiratory system the top condition for inpatient hospitalization among patients 1-20 years could be due to asthma as Hawai'i is known to be one of the states with the highest childhood asthma prevalence in the US.[44] In addition, we found diseases of the respiratory system were higher among NHPIs across all ages. Similar observations were reported in a study based on data from the Hawai'i Behavioral Risk Factor Surveillance System.[45] Overall, inpatient visits were significantly increased for the elderly population, compared to other two age groups, as reflected by the overall percentages. Factors such as increased chronic comorbidities, high disability rates, lack of immunity, and other general weaknesses due to the aging may have contributed to this difference.

Health issues should be investigated in a geographically defined region to address etiologies and clinical implications specific to the region.[46] This concern is especially pertinent in Hawai'i where regions are geographically separated into islands. Local physician shortages and other access issues may cause variations in healthcare utilization among the islands.[28,29]

Table 1A. Summary of Hawai'i Medicaid beneficiaries of age 1 to 20 years (n=108,553) with inpatient claims for the 15 multilevel CCS disease conditions, during the year 2010.

	Total	County				Gender		Ethnicity				Age (years)		
		Hono-lulu	Hawai'i	Kaua'i	Maui	Female	Male	White	Asian	His-panic	NHPI	1–5	6–14	15–20
Group Sizes														
	108,553	67,791	22,366	6,078	12,318	52,966	55,587	19,014	32,619	7,793	47,503	35,941	49,281	23,331
Disease Condition														
Diseases of the respiratory system														
	439 (0.40)	316 (0.47)	55 (0.25)	26 (0.43)	42 (0.34)	193 (0.36)	246 (0.44)	59 (0.31)	88 (0.27)	25 (0.32)	258 (0.54)	228 (0.63)	106 (0.22)	105 (0.45)
Infectious and parasitic diseases														
	396 (0.36)	244 (0.36)	71 (0.32)	31 (0.51)	50 (0.41)	247 (0.47)	149 (0.27)	54 (0.28)	55 (0.17)	22 (0.28)	262 (0.55)	119 (0.33)	54 (0.11)	223 (0.96)
Endocrine, nutritional, and metabolic diseases and immunity disorders														
	329 (0.30)	243 (0.36)	44 (0.20)	14 (0.23)	28 (0.23)	154 (0.29)	175 (0.31)	45 (0.24)	68 (0.21)	17 (0.22)	193 (0.41)	154 (0.43)	92 (0.19)	83 (0.36)
Diseases of the digestive system														
	271 (0.25)	199 (0.29)	35 (0.16)	14 (0.23)	23 (0.19)	120 (0.23)	151 (0.27)	43 (0.23)	65 (0.2)	NA	148 (0.31)	118 (0.33)	84 (0.17)	69 (0.30)
Diseases of the nervous system and sense organs														
	263 (0.24)	183 (0.27)	39 (0.17)	16 (0.26)	25 (0.20)	107 (0.20)	156 (0.28)	40 (0.21)	58 (0.18)	NA	149 (0.31)	133 (0.37)	72 (0.15)	58 (0.25)
Symptoms, signs, and ill-defined conditions and factors influencing health status														
	224 (0.21)	152 (0.22)	33 (0.15)	19 (0.31)	20 (0.16)	115 (0.22)	109 (0.20)	28 (0.15)	34 (0.10)	14 (0.18)	145 (0.31)	112 (0.31)	45 (0.09)	67 (0.29)
Injury and poisoning														
	189 (0.17)	118 (0.17)	28 (0.13)	12 (0.20)	31 (0.25)	69 (0.13)	120 (0.22)	33 (0.17)	34 (0.10)	12 (0.15)	105 (0.22)	80 (0.22)	57 (0.12)	52 (0.22)
Diseases of the blood and blood-forming organs														
	168 (0.15)	123 (0.18)	25 (0.11)	NA	15 (0.12)	98 (0.19)	70 (0.13)	20 (0.11)	32 (0.10)	NA	108 (0.23)	65 (0.18)	32 (0.06)	71 (0.3)
Congenital anomalies														
	163 (0.15)	109 (0.16)	24 (0.11)	14 (0.23)	16 (0.13)	78 (0.15)	85 (0.15)	26 (0.14)	36 (0.11)	NA	96 (0.20)	75 (0.21)	46 (0.09)	42 (0.18)
Diseases of the skin and subcutaneous tissue														
	140 (0.13)	99 (0.15)	23 (0.10)	NA	NA	54 (0.10)	86 (0.15)	13 (0.07)	15 (0.05)	NA	106 (0.22)	71 (0.20)	39 (0.08)	30 (0.13)
Mental illness														
	140 (0.13)	95 (0.14)	23 (0.10)	NA	18 (0.15)	57 (0.11)	83 (0.15)	37 (0.19)	23 (0.07)	12 (0.15)	65 (0.14)	13 (0.04)	41 (0.08)	86 (0.37)
Diseases of the genitourinary system														
	138 (0.13)	103 (0.15)	16 (0.07)	NA	NA	91 (0.17)	47 (0.08)	16 (0.08)	25 (0.08)	NA	90 (0.19)	45 (0.13)	32 (0.06)	61 (0.26)
Diseases of the circulatory system														
	136 (0.13)	82 (0.12)	27 (0.12)	13 (0.21)	14 (0.11)	59 (0.11)	77 (0.14)	24 (0.13)	26 (0.08)	15 (0.19)	67 (0.14)	46 (0.13)	43 (0.09)	47 (0.20)
Diseases of the musculoskeletal system and connective tissue														
	63 (0.06)	41 (0.06)	13 (0.06)	NA	NA	27 (0.05)	36 (0.06)	11 (0.06)	NA	NA	37 (0.08)	NA	37 (0.08)	19 (0.08)
Neoplasms														
	38 (0.04)	25 (0.04)	NA	NA	NA	14 (0.03)	24 (0.04)	NA	NA	NA	27 (0.06)	NA	14 (0.03)	14 (0.06)

Table summarizes the observed number of beneficiaries with claims and percentages (ie, in parentheses). The row given by "Group Sizes" indicates the total number of Medicaid beneficiaries reported under each group. Note: "NA" indicates insufficient counts, reported fewer than 11.

Table 1B. Summary of Hawai'i Medicaid beneficiaries of age 21 to 64 years (n=74,364) with inpatient claims for the 15 multilevel CCS disease conditions during the year 2010.

	Total	County				Gender		Ethnicity				Age (years)	
		Hono-lulu	Hawai'i	Kaua'i	Maui	Female	Male	White	Asian	Hispanic	NHPI	21–44	45–64
Group Sizes													
	74,364	45,245	16,940	4,162	8,017	44,056	30,308	21,964	21,090	3,717	26,021	45,157	29,207
Disease Condition													
Endocrine, nutritional, and metabolic diseases and immunity disorders													
	2,177 (2.93)	1,484 (3.28)	362 (2.14)	123 (2.96)	208 (2.59)	1,152 (2.61)	1,025 (3.38)	566 (2.58)	522 (2.48)	83 (2.23)	959 (3.69)	692 (1.53)	1,485 (5.08)
Diseases of the circulatory system													
	1,924 (2.59)	1,281 (2.83)	343 (2.02)	89 (2.14)	211 (2.63)	953 (2.16)	971 (3.20)	515 (2.34)	498 (2.36)	75 (2.02)	797 (3.06)	493 (1.09)	1,431 (4.90)
Mental illness													
	1,651 (2.22)	1,089 (2.41)	316 (1.87)	93 (2.23)	153 (1.91)	887 (2.01)	764 (2.52)	605 (2.75)	410 (1.94)	64 (1.72)	523 (2.01)	656 (1.45)	995 (3.41)
Diseases of the respiratory system													
	1,202 (1.62)	835 (1.85)	202 (1.19)	53 (1.27)	112 (1.40)	701 (1.59)	501 (1.65)	346 (1.58)	272 (1.29)	52 (1.40)	506 (1.94)	417 (0.92)	785 (2.69)
Diseases of the genitourinary system													
	1,177 (1.58)	807 (1.78)	183 (1.08)	71 (1.71)	116 (1.45)	684 (1.55)	493 (1.63)	287 (1.31)	305 (1.45)	43 (1.16)	521 (2.00)	421 (0.93)	756 (2.59)
Diseases of the digestive system													
	1,069 (1.44)	696 (1.54)	186 (1.10)	66 (1.59)	121 (1.51)	574 (1.30)	495 (1.63)	330 (1.5)	266 (1.26)	51 (1.37)	392 (1.51)	380 (0.84)	689 (2.36)
Infectious and parasitic diseases													
	1,054 (1.42)	697 (1.54)	173 (1.02)	68 (1.63)	116 (1.45)	588 (1.33)	466 (1.54)	315 (1.43)	219 (1.04)	41 (1.10)	460 (1.77)	467 (1.03)	587 (2.01)
Diseases of the nervous system and sense organs													
	970 (1.30)	626 (1.38)	175 (1.03)	76 (1.83)	93 (1.16)	517 (1.17)	453 (1.49)	327 (1.49)	245 (1.16)	36 (0.97)	340 (1.31)	315 (0.70)	655 (2.24)
Diseases of the blood and blood-forming organs													
	852 (1.15)	591 (1.31)	155 (0.91)	40 (0.96)	66 (0.82)	545 (1.24)	307 (1.01)	218 (0.99)	209 (0.99)	40 (1.08)	366 (1.41)	407 (0.9)	445 (1.52)
Diseases of the musculoskeletal system and connective tissue													
	804 (1.08)	502 (1.11)	162 (0.96)	55 (1.32)	85 (1.06)	414 (0.94)	390 (1.29)	300 (1.37)	167 (0.79)	31 (0.83)	283 (1.09)	193 (0.43)	611 (2.09)
Symptoms, signs, and ill-defined conditions and factors influencing health status													
	735 (0.99)	516 (1.14)	139 (0.82)	34 (0.82)	46 (0.57)	406 (0.92)	329 (1.09)	233 (1.06)	177 (0.84)	38 (1.02)	270 (1.04)	264 (0.58)	471 (1.61)
Injury and poisoning													
	657 (0.88)	389 (0.86)	130 (0.77)	45 (1.08)	93 (1.16)	310 (0.70)	347 (1.14)	237 (1.08)	161 (0.76)	20 (0.54)	220 (0.85)	258 (0.57)	399 (1.37)
Diseases of the skin and subcutaneous tissue													
	535 (0.72)	372 (0.82)	103 (0.61)	26 (0.62)	34 (0.42)	217 (0.49)	318 (1.05)	164 (0.75)	78 (0.37)	23 (0.62)	261 (1.00)	159 (0.35)	376 (1.29)
Neoplasms													
	340 (0.46)	213 (0.47)	73 (0.43)	17 (0.41)	37 (0.46)	223 (0.51)	117 (0.39)	104 (0.47)	92 (0.44)	NA	127 (0.49)	87 (0.19)	253 (0.87)
Congenital anomalies													
	71 (0.10)	46 (0.10)	12 (0.07)	NA	NA	34 (0.08)	37 (0.12)	22 (0.10)	19 (0.09)	NA	27 (0.10)	38 (0.08)	33 (0.11)

Table summarizes the observed number of beneficiaries with claims and percentages (ie, in parentheses). The row given by "Group Sizes" indicates the total number of Medicaid beneficiaries reported under each group. Note: "NA" indicates insufficient counts, reported fewer than 11.

Table 1C. Summary of Hawai'i Medicaid beneficiaries of age 65 years and above (n=18,645) with inpatient claims for the 15 multilevel CCS disease conditions during the year 2010.

	Total	County				Gender		Ethnicity				Age (years)		
		Hono-lulu	Hawai'i	Kaua'i	Maui	Female	Male	White	Asian	His-panic	NHPI	65–74	75–84	85+
Group Sizes														
	18,645	13,561	2,715	904	1,465	12,463	6,182	3,445	12,442	324	2,280	8,069	6,540	4,036
Disease Condition														
Diseases of the circulatory system														
	2,607 (13.98)	1,827 (13.47)	407 (14.99)	181 (20.02)	192 (13.11)	1,771 (14.21)	836 (13.52)	478 (13.88)	1,681 (13.51)	43 (13.27)	395 (17.32)	730 (9.05)	821 (12.55)	1,056 (26.16)
Endocrine, nutritional, and metabolic diseases and immunity disorders														
	2,151 (11.54)	1,532 (11.30)	297 (10.94)	164 (18.14)	158 (10.78)	1,492 (11.97)	659 (10.66)	380 (11.03)	1,375 (11.05)	36 (11.11)	352 (15.44)	648 (8.03)	708 (10.83)	795 (19.70)
Mental illness														
	1534 (8.23)	1,030 (7.60)	231 (8.51)	152 (16.81)	121 (8.26)	1,058 (8.49)	476 (7.70)	339 (9.84)	989 (7.95)	19 (5.86)	180 (7.89)	322 (3.99)	418 (6.39)	794 (19.67)
Diseases of the musculoskeletal system and connective tissue														
	1,399 (7.50)	908 (6.70)	277 (10.20)	116 (12.83)	98 (6.69)	1,062 (8.52)	337 (5.45)	311 (9.03)	908 (7.30)	23 (7.10)	150 (6.58)	278 (3.45)	397 (6.07)	724 (17.94)
Diseases of the genitourinary system														
	1,354 (7.26)	965 (7.12)	186 (6.85)	101 (11.17)	102 (6.96)	847 (6.80)	507 (8.20)	241 (7.00)	852 (6.85)	23 (7.10)	234 (10.26)	398 (4.93)	427 (6.53)	529 (13.11)
Diseases of the digestive system														
	1,310 (7.03)	915 (6.75)	200 (7.37)	93 (10.29)	102 (6.96)	886 (7.11)	424 (6.86)	236 (6.85)	887 (7.13)	18 (5.56)	165 (7.24)	323 (4.00)	430 (6.57)	557 (13.80)
Diseases of the respiratory system														
	1,069 (5.73)	784 (5.78)	150 (5.52)	61 (6.75)	74 (5.05)	680 (5.46)	389 (6.29)	205 (5.95)	671 (5.39)	16 (4.94)	171 (7.50)	325 (4.03)	349 (5.34)	395 (9.79)
Symptoms, signs, and ill-defined conditions and factors influencing health status														
	1,000 (5.36)	739 (5.45)	161 (5.93)	54 (5.97)	46 (3.14)	671 (5.38)	329 (5.32)	189 (5.49)	668 (5.37)	19 (5.86)	118 (5.18)	235 (2.91)	316 (4.83)	449 (11.12)
Diseases of the nervous system and sense organs														
	952 (5.11)	630 (4.65)	162 (5.97)	78 (8.63)	82 (5.60)	642 (5.15)	310 (5.01)	193 (5.60)	619 (4.98)	15 (4.63)	121 (5.31)	254 (3.15)	277 (4.24)	421 (10.43)
Diseases of the blood and blood-forming organs														
	774 (4.15)	544 (4.01)	106 (3.90)	69 (7.63)	55 (3.75)	539 (4.32)	235 (3.80)	134 (3.89)	513 (4.12)	12 (3.70)	112 (4.91)	195 (2.42)	253 (3.87)	326 (8.08)
Injury and poisoning														
	686 (3.68)	448 (3.30)	132 (4.86)	55 (6.08)	51 (3.48)	508 (4.08)	178 (2.88)	140 (4.06)	451 (3.62)	NA	85 (3.73)	172 (2.13)	201 (3.07)	313 (7.76)
Infectious and parasitic diseases														
	552 (2.96)	419 (3.09)	75 (2.76)	30 (3.32)	28 (1.91)	370 (2.97)	182 (2.94)	94 (2.73)	349 (2.81)	NA	100 (4.39)	189 (2.34)	175 (2.68)	188 (4.66)
Diseases of the skin and subcutaneous tissue														
	332 (1.78)	240 (1.77)	47 (1.73)	26 (2.88)	19 (1.30)	214 (1.72)	118 (1.91)	82 (2.38)	191 (1.54)	NA	53 (2.32)	108 (1.34)	97 (1.48)	127 (3.15)
Neoplasms														
	307 (1.65)	226 (1.67)	36 (1.33)	15 (1.66)	30 (2.05)	192 (1.54)	115 (1.86)	69 (2.00)	193 (1.55)	NA	38 (1.67)	113 (1.40)	111 (1.70)	83 (2.06)
Congenital anomalies														
	28 (0.15)	24 (0.18)	NA	NA	NA	19 (0.15)	NA	NA	22 (0.18)	NA	NA	14 (0.17)	NA	NA

Table summarizes the observed number of beneficiaries with claims and percentages (ie, in parentheses). The row given by "Group Sizes" indicates the total number of Medicaid beneficiaries reported under each group. Note: "NA" indicates insufficient counts, reported fewer than 11.

Table 2A. Summary of odds ratios (and 95% CIs) of Hawai'i Medicaid beneficiaries of age 1 to 21 years inpatient claims for the 15 multilevel CCS disease conditions during the year 2010, with respect to county, gender, ethnicity, and age subgroup.

	County			Gender	Ethnicity			Age (years)	
	Hawai'i vs Honolulu	Kaua'i vs Honolulu	Maui vs Honolulu	Male vs Female	Asian vs White	Hispanic vs White	NHPI vs White	6–14 vs 1–5	15–20 vs 1–5
Disease Condition									
Diseases of the respiratory system									
	0.49 (0.36,0.66)	0.95 (0.63,1.42)	0.69 (0.50,0.97)	1.25 (1.03,1.51)	0.78 (0.56,1.10)	1.05 (0.65,1.69)	1.64 (1.22,2.19)	0.34 (0.27,0.42)	0.64 (0.50,0.81)
Infectious and parasitic diseases									
	0.61 (0.42,0.88)	1.53 (0.99,2.38)	1.09 (0.75,1.59)	0.71 (0.56,0.91)	0.66 (0.42,1.07)	1.16 (0.63,2.14)	2.05 (1.40,2.99)	0.31 (0.23,0.44)	1.21 (0.92,1.59)
Endocrine, nutritional, and metabolic diseases and immunity disorders									
	0.50 (0.36,0.70)	0.65 (0.38,1.12)	0.60 (0.40,0.90)	1.10 (0.88,1.37)	0.74 (0.50,1.09)	0.88 (0.5,1.56)	1.52 (1.09,2.12)	0.43 (0.33,0.56)	0.75 (0.57,0.99)
Diseases of the digestive system									
	0.51 (0.35,0.74)	0.78 (0.45,1.35)	0.62 (0.40,0.97)	1.21 (0.95,1.54)	0.75 (0.50,1.11)	NA	1.22 (0.87,1.73)	0.52 (0.39,0.69)	0.85 (0.62,1.15)
Diseases of the nervous system and sense organs									
	0.63 (0.44,0.91)	1.01 (0.61,1.70)	0.73 (0.47,1.13)	1.39 (1.08,1.79)	0.76 (0.50,1.16)	NA	1.39 (0.97,1.99)	0.38 (0.29,0.51)	0.59 (0.43,0.82)
Symptoms, signs, and ill-defined conditions and factors influencing health status									
	0.56 (0.37,0.85)	1.42 (0.87,2.33)	0.65 (0.39,1.08)	0.94 (0.71,1.23)	0.67 (0.39,1.14)	1.30 (0.67,2.55)	2.02 (1.31,3.12)	0.28 (0.20,0.41)	0.71 (0.51,1.00)
Injury and poisoning									
	0.65 (0.42,0.99)	1.11 (0.61,2.01)	1.37 (0.91,2.05)	1.64 (1.21,2.20)	0.57 (0.35,0.93)	0.90 (0.46,1.75)	1.25 (0.84,1.86)	0.53 (0.38,0.74)	1.00 (0.70,1.43)
Diseases of the blood and blood-forming organs									
	0.58 (0.37,0.91)	NA	0.70 (0.41,1.20)	0.68 (0.50,0.93)	0.80 (0.46,1.42)	NA	1.95 (1.21,3.17)	0.36 (0.24,0.56)	1.67 (1.19,2.34)
Congenital anomalies									
	0.54 (0.32,0.91)	1.40 (0.77,2.57)	0.76 (0.42,1.36)	1.09 (0.78,1.53)	0.80 (0.45,1.41)	NA	1.47 (0.91,2.40)	0.42 (0.29,0.61)	0.42 (0.25,0.68)
Diseases of the skin and subcutaneous tissue									
	0.64 (0.40,1.04)	NA	NA	1.50 (1.05,2.13)	0.57 (0.26,1.26)	NA	3.10 (1.70,5.68)	0.39 (0.26,0.58)	0.53 (0.33,0.85)
Mental illness									
	0.56 (0.35,0.90)	NA	0.93 (0.56,1.55)	1.46 (1.04,2.05)	0.30 (0.18,0.52)	0.89 (0.46,1.70)	0.66 (0.44,1.00)	2.36 (1.26,4.40)	10.68 (5.95,19.16)
Diseases of the genitourinary system									
	0.44 (0.25,0.75)	NA	NA	0.49 (0.34,0.70)	0.72 (0.38,1.38)	NA	1.97 (1.15,3.38)	0.53 (0.34,0.83)	1.94 (1.31,2.87)
Diseases of the circulatory system									
	0.87 (0.55,1.38)	1.78 (0.99,3.23)	0.80 (0.43,1.47)	1.23 (0.87,1.75)	0.61 (0.34,1.09)	1.58 (0.81,3.08)	1.10 (0.68,1.78)	0.66 (0.43,1.00)	1.39 (0.91,2.13)
Diseases of the musculoskeletal system and connective tissue									
	0.84 (0.43,1.61)	NA	NA	1.21 (0.73,2.01)	NA	NA	NA	NA	NA
Neoplasms									
	NA	NA	NA	1.68 (0.87,3.25)	NA	NA	NA	NA	NA

Note: "NA" indicates cases that odds ratios were not provided due to small counts fewer than 11.

Table 2B. Summary of odds ratios (and 95% CIs) of Hawai'i Medicaid beneficiaries of age 21 to 64 years within patient claims for the 15 multilevel CCS disease conditions during the year 2010, with respect to county, gender, ethnicity, and age subgroup.

	County			Gender	Ethnicity			Age (years)
	Hawai'i vs Honolulu	Kaua'i vs Honolulu	Maui vs Honolulu	Male vs Female	Asian vs White	Hispanic vs White	NHPI vs White	45–64 vs 21–44
Disease Condition								
Endocrine, nutritional, and metabolic diseases and immunity disorders								
	0.65 (0.58,0.74)	0.94 (0.78,1.14)	0.82 (0.70,0.95)	1.12 (1.03,1.22)	0.93 (0.82,1.06)	1.09 (0.86,1.38)	1.71 (1.54,1.91)	3.63 (3.31,3.99)
Diseases of the circulatory system								
	0.73 (0.65,0.83)	0.79 (0.64,0.99)	0.98 (0.85,1.15)	1.24 (1.13,1.36)	1.03 (0.90,1.17)	1.14 (0.89,1.46)	1.66 (1.48,1.87)	4.82 (4.34,5.36)
Mental illness								
	0.71 (0.62,0.81)	0.86 (0.70,1.07)	0.73 (0.61,0.87)	1.10 (1.00,1.22)	0.67 (0.58,0.76)	0.71 (0.55,0.93)	0.79 (0.70,0.89)	2.30 (2.07,2.54)
Diseases of the respiratory system								
	0.63 (0.53,0.73)	0.69 (0.52,0.91)	0.75 (0.61,0.92)	0.90 (0.80,1.01)	0.76 (0.64,0.89)	1.06 (0.79,1.43)	1.38 (1.20,1.59)	3.16 (2.79,3.57)
Diseases of the genitourinary system								
	0.63 (0.53,0.74)	1.02 (0.79,1.30)	0.86 (0.71,1.05)	0.92 (0.82,1.04)	1.06 (0.90,1.26)	1.08 (0.78,1.49)	1.75 (1.51,2.04)	3.05 (2.70,3.45)
Diseases of the digestive system								
	0.69 (0.59,0.82)	1.03 (0.80,1.33)	0.98 (0.80,1.19)	1.09 (0.96,1.23)	0.83 (0.70,0.99)	1.12 (0.83,1.51)	1.16 (1.00,1.35)	2.88 (2.53,3.27)
Infectious and parasitic diseases								
	0.63 (0.53,0.74)	1.04 (0.81,1.34)	0.91 (0.74,1.11)	1.06 (0.94,1.20)	0.69 (0.57,0.82)	0.87 (0.63,1.21)	1.33 (1.15,1.55)	2.04 (1.80,2.31)
Diseases of the nervous system and sense organs								
	0.72 (0.60,0.85)	1.30 (1.02,1.65)	0.81 (0.65,1.02)	1.09 (0.96,1.24)	0.78 (0.65,0.92)	0.81 (0.57,1.15)	1.03 (0.88,1.21)	3.25 (2.83,3.73)
Diseases of the blood and blood-forming organs								
	0.71 (0.59,0.85)	0.76 (0.55,1.04)	0.64 (0.50,0.83)	0.76 (0.66,0.88)	0.91 (0.74,1.10)	1.16 (0.83,1.64)	1.44 (1.21,1.71)	1.85 (1.61,2.12)
Diseases of the musculoskeletal system and connective tissue								
	0.79 (0.66,0.95)	1.13 (0.85,1.50)	0.89 (0.70,1.13)	1.10 (0.96,1.27)	0.60 (0.49,0.73)	0.81 (0.56,1.18)	1.00 (0.85,1.19)	4.96 (4.20,5.85)
Symptoms, signs, and ill-defined conditions and factors influencing health status								
	0.68 (0.56,0.83)	0.69 (0.49,0.99)	0.48 (0.35,0.65)	1.03 (0.88,1.19)	0.72 (0.59,0.88)	1.12 (0.80,1.59)	1.06 (0.89,1.27)	2.82 (2.42,3.29)
Injury and poisoning								
	0.84 (0.69,1.03)	1.21 (0.88,1.65)	1.29 (1.02,1.63)	1.44 (1.23,1.68)	0.76 (0.61,0.93)	0.60 (0.38,0.95)	0.93 (0.77,1.12)	2.27 (1.93,2.66)
Diseases of the skin and subcutaneous tissue								
	0.67 (0.53,0.83)	0.73 (0.49,1.09)	0.48 (0.34,0.69)	1.84 (1.54,2.19)	0.47 (0.35,0.62)	1.04 (0.67,1.62)	1.58 (1.30,1.94)	3.67 (3.04,4.44)
Neoplasms								
	0.96 (0.73,1.27)	0.91 (0.55,1.50)	1.04 (0.73,1.49)	0.62 (0.49,0.77)	0.97 (0.72,1.30)	NA	1.29 (0.99,1.68)	4.94 (3.85,6.33)
Congenital anomalies								
	0.68 (0.35,1.30)	NA	NA	1.54 (0.96,2.48)	0.88 (0.46,1.65)	NA	1.07 (0.60,1.91)	1.27 (0.79,2.04)

Note: "NA" indicates cases that odds ratios were not provided due to small counts fewer than 11.

Table 2C. Summary of odds ratios (and 95% CIs) of Hawai'i Medicaid beneficiaries of age 65 years and above with inpatient claims for the 15 multilevel CCS disease conditions during the year 2010, with respect to county, gender, ethnicity, and age subgroup.

	County			Gender	Ethnicity			Age (years)	
	Hawai'i vs Honolulu	Kaua'i vs Honolulu	Maui vs Honolulu	Male vs Female	Asian vs White	Hispanic vs White	NHPI vs White	75–84 vs 65–74	85+ vs 65–74
Disease Condition									
Diseases of the circulatory system									
	1.06 (0.94,1.20)	1.45 (1.22,1.73)	0.90 (0.76,1.06)	1.08 (0.98,1.18)	0.81 (0.72,0.91)	1.04 (0.74,1.47)	1.49 (1.28,1.73)	1.57 (1.41,1.75)	4.01 (3.59,4.47)
Endocrine, nutritional, and metabolic diseases and immunity disorders									
	0.91 (0.79,1.04)	1.59 (1.33,1.91)	0.89 (0.74,1.06)	0.98 (0.88,1.08)	0.84 (0.74,0.95)	1.09 (0.75,1.57)	1.61 (1.37,1.89)	1.50 (1.33,1.68)	3.11 (2.77,3.50)
Mental illness									
	1.00 (0.85,1.17)	2.17 (1.78,2.63)	0.96 (0.78,1.17)	1.09 (0.97,1.23)	0.61 (0.53,0.70)	0.65 (0.40,1.05)	0.94 (0.77,1.14)	1.82 (1.56,2.11)	6.66 (5.77,7.67)
Diseases of the musculoskeletal system and connective tissue									
	1.47 (1.27,1.72)	1.78 (1.44,2.20)	0.88 (0.70,1.10)	0.72 (0.63,0.82)	0.65 (0.56,0.75)	0.88 (0.56,1.38)	0.86 (0.70,1.06)	1.95 (1.66,2.29)	6.47 (5.57,7.52)
Diseases of the genitourinary system									
	0.88 (0.74,1.04)	1.49 (1.19,1.86)	0.91 (0.73,1.13)	1.39 (1.24,1.57)	0.82 (0.70,0.96)	1.11 (0.71,1.74)	1.70 (1.40,2.06)	1.49 (1.29,1.72)	3.45 (2.99,3.98)
Diseases of the digestive system									
	1.07 (0.90,1.26)	1.44 (1.15,1.81)	0.99 (0.80,1.23)	1.11 (0.98,1.25)	0.88 (0.75,1.03)	0.88 (0.53,1.44)	1.22 (0.98,1.50)	1.77 (1.52,2.05)	4.08 (3.52,4.73)
Diseases of the respiratory system									
	0.86 (0.71,1.04)	1.06 (0.81,1.39)	0.80 (0.62,1.02)	1.29 (1.13,1.47)	0.74 (0.63,0.88)	0.88 (0.52,1.48)	1.38 (1.11,1.71)	1.48 (1.26,1.73)	3.01 (2.57,3.53)
Symptoms, signs, and ill-defined conditions and factors influencing health status									
	1.01 (0.84,1.22)	0.97 (0.73,1.29)	0.51 (0.38,0.70)	1.14 (0.99,1.31)	0.76 (0.64,0.91)	1.17 (0.71,1.91)	1.05 (0.82,1.33)	1.80 (1.51,2.15)	4.61 (3.89,5.46)
Diseases of the nervous system and sense organs									
	1.22 (1.01,1.47)	1.73 (1.35,2.23)	1.13 (0.89,1.44)	1.11 (0.97,1.28)	0.79 (0.66,0.94)	0.91 (0.53,1.57)	1.11 (0.88,1.41)	1.46 (1.22,1.74)	3.88 (3.28,4.59)
Diseases of the blood and blood-forming organs									
	0.94 (0.75,1.17)	1.80 (1.38,2.34)	0.88 (0.66,1.18)	1.00 (0.85,1.17)	0.87 (0.71,1.07)	1.04 (0.57,1.91)	1.43 (1.10,1.85)	1.72 (1.42,2.08)	3.81 (3.16,4.61)
Injury and poisoning									
	1.43 (1.16,1.77)	1.68 (1.25,2.25)	0.98 (0.73,1.32)	0.79 (0.67,0.95)	0.80 (0.65,0.98)	NA	1.08 (0.82,1.43)	1.52 (1.24,1.88)	3.95 (3.24,4.81)
Infectious and parasitic diseases									
	0.84 (0.65,1.08)	0.99 (0.68,1.45)	0.58 (0.39,0.85)	1.07 (0.89,1.29)	0.86 (0.67,1.09)	NA	1.67 (1.25,2.24)	1.23 (0.99,1.52)	2.29 (1.85,2.84)
Diseases of the skin and subcutaneous tissue									
	0.79 (0.57,1.10)	1.41 (0.93,2.13)	0.61 (0.38,0.99)	1.23 (0.97,1.54)	0.52 (0.39,0.69)	NA	1.03 (0.72,1.47)	1.26 (0.95,1.67)	2.88 (2.19,3.77)
Neoplasms									
	0.71 (0.49,1.02)	0.93 (0.55,1.58)	1.13 (0.76,1.67)	1.26 (0.99,1.59)	0.68 (0.51,0.92)	NA	0.84 (0.56,1.25)	1.29 (0.99,1.69)	1.63 (1.21,2.19)
Congenital anomalies									
	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: "NA" indicates cases that odds ratios were not provided due to small counts fewer than 11.

Lower rates observed in Hawai'i County for children and adults among many diseases could be due to the shortage of specialty physicians in rural areas, the lack of other skilled healthcare staff, such as in surgery, or the absence of modern but expensive equipment needed for many surgical and nonsurgical procedures at rural hospitals.[47,48] The high rate of injury and poisoning among adults in Maui County may indicate accidents related to a higher level of ocean activities (eg, snorkeling, swimming, surfing, etc.) and outdoor activities (eg, hiking). For the elderly group, Kaua'i County had significantly increased probabilities for many disease conditions compared to Honolulu County which was very different from adults in other counties. Noticeably, hospitalization for mental illness was substantially higher among elders on Kaua'i County. More research is needed to identify the causes of these patterns.

In this article we provide a broad overview of racial/ethnic and county-level disparities in inpatient utilization among Hawaii's Medicaid population stratified by three age groups. We found various differences that are potentially important to public health policymakers, health care practitioners, and researchers. Further research can be conducted, focusing on specific diseases and for more defined age subgroups, for example, asthma among the pediatric population.

There are several limitations with this study. Similar to other studies based on claims data, there can be erroneous data entries influencing analyses and subsequent conclusions. Given that the data is driven from ICD-9 codes, and not ICD-10 codes, the specificity of codes might not be available. This study focused on one-year of inpatient claims. More comprehensive evaluations should be performed using multi-year data, including different sources of claims such as outpatient claims data. Our work does not describe conditions occurring during the first year of birth and complications related to pregnancy. Due to the ease of Medicaid enrollment for prenatal care, many uninsured women will enroll in the Medicaid program just for prenatal care and baby deliveries. Such coverage may only occur during part of a year and are systematically different than other types of medical conditions. This study did not look into variations in rate of hospitalizations within zip codes in Honolulu, Kaua'i, Maui, and Hawai'i Counties. The Asian ethnic category in the Medicare data file is an aggregated category for multiple Asian groups such as Chinese, Japanese, Filipino, Korean, etc. However, Hawai'i is known to be the state most diverse in terms of racial/ethnic differences and use of exact racial/ethnic information would allow for more detailed comparisons.[49] Considering the broad aspects of this study, we used a wide age categorization. However, further subdivisions can be considered for more detailed analyses. Discussion of the optimal age group stratification, either statistically or biologically, is beyond the scope of this study. Despite these limitations, our study provides insights on racial/ethnic and regional disparities in the use of inpatient care for major disease categories, adjusting for age and gender, among the Medicaid population in Hawai'i.

Conclusion

Significant variation of disease patterns and utilization across racial/ethnic groups and regions in Hawai'i highlights the complexity of managing programs for Medicaid beneficiaries. Findings from this study may help the state government and health care professionals better understand potential issues and barriers in access to health care the state and guide them in developing innovative strategies or adjusting current health care policies, by focusing on racial/ethnic groups and regions that require more attention.

Conflict of Interest

None of the authors identify a conflict of interest.

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Treatment of Prurigo Pigmentosa with Diet Modification: A Medical Case Study

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Abstract

Prurigo pigmentosa is a rare inflammatory dermatitis first described in 1971. While the etiology of Prurigo pigmentosa is yet unknown, conditions associated with ketosis often accompany this rash. Prurigo pigmentosa is successfully treated with antibiotics and by resolution of ketosis. However, there is no dietary treatment option to successfully treat the rash without sacrificing ketosis. We report two cases successfully treated with increase of dietary carbohydrate intake. The second case suggests that cessation of ketosis may not be necessary to resolve Prurigo pigmentosa.

Keywords

Ketogenic Diet, Prurigo Pigmentosa, Epilepsy

Introduction

Prurigo pigmentosa (PP) is considered a rare inflammatory dermatitis first described by Nagashima, et al, in 1971.[1] It typically occurs in Asian women of child-bearing age but has also been documented in individuals in other regions and ethnicities, as well as in men.[2-9] Certain systemic conditions, including adult–onset Still's disease,[10] atopy,[11] *H. pylori* infection,[12] and Sjögren's syndrome[13] have been associated with PP. It has also been strongly associated with conditions that commonly produce ketosis, such as restrictive dieting, fasting, and uncontrolled diabetes mellitus.[2,14-18] Nutrition–related PP has not been reported in the pre-pubescent population.[2] It is rarely reported in the United States, although this may be due to the unfamiliarity of practitioners with this condition.[7]

PP has been characterized into three stages based on appearance and pathology. Early-stage lesions present as pruritic urticarial plaques or papules that are characterized pathologically by superficial perivascular neutrophilic infiltrates. Fully developed PP lesions manifest as crusted erythematous papules, papulovesicles with histology showing spongiosis and necrotic keratinocytes. Late-stage lesions evolve into smooth-surfaced pigmented macules with histological features of lymphocytic infiltrate and melanophages in the papillary dermis.[2,14,19] The morphology of the lesions is diverse, therefore differential diagnoses includes contact dermatitis, urticaria, erythema multiforme, and medication-induced responses. PP is distinguished from other skin lesions by its unique reticular pattern, present in any of the three stages.[2] A similar dermatosis, confluent and reticulated papillomatosis, appears in characteristic regions of the trunk, back and neck, but it is rarely accompanied by the intense pruritis that is characteristic of PP.[2]

In cases presenting with ketosis, administration of insulin or carbohydrates to correct ketosis resolves PP,[15,20,21] but antibiotics such as minocycline, doxycycline, and dapsone have also been used with success.[7,22] The ketogenic diet (KD) is a very low carbohydrate, moderate protein and high fat diet designed to induce hepatic production of ketone bodies as an alternative fuel source.[23-26] Ketogenic diets metabolically mimic starvation and were developed for use in humans to treat epilepsy based on an ancient practice of fasting to reduce seizures.[27,28] In recent years, applications for the KD has expanded.[24,29-31] As such, there is an increase in the number of people who experiment with the KD diet, many of whom initiate the diet on their own without medical supervision. This is reflected in the increased number of internet searches,[32] websites, blogs, and books that have emerged on variations of the KD.[33,34] With the growing popularity of the KD, reports of PP have emerged. There is a dermatologic phenomenon popularly coined "keto-rash" in internet blogs and discussions, suggesting that it may be more common in adult patients (with higher representation in the Asian population) on the KD than what is currently represented in the literature. Many clinicians remain unaware of the association of the KD with PP, suggesting there is a need for further education and knowledge.

The following two case reports detail the presentation and onset of PP in two Asian adults on the KD.

Case Report #1

An otherwise healthy 43-year-old Chinese-American woman presented with the symptoms of PP approximately 3 weeks after self-initiating the KD for weight management. Food and dietary supplement history reflected a daily net carbohydrates of 20 gm a day, 105 gm of protein daily and an unrestricted amount of fat. Her diet consisted of eggs, sausages, coffee with cream and medium-chain triglycerides (MCT) for breakfast; avocado, turkey, beef, vegetables, eggs prepared in coconut or avocado oil for lunch and dinner; nuts (macadamia, almond, coconut), sugar free ice cream and small amounts of berries as snacks. She developed lesions that evolved into erythematous papules (Figure 1). The rash improved after one week but promptly recurred and continued in a relapsing-remitting pattern. The rash was exacerbated by exercise and long hot showers. She took oral diphenhydramine and loratadine and applied topical steroids, and eliminated possible allergens such as her shampoo and nuts. All of these interventions were unsuccessful. The rash spontaneously resolved following resumption of a higher carbohydrate diet (self-initiated) and has not recurred in the 12 months since she resumed higher carbohydrate diet.

Case Report #2

An 18 year-old Japanese man was started on a classic KD at a 2:1 fat to carbohydrate and protein ratio to treat intractable

seizures. Other medical diagnoses include Dandy-Walker malformation (a rare congenital malformation of the cerebellum and 4th ventricle[35]), cerebral palsy, and intellectual disability. He was on Clobazam and Lamotrigine to treat seizures prior to initiation of the diet, and these medications remain unchanged with KD initiation. The patient was admitted to the hospital for three days to initiate the KD. Nutrition assessment done prior to admission by the RDN reflected a well-nourished male without any signs or risk factors for malnutrition, and no contraindications to initiation of the diet. The KD consisted of a Ketocal® (Nutricia North America, Gaithersburg, MD[36]) smoothie in the morning; eggs, fish, beef, vegetables, avocado, avocado oil, sesame oil, heavy whipping cream, and butter for lunch and dinner choices. All of his meals were pre-calculated by the RDN. The patient's seizures ceased on day 2 of the diet while in the hospital, which coincided with moderate ketosis (evidenced by urine ketones at 80 mg/dL on day 2). He was discharged on day 3 of the diet in ketosis (urine ketones were 160 mg/dL, serum beta-hydroxybutyrate levels were 1.28 mmol/L). Approximately 9 days after diet initiation he developed a pruritic rash characteristic of PP (Figure 2). Specimens drawn included a complete blood count with differential, C-reactive protein, and a urinalysis. Lab results were unremarkable. The potential side effects of the standard antibiotic treatments were concerning, so the Ketogenic diet team discussed discontinuing the diet with the patient's mother. The mother stated that the seizure cessation on the KD was of greater value than the discomfort of the rash, so it was decided to continue the diet. By day 14 the rash had worsened, with increased redness around the lesions. Therefore meals were modified to decrease his diet ratio to 1:1. This increased his carbohydrate total allotment from 16 gm per day to 51 gm per day. Protein intake was increased from 70 gm per day to 95 gm per day. Fat intake decreased from 173 gm per day to 146 gm per day. Despite the decrease in his KD ratio, his urine ketones remained consistently at 160 mg/dL. On day 17 the KD ratio was decreased to 0.75:1 with the addition of apple juice to each meal. To achieve this ratio his carbohydrate allotment was increased to 90 gm per day. Protein remained consistent at 95 gm/d. This resulted in decreased urine ketones of 80 mg/dL, with an occasional decrease to 40 mg/dL, and resulted in a significant improvement in pruritus and erythema the following day. Dairy sources (Ketocal®, cream, butter) were not eliminated, although Ketocal® consumption decreased as a result of patient preference. Seizure freedom was maintained throughout this time. Medications remained unchanged. At his 3-month visit, the patient's mother reported only one very mild seizure since initiation of the KD. This was a significant improvement compared to his previous baseline seizure frequency of 10-20 seizures daily. The patient's rash has been in remission for the past 8 months.

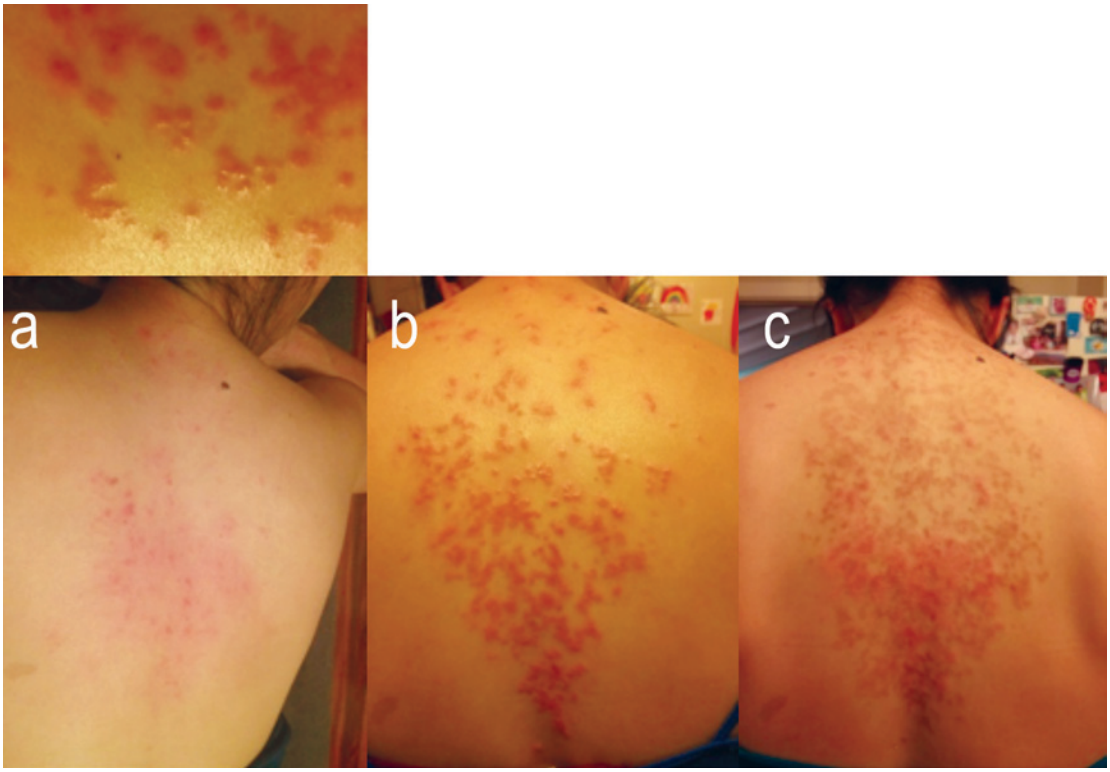

Figure 1. A 43-year old woman. Progression of prurigo pigmentosa lesions following initiation of a modified ketogenic diet.
(a) Day 22 on the KD. Erythematous papules and plaques characteristic of early lesions on the central portion of the back.
(b) Day 26 on the KD. Fully developed lesions with predominant papulovesicles distributed symmetrically in a V-shaped distribution over the upper and lower back.
(c Day 40 on the KD. Erythematous late stage lesions associated with reticular post-inflammatory hyperpigmentation in symmetrical pattern.

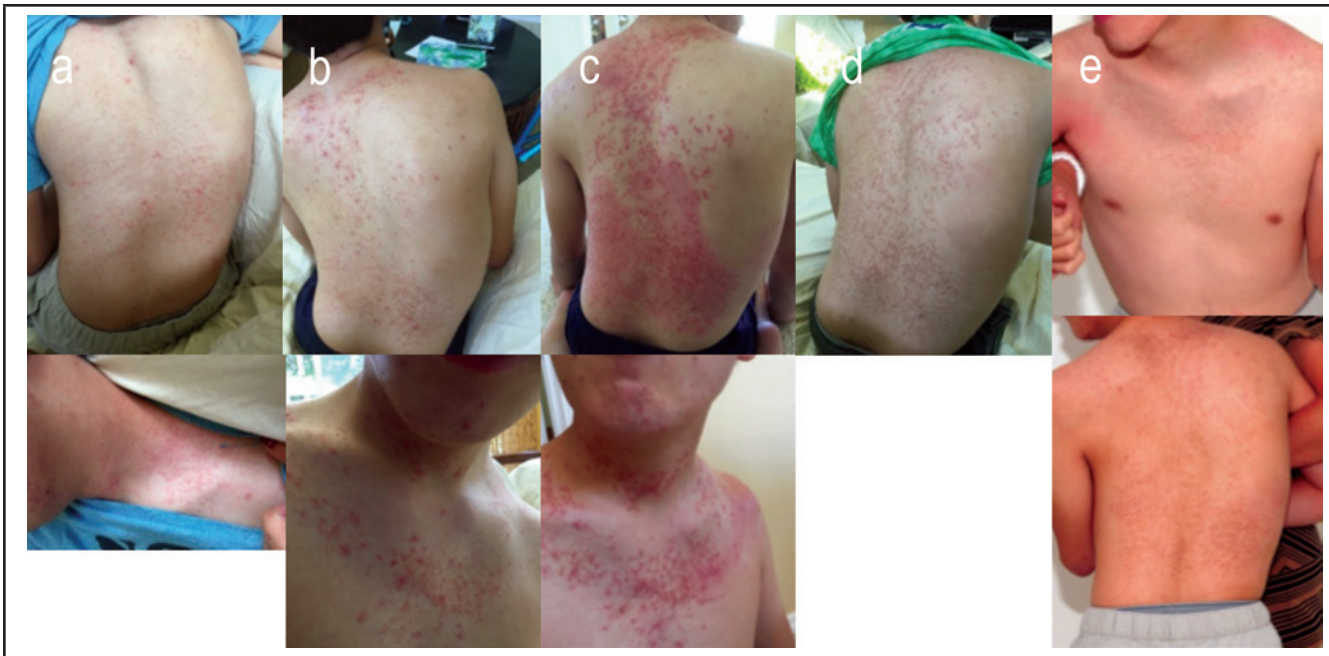

Figure 2. An 18-year old man. Progression of prurigo pigmentosa following initiation of a classic KD.
(a) Day 9 on KD @ 2:1. Eruption of erythematousd papules over the back and neck characteristic of early lesions.
(b) Day 12 on KD @ 2:1. Papulovesicle formation extending to the chest in reticular pattern.
(c) Day 14 on KD @ 2:1. Recurrent papulovesical lesions associated with post-inflammatory reticulated hyperpigmented lesions.
(d) Day 18 on KD 1 day after ratio decrease to 0.75:1. Resolving lesions, predominantly reticulated hyperpigmented macules.
(e) Day 20 on KD @ 0.75:1. Resolution of erythematous papules with remaining reticular hyperpigmentation.

Discussion

In both cases, the rash resolved with an increase in dietary carbohydrate intake. The etiology of PP is unknown[2,14]. A growing body of evidence demonstrates a connection between the gut microbiome and host immunity. Gut dysbiosis, as a result of nutritional and other environmental factors, may play a role in the pathogenesis of PP, and altering the profile of the gut microbiota through the use of antibiotics or diet would theoretically modify immune response. The effectiveness of dapsone and minocycline in treating PP speaks to this. To our knowledge, we are the first to demonstrate that complete resolution of ketosis may not be necessary to successfully treat the rash, which is of particular importance in cases where the KD is therapeutically valuable as a successful treatment modality for medical conditions. A systematic review of adverse effects of lamotrigine suggested rash was the most common adverse reaction and the most common reason for treatment discontinuation. Single maculopapular rashes are the most common type of rash reported. Rash was reported in 7.3% of the patients, and Stevens-Johnson syndrome was reported in 0.09 per 100 patients.[37] The Asian association is more commonly noted with carbamazepine. The potential underlying relationship between lamotrigine and the ketogenic diet is unknown.

Ketogenic diet centers across the US predominantly use the KD to treat intractable pediatric seizure disorders, which may help explain the uncommon incidence of PP. In addition, PP is more prevalent in Asian ethnicities, and less likely to surface in regions with smaller Asian demographics. However, as the KD is increasingly used for a number of disorders beyond pediatric epilepsy such as adult epilepsy, Alzheimer's Dementia,[38,39] Parkinson's disease,[40,41] brain and other cancers,[24] obesity,[42] Autism Spectrum Disorder,[43,44] and endurance athletics,[29,45] practitioners should be aware of the association of this dermatologic presentation with conditions that produce ketosis. Current treatment options include cessation of the KD or use of antibiotic therapy. RDNs who are trained in ketogenic therapies provide a level of expertise that may allow patients a third option for treatment of PP by helping to correctly identify the rash in its potential connection to the KD, and judiciously modifying the KD with carefully prescribed carbohydrate dosing in the diet without sacrificing ketogenesis.

Conflict of Interest

None of the authors identify a conflict of interest.

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Mala La‘au Lapa‘au – John A. Burn School of Medicine’s Hawaiian Healing Garden

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In 1993, the Medical School Hotline was founded by Satoru Izutsu PhD (former vice-dean UH JABSOM), it is a monthly column from the University of Hawai‘i John A. Burns School of Medicine and is edited by Kathleen Kihmm Connolly PhD; HJMPH Contributing Editor.

Within the campus of the University of Hawaii’s John A. Burns School of Medicine (UH-JABSOM) and the UH Cancer Center stands the vibrant *Mala La‘au Lapa‘au* (a garden of Hawaiian healing plants). The Mala La‘au Lapa‘au (Mala) is affectionately named *Ka‘ohinani*, meaning “gathering beauty” after the Nu‘uanu residence of the late *hulu kupuna* (beloved elder) and JABSOM Professor Emeritus, Dr. Kekuni Blaisdell. Ka‘ohinani is a living outdoor classroom providing opportunities for JABSOM faculty, staff, and students, community members, and visiting guests to gather in learning Hawaiian ancestral knowledge and practices of traditional healing and well-being. The medical school’s Department of Native Hawaiian Health (DNHH) served as the driving force establishing the Mala in 2005 and continues to take the lead as innovative *kahu* or stewards of the garden.

The University of Hawaii’s Commitment to a Hawaiian Sense of Place

Catalyzed by University of Hawai‘i (UH) Native Hawaiian Task Force Reports since the mid-1980’s, creating “a Hawaiian sense of place” is a directive stipulated in UH Systems, UH Manoa (UHM) and JABSOM strategic planning documents and policies.[1-9] For example, UHM’s 2002-2010 strategic plan contains the imperative to, “create a Hawaiian sense of place on campus through improved landscaping, architectural design, signage, and the creation of gathering spaces.” UHM’s 2010-2015 strategic plan re-articulates this same imperative adding, “and recommit to sustainability in facilities management and infrastructure development.” The UH Systems affirmed broader commitments in their 2015-2021 strategic plans, aspiring to be “the world’s foremost indigenous serving university” and imparting a Hawaiian sense of place on all campuses through the creation of pu‘uhonua (place of peace and inclusivity). Moreover, UH Board of Regents Policy 4.201 Sec. C, No. 7 provides that, “the (UH) president, working with the chancellors, ensures the unique commitment to Native Hawaiians is fulfilled by: encouraging Native Hawaiians to practice their language, culture, and other aspects of their traditional customary rights throughout all university campuses and providing Hawaiian environments and facilities for such activities.”

Similar language has been incorporated into JABSOM’s internal strategic planning documents, which assert, “The Hawaiian Sense of Place is a part of the essence of JABSOM” and “JABSOM embraces the concept of a Hawaiian-led place of learning.” JABSOM’s commitment to a Hawaiian sense of place is demonstrated through its leadership, administration, and faculty efforts to embrace Hawaiian values and practices. As a key leader in this endeavor, the DNHH has continued to provide guidance and direction towards meaningful implementation of these plans and policies.

A Hawaiian Sense of Place at JABSOM

When the original architectural plans were drawn up for what would become JABSOM’s new campus in *Ka‘akaukukui* (Kaka‘ako is a misnomer used for the Ka‘akaukukui area), architects consulted cultural practitioner and Kumu Hula, Frank Kawaikapuokalani Hewitt for guidance in incorporating aspects of Hawaiian culture. Elements of nature such as water, air, and earth as well as Hawaiian healing plants were incorporated into the campus design. Specifically, JABSOM chose four healing plants to be a part of its official logo: *kukui*, *popolo*, *‘awa,* and *‘ohi‘a lehua*. Kukui symbolizes enlightenment and specific parts were used medicinally to treat sores, childhood ailments and rebuild strength after an illness.[10,11] Popolo is known to be foundational in Hawaiian medicine with specific parts used to treat respiratory ailments, skin eruptions, eye infections, and sore throats.[11] ‘Awa serves an important role in ceremonies with specific parts, usually the root, chewed and or mixed with liquids. Medically ‘awa was used for the treatment of insomnia, muscle strains, kidney disorders, and headaches.[10] ‘Ohi‘a Lehua symbolizes regeneration as it is one of the first plants to appear after lava consumes and cleanses an area. Medically, ‘ohi‘a lehua flowers were combined with other medicinal plants to alleviate childbirth pains.[12] In addition to JABSOM’s plant logo, a band of traditional Native Hawaiian kapa designs encircles the third floor of campus buildings. Incorporated within this band is the depiction of the double helix of DNA, representing the importance of utilizing both modern and traditional ways of knowing when addressing health and wellness.

A committee formed on behalf of the former Office of Native Hawaiian Health (now known as the Department of Native Hawaiian Health) presented a culturally responsive and progressive proposal to the landscape architects. Committee members included the late Richard Paglinawan, noted cultural practitioner, the late Isabella Abbott, Professor Emeritus of botany at the University of Hawai'i at Manoa, and faculty members Drs. Benjamin Young, Martina Kamaka, and Nanette Judd. The group requested that all of the landscaping of the new campus represent a "Hawaiian sense of place." The group proposed native plantings that could withstand the harsh coastal environment surrounding the medical school. As part of the committee's proposal, the original smaller Hawaiian plant garden transformed into a larger garden dedicated to Native Hawaiian healing plants or la'au lapa'au (Mala La'au Lapa'au). Particular attention was paid to balancing the elements of the structural buildings with the elements in the garden. The influence of healing deities such as *Lono*, *Ku*, and *Hina* were particularly important when choosing the plants that were to be included.

After further negotiations, the landscaping plan was adapted to accommodate these requests. Native and Polynesian introduced trees and plants were to be planted throughout the central JABSOM campus and the Mala was established in the northwest corner of JABSOM's central courtyard. The outer campus landscape would have to retain the original design from the landowners, Hawai'i Community Development Authority.

Present Use of the Mala

The Mala is increasingly serving as an opportunity for educational activities, service learning, and special events. It is currently used by JABSOM as part of its medical student educational curricula. Teaching occurs throughout the academic year. Faculty and students can be found at various times, planting, harvesting, or making traditional medicine in the Mala. The Mala has also become important for ceremonial uses. Graduation, *Kihei* and 'awa ceremonies, memorial services, and formal welcomings have all been held within or adjacent to the Mala. In 2017, a special memorial event in the Mala celebrated the life of the late Judge James Burns and his many supportive contributions to JABSOM. In his honor, the Burns' immediate family concluded the event by planting a native lama tree, used in traditional healing and symbolically representing enlightenment.

The influence of the Mala can be seen in relationship to visitors of the campus. Indigenous faculty from the University of Manitoba were inspired to start their own "mala" after spending time in the JABSOM Mala. A guided tour of the Mala has also become a requested highlight during formal tours of the medical school. During student recruitment fairs and visits, hundreds of high school and middle school students have come to visit the Mala as part of their tours of the JABSOM campus; students learn about traditional healing methods and the historical basis of Hawaiian culture as related to healing. To increase awareness and expand knowledge of la'au lapa'au for all, The Native Hawaiian Center of Excellence (NHCOE) has published a mala directory that is currently used as a reference tool for teachers and students to identify and learn more about the garden's plants.[13]

As the main caretaker of the garden, the DNHH has a network of students and faculty who are invited to join monthly service days. This enables the department to control the access to the Mala as well as to restrict the use of chemicals and fertilizers on the healing plants. Concerned with Ka'akaukukui's historical use as a landfill site, DNHH sent plant and soil samples from the Mala to State of Hawai'i Department of Health Laboratory Emergency Response Program and University of Hawai'i Agricultural Diagnostic Service Center for toxicology testing in 2014. Results showed no detectable levels of mercury in plant samples and other heavy metal levels in soil samples did not exceed known safety thresholds.

Evolving & Proposed Future Expansion

In 2015, an ad hoc group of DNHH faculty, staff, and students was formed to further advance the Hawaiian sense of place policies at JABSOM. This group became known as Hui Ke Ao ʻOiwi (HKAO). Ke Ao ʻOiwi (creating culturally nurturing space to thrive) is one of four guiding principles used in the DNHH's strategic planning towards establishing a healthy and vibrant Native Hawaiian population. HKAO asserts the creation, maintenance, and enhancement of a Hawaiian sense of place at JABSOM supports greater recruitment, retention, and success for Native Hawaiian students, staff, faculty, and administrators. In early 2016, HKAO conducted a needs assessment survey about the Mala La'au Lapa'au with DNHH faculty, staff, and students. By April 2016, based on assessment findings, JABSOM's Dean Jerris Hedges signed a memorandum acknowledging DNHH's collaborative efforts with JABSOM and Cancer Research Center Facilities Management and Grounds to "expand Mala La'au Lapa'au planting and use sites within the internal landscape of the JABSOM campus." The memorandum outlined several key activities including:

- expanding garden planting areas
- increasing cultural and healing plant inventory —particularly *kalo* (taro) and '*awa* (kawa)
- creating a more prominent cultural *kipuka* (metaphorically, a place of calm and peace), or pu'uhonua, and central gathering place for Hawaiian and other indigenous students
- developing further a tribute to Hawaiian ancestral knowledge of health and healing

In accountability to assessment findings and the memorandum, HKAO was provided with DNHH funding from 2016-2017 to conceptualize the physical JABSOM interior campus courtyard as a 21st century Hawaiian place of learning for all. To reach this end, HKAO consulted architects, Native Hawaiian scholars, cultural practitioners, and businesses to inform the development of a landscape re-design plan emanating around a contemporary *halau* (an instructional meeting house) placed at the *piko* ("navel" or center) of the campus.

A design concept plan known as Halau Ola o Ka‘akaukukui was produced. The plan enhances the original Mala La‘au Lapa‘au by adding more learning stations, cultural plants, and appropriate gathering areas. Two adjacent lawns would be converted into separately themed health gardens related to traditional Hawaiian nutrition known as the Mala ‘Ai and present la‘au lapa‘au practices that appropriate non-native medicinal plants known as the Mala La‘au Kahiki. The contemporary halau would be structured circularly with thatching incorporated into the interior ceiling. At the structure’s zenith would be an oculus representing a physical piko or connection between *Wakea* (sky father) and *Papa* (earth mother). Artistic mediums depicting Hawaiian historical figures, *na mo‘olelo* (stories), and values related to health and healing will be embodied throughout the hālau. Examples include the story of Lonopuha – the origin of the art of healing in Hawai‘i, Matthew Puakahakoililanimanuia Makalua – first Native Hawaiian to become a western-trained physician, and the *Kumulipo*, a Hawaiian cosmogonic chant. Pa‘akai or salt, used in purification ceremonies, food, and medicine will be made in *kahekaheka* or artificial saltpans adjacent to the halau. Saltpans were once a natural and prolific feature along the original Ka‘akaukukui coastline (near to Ala Moana Boulevard). Connecting the Halau and Mala La‘au Lapa‘au is an elevated grass platform intended for ceremonies and performances.

In the fall of 2017, the design concept plan obtained support from DNHH Chair —Dr. Keawe‘aimoku Kaholokula, UHM Native Hawaiian Affairs Programs Officer—Dr. Kaiwipuni Lipe, the Association of Hawaiian Civic Clubs during their 58th annual convention, and JABSOM Dean Jerris Hedges. Moving forward, HKAO is now actively seeking funding and partnerships to make the design concept a reality. From this endeavor, DNHH hopes to build a legacy that honors our kupuna (elders) who have placed us in our roles to fulfill our kuleana (responsibility) to support seven-generations of healers into the future. Halau Ola o Ka‘akaukui is the next living iteration of the Mala La‘au Lapa‘au’s ability to “gather beauty” upon the foundations of our ancestors. To *ho‘i hou i ka piko* (return to the source) is to *ho‘i hou i ka mauli ola* (return to health and well-being). We hope many will join us on this transformative journey.

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Hyperuricemia and Gout in Hawai'i

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Insights in Public Health is a monthly solicited column from the public health community and is coordinated by HJMPH Contributing Editors Tetine L. Sentell PhD from the Office of Public Health Studies at the University of Hawai'i at Manoa and Donald Hayes MD, MPH from the Hawai'i Department of Health in collaboration with HJMPH Associate Editors Lance K. Ching PhD, MPH and Ranjani R. Starr MPH from the Hawai'i Department of Health.

Background

Acute gouty arthritis, or acute gout, is the most common inflammatory arthritis in the United States (US), with a lifetime prevalence of 39 per 1,000 individuals, or 8.3 million Americans, based on data from the 2007-2008 National Health and Nutrition Examination Survey (NHANES).[1] Hyperuricemia, elevated uric acid serum levels, is the well-established causal precursor in the development of gout, and may also lead to an array of chronic comorbidities.[2,3] In the 2007-2008 NHANES, over 43 million Americans had sex-specific hyperuricemia. The prevalence of gout and hyperuricemia in the US appears to be on the rise, with incidence cases of gout more than doubling between 1969 and 1996, and then doubling again between 1990 and 2010.[4-6]

Characteristics of acute gout include a sudden onset of joint pain, erythema (reddening of the skin), limited range of motion, and inflammation.[2] Acute gout most often affects the large toe, the insteps, ankles, heels, and other joints of the lower extremities.[2] Following a flare up, patients may experience an asymptomatic period that may last several months to several years.

Gout is clinically similar to rheumatoid arthritis with regards to the substantial societal and personal burden associated with long-term chronic pain and physical disability. However, while primary hospitalization rates for rheumatoid arthritis have steadily decreased, annual hospitalizations for gout in the US have doubled in the last ten years.[7] In addition to the sizeable growth in prevalence, increases in gout-related hospitalization may be a result of the intermittent and self-limiting nature of the disease, leading to inaccurate or under-diagnosis, and delaying the proper treatment of the underlying issue.[5,8] The impact of gout on patients' health-related quality of life leads to a considerable economic burden, with conservative estimates exceeding $6 billion a year in the US alone, or more than $3000 in additional annual cost of care for a patient with gout compared to one without.[9]

Gout disproportionately affects certain subgroups based on age, sex, and race/ethnicity, with those in the highest risk category often less likely to receive quality gout care.[10] For instance, individuals of Pacific Islander and Asian descent are at an increased risk of hyperuricemia and gout, which may be attributable to a genetic predisposition and historical change in dietary lifestyle.[11,12] These groups also have significant health disparities in access to high quality health care.[13]

Gout in Hawai'i

As individuals of Pacific Islander and Asian heritage contribute to the majority of Hawaii's population, this is likely an important topic for the state. Nearly every major ethnocultural group in Hawai'i is thought to have an increased risk of elevated serum uric acid levels, including Native Hawaiians, Filipinos, Micronesians, Japanese, and other Polynesian populations.[11,14,15] Data from the 2016 Hawai'i State Department of Health Behavioral Risk Factor Surveillance Survey (BRFSS) showed that 21.9% of the state's adult population, or over 200,000 individuals, have been told by a doctor that they have some form of rheumatic disease, including rheumatoid arthritis, gout, lupus, or fibromyalgia.[16] Native Hawaiians and Pacific Islanders were found to have a significantly higher prevalence of arthritis at a younger age, compared to White and Asian males in Hawai'i.[17] However, few researchers have examined gout using Hawai'i-based samples. Given the increasing national prevalence and significant impact on health-related quality of life, economic burden, and health disparities, understanding gout and hyperuricemia in Hawai'i is crucial in informing evidence-based health policies and practices. Thus, the aim of this article is to examine prior findings on gout in Hawai'i and discuss the existing gaps in the literature with specific relevance to Hawai'i.

Clinical Features of Gout

Gout is caused by the accumulation of monosodium urate (MSU) crystals within joints, and is associated with elevated uric acid in the blood, or hyperuricemia.[5] Unlike most animals, humans lack the enzyme uricase, which converts uric acid into a more soluble end-product, leading to higher levels of serum uric acid. Hyperuricemia may be attributable to either an overproduction of uric acid from purine metabolism, or an underexcretion of uric acid by the renal system. Most individuals who develop gout have issues with both overproduction and underexcretion, with underexcretion thought to be the more important contributor to the disease state.[2,18]

Clinical gout progresses through four phases: asymptomatic hyperuricemia, acute gouty arthritis, intercritical gout, and chronic tophaceous gout. The asymptomatic hyperuricemia phase is when serum urate levels are elevated, above 6.8 mg/dL, but gout symptomatology has yet to present.[2] While most individuals with asymptomatic hyperuricemia do not develop the disease, studies have found that patients with urate levels exceeding 9.0 mg/dL are six times more likely to progress into clinical gout.[19,20] Acute gouty arthritis, or acute gout, is characterized by the formation of needle-shaped MSU crystals on joints, which causes a sudden onset of pain, erythema, limited range of motion, and inflammation.[2] Following a flare up, patients enter the intercritical gout phase, an asymptomatic period that may last several months to several years. The final phase, chronic tophaceous gout, is when patients may no longer experience asymptomatic intercritical periods and begin to develop chalky deposits of MSU, called tophi, visible on radiographs.[21] In this phase, individuals often experience unremitting chronic pain.

Epidemiology of Hyperuricemia and Gout

Cases of asymptomatic hyperuricemia and acute gout may be difficult to identify in population-based studies due to the level of intervention required to establish a definitive diagnosis; as such, there have been few studies on the epidemiology of gout in any population.[22] While few studies examine the national prevalence of gout, there are even fewer studies focused on the incidence.[23] One 52-year prospective cohort study found that the incidence of gout was 4.0 per 1,000 person-years in men, and 1.4 per 1,000 person-year in women.[24] Another 12-year prospective cohort study found an incidence of gout to be 1.5 per 1,000 person-years in male health professionals.[25] Use of diuretics significantly decreases the incidence rate; among individuals not exposed to diuretics, gout incidence more than doubled from 1977 to 1996.[6]

From the existing studies, we do know some important facts. Men are significantly more likely to develop gout than women; this difference may be attributable to an increased renal excretion of urate by estrogen.[26] Consequently, while older individuals are at an increased risk of hyperuricemia in general, women are disproportionately affected by age due to decreased estrogen following menopause.[5,27] Behavioral risk factors play a major role in both the onset and management of gout. Particularly, consumption of purine-rich foods, such as red meat and seafood, can lead to an overproduction of uric acid, and as a result, an increase risk of gout.[25] Further, alcohol use, sugar-sweetened foods and beverages, and obesity have all been shown to increase serum uric acid levels and gout.[28]

Ethnocultural Disparities of Gout in Asian/Pacific Islander Populations

Several epidemiological studies have found disparities in the ethnocultural and geographical distribution of hyperuricemia, particularly in the Asian-Pacific regions. Māori and Taiwanese aborigines are reported to have the highest prevalence of gout in the world.[18] These findings lead some investigators to postulate that hyperuricemia may be associated with the evolution of Austronesian ancestry. Gosling, Matisoo-Smith, Merriman[11] suggested that endemic malaria in early Polynesian settlements may have selected for higher levels of serum urate, which plays an important role in the immunological response to malarial infections. As a result, indigenous ethno-racial groups throughout the Oceania region may be predisposed to hyperuricemia, and consequently, have an increased risk of gout.

While there is an expectation of high rates of gout in Hawai‘i, in a 1966 study, Healey, Caner, Bassett, Decker[14] found that despite prevalence of hyperuricemia and gout among other Pacific Islanders, a sample of 49 Polynesians in Hawai‘i showed unexpectedly low levels of serum urate and no cases of gouty disease; these findings have not been further investigated.[11,18]

Some studies have found that living in urban versus rural areas may further contribute to hyperuricemia in the Pacific region. For instance, Finau, Stanhope, Prior, Joseph, Puloka, Leslie[29] found that Tongans living in urbanized regions of Tonga had a higher mean serum urate level than those in rural areas, and similar trends have been observed in Papua New Guinea populations.[11] Conversely, studies out of the Philippines found an increased prevalence in gout among members of a remote village when compared to an urban community.[30,31] However, the validity of these findings have been called into question due to methodological issues, particularly involving the comparability of these two prevalence estimates.[15] Given Hawaii's significant rural populations, this may be an important topic to consider in our state.

Westernization of the Indigenous Lifestyle

Dietary and lifestyle factors are important predictors of the development and progression of hyperuricemia and gout. The westernization of the Pacific diet has led to significant changes in eating habits and lifestyle behaviors, and has often been attributed to morbidity in the region.[32,33] For example, it is widely accepted that the high rates of obesity and type II diabetes among Native Hawaiians are related to the dietary shift away from traditional foods after the rapid westernization of the Hawaiian Islands and introduction of imported foods.[34,35] Since both gout and diabetes share many of the same dietary risk factors, namely sugar-rich food/beverages and obesity, some researchers believe that westernization of dietary behaviors have also led to the high prevalence of gout in the Pacific region.[36]

Trends in environmental factors, such as urbanization and the consumption of imported meat and fish over local fruits and vegetables, appear to support the theory that the change towards a western diet has contributed to gout in the Pacific Islands.[5,37] However, other researchers suggest that a predisposition to hyperuricemia may have been prevalent before westernization, citing the evidence of gout in archaeological studies.[11] Similar conclusions have been drawn through a systematic review of Filipinos with elevated serum urate levels, noting several studies that challenge the degree of contribution from changing dietary behaviors, while also recognizing that the problem has likely been exacerbated by these changes in Pacific Islanders.[15]

Nevertheless, the progression and prognosis of the disease state is known to be influenced by purine intake, which is abundant in a western diet.[2]

Another risk factor highly associated with hyperuricemia and gout is alcohol consumption; this association appears to increase risk of gout in a dose-dependent manner.[28] While risky alcohol consumption in Asian and Pacific Islander communities remain somewhat lower or comparable to mainland US populations, rapid shifts towards westernized lifestyles may increase the risk of gout in an already at-risk population.[32,38] Furthermore, some findings have suggested that while certain Pacific Islander groups, including Native Hawaiians, are not necessarily at higher risk of alcohol consumption, those that do use alcohol are more likely to binge drink.[39,40] Given the dose-response relationship demonstrated between alcohol consumption and gout, high rates of risky drinking are cause for serious concern in the Hawai'i and Pacific Island region.

A Gap in the Literature on Gout in Hawai'i

A major challenge in assessing the disease burden of gout in the Pacific region has been the lack of follow-up investigation into the disease and associated risk factors. Despite the claim that many of these ethno-racial groups have the highest prevalence in the world, there has been almost no studies on Hawaii's unique Asian/Pacific Islander population. The bulk of the existing Hawai'i-based literature took place between the 1950s to the 1960s, with little to no follow-up.[11,15,41] While there is some research on the anthropological origins of gout in Pacific Islanders, along with some recent epidemiological studies with Māori and Taiwanese aboriginals,[5,11,23,42] literature on Native Hawaiians is severely lacking. Furthermore, while there are no existing reports on the current frequency or distribution of gout in Hawai'i, insights regarding the prevalence of risk factors strongly associated with hyperuricemia suggest that gout may be a significant cause of morbidity in the state. For example, obesity and diabetes has been on the rise since the 1990s in both Hawai'i and the US mainland, with the highest prevalence in Native Hawaiian and other Pacific Islander populations.[43] Given the recent and past health trends in known risk factors related to gout, hyperuricemia, and comorbidities among Native Hawaiian populations, there exists an urgent need for further investigation.

Aside from the need to establish the current prevalence and incidence of gout in Hawai'i-specific populations, cost analyses should be performed to ascertain the economic burden associated with hyperuricemia and gouty arthritis in the Pacific region. As acute gout presents as a painful, chronic, reoccurring condition, researchers should further investigate the impact of gout in Hawai'i, and, ideally, develop interventions that may prevent disease occurrence or mitigate the consequences for affected individuals.

Finally, given the convergence of ancient migratory patterns in the Pacific and current ethno-racial disparities within these populations, the lack of research on genetic influences needs to be addressed to better understand which population are at risk. As mentioned, findings from a small sample of Polynesians from Hawai'i by Healey, Caner, Bassett, Decker[14] suggested that Native Hawaiians may be unique in having only slightly elevated serum uric acid levels, and have a lower likelihood of developing gout. However, since 1966, there have been no further investigations into this unique finding; since the sample only consisted of 49 individuals of 'Polynesian ancestry,' the researchers were unable to ascertain the risk of gout among Native Hawaiians specifically.

Conclusion

While recent and comprehensive research into gout in Hawai'i is significantly lacking, investigation into other Pacific Island communities suggests an increased risk of hyperuricemia and gout compared to the United States mainland and with consequences for many communities in Hawai'i. Many researchers point to the effects of westernization and associated dietary changes as a contributing factor, while others suggest that a genetic predisposition may be at least adding to the prevalence of gout in these populations. The need for research and understanding on gout is likely to be very important in Hawaii's population. Without data on the distribution and other factors of disease burden, it is not possible to directly ascertain the impact of gout in Hawai'i, reduce its prevalence, and mitigate its consequences.

Given limited state-level resources and the need for spending prioritization, it is important to take advantage of funding opportunities that may help shed light on gout and other arthritic conditions that may be disproportionality affecting populations in Hawai'i. For instance, the Centers for Disease Control and Prevention recently posted a Notice of Funding Opportunity that would fund the implementation of state-based approaches to improving arthritis management and quality of life for those affected by arthritis.[44] Utilizing national-level resources may enable substantial steps towards adequately addressing gout and other arthritic conditions, and potentially reduce the long-term cost burden in Hawai'i.

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General Recommendations on Data Presentation and Statistical Reporting (Biostatistical Guideline for HJM&PH)
[Adapted from Annals of Internal Medicine & American Journal of Public Health]

The following guidelines are developed based on many common errors we see in manuscripts submitted to HJMPH. They are not meant to be all encompassing, or be restrictive to authors who feel that their data must be presented differently for legitimate reasons. We hope they are helpful to you; in turn, following these guidelines will reduce or eliminate the common errors we address with authors later in the publication process.

Percentages: Report percentages to one decimal place (eg, 26.7%) when sample size is >=200. For smaller samples (<200), do not use decimal places (eg, 26%, not 26.7%), to avoid the appearance of a level of precision that is not present.

Standard deviations (SD)/standard errors (SE): Please specify the measures used: using "mean (SD)" for data summary and description; to show sampling variability, consider reporting confidence intervals, rather than standard errors, when possible to avoid confusion.

Population parameters versus sample statistics: Using Greek letters to represent population parameters and Roman letters to represent estimates of those parameters in tables and text. For example, when reporting regression analysis results, Greek symbol (β), or Beta (b) should only be used in the text when describing the equations or parameters being estimated, never in reference to the results based on sample data. Instead, one can use "b" or β for unstandardized regression parameter estimates, and "B" or β for standardized regression parameter estimates.

***P* values:** Using *P* values to present statistical significance, the actual observed *P* value should be presented. For *P* values between .001 and .20, please report the value to the nearest thousandth (eg, $P = .123$). For *P* values greater than .20, please report the value to the nearest hundredth (eg, $P = .34$). If the observed *P* value is greater than *.999*, it should be expressed as "$P > .99$". For a *P* value less than .001, report as "$P < .001$". Under no circumstance should the symbol "NS" or "ns" (for not significant) be used in place of actual *P* values.

"Trend": Use the word trend when describing a test for trend or dose-response. Avoid using it to refer to *P* values near but not below .05. In such instances, simply report a difference and the confidence interval of the difference (if appropriate), with or without the *P* value.

One-sided tests: There are very rare circumstances where a "one-sided" significance test is appropriate, eg, non-inferiority trials. Therefore, "two-sided" significance tests are the rule, not the exception. Do not report one-sided significance test unless it can be justified and presented in the experimental design section.

Statistical software: Specify in the statistical analysis section the statistical software used for analysis (version, manufacturer, and manufacturer's location), eg, SAS software, version 9.2 (SAS Institute Inc., Cary, NC).

Comparisons of interventions: Focus on between-group differences, with 95% confidence intervals of the differences, and not on within-group differences.

***Post-hoc* pairwise comparisons**: It is important to first test the overall hypothesis. One should conduct *post-hoc* analysis if and only if the overall hypothesis is rejected.

Clinically meaningful estimates: Report results using meaningful metrics rather than reporting raw results. For example, instead of the log odds ratio from a logistic regression, authors should transform coefficients into the appropriate measure of effect size, eg, odds ratio. Avoid using an estimate, such as an odds ratio or relative risk, for a one unit change in the factor of interest when a 1-unit change lacks clinical meaning (age, mm Hg of blood pressure, or any other continuous or interval measurement with small units). Instead, reporting effort for a clinically meaningful change (eg, for every 10 years of increase of age, for an increase of one standard deviation (or interquartile range) of blood pressure), along with 95% confidence intervals.

Risk ratios: Describe the risk ratio accurately. For instance, an odds ratio of 3.94 indicates that the outcome is almost 4 times as likely to occur, compared with the reference group, and indicates a nearly 3-fold increase in risk, not a nearly 4-fold increase in risk.

Longitudinal data: Consider appropriate longitudinal data analyses if the outcome variables were measured at multiple time points, such as mixed-effects models or generalized estimating equation approaches, which can address the within-subject variability.

Sample size, response rate, attrition rate: Please clearly indicate in the methods section: the total number of participants, the time period of the study, response rate (if any), and attrition rate (if any).

Tables (general): Avoid the presentation of raw parameter estimates, if such parameters have no clear interpretation. For instance, the results from Cox proportional hazard models should be presented as the exponentiated parameter estimates, (ie, the hazard ratios) and their corresponding 95% confidence intervals, rather than the raw estimates. The inclusion of *P*-values in tables is unnecessary in the presence of 95% confidence intervals.

Descriptive tables: In tables that simply describe characteristics of 2 or more groups (eg, Table 1 of a clinical trial), report averages with standard deviations, not standard errors, when data are normally distributed. Report median (minimum, maximum) or median (25th, 75th percentile [interquartile range, or IQR]) when data are not normally distributed.

Figures (general): Avoid using pie charts; avoid using simple bar plots or histograms without measures of variability; provide raw data (numerators and denominators) in the margins of meta-analysis forest plots; provide numbers of subjects at risk at different times in survival plots.

Missing values: Always report the frequency of missing variables and how missing data was handled in the analysis. Consider adding a column to tables or a footnote that makes clear the amount of missing data.

Removal of data points: Unless fully justifiable, all subjects included in the study should be analyzed. Any exclusion of values or subjects should be reported and justified. When influential observations exist, it is suggested that the data is analyzed both with and without such influential observations, and the difference in results discussed.

THE WEATHERVANE

RUSSELL T. STODD MD; CONTRIBUTING EDITOR

THROMBECTOMY CAN SAVE LIVES—IF IT'S AVAILABLE.

Thrombectomy is beginning to transform stroke treatment. With this tool, doctors can pull clots from vessels in the brain and patients quickly return to normal. The procedure, according to Denver stroke specialist Donald F. Frei MD, has the same transformative effect on treatment of stroke as penicillin did for infections. The problem is time. For every minute with blood flow blocked, by many estimates, two million brain cells die. Patients who need thrombectomies often don't get to the right hospital in time. Stroke experts estimate that the procedure should be going to 20% or more of patients with clot-caused strokes. These patients have large vessel occlusion with clots in vessels that often trigger the worst disabilities or death. Experts are reluctant to state a specific time-window for therapy, but 4 to 4.5 hours is probably the maximum. A hospital must spend millions of dollars to gear up with special equipment and staff. This is not happening except at medical centers. Also, ambulance crews often fail to drive severe stroke patients directly to an appropriate hospital, and many stroke patients often first land in a hospital that can't do the procedure. Many patients with severe strokes are not helped by conventional treatment with drugs. When thrombectomy will become the standard of care for metropolitan areas is open to conjecture.

FAST KILL OF FLU VIRUS.

As Americans struggle through the worst influenza outbreak in a decade, Japan has approved a drug that the maker claims can kill the flu virus in a single day. Experts believe this could be a significant breakthrough in how the disease is treated. A late stage trial on American and Japanese flu patients found that the median time taken to wipe out the virus was 24 hours. That is much faster than any other flu drug on the market including Roche AG's Tamiflu that took three times longer to produce the same result. But even if the experimental drug lives up to the claim, it probably will not be available in the United States until next year.

PER USUAL OUR ELECTED REPRESENTATIVES PROTECT THEMSELVES.

Along with all the foofaraw about sexual harassment, ie, "me too" complaints, it is not surprising to find that our Congress has no significant mechanism for addressing sexual harassment by lawmakers. They have exempted themselves from open-records and set up a way for taxpayers to pickup the tab for lawmakers. To report sexual harassment, employees must report to the Office of Compliance where the accuser must go through a 90-day mandatory dispute resolution process, the first step of which is counseling. Is this surprising? Congress makes it a duty of the injured party to traverse an embarrassing labyrinth before the issue might be discussed. House Speaker Paul Ryan (R. Wis.) has promised a comprehensive review of the situation. In November 2017 both the House and Senate passed measures requiring annual sexual harassment training for lawmakers and staff. Much more is needed.

NEVER DATE A WOMAN YOU CAN HEAR TICKING.

Perhaps you can hear their biological clocks, but fewer American women are listening. The country's birthrate hit a record low in 2016 with 62 births per 1,000 women of childbearing age. The main driver of the decline is among teenagers where the rate fell 9% from the previous year to 20.3 births per 1,000 women, the lowest figure for that age group since at least 1940. The only group having fewer children was women ages 40 to 44. But unlike teens, the older women gave birth at a higher rate than the previous year increasing by 4% to 11.4 births per 1,000. The National Center for Health Statistics released the latest general fertility figures for ages 15 to 44, defined as women of childbearing age. Women ages 35 to 39 also pulled down the overall average with 52.7 per 1,000 women a decline of 2%. The only group to show an increase from 2015 was in ages 30 to 34 with an increase of 1% with 102.7 births per 1,000 women. Economists and others study these data because they reveal how many people will be competing for food, property, and jobs in the future. Of course, it is possible today's younger women are merely delaying pregnancy rather than skipping it entirely. In any case, there is no cure for birth nor death so try to enjoy the interval.

WHEN MEN REACH THEIR SIXTIES AND RETIRE, THEY GO TO PIECES. WOMEN GO ON COOKING.

If you are age 62 years and thinking of collecting social security and retiring to a life of ease, perhaps you might reconsider your plan. A significant increase in mortality starts at age 62, according to data published last December by the National Bureau of Economic Research. The escalation is much more dramatic for men than for women. Author Maria D. Fitzpatrick, associate professor of economics at Cornell University and co-author Timothy J. Moore at University of Melbourne, reviewed Multiple Cause of Death files for 1979 to 2012. The study revealed a lot happens during our early 60s; many change jobs, scale back working hours or retire. Health care coverage may shift and financial resources may go down. About 1/3 of Americans immediately claim social security at 62, and 10% of men retire in the month they turn 62. In the short run are negative consequences; many deaths come from traffic accidents with more time to drive around. Older men are more sedentary, more likely to be at risk for infection, when they lose their jobs they increase their tobacco habit. The bottom line, retirement may be bad for a man's health. So, gentlemen, keep working, at least part time. Don't just sit on the couch with a cool Bud in your hand watching the ball game.

ADDENDA

- The Russian member of the bobsled team was wearing a T-shirt "I don't do doping." He complained, "if we are here and clean, we should be able to walk under our flag." Only one problem, he failed the drug test.
- You replace your eyelashes every three months.
- America's least favorite veggie is brussels sprouts.

ALOHA AND KEEP THE FAITH rts

(Editorial comment is strictly that of the writer.)

Guidelines for Publication of HJM&PH Supplements

The following are general guidelines for publication of supplements:

1. Organizations, university divisions, and other research units considering publication of a sponsored supplement should consult with the editorial staff of HJM&PH to make certain the educational objectives and value of the supplement are optimized during the planning process. It is important that the sponsoring editor is aware of all steps to its publication. Please contact Drs. Kalani Brady or Michael Meagher for further information.

2. Supplements must have educational value, be useful to HJM&PH readership, and contain data not previously published to be considered for publication.

3. Supplements must have a sponsoring editor who will be involved in every step of the development, editing, and marketing of the publication since HJM&PH staff will only be reviewing final proofs.

4. Supplements should treat broad topics in an impartial, unbiased manner. Please prefer specific classes of drugs, rather than products, unless there are compelling reasons or unique properties of the drug (product) that justifies its treatment.

5. The authors are solely responsible for the content of their manuscripts and the opinions expressed. They are also responsible for the replicability, precision, and integrity of the data and may be asked to sign a statement to that effect prior to publication. All authors are required to disclose any primary financial relationship with a company that has a direct fiscal or financial interest in the subject matter of products discussed in submitted manuscripts, or with a company that produces a competing product. The sponsoring editor must ensure that each article submitted incorporates a disclosure statement from the authors within the body of the text. For more information, please refer to the Disclosure Statement within "Instructions to Authors" on the journal website.

6. All supplement manuscripts should undergo editorial and peer review. It is the responsibility of the sponsoring editor to ensure the integrity of authorship and review process. In addition, sponsorship implies compliance with all federal, state and local laws, rules and regulations that may be applicable in connection with its publication.

7. Publication of a HJM&PH supplement is a flat fee of $3,000 (electronic edition) plus the required State of Hawai'i sales tax. The subscription manager will email an invoice to the designated editor for payment. Checks may be made out to UCERA. (There may be additional costs for hard copy prints. Please contact Drs. Brady or Meagher.)

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10. It is the responsibility of the supplement editor and contributing team members to manage all editorial, marketing, sales, and distribution functions. If you need assistance, please contact our production manager. We may be able to help for an additional fee.

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