

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 populations¹⁹⁻²² 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 Hawai'i'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 ratios for injury and poisoning. Kaula'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, NHPs 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 Kaula'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, NHPs 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 Hawai'i'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 NHPs 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 NHPs 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 NHPs 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 NHPs. 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 NHPs 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 (5.77,6.67)
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								

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.

Acknowledgements

The authors thank Dr. Jill Miyamura of the Hawai'i Health Information Corporation for providing access to the Hawai'i Medicaid database. This work was partially funded by U54MD007601, U54MD007584, P20GM103466, and U54GM104944 grant from National Health Institute (NIH). The content is solely the responsibility of the authors and does not necessarily represent official views of NIH.

Authors' Affiliations:

- Department of Complementary and Integrative Medicine, University of Hawai'i John A. Burns School of Medicine, Honolulu, HI (CS, EL, JD, JJC)
- Department of Family Medicine & Community Health, University of Hawai'i John A. Burns School of Medicine, Honolulu, HI (LA, AH)

Correspondence to:

John J. Chen PhD; Biosciences Building, Suite 211, 651 Ilalo St., Honolulu, HI 96813; Email: jjchen@hawaii.edu

References

1. Truffer CJ, Wolfe CJ, Rennie KE. 2016 Actuarial Report On The Financial Outlook For Medicaid, Office of the Actuary Centers for Medicare and Medicaid Services, Department of Health and Human Services, 2016.
2. Adepoju OE, Preston MA, Gilbert Gonzales G. Health Care Disparities in the Post-Affordable Care Act Era. *American Journal of Public Health*, 2015; 105(5): 665-667
3. Weil A, Scheppach R. New roles for states in health reform implementation. *Health Affairs*, 2010; 29(6): 1178-82. doi: 10.1377/hlthaff.2010.0448.
4. Chen J, Vargas-Bustamante A, Mortensen K, et al. Racial and Ethnic Disparities in Health Care Access and Utilization Under the Affordable Care Act. *Medical Care*. 2016;54(2):140-146. doi:10.1097/MLR.0000000000000467.
5. Chen J, Vargas-Bustamante A, Tom SE. Health Care Spending and Utilization by Race/Ethnicity Under the Affordable Care Act's Dependent Coverage Expansion. *American Journal of Public Health*, 2015; 105(3):499-507.
6. Ward BW, Schiller JS. Prevalence of Multiple Chronic Conditions Among US Adults: Estimates From the National Health Interview Survey, 2010. *Preventing Chronic Disease*. 2013;10:E65. doi:10.5888/pcd10.120203.
7. Yu SM, Huang ZJ, Singh GK. Health Status and Health Services Access and Utilization Among Chinese, Filipino, Japanese, Korean, South Asian, and Vietnamese Children in California. *American Journal of Public Health*. 2010;100(5):823-830. doi:10.2105/AJPH.2009.168948.
8. Copeland LA, Elshaikh MA, Jackson J, et al. Underwood W. Impact of brachytherapy on regional, racial, marital status, and age-related patterns of definitive treatment for clinically localized prostate carcinoma. *Cancer*, 2005; 104 (7): 1372-1380. 10.1002/cncr.21341.
9. Jimenez DE, Cook B, Bartels SJ, et al. Disparities in Mental Health Service Use among Racial/Ethnic Minority Elderly. *Journal of the American Geriatrics Society*. 2013;61(1):18-25. doi:10.1111/jgs.12063.
10. Yu SM, Huang ZJ, Singh GK. Health Status and Health Services Access and Utilization Among Chinese, Filipino, Japanese, Korean, South Asian, and Vietnamese Children in California. *American Journal of Public Health*, 2010; 100(5):823-830. doi:10.2105/AJPH.2009.168948.
11. Barnes PM, Adams PF, Powell-Griner E. Health characteristics of the American Indian or Alaska Native adult population: United States, 2004-2008. *Natl Health Stat Report*, 2010; 20:1-22.
12. Gee GC, Ponce N. Associations Between Racial Discrimination, Limited English Proficiency, and Health-Related Quality of Life Among 6 Asian Ethnic Groups in California. *American Journal of Public Health*, 2010;100(5):888-895. doi:10.2105/AJPH.2009.178012.
13. Wu LT, Swartz MS, Brady KT, et al. Nonmedical stimulant use among young Asian-Americans, Native Hawaiians/Pacific Islanders, and mixed-race individuals aged 12-34 years in the United States. *Journal of Psychiatric Research*, 2014;59: 189-99. doi: 10.1016/j.jpsychires.2014.09.004.

14. Colby SL, Ortman JM. Projections of the Size and Composition of the U.S. Population: 2014 to 2060. Current Population Reports. U.S. Department of Commerce Economics and Statistics Administration, U.S. Census Bureau, 2015.
15. U.S. Census Bureau, 2010 Census of Population and Housing, Summary Population and Housing Characteristics, CPH-1-1, United States U.S. Government Printing Office, Washington, DC, 2013
16. Lipsky MS, Glasser M. Critical Access Hospitals and the Challenges to Quality Care. *JAMA*. 2011;306(1):96-97. doi:10.1001/jama.2011.928.
17. Escarce JJ, Kapur K. Do patients bypass rural hospitals? Determinants of inpatient hospital choice in rural California. *J Health Care Poor Underserved*. 2009; 20(3):625-44. doi: 10.1353/hpu.0.0178.
18. Douthit N, Kiv S, Dwolatzky T, et al. Exposing some important barriers to health care access in the rural USA. *Public Health*. 2015; 129(6): 611-20. doi: 10.1016/j.puhe.2015.04.001.
19. Bronstein JM, Adams EK, Florence CS. SCHIP Structure and Children's Use of Care. *Health Care Financing Review*. 2006;27(4):41-51.
20. McManus BM, Lindrooth R, Richardson Z, et al. Urban/Rural Differences in Therapy Service Use Among Medicaid Children Aged 0-3 With Developmental Conditions in Colorado. *Acad Pediatr*. 2016; 16(4):358-65. doi: 10.1016/j.acap.2015.10.010.
21. Byck GR, Walton SM, Cooksey JA. Access to dental care services for Medicaid children: variations by urban/rural categories in Illinois. *J Rural Health*. 2002;18(4):512-20.
22. Uva JL, Wagner VL, Gesten FC. Emergency department reliance among rural children in Medicaid in New York State. *J Rural Health*. 2012 Spring;28(2):152-61. doi: 10.1111/j.1748-0361.2011.00377.x.
23. Zhang S, Cardarelli K, Shim R, et al. Racial disparities in economic and clinical outcomes of pregnancy among Medicaid recipients. *Matern Child Health J*. 2013; 17(8): 1518-25. doi: 10.1007/s10995-012-1162-0.
24. Samnaliev M, McGovern MP, Clark RE. Racial/ethnic disparities in mental health treatment in six Medicaid programs. *J Health Care Poor Underserved*. 2009; 20(1):165-76. doi: 10.1353/hpu.0.0125.
25. Koroukian SM, Bakaki PM, Raghavan D. Survival disparities by Medicaid status: an analysis of 8 cancers. *Cancer*. 2012; 118(17): 4271-9. doi: 10.1002/cncr.27380.
26. Cummings JR, Wen H, Ko M, et al. Race/ethnicity and geographic access to Medicaid substance use disorder treatment facilities in the United States. *JAMA Psychiatry*, 2014 ;71(2):190-6. doi: 10.1001/jamapsychiatry.2013.3575.
27. Patterson BM, Draeger RW, Olsson EC, et al. A Regional Assessment of Medicaid Access to Outpatient Orthopaedic Care: The Influence of Population Density and Proximity to Academic Medical Centers on Patient Access. *The Journal of Bone and Joint Surgery American volume*, 2014;96(18):e156. doi:10.2106/JBJS.M.01188.
28. Ambrose AJH, Arakawa RY, Greidanus BD, et al. Geographical Maldistribution of Native Hawaiian and Other Pacific Islander Physicians in Hawai'i. *Hawai'i Journal of Medicine & Public Health*. 2012; 71(4 Suppl 1):13-20.
29. Withy K. Annual report on findings from the Hawai'i physician workforce assessment project, Report to the 2016 legislature, John A. Burns School of Medicine, Area Health Education Center, 2015. https://www.hawaii.edu/offices/eaugovrel/reports/2016/act18-sslh2009_2016_physician-workforce_annual-report.pdf. Accessed November 6, 2017.
30. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) Centers for Disease Control and Prevention. <https://www.cdc.gov/nchs/icd/icd9cm.htm>. Accessed on March 26 2017.
31. Carpenter LM, Swerdlow AJ, Fear NT. Mortality of doctors in different specialties: findings from a cohort of 20000 NHS hospital consultants. *Occupational and Environmental Medicine*. 1997; 54(6): 388-395.
32. Gaitatzis A, Carroll K, Majeed A, et al. The Epidemiology of the Comorbidity of Epilepsy in the General Population. *Epilepsia*, 2004; 45(12):1613-1622.
33. Hing E, Hall MJ, Ashman JJ, et al. National Hospital Ambulatory Medical Care Survey: 2007 Outpatient Department Summary. National health statistics reports; no 28. Hyattsville, MD: National Center for Health Statistics. 2010.
34. Kryger MH, Walid R, Manfreda J. Diagnoses received by narcolepsy patients in the year prior to diagnosis by a sleep specialist. *Sleep*. 2002; 25(1): 36-41.
35. Kyriacou DN, Handel D, Stein AC, et al. BRIEF REPORT: Factors Affecting Outpatient Follow-up Compliance of Emergency Department Patients. *Journal of General Internal Medicine*. 2005;20(10):938-942. doi:10.1111/j.1525-1497.2005.0216_1.x.
36. Naghavi M, Abolhassani F, Pourmalek F, et al. The burden of disease and injury in Iran 2003. *Population Health Metrics*, 2009; 7-9. doi: 10.1186/1478-7954-7-9.
37. Ahmedani BK, Stewart C, Simon GE, et al. Racial/ethnic differences in healthcare visits made prior to suicide attempt across the United States. *Medical care*. 2015;53(5):430-435. doi:10.1097/MLR.0000000000000335.
38. Palmer NRA, Kent EE, Forsythe LP, et al. Racial and Ethnic Disparities in Patient-Provider Communication, Quality-of-Care Ratings, and Patient Activation Among Long-Term Cancer Survivors. *Journal Of Clinical Oncology*, 2014; 32: 4087-4094.
39. Arista P, Ed T, Kwon S, et al. Recommendations for Implementing Policy, Systems, and Environmental Improvements to Address Chronic Diseases in Asian Americans, Native Hawaiians, and Pacific Islanders. *Prev Chronic Dis*, 2014; 11:140272. doi.org/10.5888/pcd11.140272.
40. Kwon SC, Rideout C, Patel S, et al. Improving Access to Healthy Foods for Asian Americans, Native Hawaiians, and Pacific Islanders: Lessons Learned from the STRIVE Program. *J Health Care Poor Underserved*. 2015 26(2): 238-68.
41. Grandinetti A, Keawe'aimoku Kaholokula J, Chang HK, et al. Relationship between plasma glucose concentrations and Native Hawaiian Ancestry: The Native Hawaiian Health Research Project. *Int J Obes Relat Metab Disord*, 2002; 26(6): 778-82.
42. Wu L-T, Blazer DG. Substance use disorders and co-morbidities among Asian Americans and Native Hawaiians/Pacific Islanders. *Psychological Medicine*. 2015;45(3):481-494. doi:10.1017/S003291714001330.
43. Meyer OL, Saw A, Cho YI, et al. Disparities in Assessment, Treatment, and Recommendations for Specialty Mental Health Care: Patient Reports of Medical Provider Behavior. *Health Serv Res*. 2015; 50(3):750-67. doi: 10.1111/1475-6773.12261.
44. Asthma in Hawaii, State Data Profiles (2011), Centers for Disease Control and Prevention. https://www.cdc.gov/asthma/stateprofiles/Asthma_in_HI.pdf. Accessed June 28 2017.
45. Jessop H, Li D, Katz AR, et al. Asthma prevalence disparities and differences in sociodemographic associations with asthma, between Native Hawaiian/Other Pacific Islander, Asian, and White adults in Hawaii - Behavioral Risk Factor Surveillance System (BRFSS), 2001-2010. *Ethn Health*. 2017 30: 1-23. doi: 10.1080/13557858.2017.1297775.
46. Dummer TJB. Health geography: supporting public health policy and planning. *CMAJ : Canadian Medical Association Journal*. 2008;178(9):1177-1180. doi:10.1503/cmaj.071783.
47. Hixon AL, Buenconsejo-Lum LE. Medical School Hotline: Developing the Rural Primary Care Workforce in Hawai'i - A 10-Point Plan. Izutsu S, ed. *Hawaii Medical Journal*. 2010;69(6 Suppl 3):53-55.
48. Withy K1, Dall T, Sakamoto D. Hawai'i physician workforce assessment 2010. *Hawaii J Med Public Health*. 2012; 71(4 Suppl 1) :6-12.
49. Lim E, Cheng Y, Reuschel C, et al. Risk-adjusted in-hospital mortality models for congestive heart failure and acute myocardial infarction: value of clinical laboratory data and race/ethnicity. *Health Services Research*, 2015; 50 Suppl1: 1351-1371.