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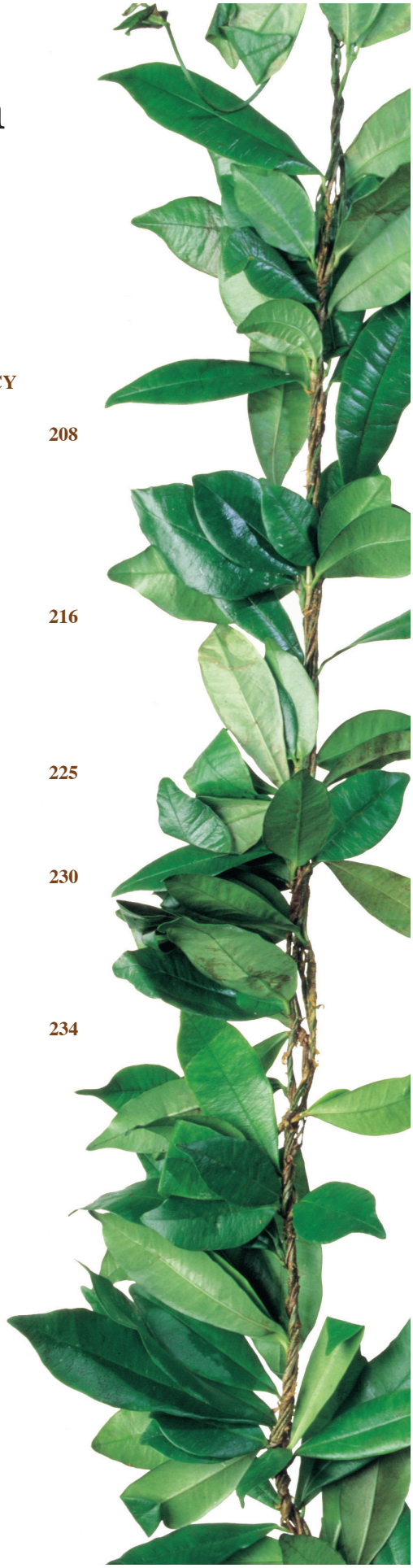

Hawai'i Journal of Health & Social Welfare
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Nā Kānaka Maoli ma nā ʻĀina ʻĒ: Exploring Place of Residency as a Native Hawaiian Health Predictor During the COVID-19 Pandemic

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Abstract

Little is known about the impacts of living in diaspora from the Hawaiian Islands on Native Hawaiian health. To address this, the authors conducted an exploratory analysis using cross-sectional data from the 2021 Native American COVID-19 Alliance Needs Assessment. A total of 1418 participants identified as Native Hawaiian (alone or in any combination), of which 1222 reported residency in the continental US and 196 in Hawai'i. Residency status in the continental US vs Hawai'i was evaluated as a predictor of survey outcomes using likelihood ratio tests on linear and logistic regression models for linear and binary outcomes, respectively. Results showed that NH residency in the continental US was significantly associated with increased odds of reporting fair or poor self-rated health; increased odds for screening positive for anxiety, depression, and suicidality; and increased odds of health insurance loss (P's < .05). Residency in the continent was also associated with lower odds of reporting a diagnosed chronic health condition (P < .05). Residency in the continental US had no observed effect on the odds that participants engaged cultural activities or cultural coping strategies. These results support the role of place of residency as an important Native Hawaiian health predictor during and beyond the COVID-19 pandemic.

Keywords

Native Hawaiian, Diaspora, Residency, Indigenous Health, COVID-19

Abbreviations and Acronyms

NACA = Native American COVID-19 Needs Assessment Survey
COVID-19 = Coronavirus Disease 2019
NH = Native Hawaiian
NHPI = Native Hawaiian and other Pacific Islander

Introduction

In 2021, the US Census reported that for the first time ever the majority of Native Hawaiians (NHs) now live outside of Hawai'i.[1-2] There are many reasons for this shift in population including settler colonialism, socioeconomic opportunity, and changing social needs.[3-7] These causes and motivations are the roots through which off-island Hawaiians form the amorphous NH diaspora,[8] or *nā Kānaka Maoli ma nā ʻĀina ʻĒ* (NHs in away lands). Like NHs in Hawai'i, research indicates that NHs in the continental US face substantial physical, behavioral, social, and COVID-19 illness and morbidity disparities.[3,9-13] Furthermore, the migration from *ka pae* ʻāina (the Hawaiian homelands), community, and culture may uniquely jeopardize NH health.[3,11] However, unlike in Hawai'i, NHs in the continent do not readily have access to culturally relevant health care services, NH providers, nor care environments that are culturally responsive towards NHs.[14-17]

Recent studies have engaged NH residents in Nevada and California to better understand how living in the continental US affects NH health.[3,6,9,11] In a 2011 qualitative study of 27 NHs living in Las Vegas, Nevada, Lasseter et al. examined the perceived effect of migration on NH health and well-being. Few immediate changes were identified, though some participants detailed a sense of separation from Hawai'i which degraded their emotional and physical health.[11] A similar study by Browne and Braun in 2017 asked 30 NH elders in Los Angeles and San Diego, California, about their experiences living in diaspora. The elders reported more economic mobility and a continued "primacy" of Hawaiian culture; however, accessing NH health care providers was extremely difficult.[3] Although these studies provide excellent insights, there is a paucity of quantitative data on how living in the continental US interacts with measures of health. Such data would help target areas of need for those in the growing NH diaspora. Moreover, the COVID-19 pandemic's elevated impact on Native Hawaiians and other Pacific Islanders (NHPIs) in the continental US elevates the urgency of understanding how residency status impacts NH health outcomes.[13,18-20] To address this need, the present study explores how place of residency may act as a quantifiable health predictor for a large population of NHs during the COVID-19 pandemic.

Methods

Data Source

This study was a secondary analysis of data from the cross-sectional Native American COVID-19 Alliance Needs Assessment (NACA; N=8549), an Indigenous-focused study in the

National COVID-19 Communities of Color Needs Assessment conducted between January and March 2021.[21-22]

Criteria

The NACA study included adults 18 years and older who identified as American Indian, Alaskan Native, First Nations, NH, and/or PI and were residents of the US and its territories. For the present study, the authors filtered for respondents who identified as NH, either alone or in combination, and who lived in either Hawai'i or the continental US (including Alaska and excluding US territories). Responses were removed if participants did not live in Hawai'i or the continental US, were not NH, were in a foreign language, contained nonsense language, had improbable completion times, and/or were duplicates. The final sample for this secondary analysis included 1418 NH respondents from the NACA study, of whom 1350 were recruited through snowball sampling and 68 were recruited through Qualtrics panels.

Recruitment and Sampling

The NACA study utilized a 2-pronged sampling approach that included respondents recruited from snowball sampling and Qualtrics panels, to ensure a diverse and balanced sample. Participants were sampled proportionally to the distribution of Indigenous populations across the four US Census regions (Northwest, Midwest, South, West). A 50% male-to-female split was sought for the NACA sample with 22% being from rural areas/tribal lands and 78% from urban areas.

Snowball recruitment was conducted through outreach to a national network of Indigenous researchers, community partners, universities, and national Indigenous organizations. In the NACA dataset, 7834 were recruited through the convenience snowball sample. The NACA also received a total of 11 617 (12.7%) raw Qualtrics responses. Of these, 1470 responses were screened by Qualtrics as being valid completions of the total responses. Further screening by the NACA team resulted in *N*=715 (6.2%) being deemed as meeting the eligibility criteria of being US residing Indigenous adults.

Data Collection

The 20-minute NACA survey was administered in English using the Qualtrics online platform.

Measures

Demographic measures. The survey instrument included questions on various demographics. This study focused on tribal identification, race/ethnicity, age, sex (female or male), household income, educational attainment, residential region type (rural/tribal land vs urban), and place of residency.

Place of residency. Continental US residency was coded as those who, at the time of survey completion, self-reported residency in the continental US including Alaska and excluding US territories. Hawai'i residency was coded as self-reported residency in Hawai'i at the time of survey completion. Responses were coded by residential region type by the NACAS team where responses from urban/suburban census classified zip codes were urban and rural responses were classified by census zip codes or if respondents were living on reservation lands or Hawaiian Homelands.

Self-rated health status was assessed using a single item asking respondents to self-rate their health status, with response options including excellent, very good, good, fair, and poor.

Health care. Three indicator variables for health care were calculated based on whether respondents reported (1) at least one diagnosed health condition from a list of 18 possible common physical and mental chronic health conditions (see **Appendix 1**), (2) insurance/benefits loss due to the pandemic, and (3) pandemic-caused difficulty accessing needed health care.

Mental health. The 4-Item Patient Health Questionnaire (PHQ-4L) was used for the anxiety and depression screens.[23] To assess suicidality, respondents were asked: "In the past month, have you seriously considered suicide, that is, seriously considered thoughts or plans to harm yourself in some way?" Participants responded either "yes" or "no". A cumulative measure was analyzed by assessing if participants were positive to any of the included mental health screens.

Cultural engagement. To assess cultural engagement, the authors examined responses to 2 questions: (1) "What have you done to cope with your stress related to the COVID-19 pandemic?", and (2) "What have been some of your thoughts, experiences, or activities during the COVID-19 pandemic?" Response options to these 2 questions included various cultural coping strategies used to protect against pandemic adversity (eg, prayed for relatives, or used traditional medicine). The authors examined responses to a third question: "Due to the constraints of the COVID-19 pandemic, was your family able to take on more of these types of activities?" Response options included "cooking together" and "engaging in cultural gatherings" among others. Relevant answers for cultural engagement measures were chosen based on interpreted alignment with NH cultural health practices.[24]

Statistical Approach

Likelihood Ratio Tests were conducted on linear regression models (linear) and logistic regression (binary) models to assess if adding the variable of residency in Hawai'i or the continental US significantly improved upon the fit of the base model (95% CI, α=.05). As a sensitivity test, 2-way analysis of covariance

(ANCOVA) tests were conducted for all measures. All models were adjusted for relevant covariates including age, educational attainment, annual household income, having another Pacific Islander identity, residential region (urban or rural), and sex. Adjusted odds ratios (aOR's) of continental living NHs (=1) to Hawai'i living NHs (=0) were reported for all binary outcomes and standardized beta (ß) coefficients for linear outcomes. Stata16, release 16 (StataCorp LLC, College Station, TX) and R version 2023.06.1 (R Foundation for Statistical Computing, Vienna, Austria) were used for data processing and analysis.[25-26] Complete case analysis was used for all statistical analyses.

Results

Demographics

Of the 1418 NHs in the sample, 86% (*n*=1222) reported continental US residency and 14% (*n*=196) reported Hawai'i residency. Median educational attainments for survey respondents in the continental US and those in Hawai'i were some college and an associate's degree respectively. Median ages for those living in the continental US and those in Hawai'i were 36 and 37 years of age respectively. Among NH continental US residents, 49% identified as female compared to 59% in Hawai'i. Sixty-seven percent of continental US residents lived in urban/suburban areas and 33% in rural areas. Comparatively, 35% of NHs in Hawai'i lived in urban/suburban areas and 65% in rural areas. An 82% majority of NH continental residents had an additional Pacific Islander identity compared to 47% of NHs in Hawai'i. States with the most respondents were Hawai'i (*n*=196), California (*n*=133), Texas (*n*=117), New York (*n*=78), and Washington (*n*=59) (data not shown). Hawai'i zip codes with the greatest number of respondents were: Honolulu (*n*=53); Wailuku (*n*=17); Wai'anae (*n*=13); Hilo (*n*=12); and Kāne'ohe (*n*=11) (data not shown). **Table 1** displays the demographics of this study compared to US Census data.

Descriptive Results

Forty percent of NH continental residents rated their health as fair or poor compared to 28% of NH Hawai'i residents. Fewer continental residents reported being diagnosed with a health condition over their lifetime than NHs in Hawai'i (61% and 79%, respectively). One in three Hawai'i and continental residents reported difficulty in accessing needed health care services due to the COVID-19 pandemic. Nearly one-third (32%) of continental residents reported losing health insurance or benefits due to the pandemic, compared to 12% of Hawai'i residents. Almost two-thirds (60%) of NH continental residents screened positive for anxiety compared to one-third (33%) of NH Hawai'i residents. Fifty-nine percent of continental residents screened positive for depression compared to 23% of Hawai'i residents. Forty-three percent of continental residents reported suicidal thoughts compared to 7.7% of Hawai'i residents. In all, 87% of continental residents screened positive for at least 1 mental health screen (anxiety, depression, and suicidality) compared to 42% of Hawai'i residents. Reported participation in family cultural activities was similar between continental NH residents and Hawai'i NH residents– 98% and 93% respectively. When asked how they dealt with stress from the pandemic, overall engagement in at least 1 cultural coping strategy was similar across groups (90% in the continent and 92% in Hawai'i). **Table 2** highlights descriptive analysis results.

Table 1. Native American COVID-19 Alliance Needs Assessment Native Hawaiian Participant Demographics by Residency Compared to the US Census (N=1418)

	NACA Survey data (N=1418)		US Census Data[1-3,40]	
Demographic Variables	**NH Continent Residents** (n=1222)	**NH Hawai'i Residents** (n=196)	**NH Continent Residents**	**NH Hawai'i Residents**
Proportion of sample residency	86%	14%	53%	47%
Median annual household income	$50 000-74 999	$50 000-74 999	$62 970[a]	$57 358
Median educational attainment	Some college	Associate's degree	Some college/ associate's degree*	Some college/ associate's degree
Median age (sd)	36 (7)	37 (15)	30*	32
% Female	49%	59%	49%*	49%
Other Pasifika identity in addition to NH	82%	47%		
Residential region type				
Rural	33%	65%		
Urban/suburban	67%	35%		

sd= standard deviation NH= Native Hawaiian. [a] Data from NH living in California (n=88 307).

Table 2. Descriptive Outcomes for Native Hawaiian (NH) NACA Survey Participants by Place of Residency (N=1418)		
	NH Continent Residents (n=1222) % (n)	**NH Hawai'i Residents (n=196) % (n)**
Test Variables		
Self-rated health "fair" or "poor"	40% (485)	18% (36)
Excellent	4% (54)	6% (12)
Very good	31% (374)	36% (70)
Good	25% (309)	40% (78)
Fair	22% (265)	14% (28)
Poor	18% (220)	4% (8)
Reported chronic health condition	61% (742)	79% (154)
Had difficulty accessing health care when it was needed	34% (419)	32% (63)
Lost health insurance/benefits	32% (391)	12% (24)
Positive anxiety screen[a]	60% (732)[b]	33% (64)[b]
Positive depression screen[a]	59% (719)[b]	23% (46)[b]
Seriously considered suicide[b]	43% (523)	7.7% (15)
Any positive mental health screen[c]	87% (1063)	42% (83)
Cultural Coping Strategies to Manage Pandemic Stress		
Prayed for friends and relatives to help them get through COVID-19's impact on their families	24% (289)	68% (133)
Prayed for spiritual support/help of creator/god/ancestors to help get through the pandemic	24% (291)	54% (105)
Cleansed self spiritually to help self or family through the stress caused by COVID-19	22% (264)	18% (35)
Talked to a medicine person/traditional healer	21% (255)	12% (24)
Reached out to elders or respected native health leaders	21% (255)	16% (32)
Engaged in meditation or mindfulness practices	20% (249)	35% (69)
Talked to a spiritual advisor	19% (233)	18% (36)
Traditional medicine/healing	19% (233)	27% (52)
Attended religious, spiritual, ceremonial, or traditional practices	18% (220)	18% (35)
Traditional chanting, singing, ceremonial drumming (eg, oli)	18% (214)	16% (32)
MEAN QUANTITY OF CULTURAL COPING STRATEGIES ENGAGED PER RESPONDENT (mean, sd)	2.05 (1.88)	2.82 (1.25)
ENGAGED AT LEAST 1 CULTURAL COPING STRATEGY	90% (1100)	92% (181)
Family Cultural Activities During the Pandemic		
Cooking together	45% (554)	55% (108)
Exercising, taking walks or doing sports or fitness together	43% (525)	55% (107)
Helping others in the community together	43% (524)	34% (67)
Working on art, crafts, or other artistic/creative skills	43% (526)	43% (84)
Practicing or starting to learn traditional language ('Ōlelo Hawai'i for NHs)	42% (517)	31% (61)
Engaging in online or social distance cultural gatherings, hula dancing, etc.	40% (493)	37% (72)
Hanging out together/family leisure time together	26% (316)	52% (102)
Engaging in social activism	19% (228)	17% (34)
MEAN QUANTITY OF CULTURAL ACTIVITIES PARTICIPATED IN BY FAMILY PER RESPONDENT (mean, sd)	3.01 (.98)	3.24 (1.72)
FAMILY PARTICIPATED IN AT LEAST 1 CULTURAL ACTIVITY	98% (1194)	93% (182)

NACA = Native American COVID-19 Alliance Needs Assessment
[a] phq-4l positive when total score ≥3
[b] n = 1413 responses analyzed due to missing data
[c] any positive depression screen, anxiety screen, and/or suicidality screen

Table 3. Inferential Analysis of the Relationship Between Living in the Continental US and NH Health Outcomes in the NACA Survey (N=1418)				
Test Variables	**Inferential statistics**		**Likelihood Ratio Test[a]**	
	aOR (95% CI)	**ß (95% CI)[a]**	***X*² (1)**	***P***
Self-rated health "fair" or "poor"[a,b]	1.24 (1.14, 1.35)	–	26.6	<.001
Reported at least one chronic health condition[a,b]	.84 (.78, .92)	–	16.5	<.001
Had difficulty accessing health care when it was needed[a,b]	.93 (.86, 1.01)	–	2.64	.106
Lost health insurance/benefits[a,b]	1.17 (1.08, 1.27)	–	15.6	<.001
Positve anxiety screen[a,b,c]	1.24 (1.14, 1.35)	–	24.6	<.001
Positive depression screen[a,b,c]	1.30 (1.19, 1.41)	–	36.5	<.001
Seriously considered suicide[a,b,e]	1.37 (1.26, 1.49)	–	56	<.001
Any positive mental health screen[a,d]	1.41 (1.32, 1.49)	–	117	<.001
Mean cultural coping strategies engaged per individual[a]	–	-.10 (-.29,.10)	10.9	.001
Engaged at least one cultural coping strategy[a,b]	.97 (.90, 1.03)	–	1.06	.305
Mean cultural activities participated in by family[a]	–	-.08 (-.25, .10)	6.85	.009
Family participated in at least one cultural activity[a,b]	1.00 (1.00, 1.00)	–	0	.981

NOTE: NACA = Native American COVID-19 Alliance Needs Assessment; aOR = adjusted odds ratio of NH Continent Residents (=1): Hawai'i Residents (=0); ß = standardized beta coefficient, CI=95% confidence interval; X^2 (1) = chi-square statistic (degrees of freedom); and *P* = *P*-value. Significance was assessed as when *P*-values were less than .05.

[a] Adjusted by educational attainment, age, income, sex, other Pacific Islander identity, and residential region type
[b] Binomial variable
[c] PHQ-4L positive when total score ≥3
[d] Any positive depression screen, anxiety screen, and/or suicidality screen
[e] N=1413 responses analyzed due to missing data

Inferential Statistics

After adjusting for covariates including age, educational attainment, annual household income, having another Pacific Islander identity, residential region (urban/suburban or rural), and sex, residency in the continental US was associated with 16% lower odds of reporting a diagnosed chronic health condition (aOR=.84, 95% CI=.78-.92) and 24% greater odds of reporting poor or fair self-rated health (aOR=1.24, 95% CI=1.14-1.35). It was further associated with 24% greater odds of a positive anxiety screen (aOR=1.24, 95% CI=1.14-1.35), 30% greater odds of a positive depression screen (aOR=1.30, 95% CI=1.19-1.41), 37% greater odds of a positive suicidality screen (aOR=1.37, 95% CI=1.26-1.49), 41% greater odds of screening positive for depression/anxiety/suicidality (aOR=1.41, 95% CI=1.32-1.49), and 17% greater odds for pandemic-related health insurance loss (aOR=1.17, 95% CI=1.08-1.27). NH continental residency was also associated with a lower mean quantities of family cultural activities (ß=-.10, 95% CI=-.25-.10) and cultural coping strategies (ß=-.08, 95% CI=-.29-.10). After controlling for covariates, residency in the continent had no significant impact on the odds for having difficulty accessing needed health care (aOR=.93, 95% CI=.86-1.01), for engaging at least 1 cultural coping strategy (aOR=.97, 95% CI=.90-1.03), nor for engaging at least 1 family cultural activity (aOR=1.00, 95% CI=1.00-1.00). **Table 3** depicts the inferential analysis results.

Discussion

This study explored the quantitative relationship between NH health outcomes during the COVID-19 pandemic and place of residency in the 2021 NACA dataset. The results showed that continental residents had significantly higher odds of reporting their health as fair or poor. The lower perceptions of health among continental-living NHs may have been a result of the increased burden of COVID-19 on continental NH communities. In 2020, COVID-19 case rates per 100 000 in California, Oregon, Utah, and King County, Washington, were nearly 5 times higher than experienced by NHPI in Hawai'i.[18-19] Moreover, 30% of NHPI continental residents in 2021– when the NACA survey was conducted– had at some point been positive for COVID-19, and 16% had lost a family member due to COVID-19.[13]

This burden likely led to heightened emotional distress among continental NHs in the survey.[27] Sixty percent of continental NHs were positive for anxiety, 59% positive for depression, and 43% had considered suicide. The prevalence of positive depression and anxiety screens were considerably higher than other assessments of NH mental health,[13,28] suggesting this particular point in the pandemic (winter 2021) uniquely affected NH mental health, especially in the diaspora; however, these results may also indicate an anomalous result in this survey. Possible mechanisms behind the high prevalence of positive mental health screens among continental NHs are complex but may have been related to the loss of loved ones, socioeconomic challenges, regionally-specific COVID-19 quarantine/social

gathering policies, barriers to cultural practices, and/or other factors independent of the pandemic.[13,29-31] Though NHs in Hawai'i also had a high prevalence of poor mental health screens, it was smaller than continental residents, perhaps because living in Hawai'i allowed more access to community, culture, and land despite pandemic restrictions.[29-31] In any case, the substantial emotional distress among NH continental residents is alarming and etiologies/interventions should be urgently explored.

Cultural access challenges also present concerns. Consistent with prior studies,[3,5,9] cultural engagement appeared to be important to NH continental residents' well-being during the pandemic as more than 90% of continental residents reported engaging in family cultural activities and cultural coping strategies. Moreover, the odds of engaging cultural activities and coping strategies were not significantly different between NHs in Hawai'i or the continent. This high engagement in culture suggests that engaging NH cultural identity was health-protective against pandemic adversity for continental residents. However, continental residency was also associated with a lower magnitude of engagement in cultural coping strategies and family cultural activities. This lower magnitude of engagement is possibly a result of limited access to organized cultural resources in the continent.[3,31] Barriers to cultural engagement may therefore limit continental residents' ability to engage identity-based well-being practices and, in turn, affect their self-rated health.

Difficulties in accessing health care may have also contributed to increased health adversity experienced by NHs living in the continental US. While a similar proportion of NHs in the continent and NHs in Hawai'i faced barriers to accessing health care when they needed it, NHs in the continent had significantly higher odds of losing health insurance than NHs in Hawai'i. It is widely understood that having health insurance improves rates of illness diagnosis, quality of care, and perceptions of health.[33-35] Poorer access to insurance could mean that NHs in the continent suffer from unseen and untreated chronic health conditions. This could explain why NHs in the continent had lower odds than NHs in Hawai'i of having a chronic condition despite worse self-rated health. To address health care inaccessibility for NH continental residents, the authors recommend steps be taken to reduce NH health care barriers such as structural racism, cultural incompetence, underrepresentation of NH providers, insurance inaccessibility, data invisibility, and health care affordability.[17,34,35-38] Consequently, it is important to improve diaspora NH access to NH or Indigenous health care services in the continental US.[14,24,39]

Limitations

The NACA study provided a unique opportunity to conduct an exploratory analysis of residency status as a NH health predictor due to its robust and geographically inclusive dataset. However, there were some limitations: the analysis used binary comparisons between NHs living in the continent and those in Hawai'i, rather than a more nuanced operationalization of place of residency (such as length of time living in the continental US); and all measures were self-reported, cross-sectional, and limited diagnostically. Possible population bias arose due to demographic characteristics which differed substantially from national data– for example, 86% of participants were continental US residents whereas, in US Census data, around 54% of NHs are continental US residents.[1-3,40] This disparity may be because the census-based sampling approach focused on representing Indigenous Americans at-large rather than NH-specifically; lastly, internet-related access difficulties may have limited the study population.

Conclusion

This exploratory study underscores that NH health may be quantifiably impacted by different environmental, social, and systemic factors which are unique to living in diaspora from the Hawaiian Islands. As such, there is a need for future research which studies how living in diaspora operates as a social determinant of health for NHs.

Conflict of Interest

This article was prepared, in part, while Dr. Walters was employed at the University of Washington, Indigenous Wellness Research Institute. The present study was internally funded by the Ola Pasifika Lab. The authors claim no conflict of interest.

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Contributors

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Appendix 1. Chronic Conditions Measures from the Native American COVID-19 Alliance Needs Assessment Survey	
Descriptive Measure	**Question and Analysis Procedure**
Reported at least one chronic health condition	Analyzed by coding a binary "Yes/No" based on if a respondent made one or more selections from the following question on the NACA survey: Have you ever been told by a doctor, nurse, or medical provider that you have (Select all that apply): 1. High blood pressure or hypertension 2. Diabetes (not including pre-diabetes) 3. Pre-Diabetes 4. Cardiovascular disease or heart disease (including blocked or hardening of the arteries, angina, heart attack, stroke or mini stroke) 5. Congestive heart failure (including weakened heart muscle or leaky valve) 6. Lung disease (like asthma, exercise-induced asthma, chronic bronchitis, emphysema, COPD) 7. Cancer that you are getting treatment for now 8. Autoimmune disease (like lupus, rheumatoid arthritis, psoriasis) 9. Kidney disease, including weak or failing kidneys (DO NOT Include kidney stones or problems with urinating) 10. HIV/AIDS 11. Hepatitis B or Hepatitis C 12. Sleep disorders/apnea 13. Low immunity/suppressed immune system (or any medication that decreases your immunity, such as for transplant or an immune disease) 14. Chronic liver disease (like fatty liver, cirrhosis) 15. Anxiety 16. Depression 17. Post-Traumatic Stress Disorder 18. Other mental health conditions

Examining Diabetes Status by the Social Determinants of Health Among Adults in Hawai‘i

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Abstract

The social determinants of health (SDoH) influence health outcomes based on conditions from birth, growth, living, and age factors. Diabetes is a chronic condition, impacted by race, education, and income, which may lead to serious health consequences. In Hawai‘i, approximately 11.2% of adults have been diagnosed with diabetes. The objective of this secondary cross-sectional study is to assess the relationship between the prevalence of diabetes and the social determinants of health among Hawai‘i adults who participated in the Behavioral Risk Factor Surveillance System between 2018-2020. The prevalence of diabetes among adults was 11.0% (CI: 10.4-11.5%). Filipino, Japanese and Native Hawaiian adults had the highest prevalence of diabetes at 14.4% (CI: 12.7-16.2%), 14.2% (CI: 12.7-15.7%), and 13.2% (CI: 12.0-14.4%), respectively. Poverty level and education were significantly associated with diabetes status. Within employment categories, the adjusted odds ratio (AOR) for retired and unable to work adults were large at AOR: 1.51 (CI: 1.26-1.81) and AOR: 2.91 (CI: 2.28-3.72), respectively. SDoH can impact the development and management of diabetes. Understanding the role SDoH plays on diabetes status is crucial for promoting health equity, building community capacity, and improving diabetes management.

Keywords

Social Determinants of Health, Diabetes, Hawai‘i, Socioeconomic Status, Built Environment

Abbreviations

AOR = adjusted odds ratio
BRFSS = Behavioral Risk Factor Surveillance System
CDC = Centers for Disease Control and Prevention
NHPI = Native Hawaiian and Pacific Islander
OR = odds ratio
SDoH = social determinants of health
SES = socioeconomic status

Introduction

Social determinants of health (SDoH) influence health outcomes based on conditions from birth, growth, living, and age factors.[1] As the SDoH encompass a variety of factors including both social and environmental factors, multiple models exist for operationalizing this term for scientific inquiry. One model developed by Healthy People 2030 separates the SDoH into 5 different domains: (1) economic stability, (2) education, (3) health care, (4) neighborhood and the built environment, and (5) social and community context.[2] While the Healthy People 2030 model divides SDoH into categories, it is important to note that social and environmental factors have a complex interconnected relationship.[3] The reciprocal interactions of the SDoH impact an individual's health rather than the independent effect of a singular domain.[3]

SDoH play a critical role in health and contribute to health inequities including disparities in diabetes prevalence.[4] Diabetes is a serious chronic health condition, and a leading cause of death in the US.[5] Furthermore it may lead to a variety of adverse health outcomes including blindness, and cardiovascular disease.[6] Type II diabetes, a preventable condition, accounts for 90 – 95% of all diabetes cases in the US.[7] Recent data estimates that 14.7% of adults in the US have diabetes, of which 11.3% have been diagnosed with diabetes, and 3.4% are undiagnosed.[7] In Hawai‘i, an estimated 11.2% of the adult population have been diagnosed with diabetes, and approximately 10 000 adults are newly diagnosed with diabetes every year.[8]

The prevalence of diabetes is unequally distributed among the adult population, especially among racial and ethnic minority groups.[6] In 2019, a study in Hawai‘i found a higher prevalence of diabetes in Native Hawaiians and Pacific Islanders (NHPIs) and Filipino residents compared to White residents.[9] This finding is consistent with previous research examining a multiethnic cohort that found Native Hawaiians and Asian populations had a higher risk for diabetes compared to their White counterparts.[10] This disparity among the Indigenous and racial minority populations in Hawai‘i is similar across the US with American Indian, Alaskan Native, Black, and Hispanic populations compared to White populations.[6] Historically, NHPI and Asian populations have been under-represented in research and placed into aggregate groupings masking subgroup differences and limiting generalizability of results.[11] Efforts to improve NHPI and Asian representation in clinical research have been made. Within the National Institutes of Health (NIH), the availability of funding for inclusion of NHPI and Asian populations in research has increased, yet underrepresentation remains an issue.[12] Inequities within minority populations go beyond clinical representation in research. Limited understanding of ethnic and cultural back-

grounds may inhibit care due to language barriers and cultural differences.[13] Considering these racial inequities that may be tied to historical injustices, additional factors such as the SDoH are needed to truly understand the intersectionality with race and ethnicity. Systemic racism and discrimination have driven social and economic inequities hindering people of color from achieving optimal health.[14-15]

Education has been reported as inversely associated with the prevalence of diabetes among adults.[6] A recent systematic review has indicated that low socioeconomic status (SES) may be a risk factor for diabetes-related complications.[16] Diabetes has an economic impact which may affect an individual's economic stability. Individuals diagnosed with diabetes have an estimated 130% higher medical expenditure compared to individuals living without diabetes.[8] In 2017, the estimated total economic burden of diagnosed diabetes in the US was upwards of $300 billion.[17] Health care access and quality are also related to diabetes prevalence, as health care access is directly related to diabetes diagnosis, surveillance, and treatment.[18-19] In neighborhood and built environment studies, green space and safe neighborhood walkability have been associated with a reduced risk for type II diabetes.[20]

Research examining the independent effects and the complex interconnected relationships between the SDoH domains can help identify nonmedical factors that influence health outcomes. The objective of this study is to assess the association between diabetes and the SDoH domains among adults in Hawai'i. By evaluating these associations, health care and public health professionals can gain a better understanding of diabetes and improve intervention efforts in at-risk populations that may be experiencing health inequities.

Methods

Data Source

The Behavioral Risk Factor Surveillance System (BRFSS) is a state-based Centers for Disease Control and Prevention (CDC)-funded survey that collects adult health-related data from randomly selected adults within each state and US territory.[21] The survey includes questions focused on health and lifestyle data pertaining to demographic characteristics, health conditions, preventive services, and health related behaviors that are collected via landline and mobile telephones using disproportionate stratified sampling.[21]

Study Population

This secondary cross-sectional study consists of Hawai'i residents who participated in BRFSS between 2018-2020. A total population of 23 338 adults, 7901 adults from 2018, 7683 adults from 2019, and 7754 adults from 2020 were included in the study. These adults represented a total weighted population of 3 348 355 adults with a weighted average population of 1 116 118 adults per year. Adults with missing information on diabetes status (n=42) were excluded from the study.

Measures

Adults with diabetes were defined based on respondents reporting "yes" to the question "have you ever been told by a doctor, nurse, or healthcare professional that you have diabetes?" Adults who responded "no," and those with gestational diabetes or pre-diabetes were defined as not having diabetes as they are distinct conditions and are separately identified through other BRFSS questions. Responses with "don't know, not sure, and refused" were classified as missing. Demographic variables included age, sex assigned at birth, race and ethnicity, marital status, home ownership, education, employment status, health care coverage, and county information.

Measures for Healthy People 2030 SDoH domains:

(1) Social and community context were not directly measured as they involve a variety of concepts such as social cohesion, support, and capital which are not easily operationalized and present within BRFSS. Age, sex assigned at birth, and race, key factors that influence a person's health outcome and overall quality of life, were used as indirect measurements and subsequently adjusted for.
(2) County and neighborhood support were used to measure the neighborhood and the built environment domain. The counties in the state of Hawai'i include Hawai'i, Maui, Honolulu, and Kaua'i county. Counties provide information regarding the resources and development of the built environment while neighborhood support was chosen as it provides information about existing physical activity related infrastructure.
(3) Employment status and poverty level were chosen to measure the economic stability domain based on precedent within existing literature.[22]
(4) Educational attainment was used to measure the education access and quality domain.
(5) Health care coverage and insurance type were chosen to measure the health care access and quality domain as they provide information related to both the access and quality components of this domain.

Age was categorized into 3 age groups including: younger adults (18-44 years), middle aged adults (45-64 years), and older adults (65 years and older). Race was categorized into White, Native Hawaiian, Filipino, Japanese, Other Asian, Pacific Islander (excludes Native Hawaiians), and Other Race groups. The Native Hawaiian category includes full and part Native Hawaiian individuals. Education included 5 categories: never attended school/only kindergarten to 8th grade, some high school (grade 9-11), high school graduate (Grade 12, or GED), some college/technical school (college 1-3 years), and college

graduate (college 4 years, or more). Neighborhood support was determined by the question on if physical activity supporting infrastructure was available within a neighborhood. Poverty levels (0-130%, 131-185%, and 186% or more) were based on the number of children less than 18 years old and adults in a household and annual household income.[23] Health insurance included private, Medicaid, and Medicare coverage. All missing data were reported.

Statistical Analysis

All analyses accounted for the complex survey design using survey weights, clustering, and design strata to represent the state's population.[24-26] Demographic characteristics (age, sex assigned at birth, race/ethnicity, home ownership, household income, employment, education level, health care coverage, and county) were examined by diabetes status and presented as weighted frequencies and 95% confidence intervals (CIs). Chi-square tests were performed to compare the frequency distribution of categorial measures in **Table 1**. Missing responses were included as a missing category but excluded from the multivariable model analysis.

Unadjusted and adjusted multivariable logistic regression models examined the association of diabetes status with each SDoH indicator. Reference groups for each SDoH indicator were based on the normative or largest category. Models were adjusted for race, sex assigned at birth, and age. Results generated from the regression models are presented as odds ratios (ORs) with 95% CIs. All statistical significance was based on $P<.05$. Statistical analysis was performed in SAS Studio version: Release 3.8 Enterprise Edition (SAS Institute, Inc., Cary, NC).

Results

The prevalence of diabetes was 11.0% (CI: 10.4-11.5%) for the total population (**Table 1**). Among age groups, older adults (65+) had the highest diabetes prevalence at 20.7% (CI: 19.3-22.1%). Males had higher diabetes prevalence compared to females at 12.0% (CI: 11.2-12.8%) and 10.3% (CI: 9.5-11.0%). Filipino, Japanese, and Native Hawaiian adults had the highest prevalence of diabetes at 14.4% (CI: 12.7-16.2%), 14.2% (CI: 12.7-15.7%), and 13.2% (CI: 12.0-14.4%), respectively. Diabetes prevalence was higher among adults with health care coverage (11.3%, CI: 10.7-11.9%) compared to those without health care coverage (7.0%, CI: 5.4-8.6%). Education status followed a negative step-wise pattern with fewer adults having diabetes with increasing education levels. Adults who never attended school, or only completed kindergarten to 8th grade had a diabetes prevalence of 18.2% (CI: 11.2-25.3%) compared to 8.4% (CI: 7.7-9.1%) among college graduates.

Table 1. Sociodemographic Characteristics and Prevalence (% [95% Confidence Interval, CI]) of Diabetes Among Adults in Hawai'i from the Hawai'i Behavioral Risk Factor Surveillance System (BRFSS) 2018-2020

Characteristics	Observed Frequency n	Weighted Prevalence % (95% CI)	Diabetes Prevalence % (95% CI)	*P*-value[a]
Total Population	23 338	N/A	11.0 (10.4-11.5)	N/A
Age Group, years				
Young Adult (18-44)	7 494	45.0 (44.1-45.9)	3.5 (2.9-4.0)	<.001
Middle Aged Adult (45-64)	7 779	30.2 (29.5-31.0)	14.3 (13.2-15.4)	
Older Adult (65+)	7 783	23.7 (23.0-24.4)	20.7 (19.3-22.1)	
Missing	282	1.2 (1.1-1.4)		
Sex Assigned at Birth				
Female	12 136	49.6 (48.7-50.5)	10.3 (9.5-11.0)	.002
Male	10 979	48.9 (48.0-49.8)	12.0 (11.2-12.8)	
Missing	223	1.5 (1.3-1.8)		
Race/Ethnicity				
White	8 306	25.7 (25.0-26.4)	6.0 (5.3-6.7)	<.001
Native Hawaiian	4 261	17.6 (17-18.3)	13.2 (12.0-14.4)	
Filipino	2 686	14.9 (14.3-15.6)	14.4 (12.7-16.2)	
Japanese	3 307	17.1 (16.4-17.8)	14.2 (12.7-15.7)	
Other	851	4.7 (4.2-5.1)	10.5 (8.8-12.1)	
Other Asian[b]	2 065	11.9 (11.3-12.5)	12.5 (10.1-14.9)	
Pacific Islander[c]	1 108	5.6 (5.1-6.0)	7.4 (5.0-9.8)	
Missing	754	2.9 (2.6-3.2)		

Table 1. Sociodemographic Characteristics and Prevalence (% [95% Confidence Interval, CI]) of Diabetes Among Adults in Hawai'i from the Hawai'i Behavioral Risk Factor Surveillance System (BRFSS) 2018-2020 (Con't)				
Marital Status				
Divorced	3 102	9.6 (9.2-10.1)	12.6 (11.1-14.2)	<.001
Married	11 627	51.9 (51.0-52.7)	12.1 (11.3-12.9)	
Never Married	5 034	25.4 (24.6-26.2)	6.5 (5.7-7.4)	
Separated	397	1.5 (1.3-1.7)	14.8 (8.4-21.2)	
Unmarried Couple	992	4.5 (4.2-4.9)	6.6 (4.6-8.5)	
Widowed	2 064	6.6 (6.1-7.0)	20.0 (17.2-22.7)	
Missing	122	0.5 (0.4-0.6)		
Home Ownership				
Other arrangement	2 513	10.3 (9.8-10.8)	6.7 (5.5-7.9)	<.001
Own	13 230	62.7 (61.9-63.5)	12.5 (11.8-13.3)	
Rent	7 485	26.4 (25.7-27.1)	9.0 (8.2-9.8)	
Missing	110	0.7 (0.5-0.8)		
Employment Status				
Employed for wages	10 331	50.3 (49.4-51.2)	7.7 (7.1-8.4)	<.001
Homemaker	687	3.3 (2.9-3.6)	7.0 (4.9-9.2)	
Not Employed	1 371	6.2 (5.7-6.6)	9.0 (7.1-10.9)	
Retired	6 445	20.9 (20.3-21.6)	21.3 (19.8-22.8)	
Self-Employed	2 646	10.4 (9.9-10.9)	7.6 (6.2-8.9)	
Student	565	3.9 (3.5-4.3)	1.7 (0.5-2.9)	
Unable to work	1 013	3.6 (3.3-3.9)	24.1 (20.4-27.7)	
Missing	280	1.4 (1.2-1.7)		
Health Coverage				
No	1 415	6.8 (6.3-7.2)	7.0 (5.4-8.6)	<.001
Yes	21 868	92.9 (92.4-93.4)	11.3 (10.7-11.9)	
Missing	55	0.3 (0.2-0.5)		
Education Level				
Never attended school/Less than Grade 8	218	2.2 (1.8-2.6)	18.2 (11.2-25.3)	<.001
Some High School	640	6.1 (5.5-6.7)	15.5 (12-18.9)	
High School Graduate	6 050	28.9 (28.1-29.7)	12.0 (11.0-13.0)	
Some College/ Technical School	6 571	32.8 (32.0-33.7)	11.1 (10.1-12.0)	
College Graduate	9 804	29.7 (29-30.4)	8.4 (7.7-9.1)	
Missing	55	0.2 (0.2-0.3)		
County				
Hawai'i	4 549	13.5 (13.1-13.9)	10.8 (9.7-12)	.154
Honolulu	10 994	65.0 (64.4-65.6)	11.4 (10.7-12.2)	
Kaua'i	2 675	4.7 (4.5-4.8)	11.2 (9.7-12.7)	
Maui	3 986	11.2 (10.9-11.6)	9.9 (8.8-11.1)	
Missing	1 134	5.6 (5.2-6.0)		

[a] *P*-values are based on a chi-square test for Diabetes prevalence
[b] Excludes Filipino and Japanese racial groups
[c] Excludes Native Hawaiian racial group

All SDoH indicators except for county and neighborhood support were associated with diabetes in the unadjusted model and adjusted model for age, sex assigned at birth, and race/ethnicity (**Table 2**). Within the unadjusted model, all household income groups had higher OR's compared to the $75 000 or more reference group. However, in the adjusted model, the $20 000 to $24 999, $25 000 to $34 999, and $50 000 to $74 999 household income groups were not associated with odds of diabetes.

Diabetes status was statistically associated with poverty level and employment status, after adjusting for age, sex and race/ethnicity. However, the employment statuses of homemaker, not employed, and self-employed, and poverty level 186-300% were not associated with diabetes in either model. Adults with diabetes were more likely to be in the 0-100% poverty level (adjusted odds ratio [AOR]: 1.64, CI: 1.36-1.97), and the 101-185% poverty level (AOR: 1.30, CI: 1.10-1.55) compared to the 301% or more poverty group. Adults who are retired (AOR: 1.51, CI: 1.26-1.81) or unable to work (AOR: 2.91, CI: 2.28-3.72) were more likely to have diabetes compared to the individuals employed for wages.

Among education level, diabetes was inversely associated with higher levels of educational attainment. Never attended school/grade 8 or less was not associated with diabetes in the adjusted model but was associated with diabetes in the unadjusted model (AOR: 2.48, CI: 1.53-4.02). Diabetes status was inversely associated with no health care coverage for the unadjusted model (OR: 0.59, CI: 0.46-0.76) but this was not statistically significant in the adjusted model (AOR: 0.78, CI: 0.59-1.02). Among those with health insurance, individuals with Medicare and Medicaid were 1.22 (CI: 1.04-1.44), and 1.58 (CI: 1.23-2.02) times as likely to have diabetes compared to those with private health insurance in the adjusted model.

Table 2. Unadjusted and Adjusted[a] Odds Ratio (OR) and Confidence Intervals (CI) of Diabetes Status by the Social Determinants of Health (SDoH) Domains, Hawai'i Behavioral Risk Factor Surveillance System (BRFSS), 2018 – 2020

SDoH Domain	Unadjusted OR [95% CI]	*P*-value	Adjusted[a] OR [95% CI]	*P*-value
SDoH Domain: Neighborhood and the Built Environment				
County				
Hawai'i	0.94 [0.82-1.09]	.411	0.91 [0.78-1.06]	.211
Honolulu	Ref		Ref	
Kaua'i	0.98 [0.83-1.16]	.820	0.93 [0.78-1.11]	.439
Maui	0.85 [0.74-0.99]	.037	0.86 [0.73-1.01]	.062
Neighborhood Support				
Yes	Ref		Ref	
No	1.06 [0.93-1.19]	.395	0.95 [0.83-1.08]	.399
SDoH Domain: Economic Stability				
Household Income				
Less than $10,000	2.06 [1.54-2.76]	<.001	2.02 [1.43-2.85]	<.001
$10,000 to $14,999	2.41 [1.80-3.23]	<.001	2.01 [1.46-2.76]	<.001
$15,000 to $19,999	1.78 [1.42-2.24]	<.001	1.56 [1.21-2.00]	.001
$20,000 to $24,999	1.37 [1.09-1.72]	.006	1.25 [0.98-1.59]	.075
$25,000 to $34,999	1.47 [1.18-1.82]	.001	1.23 [0.99-1.53]	.057
$35,000 to $49,999	1.68 [1.40-2.02]	<.001	1.48 [1.22-1.80]	<.001
$50,000 to $74,999	1.32 [1.11-1.58]	.002	1.19 [0.98-1.43]	.077
$75,000 or more	Ref		Ref	
Employment Status				
Employed for wages	Ref		Ref	
Homemaker	0.91 [0.64-1.28]	.583	1.04 [0.73-1.50]	.82
Not Employed	1.18 [0.92-1.52]	.193	1.22 [0.93-1.60]	.151
Retired	3.25 [2.85-3.70]	<.001	1.51 [1.26-1.81]	<.001
Self-Employed	0.98 [0.79-1.22]	.840	0.87 [0.70-1.09]	.234
Student	0.20 [0.10-0.43]	<.001	0.47 [0.22-1.00]	.051
Unable to work	3.82 [3.07-4.76]	<.001	2.91 [2.28-3.72]	<.001

Table 2. Unadjusted and Adjusteda Odds Ratio (OR) and Confidence Intervals (CI) of Diabetes Status by the Social Determinants of Health (SDoH) Domains, Hawai'i Behavioral Risk Factor Surveillance System (BRFSS), 2018 – 2020 (Con't)				
Poverty Level				
0-100%	1.42 [1.21-1.66]	<.001	1.64 [1.36-1.97]	<.001
101-185%	1.31 [1.11-1.54]	.001	1.30 [1.10-1.55]	.003
186-300%	0.93 [0.80-1.10]	.394	1.05 [0.89-1.25]	.558
301% or more	Ref		Ref	
SDoH Domain: Education Access and Agency				
Education Level				
Never attended school/ Grade 8 or less	2.48 [1.53-4.02]	<.001	1.31 [0.75-2.29]	.337
Some High School	2.01 [1.52-2.66]	<.001	1.83 [1.34-2.51]	<.001
High School Graduate	1.49 [1.31-1.70]	<.001	1.49 [1.29-1.72]	<.001
Some College/Technical school	1.36 [1.19-1.54]	.002	1.24 [1.08-1.42]	.003
College Graduate	Ref		Ref	
SDoH Domain: Healthcare Access and Agency				
Health Coverage				
No	0.59 [0.46-0.76]	<.001	0.78 [0.59-1.02]	.073
Yes	Ref		Ref	
Health Insurance Type				
Private	Ref		Ref	
Medicaid	1.42 [1.13-1.78]	.002	1.58 [1.23-2.02]	<.001
Medicare	2.08 [1.83-2.36]	<.001	1.22 [1.04-1.44]	.017

[a] Adjusted for age, sex assigned at birth, and race/ethnicity

Discussion

Diabetes status was associated with age, sex assigned at birth, race, education, poverty level, and health coverage. Previous studies have reported associations with diabetes and income, education, the built environment, and race.[27-39] In this study, diabetes status was also associated with economic stability, and other researchers have found similar associations with income and poverty level.[28-29] Research in Hawai'i has demonstrated increased diabetes risk with lower household income.[9] One study utilizing national health data found a stepwise association gradient with increasing diabetes prevalence among the lower income group.[30] Hawai'i has a high cost of living and subsequently a high median household income of $83 173.[40] For this reason, poverty level may be a better indicator of SES than income because it incorporates the cost of living and number of people in the household. SES is a combined measure known to be inversely associated with diabetes. A 2006 study conducted by Borell et al found an association between education and diabetes prevalence, similar to the results of this study.[41]

Having health care is the strongest predictor for diabetes screening among adults,[42] and uninsured adults are more likely to have undiagnosed diabetes because of limited access to medical care.[43] This may explain why not having health care coverage was inversely associated with diabetes status in this study. Health care is important in the diagnosis and monitoring of diabetes by medical professionals. Increased access to adequate health care and resources in remote communities living in rural areas are needed. Limited internet accessibility, public transportation, food, and economic insecurity, far distance from health facility, and social isolation present challenges for at-risk populations from receiving optimal care.[44-46] The COVID-19 pandemic highlighted the persistent challenge populations in remote areas face, especially older adults, in receiving health care and social services.

This study's findings differed from previous findings that found associations between diabetes and the neighborhood and built environment.[27, 31-39] As a multiple-island state, the geographical composition of Hawai'i is different from previously studied locations. The natural environment and wet and dry season climate of Hawai'i promote outdoor recreation that supports more physical activity compared to other geographic locations. The islands in Hawai'i are relatively small compared to other US states, and the short distance between hiking trails and beaches may increase the use of these spaces for physical activity. This may explain why physical activity promotion infrastructure, a measure of neighborhood support, was not statistically associated with diabetes. Overall, the residents of Hawai'i have

the highest life expectancy in the US at 80.7 years which may be attributed to an active lifestyle among many other potential factors.[47] Previous studies have reported large differences in life expectancy by race groups in Hawai‘i.[48] Associations between diabetes and the built environment may exist by race groups, which this study did not assess.

In Hawai‘i, the majority of adults living with diabetes were among minority racial groups with low socioeconomic status, less education, and no health care coverage compared to adults living without diabetes. This study did not stratify by race when examining the SDoH by diabetes. However, a 2019 Hawai‘i BRFSS study reported an association with diabetes and SDoH inequities among those who identified as Japanese, Filipino, Native Hawaiian and Pacific Islander, or Chinese compared to White adults.[9] Another study reported income and education disparities in minority racial groups and diabetes status.[29] Native Hawaiian populations from low SES are at an increased risk of social and health inequities, such as limited access to care and substandard living conditions.[49]

The relationship between the SDoH and diabetes is complex as the SDoH may not only contribute to the development of diabetes but also impact diabetes management. Research on a national level has shown that houselessness, food insecurity, lack of health insurance, and low economic stability all negatively impact diabetes management.[50-53] As many of these factors are similarly associated with diabetes prevalence, more research is needed to tease out the role the SDoH play in the development and management of diabetes. Through new research, targeted interventions may be developed to help improve both diabetes prevention and management.

This study has several limitations. The SDoH among adults living with diabetes were assessed, yet the cross-sectional methodology inhibits causal inferences from being made. It is unclear the directionality of the associations, if the SDoH influenced a person's diabetes status, or if the diabetes status affected the SDoH. The BRFSS collects self-reported information that could lead to information bias. Individuals without a phone, and incarcerated are not included in BRFSS which is a potential source of selection bias. Houselessness is associated with low income, less education, and limited access to care that may lead to undiagnosed and untreated diabetes prevalence. Although this study did not examine houselessness by race, the authors did assess home ownership that included adults who own, rent, or have other living arrangements. Data regarding undiagnosed diabetes were not available, and thus could not be evaluated in the context of the SDoH. It is likely that the prevalence of undiagnosed diabetes is associated and impacted by the various SDoH indicators assessed in this study. The term SDoH is very broad and complex with numerous levels of measures. While this study was able to examine the SDoH in the context of the five domains from the Healthy People 2030 model, other facets such as food, community safety, and more were not assessed in this study. Commonly studied disparities with diabetes such as food insecurity, health literacy, and health care provider availability were not evaluated. Furthermore, confounding factors such as smoking, and obesity were not adjusted for in the multivariable model as the focus of this study was to evaluate the SDoH.

This study adjusted for race, sex assigned at birth, and age. While it is common practice to adjust for race, it is important to note that race is a social construct and a primary driver for SDoH and inequities in income, living conditions, and education especially among communities of color. Race is not an appropriate predictor for various health outcomes and conditions.[54] Instead, the causal effect of race may be better understood through evaluation of social factors such as the SDoH.[55] Previous studies have found that SDoH indicators are better predictors for adverse health outcomes compared to race.[56-57] This study did not compare the predictive power of SDoH indicators versus race. Further research on diabetes and SDoH inequities among race groups is needed.

This study has many strengths. The BRFSS is conducted every year throughout the state of Hawai‘i and uses validated methodology to collect information. The survey also accounts for population weights to be a representative sample of the population. Unlike many studies, Hawai‘i has a diverse minority race/ethnic population and a high representation of NHPI and Asian groups. The NHPI group can be disaggregated into two groups to further assess and better understand each group specific health needs. Key aspects of the SDoH domains were evaluated from the Healthy People 2030 model.

Conclusion

These results add to the growing literature on SDoH, health disparities, and diabetes status in Hawai‘i. A variety of SDoH indicators were statistically associated with lifetime prevalence of health care provider-diagnosed diabetes in Hawai‘i. The study's findings are consistent with other studies, except for neighborhood environment, which evaluated SDoH and diabetes in other populations, supporting that SDoH are associated with general health outcomes and diabetes. Additional research is needed to evaluate the impact of SDoH on diabetes prevalence and incidence within Hawai‘i. Understanding the role SDoH plays on diabetes status is crucial for promoting health equity, building community capacity, and improving diabetes management.

Conflict of Interest

None of the authors identify a conflict of interest.

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Midlife and Older Age Methamphetamine Poisoning Deaths in Hawai‘i

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Abstract

Unintentional and undetermined intent drug overdose fatality records from the State Unintentional Drug Overdose Reporting System (SUDORS) for Hawai‘i from July 1, 2020, to December 31, 2021 revealed that 58.2% of decedents were aged 50 – 75. The main substance associated with cause of death for those aged 50 – 75 years was methamphetamine, followed by a combination of mixed drugs. Of those aged 50 and older, 25.5% died from cardiovascular or neurological complications which were likely to be associated with chronic, long-term methamphetamine use. Based on death investigator narrative reports, 76.5% of the older decedents had a history of substance abuse, suggesting possible long-term substance use starting at a young age. The trajectory of substance use over the life course is often influenced by life events and transitions, which can be stressors. Hawai‘i *kūpuna* (older adults) should be screened for substance use and dependence to ensure that there is treatment if needed, for the entirety of this use trajectory. Also, barriers to *kūpuna* seeking treatment, such as stigma towards drug use should be addressed.

Keywords

substance abuse, overdose, addiction, older adults, midlife

Abbreviations and Acronyms

ED = emergency department
CDC = Centers for Disease Control and Prevention
OUD = opioid use disorder
SUD = substance use disorder
SUDORS = State Unintentional Drug Overdose Reporting System
TEDS-D = Treatment Episode Data Set: Discharges

Introduction

Substance use disorder (SUD) is defined as the recurrent use of drugs, including alcohol and tobacco, which causes significant impairment including health problems, disability, and failure to meet major responsibilities at work, school, or home.[1] Substance use can more often go undetected among older adults compared to younger adults because older adults may be in retirement or no longer have significant or prolonged interactions with the public.[2] Substance abuse can also present differently at an older age compared to a younger age. Symptoms of substance use, dependence, or abuse may be disguised by symptoms of aging or other age-related medical conditions. Dementia, anxiety, or depression are symptoms of SUDs in older adults, which can contribute to SUDs being underdiagnosed in the older adult population without proper screening.[3] Age at start of drug dependency is important to consider when addressing substance use among older adults. Some older adults begin experiencing SUD early in life and live into old age while continuing to abuse substances, and advancements in treatment as well as harm reduction strategies have extended the life span of this group.[4]

Based on National Vital Statistics System data, in 2018 – 2021,[5] among alcohol and/or drug induced deaths in the State of Hawai‘i, 28.3% of deaths were in the age group 60 – 79 years. In contrast, 6.8% of alcohol and/or drug induced deaths in Hawai‘i were among younger decedents, in the age range of 15 – 29 years. According to Hawai‘i State Department of Health, 12.0% of alcohol and / or drug related emergency department (ED) discharges from January 2018 through June 2022, were for patients of aged 65 years and over. In comparison, 2.0% of alcohol and/or drug ED discharges in the same period were for patients aged 18 or younger.[6]

Nationally, Hawai‘i ranks third highest in psychostimulant deaths by state.[7] A psychostimulant is a psychotropic substance with the ability to stimulate the central nervous system, causing excitation, elevated mood, and alertness.[8] These include illicit drugs such as methamphetamine and cocaine, as well as therapeutic drugs such as mixed amphetamine salts (eg, Benzedrine, Adderall), methylphenidate (eg, Ritalin), and modafinil (eg, Provigil).[9] High rates of methamphetamine use has been an ongoing problem in Hawai‘i for decades.

Methamphetamine is a powerful central nervous system stimulant that has well-documented health implications. Studies have shown that methamphetamine use can result in increased heart rate and blood pressure, leading to additional strain on the cardiovascular system.[10] Prolonged or excessive methamphetamine use can result in sustained high heart rates and blood pressure, increasing the risk of serious cardiovascular complications such as arrhythmias, myocardial infarction, and stroke.[11] In addition, chronic use of methamphetamine can exacerbate underlying conditions, such as dilated cardiomyopathy, which is a specifically known as methamphetamine-associated cardiomyopathy.[12] Methamphetamine use has been shown to have significant neural implications, causing long-lasting changes in the brain, particularly in regions associated with reward, motivation, and decision-making.[13] Methamphetamine

use has also been associated with changes in gray and white matter integrity in various brain regions which are involved in cognition, memory, and emotional regulation.[14] Chronic, long-term methamphetamine use has been shown to be associated with increased risk of mental health disorders such as anxiety, depression, and psychosis.[15] It is important to consider these neural and cardiovascular implications when examining SUDs among older adults because this disorder can be disguised as other age-related conditions that are common in older adults. Demographic trends in substance abuse treatment show that the numbers of patients in older age groups are increasing, and are projected to continue increasing, which suggests prolonged use of drugs from younger age into older age.[16] In other words, there may be an aging population of people with SUD.

Many older adults are at higher risk of substance abuse, which is an issue that is underexplored in Hawai'i. While illicit drug use typically declines after young adulthood, nearly 1 million adults aged 65 and older in the U.S. live with a SUD, as reported in 2018 data.[17] While the total number of SUD admissions to treatment facilities in the U.S. between 2000 and 2012 differed slightly, the proportion of admissions of older adults increased from 3.4% to 7.0% during this time.[18] Little is known about the effects of drugs and alcohol on the aging brain. However, older adults typically metabolize substances more slowly, and their brains can be more sensitive to drugs.[19]

The purpose of this study is to examine the extent to which individuals at midlife and old age in Hawai'i are dying from unintentional drug overdose and whether this may be related to chronic, long-term substance dependence.

Methods

The dataset used for analysis is from the State Unintentional Drug Overdose Reporting System (SUDORS), which is part of the Centers for Disease Control and Prevention (CDC) Overdose Data to Action Program and is a state-based surveillance system that collects data on unintentional and undetermined intent drug overdose deaths. Each state collects and abstracts data from death certificates, medical examiner/coroner reports (including scene findings, autopsy reports, and full postmortem toxicology findings), and death investigator narratives (including medical histories from primary care providers, and interviews with decedent family members, spouses/partners, and friends) for entry into a shared web-based CDC platform with the National Violent Death Reporting System.

This study was reviewed by the University of Hawai'i Office of Research Compliance and received an exemption for Institutional Review Board (IRB) approval. This analysis includes SUDORS data for unintentional overdose deaths from July 1, 2020, to December 31, 2021. The data from July to December of 2020 consists of deaths that occurred only in Honolulu County, due to each county having different systems and protocols and the resulting administrative delay in receiving their records in that period. The remaining period from January to December 2021 consists of data from all 4 counties. The following elements were analyzed: age, sex, cause of death, substances associated with cause of death, mental health diagnosis, history of cardiovascular disease, neurological damage, and history of substance abuse through analysis of the death investigator narratives.

The death investigator narrative is a written summary for each incident that captures a description of the fatal overdose incident; provides context about the circumstances of the incident including drug paraphernalia (if any) found at the scene; records medical history from the primary care provider (if any) including any known history of substance use; records interviews with family members and people in relationships with the decedents who had observed the decedents using or abusing drugs; and additional qualitative detail that cannot be quantitatively captured elsewhere in the data abstraction process.

The analytical approach taken was to first determine the extent of older decedents in the dataset. More than half of the cases were decedents aged 50 years and older. The full sample was then sub-divided to older decedents for further descriptive analysis. The age cutoff selected for older adults with SUD was 50 years and older to be consistent with other studies about older adults and SUD and opioid use disorder (OUD).[19-21] As such, the older group of decedents in this sub-sample was aged 50–75 years. The younger group of decedents aged 14–49 years was then used for comparison.

Results

The SUDORS data showed that there were 263 total unintentional and undetermined intent fatal drug overdoses in Hawai'i between July 1, 2020, and December 31, 2021. **Table 1** presents information about the decedent sample. The age range of decedents observed in the sample was 14–75 years old. Male decedents made up 76.4% and female decedents 23.6% of the 263 overdose deaths. From this full enumeration of substance use deaths accessed from the Medical Examiner/Coroner for analysis, the majority (58.2%) were decedents aged 50–79 years. Specifically, 28.1% of all decedents were in the age range 50–59 years, 26.6% of decedents were 60–69 years, and 3.5% of decedents were 70–79 years. In terms of substance types associated with cause of death, 64.3% of deaths were attributed to methamphetamine toxicity while opioid toxicity accounted for 16.4% of deaths. In terms of opioid and methamphetamine combination poisoning, mixed opioid - methamphetamine toxicity accounted for 11.4% of fatal unintentional overdoses. Older decedents aged 50–75 years were more likely to have died of methamphetamine poisoning compared to younger decedents aged 14–49 years (75.8% versus 48.2%). In contrast, younger decedents were more likely to have died from opioid poisoning than older decedents (21.8% versus 12.4%) or from mixed opioid-methamphetamine toxicity (16.4% versus

Table 1. Summary Decedents' Autopsy, Toxicology, Medical History and Death Investigator Narratives, SUDORS Hawai'i Fatal Overdose Data, 7/1/2020 – 12/31/2021

	All Decedents Aged 14 – 75 years N=263 %	Younger Decedents Aged 14 – 49 years n=110 %	Older Decedents Aged 50 – 75 years n=153 %
Sex			
Male	76.4	72.7	79.1
Female	23.6	27.3	20.9
Age Range			
10 - 19	2.3	4.5	
20 - 29	7.2	17.3	
30 - 39	13.7	32.6	
40 - 49	18.6	45.6	
50 - 59	28.1		48.4
60 - 69	26.6		45.7
70 - 79	3.5		5.9
Substance Type(s) Based on Decedent Toxicology	**%**	**%**	**%**
Only Methamphetamine	64.3	48.2	75.8
Only Opioid(s)	16.4	21.8	12.4
Opioid(s) and Methamphetamine Combination	11.4	16.4	7.8
Meth and Other Stimulant(s) Combination	0.8	1.8	None
Other Stimulant(s) Only	2.3	2.7	2
Opioid(s) and Other Stimulant(s) Combination	1.9	4.6	None
Other Drugs (No Opioids or Stimulants)	3	4.6	2
Death Investigator Narrative	**%**	**%**	**%**
Had History of Substance Use	69.6	60	76.5
Polysubstance Use in Cause of Death	23.6	30	19
Medical History of Cardiovascular Disease	43.7	40	46.4
Methamphetamine Use and Neurological Condition in Cause of Death	9.1	6.4	11.1
Methamphetamine Use and Cardiovascular Disease in Cause of Death	12.9	10.9	14.4

SUDORS = State Unintentional Drug Overdose Reporting System

7.8%). More younger decedents died from combinations of stimulants and opioids than older decedents. When studying the death investigators detailed narrative reports, it was found that 30.0% of younger decedents' cause of death was attributed to polysubstance use, defined as more than just a combination of opioids and stimulants, and included prescription medication for non-pain use, and illicit drugs. To a lesser extent, 19.0% of older decedents' cause of death was attributed to polysubstance use.

Next, the dataset showed that a higher proportion of older decedents had a recorded medical history of cardiovascular disease. The medical examiner/coroner record showed that 46.4% of older decedents had a medical history of cardiovascular disease, and 14.4% of older decedents' causes of death were attributed to both methamphetamine use and cardiovascular disease (eg, cardiomyopathy). Finally, based on available medical records in the SUDORS dataset, interviews with primary care providers, family members, and people in relationships with the decedents, 76.5% of older decedents had a history of substance use compared to 60.0% of younger decedents.

Discussion

According to the dataset, most overdose deaths among adults aged 50 years and older involved methamphetamine, and 25.5% of these older adults died from neurological or cardiovascular complications, which is consistent with long-term methamphetamine use over the life course. Additionally, most decedents had a known history of drug abuse. The statistics from **Table 1** strongly suggest that in Hawai'i, people who use drugs long-term tend to use methamphetamine and are far more likely to die from methamphetamine poisoning at midlife and old age as compared to younger age. The trajectory of substance use over the life course is often influenced by life events and transi-

tions, such as changes in education, work, marriage, military, or retirement.[21] As people enter later stages of life, there are many stressors that can increase the likelihood of substance abuse. Precipitants of increased substance use in older age include reduced responsibilities and retirement, caregiving, and bereavement.[22] However, motives for methamphetamine use in older age are largely underexplored. One study suggests that emphasis on quality of life, social isolation, apathy, lack of employment responsibility, comorbid psychiatric and medical illness, and indifference to the risks associated with substance use are factors needing further exploration when studying motivations for substance use among the elderly.[23] There is also some research on the motivations for methamphetamine use among gay and bisexual men over 50 that suggests some use it to enhance sexual experiences.[24]

Additionally, this study found that there were fewer deaths among older adults in Hawai‘i due to other stimulants, or combinations of methamphetamine or opioids with other stimulants when compared to the younger age group. It appears that older decedents tended to only use methamphetamine, instead of mixed drug use, possibly due to preference or availability.

According to the Treatment Episode Data Set-Discharges (TEDS-D) for Hawai‘i in 2020, there were fewer numbers of treatment episodes among persons aged 50 and older compared to younger ages.[25] As seen in our results, there are higher rates of unintentional and undetermined intent fatal overdoses among adults aged 50 and older compared to other age groups. This indicates an intervention opportunity to prevent overdose deaths among older adults by making it a priority to screen Hawai‘i *kūpuna* (older adults) for substance dependence and to offer them treatment support. Furthermore, it is important to address barriers to treatment that this population may experience. There is often stigma and shame surrounding SUD as a disease, which can create more of a challenge for *kūpuna* to recognize or admit that they may need help.

Limitations

A limitation of this study is that the SUDORS data from the 6-month period of July to December 2020 consists of deaths that occurred only in Honolulu County, which made up 76.0% of the total fatal overdose deaths reported to SUDORS for Hawai‘i in that period. This period was included to ensure all available data was analyzed and to increase the sample size. All counties in the state of Hawai‘i were captured in the remaining data.

Conclusion

More research is needed to expand understanding of older adults struggling with addiction in Hawai‘i. There is much attention towards addiction at younger age, but there needs to be more recognition of this issue among those in midlife and older age as well. Because of stigma, older adults who use drugs may be concealing, or unable to recognize, their addiction. The authors propose 3 public health recommendations to address this issue. The first recommendation is to engage older adult groups in the community to openly talk about drug use, particularly methamphetamine use, through key informant interviews, focus groups, and special interest groups such as the Executive Office on Aging Policy Advisory Board for Elder Affairs. Second, is to empower them to seek treatment by taking steps to reduce stigma and barriers through community education and outreach. Third, it is important to for providers to recognize mental health issues that commonly arise from age-related changes, such as dementia and memory loss, as well as life transitions in older age, and how they can affect substance use. Screening for SUD among older adults who have dementia, anxiety and depression may help address this issue. Providers should also take an age-sensitive and age-specific treatment approach.

Conflict of Interest

None of the authors identify any conflict of interest.

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Kaua‘i Rural and Public Health Selective: A Family Medicine Residency First

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Abstract

Governmental public health professionals and community physicians often have limited understanding of each other's roles and responsibilities. To increase the connection between public health and primary care as well as to incorporate rural health care in graduate medical education training, a new "Kaua‘i Rural and Public Health Selective" brings Family Medicine resident physicians (Residents) into the local health department on Kaua‘i. This first-time collaboration between the Kaua‘i District Health Office (KDHO) and University of Hawai‘i John A. Burns School of Medicine (JABSOM) Family Medicine Residency Program advances Residents' understanding of public health and has been well-received by Residents and by department of health staff. Future plans include evaluation and continued incorporation of public health experiences into the core curriculum of a rural Family Medicine residency training program based on Kaua‘i.

Acronyms

ACGME = Accreditation Council for Graduate Medical Education
CASPER = Community Assessment for Public Health Emergency Response
CDC = Centers for Disease Control and Prevention
CHW = community health worker
DHO = district health officer
FQHC = federally qualified health center
HLH = Ho‘ola Lahui Hawai‘i
JABSOM = John A. Burns School of Medicine
KDHO = Kaua‘i District Health Office
PGY 3 = post graduate year 3
UH = University of Hawai‘i

Problem Statement

The COVID-19 pandemic demonstrated the importance of collaboration between public health professionals and health care providers.[1] Yet health care providers and public health professionals frequently have little practical understanding of each other's intersecting roles and responsibilities. In rural communities, this interdependence is arguably more pronounced. With limited local resources and significant geographic barriers to accessing additional resources in Hawai‘i, close collaboration is essential to making the most efficient use of clinical and public health capabilities in managing public health issues. Additionally, as of July 2023, Accreditation Council for Graduate Medical Education (ACGME) requirements for Family Medicine place a strong emphasis on training Residents to address community health and incorporate community-oriented primary care, a model of health care that integrates public health and primary care.[2]

Methods

The University of Hawai‘i (UH) John A. Burns School of Medicine (JABSOM) Family Medicine Residency Program Director and the Kaua‘i District Health Officer (DHO) developed the 4-week "Kaua‘i Rural and Public Health Selective" to be offered to third year (PGY3) Family Medicine Residents. They spend half of their time in the outpatient clinics of Ho‘ola Lahui Hawai‘i (HLH), which is Kaua‘i's federally qualified health center (FQHC) and Native Hawaiian Health clinic, where they work with community Family Medicine physicians to provide primary care to patients. The other half of their time is spent at the Kaua‘i District Health Office (KDHO) working alongside and learning from public health frontline staff. Assigned public health readings introduce Residents to Foundational Public Health, Health Equity, Community Health Needs Assessments, the Centers for Disease Control and Prevention's (CDC) Morbidity and Mortality Weekly Report, Health Impacts of Climate Change, and several other related topics.

Goals of the experience are to:

- Enhance Resident understanding of the breadth and depth of local governmental public health practice.
- Broaden Resident understanding of health conditions to include root causes which may be amenable to systems and policy level interventions.

• Deepen Resident understanding of health equity and "social determinants of health" to include consideration of community and structural features that perpetuate systems of inequity.

Objectives include having Residents:

• Participate in a wide variety of public health activities, including activities serving diverse communities of Kaua'i.
• Identify a public health issue of interest and explore its impacts on health, health equity and potential advocacy, systems, and policy approaches to addressing those impacts.
• Describe at least 3 ways in which primary care and public health intersect.

Residents spend time with the physician DHO attending local, statewide, and national meetings and workgroups. They accompany KDHO staff in a broad range of field activities. Specific activities are driven by program schedules and the vicissitudes of public health events.

Four Residents completed the selective in the first year. On average, each Resident participated in 21 distinct field activities (range 20-22). Activities undertaken by the first cohort are listed in **Table 1**. Those in **boldface** were experienced by all 4 Residents.

Results

This is the first official collaboration between a residency program and a district health office in Hawai'i and the first time that Residents have been offered a focused experience in governmental public health. Resident feedback has been overwhelmingly positive, citing the rotation as highly valuable for their training as primary care physicians integrated in the community. Residents strongly prefer experiential activities over didactics: "Let us join you while you do your work; don't just tell us about it." Staff also prefer this approach.

Specific comments from Residents include:

• "I've been a bad doctor. I'll do better from now on!" (regarding disease reporting)
• "Now when I tell a patient with suspected mosquito-borne disease that the health department will come check for mosquitoes around their house, I'll be able to tell them exactly what to expect."
• "Now I can really tell people what ocean water health advisories mean, including their limitations."
• "I never knew about cesspools!"
• "This is one of the best rotations of my residency."
• "There's so much I didn't know about public health. I wish I'd learned earlier."

Each participant produced 2 end-of-rotation deliverables:

(1). Reflective essay on either the relationship between primary care and public health, or the ways in which local public health promotes health equity; and
(2). Final presentation to KDHO staff and to residency peers, on a public health topic explored during the rotation.

Final papers and presentations reflected Residents' experiences and provided an opportunity for Residents to synthesize their learning.

Two Residents wrote about health equity, noting that the multilingual/multicultural CHW team "meets people where they are" in their language of choice. Seeing the work in action on the field brought home the value of this approach. For example, Play Streets Kaua'i promotes healthy behaviors and physical activity in an easily accessible, but underutilized neighborhood park, near where people live. It was noted that KDHO staff pays close attention to providing services and promoting health *for all* in the community.

Two Residents wrote about the intersection of primary care and public health. The Maui fire response required both individual health care and population level services. Shared responsibility for serving Hawai'i's diverse communities and remaining cognizant of the multi-generational impacts of colonization were cited, as were water rights and rebuilding Lahaina. They noted that clear, consistent public health messaging supports primary care providers, and that coordination between public health and clinicians improves the efficacy of both.

A presentation about ocean-water monitoring described the process from beach-front water sampling, to laboratory testing, and finally to public sharing of water quality data. The Resident highlighted the complexity and limitations of the measures used. A presentation on substance use and abuse explored local community resources. Presentations on food insecurity and on the intersection of climate change, water, and health explored systems and policy opportunities for change.

KDHO staff attending these presentations reported that they were informative and engaging. Attendance by staff increased with each subsequent Resident, indicating that the presentations were considered worthwhile and enjoyable.

Upon returning to O'ahu, Residents delivered a version of this presentation to their Resident colleagues, faculty, and in one case, to prospective residency applicants. The topics proved to be stimulating and novel, often providing systems-based learning with a broader scope than a clinical case presentation. Presenters demonstrated enthusiasm in sharing their experience, which in turn has generated interest for other junior Residents to participate in this rotation in the future.

Table 1. Public Health Field Activities in Kaua‘i Involving Family Medicine Residents Academic year July 2023-June 2024	
Public Health Area	Activities
Communicable disease control	• **Disease outbreak/reporting response protocols** • Hansens' Disease clinic, including newly diagnosed case • Subsequent encounter with same patient at HLH • Response to suspected arboviral disease • Review of leptospirosis data, reporting requirements, and surveillance methods • Long term care facility disease outbreak control visit • CDC Clinician Outreach and Communication Activity call reviewing updated respiratory season vaccine guidelines • Infection control training "Escape Room" style
Epidemiology and data use	• **Introduction to Public Health Epidemiology** • In-person discussion with epidemiologist and team • Lunch & Learn: Public Health Surveillance • Community Health Needs Assessment—introduction • Policy Map health mapping tool demonstration
Public health nursing	• **Program overview** • Meeting with School Health Assistants • Home visits • Tuberculosis case management
Developmental disabilities case management	• **Program overview** • **Children with Special Health Needs program overview**
Vital records	• **Birth and death registration processes** • Home birth registration
Public health emergency preparedness and response	• **Program introduction** • **Community Assessment for Public Health Emergency Response (CASPER)/Rapid Needs Assessment methodologies and applications** • Statewide Maui Fire emergency response coordination call • Medical Reserve Corps quarterly meeting
Community engagement and outreach	• **Community outreach and home visits with multi-lingual community health worker (CHW) team including Marshallese, Ni‘ihau/Hawaiian, and Filipino communities** • Play Streets Kaua‘i community event • Community outreach at Salvation Army, Malama Kaua‘i (local food production organization), Kaua‘i Economic Opportunity (homeless serving organization) • Statewide training on community engagement and health education • Community Health Fair
Health promotion	• **Chronic Disease Prevention/Health Promotion program overview** • KDHO "walk with a doc" • Agency on Elderly Affairs annual symposium
Water quality	• Clean Water Branch ocean water sampling & testing
Food safety	• Restaurant inspections
Vector control	• **Site visit/program overview** • Dengue fever field activities—mosquito surveillance and abatement field activities
Maternal, child, adolescent health	• **Family Health Services overview** • Site visits: WIC, community resource kiosk • Kaua‘i Abortion Access Alliance meeting • Maternal Mortality Review • Safe Infant Sleep workgroup meeting
Mental Health/Behavioral Health	• **Child & Adolescent Mental Health services overview** • Meet with substance use treatment physician (in response to Resident interest) • Friendship House site visit (serves individuals with serious mental illness transitioning into workforce)
Equity	• **Readings and discussion with DHO and KDHO staff** • Native Hawaiian Healing workshop (arranged independently) • Office of Health Equity strategic planning meeting
Leadership meetings	• **Discussion with DHO** • DOH Director • National Association of County and City Health Officials Board of Directors • Lihu‘e Business Association, Mayor's community resiliency presentation • Kaua‘i Wellness Partnership • KDHO Management Team

KDHO staff were encouraged to work with Residents, but doing so was voluntary. Some had workload concerns, and some had concerns about having their work observed by outsiders. As staff gained experience precepting, they expressed increased comfort and confidence in that role, along with recognition that they have a great deal to offer these physicians in training.

The clinical aspect of the rotation took place at HLH. Residents worked with Family Medicine physicians to provide primary care to a diverse patient population in a rural underserved area. The Residents were able to witness the intersection of the KDHO and outpatient care, including an example where KDHO staff accompanied a patient to their clinic visit to assist in care coordination. The Residents also had opportunities to learn about traditional Native Hawaiian healing practices through work with a practitioner from HLH La'au Lapa'au and participating in an event with community La'au Lapa'au practitioners that included practices such as Lauhala weaving. One Resident was also able to work in the Waimea Clinic to work directly with Native Hawaiian patients from Ni'ihau. Additionally, the FQHC started a mobile outreach clinic to provide care around the island in underserved communities, particularly those that included the houseless. The mobile outreach clinic team includes a Family Medicine physician, social worker, registered nurse, medical assistant, and receptionist. Given the recent start of the mobile outreach clinic, only 1 Resident was able to participate. However, this is expected to be incorporated into the rotation in the future.

Future Directions

This collaboration has enriched Family Medicine Residents and public health staff. Resident comments, written assignments, and final presentations indicate goals are being well met. One Resident at a time, no more than 6 times per year, is proving to be entirely manageable for this health department of about 70 staff serving a population of 75 000. Training in the preceptor role and sharing of best practices will continue to make this a feasible activity for KDHO staff.

The Kaua'i Rural and Public Health Selective is being offered again in the coming year. Interest among the next cohort of PGY3 Residents will be a good indication of the success of this first year's effort.

Additional activities available to Residents will include:

- Participate in a CASPER survey
- School-based influenza vaccination clinics
- National Public Health Week open-house
- Day program for developmentally disabled adults
- Emergency Preparedness trainings
- National Violent Death Reporting System training
- Child and/or Domestic Violence death reviews
- Child Abuse/Neglect and Domestic Violence prevention workgroups
- HIV/AIDS and STD community outreach
- Individual Service/Education Plan meetings
- Suicide Prevention Task Force
- Expanded participation in HLH's mobile outreach clinics.

UH JABSOM currently has a Health Resources and Services Administration planning grant to implement a Rural Family Medicine Residency Program on Kaua'i. The residency program is expected to be highly community-based and community-engaged, including core curricular experiences with KDHO. The Rural and Public Health Selective will inform public health components of that curriculum as it is developed and serves to meet the new ACGME program requirements for Family Medicine. If KDHO and HLH capacity and Resident interest continue, the Selective could continue for O'ahu-based Family Medicine Residents alongside the new Kaua'i Residency program.

This initiative may be applicable for others working to enhance coordination between public health and health care providers. Experiences with rural health care during training have been shown to increase the likelihood for physicians to pursue rural practice after graduation.[3] Therefore this rotation has implications for workforce development for rural areas of Hawai'i that have an urgent physician shortage. Future directions include replicating aspects of this experience in other local public health offices and further evaluating impacts on knowledge, skills, and behaviors of participating Resident physicians, as well as working to strengthen precepting skills of KDHO staff.

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Medical School Hotline

One Health in Medical Education: A Proposed Framework

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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; HJH&SW Contributing Editor.

Abstract

The One Health concept focuses on the interconnections between human health, animal health, and the environment, stressing the need for interdisciplinary collaborations to address complex issues such as the health challenges posed by climate change and global pandemics. One Health is a central part of the curriculum of veterinary schools, however, it is rarely incorporated into medical school education. Nationally, there are limited examples of formal One Health education and training for medical students. To incorporate One Health into its curriculum, John A. Burns School of Medicine developed a Dean's Certificate of Distinction in One Health that consists of a One Health foundational course, a clinical One Health elective course, participation in the One Health Interest Group, engagement in One Health educational and outreach activities, and a One Health research or curriculum development project. To the authors' knowledge, this is the first One Health certificate program developed and implemented in any Association of American Medical Colleges accredited medical school. Although introducing similar programs into medical curricula will continue to be challenging, we hope it will serve as a framework for other academic institutions.

Keywords

One Health; Dean's Certificate of Distinction; medical education; multidisciplinary

Abbreviations and Acronyms

AAMC = Association of American Medical Colleges
CDC = Centers for Disease Control and Prevention
COD = Dean's Certificate of Distinction in One Health
JABSOM = John A. Burns School of Medicine
NOAA = National Oceanic and Atmospheric Administration
UCD = University of California, Davis
USDA = United States Department of Agriculture

Introduction

One Health is a multidisciplinary and emerging concept that recognizes the interconnections between human, animal, and environmental health, a concept that is an integral component of veterinary education[1] but is not universally incorporated into medical school curricula. It emphasizes collaboration between professional fields and has gained greater significance due to the interdisciplinary approaches required to address current health challenges due to the COVID-19 pandemic and climate change.[2]

The recognition of the interrelationship between animal and human health dates back to the 1800s[3] and has increased in prominence in recent years, now including the concept of ecosystem health. In 2004, an international symposium of worldwide health experts established the Manhattan Principles to provide a more holistic approach to preventing epidemic/epizootic disease and maintaining ecosystem integrity.[4] The US Centers for Disease Control and Prevention (CDC) established the CDC One Health Office in 2009,[3] and in 2022 a comprehensive One Health Joint Plan of Action was endorsed by the Quadripartite organization consisting of 4 agencies: the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Program (UNEP), the World Health Organization (WHO), and the World Organization for Animal Health (WOAH).[5] These developments provided corroboration that a One Health approach is needed to solve problems threatening humans, animals, and the environment.

The One Health concept was introduced into veterinary medical education in the 1960s[6] and in 2011 the Association of American Veterinary Colleges recommended that all veterinary students achieve competency in 3 areas: clinical, professional, and One Health.[7] The University of California, Davis, (UCD) School of Veterinary Medicine created the One Health Institute, which allows students to participate in medical, public health, and conservation projects.[8] Nevertheless, this concept is not uniformly included in US medical education, leaving a massive, untapped opportunity for interdisciplinary collaboration and global health advancement.[9] For the few US medical schools with One Health

as part of their curricula, student participation remains limited and opportunities vary.[9] A survey of 133 American medical schools in 2020 found that only 56% included One Health in some form, ranging from minor references in Microbiology to elective courses focused on One Health.[9] One example is Washington University School of Medicine that partnered with the Saint Louis Zoo and the University of Missouri's College of Veterinary Medicine to provide One Health exposure consisting of veterinary hospital tours, a One Health fair and conference, and health care professional presentations.[10] Another example is Georgetown University School of Medicine which offers an introductory lecture-based elective course exploring various One Health topics.[9] Harvard Medical School offers one of the most interactive One Health elective courses, where students shadow the daily clinical practice of veterinarians at the Franklin Park Zoo.[9] Though these offerings hold promise, there is considerable potential for expansion and commitment to provide opportunities to familiarize medical students with this approach.

The John A. Burns School of Medicine (JABSOM) at the University of Hawai'i at Mānoa recently implemented a Dean's Certificate of Distinction (COD) in One Health in May 2022. COD students are provided opportunities to view medicine through the One Health lens throughout the 4 years of medical school, ranging from course electives to school-wide symposiums to clinical rotations at the Honolulu Zoo. The COD also outlines various avenues for students to pursue their One Health-related interests, including research opportunities, in collaboration with local One Health stakeholders.

Certificate Program Development

The JABSOM COD in One Health was established to provide opportunities for medical students to engage in education and research centered on One Health. At the outset, JABSOM One Health program leaders reached out to stakeholders across different organizations, collaborated with medical education faculty, and gauged student interest. Then created a logic model detailing the necessary inputs, activities, outputs, and outcomes to be achieved through the COD program (**Figure 1**). Required inputs included resources provided by stakeholders, students, faculty, and guidance from the JABSOM Office of Medical Education. These resources led to the creation of a range of activities throughout the 4-year medical curriculum that included One Health courses, symposia, community outreach events, interdisciplinary lectures and workshops, the creation of a One Health interest group, and the development of a clinical practicum in One Health. The JABSOM One Health COD curriculum spans over all 4 years of medical school (**Figure 2**).

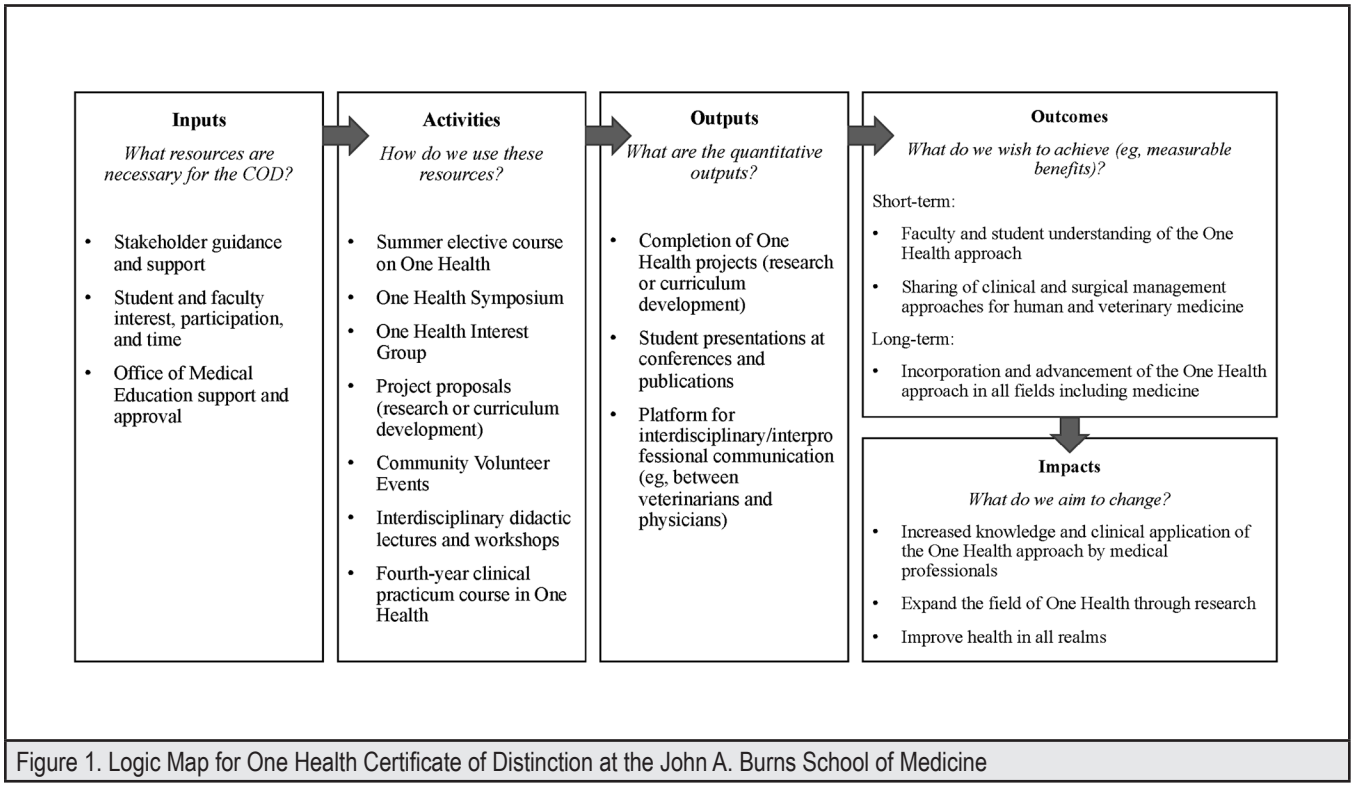

Figure 1. Logic Map for One Health Certificate of Distinction at the John A. Burns School of Medicine

COD= certificate of distinction

Year 1	Year 2	Year 3	Year 4

• Enroll in One Health COD program
• Introduction to One Health Course (summer)
• One Health interest group meetings
• Participate in One Health activities:
  • Seminar or workshop presentations
  • JABSOM sustainability or One Health event
  • Interdisciplinary workshop on One Health
  • Community volunteer activity related to One Health
• Complete entry survey
• Prepare COD individual development plan (IDP)
	• One Health interest group meetings
	• Participate in One Health activities:
	  • Seminar or workshop presentations
	  • JABSOM sustainability or One Health event
	  • Interdisciplinary workshop on One Health
	  • Community volunteer activity related to One Health
	• Develop and present a One Health project proposal (research or curriculum development)
	• Annual reflection and discussion of progress on COD with One Health advisor
		• One Health interest group meetings
		• Work on the One Health project proposed in Year 2
		• Organize one of the following leadership or mentoring activities:
		  • Guest speaker for One Health
		  • JABSOM sustainability or One Health event
		  • Interdisciplinary workshop on One Health
		  • One Health education for pre-health/pre-law students
		• Annual reflection and discussion of progress on COD with One Health advisor
			• One Health interest group meetings
			• Practicum experience in One Health
			  • Clinical One Health elective, or
			  • Interdisciplinary One Health experience with community organization
			• Complete and present the One Health project to a public audience (medical school symposium or other approved meeting)
			• Complete exit survey
			• Discuss COD IDP accomplishments and provide feedback on COD experience with One Health advisor

Figure 2. One Health Certificate of Distinction Curriculum at the John A. Burns School of Medicine

COD= certificate of distinction; IDP=Individual Development Plan

The quantitative outputs of the program include the completion of a One Health research or curriculum development project, dissemination of the project outcomes in a conference presentation or publication, and One Health events engaging veterinarians, physicians, and environmental scientists.

Short-term outcomes of the program are increased understanding of the One Health approach by faculty and students and sharing of clinical approaches used in human and veterinary medicine. Long-term outcomes are the broad integration of One Health in all fields, including human medicine. The projected impacts of the program are to assimilate the One Health approach into standard medical practice, to expand One Health knowledge, and to enhance health in all realms: human, animal, and environmental.

The authors investigated the format of the other JABSOM certificate programs to create a similar, standardized curriculum. They partnered with stakeholders from different disciplines including the Honolulu Zoo veterinarian, community veterinarians, scientists from the National Oceanic and Atmospheric Administration (NOAA), and faculty from the JABSOM Department of Tropical Medicine, Medical Microbiology & Pharmacology, the College of Tropical Agriculture and Human Resources, Department of Human Nutrition, Food and Animal Sciences, and the Thompson School of Social Work & Public Health, Office of Public Health Studies.

First- and second-year medical students are eligible to enroll in the COD program. The application process for students interested in participating in the COD program includes completing an online form and meeting with the One Health Advisor to discuss program requirements. The certificate program requires satisfactory completion of the One Health COD curriculum requirements by April 1st of the graduating year. Participants who complete the curricular elements are awarded the COD by the JABSOM Dean at graduation.. The current cohort of participants for the One Health COD includes 1 fourth-year, 5 third-year, 1 second-year, and 3 first-year medical students.

Outreach & Collaborative Activities

To date, outreach activities have included a beach clean-up in partnership with NOAA in November 2023 and activities in January 2024 during the internationally proclaimed One Health Awareness Month. The beach clean-up included a presentation by Dr. Diana Kramer, the Regional Stranding Coordinator for NOAA Fisheries, on the application of the One Health approach for the preservation, recovery, and stewardship of marine protected species and the ocean ecosystem in Hawai‘i. A collaborative activity in February 2022 was a journal club meeting of medical students from JABSOM and veterinary students from the UCD School of Veterinary Medicine. The meeting topic was the potential of sequential antibiotic therapy as a means for controlling the emergence of antimicrobial resistance.[11, 12]

Other interdisciplinary One Health Month activities made available to the entire medical school included seminars presented by Dr. Neil Vezeau, a United States Department of Agriculture (USDA) Food Safety Veterinarian, on the One Health approach to the Maui wildfires, and from JABSOM faculty Dr. Elizabeth Kiefer on the effects of climate change on health. The month's activities also included a community display to increase public awareness of One Health and a JABSOM Walks for Aloha community event featuring a One Health talk by Dr. Sandra Chang.

Curriculum Development

A JABSOM One Health Symposium for first- and second-year medical students was held in September 2022. The symposium was organized by One Health Interest Group members and JABSOM One Health faculty. This symposium included presentations by Dr. Bonnie Buntain, a national One Health expert; Dr. Jill Yoshicedo, the Honolulu Zoo chief veterinarian; and Dr. Michelle Barbieri from NOAA. JABSOM Tropical Medicine faculty and graduate students assisted in leading case study breakout sessions. The symposium was attended by 163 individuals representing the entire first- and second-year medical student classes. In addition to the symposium, work is in progress to introduce One Health concepts into problem-based learning case modules.

Scientific Research

Medical students enrolled in the COD are working on research projects with the Honolulu Zoo veterinarian, Dr. Jill Yoshicedo, to address clinical problems and compose case reports relating to animal health. During the summer of 2022, 3 medical students studied the causes of morbidity and mortality of zoo animals over the past 10 years to identify potential common risk factors for infectious and non-infectious diseases in zoo animals and to compare these risk factors to those associated with human disease.

Presentations

Students developed posters for a One Health symposium held at UCD in October 2022. One COD student presented his experiences as a participant in the One Health COD program at the 21st Federation of Asian Veterinary Associations Congress in Fukuoka Japan in November 2022. In February 2023, a group of medical, graduate, and undergraduate students participated in an invited poster presentation on UH One Health initiatives at the UH Mānoa Research Day at the Hawai'i State Capitol Building. Finally, an overview of the COD program was presented by a One Health interest group representative at the April 2024 Biomedical Sciences Symposium to increase awareness of One Health opportunities at JABSOM.

Discussion

The JABSOM COD in One Health allows interested medical students to further their study of One Health by developing a deep knowledge base on this topic, applying this knowledge to address clinical problems, and sharing and communicating this knowledge to their peers and the general public. To the authors' knowledge, this is the first certificate curriculum in One Health developed at an AAMC-accredited medical school. Other medical schools cite various reasons for One Health's minimal inclusion in medical school curricula, including limited time for additional content in the medical school curriculum, geographic paucity of veterinary partners, and lack of health care professionals sufficiently well-versed in One Health to serve as faculty.[9] The fact that JABSOM is a community-based medical school positions it well to provide collaborative, interdisciplinary training, leveraging existing relationships with local community organizations, state government agencies, and affiliated healthcare professionals as One Health resources.

Although the direct impact of a One Health approach on physician success has yet to be determined, the recent breakthroughs in medical research obtained using One Health perspectives are encouraging. For example, comparative oncology has brought together veterinarians, physicians, and researchers to discover novel therapeutic solutions for cancers including lymphomas, osteosarcoma, and melanomas.[13] The recent development of *One Health Advances,* a journal dedicated to advancing One Health-related topics such as antimicrobial resistance, zoonotic diseases, and food safety showcases the need for medical professionals to understand the interdependence of animal, human, and environmental health.[14] Following the graduation of One Health COD cohorts, the outcomes of this curriculum will be evaluated and quantitative and qualitative data on student experiences and program outcomes will be documented.

In conclusion, the One Health COD is a novel multidisciplinary approach to educating medical students about a concept relevant to a wide range of clinical settings. The hope is to create One Health practitioners capable of breaking down silos and creating interdisciplinary collaborations to improve health outcomes across human, animal, and plant ecosystems.[15] Integrating the concept of One Health into medical curricula will continue to be challenging, but the hope is that this will serve as a framework for other academic settings. Through the COD, medical students will gain One Health competencies enabling them to provide improved patient care and promote health for all species.

Conflict of Interest

None of the authors identify a conflict of interest.

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Guidelines for Publication of Hawai'i Journal of Health & Social Welfare Supplements

The Hawai'i Journal of Health & Social Welfare (HJH&SW) partners with organizations, university divisions, and other research units to produce topic-specific issues of the journal known as supplements. Supplements must have educational value, be useful to HJH&SW readers, and contain data not previously published elsewhere. Each supplement must have a sponsor(s) who will work with the HJH&SW staff to coordinate all steps of the process. Please contact the editors at hjhsw@hawaii.edu for more information if you would like to pursue creating a supplement.

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2. Supplements should treat broad topics in an impartial and unbiased manner. They must have educational value, be useful to HJH&SW readership, and contain data not previously published elsewhere.

3. Supplements must have a sponsor who will act as the guest editor of the supplement. The sponsor will be responsible for every step of the publication process including development of the theme/concept, peer review, editing, preliminary copy editing (ie, proof reading and first round of copy editing), and marketing of the publication. HJH&SW staff will only be involved in layout, final copy editing and reviewing final proofs. It is important that the sponsor is aware of all steps to publication. The sponsor will:

a. Be the point of contact with HJH&SW for all issues pertaining to the supplement.

b. Solicit and curate articles for the supplement.

c. Establish and oversee a peer review process that ensures the accuracy and validity of the articles.

d. Ensure that all articles adhere to the guidelines set forth in journal's Instructions to Authors page (https://hawaiijournalhealth.org/authors.htm), especially the instructions for manuscript preparation and the statistical guidelines.

e. Obtain a signed Copyright Transfer Agreement for each article from all authors.

f. Comply with all federal, state, and local laws, rules, and regulations that may be applicable in connection with the publication, including ensuring that no protected health information appears in any article.

g. Work with the editorial staff to create and adhere to a timeline for the publication of the supplement.

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4. Upon commissioning a supplement, the sponsor will be asked to establish a timeline for the issue which the sponsor and the HJH&SW editor(s) will sign. The following activities will be agreed upon with journal publication to take place no later than 24 months after signing. Extensions past the 24 months will be subject to additional fees based on journal publication rates at that time:

- Final date to submit a list of all articles, with working titles and authors
- Final date for submitting Word documents for copy editing
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Revised 3/21/23

Hawai‘i Journal of Health & Social Welfare
Style Guide for the Use of Native Hawaiian Words and Diacritical Markings

The HJH&SW encourages authors to use the appropriate diacritical markings (the ‘okina and the kahakō) for all Hawaiian words. We recommend verifying words with the Hawaiian Language Dictionary (http://www.wehewehe.org/) or with the University of Hawai‘i Hawaiian Language Online (http://www.hawaii.edu/site/info/diacritics.php).

Authors should also note that Hawaiian refers to people of Native Hawaiian descent. People who live in Hawai‘i are referred to as Hawai‘i residents.

Hawaiian words that are not proper nouns (such as keiki and kūpuna) should be written in italics throughout the manuscript, and a definition should be provided in parentheses the first time the word is used in the manuscript.

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Hawai‘i	**Lāna‘i**	**‘ohana**
kūpuna	**Mānoa**	**Wai‘anae**

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