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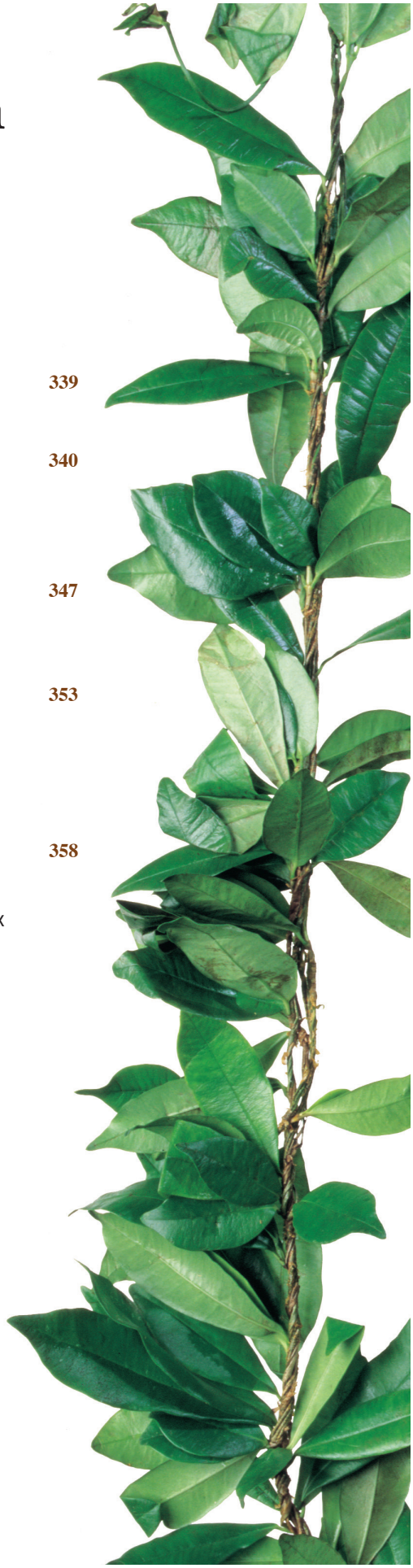

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Aim:
The aim of the Hawai‘i Journal of Health & Social Welfare is to advance knowledge about health and social welfare, with a focus on the diverse peoples and unique environments of Hawai‘i and the Pacific region.

History:
In 1941, a journal then called The Hawai‘i Medical Journal was founded by the Hawai‘i Medical Association (HMA). The HMA had been incorporated in 1856 under the Hawaiian monarchy. In 2008, a separate journal called the Hawai‘i Journal of Public Health was established by a collaborative effort between the Hawai‘i State Department of Health and the University of Hawai‘i at Mānoa Office of Public Health Studies. In 2012, these two journals merged to form the Hawai‘i Journal of Medicine & Public Health, and this journal continued to be supported by the Hawai‘i State Department of Health and the John A. Burns School of Medicine.

In 2018, the number of partners providing financial backing for the journal expanded, and to reflect this expansion the name of the journal was changed in 2019 to the Hawai‘i Journal of Health & Social Welfare. The lead academic partners are now the six units of the UH College of Health Sciences and Social Welfare, including the John A. Burns School of Medicine, UH Public Health, the Myron B. Thompson School of Social Work, the School of Nursing and Dental Hygiene, the UH Cancer Center, and the Daniel K. Inouye College of Pharmacy. Other partners are the Hawai‘i State Department of Health and the UH Office of the Vice Chancellor for Research. The journal is fiscally managed by University Health Partners of Hawai‘i.

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Hawai'i Journal Watch

Karen Rowan MS

Highlights of recent research from the University of Hawai'i and the Hawai'i State Department of Health

Passing and Implementing Restrictions on Flavored Tobacco Products

To successfully pass and implement policies that restrict the sale or use of flavored tobacco products, public health advocates should focus on engaging community partners and retailers. Researchers including Rebekah Rodericks, MSc, of the Office of Public Health Studies, interviewed 17 key informants with expertise in flavored tobacco bans in the US and Canada, and analyzed transcripts of the interviews for key themes. Results showed that comprehensive bans on the products were more effective and easier to enforce than partial bans, that media campaigns to raise awareness were important, and that education of retailers was crucial. Partnering with community advocates can help in eliciting support from elected officials and addressing resistance. The findings also suggested a 6-month preparation period is beneficial for successful implementation of new policies. Overall, the study demonstrated that tobacco policy experts are engaged in knowledge sharing and building on efforts across jurisdictions.

- Peck K, Rodericks R, Irvin L, et al. Identifying best practices in adoption, implementation and enforcement of flavoured tobacco product restrictions and bans: Lessons from experts. *Tob Control*. 2020;tobaccocontrol-2020-055884. doi:10.1136/tobaccocontrol-2020-055884

A Blood Test for microRNA Tracks with Colorectal Cancer Stage

A strong relationship has been found between people's levels of certain microRNA (miR) molecules measured from a blood sample and their stage of colorectal cancer (CRC). Researchers including Scott Kuwada, MD, of the UH Cancer Center, investigated 4 types of miR in 73 people with CRC and 18 healthy controls. Participants lived in Hawai'i or Japan and were an ethnically diverse group. The researchers measured the levels of these miRs in extracellular vesicles in the blood as well as "non-vesicular" miR in the plasma. Results showed that for 3 of the 4 miRs examined, the ratio of non-vesicular to extracellular vesicle miR correlated with CRC stage, compared to controls. In general, the levels of all 4 miRs in extracellular vesicles were lower in participants with more advanced CRC. The researchers concluded more study is needed to determine the utility of measuring miR levels in cancer screening.

- Shiosaki J, Tiirikainen M, Peplowska K, et al. Serum micro-RNA identifies early stage colorectal cancer in a multi-ethnic population. *Asian Pac J Cancer Prev*. 2020;21(10):3019-3026. doi:10.31557/APJCP.2020.21.10.3019

Shark-Related Injuries in Hawai'i

Among the 61 people with shark-related injuries reported in Hawai'i from 2009 through 2019, there were 4 deaths. Researchers including Victoria Scala, MD, of the John A. Burns School of Medicine, conducted a retrospective review of incidents on the State of Hawai**'i**'s Shark Incidents List. Results showed there were 25 cases of injuries on Maui (including all 4 deaths), and 16 on O'ahu. Most cases (57%) occurred in turbid water. Tiger sharks were involved in 71% of the cases where the shark was identified; 52% of tiger shark injuries occurred between September and November. Among the 12 patients treated at the state's level 1 trauma center, 11 had extremity injuries, including 3 who had lower extremity amputations. Two of the 12 patients had vascular injuries, and 5 had nerve injuries. The mean time from injury to emergency department arrival was 63 minutes. The researchers concluded that control of blood loss prior to hospital arrival was particularly important for better outcomes.

- Scala VA, Hayashi MS, Kaneshige J, Haut ER, Ng K, Furuta S. Shark-related injuries in Hawai'i treated at a level 1 trauma center. *Trauma Surg Acute Care Open*. 2020;5(1):e000567. doi:10.1136/tsaco-2020-000567

Antinflammatory Mechanisms of Noni Fruit Juice Revealed

Juice from noni fruit (*Morinda citrifolia*) is used in Polynesia as a traditional folk medicine. Researchers including Peng Huang, of the Daniel K. Inouye College of Pharmacy, isolated 5 compounds from commercially available noni juice by using column chromatography and high-performance liquid chromatography. In *in vitro* experiments, the compounds inhibited the activity of a transcription factor called NF-κB, which regulates responses to inflammation. In addition, in a cell culture of macrophages that were activated to produce the inflammatory compound nitric oxide, 2 of the noni juice compounds reduced the concentration of nitric oxide present in the cultures. Results also showed the compounds may act to reduce inflammation by interacting with an enzyme called IκB kinase, which activates NF-κB. The researchers concluded that although further study is needed, the compounds' mechanisms of anti-inflammatory action suggest they could be used in the treatment of inflammation-related disorders.

- Lee D, Yu JS, Huang P, et al. Identification of anti-inflammatory compounds from Hawaiian Noni (*Morinda citrifolia* L.) Fruit Juice. *Molecules*. 2020;25(21):E4968. Published 2020 Oct 27. doi:10.3390/molecules25214968

2015-2016 Dengue Outbreak Examined

In the outbreak of dengue on Hawai'i Island in 2015-2016, 218 cases were reported, including 37 people who required hospitalization. Researchers including David I. Johnston MPH, of the Hawai'i State Department of Health (HDOH), examined the cases then administered a questionnaire with each person to collect data on symptoms and risk factors. Results showed that among the confirmed cases, 82.6% were ages 18 and older, and 50.4% were male. The most common symptoms were fever, muscle/body aches, and headache. Nearly half (47.3%) of the cases reported mosquitoes inside their home during the week before they became ill. Of the 209 who had screened windows or doors, 38.8% reported having holes or tears in the screen, and 28.9% of all cases reported having standing water on their property. The researchers concluded that although people may know how to protect themselves from mosquitoes, they do not necessarily practice these behaviors, so greater public education and outreach efforts are needed.

- Johnston DI, Viray MA, Ushiroda JM, et al. Investigation and response to an outbreak of dengue: Island of Hawaii, 2015-2016. *Public Health Rep*. 2020;135(2):230-237. doi:10.1177/0033354920904068

Neurologist Attitudes on Practicing in Hawai‘i

Selin Kutlu MA; William B. Harris BA; Christina E. Tse BA; Nicole E. Anzai BS; Heather Miura BA; Bryce Kalei Chang BA; and J. Douglas Miles MD, PhD

Abstract

There is a shortage of neurologists nationwide, and the demand for neurologists is expected to increase in the upcoming years while the pool of practicing neurologists dwindles. Per Hawai'i Neurological Society, there were 44 practicing neurologists in the state of Hawai'i in 2019, representing a shortage of approximately 28 neurologists. Considering that Hawai'i is geographically, demographically, and culturally distinct compared to other states, a concern is that practicing neurology in Hawai'i poses unique challenges that may contribute to the low numbers of neurologists. An anonymous online survey was sent via email to all members of the Hawai'i Neurological Society from February 2019 to June 2019, inquiring about aspects of their practice they considered unique to Hawai'i. Twenty-three neurologists completed the survey, representing 52% of Hawai'i's neurology workforce. One neurologist completed a portion of the survey. Twenty-five percent of participants were born and raised or completed their medical education in Hawai'i. Self-reported reasons for practicing in Hawai'i included family, lifestyle, and patient population despite financial challenges and limited resources and opportunities. Participants suggested introducing a mandatory neurology rotation for Hawai'i medical students and creating an in-state neurology residency program to combat the growing neurologist shortfall in Hawai'i. This survey identified local strengths and challenges in the field of neurology, potential ways to improve the practice environment in Hawai'i, and neurologists' perspectives on ways to address the neurology shortage.

Keywords

neurologists, physicians, Hawai'i, shortage, burnout

Abbreviations and Acronyms

HNS = Hawai'I Neurological Society
JABSOM = John A. Burns School of Medicine
MD = Doctor of Medicine
US = United States

Introduction

The first neurological specialists to practice in the state of Hawai‘i were Fredrick Reichert MD, a neurosurgeon from Stanford University who practiced part-time in Hawai‘i, shortly followed by Ralph B. Cloward MD, a neurosurgeon who practiced full-time in Hawai‘i starting in 1938.[1] Since then, the field of neurology in Hawai‘i has evolved. As of 2019, the Hawai‘i Neurological Society reported 44 neurologists in Hawai‘i who served a population of 1 420 491.[2] A national physician shortage in the United States (US) has been well-documented.[3,4] In the US, there is expected to be a greater shortfall of neurologists than many other specialties.[3,5] The national supply of neurologists is predicted to increase from 16 366 in 2012 to 18 060 in 2025, but with an increased shortfall from 11% to 19% with the growing population.[4] In addition to the marked shortfall of neurologists in Hawai‘i, the islands' unique geography isolates particular populations from neurological care.[6] There is a need for approximately 3 neurologists in Kaua‘i County, 9 in Hawai‘i County, 4 in Maui County, and 10 in Honolulu County, with an overall statewide need of approximately 26 neurologists.[6]

In response to the national and state-level physician shortages, many studies have analyzed mechanisms that might explain the demand and shortage.[3,7,8] One factor thought to contribute significantly to the shortage is physician burnout. Neurology is among the top 10 specialties with the highest rates of burnout and lowest rates of satisfaction with work-life balance.[9] In studies of US neurologists, over 60% reported at least 1 symptom of burnout and rates of burnout increased from 2011 to 2014.[9–11] Another important contributor to physician shortage might be location. Relative to urban areas, neurologists practicing in more rural areas report greater levels of dissatisfaction.[12] This may be due to decreased resources, funding, staff, and support. Conversely, teaching and research have been associated with higher physician career satisfaction, likely as a result of increased interactions, collaborations, and a more stimulating environment.[12]

One factor perpetuating the neurologist shortage worldwide is an absence of medical students who want to pursue a career in neurology.[3] Medical schools may be trying to increase recruitment through their curriculum. In the 2018–2019 academic year, 86% of medical schools reported having a mandatory neurology clerkship.[13] However, as the only 4-year allopathic medical school in Hawai‘i, the John A. Burns School of Medicine (JABSOM) does not have a third-year neurology clerkship rotation nor a neurology residency program.[14]

Neurologists currently practicing in Hawai‘i were surveyed to understand the present and future directions of neurology in the state. To the authors' knowledge, this cohort of neurologists has never been surveyed previously about the climate of their work environments. By examining the strengths, challenges, and disparities within the field, this small pilot study seeks to understand the benefits and barriers of practicing neurology in Hawai‘i to improve recruitment, retention, and perspective on the neurology shortage in Hawai‘i.

Methods

Recruitment and Consent

Neurologists in Hawai‘i were emailed the link to an anonymous online survey about their attitudes regarding practicing neurology in Hawai‘i. Email addresses were obtained from the Hawai‘i Neurological Society (HNS), the state neurological association. HNS attempts to maintain an accurate list of all the neurologists in the state, regardless of whether they are active members of the organization and reported 44 practicing neurologists at the time of data collection. Approval for the study was obtained from the HNS board of directors and the University of Hawai‘i Institutional Review Board (2018-00855) before the survey. The authors of this paper also made brief in-person announcements at HNS meetings to encourage participation. Participation took place from February 2019 through June 2019 and was voluntary.

A waiver of informed consent was obtained from all participants on the first page of the online survey and was sent as an attachment in the email inviting participation. There was no payment or other compensation incentive for participation.

Measures

The 26-question online survey was administered using REDCap, a Health Insurance Portability and Accountability Act-compliant electronic survey database. Measures of physician attitudes were adapted from measures used in The Queens Medical Center physician satisfaction survey with permission from The Queens Medical Center. The survey included questions regarding practice characteristics and physician training background and attitudes regarding practicing in Hawai‘i. Due to concerns expressed by HNS board members about the possibility of participant demographics identifying survey respondents, demographics were not included in the survey. Finally, the survey included questions to ascertain neurologists' thoughts on how their practice and the neurology shortage in Hawai‘i might be improved.

Data Analysis

Microsoft Excel 2011 version 14.0.0 (Microsoft Corporation: Redmond, WA) was used to report descriptive statistics. Due to the nature of the questions, inferential statistics were not applied.

Results

Twenty-three neurologists completed the survey ($n = 23$, 96%). An additional neurologist only completed a portion of the survey ($n = 1$, 4%). On average, participants spent 14 years practicing in Hawai‘i, ranging from 1.2 to 32 years. Most participants ($n = 18$, 75%) were neither born nor raised in Hawai‘i and did not complete any part of their collegiate or medical education in Hawai‘i.

Family ties were most commonly indicated as a primary motivation for practicing in Hawai‘i for 38% ($n = 9$) of respondents (Figure 1). Other frequently indicated primary or secondary motivations included location ($n = 14$, 58%), lifestyle ($n = 12$, 50%), and patient population ($n = 9$, 38%). Of note, for secondary motivations, respondents could choose more than 1 answer. Concerning patient population, respondents noted Hawai‘i's diverse and underserved patient population, including patients of Native Hawaiians, Guamanians, Chinese, Japanese, Koreans, and Other Pacific Islanders. One unique motivation for practicing in Hawai‘i was that Hawai‘i represented the only place that offered "the opportunity to build a neurology program."

Twenty respondents (87%) reported subspecializing, with the majority being stroke, neuromuscular, neurodegenerative/dementia, movement disorders, and concussion/traumatic brain injury (Figure 2). Of those reporting a subspecialty ($n = 23$), 16 (70%) self-reported being board certified in their subspecialty. Sixteen respondents (70%) also indicated difficulties in finding neurology consults in certain subspecialties, particularly for multiple sclerosis ($n = 1$, 6%), neurodegenerative/dementia ($n = 1$, 6%), and movement disorders ($n = 1$, 6%). It should be noted that there are fellowships, but no board certification for these subspecialties.

Participants were asked to compare key aspects of practice and lifestyle in Hawai‘i versus the contiguous US (Figure 3). Neurologists in Hawai‘i agreed or strongly agreed that compared to the continental US, there were "sufficient numbers of patients to have a successful practice" ($n = 21$, 91%), "a patient population with unique medical and intellectual challenges" ($n = 17$, 74%), and "opportunities to provide direct patient care" ($n = 18$, 78%). Additionally, neurologists in Hawai‘i disagreed or strongly disagreed that Hawai‘i, compared to the continental US, offers "increased academic employment opportunities" ($n = 17$, 74%), "opportunities to do both patient care and research" ($n = 15$, 65%), and "opportunities to participate in drug studies" ($n = 11$, 48%).

When asked about adding neurologists to their practice, 19% ($n = 4$) felt that 4 or more neurologists could be added, 43% ($n = 9$) of participants felt that they could add 1 or 2 neurologists, and 38% ($n = 8$) of participants felt that no additional neurologists could be added to their practice ($n = 21$).

Participants selected from a list of ways JABSOM could improve Hawai‘i's physician shortage in neurology ($n = 23$, 96%). Note that the participants could have selected more than one answer. From these options, "neurology rotation for 3rd year medical students" was indicated by 74% ($n = 17$) of participants, "neurology residency program" by 74% ($n = 17$), "more opportunities to interact with practicing neurologists" by 61% ($n = 14$), "scholarship for medical students committed to neurology" by 30% ($n = 7$), and "more research opportunities in neurology" by 17% ($n = 4$).

Participants were asked to indicate up to three of the most important challenges of working in Hawai‘i when they first started compared to their practice now (Figure 4). Over one-third of respondents cited cost of living ($n = 11$, 48%), bureaucracy ($n = 9$, 39%), lack of sufficiently skilled specialists ($n = 9$, 39%), and reimbursement rates/salaries ($n = 9$, 39%) as major challenges when starting their practice in Hawai‘i. The current major challenges for neurologists in Hawai‘i are bureaucracy, lack of sufficiently skilled specialists, physician shortage, and reimbursement rates/salaries. Note that respondents were able to choose their top 3 challenges.

Neurologists were asked about their perceptions of practicing in Hawai‘i ($n = 23$, 96%). The vast majority of respondents rated the overall practice environment in Hawai‘i ($n = 19$, 83%) and quality of neurology care ($n = 21$, 91%) as excellent, good, or satisfactory. Furthermore, 83% ($n = 19$) of respondents stated that they would recommend a neurologist from Hawai‘i to their friends and relatives. The majority of respondents ($n = 14$, 61%) agreed that there is open and honest communication among neurologists in Hawai‘i.

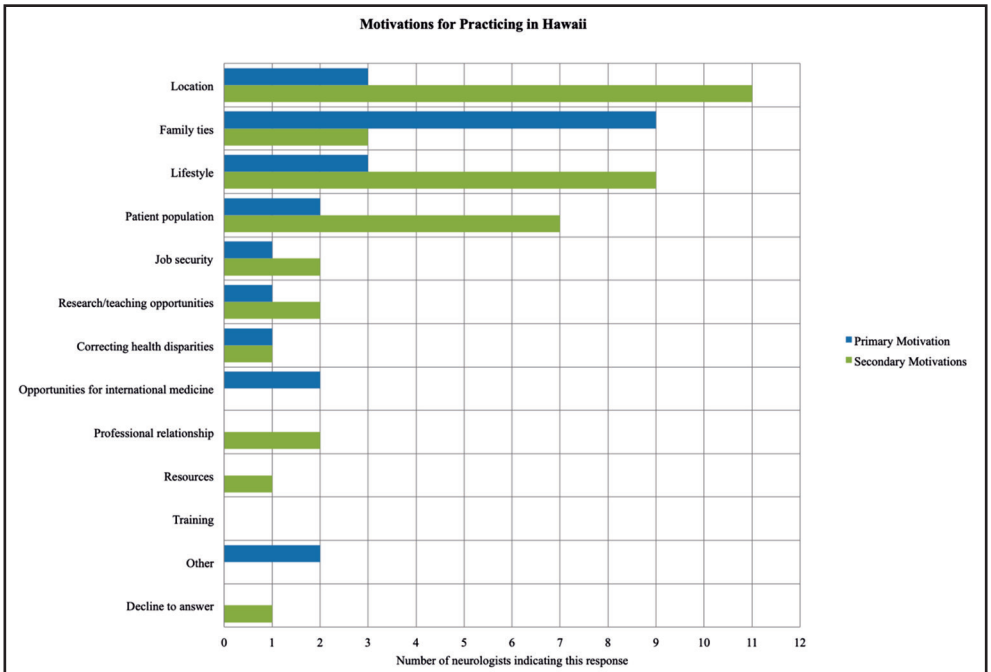

Figure 1. Participant motivations for practicing in Hawai‘i listed in descending order. Blue indicates primary motivations (n = 24). Green indicates secondary motivations, of which respondents could choose more than 1 answer. Twenty-three neurologists completed the survey; 1 neurologist completed a portion of the survey.

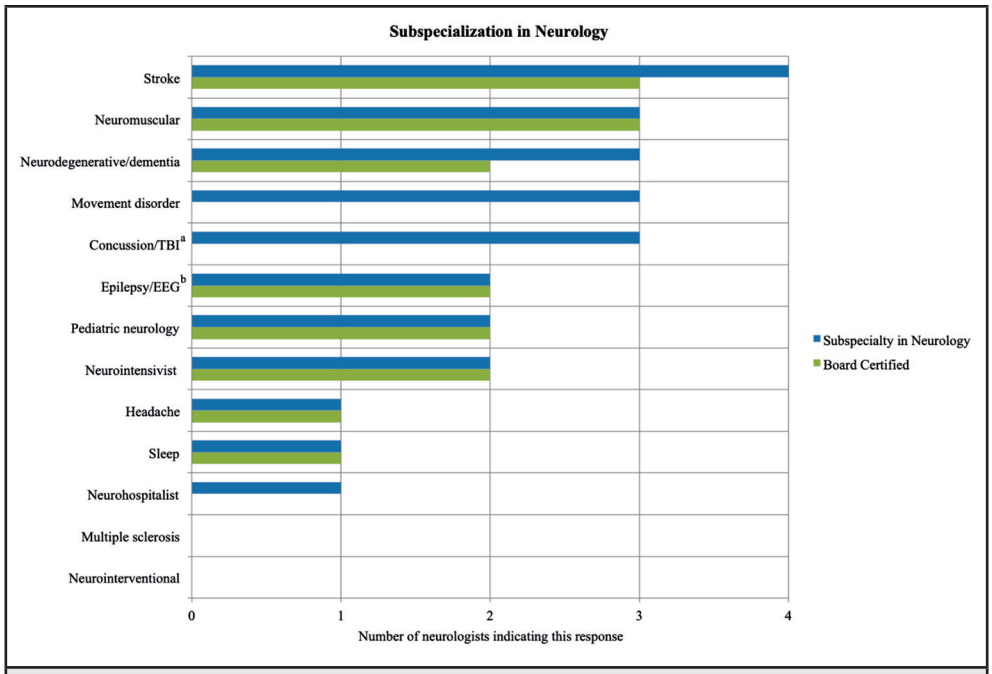

Figure 2. Self-reported neurology subspecialty. Blue indicates the participants' subspecialty (n = 20). Green indicates participants' board certification (n = 16).

[a]EEG = Electroencephalogram; [b]TBI = Traumatic Brain Injury

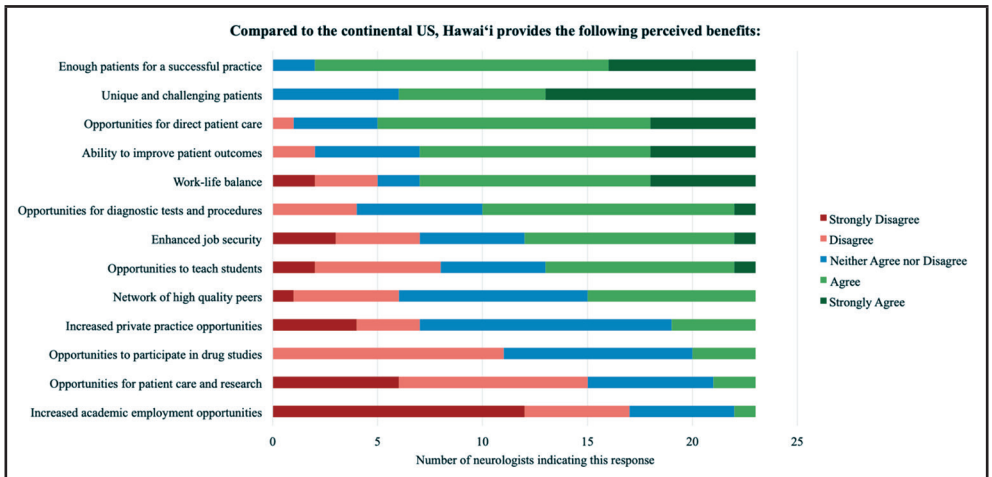

Figure 3. Perceived benefits of practicing neurology in Hawai'i compared with the rest of the US, listed in descending order (n = 23). Twenty-three neurologists completed the survey; 1 neurologist completed a portion of the survey.

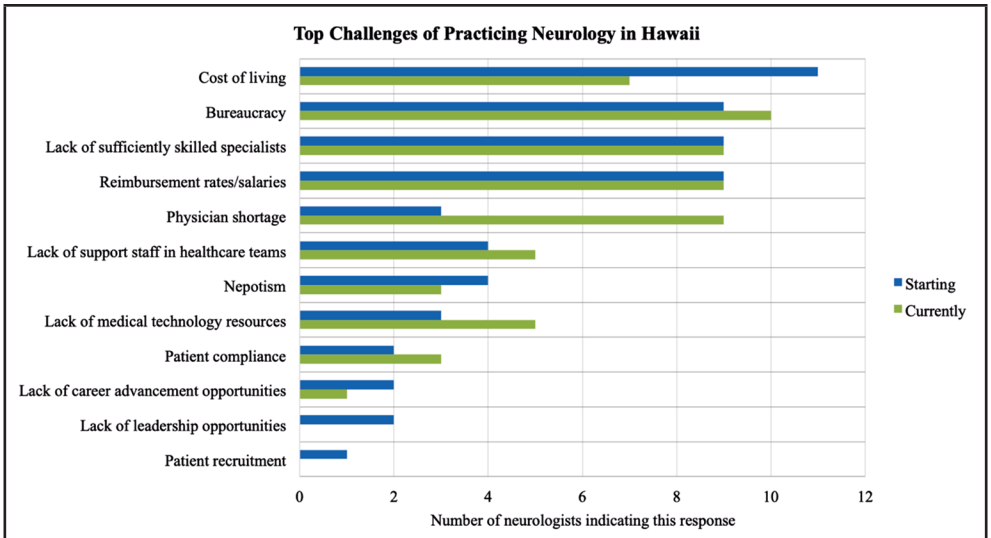

Figure 4. Challenges (participants had the option to select up to 3) indicated by neurologists when they first started practicing in Hawai'i (green) versus their current practice in Hawai'i (blue) (*n* = 23). Twenty-three neurologists completed the survey; 1 neurologist completed a portion of the survey.

Discussion

In this study, several motivations and challenges unique to practicing neurology in Hawai'i were identified. Among the most commonly indicated motivations were location, family ties, and lifestyle. The most commonly indicated challenges of practicing in Hawai'i compared with the continental US included cost of living, bureaucracy, lack of sufficiently skilled specialists, reimbursement, and physician shortage. While factors such as cost of living and nepotism reportedly decreased from when neurologists first began working, factors such as lack of adequate support staff and physician shortage became an increasing hindrance.

The lack of neurologists, subspecialists, and neurology support staff may increase the burden on neurologists in Hawai'i and translate to longer work hours, higher patient and call volume, poorer quality of care, and longer patient wait times. Stroke has been reported as one of the leading causes of death in Hawai'i between 2014 and 2017.[15,16] Despite stroke being the most commonly indicated subspecialty by Hawai'i neurologists, 1 participant indicated that the overwhelming demand resulted in neurologists from other subspecialties caring for stroke patients, which may uniquely contribute to decreased job satisfaction and burnout of neurologists in this state. A cohort of neurologists previously reported working longer hours than physicians in general, and the increased percentage of time worked was associated with decreased job satisfaction.[10] Greater number of hours worked, nights on call, and outpatient volume were also associated with higher burnout risk.[17]

Recruitment of more neurology-trained support staff and advanced practitioners, including neurology technicians, nurses, nurse practitioners, and physician assistants, may decrease the risk of physician burnout and further extend the limited supply of neurologists in Hawai'i. With its inaugural class for the 2020–2021 academic year, the establishment of the MEDEX Northwest Physician Assistant Program in Hawai'i aims to address this need.[18] Multidisciplinary training for neurologists, residents, and medical students may also be warranted to familiarize physicians with how best to incorporate advanced practitioners in a changing practice landscape.[19]

However, to directly improve the shortfall of neurologists in Hawai'i,[6] one of the identified factors most feasible to address is family ties. Family was the top primary motivation for practicing neurology in Hawai'i. This finding suggests that an effective strategy for increasing the number of neurologists practicing in Hawai'i may be to attract in-state medical students into the field of neurology. Furthermore, as indicated by 71% of respondents, a third-year neurology clerkship and residency program may be a solution to alleviate the neurologist shortage in the state through increased retention.

The literature suggests that positive experiences in neurology clerkship rotations are strongly predictive of student interest in neurology; conversely, the absence of a neurology clerkship rotation predicts significantly lower interest in neurology.[20] The addition of a mandatory neurology clerkship to Hawai'i's medical school curriculum may be a valuable strategy to stimulate local medical student interest. In-state training programs

would facilitate the professional support network that can encourage retention of Hawai‘i-trained neurology residents to practice neurology in-state. Indeed, Hawai‘i leads the nation in retaining physicians in-state, with 86.3% of physicians who complete undergraduate and graduate medical education in Hawai‘i staying in the state to practice.[2] Moving beyond the undergraduate medical education, participants felt that a local neurology residency program would reduce the physician shortage within this specialty. Although there have not been studies pertaining to neurology to demonstrate this, there have been studies in other medical specialties that correlate site of training to location of practice. For example, in the continental US, over half of newly trained family physicians and dermatologists practice within 100 miles of their training sites.[21,22] Coupled with the finding that nearly two-thirds of those surveyed reported that additional neurologists could realistically be added to their practice, with 19% reporting room for 4 or more neurologists, an in-state residency has the potential to impact the neurologist shortage significantly. None of the 24 neurologists surveyed disputed the fact that Hawai‘i has enough patients to sustain a neurology practice.

The creation of neurology clerkships and residency programs is not without major challenges. JABSOM does not have a university hospital but relies on community hospitals and clinics to provide clinical experience.[23] As a result, the institution of a clerkship or residency program would logistically require extensive discussion and agreement among the JABSOM faculty and staff and between the various healthcare systems, physician community, and national accreditation bodies. Another barrier to establishing a neurology clerkship and residency program is the greater demand for neurologists to serve as preceptors in addition to caring for their patients. With the recent increase in matriculating JABSOM class size, it will be challenging to meet the demand for preceptors given the modest number of community neurologists.[6]

Increasing medical student exposure without overwhelming the faculty neurologists might be a challenge. One viable option may be for JABSOM to offer a neurology elective to first- and second-year medical students. A neurology elective would allow students to explore neurology topics and gain clinical experience from the start of their medical education. In a survey of medical students pursuing a career in neurology, those who excelled in preclinical neuroscience curricula were significantly more likely to become neurologists.[20] Two-thirds of respondents cited increased opportunities to interact with practicing neurologists as an important way for students to gain exposure to neurology. Respondents also felt that providing opportunities in neuroscience research was a key factor in promoting student interest in neurology. Although an elective in neurology research is currently offered at JABSOM, students without prior exposure may be more interested in participating in a general neurology elective to gain knowledge and experience before feeling equipped to undertake research in the field.

The benefit of implementing more neurology into the curriculum may be bidirectional. The creation of a preclinical elective, third-year clerkship, or local residency program may concurrently address the lack of academic opportunities in Hawai‘i compared with the continental US, reported as the most common relative deficit by participants. As indicated in the literature, neurologists involved in research and teaching report greater satisfaction with their specialty, as well as greater satisfaction in their relationships with colleagues and patients.[12] Neurologists who engaged in academic practice had lower burnout rates, higher rates of career satisfaction, and higher quality of life than neurologists solely in clinical practice.[10] Neurologist engagement with medical students and residents as preceptors, attendings, and principal investigators may help decrease the neurology shortage in Hawai‘i by creating more opportunities for medical students to pursue neurology and increasing satisfaction and longevity among practicing neurologists by offering rewarding alternatives to pure clinical practice.

In summary, the results of this survey of practicing neurologists in Hawai‘i support a recognized need for more neurologists in Hawai‘i. Job security, maintaining family ties, and a highly satisfying practice environment may be incentives for future locally trained neurology residents to remain in Hawai‘i. Creating more educational opportunities for students and increasing interaction with neurologists may help decrease the neurologist shortage in Hawai‘i and increase satisfaction and longevity among practicing neurologists. Additionally, a neurology residency program could ameliorate the 2 largest deficits in practicing neurology according to participants, namely academic opportunities and research opportunities. Due to the small sample size and moderate response rate, definitive recommendations cannot be made. However, the results of this survey offer provocative ideas voiced by a majority of the state’s practicing neurologists that may be useful in discussions about the future of neurology in Hawai‘i.

Strengths, Limitations, and Future Directions

This research study’s strengths include endorsement by the HNS and the response from neurologists invested in medical education and the practice of neurology in Hawai‘i. To the authors’ knowledge, this is the first survey of its kind to assess the practice environment and satisfaction of neurologists practicing in Hawai‘i.

The current research limitations include a lack of key demographic data such as neurologists’ age, sex, ethnic background, practice size, and rural/urban practice. Demographic data give a better sense of the practice environment and can help gauge the longevity of the current body of practitioners and rates of progression of the physician shortage. In this small pilot study, the researchers chose not to obtain demographic data to avoid identifying participants in this small community.

Future studies may benefit from the inclusion of neurologists practicing in the continental US to directly compare with responses from neurologists in Hawai‘i. Other factors to consider might include the number of hours devoted to clinical practice, rural versus urban practice environment, and questions that specifically focus on physician burnout. Despite achieving participation rates similar to other physician surveys,[24,25] considering the small sample size of neurologists in Hawai‘i, future research would benefit from increased participation rates.

Conflict of Interest

None of the authors reported any conflict of interest.

Disclosure Statement

J. Douglas Miles is on faculty at the John A. Burns School of Medicine. He is also the President of the Hawai‘i Neurological Society; this is a non-compensated position. None of the authors reported any financial disclosure.

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References

1. Swinney C, Obana W. The history of neurosurgery in the Hawaiian islands. *World Neurosurg*. 2018;109:377-380. doi:10.1016/j.wneu.2017.10.065
2. *Hawaii Physician Workforce Profile*. Association of American Medical Colleges; 2019:1-3. https://www.aamc.org/system/files/2019-12/state-physician-Hawaii-2019%5B1%5D.pdf. Accessed March 23, 2020.
3. Burton A. How do we fix the shortage of neurologists? *Lancet Neurol*. 2018;17(6):502-503. doi:10.1016/S1474-4422(18)30143-1
4. Dall TM, Storm MV, Chakrabarti R, et al. Supply and demand analysis of the current and future US neurology workforce. *Neurology*. 2013;81(5):470-478. doi:10.1212/WNL.0b013e318294b1cf
5. Howley EK. What can be done about the coming shortage of specialist doctors? *US News & World Report*. https://health.usnews.com/health-care/patient-advice/articles/2018-05-02/what-can-be-done-about-the-coming-shortage-of-specialist-doctors. Published May 2, 2018. Accessed September 29, 2019.
6. Withy K. *Hawai'i Physician Workforce Report*. University of Hawaii; 2018:1-22. http://www.hawaii.edu/govrel/docs/reports/2019/act18-sslh2009_2019_physician-workforce_annual-report.pdf. Accessed September 9, 2019.
7. Ringel SP. The practice of neurology: Looking ahead by looking back. *Neurology*. 2015;84(20):2086-2091. doi:10.1212/WNL.0000000000001589
8. Racette BA, Holtzman DM, Dall TM, Drogan O. Supply and demand analysis of the current and future US neurology workforce. *Neurology*. 2014;82(24):2254-2255. doi:10.1212/WNL.0000000000000509
9. Shanafelt TD, Hasan O, Dyrbye LN, et al. Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014. *Mayo Clin Proc*. 2015;90(12):1600-1613. doi:10.1016/j.mayocp.2015.08.023
10. Busis NA, Shanafelt TD, Keran CM, et al. Burnout, career satisfaction, and well-being among US neurologists in 2016. *Neurology*. 2017;88(8):797-808. doi:10.1212/WNL.0000000000003640
11. Miyasaki JM, Rheaume C, Gulya L, et al. Qualitative study of burnout, career satisfaction, and well-being among US neurologists in 2016. *Neurology*. 2017;89(16):1730-1738. doi:10.1212/WNL.0000000000004526
12. Teixeira-Poit SM, Halpern MT, Kane HL, Keating M, Olmsted M. Factors influencing professional life satisfaction among neurologists. *BMC Health Serv Res*. 2017;17(1):409. doi:10.1186/s12913-017-2343-8
13. Clerkship requirements by discipline. Association of American Medical Colleges. https://www.aamc.org/data-reports/curriculum-reports/interactive-data/clerkship-requirements-discipline. Published 2019. Accessed March 21, 2020.
14. HRP residency and fellowship programs. Hawaii Residency Programs, Inc. https://hawaiiresidency.org/hrp/residency-fellowship-programs. Accessed March 23, 2020.
15. Centers for Disease Control and Prevention. Stats of the State of Hawaii. National Center for Health Statistics. https://www.cdc.gov/nchs/pressroom/states/hawaii/hawaii.htm. Published April 13, 2018. Accessed March 23, 2020.
16. Hawaii Health Data Warehouse. *Deaths in Hawaii Due to Stroke*. Hawaii State Department of Health, Office of Health Status Monitoring, Vital Statistics; 2017:1-5. http://hhdw.org/wp-content/uploads/AAMR_Stroke_3AGG.pdf. Accessed March 23, 2020.
17. LaFaver K, Miyasaki JM, Keran CM, et al. Age and sex differences in burnout, career satisfaction, and well-being in US neurologists. *Neurology*. 2018;91(20):e1928-e1941. doi:10.1212/WNL.0000000000006497
18. MEDEX Plans Expansion to Hawaii. July 2019. https://depts.washington.edu/medex/medex-plans-expansion-to-hawaii/. Accessed March 23, 2020.
19. Ringel SP. The practice of neurology: Looking ahead by looking back. *Neurology*. 2015;84(20):2086-2091. doi:10.1212/WNL.0000000000001589
20. Gutmann L, Cahill C, Jordan JT, et al. Characteristics of graduating US allopathic medical students pursuing a career in neurology. *Neurology*. 2019;92(17):e2051-e2063. doi:10.1212/WNL.0000000000007369
21. Fagan BE, Finnegan SC, Bazemore AW, Gibbons CB, Petterson SM. Migration after family medicine residency: 56% of graduates practice within 100 miles of training. *Am Fam Physician*. 2013;88(10):704.
22. Resneck JS, Kostecki J. An analysis of dermatologist migration patterns after residency training. *Arch Dermatol*. 2011;147(9):1065-1070. doi:10.1001/archdermatol.2011.228
23. JABSOM News. Points of Pride at the John A. Burns School of Medicine. UH Med Now. https://jabsom.hawaii.edu/points-of-pride-at-the-john-a-burns-school-of-medicine/. Published August 9, 2018. Accessed March 23, 2020.
24. Nicholls K, Chapman K, Shaw T, et al. Enhancing response rates in physician surveys: the limited utility of electronic options. *Health Serv Res*. 2011;46(5):1675-1682. doi:10.1111/j.1475-6773.2011.01261.x
25. Asch S, Connor SE, Hamilton EG, Fox SA. Problems in recruiting community-based physicians for health services research. *J Gen Intern Med*. 2000;15(8):591-599. doi:10.1046/j.1525-1497.2000.02329.x

Evaluating Potential Mosquito Breeding Sites on a University Campus

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Abstract

In recent decades, mosquito-borne diseases (MBDs) such as Zika, chikungunya, malaria, and dengue have spread to more urban areas previously free of such diseases. Globalization has increased the infection potential for diseases and their vectors, placing tropical tourist destinations, such as Hawai'i, at risk for MBD epidemics. A cross-sectional study was conducted on the University of Hawai'i at Mānoa campus to assess potential mosquito breeding sites. The campus was stratified by land use designation and randomly sampled. Residential areas had the highest potential for breeding sites with high numbers of discarded plastic food and beverage containers. Recommended prevention strategies to curb littering in the residential area include awareness campaigns and encouraging collaboration between maintenance authorities to enhance oversight. This study highlights the importance of individual awareness and prevention of environment modifications that could contribute to the development of mosquito breeding sites.

Keywords

Mosquito control, environment and public health, cross-sectional study

Abbreviations and Acronyms

MBD = Mosquito-borne disease
UHM = University of Hawai'I at Mānoa

Introduction and Purpose

Mosquito-borne diseases (MBDs) are among the deadliest and most well-known vector-borne diseases and include chikungunya, dengue, Zika, and malaria.[1] On a global scale, MBDs, such as malaria, are responsible for nearly 400 000 deaths per year.[1] These diseases disproportionately burden the poorest populations with inadequate health care infrastructure. Urbanization in previously untouched natural environments has been shown to create novel genetic opportunities for mosquito species to adapt to urban conditions successfully.[2] The rapid modernization of low and middle-income countries has also increased opportunities for interaction between human and mosquito species, thus increasing the global incidence of MBDs. Further, recent outbreaks have shown that urban areas are highly effective breeding sites for mosquitoes, which increases the likelihood of disease transmission.[3] The establishment of disease-transmitting mosquitoes in dense human populations is a significant threat to public health; it is estimated that 3.9 billion people globally are at risk of an MBD epidemic.[4]

Hawai'i is of particular concern for MBD outbreaks because the temperate climate allows for a year-round breeding season. *Aedes aegypti,* the mosquito that transmits yellow fever, has not yet sustained a widespread population on O'ahu (the most densely populated island). In contrast, *Aedes albopictus*, the Asian tiger mosquito, is found on nearly all Hawaiian Islands.[5] Both mosquito species pose a threat to community health. While a consistent, isolated population of *Ae. aegypti* only exists on Hawai'i island; it has recently been found on O'ahu.[5] The dominant mosquito species in Hawai'i, *Ae. albopictus*, is a vector for dengue, chikungunya, Zika, and other arboviruses. In the past, *Ae. albopictus* has been responsible for outbreaks of locally-transmitted dengue in Hawai'i.[6] There is the potential for large MBD outbreaks if *Ae. aegypti* were to establish a population on O'ahu.[5]

Currently, the only ongoing mosquito surveillance program in the state of Hawai'i is at Daniel K. Inouye International Airport, under the direction of the Centers for Disease Control and Prevention.[5] The airport is a major site for international and domestic human interaction. According to the State of Hawai'i Department of Transportation, more than 20 million visitors pass through the Daniel K. Inouye International Airport every year.[7] The Hawai'i State Department of Health estimates that approximately seven confirmed cases of dengue are imported into Hawai'i annually.[8] While autochthonous transmission of dengue is uncommon, the risk exists if an infected individual is bitten in Hawai'i.[9]

While *Ae. aegypti* has a greater preference for biting humans than *Ae. albopictus*, both species are well-adapted to oviposit in small objects containing water left around human habitats.[10,11] This can have significant consequences in Hawai'i where rain is expected year-round. Potential mosquito habitats in Hawai'i include any cup-like plant, garden pots, refuse, tires, construction materials, and pools created by intent or poor irrigation.[10,12,13] Bromeliads, commonly used in landscaping, are of particular concern in Hawai'i because they are a well-established breeding site for all mosquitoes due to their cup-like axis.[13] Failure to maintain urban environments due to human oversight has also been cited as the main factor in developing urban mosquito populations.[14]

The University of Hawai'i at Mānoa (UHM) campus is a highly trafficked environment for most of the year, is heavily landscaped, and receives rainfall year-round, which points to its potential as an outbreak site. UHM Landscape Services is responsible for the maintenance of the main campus grounds, which does not include athletics grounds, student housing, and

faculty housing.[15] According to the UHM Landscaping Services, maintenance of potential mosquito breeding sites is done on a "reactive" basis, rather than a proactive one (personal communication, Mr. Jason Ramelb, 2018). Although using cup-like plants, such as bromeliads, for landscaping is avoided on campus, there are many urban and natural environmental intersections that may promote mosquito breeding and MBD transmission. The purpose of this study was to conduct a point-in-time landscape analysis to assess the potential risk of establishment of mosquito breeding sites on the UHM campus.

Methods

"Potential mosquito breeding sites" were defined as any container-objects that could hold any amount of water for a prolonged period. The literature further defined this criterion as objects commonly found to breed mosquitoes in Hawai'i, such as the bromeliad plant, tree holes, and construction materials.[10,12,13] Other objects not specific to Hawai'i included empty planters, trash, tires, broken pipes, and pools.[12,14]

The study area was categorized using the UHM Landscape Master Plan,[15] which stratified the campus into the following designations: courtyard, streetscape, civic space, special/unique, residential, interstitial/connective, natural area, and undeveloped area. The natural and undeveloped areas were not sampled because they included forests and a stream, therefore impractical to assess with the limited resources of this study. Within each land use designation category, individual areas were numbered. Using a random number generator, one area was randomly selected to represent the land designation. A stratified random sampling technique was done to optimize the selection of a representative sample from each land designation category.[16]

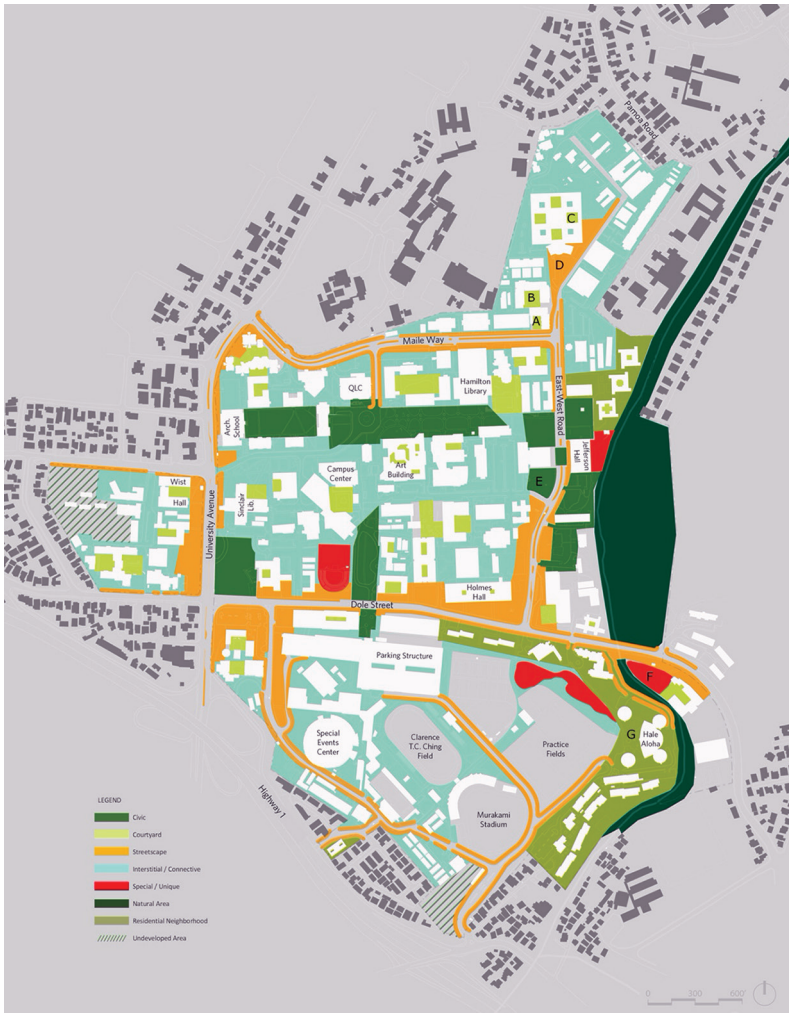

Figure 1. Map of the University of Hawai'i at Mānoa Campus Stratified by Land Use Designation according to the University of Hawai'i at Mānoa Landscape Master Plan[a]

[a]Sasaki Associates Inc. The University of Hawai'i at Mānoa Landscape Master Plan. https://web.archive.org/web/20161101172031/http://manoa.hawaii.edu/planning/LMP_May2012.pdf. Published 2012. Accessed May 28, 2020.

Figure 2. Standardized Systematic Area Sampling Methodology for Mosquito Breeding Site Survey, University of Hawai'i at Mānoa Campus, July-August 2018

Each area was surveyed in a standardized manner over a 3-week period between July 25, 2018 to August 8, 2018 at 12:00 PM Hawai'i Standard Time. For each area, the surveyor started at one corner and walked heel to toe in a straight line until a land border was reached. Once the border was reached, the surveyor turned 90 degrees, walked forward 18 inches, turned another 90 degrees, and headed back in the opposite direction, repeating the heel to toe survey. The surveyor would then pause to take notes and pictures of the observation thus far. This process was repeated until the designated area was completely assessed.

A new sample area was assessed twice weekly. After data collection, the surveyor tallied the number of each type of potential mosquito breeding objects and categorized each object as either "natural" (eg, plant, tree root depression, coconut husk, pond)[2,13,14] or "urban" (eg, plastic cup, soda can, trash, planters).[2,3,14] This study did not include human participants or the use of animals; hence it was exempt from IRB or IACUC approval.

Results

The courtyard land designation consisted of several separate areas (courtyards A, B, & C on the map). In Courtyard A, 8 empty planters, a broken water pipe, 11 open kukui nut shells, 4 open plastic containers, a patch of bromeliad plants, and 2 human-made ponds were observed as potential mosquito-breeding sites. A few of the planters, as well as the patch of bromeliads, were well-shaded. In general, Courtyard A appeared to be less maintained by the landscaping and maintenance crews than the other courtyards based on the amount of natural waste on the ground. Courtyard B appeared to be well-maintained, reflected by the lack of natural waste on the ground and the overall cleanliness. A few novel potential mosquito-breeding sites were observed in dried coconut shells and tree husks that held water. One of the landscaped trees in the courtyard, Madre de cacao (*Gliricidia sepium*), showed natural exposed root depressions that qualified as a novel breeding opportunity. Courtyard C was generally well-maintained and did not have as many tables and benches as courtyards A and B. Three open plastic bags, several patches of mother-in-law's tongue (*Sansevieria trifasciata*), two structural depressions, and one open plastic container were observed. The 3 courtyards had a total of 32 natural objects and 10 urban objects that might serve as mosquito breeding sites. No mosquito larvae were observed inside the objects.

The streetscape ("D" on the map) consisted of the paved road and sidewalk from the intersection of East-West Road and Maile Way to the portable classrooms. A total of 1 natural container, a coconut shell, and 3 plastic containers in the form of 2 open planters and a plastic drink cap were observed. The streetscape was well-maintained and was not heavily trafficked during the time of observation. The streetscape had a total of 1 natural object and 3 urban objects. No mosquito larvae were observed inside the objects.

The civic spaces ("E" on the map) had a large number of natural potential mosquito-breeding sites due to the large banyan trees in the area. One plastic container, 2 bottle caps, and 1 plastic wrapper were observed. The 5 Chinese Banyan trees (*Ficus microcarpa*) in the area showed exposed root depressions and deep, container-like depressions within the tree trunks. A total of 29 natural and 4 urban potential mosquito-breeding sites were observed. Due to construction, the total area observed for the civic spaces land designation was smaller than the area originally planned to be sampled.

The special land designation area ("F" on the map) consisted of the loʻi (a taro patch), which is detached from the main campus. The area was well-maintained, with no observable trash. Although the loʻi is defined by its water ponds, there was a continuously running stream of water to interrupt the ponds. A flock of ducks was also observed wading into the ponds. A total of 21 open, gourd-like shells were observed under the lone Laʻamea tree (*Cresentia cujete*). The fallen gourd-like fruit provided many natural mosquito-breeding opportunities. No mosquito larvae were present inside the gourds. There were no urban objects observed in the special land designation area.

The residential land designation ("G" on the map) consisted of the student housing apartments detached from the main university campus. A total of 35 open plastic containers were observed and 2 empty planters, 23 soda cans, and several piles of disintegrating plastic bags. There were 68 total urban potential mosquito-breeding sites and no natural potential mosquito-breeding sites. Significant piles of plastic waste were observed on the opposite side of the fencing that separates the student housing apartments from the athletic complex. Due to earlier precipitation, many of the open plastic objects contained rain-water and insects. At the time of observation, students were in the process of moving back into student housing. This resulted in more foot traffic in the residential area than the other parts of the university campus.

Figure 3. Pictures of Potential Mosquito Breeding Sites Observed During the Study Period, University of Hawaiʻi at Mānoa Campus, July-August 2018

Clockwise from bottom left: empty gourd-like fruits from the Laʻamea tree observed in the loʻi; empty planters and water-containing plastic cups observed in the Courtyards; a patch of well-shaded bromeliad plants observed in the Courtyards; a plastic container with rain water and cockroaches observed in the Residential area.

Table 1. Observed Potential Mosquito-breeding Sites, University of Hawai'i at Mānoa Campus Stratified by Container Type and by Land Use, July–August 2018

Container Type	Courtyard	Streetscapes	Civic Spaces	Special	Residential
Natural Objects					
Pond	2	0	0	0	0
Tree root depressions	4	0	29	0	0
Kukui nut husk	11	0	0	0	0
Coconut husk	3	1	0	0	0
Other container plant	7	0	0	21	0
Bromeliad	5	0	0	0	0
Subtotal	**32**	**1**	**29**	**21**	**0**
Urban Objects					
Planter	8	2	0	0	2
Plastic cup[a]	1	1	3	0	35
Soda can[a]	0	0	0	0	23
Trash[a]	0	0	1	0	8
Broken water pipe	1	0	0	0	0
Subtotal	**10**	**3**	**4**	**0**	**68**
Total	**42**	**4**	**33**	**21**	**68**

[a] Objects found on the ground.

Discussion

Each land designation displayed varying levels of potential mosquito breeding grounds. Overall, the residential area demonstrated the highest potential, with a total of 68 observed breeding locations. In contrast, the streetscapes area demonstrated the least potential, with a total of 4 observed breeding locations. The top 3 areas of counted potential breeding locations (in order) were the residential, courtyard, and civic space areas. The types of objects counted varied according to the area sampled. Of the top 3 areas, the most common possible breeding sites observed were plastic containers, soda cans, tree root depressions, and other container-like plants. The counted objects in the residential area, which was the most trafficked area at the time of observation, were almost exclusively plastic containers and soda cans. This points to a high level of human interaction with the natural environment in this area compared to other observed areas. In comparison, the courtyard area had greater heterogeneity in the types of counted objects. Courtyard A had the highest variation and total count of objects compared to the other courtyards. According to the "Landscaping Master Plan" such as ponds and bromeliads, the presence of highly discouraged landscaping elements, as well as the general amount of fallen plant matter on the ground, demonstrates potential mosquito breeding areas that could be prevented, managed, or maintained in a more optimal manner.

Limitations

During the observation period, there was significant construction activity to re-pave large areas of the campus, which closed off many areas to the public. This resulted in re-selecting the interstitial/connective area sample because the original selection was unable to be accessed. This construction also reduced the size of the total area observed for the civic spaces land designation. Also, many of the selected areas were altered in a way that did not fully represent the area originally depicted on the Landscaping Master Plan. A few of the sample areas were very large and could not be surveyed in one day. For those areas, they were broken into smaller areas to be surveyed on different days. A single observer conducted the land use survey in each designated area, so we were unable to assess or measure inter-observer reliability, but the use of a standardized survey strategy helped to optimize validity.

The time of observation for all areas was done during summer break, which greatly reduced the amount of foot traffic on campus. Had the observation been during the Fall or Spring semesters, the observed counts of potential breeding sites may have been significantly higher. Due to the nature of the observation, the number of counted objects could have been influenced by human error. For example, the observer may have miscounted the observed objects. It is also possible that visually obscured sites (eg, sites extending underground) may have been missed. Lastly, due to the cross-sectional nature of the study, the findings are reflective of the dates of observation.

Conclusion

The land designation areas with the highest potential risk for establishing mosquito breeding sites are the courtyard and residential areas. Interventions to address the prevention and removal of high-risk objects should consider the type of objects and who is responsible for their disposal in that area. Mosquito-breeding development risk awareness campaigns should be targeted towards the campus as a whole and specifically towards faculty members, staff, and students working in buildings with courtyards and other natural areas. Due to seemingly limited maintenance in those areas, individuals in such departments should be aware of what natural elements pose the greatest risk and how to store container objects outside to reduce potentially dangerous environment modifications. Greater collaboration between the UHM landscaping and maintenance division and academic departments (eg, Department of Plant and Environmental Protection Sciences) is also encouraged to assist in the surveillance and prevention of mosquito breeding sites and strengthening pest-management plans. The UHM landscaping services do not have jurisdiction in the residential areas and rely on contracted services to maintain these spaces. The number of discarded food and beverage containers, as opposed to the number of natural and infrastructural potential breeding sites, clearly incriminates human activity. While other campus areas only operate during the day, residential campus life continues well into the night, when maintenance services are unavailable. Therefore, to prevent the establishment of mosquitoes and other pests in the residential area, mosquito-borne disease awareness should be targeted towards students living on campus. Awareness campaigns should stress the importance of individual action and proactive approaches to reduce mosquito-breeding sites. Another suggestion is to increase the number of trash receptacles around the residential areas. This would deter campus residents from discarding trash in areas that are not maintained, such as beyond the fence that separates the residential area from the athletic complex.

To prevent future MBD epidemics, it is highly encouraged to implement MBD awareness campaigns aimed at faculty, students, and staff in high-risk areas to promote individual preventive action.

Global trends show that human encroachment into natural areas, driven by fast urban development, has influenced the emergence of mosquito-borne diseases in previously unseen areas.[2] Hawai‘i is unique because of its location, environment, and popularity as a travel destination. Acting as a microcosm for the density and diversity of the human population on O‘ahu, the observation of potential mosquito breeding sites on the UHM campus shows that the risk of mosquito population establishment increases with the lack of individual awareness and the absence of a comprehensive maintenance plan in high trafficked areas. This has direct implications for other tropical regions with similar human-urban environmental interactions.

Conflict of Interest

None of the authors identify a conflict of interest.

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References

1. World Health Organization. Mosquito-borne diseases. http://www.who.int/neglected_diseases/vector_ecology/mosquito-borne-diseases/en/. Published October 17, 2016. Accessed April 4, 2018.
2. Kamdem C, Tene Fossog B, Simard F, Etouna J, Ndo C, Kengne P, et al. Anthropogenic habitat disturbance and ecological divergence between incipient species of the malaria mosquito Anopheles gambiae. *PLoS ONE*. 2012; 7(6); DOI:10.1371/journal.pone.0039453
3. Lindsay SW, Wilson A, Golding N, Scott TW, Takken W. Improving the built environment in urban areas to control Aedes aegypti-borne diseases. *Bull World Health Organ.* 2017; 95(8): 607-608; DOI:10.2471/BLT.16.189688.
4. Murdock CC, Evans MV, McClanahan TD, Miazgowicz KL, Tesla B. Fine-scale variation in microclimate across an urban landscape shapes variation in mosquito population dynamics and the potential of Aedes albopictus to transmit arboviral disease. *PLoS Negl Trop Dis*. 2017; 11(5); DOI:10.1371/journal.pntd/0005640
5. Hasty JM, Yang P, Oshiro P, Nakasone L, Whelen C. Mosquito Surveillance Program Using Ovitraps Detected Aedes aegypti at the Honolulu International Airport in 2012. *Proceedings of the Hawaiian Entymological Society.* 2015. 47:1-11
6. McClure KM, Lawrence C, Kilpatrick AM. Land Use and Larval Habitat Increase Aedes albopictus (Diptera: Culicidae) and Culex quinquefasciatus (Diptera: Culicidae) Abundance in Lowland Hawaii. *J Med Entomol*. 2018. 55(6):1509-1516; DOI:10.1093/jme/tjy117.
7. Daniel K. Inouye International Airport. Airport Info. http://airports.hawaii.gov/hnl/airport-info/. Published 2017. Accessed October 4, 2018.
8. Hawai‘i State Department of Health. Mosquito-Transmitted Diseases. http://health.hawaii.gov/docd/disease-types/mosquito-transmitted/. Published 2017. Accessed August 24, 2018.
9. Faraji A, Egizi A, Unlu I, Crepeau T, Healy SP, Gaugler R. Comparative host feeding patterns of the Asian tiger mosquito, Aedes albopictus, in urban and suburban northeastern USA and implications for disease transmission. *PLoS Negl Trop Dis*. 2014. 8(8); DOI: 10.1371/journal.pntd.0003037.
10. Winchester J. Aedes mosquitoes in Hawaii. Handle Proxy. http://hdl.handle.net/10125/101582. Published August 1, 2011. Accessed July 18, 2018.
11. Kolivras KN. Mosquito Habitat and Dengue Risk Potential in Hawaii: A Conceptual Framework and GIS Application. *Professional Geographer*. 2006. 58(2):139-154; DOI:10.1111.j.1467-9272.2006.00521.
12. Leong MKH, Grace JK. Occurrence and Distribution of Mosquitoes (Diptera: Culicidae) of Public Health Importance on the Island of Oahu. *Hawaiian Entomological Society*. 2009. 41:57-70
13. Yang P, Furumizo R, Tangalin L, Takekuma C, Hall KE. Mosquito species breeding in bromeliad axils on the island of Kauai, Hawaii. *Proc Hawaiian Entomol Soc.* 2003. 36:95-101; DOI:10125/102
14. Mattah PA, Futagbi G, Amekudzi LK, Mattah MM, de Souza DK, Kartey-Attipoe WD, et al. Diversity in breeding sites and distribution of anopheles mosquitoes in selected urban areas of southern Ghana. *Parasit Vectors*. 2017. 10(1):25; DOI: 10.1186/s13071-016-1941-3.
15. Sasaki Associates Inc. The University of Hawai‘i at Mānoa Landscape Master Plan. https://web.archive.org/web/20161101172031/http://manoa.hawaii.edu/planning/LMP_May2012.pdf. Published 2012. Accessed May 28, 2020.
16. Cochran WG. Sampling techniques, 3rd ed. New York, NY: John Wiley & Sons; 1977:89-114.

Special Feature

Diagnosis and Treatment of Neuroangiostrongyliasis in Hawai‘i

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Abstract

Angiostrongylus cantonensis *is a metastrongylid lungworm of rats with a global distribution and the cause of neuroangiostrongyliasis in humans. In Hawai‘i, neuroangiostrongyliasis cases have occurred sporadically since 1960; however, in 2001, the number of cases on Maui and Hawai‘i Island began to increase significantly. Since most human treatment trials have been conducted in Thailand, where the disease is usually mild, there is a need to develop treatment protocols for Hawai‘i, where there is a broader disease spectrum. In 2018, preliminary guidelines for the diagnosis and treatment of neuroangiostrongyliasis were developed for Hawai‘i's physicians. This article summarizes those guidelines and provides additional recommendations for individuals who recently ingested an infected intermediate host.*

Keywords

Angiostrongylus cantonensis, *eosinophilic meningitis*

Acronyms and Abbreviations

CDC = Centers for Disease Control and Prevention
CNS = central nervous system
CSF = cerebral spinal fluid
HIDOH = Hawai‘i State Department of Health
NAS = Neuroangiostrongyliasis
RTi-PCR = real-time polymerase chain reaction

Hawai‘i played a significant role in defining the etiology, epidemiology, pathology, and prevention of neuroangiostrongyliasis (NAS) in Hawai‘i and the Pacific.[1,2] Since its recognition in 1945, this painful disease continues to expand its geographical range and evoke a lifelong malady for small percentage of cases.[3–5] Other countries look to Hawai‘i for guidance in the diagnosis and treatment of NAS due to our consistent but sporadic number of annual cases.[6]

Angiostrongylus cantonensis (*A. cantonensis*) is a parasitic nematode of rats. This neurotropic organism has an obligatory but transient developmental phase in the rat's central nervous system (CNS) before migrating to and maturing in the pulmonary arteries.[7] Gastropods (slug and snails) are the intermediate host, but various vertebrates and invertebrates serve as transport hosts.[8] Humans are accidental dead-end hosts. The infectious larval stage, encapsulated within the intermediate host, enters the CNS and molts twice to form young adults. Migrating and disintegrating larvae and young adults induce an inflammatory response leading to eosinophilic meningitis, the hallmark of NAS. The disease in humans is commonly known as Rat Lungworm Disease. The infection results in various neurologic manifestations with the possibility of long-term disabilities.[9,10] Death may occur with heavy infections, although the rate is considered low.[9,11,12] Infants and young children, however, are at greater risk for severe neurological damage and mortality.[13,14]

A. cantonensis was introduced into Hawai‘i from Asia, although the exact date of the parasite's establishment is unknown. The first cases of eosinophilic meningitis in Hawai‘i were reported in the 1960s.[15,16] In both case reports, the parasite was found on autopsy and was noted to be present in the geographic locations frequented by the patients.

In 2016, Governor David Ige established a Joint Task Force to assess the threat of NAS in Hawai‘i.[17] The clinical subcommittee of the Task Force, in 2018, released preliminary clinical guidelines to facilitate the diagnosis and treatment of this erratically occurring infection.[18] Since the release of the guidelines, awareness has led to patients being diagnosed and treated promptly; however, there are individuals in which the disease is not considered upon presentation of symptoms. This delay in the initiation of treatment may lead to neurological deterioration.[13]

The key recommendations of the guidelines are summarized here, followed by additional recommendations for individuals with a recent history of gastropod ingestion.

Diagnosis

1. Physicians should have a high index of suspicion for NAS, especially in residents or recent visitors to Hawai‘i, especially Hawai‘i Island, also known as the Big Island.[12]

2. Typical symptoms in adults include severe headaches, neck stiffness, nausea, abnormal sensations of the skin, and muscle pains. The majority of patients present with headache, but the lack of headache should not exclude the consideration of NAS.

3. Highly suggestive symptoms and signs include papilledema, migratory hyperesthesia, cranial nerve abnormalities, ataxia, and focal neurologic findings that are migratory or do not follow a dermatomal distribution.

4. Typical symptoms in infants, toddlers, and young children include fever, abdominal pain, vomiting, irritability, inconsolability, poor appetite, muscle weakness, fatigue, and lethargy.[19]

5. Lumbar puncture is an essential procedure in the evaluation of suspected NAS. It is a low-risk procedure with diagnostic and therapeutic benefits.

6. Eosinophilic meningitis is a distinctive feature of NAS. It has been traditionally defined as the presence of 10 or more eosinophils per μL of cerebral spinal fluid (CSF) or eosinophils accounting for more than 10% of the white blood cells when there are at least six total white blood cells per μL of CSF.[20]
   a. CSF eosinophil counts may be absent or low early in the course of the disease, requiring repeat lumbar punctures if NAS is still suspected.
   b. The diagnostic laboratory should specifically stain the CSF smear for the presence of eosinophils.

7. A presumptive diagnosis of NAS requires all three of the following:
   a. A history of suggestive symptoms and signs,
   b. Evidence of eosinophilic meningitis, and
   c. A history of intermediate host exposure or residence in or recent travel to an endemic area.

8. Confirmation of infection is determined by finding larvae in the CSF, although this is rare, or by detecting *A. cantonensis* DNA by real-time polymerase chain reaction (RTi-PCR) in CSF.[21] This test is available in Hawai‘i through the Hawai‘i State Department of Health (HIDOH).[22] RTi-PCR may be negative in the early stages of the infection, necessitating repeating the lumbar puncture and RTi-PCR assay.[12]

9. Baseline studies should include a complete blood count with differential, serum electrolytes, liver function tests, renal function tests, blood glucose, urinalysis, ophthalmologic exam, and chest x-ray. Peripheral eosinophil counts of ≥ 500 cells/μL are often present during the illness but may be absent.[23]

10. Occasionally, larvae can migrate into the eye. Infection can be mildly symptomatic or cause an inflammatory reaction leading to pain, iritis, vitreous haziness, ophthalmitis, or retinal detachment. Diplopia and strabismus have been reported.

11. Magnetic resonance imaging (MRI) of the brain, although not required, may help rule out other causes of meningitis. Focused MRI of the spine may be appropriate if indicated by clinical presentation.

12. Other diagnostic tests for NAS are not approved by the US Food and Drug Administration.

Treatment

1. Start corticosteroids as soon as a presumptive diagnosis of NAS is made and assuming there are no contraindications. High-dose corticosteroids for 14 days have been shown to improve clinical outcomes.[24]

2. For ocular angiostrongyliasis, several treatment options are available to remove the parasite from the eye.[25] Anthelmintic drugs are contraindicated for ocular angiostrongyliasis.

3. The addition of albendazole, an anthelmintic drug, may provide additional benefits, though there is limited evidence of this in the literature.[26,27]
   a. Dosage (adults): 15 mg/kg/day twice daily for 14 days with meals.
   b. If albendazole is used, combine with corticosteroids to blunt any possible increase in the inflammatory response to dying larvae.

4. Careful clinical monitoring is recommended in all patients, and specialist consultation (eg, infectious disease, neurology, pain management, etc) may be advisable.
   a. Patients should be monitored until all symptoms have resolved, which may range from weeks to months.
   b. Psychosocial issues may arise and should be identified and addressed as needed.

Post-Exposure Prophylaxis

The infectious dose and the probability of infection following the ingestion of a gastropod are unknown. We postulate that prophylactic treatment with albendazole should be effective if given within 2 weeks post-ingestion. There is no human evidence for the use of albendazole to prevent infection. Therefore, these recommendations are expert opinion extrapolated from animal studies and 1 human treatment trial.[26,28]

1. Individuals who have ingested a gastropod or transport host (eg, flatworms, centipedes, freshwater shrimp, frogs, etc.) within the past 14 days should be considered for post-exposure prophylaxis with albendazole.

2. Individuals who suspect they ingested a gastropod or transport host should be evaluated on a case-by-case basis.

3. Albendazole should be given at 15 mg/kg/day twice a day with meals for 14 days (adults).

4. Patients should be closely monitored for the development of neurological signs and symptoms for 30 days or more and for the possible adverse effects of the long-term use of albendazole.

Discussion

Eosinophilic meningitis caused by *A. cantonensis* is a migratory, multifocal CNS inflammatory condition. The extent and severity of the illness are determined by the number of larvae reaching the CNS, the movement of those larvae within the CNS, the host's inflammatory response to the larvae, as well as the location of the dying larvae within the CNS.[29] The average incubation period ranges from 1 to 3 weeks; however, it can vary from 1 day to 6 weeks.[30]

A. cantonensis has been an enzootic parasite in Hawai'i since the 1960s, with human cases reported in most years since then.[31] In humans, the disease ranges from mildly symptomatic to a severe illness requiring hospitalization. The most widely reported symptom is headache, which prompts patients to seek medical help. We are aware of symptomatic patients visiting multiple physicians or clinics before an appropriate workup was conducted. Although there is limited human evidence, animal studies suggest that early treatment may improve patient outcomes.[28]

Physicians should consider NAS in the differential diagnosis of patients presenting with dysesthetic neuropathic symptoms, especially with a history of recent gastropod exposure. The initial presentation of NAS might be misinterpreted as functional disease, Guillain-Barré syndrome, acute encephalopathic, or myelopathic syndromes.[14]

The administration of high-dose corticosteroids can significantly reduce the duration of headache.[24] Severe muscle pain, which may be refractory to standard analgesics, is a common complaint by patients with acute illness.[32] Recently, intravenous lidocaine and ketamine have been shown to help with intractable neuropathic pain associated with severe NAS.[10,32,33]

There are conflicting opinions on the use of albendazole in managing NAS patients. However, it may be the timing of administration that influences outcomes.[34] A study in rabbits, using albendazole without steroid coverage, indicated that albendazole was unsuitable for the treatment of NAS.[35] Conversely, studies in mice have shown that albendazole can arrest parasite development in the CNS if given within 10 days of ingestion.[28,36] Human studies indicate that albendazole is safe in the treatment of NAS, although its effectiveness cannot be determined.[27,37] Since most patients do not know when they were infected, the consensus of this group is that the benefits of using albendazole under steroid coverage in symptomatic patients outweigh the potential for increased inflammatory response.

Rare adverse effects have been reported with the long-term use of albendazole. Patients should be monitored for hematological, liver, and renal changes.[38] In the United States, albendazole is expensive and sometimes difficult to obtain, necessitating the need to develop a statewide plan to ensure its affordability and availability.[39]

Eosinophilic meningitis became a reportable disease in Hawai'i in 2007. Since then, the majority of cases have been reported from Hawai'i Island (Figure 1). The RTi-PCR assay for NAS was developed in 2016 by the Centers for Disease Control and Prevention (CDC) and the HIDOH's Laboratory Division and has been used to confirm the presence of *A. cantonensis* DNA in the CSF of patients with eosinophilic meningitis.[21] A study conducted by the HIDOH revealed 82 probable NAS cases between 2007 and 2017. Fifty-one of these cases were confirmed by parasite isolation (n=1) or a positive RTi-PCR.[12]

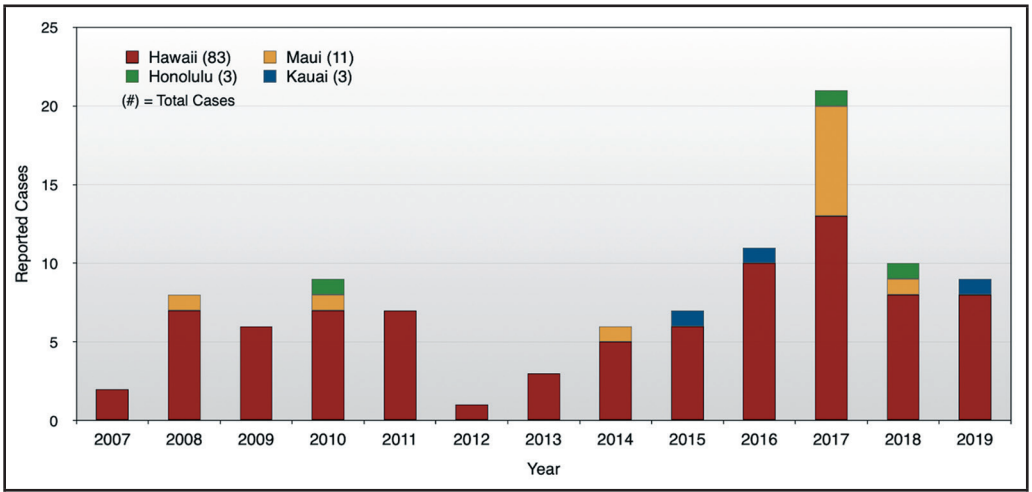

Figure 1. Number of Neuroangiostrongyliasis Cases Reported in the Hawaiian Islands by County and Year.[46]

A number of individuals diagnosed with NAS in Hawai‘i have developed long-term debilitating conditions. Little is known about the percentage of patients who develop long-term sequelae, why it occurs, or how best to treat the residual disabilities. The Hilo Medical Center has organized a very successful support group for these patients.[40] We enthusiastically support this endeavor and encourage future studies on the long-term effects and care of NAS patients.

A debated issue is the use of anthelmintic drugs for individuals who recently ingested a slug or snail. There are currently no *in-vivo* or *in-vitro* studies on the post-exposure use of antiparasitic medications to prevent NAS. The medical community in Australia has hypothetically addressed this issue by recommending the prophylactic use of albendazole in children.[41,42] Although clinical evidence is lacking, we feel in such cases, prescribing albendazole, as recommended for treatment, is appropriate if given within 14 days of ingestion. These individuals should be closely monitored for the development of meningitis and drug side effects. Asymptomatic patients who ingested a gastropod greater than 14 days earlier should be evaluated on a case-by-case basis.

The Hilo Medical Center recently released a protocol for post-exposure prophylaxis using an over-the-counter medication commonly used for pinworms, pyrantel pamoate.[43] There are no published human trials supporting the use of pyrantel pamoate or shortening the course of albendazole mentioned in the protocol, but the regimen should not be detrimental if followed as directed. For these individuals, follow-up with their primary care physician is crucial since pyrantel pamoate is not a substitute for the urgent administration of albendazole.

Globally, the primary source of human infection is the ingestion of raw or undercooked intermediate or transport hosts for dietary or cultural reasons.[44] However, in Hawai‘i, terrestrial or freshwater gastropods are not part of the local diet. A survey of gastropods revealed high rates of infection across the state, with many different taxa being infected and some species harboring substantial parasite burdens.[45] Therefore, all gastropods encountered in Hawai‘i should be considered infected and capable of causing serious illness.

Many NAS patients cannot recall how they were infected. A 2011 study by the HIDOH and the CDC showed that NAS patients from Hawai‘i Island were more likely to consume uncooked homegrown produce and see gastropods on their produce than patients from other islands.[46] These results suggest that not following safe food practices by not properly washing homegrown vegetables and leaving consumables unprotected from gastropods pose a potential risk for human infection. In addition, outdoor pet food can attract gastropods near homes and increase the potential for human exposure, especially for toddlers, pets, and other animals.[47]

Visitors to Hawai‘i are also at risk of infection if they are unaware of the parasite's presence. Between 2015 and 2018, 7 visitors acquired NAS while visiting the state of Hawai‘i.[48] HIDOH, in collaboration with the State Tourism Authority, has developed messages directed at visitors, such as video warnings at baggage claim areas.[49]

In theory, NAS is a preventable disease.[50] The decrease in the number of cases in Taiwanese children is believed, in part, to be due to public health measures.[51] Public health messaging can be effective, but it requires a sustained societal commitment. With two years of funding, the HIDOH developed announcements for radio, television, and movie theaters.[49,52] In addition, informational posters were placed in shopping malls throughout the state. Privately, a few supermarkets and farmers markets post fliers promoting the washing of fruits and vegetables before consumption. Preventive messaging in schools can educate children about this illness, which may translate into parents becoming more aware of the risk of acquiring the disease.[53]

Preventive messages should recommend the following actions: (1) cooking of intermediate and transport hosts in boiling water for 3–5 minutes, (2) the need to eradicate gastropods and rodents near homes and vegetable gardens, (3) the importance of handwashing after gardening or handling gastropods, and (4) the importance of not eating unwashed fruits and vegetables, where small gastropods may be hiding.[54, 55]

Additional information about *Angiostrongylus cantonensis* for consumers and health care providers can be found on the HIDOH's webpage.[56]

The clinical guideline posted on the HIDOH website has recently been published.[18,57]

Conflict of Interest

None of the authors identify a conflict of interest.

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References

1. Alicata JE. Angiostrongyliasis cantonensis (Eosinophilic Meningitis): Historical Events in its Recognition as a New Parasitic Disease of Man. *J Wash Acad Sci*. 1988;78(1):38-46.
2. Wallace G, Rosen L. Studies on eosinophilic meningitis. V. Molluscan hosts of Angiostrongylus cantonensis on Pacific Islands. *Am J Trop Med Hyg*. 1969;18(2): 06-216.
3. Nomura S, Lin PH. First case report of human infection with Haemostrongylus ratti Yokogawa. *Taiwan No Ikai*. 1945;3:589-592.
4. Tiernan JR, Prociv P. Eosinophilic meningoencephalitis with permanent sequelae. *Med J Aust*. 1987;147(6):294-295.
5. Eamsobhana P. Eosinophilic meningitis caused by Angiostrongylus cantonensis--a neglected disease with escalating importance. *Trop Biomed*. 2014;31(4):569-578.
6. Prociv P. Need for Critical Rethinking in Clinical Approaches to Neuroangiostrongyliasis. *Am J Trop Med Hyg*. 2019;101(4):951.
7. Bhaibulaya M. Comparative studies on the life history of Angiostrongylus mackerrasae Bhaibulaya, 1968 and Angiostrongylus cantonensis (Chen, 1935). *Int J Parasitol*. 1975;5(1):7-20.
8. Cowie RH. Pathways for transmission of angiostrongyliasis and the risk of disease associated with them. *Hawaii J Med Public Health*. 2013;72(6 Suppl 2):70-74.
9. Alto W. Human infections with Angiostrongylus cantonensis. *Pac Health Dialog*. 2001; 8(1): 176-182.
10. McAuliffe L, Fortin Ensign S, Larson D, et al. Severe CNS angiostrongyliasis in a young marine: a case report and literature review. *Lancet Infect Dis*. 2019; 19(4): e132-e142.
11. Punyagupta S, Juttijudata P, Bunnag T. Eosinophilic meningitis in Thailand. Clinical studies of 484 typical cases probably caused by Angiostrongylus cantonensis. *Am J Trop Med Hyg*. 1975;24:921-931.
12. Johnston DI, Dixon MC, Elm JL, Calimlim PS, Sciulli RH, Park SY. Review of Cases of Angiostrongyliasis in Hawaii, 2007–2017. *Am J Trop Med Hyg*. 2019;101(3):608-616.
13. Evans-Gilbert T, Lindo JF, Henry S, Brown P, Christie CDC. Severe eosinophilic meningitis owing to Angiostrongylus cantonensis in young Jamaican children: case report and literature review. *Paediatr Int Child Health*. 2014;34(2):148-152.
14. Berkhout A, Prociv P, Herbert A, Anthony LT, Nourse C. Two cases of neuroangiostrongyliasis: A rare disease because rarely considered or rarely diagnosed? *J Paediatr Child Health*. 2019;55(12):1463-1469.
15. Horio SR, Alicata JE. Parasitic meningo-encephalitis in Hawaii. A new parasitic disease of man. *Hawaii Med J*. 1961;21:139-140.
16. Rosen L, Chappell R, Laqueur GL, Wallace GD, Weinstein PP. Eosinophilic meningoencephalitis caused by a metastrongylid lung-worm of rats. *J Am Med Assoc*. 1962;179:620-624.
17. DOH NEWS RELEASE: Joint Task Force Established to Combat Rat Lungworm Disease in Hawaii. Published May 13, 2016.. https://governor.hawaii.gov/newsroom/latest-news/doh-news-release-joint-task-force-established-to-combat-rat-lungworm-disease-in-hawaii/. Accessed July 9, 2020
18. *Preliminary Guidelines for the Diagnosis and Treatment of Neuroangiostrongyliasis (Rat Lungworm Disease) in Hawaii*. Hawaii State Department of Health 2018. https://health.hawaii.gov/docd/disease_listing/rat-lungworm-angiostrongyliasis/. Accessed April 22, 2020.
19. Char DFB, Rosen L. Eosinophilic meningitis among children in Hawaii. *J Pediatr*. 1967;70(1):28-35.
20. Kuberski T. Eosinophils in cerebral spinal fluid: criteria for eosinophilic meningitis. *Hawaii Med J*. 1981;40(4):97-98.
21. Qvarnstrom Y, Xayavong M, da Silva ACA, et al. Real-Time Polymerase Chain Reaction Detection of Angiostrongylus cantonensis DNA in Cerebrospinal Fluid from Patients with Eosinophilic Meningitis. *Am J Trop Med Hyg*. 2016;94(1):176-181.
22. *Specimen Requirements for Angiostrongylus Cantonensis Detection by Real-Time (RTi) Polymerase Chain Reaction (PCR) on Clinical Specimens*. Hawaii State Department of Health; 2019. https://health.hawaii.gov/statelab/files/2013/07/sld-brs-sr-angio2.pdf. Accessed April 22, 2020.
23. Sawanyawisuth K, Sawanyawisuth K, Senthong V, et al. Peripheral eosinophilia as an indicator of meningitic angiostrongyliasis in exposed individuals. *Mem Inst Oswaldo Cruz*. 2010;105(7):942-944.
24. Chotmongkol V, Sawanyawisuth K, Thavornpitak Y. Corticosteroid treatment of eosinophilic meningitis. *Clin Infect Dis*. 2000;31(3):660-662.
25. Sinawat S, Sanguansak T, Angkawinijwong T, et al. Ocular angiostrongyliasis: clinical study of three cases. *Eye*. 2008;22(11):1446-1448.
26. Jitpimolmard S, Sawanyawisuth K, Morakote N, et al. Albendazole therapy for eosinophilic meningitis caused by Angiostrongylus cantonensis. *Parasitol Res*. 2007;100(6):1293-1296.
27. Chotmongkol V, Kittimongkolma S, Niwattayakul K, Intapan PM, Thavornpitak Y. Comparison of prednisolone plus albendazole with prednisolone alone for treatment of patients with eosinophilic meningitis. *Am J Trop Med Hyg*. 2009;81(3):443-445.
28. Hwang KP, Chen ER. Larvicidal effect of albendazole against Angiostrongylus cantonensis in mice. *Am J Trop Med Hyg*. 1988;39(2):191-195.
29. Charunwatthana P, Wattanagoon Y. Eosinophilic Meningitis: (Angiostrongylus cantonensis, Parastrongylus cantonensis). In: Ryan ET, Hill DR, Solomon T, Aronson NE, Endy TP, eds. *Hunter's Tropical Medicine & Emerging Infectious Diseases*. 10th ed. Elsevier;2020:891-894.
30. Hochberg NS, Park SY, Blackburn BG, et al. Distribution of eosinophilic meningitis cases attributable to Angiostrongylus cantonensis, Hawaii. *J Emerg Infect Dis*. 2007;13(11):1675-1680.
31. Cowie RH. Angiostrongylus cantonensis: Agent of a Sometimes Fatal Globally Emerging Infectious Disease (Rat Lungworm Disease). *ACS Chem Neurosci*. 2017;8(10):2102-2104.
32. Cucueco, K, Bathen, K, Fischberg, D. Lidocaine Infusion for Refractory Pain from Rat Lungworm Disease — Honolulu, Hawai'i. *Hawaii J Health Soc Welf*. 2020;79(8):246-248.
33. Busse, J, Gottlieb, D, Ferreras, K, Bain, J, Schechter, W. Pharmacological Management of Severe Neuropathic Pain in a Case of Eosinophilic Meningitis Related to Angiostrongylus cantonensis. *Case reports in anesthesiology*. 2018; Article ID 5038272; 4 pages.
34. Prociv P, Turner M. Neuroangiostrongyliasis: The "Subarachnoid Phase" and Its Implications for Anthelminthic Therapy. *Am J Trop Med Hyg*. 2018;98(2):353-359.
35. Wang LC, Jung SM, Chen CC, Wong HF, Wan DP, Wan YL. Pathological changes in the brains of rabbits experimentally infected with Angiostrongylus cantonensis after albendazole treatment: histopathological and magnetic resonance imaging studies. *J Antimicrob Chemother*. 2006;57(2):294-300.
36. John DT, Martinez AJ. Animal model of human disease. Central nervous system infection with the nematode Angiostrongylus cantonensis. Animal model: eosinophilic meningoencephalitis in mice infected with Angiostrongylus cantonensis. *Am J Pathol*. 1975;80(2):345-348.
37. Diao Z, Chen X, Yin C, Wang J, Qi H, Ji A. Angiostrongylus cantonensis: effect of combination therapy with albendazole and dexamethasone on Th cytokine gene expression in PBMC from patients with eosinophilic meningitis. *Exp Parasitol*. 2009;123(1):1-5.
38. Bloom AK, Ryan ET. Albendazole. In: Magill AJ, Hill DR, Solomon T, Ryan ET, eds. *Hunter's Tropical Medicine and Emerging Infectious Disease (Ninth Edition)*. W.B. Saunders; 2013:1088-1089.
39. Costantini S, Walensky RP. The Costs of Drugs in Infectious Diseases: Branded, Generics, and Why We Should Care. *J Infect Dis*. 2020;221(5):690-696.
40. *Rat Lungworm Support Group*. Hilo Medical Center. https://www.hilomedicalcenter.org/our-services/support-groups/rat-lungworm-support-group/. Accessed April 22, 2020.
41. *Snail and Slug Ingestion: Practice Guideline*. The Sydney Children's Hospital Network; 2018. http://www.schn.health.nsw.gov.au/_policies/pdf/2018-163.pdf. Accessed April 22, 2020.
42. *Paediatric Guideline: Snail and Slug Ingestion*. Children's Health Queensland Hospital and Health Service; 2019. https://www.childrens.health.qld.gov.au/wp-content/uploads/PDF/ams/gdl-01219.pdf. Accessed April 23, 2020.
43. Hilo Medical Center Updates Early Treatment Protocol for Rat Lungworm. 2020. https://www.hilomedicalcenter.org/hilo-medical-center-updates-early-treatment-protocol-for-rat-lungworm/. Accessed April 22, 2020.
44. Khamsai S, Chindaprasirt J, Chotmongkol V, et al. Clinical features of eosinophilic meningitis caused by Angiostrongylus cantonensis in Thailand: a systematic review. *Asia-Pac J Sci Technol*. 2020; 25(2): Article ID.: APST-25-02-09.
45. Kim JR, Hayes KA, Yeung NW, Cowie RH. Diverse gastropod hosts of Angiostrongylus cantonensis, the rat lungworm, globally and with a focus on the Hawaiian Islands. *PLoS One*. 2014;9(5):e94969
46. Hochberg NS, Blackburn BG, Park SY, Sejvar JJ, Effler PV, Herwaldt BL. Eosinophilic Meningitis Attributable to Angiostrongylus cantonensis Infection in Hawaii: Clinical Characteristics and Potential Exposures. *Am J Trop Med Hyg*. 2011;85(4):685-690.
47. Hollingsworth R, Howe K, Jarvi S. Control Measures for Slug and Snail Hosts of Angiostrongylus cantonensis, with Special Reference to the Semi-slug Parmarion martensi. *Hawaii J Med Public Health*. 2013;72(6 (Suppl 2)):75-80.
48. Summary of Reported Cases of Notifiable Diseases 2009-2018. https://health.hawaii.gov/docd/resources/reports/summary-of-reported-cases-of-notifiable-diseases/. Accessed April 22, 2020.
49. DOH: Rat Lungworm Disease in Hawaii: Supplemental Legislative Report on FY 2019 Prevention & Collaboration Efforts. https://health.hawaii.gov/docd/files/2019/10/DOH-2019_RLWD-Supplemental-Leg-Report-FINAL-101519.pdf. Accessed July 28, 2020.
50. Hollyer J. Telling Consumers, Gardeners, and Farmers about the Possible Risk of Rat Lungworm in the Local Food Supply in Hawaii. *Hawaii J Med Public Health*. 2013;72(6 (Suppl 2)):82.
51. Tseng Y-T, Tsai H-C, Sy CL, et al. Clinical manifestations of eosinophilic meningitis caused by Angiostrongylus cantonensis: 18 years' experience in a medical center in southern Taiwan. *J Microbiol Immunol Infect*. 2011;44(5):382-389.
52. DOH launches first statewide media campaign on rat lungworm disease prevention. 2017. https://governor.hawaii.gov/newsroom/latest-news/doh-launches-first-statewide-media-campaign-on-rat-lungworm-disease-prevention/. Accessed July 9, 2020.
53. Howe K, Bach J, DeCoito M, Frias S, Hatch R, Jarvi S. Reducing Rat Lungworm Disease in Hawaii Through a Collaborative Partnership With K-12 School Garden and Agriculture Projects. *Front Public Health*. 2018;6(article 203):1-9.
54. Medeiros MCI, Rollins RL, Echaluse MV, Cowie RH. Species Identity and Size are Associated with Rat Lungworm Infection in Gastropods. *EcoHealth*. 2020;17(2):183-193.
55. Yeung, NW, Hayes, KA, Cowie, RH. Effects of washing produce contaminated with the snail and slug hosts of Angiostrongylus cantonensis with three common household solutions. *Hawaii J Med Public Health*. 2013;72(6 (Suppl 2)):83-86
56. *Angiostrongyliasis (Rat Lungworm) Resources*. Hawaii State Department of Health. https://health.hawaii.gov/docd/disease_listing/rat-lungworm-angiostrongyliasis/. Accessed April 24, 2020
57. Ansdell V, Kramer KJ, McMillan JK, Gosnell WL, Murphy GS, Meyer BC, Blalock EU, Yates J, Lteif L, Smith OA, Melish M. Guidelines for the diagnosis and treatment of neuroangiostrongyliasis: updated recommendations. Parasitology. 2020. Jul 30:1-7. doi: 10.1017/S0031182020001262.

Hawai‘i Keiki Health Hotline: A Sustainable Option for Providing Health Resources and Telehealth Services

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The Spotlight on Nursing is a recurring column from the University of Hawai‘i at Mānoa's School of Nursing and Dental Hygiene (UHM SONDH). It is edited by Mary G. Boland DrPH, RN, FAAN, Dean of UHM SONDH; Kristine Qureshi PhD, RN, CEN, PHNA-BC, FAAN, Associate Dean of Research for UHM SONDH and HJH&SW Contributing Editor; and Joanne R. Loos PhD, Science Writer for UHM SONDH.

The Hawai‘i Keiki (HK) Program provides school-based health services to students through a partnership between the University of Hawai‘i at Mānoa School of Nursing & Dental Hygiene (UHM SONDH) and the Hawai‘i State Department of Education (DOE). The HK Program was launched in 2014 with 4 staff nurses, and has since grown to include 1 medical assistant, 6 registered nurses (RNs) and 15 advance practice registered nurses (APRNs) in the 2019-2020 academic year, serving all 15 DOE complex areas. The program continues to expand, with a dental screening and sealants program initiated for second graders during the 2019-2020 school year, and 15 new RNs added in the 2020-2021 school year to assist schools in responding to COVID-19.

The program has 4 core goals to support the DOE school and student academic success: (1) reduce health-related chronic absenteeism and minimize interruption to instructional time; (2) enhance wellness in the school environment and community; (3) promote optimal student health through preventive screening and support for children with chronic health conditions; and (4) collaborate with primary care providers, community partners, organizations, and resources to provide coordinated school health programs and services. During the 2019-2020 academic year, the HK staff conducted 8024 health room visits for illness, injury, and health guidance, with 88% students returning to classes after the visit and an average visit length of 18 minutes. These nurses also educated students and teachers on various health topics while also partnering with Project Vision, Vision to Learn, Lions Sight, Lions Club, and the DOH Stop Flu at School campaign to provide hearing screening, vision screening, and flu vaccinations for students.

Due to the COVID-19 pandemic, educational delivery in the DOE was transitioned in March 2020 to a primarily online platform. As such, many students were no longer coming to the school campuses. This decreased access to school-based health services as well as free food and other support services that are provided to many children in the schools. Recognizing these impacts, the DOE partnered with HK to start up the HK Health Hotline (HKHH) that launched on May 1.[1] The goal of the program was to provide equitable access to health services for all DOE students using interactive technology and mobile devices, regardless of location. The HKHH objectives included: (1) increasing the number of children who are able to access health services during a pandemic; (2) assuring continuity of care with a known and trusted provider; (3) providing families an alternative means for accessing health services; (4) reducing morbidity and mortality for students with chronic physical and mental health conditions; (5) maintaining compliance with the Health Insurance Portability and Accountability Act (HIPAA) and the Family Educational Rights and Privacy Act (FERPA); and (6) ensuring students are healthy and ready to learn when campuses reopen. While telehealth technology is not new to school-based health clinics and providers, it was not a service that HK offered previously.[2]

During the planning stage of the HKHH, the leadership team identified specific HK staff/teams to assume various tasks. An essential component within the development of a quality health hotline/telehealth delivery system is the creation of the operational policies and procedures which guide the program.[3] The HKHH operations are codified in a manual that includes the policy and procedures for obtaining patient consent, selection and function of equipment/software, patient privacy and confidentiality, telehealth patient safety, parental/legal representation, special considerations during COVID-19, operational

workflows, clinical workflows with documentation procedures, as well as data collection, reporting and quality assurance. The HK administrative team reviewed each of these processes and documents, then passed them through the appropriate departments at University Health Partners (a HK Program Practice Partner) for approval, and also shared with DOE for their feedback and approval.

Technology considerations for the program included secured laptop/cellphone utilization, a hotline service that receives the calls (Jive), a triage tool (Clear Triage) that provides a nursing triage platform and aids in documentation of calls and parent/guardian education, telehealth platforms (Doxey.me and Facetime), and interpretive services (Boostlingo). The technology also includes the electronic health record (EHR) documentation platforms HealthOfficeAnywhere (for RNs and APRNs) and Epic (for APRNs). Workflows developed for the HKHH include: telephone triage, telehealth visits, telehealth visit using a translation service, process for referring student to DOE behavior health counselors, prescription refills, follow-up phone calls, and a workflow for calls not related to a health concerns on a DOE student.

Prior to the launch of the telehealth program, the staff underwent extensive training, including beta testing platforms, mock scenarios/calls, and an evaluation of the staff's comfort and competency. A debriefing session occurred after each training session, which allowed staff to identify any issues or concerns which needed to be addressed. While staff underwent training, the communications teams from SONDH and DOE worked collaboratively to increase the awareness of the upcoming program which was accomplished with flyers, news media, and social media posts.

On May 1, 2020, the program launched and began providing services Monday through Friday, with the exception of school holidays. During the first 5 months, 161 HKHH encounters were logged. The HKHH was accessed most often (n=130) to answer questions that were not related to a specific student health concern, but rather regarding return to school health requirements, school, and community health resources (Figure 1).

The remaining 31 of the 161 HKHH encounters were related to student health concerns/illnesses for specific students that required nursing triage for physical and/or mental health issues/concerns. These calls resulted in the provision of health education, the scheduling and conducting of a telehealth visits by a HK APRN and/or a referral to a DOE school behavioral health counselor or the student's primary care provider. The largest number of calls came from Honolulu County, followed by Hawai'i, Maui, and Kaua'i Counties.

The initial success led to additional funding from HMSA Foundation and CARES Act funds to continue services throughout the summer months - a new service for the HK program. As K-12 campuses in Hawai'i have reopened in various phases, the

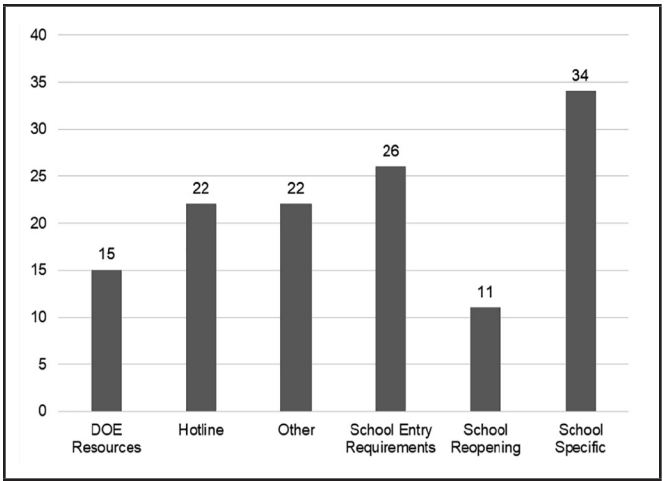

Figure 1. Hotline Calls for Information Requests Not Related to a Student Health Concern (n=130)

HKHH has become a valuable resource for health information about COVID-19, recommendations for safe school reopening guidance, and access to vital school/community resources for students and families. In addition, families that are concerned about their child's physical or behavioral health can call the HKHH to receive care via telephone triage, telehealth services, or referral to a DOE school behavioral health counselor. The HKHH visits are not meant to replace a student's primary care provider, but rather they provide families with an alternative way to access health service while supporting social distancing. The student's primary care providers receive documentation after each hotline call related to a physical or mental health concern. The HKHH services are provided at no cost to the HIDOE students. Families with medical insurance are asked to provide their health insurance for telehealth visits only. The student's health insurance is billed, however there are no co-pays for any family. All DOE public students receive the HKHH services regardless of insurance status.

While DOE campuses begin to reopen in various phases during the 2020-2021 academic year, the HKHH will continue to provide nursing care within the existing school-based health clinics. The HK Program recognizes that providing families and their children with up to date resources and access to health services will continue to be a challenge in our state. Students, now more than ever, have social, emotional and physical health needs that need to be addressed in order for them to be healthy, ready to learn, and successful in school and life. With the continued utilization of the HKHH, the nurses can improve access to care and health outcomes for students in DOE schools, particularly those who live in underserved areas. The HKHH is a viable option that provides families an alternative means of accessing a professional nurse for information, health education, and health services, and is focused on helping to assure that the children of Hawai'i are healthy and ready to learn in our schools.

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References

1. The University of Hawai'i at Mānoa School of Nursing and Dental Hygiene. Hotline available for hidoe student-related health questions and telehealth visits. 2020 Health Hotline and Telehealth. https://nursing.hawaii.edu/hawaii-keiki/school-based-health-services/may-2020-health-hotline-and-telehealth/ Accessed October 13, 2020.
2. Love H, Panchal N, Schlitt J, Behr C, Soleimanpour S. The use of telehealth in school-based health centers. *Global Pediatric Health*. 2019;6;2333794X19884194. https://doi.org/10.1177/2333794X19884194
3. American Academy of Pediatrics. Telehealth support. https://www.aap.org/en-us/professional-resources/practice-transformation/telehealth/Pages/compendium.aspx. Accessed October 13, 2020.

Hawai‘i Journal of Health & Social Welfare (HJH&SW)

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.

Examples of Hawaiian words that may appear in the HJH&SW:

‘āina	***Mānoa***
ali‘i	***Māori***
Hawai‘i	***Moloka‘i***
kūpuna	***O‘ahu***
Kaua‘i	***‘ohana***
Lāna‘i	***Wai‘anae***

Hawai'i Journal of Health & Social Welfare (HJH&SW)

Guidelines for Publication of HJH&SW 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.

The following are general guidelines for publication of supplements:

1. Organizations, university divisions, and other research units considering publication of a sponsored supplement should consult with the HJH&SW editorial staff to make certain the educational objectives and value of the supplement are optimized during the planning process.

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, 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.
h. Communicate any issues or desired changes to the HJH&SW staff in a timely manner.

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
- Final date for submitting Word documents for layout
- Final date to request changes to page proofs (Please note that changes to page proofs will be made only to fix any errors that were introduced during layout. Other editing changes will incur an additional fee of $50 per page.)

5. The cost of publication of a HJH&SW supplement is $5,000 for an 8-article edition with an introduction from the sponsor or guest editor. Additional articles can be purchased for $500 each with a maximum of 12 articles per supplement. This cost covers one round of copy editing (up to 8 hours), layout, online publication with an accompanying press release, provision of electronic files, and indexing in PubMed Central, SCOPUS, and Embase. The layout editor will email an invoice for 50% of the supplement to the designated editor for payment upon signature of the contract. The remaining will be due at the time of publication. Checks may be made out to UCERA.

6. The sponsor may decide to include advertisements in the supplement in order to defray costs. Please consult with the HJH&SW advertising representative Michael Roth at 808-595-4124 or email rothcomm@gmail.com for assistance.

7. Supplement issues are posted on the HJH&SW website (http://www.hawaiijournalhealth.org) as a full-text PDF (both of the whole supplement as well as each article). An announcement of its availability will be made via a press release and through the HJH&SW email distribution list. Full-text versions of the articles will also be available on PubMed Central.

8. It is the responsibility of the sponsor to manage all editorial, marketing, sales, and distribution functions. If you need assistance, please contact the journal production editor. We may be able to help for an additional fee.

9. The editorial board reserves the right of final review and approval of all supplement contents. The HJH&SW will maintain the copyright of all journal contents.

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Sample Workflow and Timeline for a Supplement

1. The sponsor contacts the HJH&SW editors (hjhsw@hawaii.edu) to discuss the supplement topic, estimated timeline, length and cost. HJH&SW staff will review the journal requirements for articles and share our review process with the sponsor. **Time frame: 2 weeks**

2. The sponsor will complete the draft contract and pay a non-refundable deposit of $2500 or half the contract value. **Time frame: 3 days**

3. The sponsor will solicit articles for the supplement. **Time frame: 3-6 months**

Articles must comply with:

- Instructions for Manuscript Preparation and Submission of Research Articles
- Instructions for Manuscript Preparation and Submission of Columns
- HJH&SW Statistical Guidelines
- HJH&SW Style Guide for Native Hawaiian Words and Phrases
  AMA Manual of Style A free summary can be found here.

4. The sponsor will oversee the article selection, peer review, and editing process. We recommend that time be allowed for at least two rounds of reviews for each article. **Time frame: 3-6 months**

- Ensure that each article includes Institutional Review Board (IRB) review and approval, and a statement disclosing any conflicts of interest.
- Obtain a Copyright Transfer Agreement signed by all authors for each article.

5. *Optional*: During this time, the sponsor can solicit advertisements for the supplement to help defray costs for publication and/or printing. To initiate this process, the sponsor will work the HJH&SW advertising representative Michael Roth at 808-595-4124 or rothcomm@gmail.com.

6. The sponsor or their designee will conduct a final review of each article to ensure adherence to HJH&SW guidelines and AMA style. **Time frame: 2 weeks**

7. For each article, the sponsor will submit the final Word document and Copyright Transfer Agreement to the HJH&SW journal production editor. The journal production editor will send the articles to the copy editor for final journal style review. Copyediting will be 8 hours per edition plus 1 hour per article for additional articles purchased. Any additional hours will be billed at $100 per hour. **Time frame: 2 weeks**

8. The sponsor will submit the final articles to the layout editor for formatting. **Time frame: 1 month**
Acting in the role of guest editor, the sponsor will include a column introducing the supplement.
IMPORTANT: All articles submitted for layout should be in their finalized form. Page proofs will be returned to the sponsor for their review and approval, but changes will only be made to fix any errors that were introduced during the layout process. Any editing or changes to the text or figures after the initial copy layout will incur a fee of $50 per page.

9. The sponsor will review the electronic copy from the layout editor and submit any final corrections. **Time frame: 5 working days**

10. The layout editor will make the final corrections and provide a finished electronic copy of the supplement to the sponsoring editors to allow time for printing.

11. The managing editor will work with the sponsor to draft a press release. Sponsors should contact the managing editor at least 30 days prior to the date of publication to plan and script the press release. Sponsors are encouraged to submit 1-2 photos to accompany the press release. Note that obtaining signed photo releases is the responsibility of the sponsor.

12. The supplement will be published online along with the press release. An electronic copy will be sent to our subscribers and circulation lists, and the edition will be forwarded to the National Library of Medicine for indexing and made available for no cost access to the public.

Revised 2/6/20

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